4.0 Infrastructure Costs

4.1 Summary of Costs for Individual Utilities

In this section we present summary level findings regarding the capital costs associated with serving the needs of the growing Albuquerque metropolitan area. In particular we focus on the major utilities or types of infrastructure—the public water supply, the drainage system, wastewater, and road-related transportation and transit. Together these account for the vast majority of the (non-school) capital budget requirements of general purpose governments, both in New Mexico and throughout the United States.

The detailed findings for these utilities are presented in subsequent sections of this chapter, with a focus on several topics. For each utility, we first review the existing capacity and capacity constraints (deficiencies). Second, we examine costs. These include rehabilitation costs associated with the existing utility, costs related to correcting service deficiencies, and costs of new infrastructure to accommodate development. We close each of these sections with a review of key assumptions and supporting information.

Each section also contains an analysis of operation and maintenance costs; however, we do not describe these costs in this summary section. These costs, however, play a role in the benefit cost analysis associated with each of the scenarios.

These estimates of costs represent the level of capital expenditures that will be required to accommodate the levels of population and employment growth forecast for the year 2020 in Bernalillo County and the City of Albuquerque. However, it is important to note that these costs are not tied to the year in which they would need to occur. Rather, they represent a level of expenditures sufficient to provide utilities in a manner consistent with level of service standards. Thus, for example, if the region were to grow more slowly or more quickly, these costs would still represent the levels of expenditures required to accommodate a population of some 640,000 people and an employment base of approximately 448,000. Were growth to occur more quickly in adjacent counties, and less quickly in Bernalillo County and the City of Albuquerque, this would only affect the period of time over which these expenditures would be required, not the magnitude of the expenditures themselves.

Finally, readers should bear in mind that some of the costs described in this summary section and the more detailed sections that follow were developed based upon conservative assumptions. Among these are:

- The minor street cost calculations use a 28-foot cross-section instead of 32-foot cross-section, which would lead to higher costs for scenarios that require more minor street construction (e.g., Trend).
- The Ridgecrest Trunk has excess water capacity; therefore, the cost of service in this area should be lower.

- There may be higher installation costs for water and wastewater lines in the basalt areas of the West Side.
- Some costs of new parallel wastewater lines may not be needed because rehabilitation will increase capacity.
- The Metropolitan Transportation Plan includes conservative assumptions about costs since it is a fiscally constrained plan.
- The computer model used to estimate vehicle miles traveled for the scenarios is conservative because it does not adjust for fewer trips being made due to mixed land uses and higher densities.
- While the hydrology engineering consultants recommended that the land above the escarpment in the northwest area has a low priority for development, there were tens of millions of dollars in storm drainage costs in this area. .
- Water operation and maintenance costs are on a per gallon basis. However, existing infrastructure would have to be maintained regardless of whether it is being used to full capacity. Therefore, there should be a negligible operation and maintenance cost for utilization of current excess water capacity.

Water

The lowest cost growth alternative is the Balanced Scenario. The estimated capital cost of this scenario is $565 million, compared to $569 million for the Downtown scenario and $686 million for the Trend scenario.

The current City of Albuquerque water system is the principal water provider in Bernalillo County, serving a population of 480,000. The system has developed over the years on both the east and west sides of the river. Water is delivered in an east/west direction by major transmission facilities called trunk lines, which have the capability to distribute water to several different pressure zones. There are 12 pressure zones on the east side and five pressure zones on the West Side today.

System pump station

In 1994 the annual average water demand was 250 gallons per person per day. An aggressive water conservation program has been implemented successfully, and this has reduced demand by around 20%. The conservation goal is to achieve a 30% reduction by the year 2004. The water distribution system that was analyzed for this project assumes the successful implementation of this 30% demand reduction, for all of the scenarios. In the event such reductions do not occur, the costs for all scenarios would increase correspondingly.

There are two water trunk lines that may have excess capacity today—the Freeway and Montgomery trunks. The current system has sufficient capacity to serve the Water Service Area, and thus there are no areas of deficiency at this time.

One source of uncertainty with regard to the future cost of water infrastructure is associated with a review currently underway by the United States Environmental Protection Agency (EPA). EPA will publish new standards for allowable arsenic levels in public water within the next two years. It is thought that the allowable levels of arsenic will be lowered substantially from those currently permitted, with the result that half of Albuquerque's existing wells could require additional water treatment. The annual cost of this treatment is estimated to be $3–$4.5 million. Arsenic levels are higher in some parts of the community than others; thus, treatment costs also may vary according to the location of growth.

The City of Albuquerque's water system is currently undertaking numerous rehabilitation projects. As growth occurs additional rehabilitation will be required, including the rehabilitation and replacement of facilities that have reached the end of their useful life. These include wells, pump stations, reservoirs, meter replacement, and pipeline replacement. Costs for rehabilitation are estimated to exceed $20 million annually.

Water line rehab project

While rehabilitation and replacement costs account for approximately half of the total, combined long-term capital costs for the water system, new wells, water rights, reservoirs, pump stations, master plan transmission, and infill pipelines account for the other half of the water costs. Many of these costs do not vary across scenarios; however, the costs of small diameter piping are a function of the density at which land is developed, and thus scenarios, which use less land, will also require less pipe.

The primary difference in the costs of growth-related water service, however, relates to the costs of providing service on the West Side. Significantly higher expenditures for storage, pumping, and transmission are required for the Trend scenario, as a result of development west of the escarpment. These affect costs in four of the City's trunk line areas—College, Atrisco, Pajarito, and Corrales.

Thus, looking at the growth-related water service costs, almost all of the roughly $100 million difference can be explained by the cost of providing service outside of the existing water area to higher elevations west of the escarpment. In all, the range of costs across the three scenarios differs by approximately 21%.

Hydrology

Domingo Baca arroyo

The lowest capital costs (including rehabilitation, fixing deficiencies, and adding new facilities) are for the Downtown scenario and are estimated at $470 million. In comparison, the Balanced scenario is estimated to cost $496 million, while the Trend scenario will cost $534 million.

Primary responsibility for the provision of drainage services belongs to the City of Albuquerque, with some responsibility falling to the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) also. AMAFCA, which averages approximately $5.4 million per year in flood control related construction, is primarily responsible for the North and South Diversion Channels and some major arroyos. The City, which spends approximately $10.3 million per year on flood control related construction, is responsible for all underground systems and the remainder of the arroyos.

Existing drainage structures were designed to prevent damage during a 100-year storm and were designed with capacity for full build-out of the drainage basin at densities compatible with the zoning in place at the time of construction. Unfortunately, in the early 1990s local hydrologic analysis methods were revised, which increased the amount of estimated runoff. This resulted in some systems becoming deficient. None of the drainage basins have excess capacity, and all have some degree of deficiency or require rehabilitation. Areas in the valley are relatively more difficult to drain due to much of the area being lower than the river, flat grades, and limited outfalls to the Rio Grande. Areas in the far northeast heights and La Cueva-Camino, commonly known as North Albuquerque Acres, have experienced piecemeal development of the area platted in the 1930s, leaving much of the needed drainage infrastructure for the already overburdened public deficiency list. In the far northwest portion of the study area above the escarpment, substantial basalt will increase the costs of providing drainage infrastructure due to costs associated with construction in this type of rock.

Within the 1960 City Boundary, upstream growth will require increasing the size of existing facilities or construction of detention ponds. Several parts of the City have drainage systems that were designed many years ago to old standards and do not have adequate capacity to accommodate increased runoff. This has resulted in the identification of additional deficiencies in the Northeast Heights, the Southeast Heights and the Valley.

The majority of new infrastructure will be required at the fringe areas Outside the Water Service Area where no storm drainage infrastructure currently exists. Improvements required in the Quail Ranch will include detention ponds so that the downstream capacity of existing drainage facilities is not exceeded. Elsewhere in the northwest area above the escarpment, shallow basalt makes trenching for utilities difficult and costly. Improvements for the Westland property include a diversion channel north of I–40, escarpment drainage, and the construction of detention dams. The region above the southwest valley will require the construction of diversion channels, additional storm drains, and dams. Development of Mesa del Sol will involve mostly non-conventional drainage systems with minimal surface discharge off site, reducing the cost of drainage. The Mesa del Sol area will have relatively lower drainage improvement costs, although many current State and City drainage standards must be waived to accommodate the proposed development scenario.

One potential complicating factor is the pending EPA, National Pollution Discharge Elimination System storm water permit that has been considered eminent since 1991 but, due to EPA delays, has not been issued. It is hoped that Best Management Practices will satisfy requirements in lieu of more aggressive treatments and numerical standards.

Overall, the cost of drainage is closely linked to the number of acres developed in a given basin or sub-basin. As a result, patterns of urban development that make more efficient use of land reduce drainage infrastructure costs and requirements. This results in capital expenditures that are approximately $38–$64 million lower for the Balanced and the Downtown scenarios than for the Trend scenario.

Wastewater

The City of Albuquerque's sewer system is the principal provider for wastewater treatment services in Bernalillo County, and it contains 17 major basins. Generally, wastewater flows begin in sewers, laterals, and interceptors on the extremities of the east and west sides of the service area and are added successively to interceptors in each sub-basin moving downward in a southerly direction to the Rio Grande. The Southside Water Reclamation Plant is the treatment site for wastewater for the entire system. The current capacity of the plant is 76 million gallons per day (mgd), and the average flow received is 56 mgd.

A number of lines within the existing system have excess capacity today. These are distributed throughout all parts of the City. Deficient capacity also exists in some areas. Many of these deficiencies are concentrated in the lowest elevations and more central locations of the Albuquerque metropolitan area. This is a result of a gravity feed system that puts the maximum volumes into pipes and elevations nearest the treatment plant.

Wastewater treatment plant

The area within the 1960 City Boundary will experience capacity constraints in its transmission lines under all three scenarios. Costs for providing new parallel lines have been estimated and are included in costs for all scenarios. In addition to parallel interceptors, growth will require the construction of new service connections, interceptors, waste stations, collection lines, and treatment plant expansion. The wastewater treatment expansion cost is estimated at $73 million, and the cost of new parallel lines is $15 million. Finally, County wastewater needs will add approximately $10–$17 million.

The more efficient use of serviced land results in cost savings because of the need to provide fewer feet of small diameter pipe and opportunities to use existing service connections on certain sites. However, since many of the lines in developed areas are near capacity, or suffer from deficiencies as a result of their location, costs for service lines in the existing 1960 City Boundary would be higher under the more compact scenarios (Balanced and Downtown). Conversely, costs for lines, connections, lift stations, and related facilities in areas not currently served would be nearly twice as expensive in the Trend scenario as in the Downtown scenario.

To conclude, unique growth-related costs vary from $251 million for the Downtown scenario to $280 million for the Trend ($267 million for Balanced). This difference of $29 million represents an increase in growth-related wastewater capital costs of 12% between the Downtown and the Trend scenarios.

Transportation

The Trend scenario has the largest unique road capital costs, totaling $331 million. Unique road capital costs would be $267 million for the Balanced scenario and $260 million for the Downtown scenario. In comparison, common capital costs for road rehabilitation, fixing deficiencies, and new roads total $1.5 billion and account for more than 80% of total road costs.

Transit system capital costs for fleet expansion and vehicle replacement are approximately one-quarter of the total transportation capital costs. The Trend Scenario has the highest unique transit capital costs at $284 million, while the Balanced and the Downtown scenarios have unique transit capital costs of $210 million. All three scenarios assume the same size bus fleet; however, cost differences are attributable to the greater number of daily miles traveled by buses in the Trend Scenario, requiring more frequent vehicle replacement. Common transit capital costs account for $39 million or one-eighth of the total transit capital costs.

Information about the supply and demand for road facilities is kept principally by the MRGCOG, the designated Metropolitan Planning Organization for the Albuquerque region. Data collected by MRGCOG suggests that the majority of roads within the study area today are currently operating below capacity. However, other roadways and portions of roadways are operating above capacity. Outside the Water Service Area, roadways operating over capacity are those linking Albuquerque to Rio


Sun Tran bus

Rancho and Corrales. Within the Water Service Area, the North Valley Bridge crossings—Alameda and Paseo del Norte—are capacity deficient. Several of the roads east of I–25, including Alameda, Paseo del Norte, and Academy, are operating above capacity, as are many of the north/south streets in the North Valley. Within the 1960 City Boundary, isolated areas of congestion occur on Gibson Boulevard, I–25, and 2nd and 4th Streets.

Forecasts of capacity deficiencies in the year 2020 suggest that these conditions will change significantly, i.e., roadway congestion will increase markedly. Capacity deficiencies will exist for all three of the scenarios analyzed in this report. Differences in costs, therefore, come principally from the need to construct certain individual facilities as part of the different scenarios.

Transportation planners from the metropolitan area recently revised a long-range Metropolitan Transportation Plan in which they identified the need for expansion of existing facilities and the construction of new facilities for the Trend scenario. This scenario was developed by and for the Council of Governments as part of its Long-Range Transportation Planning Work Plan and was adopted for use in this planned growth strategy.

The Metropolitan Transportation Plan lists new roadway construction projects required for the Trend scenario. MRGCOG planning staff and consultants reviewed and slightly modified this list as part of travel demand forecasts conducted for this study for the Balanced and Downtown Scenarios. Costs for new major road construction for the Downtown and Balanced scenarios were found to be approximately 93% of the costs of new major road construction for the Trend scenario. In addition, costs for minor roadways needed to serve residential growth in the Downtown and Balanced scenarios were estimated to cost approximately 80 and 72%, respectively, of the costs of new minor road construction in the Trend scenario, with 1,362 miles of new local roads required for the Trend scenario, 1,121 miles for the Downtown scenario, and 936 miles for the Balanced scenario.

Road construction on Lomas Boulevard

About 40% of the capital costs for road transportation would be spent for the rehabilitation and reconstruction of streets and roads. The City of Albuquerque recently reassessed street conditions and found that 27% of its lane-miles are in poor or very poor condition and 43% in fair condition. Costs for rehabilitating these roads up to "good" condition are common to all three growth scenarios.

Concluding Remarks

This cost analysis is conservative. The cost differences in this report focus only on water, sewer, drainage, and road and transit transportation systems. Certain capital costs have not been included in this analysis, such as costs associated with additional treatment of ground water to remove levels of arsenic currently permitted by federal standards or potential costs of providing additional sources of water supply and distribution in the event that the City's ambitious goals for water conservation are not reached. There are no cost savings associated with the reuse of public school facilities. Operations and maintenance costs have not been focused upon in this summary.

In assessing the costs of supporting development as presented in later sections of this chapter, we have calculated total costs, and public and private costs separately. Some people believe that the only costs, which require consideration in an analysis of this kind, are public costs. They argue that if the costs of building or maintaining certain infrastructure is borne at first by the private sector; therefore, there are no costs. This is false. Irrespective of the source of capital used to construct and maintain infrastructure, expenditures represent resources, which could be used for other purposes were they not used for roads, sewer and water lines, or drainage facilities. Whether the initial source of funds for capital improvement comes from taxes, fees, private mortgage lending, General Obligation bonds, or other means makes little difference to the overall welfare of residents in Bernalillo County. This issue is explored further in the work of economist Michael McKee that is presented in Section 2 of this report.

This analysis is a cost analysis, it is not yet a comparison of benefits and costs. Other portions of this Planned Growth Strategy, Part 1 – Findings Report involve more complete analyses of the social and economic benefits and costs of growth.

4.2 Water System Findings

4.2.1 Summary

Based on the analysis, the Downtown scenario and the Balanced scenario had very similar costs, both of which were lower than the Trend scenario. The estimated total capital costs are as follows:

Downtown Alternative...........$568,680,000
Balanced Alternative.............$565,200,000
Trend Alternative..................$685,807,000

The estimated annual operation and maintenance costs associated with Downtown and Balanced scenarios ($6,203,000) are slightly lower than with the Trend scenario ($6,767,000).

In addition to the costs above, there are annual operation and maintenance and rehabilitation costs that are common to all three scenarios. The annual operation and maintenance costs for the system as it exists are approximately $21,000,000.

The annual rehabilitation needs for the existing system are projected to be $20,216,000. This is compared to the current annual budget of approximately $15,200,000 resulting in a projected annual rehabilitation shortfall of $5,016,000. It should be noted that actual capital spending often is notably lower than the amount budgeted, increasing the shortfall.

The cost split for public versus private funds for the capital costs have been estimated and are as follows:

Table 42 Public/Private Cost Split by Scenario

Scenario	Estimated Public Costs	Estimated Private Costs
Downtown	$330,520,000	$238,159,000
Balanced	$339,213,000	$225,987,000
Trend	$370,157,000	$315,649,000

Costs summarized above are shown on Tables A.2–A.4 in Appendix A.

All costs presented here are in 1998 dollars. The costs used in this report for any infrastructure improvements and operation and maintenance were obtained from past City of Albuquerque Water Utility Division project experience. The costs presented herein are intended to be used for comparison of the relative costs between the three scenarios only. Actual capital and added annual costs for any improvements needed to meet future increased demand will vary from the costs presented herein.

4.2.2 Purpose

The purpose of this section is to provide conceptual capacity and costs information related to the City of Albuquerque water supply system. Both the current system and projected growth for three scenario growth scenarios will be evaluated. The water supply system consists of wells, piping, pump stations, and reservoirs. In the future, a surface water treatment plant will be added to the Albuquerque water system. The City of Albuquerque currently is implementing numerous rehabilitation programs for the water system components that are required for the normal operation of any water system.

The Planned Growth Strategy investigates three alternative growth scenarios: (1) Trend Alternative, (2) Balanced Alternative, and (3) Downtown Alternative. A description of the three scenarios is found in Chapter 4.0. Figures 21–26 (pgs.95-105) display population and employment by water trunk and zone for the three scenarios. The estimated capital and operational costs for the expansion of the water system infrastructure associated with these three growth scenarios are presented in this report. This conceptual analysis of the water system scenarios needed to serve the projected populations in the year 2020 is intended to identify potential cost differences in infrastructure requirements associated with the three growth scenarios.

The conceptual evaluation of the water system and the improvements required for growth scenarios were developed based on standard engineering concepts and input from the Water Utility Division staff. The City of Albuquerque is in the process of developing a computer model for the water distribution system that will allow detailed evaluation of the growth scenarios. Without this completed and calibrated model, the analysis of the water system is subject to further engineering analysis and evaluation.

4.2.3 Water System Capacity

Water Service Area

The current City of Albuquerque water system Water Service Area provides water service for approximately 450,000 people. The current population within the Albuquerque area is about 480,000. The projected population in the year 2020 is estimated to be around 625,000, or an increase of around 145,000 people.

In an effort to identify the "core" water system, the January 1, 1960 City Boundary was determined. The Water Service Area outside of the 1960 City Boundary was also identified. Growth within the 1960 City Boundary and existing service area outside the boundary, but within the Water Service Area, is identified as potential infill. The area Outside the Water Service Area is deemed expansion area and will require an expansion of the water system to serve this area.

It is assumed that any growth into areas Outside of the Water Service Area would warrant extension of the water system to serve this population. Therefore, no matter how small the projected population growth in these zones, costs are included in this report to extend water service to these zones.

The projected population increase for each growth scenario was provided by the planning group of the Parsons Brinckerhoff team based on the input from the City and County Planning staff. The growth was distributed by DASZ for each scenario. The AGIS system was then used to overlay the trunk and pressure zones for the water system with the DASZ population increases to determine what the projected population increase would be in each trunk-zone.

The three growth scenarios result in different levels of populations in the three zones of development described above: 1960 City Boundary, Water Service Area, and Outside the Water Service Area. The projected population increase of 145,000 people is distributed differently for each growth scenario. The estimated percentage of the projected 2020 population increase (not total population) in the service zones for each growth scenario is presented in Table 43.

Table 43 Distribution of Population Increase by Service Zone

	Trend Alternative Population Increase (%)	Balanced Alternative Population Increase (%)	Downtown Alternative Population Increase (%)
1960 City Boundary	7	24	16
Water Service Area	55	50	63
Outside Water Service Area	38	26	21

The total population by growth scenario is presented in Table 44.

Table 44 Total Projected Population by Growth Scenario and Service Zone, 2020

	Trend Alternative Total Population	Balanced Alternative Total Population	Downtown Alternative Total Population
1960 City Boundary	259,168	284,054	271,661
Water Service Area	280,485	273,721	288,351
Outside Water Service Area	86,950	69,876	60,539

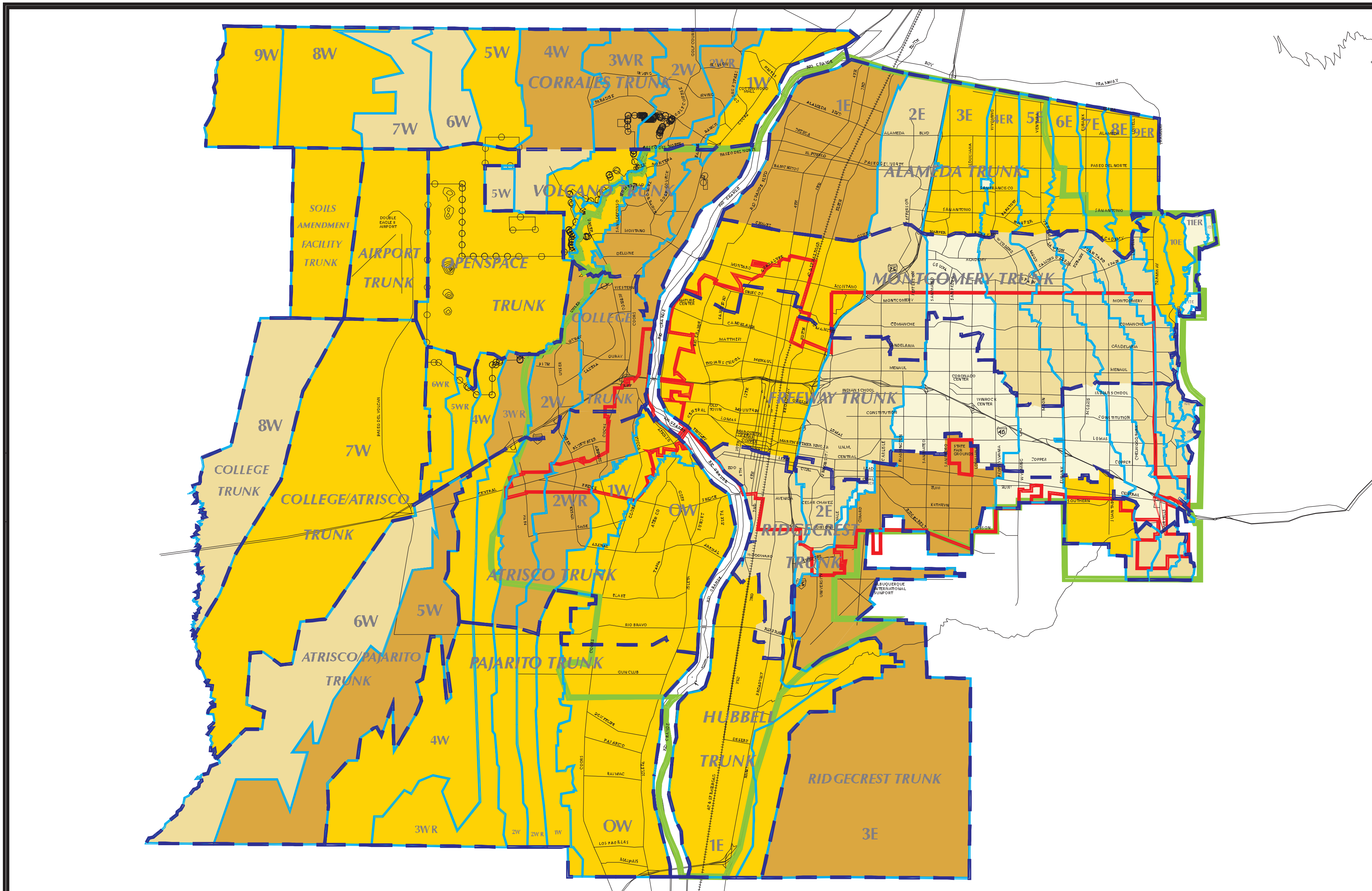


Figure 21

Trend Population Growth Forecast for Year 2020 by Water Trunk & Zone

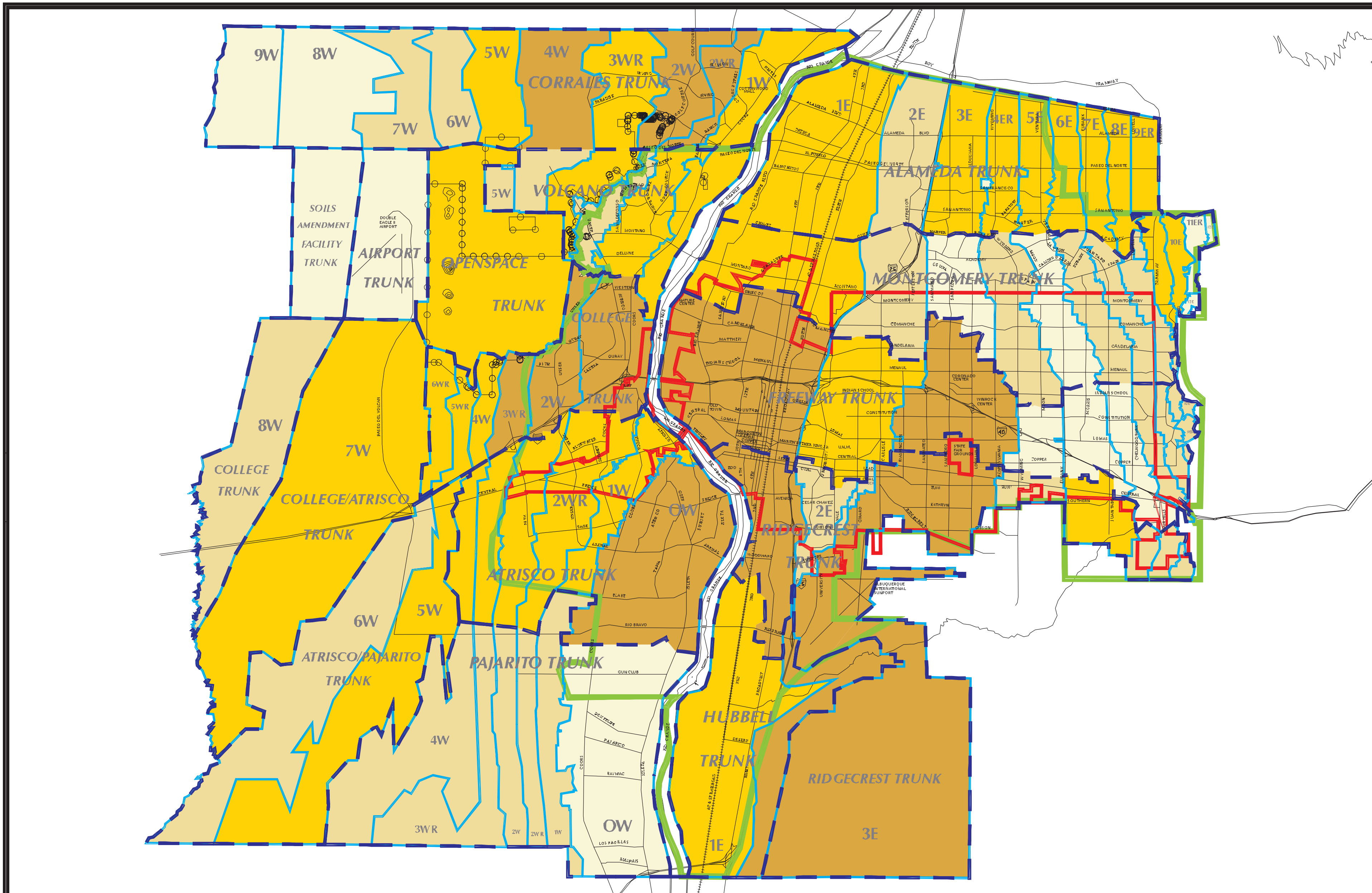
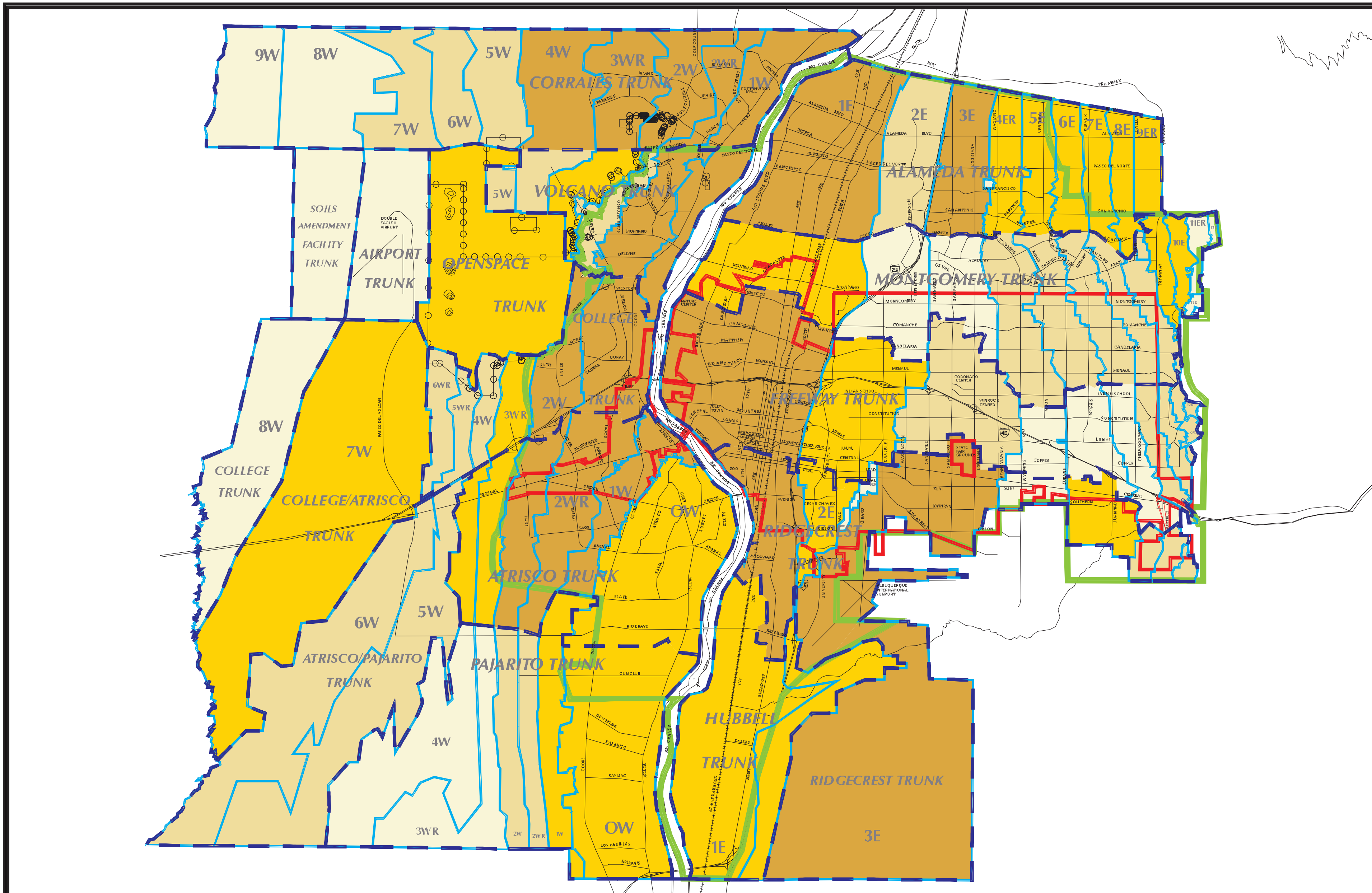


Figure 22

Balanced Population Growth Forecast for Year 2020 by Water Trunk & Zone



Less than 0
Between 1 to 999
Between 1,000 to 2,999
Greater than 3,000

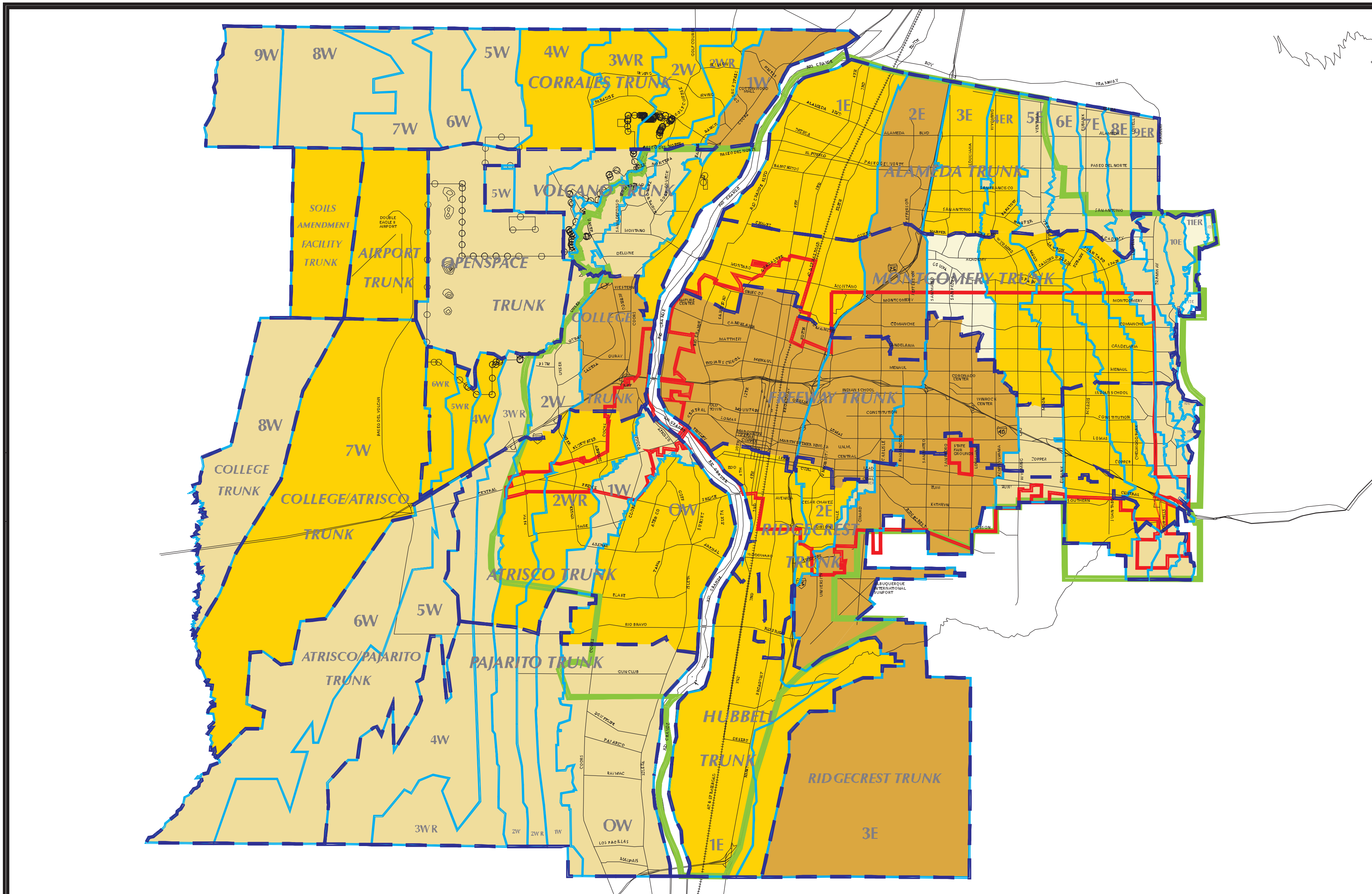
1960 City Limits
Water Service Area

Figure 23

Downtown Population Growth Forecast for Year 2020 by Water Trunk & Zone

Scale: 1 inch = 3 miles

Map Printed December 1998



Less than 0	1960 City Limits
Between 1 to 999	Water Service Area
Between 1,000 to 4,999	
Greater than 5,000	

Figure 24

Trend Employment Growth Forecast for Year 2020 by Water Trunk & Zone

Scale: 1 inch = 3 miles

Map Printed December 1998

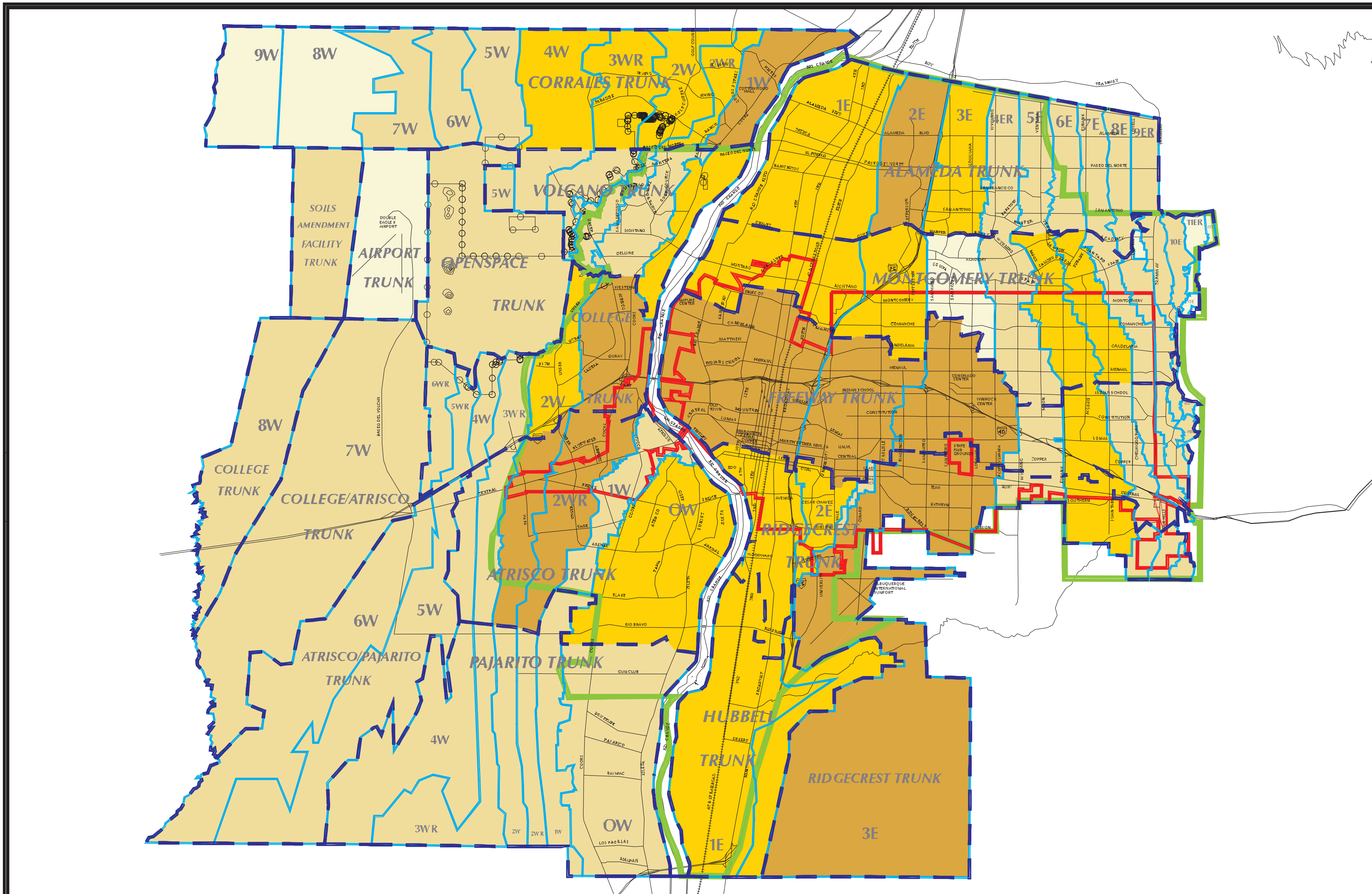
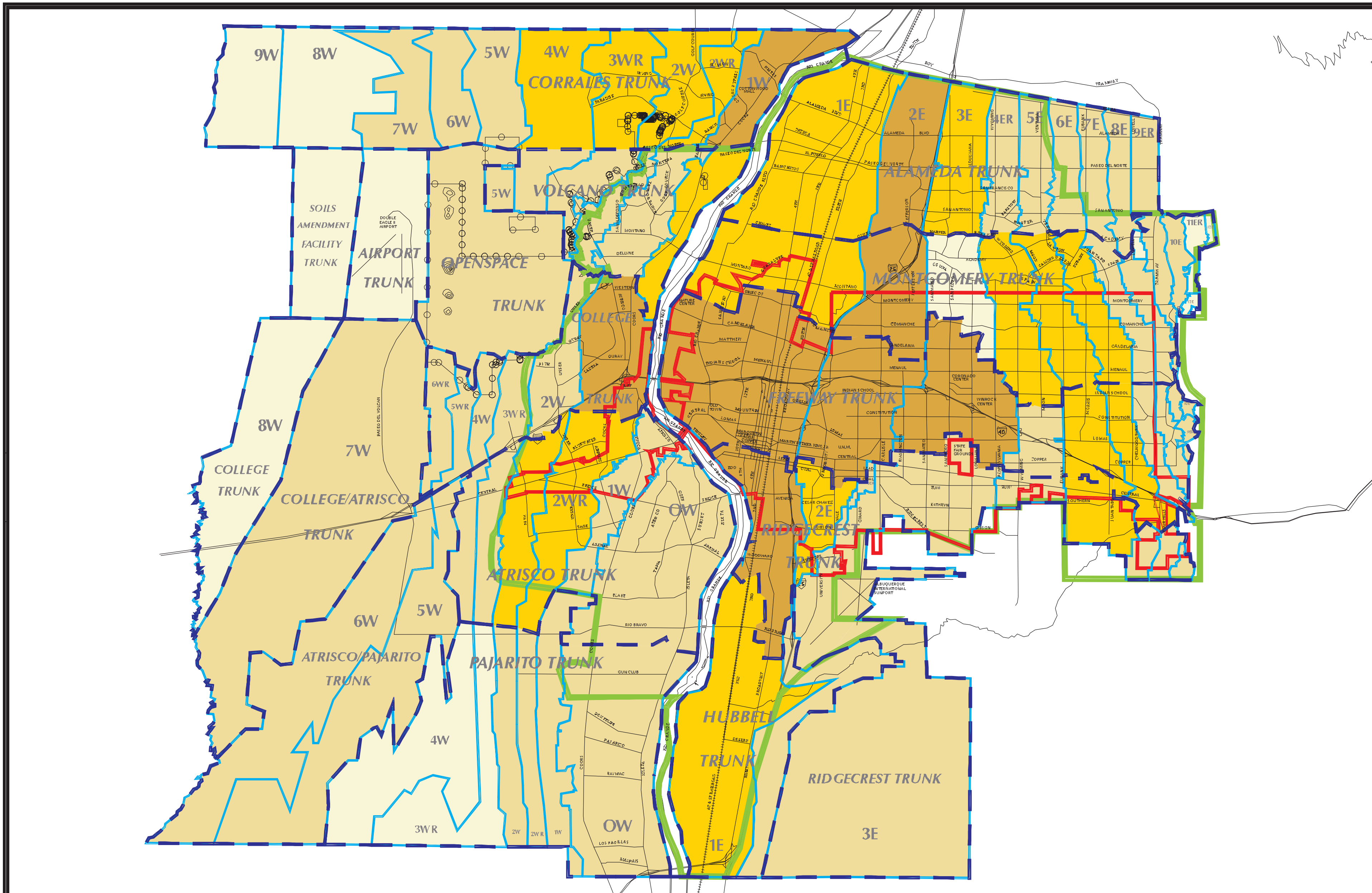


Figure 25

Balanced Employment Growth Forecast for Year 2020 by Water Trunk & Zone



Less than 0
Between 1 to 999
Between 1,000 to 4,999
Greater than 5,000

1960 City Limits
Water Service Area

Figure 26

Downtown Employment Growth Forecast for Year 2020 by Water Trunk & Zone

Scale: 1 inch = 3 miles
Map Printed December 1998

Water System Capacity

The existing water system has developed over the years to include a system on the east side of the river and a system on the west side. The water is delivered in an east-west direction by major transmission facilities called trunk lines. The trunk lines have the capability to distribute water to several different pressure zones as the elevation of the service area changes. For instance, there are approximately 12 pressure zones on the east side of the river and five pressure zones on the West Side.

The trunk transmission lines consist of the following:

- East side from the north to the south:
  - Alameda
  - Montgomery
  - Freeway
  - Ridgecrest
- West side from the north to the south:
  - Volcano Cliffs
  - College
  - Atrisco

These trunks have wells providing water to them and utilize numerous reservoirs and pump stations for operation of the trunk.

In 1994, the citywide annual average water demand was 250 gallons per capita per day (gpcd). An aggressive water conservation program was implemented in that year and has since reduced the water demand by around 20%, resulting in a per capita use of around 200 gpcd in 1998. The water conservation goal is to achieve a 30% reduction by the year 2004, which will result in a per capita demand of 175 gpcd. The water distribution system was designed for the higher demands, and as a result of conservation, the system has excess capacity in certain trunks. However, the water distribution system was also designed to provide water for firefighting purposes. In many cases, the fire flow demands are greater than the maximum hour demands for normal use. As such, it is not possible to identify specific pipelines that may have excess or deficient capacity without the use of the water distribution system hydraulic model.

Based on the experience of the Water Utility Division, there are three trunks that may have excess capacity to handle future growth. These trunks are the Freeway, Montgomery, and Ridgecrest trunks. Based on the growth projected by the three growth scenarios, it was estimated that there is sufficient capacity to accommodate the additional water demand.

The current water supply system has sufficient capacity to serve the Water Service Area. As such, there are no areas of deficiency at this time. As with most water utilities across the United States, the City of Albuquerque has taken responsibility for providing a fully operational and reliable water system that serves its customers in an efficient manner. Therefore, any problem areas or deficiencies are corrected by the Water Utility Division and a reliable water service is provided to its customers.

4.2.4 Cost Analysis for Water System

Operation and Maintenance

The Water Utility Division is responsible for the overall operation and maintenance of the water supply system. This includes many activities and components including labor, power, chemicals, and replacement equipment. Currently, the Water Utility Division annual operation and maintenance budget includes approximately $14 million for maintenance and $7 million for operations. This is a total annual budget of $21 million for operation and maintenance to serve the existing service area. Based on the current operation and maintenance demands, the current budget is sufficient for its purpose. The cost of operation and maintenance will increase in the future due to inflation, aging system components, and requirements for treating surface water, and perhaps the need to treat the ground water for arsenic removal. However, in terms of 1998 dollars, the operation and maintenance budget for the existing system is expected to remain fairly constant.

The current operation and maintenance budget provides service for the customers in the 1960 City Boundary and the Water Service Area at an approximate distribution of 55% and 45%, respectively. Therefore, the current annual operation and maintenance costs can be distributed approximately as presented in Table 45.

Water repair work on San Mateo

Table 45 Current Operation and Maintenance Costs Distribution

Service Zone	Annual O&M Costs
1960 City Boundary	$11,550,000
Water Service Area	$9,450,000

The City of Albuquerque is expected to begin using surface water in the year 2005. The surface water treatment facility will increase the operation and maintenance beyond the current levels. The water treatment facility is a technically advanced process requiring a specialized operational staff, chemicals, and power. Preliminary estimates for the annual operation and maintenance costs associated with an 84 mgd water treatment plant are as presented in Table 46.

Table 46

Operation and Maintenance Costs for Water Treatment Plant

O&M	Costs
Labor	$1,497,000
Chemicals	$4,091,000
Power	$4,595,000
Maintenance Costs	$2,333,000
Annual Total	$12,516,000

The annual operation and maintenance cost estimate results in a unit cost of around $0.41 per 1,000 gallons of water produced. The cost of the water treatment plant will need to be added to the current operation and maintenance costs related to the wells, pump stations, reservoirs, and piping that will still require attention even when the water treatment facility is implemented. Presented in Table 47 are the estimated surface water treatment annual operation and maintenance costs distributed to service zones for each growth scenario.

Table 47 Operation and Maintenance Costs for Surface Water Treatment

	Total Population by Service Zone (%)			O&M Costs for Surface Water Treatment			
Scenario	1960 City Boundary	Water Service Area	Outside Service Area	1960 City Boundary	Water Service Area	Outside Service Area	Total O&M Costs
Trend	41	45	14	$5,131,560	$5,632,200	$1,752,240	$12,516,000
Balanced	45	44	11	$5,632,200	$5,507,040	$1,376,760	$12,516,000
Downtown	44	46	10	$5,507,040	$5,757,360	$1,251,600	$12,516,000

Another potential operation and maintenance cost that may be required in the near future for the City of Albuquerque is the cost of treatment for arsenic removal. The EPA published new arsenic standards in June of 2000 and promulgated the regulation in January of 2001. The arsenic maximum contaminant level for drinking water was lowered from 50 micrograms per liter (mg/L) to 10 mg/L. At this contaminant level (10 mg/L), around half of the existing 92 wells will need to have treatment. The preliminary cost of the operation and maintenance for arsenic treatment will be in the $0.25/1,000 g to $0.35/1,000 g range and will result in an annual cost of $3–$4.5 million. The requirements for arsenic treatment were unknown at the time this section was written and were not included in the estimated operation and maintenance costs

The increased population growth will result in additional operation and maintenance costs for the water supply system. Currently, the annual operation and maintenance costs are around $21 million for a population of 450,000. This results in a unit operation and maintenance cost of around $47 per person. This cost is expected to remain fairly constant as population growth under the Trend scenario is assumed to occur at current development densities. However, the Downtown and the Balanced scenarios consist of growth that is assumed to be a higher density development, approximately 25% greater than the Trend scenario. The fixed operation and maintenance costs for wells and pump stations will remain the same but the 25% higher density will result in a 25% savings on pipeline operation and maintenance. As a result, the projected operation and maintenance costs for future growth under the Downtown and the Balanced scenarios is estimated to be about $43 per person.

The estimated operation and maintenance cost for each growth scenario, separated by service zone, is presented in Table 48 (pg.110). The operation and maintenance costs associated with the current and projected water systems are summarized in Table 49 (pg.110).

Table 48 Estimated Additional Operation and Maintenance Costs for Growth

	Population Increase by Service Zone (%)			O&M Costs for Growth			
Scenario	1960 City Boundary	Water Service Area	Outside Service Area	1960 City Boundary	Water Service Area	Outside Service Area	Total O&M Costs
Trend	7	55	38	$473,700	$3,721,900	$2,982,500	$7,178,000
Balanced	24	50	26	$1,488,700	$3,101,500	$1,843,800	$6,434,000
Downtown	16	63	21	$992,500	$3,907,900	$1,649,600	$6,550,000

Table 49 Summary of Estimated Operation and Maintenance Costs by Growth Scenario

Scenario	1960 City Boundary	Water Service Area	Outside Service Area	Total
Trend Current	$11,550,000	$9,450,000	$0	$21,000,000
Trend Increased	$473,700	$3,721,900	$2,982,500	$7,178,000
Trend Surface Water	$5,131,560	$5,632,200	$1,752,240	$12,516,000
Trend Total	$17,155,260	$18,804,100	$4,734,740	$40,694,100
Balanced Current	$11,550,000	$9,450,000	$0	$21,000,000
Balanced Increased	$1,488,700	$3,101,500	$1,843,800	$6,434,000
Balanced Surface Water	$5,632,200	$5,507,040	$1,376,760	$12,516,000
Balanced Total	$18,670,900	$18,058,540	$3,220,560	$39,950,000
Downtown Current	$11,550,000	$9,450,000	$0	$21,000,000
Downtown Increased	$1,488,700	$3,101,500	$1,649,600	$6,550,000
Downtown Surface Water	$5,507,040	$5,757,360	$1,251,600	$12,516,000
Downtown Total	$17,545,740	$18,308,860	$2,901,200	$40,066,000

The operation and maintenance costs are estimated to be slightly less for the Balanced and the Downtown scenarios. It should be noted that these estimates are conceptual in nature and further engineering analysis is needed to establish a more refined estimate of annual operation and maintenance cost differences.

Water System Rehabilitation Costs

The City of Albuquerque Water Utility Division currently has numerous rehabilitation projects identified in an ongoing effort to maintain the viability of the water system. The rehabilitation projects are related to the service zones defined by the 1960 City Boundary area and the Water Service Area boundary. As growth occurs, rehabilitation of new facilities will be required. As such, the expenditures of funds for rehabilitation of facilities that have reached their useful life will be an ongoing requirement. The rehabilitation projects that will require funding are presented below.

Well Rehabilitation

The City of Albuquerque currently has 92 wells in service. These wells require rehabilitation for many purposes including pump and motor replacement, electrical upgrades, casing corrosion, casing lining due to water level declines, and many other factors. Currently, Water Utility Division proposes to spend around $2.8

million annually for the rehabilitation of various wells in the system. This cost is anticipated to remain fairly constant in 1998 dollars.

Pump Station Rehabilitation

The Water Utility Division operates and maintains 27 booster pump stations in the water distribution system. Pump station rehabilitation includes such things as pump and motor replacement, electrical upgrades, building rehabilitation, etc. The Water Utility Division currently spends around $1.8 million for pump station rehabilitation. These costs are anticipated to remain at approximately this level in 1998 dollars.

Reservoir Rehabilitation

The Water Utility Division currently operates and maintains 45 water storage reservoirs in the water distribution system. These reservoirs are constructed of both steel and concrete. The steel reservoirs require painting periodically, and floor plate replacement is occasionally required. The concrete reservoirs have shown structural deterioration and require a wide range of rehabilitation, from structural repair to full replacement. The Water Utility Division currently spends around $1.5 million annually for reservoir rehabilitation. These costs are anticipated to remain at approximately this level in 1998 dollars.

Supervisory, Control, and Data Acquisition System Improvement

The Supervisory, Control, and Data Acquisition system allows the Water Utility Division to effectively operate and monitor the water system. The Supervisory, Control, and Data Acquisition system consists of remote sensors and controls that allow the pump stations, reservoirs, and piping components to be monitored and controlled remotely by the Operations staff. This system is an important and integral component of the overall water system. Upgrades and improvements are a constant requirement. The Water Utility Division currently spends around $1.6 million annually for the Supervisory, Control, and Data Acquisition system improvements. These costs are anticipated to remain at approximately this level in 1998 dollars.

Meter Replacement

This rehabilitation work element is required due to the aging of meters in the distribution system. As meters age, they lose accuracy and register less water. Therefore, the City loses revenue from old inaccurate meters. The Water Utility Division currently spends approximately $500,000 annually for meter repair and replacement. In addition to meter repairs and replacement, the meter boxes are also in need of rehabilitation. It is estimated that a budget of $1.5 million will be required to fully implement a meter and meter box repair and replacement program to effectively deal with aging meters. A budget of $1.5 million annually for meter repair and replacement will be included with this report.

Pipeline Replacement

The water distribution system is constructed with approximately 100 miles of steel water pipe. This represents around 4% of the total 2,400 miles of piping in the system. This steel water pipe was installed without interior or exterior coatings. Consequently, all of this steel pipe is expected to need to be replaced by 2020. The system also includes about 950 miles of small diameter cast iron pipe. Past experience indicates that about 50% of this pipe will have to be replaced by 2020.

Waterline replacement

The Water Utility Division staff currently is budgeting around $3.0 million annually for piping replacement. Due to the need to replace the existing steel and cast iron water lines, it is estimated that a budget of about $7 million annually will be required. This is based on the assumption that all of the steel piping and one-half of the cast iron piping will need to be replaced by 2020.

Other Improvements

The existing chlorination, fluoridation, and other miscellaneous facilities also require rehabilitation or replacement. In addition, the City has experienced leakage problems with plastic service lines. These lines are being replaced with copper service lines. It is estimated that this rehabilitation will require an annual budget of $4 million.

Summary of Rehabilitation Costs

The total estimated rehabilitation costs for the water system are presented in Table 50. The total annual amount needed for rehabilitation is identified as $20.2 million. (Editor's note: This compares to the average annual expenditure for water system rehabilitation in fiscal years 1998 to 2000 of $9.1 million dollars. See: Chapter 9 of Planned Growth Strategy, Part 2-Preferred Alternative, entitled City and County Financial and Planning Requirements.)

Table 50 Estimated Rehabilitation Costs

Rehabilitation Component	Estimated Annual Cost
Wells	$2,800,000
Pump Stations	$1,800,000
Reservoirs	$1,500,000
Supervisory, Control, and Data Acquisition System	$1,600,000
Meter Repairs/Replacements	$1,500,000
Pipeline Replacements	$7,016,000
Other	$4,000,000
Total Rehabilitation Costs	$20,216,000

New Infrastructure Costs

New water system facilities will be required to accommodate the growth projected for the three scenarios. The individual components of the new facilities are described on the following page.

New Wells

As growth continues, it will be necessary to provide a reliable water supply by constructing new production wells. The new wells will be required as functional additional water demands result from population increases. Based on recent City of Albuquerque experience, the cost to permit, drill, develop, and integrate a municipal well is around $2,500,000. This includes pump buildings, site electrical, controls, and collector piping. The wells must supply maximum daily demands that are estimated to be 400 gpcd for residential and 50 gpcd for employment use. The typical production well in Albuquerque has a capacity of around 2,000 gallons per minute. Based on the above, it is calculated that the one-time cost for a new well is $347 per capita population and $43 per capita employment.

Water Rights

Supplying additional water will require the acquisition of new water rights. The estimated cost of water rights is $3,000 per acre-foot. The annual average water demand in the year 2020 is anticipated to be 175 gpcd for residential use and 30 gpcd for employment. This calculates to a cost of $590 per person and $100 per employee.

New Reservoirs

As growth moves into areas currently not served, the construction of water storage reservoirs will be required. These reservoirs will provide storage to meet peak water demands and for firefighting purposes. The reservoir costs are based on $0.50 per gallon of storage, which includes an allowance for the reservoir, foundation, site work, and miscellaneous piping and valves. This cost then is allocated across the pressure zones that it will serve. The size of the reservoir will be based on a typical reservoir constructed by the City of Albuquerque, which in most cases is six million gallons. The typical reservoir cost is therefore $3 million.

Water reservoir

New Pump Stations

New pump stations will be required to provide pressure and water conveyance capabilities in the distribution system. Pump station costs are based on an average cost of $1,500,000–$2,000,000 per pump station and, as with the reservoir cost, is spread across the pressure zones that it would serve.

New Transmission Pipelines

New transmission pipelines will be required to serve the new development in the extended service areas. Transmission lines are major pipelines that serve as a connection between the pump stations and the reservoirs and are typically in the 24- to 36-inch diameter range. The size of the transmission pipelines was estimated with input from the Water Utility Division based on estimated water demands. A unit price of $3 per inch diameter is used to develop a capital cost for the pipeline and, as with the reservoirs and pump stations, the cost was allocated across the pressure zones that it would serve.

Master Plan and Infill Pipelines

Master plan lines are simply 16-inch and larger diameter lines that supply approximately one quarter section of new development. These lines will be located on the outer edges of the quarter section. Infill lines are smaller diameter pipelines that distribute the water within the new development. The pipelines serving the new development are assumed to consist of the following for each quarter section of development:

- 5,000 lineal feet of 16-inch and larger diameter pipe
- 30,000 lineal feet of 6-inch diameter pipe
- 5,000 lineal feet of 12-inch diameter pipe

The cost of these pipelines was estimated based on a unit cost of $3 per inch diameter per lineal foot. The total cost of these pipelines therefore will be $960,000 per quarter section of development.

The population associated with development is expected to have different densities for the three growth scenarios. For the Trend scenario, the new growth density is estimated to be the same as current City of Albuquerque densities. Currently, the City of Albuquerque serves around 450,000 people over an area of 177 square miles. This is an average density of approximately 2,540 people per square mile or around 640 people per quarter section of development. The unit cost for master plan and infill lines for the Trend scenario therefore will be $1,480 per person.

For the Balanced and Downtown scenarios, the density was assumed to be on average 25% denser than existing development. The denser development therefore will be assumed to be around 800 people per quarter section. This results in a unit cost of master plan and infill piping of $1,110 per person. This lower unit cost will be used for the Balanced and Downtown scenarios.

Water Service Connections

The service connection from the water main to the structure consists of a main tap, a corporation stop, a ¾-inch copper pipeline, a valve at the property line, and a meter. The total cost of this service connection is estimated to be $1,095. Assuming 2.5 people per single family residential unit, this costs equals around $438 per person. For commercial development, we have assumed an average of 10 employees per ¾-inch service, which equals $43 per employee. Many of the land parcels that will be developed currently have water service lines installed. Those parcels with water service lines will not require the cost of installation of the services and will be accounted for in this analysis.

East Mountain Private Wells

The water supply in the majority of the East Mountain area is expected to consist of private wells. The cost of a new well is estimated to be $7,500. Assuming 3.0 people per house in the East Mountains, the cost of a new well per person is estimated to be $2,500. For commercial areas in the East Mountains, it is assumed that one well can serve around 20 employees and will result in a unit cost of $375 per employee.

Summary of New Water Facility Costs

The computations for estimating the new water facility capital costs for the three growth scenarios are presented in Tables A.2–A.4 in Appendix A. A summary of these costs is shown in Table 51.

Table 51 Summary of Estimated Capital Costs

Scenario	1960 City Boundary	Water Service Area	Outside Service Area	Total
Trend	$101,002,000	$301,432,000	$283,373,000	$685,807,000
Balanced	$124,722,000	$251,543,000	$188,935,000	$565,200,000
Downtown	$117,489,000	$295,362,000	$155,829,000	$568,680,000

Public and Private Estimated Costs

The costs for new water facilities will be born by both the public and private sectors. The public funds will be provided by utility rate payers. The private funds will be provided from individual developers. The estimated capital cost split for water facilities is presented below in Table 52.

Table 52 Public-Private Capital Cost Split

Water Facility	Public Cost Share (%)	Private Cost Share (%)
Production Wells	50	50
Pump Stations	50	50
Water Storage Reservoirs	50	50
Transmission Pipelines	50	50
Master Plan Pipelines (18–35 inch) and Infill Pipelines (6–12 inch)	20	80
Water Service Connections	0	100

Based on the estimated cost share for the public and private sectors, the cost share for the projected capital costs of the water system components is presented in Table 53.

Table 53 Estimated Public and Private Costs

Scenario	Estimated Public Costs	Estimated Private Costs	Total
Downtown	$330,520,000	$238,159,000	$568,680,000
Balanced	$339,213,000	$225,987,000	$565,200,000
Trend	$370,157,000	$315,649,000	$685,807,000

4.3 Drainage System Findings

4.3.1 Summary

The three scenarios differ in terms of the cost of providing drainage facilities. The cost of rehabilitation, deficiencies, and new facilities for the Trend scenario is $534 million, for the Balanced scenario $496 million, and for the Downtown scenario $470 million. The costs of deficiency projects, defined as expanding existing drainage infrastructure needed to accommodate storm water runoff in a manner consistent with adopted engineering standards, are approximately the same for all scenarios. Rehabilitation costs are defined as the cost of correcting the substandard physical condition of existing hydrology infrastructure without increasing capacity (e.g., cavitation, concrete spalling) and are approximately $36 million for all scenarios. New construction of drainage facilities ("growth") is most costly in the Trend scenario, with a range of $64 million between the Trend costs and the Downtown costs.

4.3.2 Capacity of the Existing Drainage System

Extent of Current Service

The existing major drainage structures are designed for a 100-year storm or greater. The existing drainage systems have adequate capacity for growth with the exception of planned Capital Improvements Program projects inventoried in Table A.5.

The collection drainage systems associated with major drainage outlets have numerous areas with deficiencies particularly in the older part of Albuquerque (1960 City Boundary on the figures). The proposed Capital Improvements Program projects include upsizing of storm drains, pump stations, improvements to the Alameda Drain, detention ponds, and dip section replacements. With these planned improvements, storm drainage service will be provided for the currently developed Water Service Area within the study area.

Areas with Excess Capacity

None of the drainage basins in the study area have excess capacity.

Areas with Deficient Capacity

All the drainage basins have some degree of deficiency as outlined in the following section and shown in the cost analysis spreadsheets (see Tables A.6–A.8 in Appendix A).

4.3.3 Cost Analysis for Drainage System

Operation and Maintenance

The current annual amount for operation and maintenance is approximately $2 million[1]. This is the amount spent by AMAFCA, City, Bernalillo County, and Middle Rio Grande Conservancy District (MRGCD) to clean sediment and debris from drainage facilities and to perform maintenance service on a regular basis. The current $2 million was converted to an area-based operation and maintenance amount of $350 per acre per year and applied to the growth figures in each scenario. The operation and maintenance annual costs were converted to 1998 dollars over the 25-year period.

Rehabilitation

The report uses the 1960 City Boundary to define rehabilitation. Rehabilitation is allocated only in the 1960 City Boundary because this region has the oldest infrastructure. Rehabilitation projects are ones that correct unacceptable physical conditions of infrastructure without adding capacity. The annual expenditure for rehabilitation of existing drainage infrastructure by AMAFCA, City, Bernalillo County, and MRGCD is approximately $1.8 million. The total cost of these rehabilitation expenditures is $36 million.

Existing Deficiencies

Deficiency in drainage infrastructure is defined as the lack of capacity in relationship with adopted engineering standards. Deficiency projects expand existing hydrology infrastructure capacity. Deficiencies occur for the following reasons:

Capacity problems. Upstream growth requires upsizing existing facilities. The 1960 City Boundary includes the lower parts of the City with systems that were designed many years ago that may not be adequate to accommodate increased runoff.

New Standards. Local hydrologic analysis methods were revised in the early 1990s. The result of the revision was higher measures of estimated runoff, which caused systems to be labeled deficient.

Drainage system failure

The drainage basins in the Northeast Heights, Southeast-Near Heights, and the Valley represent the greatest areas of deficiencies. These areas are mostly developed. In the Valley, the flat grades and low-lying areas increase the complexity of providing 100-year flood protection. As a result, it is not economically feasible to provide 100-year flood protection in all locations. The protection may be for less than a 100-year storm, such as a 2- or 10-year storm. In the Far Northeast Heights and La Cueva-Camino basins, the area commonly known as North Albuquerque Acres, was platted in the 1930s and has experienced piecemeal development, leaving much of the needed drainage infrastructure for the already overburdened public deficiency list. Until the major drainage infrastructure is constructed, this area will be difficult to develop in a comprehensive manner.

Projects to Correct Deficiencies

An inventory of major projects planned for construction has been compiled based on AMAFCA and City proposed schedules and current major drainage management plans. The project inventory can be found in Table A.5 in Appendix A. It is assumed that 100% of the cost of all hydrology projects apportioned to the 1960 City Boundary of Albuquerque is classified as “deficiency” or “rehabilitation.” Furthermore, 70% of the cost of the hydrology projects occurring within the area between the 1960 City Boundary and the Water Service Area also is classified as “deficiency”. The remaining

30% of the cost of these projects is considered to be “growth” related.

Within the 1960 City Boundary and the current Water Service Area, the following describes the infrastructure needs:

South Eubank. This area is partially developed and drains to the Tijeras Arroyo. The City plans to build this major infrastructure in the next five years for an approximate cost of $9 million.

North Valley. This area is currently being studied by Smith Engineering for AMAFCA and Bernalillo County. This project is in the problem identification phase. The area has limited outfalls to the Rio Grande with the Alameda Drain being the primary drainage facility. It is anticipated that storm water discharge from developments will be restricted with detention ponds. Collection systems will be added to convey runoff to the existing outlets at Alameda Boulevard, Paseo del Norte, and Montaño Road.

Southwest Valley. The Corps of Engineers is currently evaluating the Southwest Valley. A recent study by the AAR Larkin Group identified the need for a major investment in storm drainage infrastructure. Key issues include:

- The quantity and quality of water discharged to the Isleta Pueblo to the south of I–25.
- The MRGCD drains are presently used for irrigation and drainage.
- The flat grades make the drainage difficult.
- This area is lower than the Rio Grande requiring pumping.

Isleta. Improvements are currently being planned in the Isleta Boulevard corridor.

South Broadway. The area east of the Rio Grande has an outfall to the river with the San Jose Drain. The City plans improvements to the Broadway/San Jose system to improve drainage in this area. The area south of the San Jose Drain is flat with the MRGCD Drains (Pajarito and Isleta) providing the drainage.

La Cueva-Camino and Far NE Heights. North Albuquerque Acres is contained within these drainage basins and is planned to be primarily low-density residential. The major drainage corridors in the area include the La Cueva-Camino Arroyos and the Domingo Baca Arroyo. Both these basins have drainage plans developed with the Domino Baca major infrastructure primarily in place, except for the Paseo del Norte storm drain system east of Wyoming. The La Cueva-Camino Drainage Master Plan includes $20 million of improvements including detention dams, avulsion structures, and channel stabilization.

Projects to Provide New Infrastructure

In this report some new infrastructure was allocated for anticipated growth within the current Water Service Area. The majority of the new infrastructure, however, will be required at the fringe areas Outside the Water Service Area. The project inventory in Table A.5 lists numerous projects designated as long range, which means that they will not be considered for construction until after the year 2002.

The following describes the infrastructure needs of the region Outside the Water Service Area:

Drainage development project

Upper Calabacillas and Piedras Marcadas. The project known as Quail Ranch is contained within these drainage basins. Located in far northwest Albuquerque, Quail Ranch is in the conceptual planning phase for 1000 acres located in the southeast corner of the Upper Calabacillas drainage basin and the westernmost part of the Piedras Marcadas drainage basin. This development will use detention to maintain historic flows. The estimated cost of detention and associated major infrastructure is approximately $2.0 million. The cost to develop the lots and commercial development in the area is approximately $8 million (minor infrastructure). This area is located outside the existing service area.

Northwest Area above the Escarpment. This area is included in the following drainage basins: Piedras Marcadas, Mariposa, Boca Negra, and Rinconada, and in the higher elevations of Ladera-Mirehaven. Partially owned by the National Park Service and by private owners, this area has shallow basalt making trenching for utilities difficult and costly. The development of the basalt area above the escarpment on the West Side will result in expensive drainage infrastructure. This area will require detention of developed flows before releasing storm drainage down the escarpment. Ideally, the land atop the escarpment should be planned with low priority for development due to the high cost of construction and the sensitive nature of the area.

West I–40—Upper Amole—Ladera-Mirehaven. This region is included in the West I–40 Drainage Master Plan, the upstream portion of which is still in the conceptual phase. The major infrastructure improvement includes the diversion channel north of I–40, escarpment drainage, and the Amole detention dams. The estimated cost for these improvements is $50 million. The Westland Sector Plan, basically the area west of Unser and north of I–40, drains to this system. Right-of-way has been set aside for these improvements as development occurs. The land closest to I–40 is a developing area of the City.

Region above the Southwest Valley. This area includes the drainage basins Don Felipe-Raymac-McCoy and Amole-Hubbell, and drains to several AMAFCA detention dams—McCoy, Los Indios, Raymac, Don Felipe, Hubbell, and Westgate. These detention dams are designed for developed conditions and require sediment removal after major rainfall events. The dams have gated principal spillways and discharge to MRGCD facilities when permitted. AMAFCA is working on a project that will provide discharge from these dams to the Rio Grande. The McCoy Diversion Channels, a $4 million project in the Don Felipe-Raymac-McCoy drainage basin, may not be constructed in this study period due to the limited development in this sub-basin.

Mesa del Sol. The New Mexico State Land Office owns this 13,000-acre area, located south of the Albuquerque International Airport. The area is planned for urban centers with conventional and non-conventional drainage. The primary development area will drain to the existing playa lakes and will have zero surface discharge off site. This will reduce the cost for drainage; however, the cost of land will be higher. From the perspective of drainage costs, the Mesa del Sol area is an ideal area to develop. However, many current State of New Mexico and City of Albuquerque drainage standards must be waived to accommodate the proposed development scenario.

Cost Analysis Spreadsheets

The cost analyses for the three scenarios are presented in Tables A.6–A.8. These costs are based on two main cost sources:

Major Costs. These are the proposed major drainage improvements as described in this section. They represent the major storm drainage infrastructure including dams, channels, and major storm drain trunks. The major costs are typically built using public funds with possible cost sharing by the developer (see Public-Private Cost Analysis below). The major costs may actually be smaller than the minor costs for a drainage basin. They are referred to as “major” because they are typically large projects that must be constructed within a shorter time than the complete buildout of a drainage basin.

Minor Costs. These are costs based on the requirements to develop individual residential lots and commercial parcels of land. The minor costs are typically borne by the developer, and thus are included in the private costs (see Public-Private Cost Analysis, pg.121.

Population and employment growth figures provided by the City of Albuquerque Planning Department were used to develop the minor costs based on persons per acre. The three growth scenarios were overlaid on the drainage basins with the AGIS staff providing the population and employment growth per basin. The population and employment growth was converted to residential and business areas to estimate the hydrology costs to develop the areas. The conversion to area was made based on 11 persons per acre for residential usage and 54 persons per acre for businesses.

The minor costs to develop vary from basin to basin based on the amount of growth forecasted and whether or not the drainage basin contains basalt near the surface. The minor cost multiplier per acre of development was estimated based on past projects. The estimated cost for residential grading and minor drainage is $8,000–$12,000 per acre. The amount increases to $12,000 when there is basalt near the surface. Likewise, the cost per acre for grading and drainage for business usage ranges from $12,000–$18,000 per acre. Businesses have greater runoff due to more paved land required for parking, which increases the minor costs.

Public-Private Cost Analysis

The drainage infrastructure costs were split between the public and private sectors. The following Table 54 from City of Albuquerque was used as a guide for computing the public and private costs.

The public sector typically funds the construction of large drainage projects (included in major costs) that facilitate the buildout of a drainage basin. The private sector typically funds the smaller drainage projects (the inlets, smaller storm drains and structures included in the minor costs) that discharge to the large infrastructure.

Note that in many of the planned Capital Improvements Program projects (calculated as major costs in the hydrology costs analysis) the funding is already established and varies from the table. In those cases the established planned funding was used. The public-private cost split for each of the major costs is shown in Table 55 and is detailed in Table A.5.

Table 54. Hydrology Public-Private Cost Split

Drainage Infrastructure	Public (%)	Private Cost Recovery (%)
Large dams (greater than or equal to 10 acre-feet)	70	30
Small dams (less than 10 acre-feet)	0	100
Diversion channels	100	0
Storm drain trunk lines	20	80
Hard lined and soft lined channels	50	50
Crossing structures—arterial or collector streets	50	50
Crossing structures—local streets	0	100
Collection system—storm drains (smaller lines)	0	100

Table 55 Summary of Cost Analysis for Drainage

		Deficiency and New	
Scenario	O&M and Rehabilitation	Public	Private
Trend	$73,413,142	$314,141,187	$184,383,066
Balanced	$66,038,755	$305,548,163	$155,035,170
Downtown	$65,390,949	$288,549,059	$145,806,299

4.3.4 Supporting Information

Key Assumptions

The key assumptions used in the calculation of hydrology costs for planned growth management fall into two categories:

Overall Analysis Method. The entire study area is divided into drainage basin subareas so that smaller areas can be examined.

Cost Analysis. The operation and maintenance costs are computed for each drainage basin. The major and minor costs are computed and then apportioned to the rehabilitation, deficiencies, and new categories.

Overall Analysis:

- The 1960 City Boundary (red line on the figures) designates areas of storm drainage Rehabilitation and Deficiencies.
- The area between the current Water Service Area (green line) and the red line designates areas of deficiencies and new infrastructure.
- The project study limits designate the outermost boundary for new infrastructure.
- Rehabilitation costs are based on expenditures of different agencies to correct unacceptable physical condition of hydrology infrastructure without adding capacity.
- The drainage basin boundaries on the figures were drawn based on existing drainage management plans and hydrologic basin boundaries.
- The major drainage improvements were grouped according to the drainage basin in which they are located.

Costs:

- The major costs are based on proposed major drainage improvements as described in Section 4.3.3 and inventoried in Table A.5.
- The major costs for basins with long-range projects are computed with the full cost of the long-range projects applied to the scenario with the maximum growth in population and employment. The remaining two scenarios have a percentage of the long-range projects costs applied based on the ratio of the lesser growth to the maximum growth.
- The major costs were split between the public and private sectors based on the guidelines given in Table 54 (pg.121), except in the projects where funding has already been established.
- The minor costs are based on population and employment growth converted to residential and business acreage as described in this section.
- The minor cost multiplier ($8,000–$12,000/acre for residential and $12,000–$18,000/acre for business) was estimated based on past projects. The higher minor cost is used for areas with basalt, which are more costly to develop because of the difficulty of excavation.
- For the Balanced and Downtown scenarios, there is a 25% increase in population and employment density. This number is reflected in the increase in persons per acre. The number of persons per acre increases from 11–14 for residential usage, and from 54–68 for business usage.

- Operation and maintenance costs are computed at $350 per acre per year, with acreage calculated based on the population and employment figures compiled by AGIS. The growth-based operation and maintenance acreage varies from 11–14 persons per acre for residential usage, and from 54–68 persons per acre for businesses, depending on the scenario. For the existing-based operation and maintenance costs, the per-acre value is based on 11 for residential usage, and 54 for business usage.
- The apportioned capital costs are based on the sum of the major and minor costs.
- The apportioned costs for the area within 1960 City Boundary were distributed assuming that 30% was required for rehabilitation and 70% for correcting deficiencies in capacity.
- The apportioned costs for the area between the 1960 City Boundary and Water Service Area were distributed assuming that 70% was required for deficiencies and 30% for new infrastructure.
- The apportioned capital costs relate directly to each drainage basin's percentage content of the three defined boundaries: 1960 City Boundary, area between the 1960 City Boundary and the Water Service Area, and Outside the Water Service Area. For example, if 100% of the drainage basin fell within the area between the 1960 City Boundary and the Water Service Area, then 100% of costs for that basin were divided as 30% growth and 70% deficiencies.
- Any areas of growth Outside the Water Service Area were assumed to be for new infrastructure.

A consequence of drainage related problems

Figure 27 (pg.125) shows the existing drainage system. Figures 28–30 (pg.127-131) show the population, and Figures 31–33 (pg.133-137) show the employment associated with the three scenarios by Storm Basin.

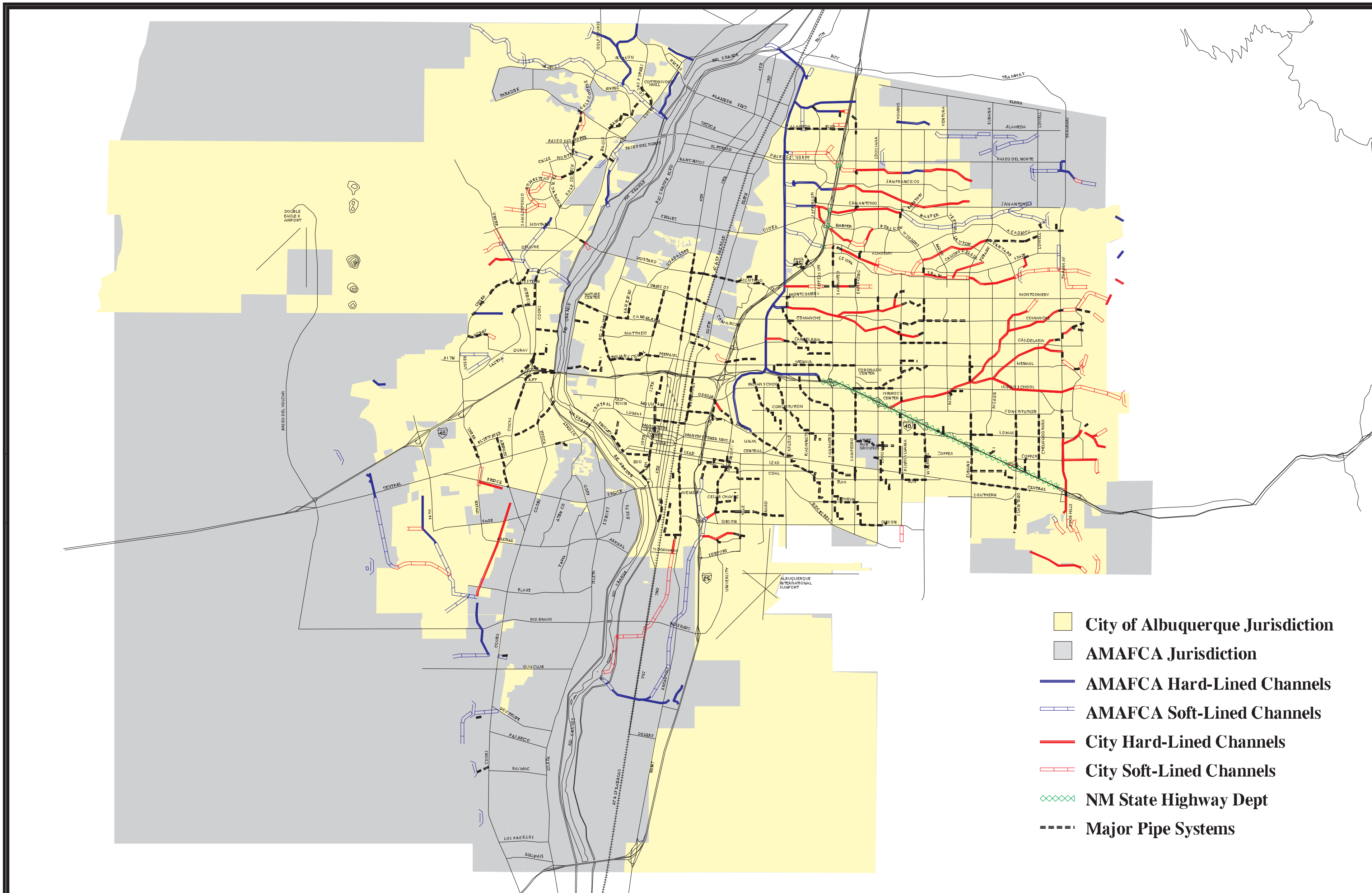
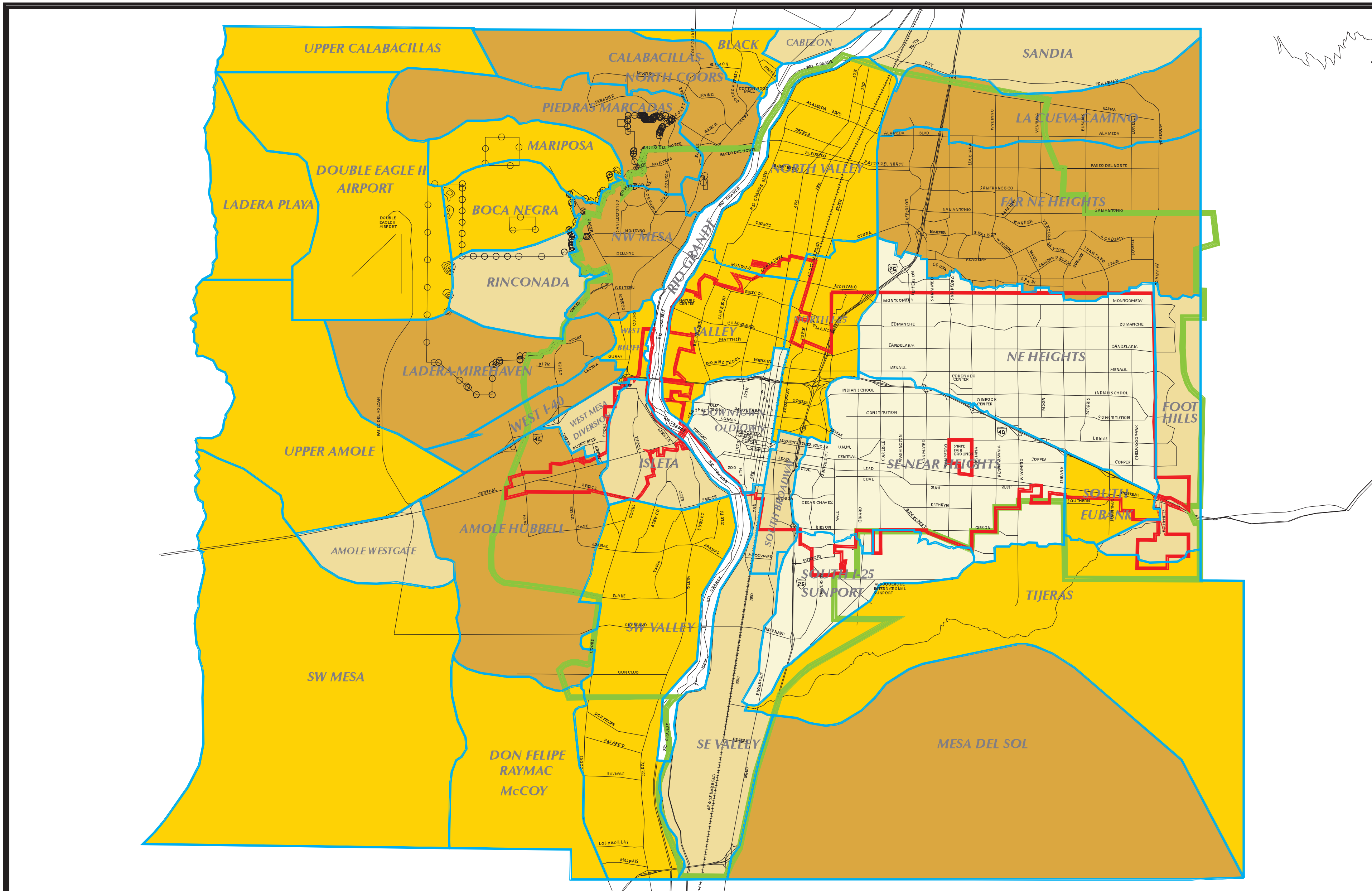


Figure 27
Existing Drainage System in the Albuquerque Metropolitan Area

Scale: 1 inch = 3 miles
Map Printed December 1998



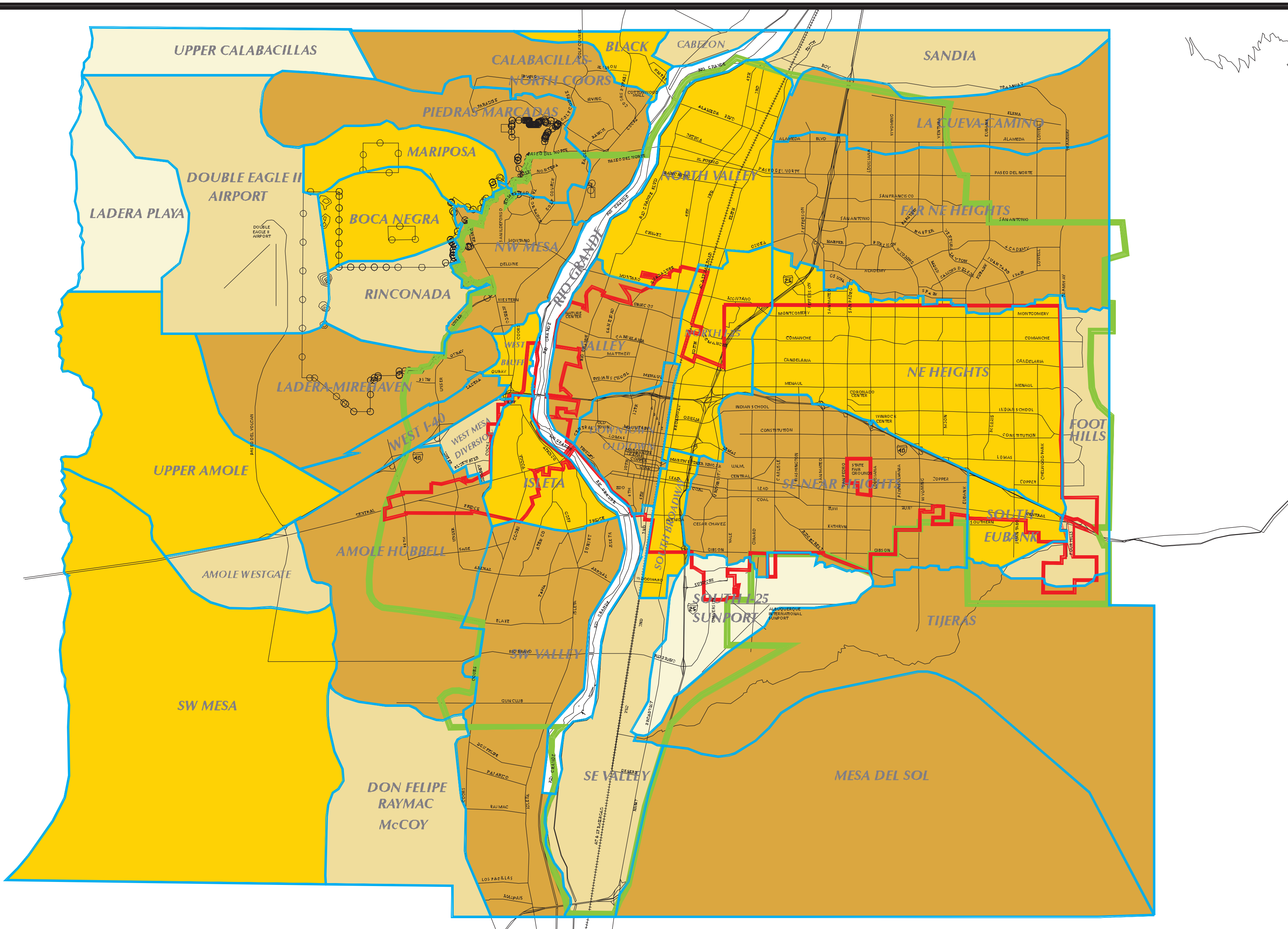
Less than 0
Between 1 to 999
Between 1,000 to 2,999
Greater than 3,000

1960 City Limits
Water Service Area

Figure 28

Trend Population Growth Forecast for Year 2020 by Storm Basin

Scale: 1 inch = 3 miles
Map Printed December 1998



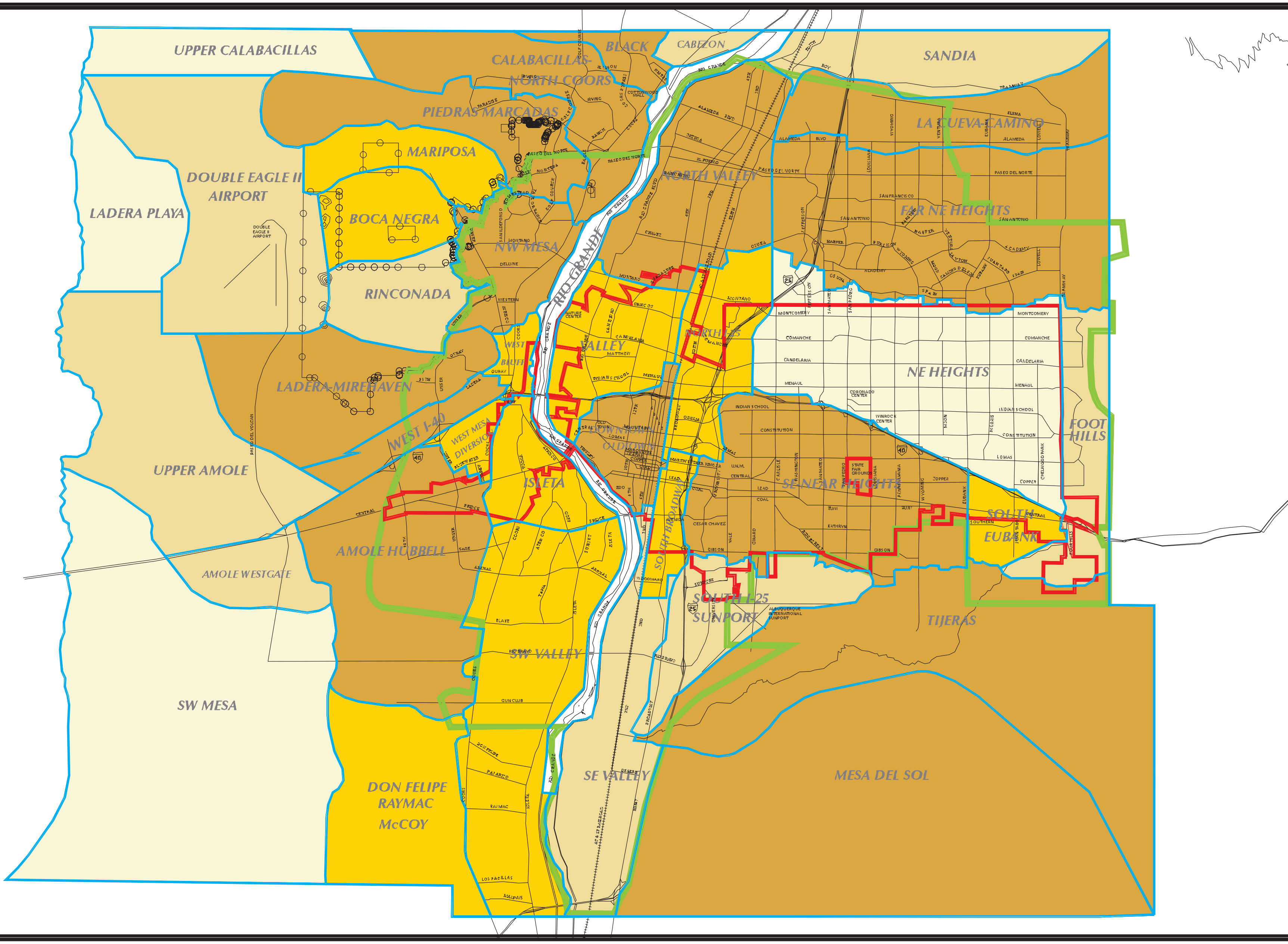
Less than 0
Between 1 to 999
Between 1,000 to 2,999
Greater than 3,000

1960 City Limits
Water Service Area

Figure 29

Balanced Population Growth Forecast for Year 2020 by Storm Basin

Scale: 1 inch = 3 miles
Map Printed December 1998



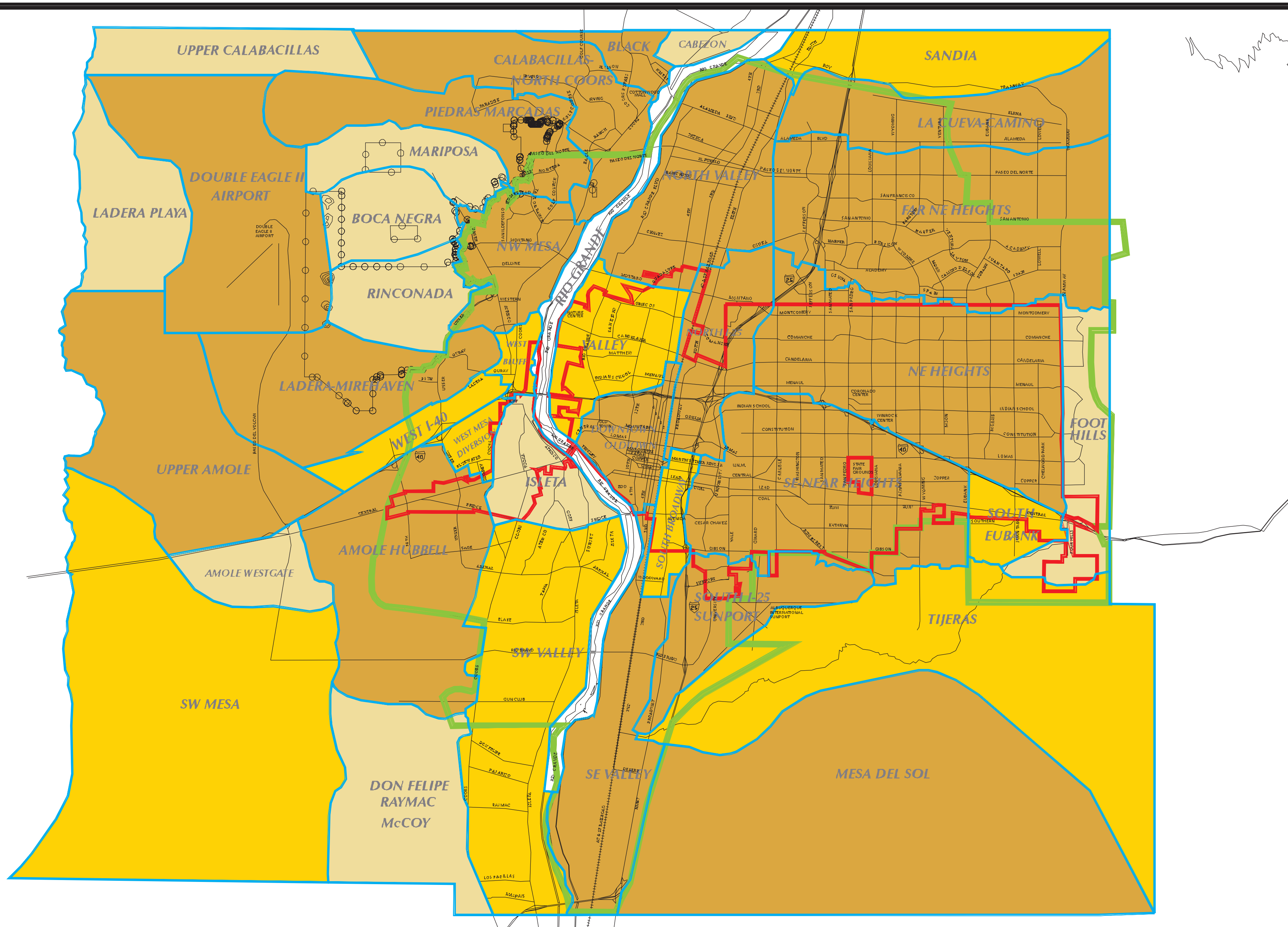
Less than 0	1960 City Limits
Between 1 to 999	Water Service Area
Between 1,000 to 2,999	
Greater than 3,000	

Figure 30

Downtown Population Growth Forecast for Year 2020 by Storm Basin

Scale: 1 inch = 3 miles

Map Printed December 1998



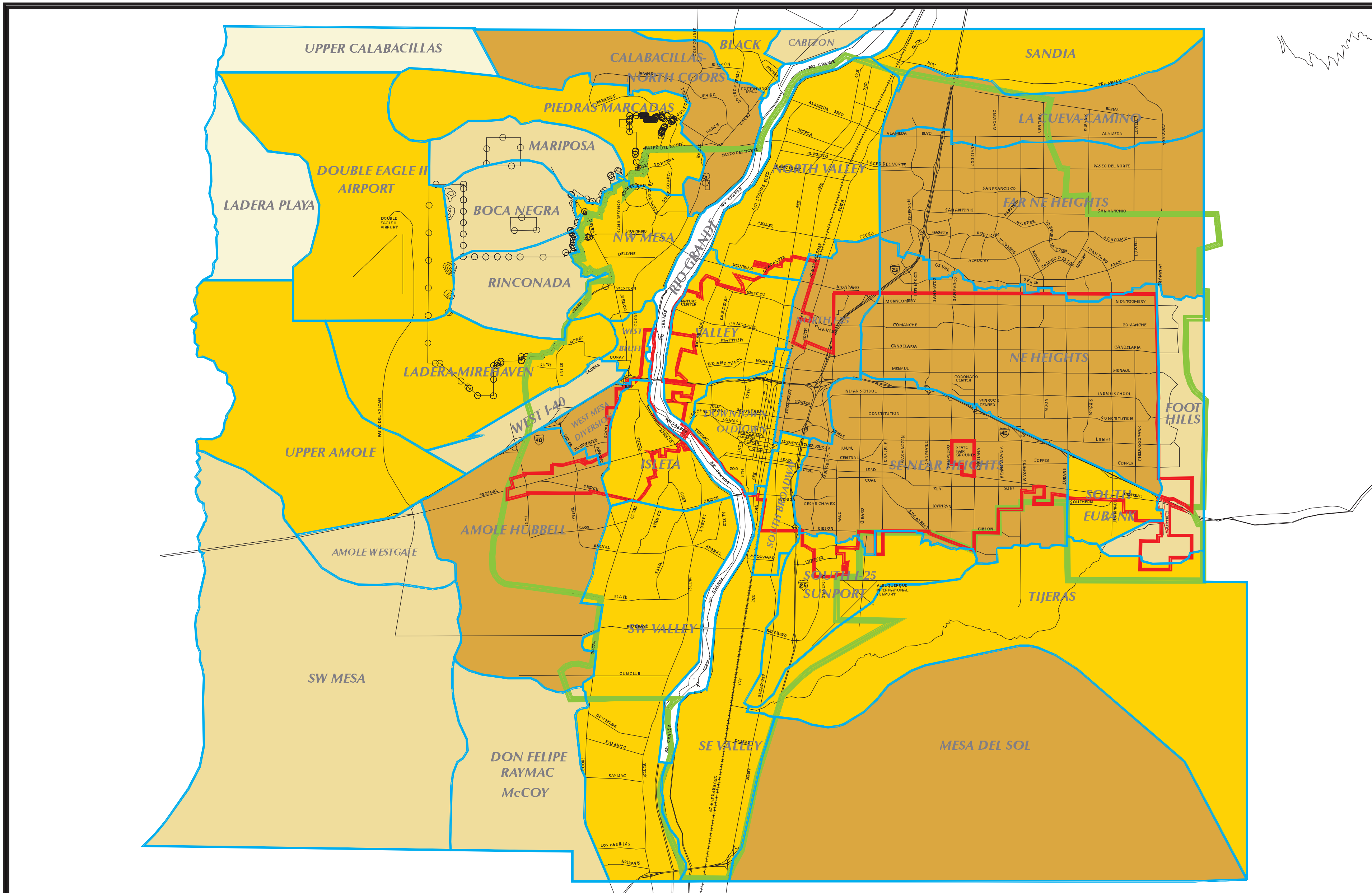
Less than 0
Between 1 to 999
Between 1,000 to 4,999
Greater than 5,000

1960 City Limits
Water Service Area

Figure 31

Trend Employment Growth Forecast for Year 2020 by Storm Basin

Scale: 1 inch = 3 miles
Map Printed December 1998

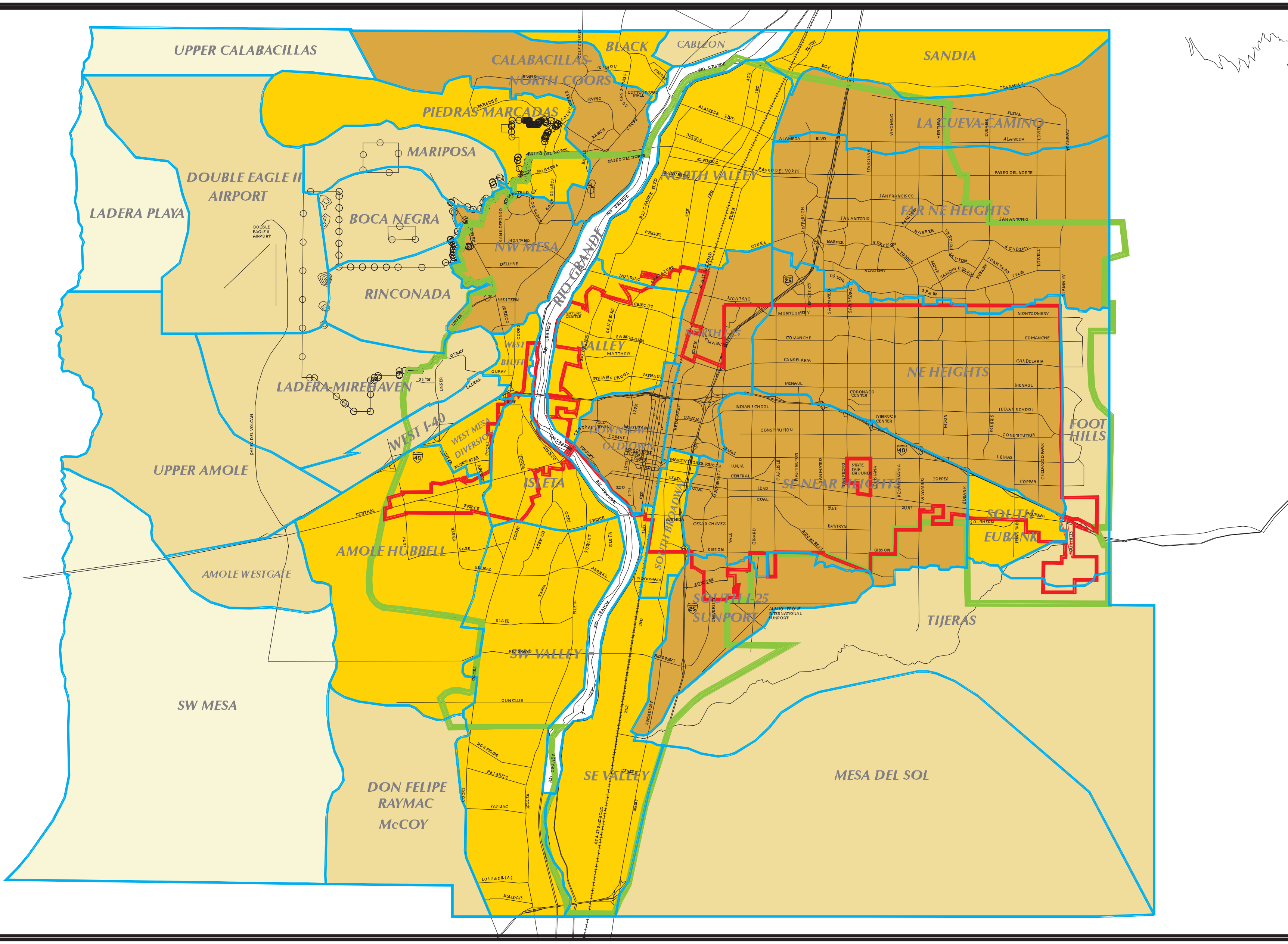


Less than 0
Between 1 to 999
Between 1,000 to 4,999
Greater than 5,000

1960 City Limits
Water Service Area

Figure 32
Balanced Employment Growth Forecast for Year 2020 by Storm Basin

Scale: 1 inch = 3 miles
Map Printed December 1998



Less than 0
Between 1 to 999
Between 1,000 to 4,999
Greater than 5,000

1960 City Limits
Water Service Area

Figure 33

Downtown Employment Growth Forecast for Year 2020 by Storm Basin

Scale: 1 inch = 3 miles

Map Printed December 1998

4.4 Wastewater System Infrastructure Analysis

4.4.1 Capacity Analysis

The City of Albuquerque's sewer utility system is separated into 17 major basins as shown on Figure 34 (pg.143). For this analysis the basins, all but Sandia Heights and Mesa del Sol were each segmented into two or more sub-basins, each represented by one or more interceptors conveying wastewater through the sub-basin and from upstream areas. The major interceptors and primary manholes within each sub-basin were identified using the City Automated Sewer Distribution System Sectional Maps. Utilizing GIS, DASZs were overlain on the sewer sub-basin coverage, and population and employment data available from MRGCOG, including estimates of current population and employment and year 2020 population and employment DASZ forecasts, were re-aggregated for each sub-basin, for each of the three growth scenarios.

An equation was developed to convert total population and total employment to peak wastewater flow within each sub-basin. This equation followed the engineering design criteria in the City Public Works Department Development Process Manual. Average flow was modified to reflect the ratio of population and employment and the respective sewer use, based on City billing records and wastewater flow received at the treatment plant. This equation assumes a peak flow of 2.5 times average flow to the .8875 power and a design flow at 1.2 times peak flow.

Sewer reapir on Rio Grande

A capacity analysis was performed on each sub-basin in the sewer interceptor system. The capacity analysis was derived from pipe size, average slope, and peak carrying capacity data supplied from the City. The total pipe capacity of the primary sewer interceptors within each sewer sub-basin was compared to the design (peak hourly) flow expected, as calculated from the population and employment data, for each sub-basin as explained above. The difference between an interceptor's flow capacity and design flow for each sub-basin that would contribute to the interceptor was calculated. When an interceptor's flow capacity could not meet the total design flow for the current population and employment and the 2020 population and employment for each growth scenario, a parallel pipe was sized to accommodate the excess wastewater flow.

Extent of Current Service

Figure 34 (pg.143) shows the 17 major sewer basins, sewer sub-basins, and major interceptors including the 1960 City Boundary, and the current service area boundary. Areas outside the Water Service Area include the New Mexico Utilities, West Fringe, Sandia Heights, and Kirtland sewer basins, including sub-basins of the northeast (NE-06, NE-07, NE-08), Coors (CO-04, CO-05), and Tijeras (TJ-01) basins. The proposed Mesa del Sol, Quail Ranch, and Westland developments are all located outside the current service area.

Generally, wastewater flow begins in sewer laterals and interceptors at the extremities of the east and west sides of the service area and is added successively to interceptors in each sewer sub-basin as it moves downward in a southerly direction to the Rio Grande, until it reaches the Southside Water Reclamation Plant where the wastewater is treated. Due to the design of the sewer system, much of the wastewater flow is received at a few common locations. The current capacity of the Southside Water Reclamation Plant is 76 mgd, and the average flow received by the plant is 56 mgd.

Areas and Facilities with Excess and Deficient Capacity Today

Table A.9 in Appendix A presents the interceptor pipe capacity and current demand for each sub-basin including the upgradient sub-basin wastewater flow contributions. The difference between pipe capacity and the total demand is presented in Table 56 and is based on estimates of current population and employment as determined from the capacity analysis described above. A positive difference between pipe capacity and total demand is measured as excess capacity whereas a negative difference indicates a deficiency. Figure 35 (pg.145) identifies the locations of interceptors within each sub-basin with excess capacity.

Table 56 lists the interceptors with current deficient design flow capacity located in various sewer basins as determined from the capacity analysis based on estimates of current population and employment. Figure 35 identifies the locations of interceptors with deficient capacity. Table 57 (pg.141) presents the necessary pipe diameters and lengths needed for a parallel pipe to meet the flow deficiency in the sub-basin.

Table 56 Interceptors with Current Deficient Flow Capacity

Basin	Sub-Basin	Pipe Capacity (mgd)	Total Sub-Basin Design Flow Demand (mgd)	Deficient Design Flow Capacity (mgd)
Campus	CA-01	4.50	5.26	0.76
	CA-03	16.36	19.48	3.12
Edith	ED-02	1.72	3.15	1.43
	ED-06	16.37	17.86	1.49
	ED-07	48.77	83.06	34.29
Four Hills	FH-04	1.69	1.87	0.18
Northeast	NE-04	3.45	5.36	1.91
NW Valley	NW-03	0.56	1.36	0.80
	NW-05	2.14	3.77	1.63
Southeast	SE-04	19.39	84.09	64.7
Tijeras	TJ-05	78.22	83.89	5.67
Uptown	UP-05	42.00	42.03	0.03

4.4.2 Cost Analysis

This analysis provides an estimate of the capital and annual costs in today's dollars needed to build and maintain the Albuquerque wastewater collection and treatment system and to keep it operating at full capacity in the year 2020 for each of the three alternative growth scenarios. A systemic approach to determine the capital and annual costs associated with each development scenario was performed. Capital and annual costs common to each growth scenario were separated from costs unique to each scenario in order to provide a better comparison. These unique or individual costs will assist in the identification and selection of the most feasible and least costly development scenario.

Table 57 Existing Parallel Line Deficiency Capital Costs

Basin	Sub-basin	Pipe Diameter (inches)	Pipe Length (feet)	Cost
Campus	CA-01	8.9	5,900	$393,312
	CA-03	18.1	1,050	$142,704
Edith	ED-02	15.7	12,800	$1,508,073
	ED-06	16.3	4,800	$587,136
	ED-07	35.3	8,400	$2,223,641
Four Hills	FH-04	5.2	5,000	$196,346
Northeast	NE-04	14.3	15,600	$1,667,298
NW Valley	NW-03	11.8	5,700	$504,140
	NW-05	10.9	9,900	$811,421
Southeast	SE-04	70.8	11,100	$5,893,734
Tijeras	TJ-05	22.3	7,200	$1,202,551
Uptown	UP-05	3.6	4,500	$119,882
TOTAL				$15,250,237

The current costs to upgrade and maintain the wastewater collection and treatment system to accept 2020 wastewater flows were based on growth forecasts and were determined for areas with existing infrastructure, areas currently served by the wastewater system but with additional room for expansion, and areas outside of the system's boundary that are currently unserved.

Parallel interceptors will be necessary to convey excess wastewater flow in the areas with existing infrastructure. Additional development in the built-up areas will require new service lines. Master plan sewer lines (interceptors), service and small collection lines, and lift and odor control will be necessary to connect unserved sub-basins, including the proposed new developments, to the wastewater conveyance system. For areas that are already served by the wastewater system that have room for expansion, new small collection lines and service connections will be needed.

Sewer interceptor under construction

Capital and annual costs were developed for each scenario, were determined for each sub-basin, and totaled such that the three alternative scenarios could be compared. These are current costs and are based on 2020 population forecasts. These costs are presented in the following sections and are displayed in Tables A.10 and A.11 in Appendix A.

Existing Interceptor Deficiencies

The costs to provide parallel interceptors to correct existing deficiencies based on current population and employment at design (peak hourly) flow rates are provided above in Table 57 (pg.141). These costs are shared costs common to each of the three scenarios.

Common Costs

Wastewater treatment plant expansion, correcting existing parallel line deficiencies, and rehabilitation/replacement costs are fixed capital costs common to all scenarios. The capital and annual costs common to all scenarios are provided in Table 58.

Table 58 Capital and Annual Costs Common to All Scenarios

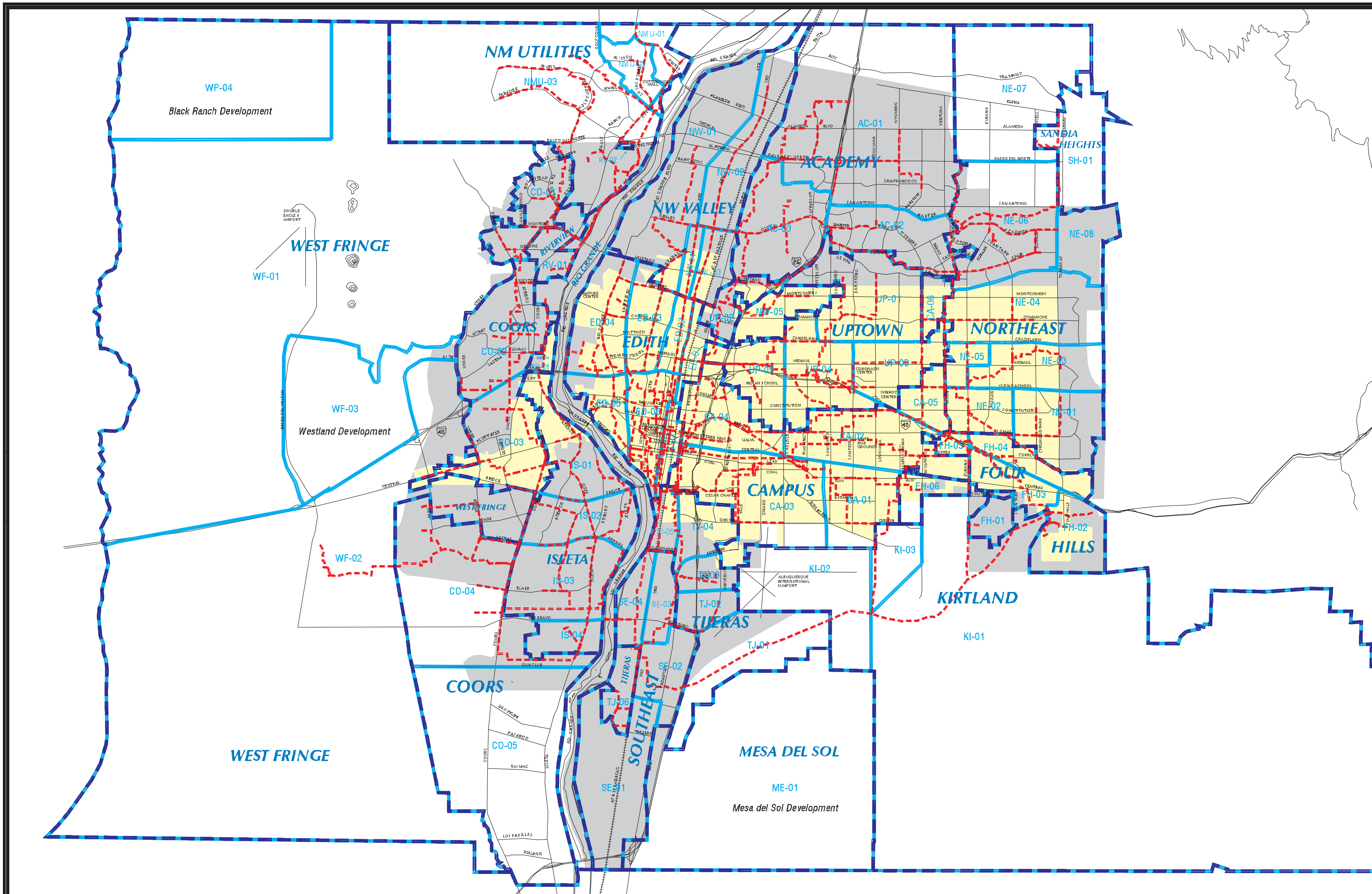
Common Capital Need	Cost
Wastewater Treatment Plant Expansion	$73,400,000*
New Parallel Lines	$15,250,000
Rehabilitation/Replacement	$347,000,000
Total Common Capital Cost	$435,650,000
Common Annual O& M Need	**Cost**
Wastewater Plant Operation/Maintenance	$11,871,208*
Existing Line Maintenance	$4,493,560*
Lift Station & Odor Control	$1,818,364*
Total Common Annual O&M Cost	$18,183,132

* Estimated average value—this number varies slightly among the three scenarios due to small differences in overall total population and employment.

New Infrastructure, by Alternative

Individual capital and annual costs unique to the three scenarios under consideration have been developed and are presented in Tables 59–63 (pg.153-154). The Trend scenario assumes extensive development on the urban fringe, with the addition of the Mesa del Sol, Quail Ranch, and Westland developments to the City's sewer system. The Balanced scenario assumes the addition of the Mesa del Sol and Westland developments to the City's sewer system. The Downtown scenario assumes development will occur primarily within the City and includes the addition of Mesa del Sol to the sewer system.

The wastewater system service area has been separated into three areas to help the City plan for growth as well as to compare growth scenarios. Development within the 1960 City Boundary would require expanding existing infrastructure with parallel sewer interceptors and service connections, while development in unserved areas would require the general expansion of sewer service including master plan sewer lines, small collection lines, service lines, and lift and odor control stations. Development in the Water Service Area would require new parallel interceptors, small collection lines, and new service lines. Interceptor locations of needed parallel lines are shown for the Trend Alternative in Figure 36 (pg.147), for the Balanced Alternative in Figure 37(pg.149), and for the Downtown Alternative in Figure 38 (pg.151).



1960 City Limits
Current Service Area Boundry
Major Sewer Basin
Sewer Sub-Basin
Interceptor

Figure 34
Sewer Basins in the Albuquerque Metropolitan Area

Scale: 1 inch = 3 miles
Map Printed December 1998

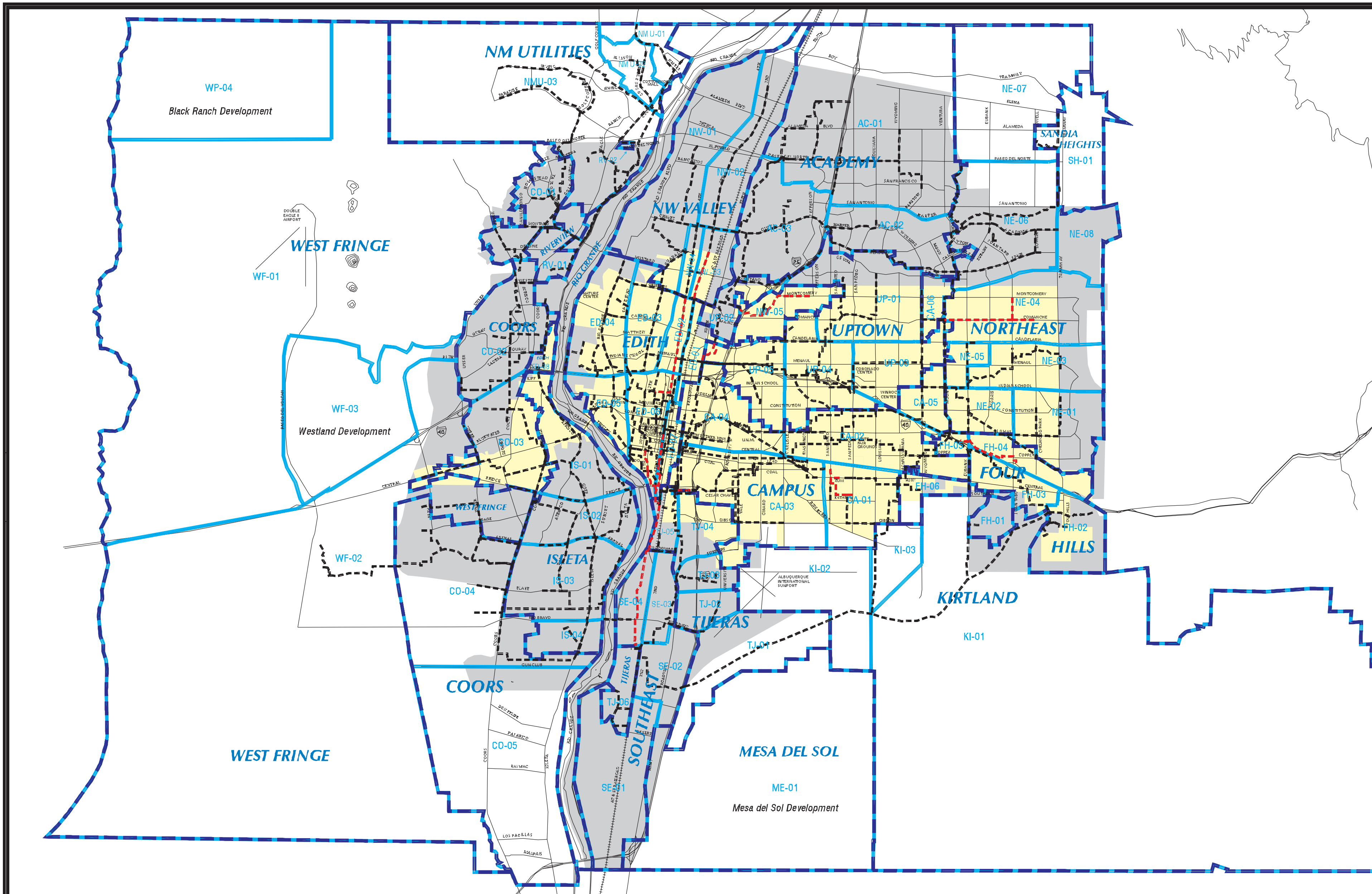
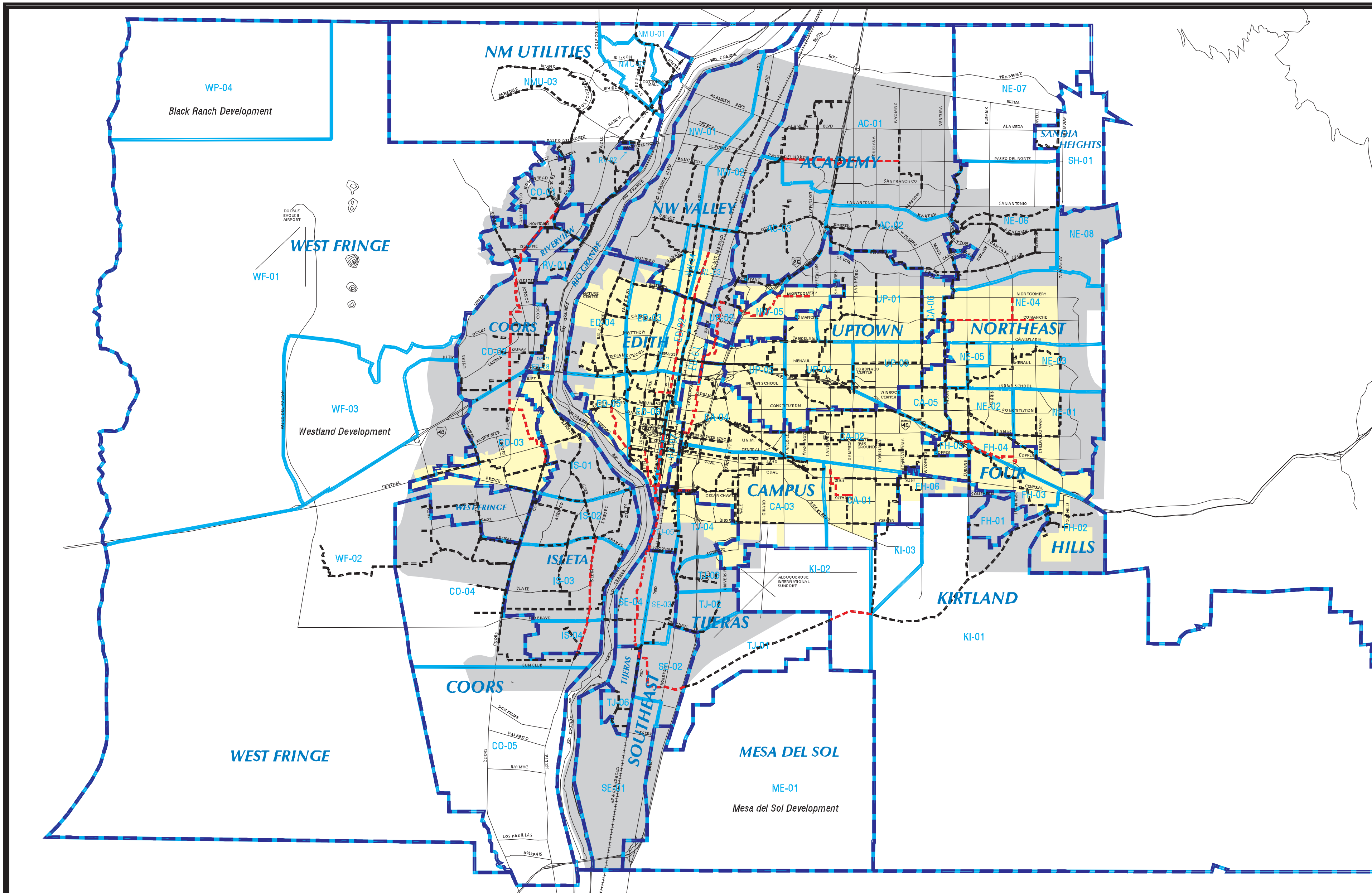


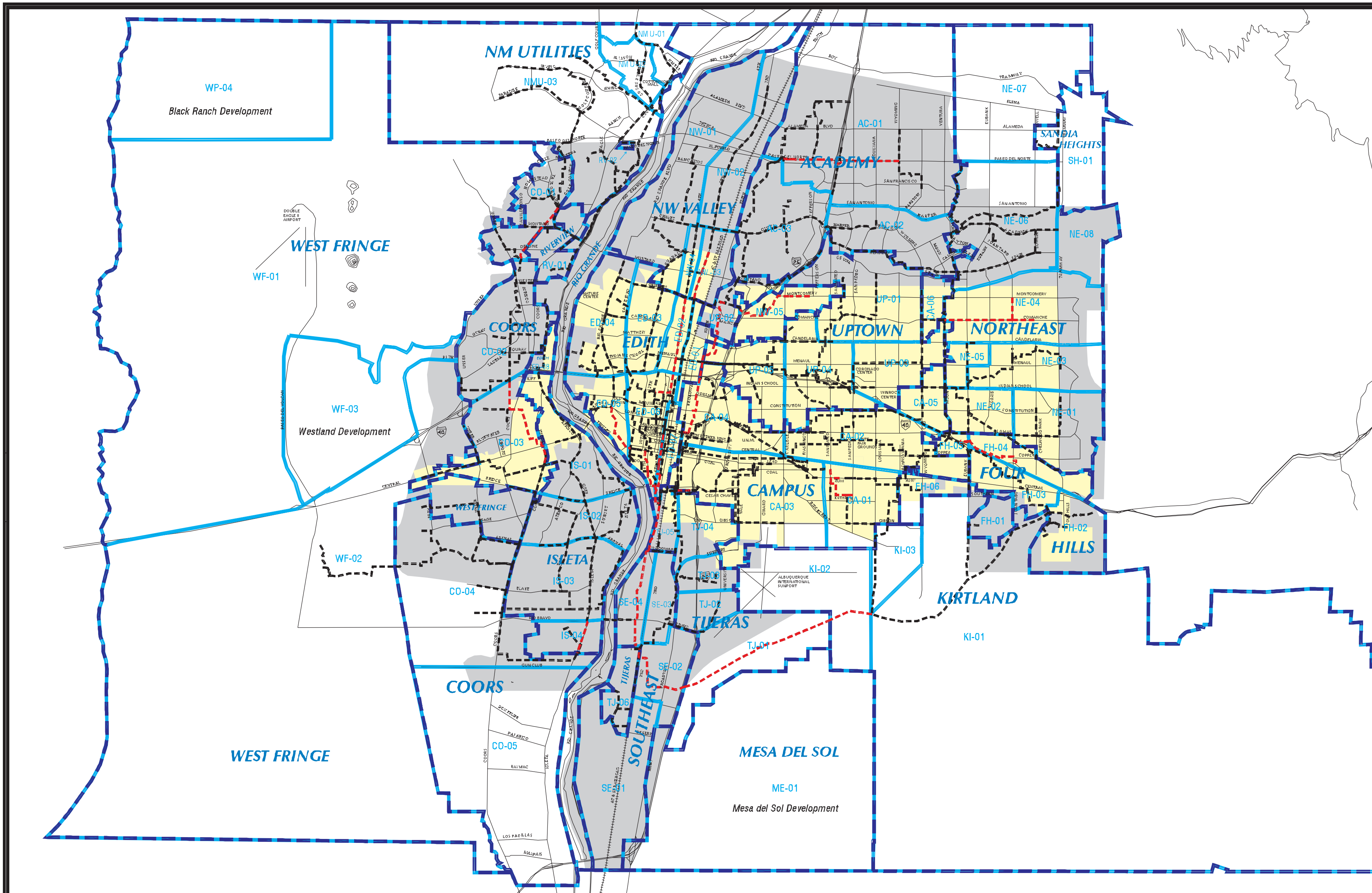
Figure 35
Current Interceptor Capacity in the Albuquerque Metropolitan Area



1960 City Limits
Current Service Area Boundry
Major Sewer Basin
Sewer Sub-Basin
Excess Capacity
Deficient Capacity

Figure 36
Trend Scenario Interceptor Capacity in the Albuquerque Metropolitan Area

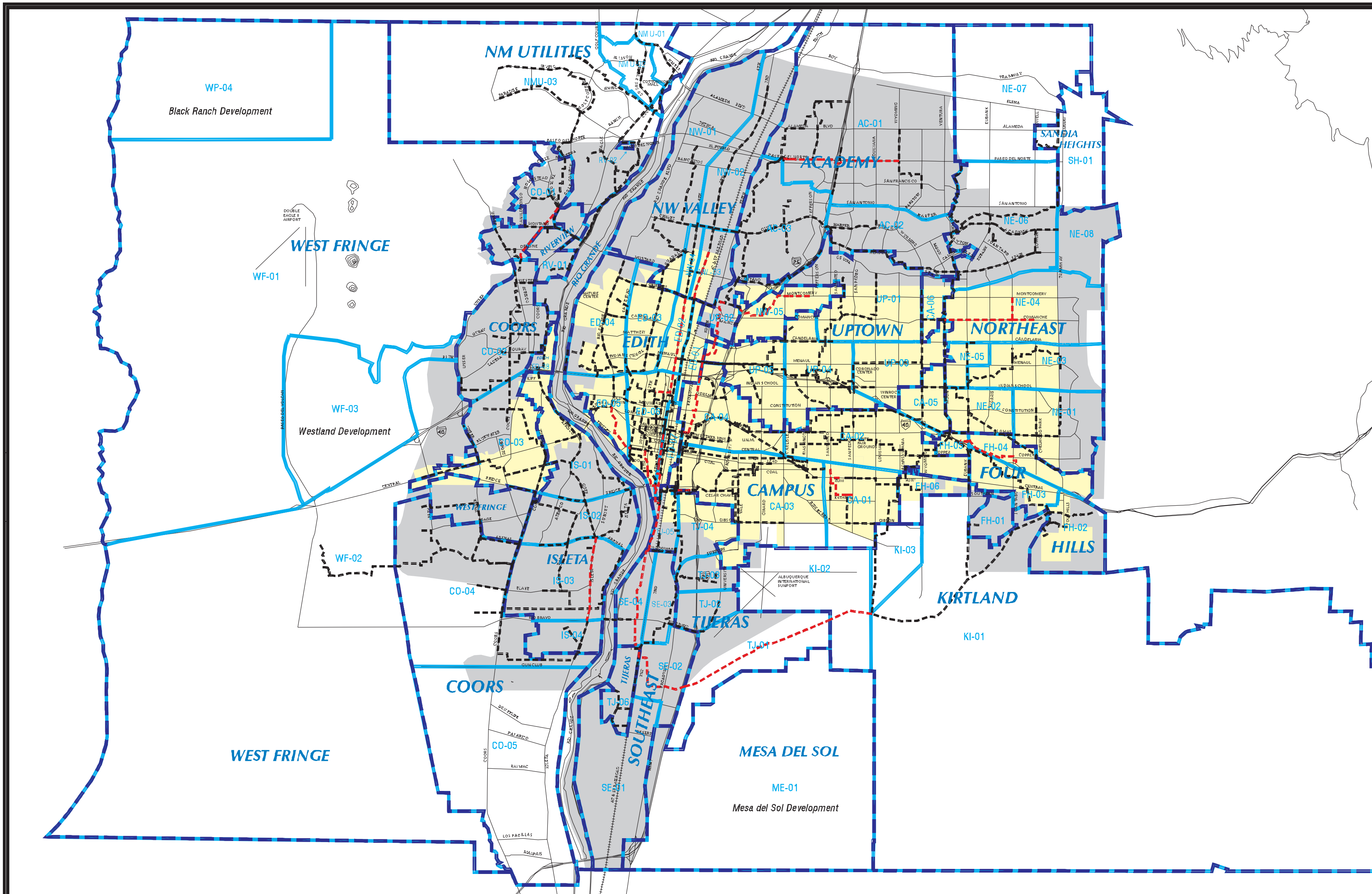
Scale: 1 inch = 3 miles
Map Printed December 1998



1960 City Limits
Current Service Area Boundry
Major Sewer Basin
Sewer Sub-Basin
Excess Capacity
Deficient Capacity

Figure 37
Balanced Scenario Interceptor Capacity in the Albuquerque Metropolitan Area

Scale: 1 inch = 3 miles
Map Printed December 1998



1960 City Limits	Current Service Area Boundry
Major Sewer Basin	Sewer Sub-Basin
Excess Capacity	Deficient Capacity

Figure 38
Downtown Scenario Interceptor Capacity in the Albuquerque Metropolitan Area

Scale: 1 inch = 3 miles
Map Printed December 1998

The 1960 City Boundary and the current service area were overlaid on the sewer distribution system figure with the sewer basin and sub-basin coverages. Each sub-basin was evaluated to determine the percentage of the sub-basin area located within the 1960 City Boundary, in the Water Service Area, or Outside the Water Service Area boundaries.

Tables A.10 and A.11 present the itemized individual capital and annual costs for each sub-basin for each scenario and the costs by service area. Tables 59–61 summarize the capital costs for each scenario and the costs by service area. The costs presented in Tables 59–61 are unique to each scenario and do not include the common costs presented in Table 58.

Table 59 Capital Costs for Trend Scenario by Service Area

	Cost by Service Area			
Capital 2020 Need	1960 City Boundary	Water Service Area	Outside Service Area	Total
Service Lines	$23,768,606	$76,221,623	$51,932,826	$151,923,055
Parallel Lines	$5,507,267	$12,325,001	$299,113	$18,131,382
Master Plan Sewer Lines	$0	$0	$18,958,941	$18,958,941
Small Collection Lines	$0	$45,173,099	$27,365,277	$72,538,376
Lift Stations & Odor Control	$0	$0	$1,194,264	$1,194,264
Septic Tanks	$0	$0	$17,393,000	$17,393,000
TOTAL	$29,275,873	$133,719,723	$117,143,421	$280,139,017

Table 60 Capital Costs for Balanced Scenario by Service Area

	Cost by Service Area			
Capital 2020 Need	1960 City Boundary	Water Service Area	Outside Service Area	Total
Service Lines	$53,391,758	$51,269,187	$48,223,296	$152,884,241
Parallel Lines	$5,276,613	$10,859,654	$1,559,038	$17,695,305
Master Plan Sewer Lines	$0	$0	$18,165,826	$18,165,826
Small Collection Lines	$0	$41,565,461	$25,410,592	$66,976,053
Lift Stations & Odor Control	$0	$0	$1,144,304	$1,144,304
Septic Tanks	$0	$0	$9,808,000	$9,808,000
TOTAL	$58,668,371	$103,694,302	$104,311,056	$266,673,729

Table 61 Capital Costs for Downtown Scenario by Service Area

	Cost by Service Area			
Capital 2020 Need	1960 City Boundary	Water Service Area	Outside Service Area	Total
Service Lines	$66,644,872	$53,609,952	$25,768,314	$146,023,138
Parallel Lines	$4,864,712	$10,182,086	$1,153,046	$16,199,844
Master Plan Sewer Lines	$0	$0	$13,364,845	$13,364,845
Small Collection Lines	$0	$46,750,932	$13,578,253	$60,329,185
Lift Stations (new) Lift Stations & Odor Control	$0	$0	$841,880	$841,880
Septic Tanks	$0	$0	$14,259,000	$14,259,000
TOTAL	$71,509,584	$110,542,970	$68,965,338	$251,017,892

Tables 62 and 63 compare the capital and annual costs among scenarios, and the capital costs by service area. These costs are unique to each scenario and do not include the common costs presented in Table 58.

Table 62 Comparison of Unique Capital Costs between Scenarios by Service Area

		Costs by Service Area		
Scenario	Capital Costs Total	1960 City Boundary	Water Service Area	Outside Service Area
Trend	$280,139,017	$29,275,873	$133,719,723	$117,143,421
Balanced	$266,673,729	$58,668,371	$103,694,302	$104,311,056
Downtown	$251,017,892	$71,509,584	$110,542,970	$68,965,338

Table 63 Comparison of Unique Annual Costs between Scenarios

Scenario	Annual Costs Total	Septic Tank Annual Maintenance	Parallel & New Lines Maintenance
Trend	$1,440,409	$1,373,480	$66,929
Balanced	$1,118,332	$1,070,080	$48,252
Downtown	$1,301,333	$1,248,120	$53,213

Table 64 Comparison of Total Capital Costs and Public-Private Cost Split between Scenarios

Scenario	Capital Costs Total	Public Cost	Private Cost
Trend	$715,789,018	$433,011,146	$282,777,872
Balanced	$702,323,729	$432,361,578	$269,962,151
Downtown	$686,667,892	$429,001,661	$257,666,232

All three scenarios share the common capital cost of $435,650,000 presented in Table 58 in addition to the individual cost presented in Table 62. The Trend scenario has the overall greatest cost and greatest cost in the non-served (out of service) area. This is expected because this scenario includes dispersed development on the fringe of the system, with the addition of the Mesa del Sol, Quail Ranch, and Westland developments to the City's sewer system. The Downtown scenario has the greatest cost in the 1960 City Boundary area because this scenario encourages increased population and employment within the City. The Balanced scenario generally falls between the Trend and Downtown scenarios. The greatest differences in the capital costs are associated with the three service areas due to varying growth patterns among the scenarios.

All three scenarios share the common annual cost of $18,183,132 presented in Table 58 with the additional individual costs presented in Table 63. The differences in annual costs between the scenarios are small because the majority of the annual costs are common to all scenarios.

4.4.3 Public Versus Private Cost

The total capital cost of each scenario (common cost in Table 58(pg.142) plus unique costs in Table 62(pg.154) including the split between public and private costs is presented in Table 64. A breakdown of costs by wastewater infrastructure item is presented in Table 65.

Table 65 Public-Private Cost Split by Scenario

Wastewater Infrastructure	Total Cost	Public Cost (%)	Public Cost	Private Cost (%)	Private Cost
Trend Scenario					
Service Lines	$151,923,055	0	$0	100	$151,923,055
Interceptor Lines					
Parallel Lines (Common)	$15,250,000	100	$15,250,000	0	$0
Parallel Lines (Unique)	$18,131,382	50	$9,065,691	50	$9,065,691
Master Plan Sewer Lines	$18,958,941	50	$9,479,471	50	$9,479,471
Rehab./Replacement	$212,960,000	100	$212,960,000	0	$0
Collection Lines	$72,538,376	0	$0	100	$72,538,376
Rehab./Replacement	$67,540,000	100	$67,540,000	0	$0
Lift Station & Odor Control	$1,194,264	70	$835,985	30	$358,279
Rehab./Replacement	$3,400,000	100	$3,400,000	0	$0
Treatment Plant					
Expansion	$73,400,000	70	$51,380,000	30	$22,020,000
Rehab./Replacement	$63,100,000	100	$63,100,000	0	$0
Septic Tank	$17,393,000	0	$0	100	$17,393,000
Total	$715,789,018		$433,011,146		$282,777,872
Balanced Scenario					
Service Lines	$152,884,241	0	$0	100	$152,884,241
Interceptor Lines					
Parallel Lines (Common)	$15,250,000	100	$15,250,000	0	$0
Parallel Lines (Unique)	$17,695,305	50	$8,847,653	50	$8,847,653
Master Plan Sewer Lines	$18,165,826	50	$9,082,913	50	$9,082,913
Rehab./Replacement	$212,960,000	100	$212,960,000	0	$0
Collection Lines	$66,976,053	0	$0	100	$66,976,053
Rehab./Replacement	$67,540,000	100	$67,540,000	0	$0
Lift Station & Odor Control	$1,144,304	70	$801,013	30	$343,291
Rehab./Replacement	$3,400,000	100	$3,400,000	0	$0
Treatment Plant					
Expansion	$73,400,000	70	$51,380,000	30	$22,020,000
Rehab./Replacement	$63,100,000	100	$63,100,000	0	$0
Septic Tank	$9,808,000	0	$0	100	$9,808,000
Total	$702,323,729		$432,361,578		$269,962,151
Downtown Scenario					
Service Lines	$146,023,138	0	$0	100	$146,023,138
Interceptor Lines					
Parallel Lines (Common)	$15,250,000	100	$15,250,000	0	$0
Parallel Lines (Unique)	$16,199,844	50	$8,099,922	50	$8,099,922
Master Plan Sewer Lines	$13,364,845	50	$6,682,423	50	$6,682,423
Rehab./Replacement	$212,960,000	100	$212,960,000	0	$0
Collection Lines	$60,329,185	0	$0	100	$60,329,185
Rehab./Replacement	$67,540,000	100	$67,540,000	0	$0
Lift Station & Odor Control	$841,880	70	$589,316	30	$252,564
Rehab./Replacement	$3,400,000	100	$3,400,000	0	$0
Treatment Plant					
Expansion	$73,400,000	70	$51,380,000	30	$22,020,000
Rehab./Replacement	$63,100,000	100	$63,100,000	0	$0
Septic Tank	$14,259,000	0	$0	100	$14,259,000
Total	$686,667,892		$429,001,661		$257,666,232

4.4.4 Supporting Information

City system costs and the City of Albuquerque Water and Wastewater Utility Program Assessment (Parsons Engineering Science, Inc., March 1997) were used as the main resources for developing capital and annual costs for the scenarios along with the Trend estimate of the current population of 492,653 and current employment of 302,148 served by the wastewater system. Per capita costs include both population and employment. Capital costs were broken down into various separate categories. These categories, the basis (source) of the costs, as well as the allocation of costs per sub-basin associated with these categories are summarized in the following Tables 66–69.

Table 66 Basis of Capital Costs

Capital Needs	Distribution of Total Value (%)	Allocation of Cost. SFD = $2,858 (City System Cost)	Allocation of Cost by Person/Job*
Master Plan Sewer Lines	17.9	$512	$127
Small Collection Lines	44.3	$1,266	$313
Lift Stations & Odor Control	1.2	$34	$8
Treatment Plants	36.6	$1,046	$259
Service Lines	Separate cost basis	$2,400	$594
Total		$5,258	$1,301

* Cost per SFD equal cost/2.5. Assumptions in PGS involve conversion to cost per resident and job. Totals used are 492,652 population and 302,148 jobs, which totals 794,801. Cost per resident and job is calculated by x/2.5 = 794,801/492,652, where x = 4.04. This figure was divided into each of the cost totals in table column 3.

Table 67 Allocation of Costs to Service Areas

Capital Needs	Sub-Basins with Existing Infrastructure (1960 City Boundary)	Sub-Basins Already Served but with Room for Expansion (Water Service Area)	Unserved Sub-Basins (Outside Service Area)
Master Plan Sewer Lines			X
Parallel Lines	As needed in sub-basin	As needed in sub-basin	
Small Collection Lines		X	X
Lift Stations & Odor Control			X
Treatment Plant	X	X	X
Service Lines	X*	X*	X*

* Adjusted for percentage of vacant land within sub-basin with existing service connections.

Table 68 Wastewater Sub-Basin Distribution

Sub-Basins with Existing Infrastructure	Sub-Basins Already Served but with Room for Expansion	Unserved Sub-Basins
AC-02, CA-01, CA-02, CA-03, CA-04, CA-05, CA-06, CO-01, ED-01, ED-02, ED-03, ED-04, ED-05, ED-06, ED-07, FH-03, FH-04, FH-05, FH-06, NE-01, NE-03, NE-04, NE-05, NW-03, NW-04, NW-05, UP-01, UP-02, UP-03, UP-04, UP-05, TJ-05	AC-01, AC-03, CO-02, CO-03, CO-04, ED-08, FH-01, FH-02, IS-01, IS-02, IS-03, IS-04, NE-06, NE-08, NW-01, NW-02, SE-02, SE-03, SE-04, SH-01, TJ-02, TJ-03, TJ-04, TJ-06, NMU-01, NMU-02, NMU-03, RV-01, RV-02	CO-05, KI-01, KI-02, KI-03, ME-01, NE-07, SE-01, TJ-01, WF-01, WF-02, WF-03, WP-04

Total estimated wastewater rehabilitation/replacement needs over the next 25 years is approximately $347,000,000 and includes the sewers, odor control stations, pumping stations, and the wastewater treatment plant. (This figure is consistent with an separate independent assessment—see the City of Albuquerque Water and Wastewater Utility Program Assessment, Parsons Engineering Science, Inc., March 1997. [492,652 (population) + 302,148 (jobs)/ $370,000,000 = $436.59 per capita (population and employee)]. Parallel line costs were estimated at $7.50 per foot/inch diameter (Parsons ES)).

Street cave in at sewer rehab project.

The annual costs were broken down into six separate categories. These categories and the basis of the costs associated with these categories are provided in Table 69.

Table 69 Basis of Annual Costs

Annual Needs	Cost (Source)
Wastewater Plant Operation and Maintenance	$10.99 per capita (Parsons ES).
Existing Line Maintenance	$4.16 per capita (City, Parsons ES).
Parallel and New Line Maintenance	$0.40 per foot of pipeline (Parsons ES)
Lift Stations & Odor Control	$1.68 per capita (Parsons ES).
Septic Tanks Annual Maintenance	$40.00 per capita (local company)

The total operation and maintenance cost per capita served by the wastewater system is $16.83. Of this amount, it is assumed that 10% ($1.68) is for lift station and odor control operation and maintenance. The City currently spends $3,303,192 or $4.16 per capita for annual operation and maintenance on existing sewer lines. The remaining $10.99 per capita expense is for wastewater plant operation and maintenance.

The City sewer system is comprised of approximately 1,653 miles of sewer lines that cost $3,303,192 annually to maintain. This translates to an average annual maintenance cost of $0.40 per foot of sewer line.

4.5 Transportation System Findings

4.5.1 Summary

This section contains cost estimates for the transportation system, including road and transit costs, and transportation operating costs for both the public and private sectors.

The road capital costs account for more than three-quarters of the total capital cost of transportation. Common capital costs for road facilities total $1,500 million and account for more than 80% of the road cost. The Trend Scenario has the largest set of unique road capital costs, $331 million; followed by the Balanced Scenario at $267 million and the Downtown Scenario at $260 million. This means that the Downtown Scenario road capital costs would be $71 million, or 21%, less than the Trend Scenario. The Balanced Scenario costs would be $64 million, or 19%, less than the Trend Scenario.

The transit system capital costs amount to approximately one-quarter of the total transportation capital costs. The majority of this cost is attributable to the cost of expanding the bus fleet and replacing buses on a regular basis. The common transit capital costs account for $39 million or one-eighth of the total transit capital costs. The Trend Scenario has the highest unique transit capital costs, totaling $284 million. The Balanced Scenario and the Downtown Scenario have unique transit capital costs of $210 million, 27% less than the costs of the Trend Scenario. While all three scenarios assume the same size bus fleet, the cost differences are attributable to the greater number of daily miles traveled by the buses in the Trend Scenario. This higher mileage translates into more frequent vehicle replacement and, hence, higher capital costs.

The total transportation capital cost would be more than $2 billion over the forecast period and more than 80% of these costs are common to all scenarios. The Trend Scenario has the highest unique transportation capital cost, which total $615 million. At $477 million, the Balanced Scenario unique transportation capital costs would be $138 million less than the Trend Scenario. At $470 million, the Downtown Scenario unique transportation capital costs would be $145 million less than the Trend Scenario.

Transportation operating costs that were estimated for the year 2020 included the public cost of transportation, the private cost of transportation, and a portion of the societal cost of transportation. Analysis of the 2020 transportation costs provides an estimate of how much change there is in the day-to-day transportation cost as a result of the different land use scenarios. The difference in the operating cost starts at $0 in the first year of analysis and grows to between $83 and $115 million per year by 2020. This is a difference of about 3% in the operational cost of transportation and is nearly equal to the difference in the capital cost over the entire analysis period. Estimates of the cumulative difference in transportation operating cost were not undertaken as part of this analysis; however, a simplified calculation of this cumulative value would place it at between $1 billion and $1.4 billion over a 25-year period.

Private vehicle operating costs are the largest portion, more than 49%, of the annual vehicle transportation operating costs. Total operating costs are highest in the Trend Scenario at $4.38 billion per year in 2020. The Balanced Scenario has the lowest cost at $4.26 billion per year in 2020. The Downtown Scenario is similar with a total of $4.29 billion per year.

Transit operating costs include both public and private costs. The private costs are the fares that are paid by the riders of the system, and the public costs represent the costs paid by other governmental sources. Transit operating costs are the smallest portion of the annual transportation cost, totaling less than 1% of the total annual transportation operating costs. Transit costs are directly related to the level of service provided. Accordingly, the Trend Scenario has the highest annual operating costs, which total $37 million per year for both public and private costs. The Downtown and Balanced Scenarios have operating costs totaling $35 million per year.

The one societal cost of transportation that was estimated is the cost of air pollution. Air quality costs are directly related to the number of vehicle miles traveled and are largely comprised of private costs such as increased public health costs associated with dust and other airborne pollutants. The lowest societal costs are in the Downtown Scenario, which total $524 million per year. The Balanced Scenario has costs that total $525 million per year. The Trend Scenario has societal costs that total $540 million per year. The costs for the Trend Scenario are 2.8% higher than the costs for the Downtown and the Balanced Scenarios.

One other portion of the full cost of travel was estimated, the annual cost of travel time in private vehicles. The cost of travel time accounts for approximately one-third of the annual operational cost of travel. The lowest cost of travel time occurs in the Balanced Scenario, which totals $1.597 billion per year in 2020. The Downtown Scenario cost of travel time totals $1.636 billion in 2020, or 2% more than the Balanced Scenario. The Trend Scenario has the highest cost at $1.639 billion in 2020 (Table 70 (pg.160).

4.5.2 Introduction

In the sections that follow, we will evaluate the study area's existing roadway capacity and the extent to which that capacity is currently being used. Second, we will quantify the transportation costs associated with the implementation of each of three growth scenarios. We divided the costs associated with each growth scenario further by where they were located within the three service areas.


Westside roadways

Focusing on roadway infrastructure conditions and needs, we exclude pedestrian and bicycle improvements at this time, although the MRGCOG has issued plans

Table 70 Transportation Costs by Scenario, $ Millions

	Scenario		
Road Capital Costs	**Trend**	**Balanced**	**Downtown**
Common Capital Costs	$1,500	$1,500	$1,500
Unique Scenario Costs	$331	$267	260
Total in Millions	$1,831	$1,767	$1,760
Difference from Trend		$(64)	$(71)
Transit System Capital Cost			
Common Capital Costs	$39	$39	$39
Unique Scenario Costs	$284	$210	$210
Total in Millions	$323	$249	$249
Difference from Trend		$(74)	$(74)
Total Transportation Capital Cost			
Common Capital Costs	$1,814	$1,814	$1,814
Unique Scenario Costs	$615	$477	$470
Total in Millions	$2,429	$2,291	$2,284
Difference from Trend		$(138)	$(145)
2020 Annual Vehicle Transportation Operating Cost			
Annual Private Vehicle Cost	$2,162	$2,105	$2,099
Annual Public Transit Costs	25.8	24.6	24.6
Annual Private Transit Costs	11.0	10.5	10.5
Annual Private Cost of Travel Time	$1,639	$1,597	$1,636
Societal Costs	$540	$525	$524
Total Annual Operating Cost in Millions	$4,377	$4,262	$4,294
Difference from Trend		$(115)	$(83)

Source: Parsons Brinckerhoff

and cost estimates for such improvements. We consider these costs common to all three scenarios. See section 4.5.7 for further discussions of non-motorized travel demand. Subsequently, we offer findings regarding public transportation costs that draw from separate studies on the costs of providing bus services to the Middle Rio Grande region.

Next, this section contains an estimate of the annual operating cost of the transportation system. This cost estimate includes the total private cost of vehicle operation in the County as well as public road and transit cost. Finally, this section looks briefly at one of the societal costs of vehicle operation, air pollution. This cost is also included in the summary of cost for transportation.

4.5.3 Existing Capacity Analysis

Data on the existing capacity of the study area's major roads (those classified as collectors or above) and the traffic volumes carried were obtained from the Public Works Division of Bernalillo County. The most recent data available were for the year 1995. Figure 39(pg.163) shows graphically the volume-to-capacity (V/C) ratios for the evening peak hour. Roadways with excess capacity is shown in dark green, which signifies that V/C ratios are less than 0.9. Light green colored roadways have V/C ratios between 0.9–1.0, which while technically under capacity, are likely operating at a level-of-service "E," which is considered unacceptable by both the City's and County's standards. Pink (V/C of 1.0–1.3) and red (V/C over 1.3) roadways are currently operating over capacity in the evening peak hour.

Roadways with Excess Capacity

The preponderance of green on Figure 39 signifies that the majority of roads within the study area are currently operating below capacity. Outside the Water Service Area, roads in the South Valley as well as I–40 and I–25 currently have excess capacity. Within the Water Service Area, the roads in the Far Northeast Heights, South Valley, and West Side are also generally operating below capacity. In the 1960 City Boundary, most of the Northeast and Southeast Heights and Downtown roadways, as well as most of I–40, have low peak hour V/C ratios. However, excess capacity for the Interstates appears to have resulted from coding into the analysis a lower level-of-service capacity for these facilities. Consequently, the volume to capacity ratios reported probably are too liberal for the Interstate system.

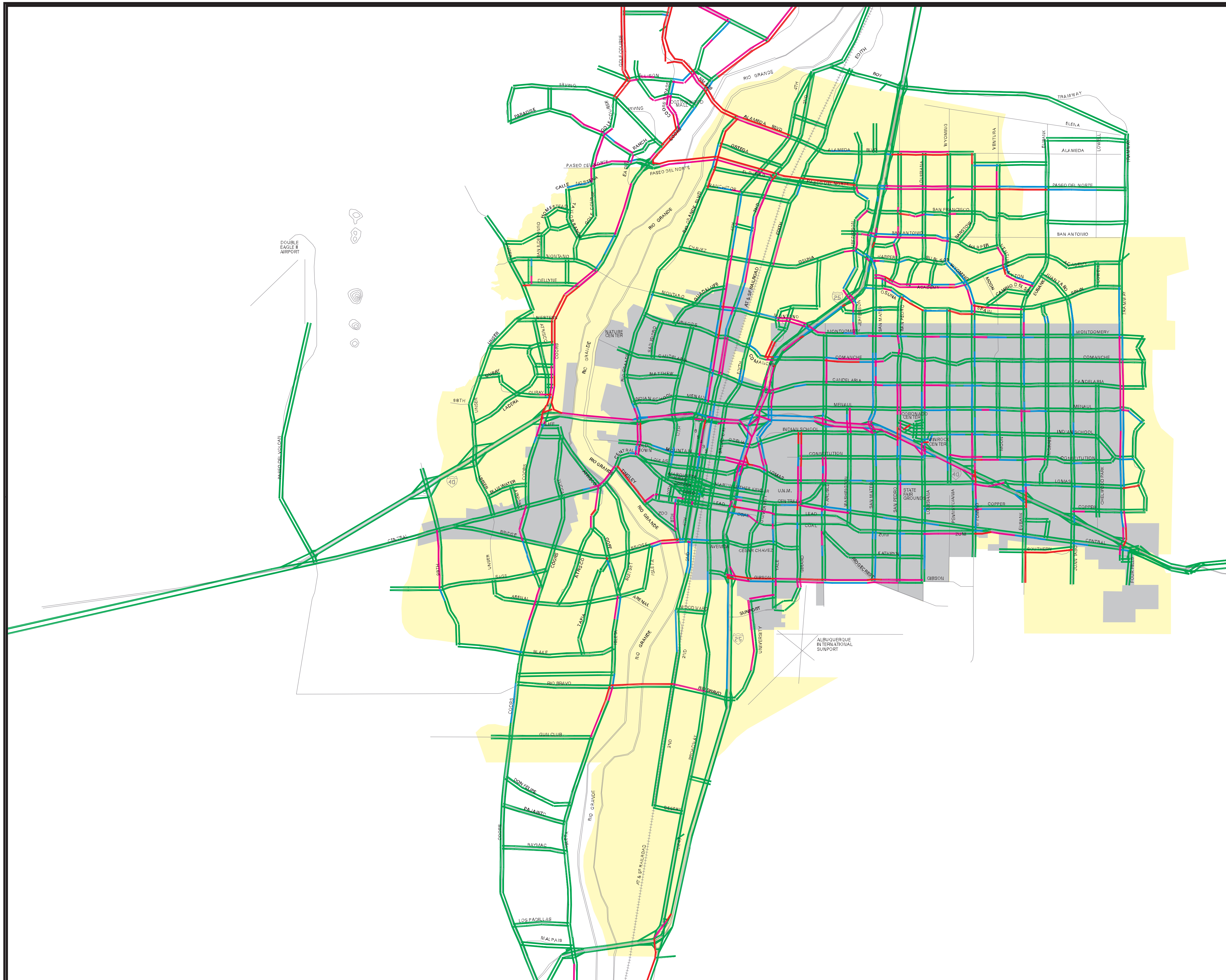
Roadways with Deficient Capacity

Isolated roadways and portions of roadways that are operating above capacity exist throughout the study area; however, larger groups of congested roadways appear on Figure 39 that deserve mention here. Outside the Water Service Area, the roadways operating over capacity are generally those linking Albuquerque to Rio Rancho and Corrales: Golf Course and Coors north of Paseo del Norte, Alameda west of Coors, and Corrales Road. Within the Water Service Area, the North Valley bridge crossings—Alameda and Paseo del Norte—are capacity deficient. Probably because the Montaño bridge was not constructed in 1995, Montaño is shown as operating below capacity in the 1995 evening peak; however, Coors from I–40 north to Montaño is shown over capacity. It is probable that the opening of the Montaño Bridge alleviated some of that congestion on Coors. Several of the roads just east of I–25, namely Alameda, Paseo del Norte, and Academy, are operating above capacity, as are many of the north-south streets in the North Valley—portions of 4th, 2nd, Edith, and Rio Grande. Both of these problem areas result from commuters leaving employment areas such as Downtown and the North I–25 corridor to travel home to neighborhoods in the North Valley and Northeast Heights. Within the 1960 City Boundary, the areas of congestion are more isolated: Gibson Boulevard, I–25 adjacent to the Big I, Tingley, and 4th and 2nd Streets, to name a few. The next section focuses on the costs of deficiencies and new construction.

4.5.4 Cost Analysis

The transportation costs associated with each growth scenario were broken down according to type: costs to mitigate future deficiencies on existing roads, costs to build new roads, and costs to rehabilitate and reconstruct existing roads.

Volume-to-capacity plots were developed for the year 2020 evening peak hour for each of the three growth scenarios and are shown in Figures 40–42 (pgs.165-169). Each scenario assumes that the improvements to mitigate future deficiencies and new construction projects identified in the sections below have been put in place.



1995 Peak P.M. Hour V/C Ratios

Legend

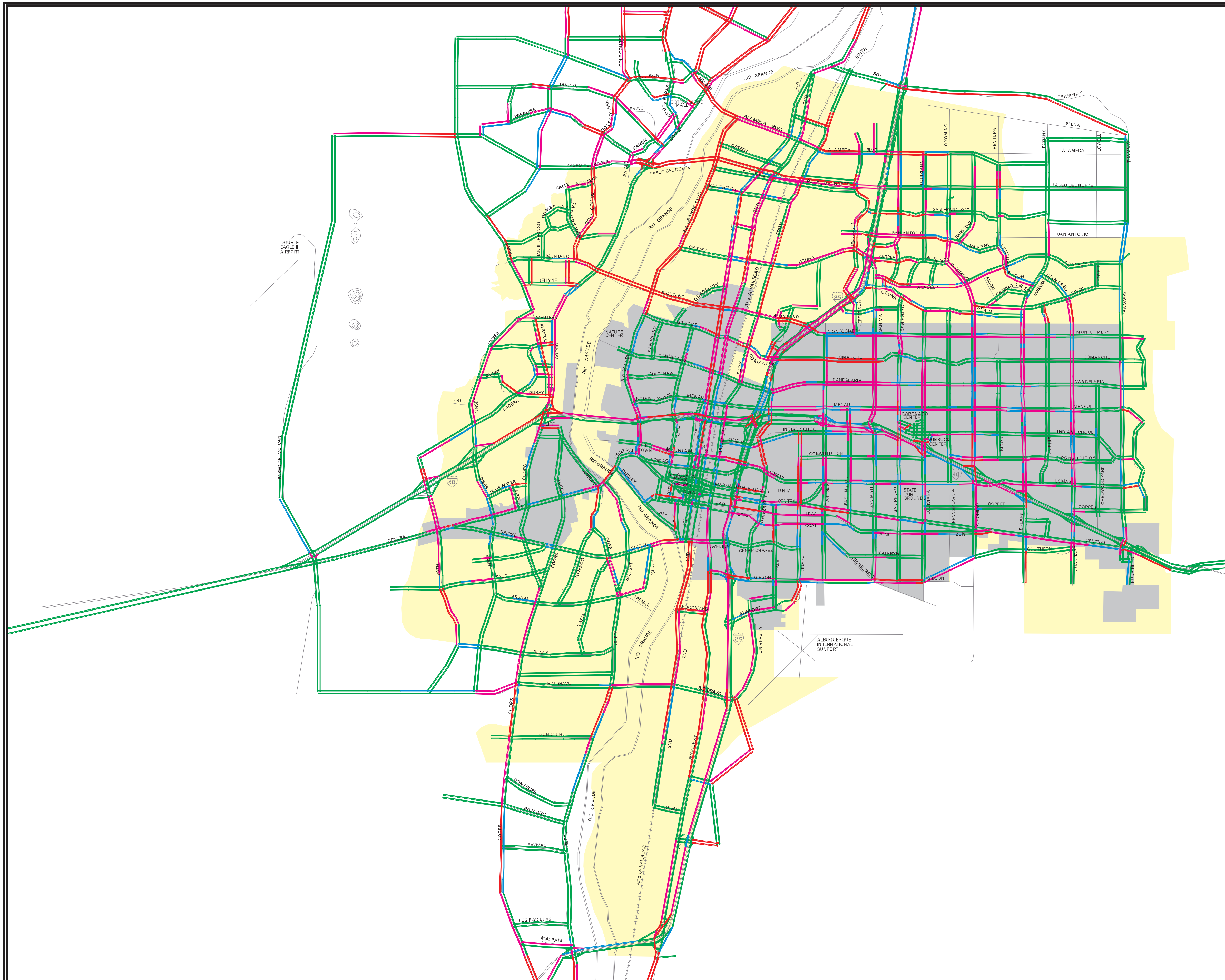
- < 0.9 V/C
- 0.9 to 1.0 V/C
- 1.0 to 1.3 V/C
- > 1.3 V/C
- 1960 City Limits
- Water Service Area

NORTH-SOUTH ROADWAYS
Rightside = North Bound
Leftside = South Bound

EAST-WEST ROADWAYS
Topside = West Bound
Bottom = East Bound

Figure 39

Scale: 1 inch = 2 miles
Map Printed January 2001



2020 Trend

P.M. Peak Hour V/C Ratios

Legend

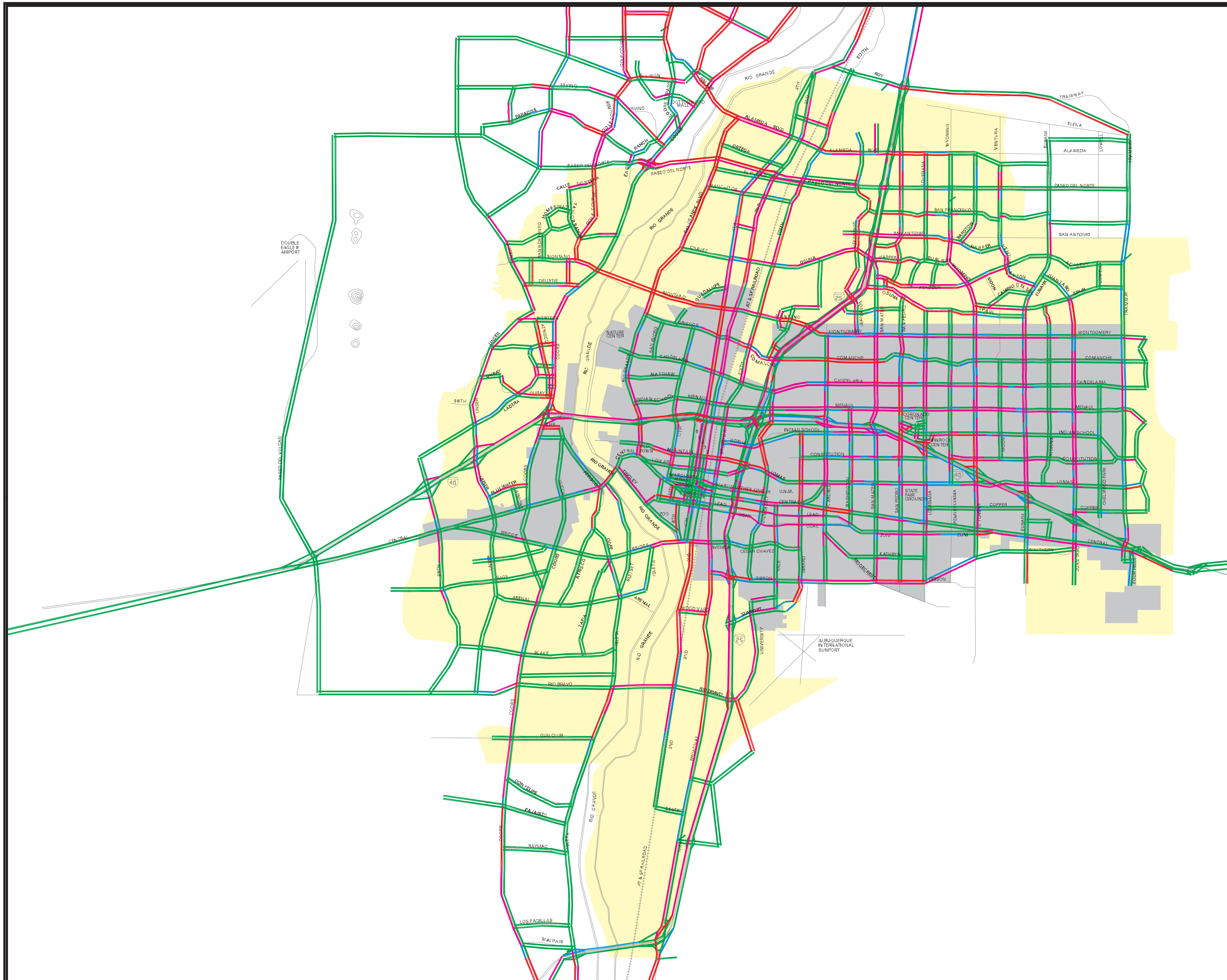
- < 0.9 V/C
- 0.9 to 1.0 V/C
- 1.0 to 1.3 V/C
- > 1.3 V/C
- 1960 City Limits
- Water Service Area

NORTH-SOUTH ROADWAYS
Rightside = North Bound
Leftside = South Bound

EAST-WEST ROADWAYS
Topside = West Bound
Bottom = East Bound

Figure 40

Scale: 1 inch = 2 miles
Map Printed January 2001



2020 Downtown

P.M. Peak Hour V/C Ratios

Legend

- < 0.9 V/C
- 0.9 to 1.0 V/C
- 1.0 to 1.3 V/C
- > 1.3 V/C

- 1960 City Limits
- Water Service Area

NORTH-SOUTH ROADWAYS

Rightside = North Bound

Leftside = South Bound

EAST-WEST ROADWAYS

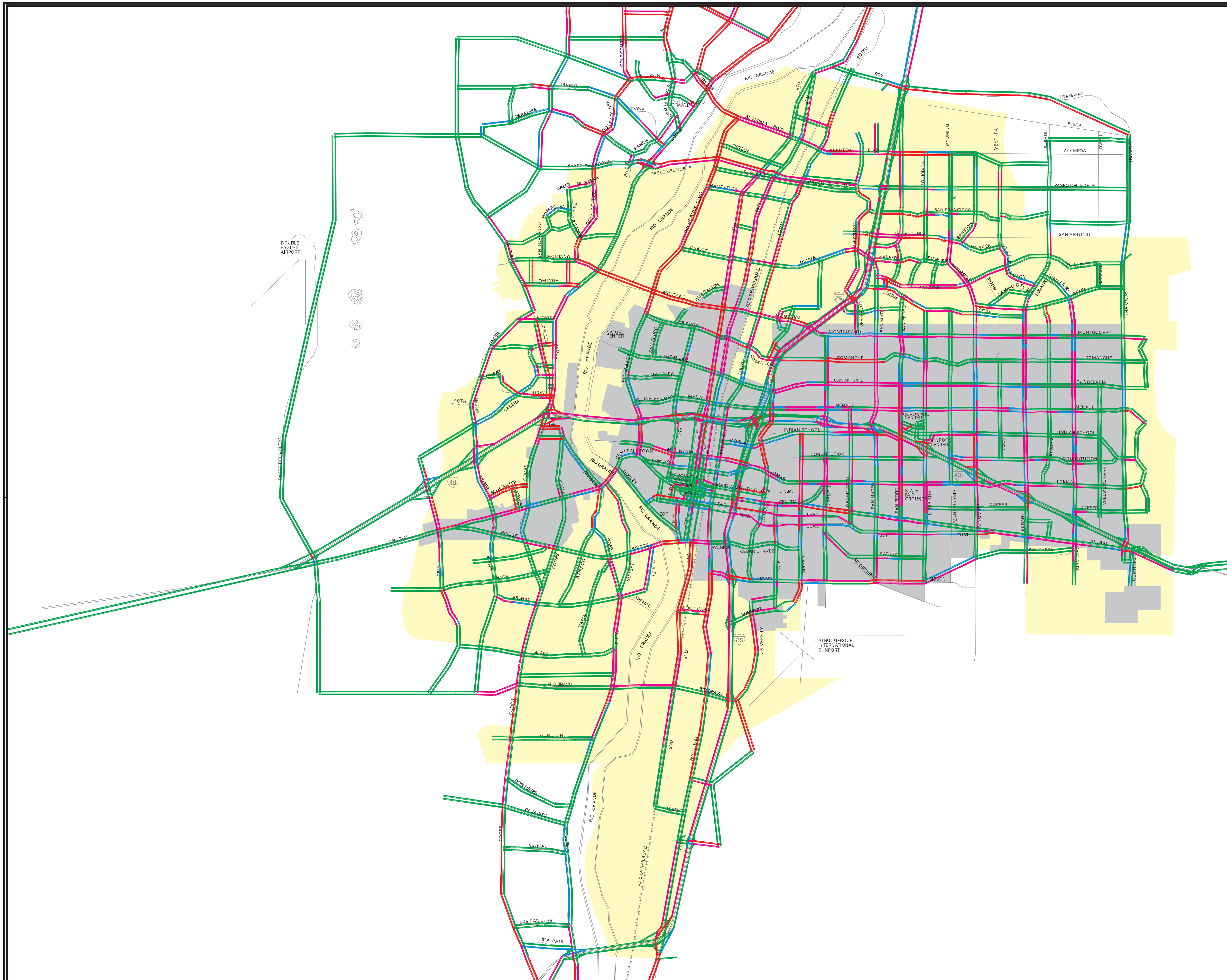
Topside = West Bound

Bottom = East Bound

Figure 41

Scale: 1 inch = 2 miles

Map Printed January 2001



2020 Balanced

P.M. Peak Hour V/C Ratios

Legend

- < 0.9 V/C
- 0.9 to 1.0 V/C
- 1.0 to 1.3 V/C
- > 1.3 V/C

- 1960 City Limits
- Water Service Area

NORTH-SOUTH ROADWAYS
Rightside = North Bound
Leftside = South Bound

EAST-WEST ROADWAYS
Topside = West Bound
Bottom = East Bound

Figure 42

Scale: 1 inch = 2 miles
Map Printed January 2001

Costs to Mitigate Future Deficiencies

The Metropolitan Transportation Plan is a financially-constrained plan that lists a number of roadway improvements in an effort to develop an “integrated intermodal transportation system.” The Metropolitan Transportation Plan calls for several roadway widening projects, as listed in Table A.12 in Appendix A. The costs for each of the improvements listed in the Metropolitan Transportation Plan were provided in the document and were assumed to be in place for all three of the growth scenarios. Each improvement project was then inspected to see in which of the three service areas it was located. Some projects were located across service area boundaries, and their costs were divided proportionally.

Staff at Bernalillo County Public Works and consultant staff took the land use plans for each of the three growth scenarios and used the V/C plots shown on Figures 40–42 (pg.165-169) and professional judgment to developed a Network Optimization Summary. This lists feasible roadway widening and new construction projects applicable to each scenario to optimize the efficiency of each scenario’s roadway network. The costs for these projects were estimated by comparing them to similar projects listed in the Metropolitan Transportation Plan. Table A.12 lists the costs of projects identified in the Network Optimization Summary. It should be noted that in two places the Metropolitan Transportation Plan calls for improvements (widening Arenal from Isleta to Coors and Isleta from Rio Bravo to Arenal from two to four lanes) that the staff have taken out of the Balanced Scenario. All of the costs use1998 dollars.

Approximately $446 million in upgrade costs are common to all three scenarios. When looking at the differing costs, the Balanced plan has the greatest amount of costs to mitigate deficiencies: $42.6 million. The Trend Scenario’s costs are about $17.0 million, and the Downtown Scenario’s costs are projected at $14.9 million. In the Trend Scenario, 82% of the differing costs are for projects in the Water Service Area and 18% are outside. In the Downtown Scenario, nearly 100% of the differing costs are in the Water Service Area. In the Balanced Scenario, the differing costs are split between 52% in the 1960 City Boundary and 48% in the Water Service Area.

Costs for New Construction

In addition to widening projects, the Metropolitan Transportation Plan lists new roadway construction projects for the major network roads (Table A.13). The costs for each of the new roadways listed in the Metropolitan Transportation Plan were provided in the document and were assumed to be in place for all three growth scenarios. Each new roadway project was then inspected to see in which of the three service areas it was located. Some projects were located across service area boundaries, and their costs were divided proportionally.

The Bernalillo County Public Works’ Network Optimization Summary, as developed by staff, also lists new roadway construction projects. The costs for these projects were estimated by comparing them to similar projects listed in the Metropolitan Transportation Plan. Table A.13 lists the costs of major road projects identified in the Network Optimization Summary. Again there are exceptions to the Metropolitan Transportation Plan that should be noted. The Metropolitan Transportation Plan shows Los Picaros from Broadway to University as having two new lanes, while the Network Optimization Summary has that project removed from the Downtown Scenario. The Metropolitan Transportation Plan also has University from Rio Bravo to Mesa del Sol Parkway as having four new lanes, and this has been taken out of the Trend and Downtown Scenarios in the Network Optimization Summary. Additionally, Rainbow from Unser to McMahon was assumed to be unnecessary for the expected growth in the Downtown and Balanced Scenarios.

The costs for new major road construction for the Downtown and Balanced Scenarios are approximately 93% of the costs of new major road construction in the Trend Scenario. None of the new construction projects lies within the 1960 City Boundary. In the Trend Scenario approximately 18% of the costs for new roadways falls in the Water Service Area boundaries, with the other 82% being Outside the Water Service Area. In both the Downtown and Balanced Scenarios, approximately 20% of the costs for new roadways fall in the Water Service Area boundaries, with the other 80% lying Outside the Water Service Area.

Costs for minor roads were obtained using a table of population and employment growth for each of the three scenarios between the years 1995 and 2020. First, it was assumed that zones and areas that are currently built out could not have local roads added to them. Consultant staff visually analyzed each DASZ with Bernalillo County Public Works staff to determine which DASZs are already built out, so that no new local road costs would be assigned to these DASZs. Next, each DASZ was analyzed to determine whether it would be an employment center in the future. The criteria for being an employment center was chosen as having at least 600 employees in the 2020 scenario and having a ratio of employees to employees plus dwelling units of at least 90%. DASZs that are not already built out and that would not be considered employment centers in the future were then assigned a mileage of local roads for new residential development. In all scenarios for the East Mountain DASZs, this was assumed to be 0.0839 miles per each new dwelling unit, and in the Trend Scenario for other DASZs, was assumed to be 0.0095 miles per each new dwelling unit, based on a number of miles of local road per dwelling unit typically observed in these areas. A rate of 0.0076 miles per dwelling unit (25% more dense than 0.0095 miles per dwelling unit) was used for the Balanced and Downtown Scenarios in DASZs not in the East Mountain area. DASZs that are not already built out and that may be considered employment centers in the future were also assigned a mileage of local road, 0.00045 miles per employee in the Trend Scenario, based on a rate currently observed in industrial areas. Again, a 25% greater density was assumed for the Balanced and Downtown Scenarios, and a rate of 0.00036 miles per employees was used. Table A.14 in Appendix A shows the number of miles of local road required for each growth scenario by DASZ and also shows the costs of constructing the roads. All new local roads were assumed to be standard 24-foot wide paved roads (28-foot face-to-face section), although the roads in the East Mountain DASZs were assumed to be built without curb and gutter or sidewalk. Supporting information for the cost of local roads is presented later in this report.

The costs for new minor road construction for the Downtown and Balanced Scenarios are approximately 80% and 72%, respectively, of the costs for new minor road construction in the Trend Scenario. 1,362 miles of new road would be required for the Trend Scenario, 1,121 miles required for the Downtown Scenario, and 936 miles required for the Balanced Scenario. In the Trend Scenario, approximately 9% of costs fall within the 1960 City Boundary, 32% in the Water Service Area boundaries, and the other 59% are Outside the Water Service Area. In the Downtown Scenario, approximately 12% of costs fall within the 1960 City Boundary, 37% in the Water Service Area boundaries, and the remaining 51% are Outside the Water Service Area. In the Balanced Scenario the split is 14% of costs within the 1960 City Boundary, 32% in the Water Service Area boundaries, and 54% Outside the Water Service Area.

Rehabilitation and Reconstruction Costs

Street in need of rehab and street with repairs completed

In 1998, the City of Albuquerque assessed its street conditions and found 27% of its roads in poor or very poor condition, 43% in fair condition, 19% in good condition, and 11% in excellent condition. Figure 43 (pg.175) shows road conditions within the City of Albuquerque. Bernalillo County Public Works did not have an estimate of the number of lane miles in need of repair, but it did estimate that the cost of rehabilitating existing County roads was $188 million. City and County staff estimate that half of this cost is assumed to occur in the Water Service Area and the other half Outside the Water Service Area. The Metropolitan Transportation Plan lists roadways that will require rehabilitation or reconstruction by the year 2020; the costs for these projects are shown in Table A.15 in Appendix A. These costs were assumed to be common to all three growth scenarios.

Rehabilitation and reconstruction costs within the 1960 City Boundary make up about 42% of all costs; Costs for rehabilitation and reconstruction within the Water Service Area make up approximately 41.5% of all costs, and Outside the Water Service Area roughly 16.5% of all costs.

Summary of Costs

The capital costs for roads that are common to all three scenarios are approximately $1.3 billion, or more than 80% of the total in each scenario. This reflects the substantial common cost associated with two sets of capital improvements:

1. Rehabilitation and reconstruction of major and local facilities, and
2. Cost of the Metropolitan Transportation Plan facility projects that meet the 2020 transportation needs.

Reconstruction and roadway rehabilitation accounts for more than half ($724 million) of the common capital cost. The projects needed to correct common deficiencies in road capacity account for more than $446 million. An additional $142 million of capital costs are for the construction on new major roads that are common to all scenarios.

Scenario-specific costs show the greatest amount of variance in two areas—common deficiencies and new roads. The Balanced Scenario has the highest cost for the correction of deficiencies. Much of these costs are improvements for High Occupancy Vehicle facilities. The Trend Scenario is the most expensive of the three scenarios. The Downtown Scenario has the lowest capital cost.

Within the 1960 City Boundary, the highest costs are estimated for the Balanced Scenario ($652 million). The Trend and Downtown Scenarios have lower costs. In the Water Service Area, all three scenarios have similar costs, ranging from $599 million (Balanced Scenario) to $618 million (Trend Scenario). However, the cost of providing roads to the area Outside the Water Service Area shows the most variation. The Balanced and Downtown Scenarios have costs that are similar. The Trend Scenario costs are approximately $66-$72 million higher than the other two scenarios, as shown in Table 71.

Table 71 Transportation Capital Cost (Roads) by Area

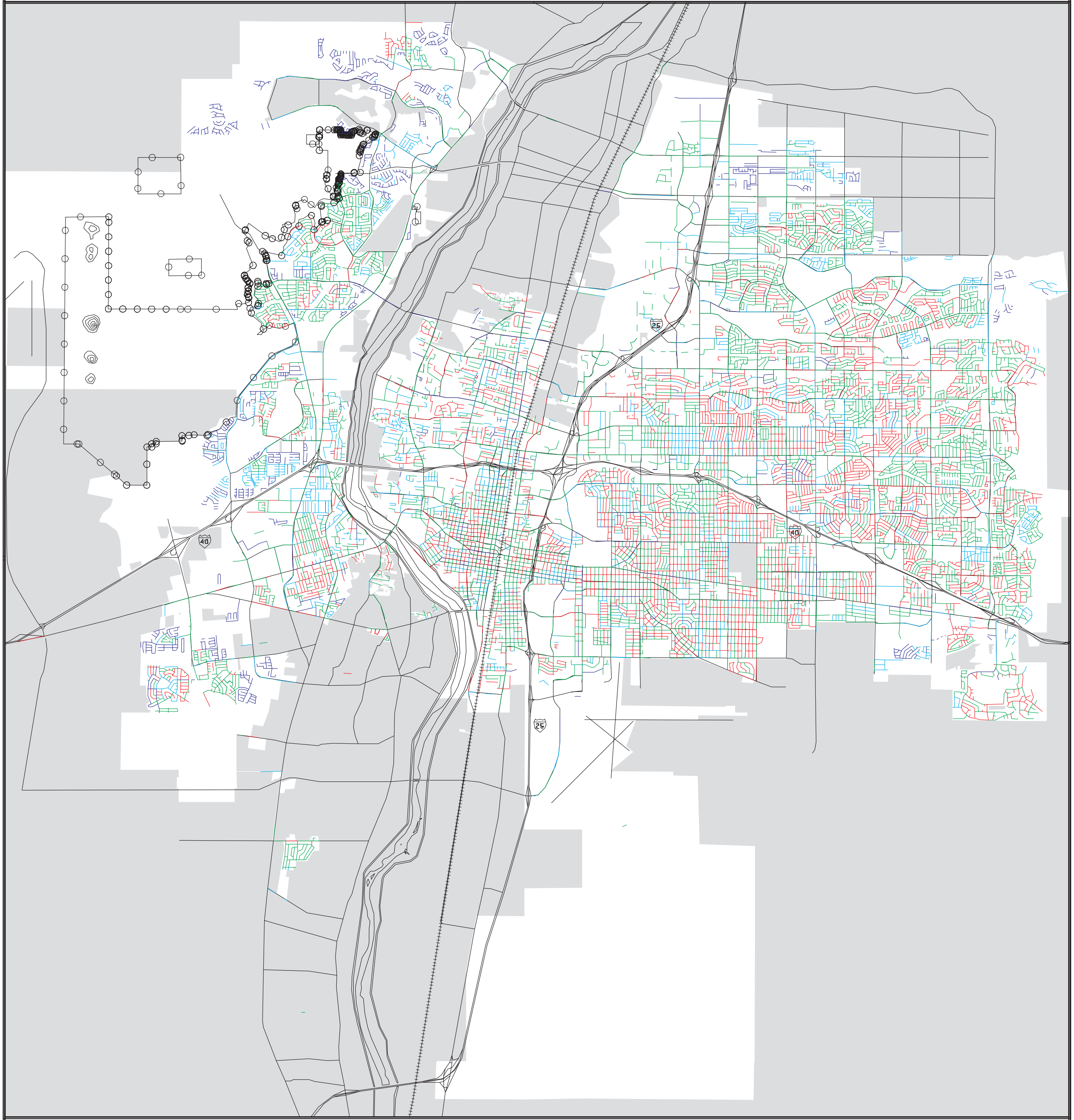
Scenario	1960 City Boundary	Water Service Area	Outside Service Area
Trend			
Mitigate Deficiencies	$295,134,400	$101,525,600	$66,494,000
New Major Roads	–	$31,392,500	$139,692,500
New Minor Roads	$25,025,700	$91,802,123	$167,918,214
Rehab/Reconstruction	$305,355,752	$299,975,688	$118,964,500
County Rehab	–	$94,000,000	$94,000,000
Total Capital Cost	$625,515,852	$618,695,911	$587,069,214
Balanced			
Mitigate Deficiencies	$317,414,650	$107,843,350	$63,494,000
New Major Roads	–	$31,500,000	$128,800,000
New Minor Roads	$28,890,121	$65,683,236	$110,149,114
Rehab/Reconstruction	$305,355,752	$299,975,688	$118,964,500
County Rehab	–	$94,000,000	$94,000,000
Total Capital Cost	$651,660,523	$599,002,274	$515,407,614
Downtown			
Mitigate Deficiencies	$295,134,400	$102,478,600	$63,494,000
New Major Roads	–	$30,892,500	$128,192,500
New Minor Roads	$26,966,946	$84,108,607	$116,583,137
Rehab/Reconstruction	$305,355,752	$299,975,688	$118,964,500
County Rehab	–	$94,000,000	$94,000,000
Total Capital Cost	$627,457,098	$611,455,395	$521,234,137

Source: Parsons Brinckerhoff

Figure 43

City Road Conditions

May 2000



Legend

Excellent
Fair
Good
Poor

4.5.5 Supporting Information

A number of assumptions were made in determining the cost estimates above. The sections below provide supporting information for those assumptions.

Costs for Mitigating Deficiencies and Constructing New Major Roadways

The roadway improvements included in this report are listed either in the Metropolitan Transportation Plan or the Bernalillo County Network Optimization Summary. Roadway improvements listed in the Metropolitan Transportation Plan include estimated construction costs, shown in Table A.16.

Table A.17 in Appendix A summarizes the assumptions made to estimate major roadway construction costs. The estimated construction costs of the roadways listed in the Network Optimization Summary were derived using several methods. First, the construction costs from the Metropolitan Transportation Plan were converted to a unit cost per mile of roadway. The roadway improvements listed in the Network Optimization Summary were then compared to those listed in the Metropolitan Transportation Plan. Where similar improvements located in similar areas were present in both the Network Optimization Summary and Metropolitan Transportation Plan, the unit cost per mile of roadway from the Metropolitan Transportation Plan was applied to the length of roadway described in the Network Optimization Summary, and a total cost was calculated. Where improvements in the Network Optimization Summary and Metropolitan Transportation Plan were dissimilar, two other methods were used. For improvements that required striping only (such as converting an existing lane to an High Occupancy Vehicle lane), a unit cost per mile of striping was calculated. The unit cost per mile was calculated using the New Mexico State Highway and Transportation Department price for 4-inch striping per foot and multiplying it by two lanes and then by 5,280 feet/mile. This gave a unit cost of roughly $25,000 per mile, which was then applied to the scenarios that included striping only. Engineering judgment based on consistent assumptions was used to estimate construction costs for the interchange ramps and overpasses, bridge construction and reconstruction, and signalization improvements.
Estimating New Local Street Mileage

Using the year 2020 population data for each of the three growth scenarios, DASZs were identified that had a growth in employment or number of dwelling units from the year 1995. A sample of existing residential DASZs in the area was then examined to calculate an average number of miles of local road required per dwelling unit—this value of 0.0095 miles per dwelling unit (about 50 feet/dwelling unit) was used for the Trend Scenario. It was assumed that densities in the Balanced and Downtown Scenarios would be approximately 25% greater, so a value of 0.0076 miles per dwelling unit was used in those cases. A sample of existing residential DASZs in the East Mountain area yielded an average of 0.0839 miles/dwelling unit (about 443 feet/dwelling unit), which was applied to the East Mountain DASZs in all three scenarios. Next, the DASZs in a sample of industrial areas were examined to calculate an average number of local road miles required per employee in DASZs that qualified as employment centers—this value of 0.00045 miles per employee (about 2.34 feet per employee) was used for the Trend Scenario. Again, the assumption was made that densities in the Balanced and Downtown Scenarios would be 25% greater than in the Trend Scenario, and a value of 0.00036 miles per employee was used for those scenarios.

Minor Street Costs

Local streets were priced based on the following assumptions:

- A 28-foot face-to-face section (24-foot wide paved section);
- Standard curb and gutter;
- A 4-foot sidewalk on both sides of the road;
- A paving section with two 2-inch asphalt lifts, two 6-inch lifts of subgrade compacted to 95%, natural ground compacted to 90%, and one layer each of tack coat and prime coat;
- Compaction of subgrade extending one foot behind the curb; and
- Clearing and grubbing, including sidewalk.

Because the land for minor streets is assumed to be furnished by the developer, no costs for right-of-way are included. If we were to include right-of-way costs, the effect would be to increase the cost for the Trend Scenario relative to the more compact scenarios.

Table 72 shows how the unit cost for one linear foot of local road at $58.39 was calculated. The City of Albuquerque's 1997 unit prices were used, since these have remained stable.

Table 72 Cost for One Linear Foot of Local Road

Item	Quantity in One Linear Foot	Unit Price	Cost
Site clearing and grubbing	4.4 cubic yards	$0.18/cubic yard	$0.79
Subgrade prep (2 6-inch lifts = 3.5 cubic yard/lift)	7.0 cubic yards	$1.01/cubic yard	$7.07
Asphalt paving (2 2-inch lifts = 2.7 cubic yard/lift)	5.4 cubic yards	$1.58/cubic yard	$8.53
Prime coat	2.7 cubic yards	$0.31/cubic yard	$0.84
Tack coat	2.7 cubic yards	$0.17/cubic yard	$0.46
Standard curb & gutter	2.0 linear foot	$11.14/ linear foot	$22.28
4 inch sidewalk, 4 feet wide	0.88 cubic yards	$20.93/cubic yard	$18.42
TOTAL			$58.39

Roads in the East Mountain area (DASZs 3111–3132 and DASZs 3142–3301) were assumed to be built to County standards; that is, without curbs, gutters, or sidewalks. This assumption brought the local road cost for these DASZs down to $17.69 per linear foot.

The proportion of the transportation capital costs to be borne by the public versus the private sector was determined using the following method and is summarized in Table 73. First, based on discussions with Bernalillo County Public Works staff,

Table 73 Public vs. Private Transportation Costs

Trend Scenario	1960 City	Public	Private	Water Service Area	Public	Private	Out of Service Area	Public	Private	TOTAL	Public	Private
Mitigate Deficiencies	$295,134,400	$175,117,040	$120,017,360	$101,525,600	$59,315,360	$42,210,240	$66,494,000	$39,390,800	$27,103,200	$463,154,000	$273,823,200	$189,330,800
New Major Roads	$0	$0	$0	$31,392,500	$18,635,500	$12,757,000	$139,692,500	$83,615,500	$56,077,000	$171,085,000	$102,251,000	$68,834,000
New Minor Roads	$25,025,700	$0	$25,025,700	$91,802,123	$0	$91,802,123	$167,918,214	$0	$167,918,214	$284,746,037	$0	$284,746,037
Rehab/Reconstruction	$305,355,752	$305,355,752	$0	$299,975,688	$299,975,688	$0	$118,964,500	$118,964,500	$0	$724,295,940	$724,295,940	$0
County Rehab	$0	$0	$0	$94,000,000	$94,000,000	$0	$94,000,000	$94,000,000	$0	$188,000,000	$188,000,000	$0
Total Capital Cost	$625,515,852	$480,472,792	$145,043,060	$618,695,911	$471,926,548	$146,769,363	$587,069,214	$335,970,800	$251,098,414	$1,831,280,977	$1,288,370,140	$542,910,837

Balanced Scenario	1960 City	Public	Private	Water Service Area	Public	Private	Out of Service Area	Public	Private	TOTAL	Public	Private
Mitigate Deficiencies	$317,414,650	$188,485,190	$128,929,460	$107,843,350	$64,706,010	$43,137,340	$63,494,000	$37,590,800	$25,903,200	$488,752,000	$290,782,000	$197,970,000
New Major Roads	$0	$0	$0	$31,500,000	$18,700,000	$12,800,000	$128,800,000	$77,080,000	$51,720,000	$160,300,000	$95,780,000	$64,520,000
New Minor Roads	$28,890,121	$0	$28,890,121	$65,683,236	$0	$65,683,236	$110,149,114	$0	$110,149,114	$204,722,471	$0	$204,722,471
Rehab/Reconstruction	$305,355,752	$305,355,752	$0	$299,975,688	$299,975,688	$0	$118,964,500	$118,964,500	$0	$724,295,940	$724,295,940	$0
County Rehab	$0	$0	$0	$94,000,000	$94,000,000	$0	$94,000,000	$94,000,000	$0	$188,000,000	$188,000,000	$0
Total Capital Cost	$651,660,523	$493,840,942	$157,819,581	$599,002,274	$477,381,698	$121,620,576	$515,407,614	$327,635,300	$187,772,314	$1,766,070,411	$1,298,857,940	$467,212,471

Downtown Scenario	1960 City	Public	Private	Water Service Area	Public	Private	Out of Service Area	Public	Private	TOTAL	Public	Private
Mitigate Deficiencies	$295,134,400	$175,117,040	$120,017,360	$102,478,600	$59,887,160	$42,591,440.00	$63,494,000	$37,590,800	$25,903,200	$461,107,000	$272,595,000	$188,512,000
New Major Roads	$0	$0	$0	$30,892,500	$18,535,500	$12,357,000.00	$128,192,500	$76,915,500	$51,277,000	$159,085,000	$95,451,000	$63,634,000
New Minor Roads	$26,966,946	$0	$26,966,946	$84,108,607	$0	$84,108,607.00	$116,583,137	$0	$116,583,137	$227,658,690	$0	$227,658,690
Rehab/Reconstruction	$305,355,752	$305,355,752	$0	$299,975,688	$299,975,688	$0.00	$118,964,500	$118,964,500	$0	$724,295,940	$724,295,940	$0
County Rehab	$0	$0	$0	$94,000,000	$94,000,000	$0.00	$94,000,000	$94,000,000	$0	$188,000,000	$188,000,000	$0
Total Capital Cost	$627,457,098	$480,472,792	$146,984,306	$611,455,395	$472,398,348	$139,057,047.00	$521,234,137	$327,470,800	$193,763,337	$1,760,146,630	$1,280,341,940	$479,804,690

all rehabilitation and reconstruction costs from Table A.15 were assigned to the public. The other assignments were done using these assumptions provided by the Planned Growth Strategy Management Committee based on discussions with private sector stakeholders:

- Costs associated with arterials would be assigned 60% to the public and 40% to the private sector,
- Costs associated with collectors would be assigned 20% to the public and 80% to the private sector, and
- Costs associated with local (minor) roads would be assigned 100% to the private sector.

Consequently, 100% of the minor road costs from Table A.14 were assigned to the private sector. Next, the roadway improvements listed in Table A.12 (costs to mitigate deficiencies), and Table A.13 (new construction costs for major roads), were categorized as arterial or collector improvements as shown on those tables. The costs were then divided as described above to yield totals for the public versus the private sector.

The proportion of the total transportation capital costs to be borne by the public varies little between scenarios. In the Trend Scenario, $1,288 million (70%) of the $1,831 million total were assigned to the public. In the Balanced Scenario, $1,299 million (74%) of the $1,766 million total were assigned to the public. Finally, in the Downtown Scenario, $1,280 million (73%) of the $1,760 million total were assigned to the public.

4.5.6 Transit Cost

The City of Albuquerque's existing transit system consists of SunTran, providing bus service, and SunVan, a paratransit service provider, supplying variable route service. SunTran reports that it carried a daily average of 16,804 passenger trips using its fleet of 128 buses in 1995. The annual operating cost for the existing system in FY 99 was $14,331,000 (Source: City of Albuquerque).

SunTran bus on Central

Existing SunTran ridership is considered to be modest when compared to peer cities, such as Austin, Tucson, or Salt Lake City. While ridership on the SunTran system has been increasing slowly in recent years, this trend follows a period of declining ridership. SunTran has begun a modest set of service expansions recently. These changes are intended to improve the efficiency of a system that until recently had some routes with no midday service, very limited weekend service, no evening service, and no service on six major holidays.

For purposes of this analysis, it is assumed that the bus system will be expanded until it reaches a total of 314 buses. A fleet of 314 buses was designated to serve the Albuquerque area in the recent proposal to establish a Regional Transit Authority in the Middle Rio Grande Region (Table 74).

Transit system operating costs are directly related to the size of the vehicle fleet and the total hours of operation. The capital cost of the bus system is closely associated with the acquisition of new buses and the frequency of bus replacement. All of the scenarios assume the same level of bus acquisition, but they assume two schedules of bus replacement. The bus fleet in the Trend Scenario will drive 5% more miles to cover more area to serve the same population than the Downtown and Balanced Scenarios. This is expected to result in a slightly shorter replacement schedule for the Trend Scenario.

Table 74 Comparable Transit System Data

City	Average Transit Trips Per Day	Transit Vehicles	Average Daily Trips Per Vehicle
Albuquerque SunTran	16,804	128	131
Austin, Texas	103,700	404	257
Salt Lake City, Utah	83,900	594	141
Tucson, Arizona	53,700	200	269
Capacity of Albuquerque fleet if operated more efficiently	25,600	128	200
2020 Bus Fleet, All Scenarios*		314	

* From Regional Transit Authority Service Plan

The process of estimating the number of transit trips in the Downtown, Balanced, and Trend Scenarios begins with the methodology set out in the Transportation Evaluation Study memorandum “Transportation-Related Impacts of Alternative Future Place Image” (Parsons Brinckerhoff 1997). This memo produced initial estimates of transit ridership based upon four alternative methods. For the purpose of this section, transit ridership estimates based on the memo’s TCRP Report 16 equations will be used (see pages 3 and 4 of the 1997 memorandum). This is the most conservative of the four methods used in that memorandum. The results of this process for the Downtown Scenario are shown in Table 75.

Table 75 Updated Transit Ridership Projection for Downtown Scenario, Estimated by Corridor

	Daily Transit Riders	
Corridor	**1995**	**2020**
Balanced Scenario Corridors	8,664	14,100
Other Corridors	4,920	20,500
Simple Total	13,584	34,600
Corridor Total—no double counting	11,000	33,800
Ratio of Corridor to Total Ridership	68%	50%*
Estimated Total Ridership	16,174	67,600

* Projected
Source: Parsons Brinckerhoff

Current population and employment projections for all three scenarios were reviewed and organized by transportation corridor. In the Downtown Scenario, it is estimated that 33,800 transit trips per day will be generated in focused growth corridors. Furthermore, it is assumed that an expanded bus system serving Albuquerque will generate half of its trips from the area outside the focused growth corridors and half from the corridors themselves. Accordingly, the projected average daily transit ridership for the Downtown Scenario is 67,600 trips per day.

The "Balanced Scenario Corridors" are the focused growth corridors used in the Balanced Scenario. The "Other Corridors" contain the traffic analysis zones that comprise the remainder of the growth corridors in the Downtown Scenario. The traffic analysis zones in all these corridors produced 68% (11,000) of the total daily transit trips in 1995. They are also expected to be a primary source of transit riders in all of the planned growth scenarios.

Average daily transit ridership for the Balanced Scenario was estimated by comparing the projections for the Balanced and Downtown Scenarios. As a result of this analysis, it was determined that the transit ridership in the Balanced Scenario corridors is expected to be 90% of the ridership in the Downtown Scenario. It is assumed that like the Downtown Scenario, the Balanced Scenario gets half of its ridership from the corridor and about half from the remaining portion of the urban area. As a result of this analysis, the projected 2020 daily transit ridership is expected to be 61,000 trips (Table 76).

Table 76 Transit Ridership Projection for Balanced Scenario Estimated by Corridor

	Daily Transit Riders	
Corridor	**1995**	**2020**
Balanced Scenario Corridors	8,664	31,140
Other Corridors	4,920	30,420
Simple Total	13,584	61,560
Corridor Total—no double counting	11,000	30,500
Projected Ratio of Corridor to Total Ridership	68.01%	50%*
Estimated Total Ridership	16,174	61,000

* Projected

Balanced Population and Employment Projections = 90% of Corridors in Downtown Scenario

A similar process was followed to estimate the ridership for the Trend Scenario. A comparison of the corridor projections under the Downtown and the Trend Scenarios resulted in an estimate of Trend Scenario ridership that is 80% of ridership in the Downtown Scenario in the corridors. It was also assumed that the land use pattern for the remainder of the urban area would produce fewer transit riders than the Balanced or the Downtown Scenarios. Therefore the proportion of total transit ridership outside of the corridors was projected to decrease. As a result, the corridors are expected to produce more of the total ridership (55%) in the Trend Scenario than they produce in the other two scenarios. As a result of this analysis, it is estimated that the Trend

Scenario will produce 49,091 daily riders in 2020 (Table 77).

Table 77 Transit Ridership Projection for Trend Scenario' Estimated by Corridor

Corridor	Daily Transit Riders 1995	2020
Balanced Scenario Corridors	8,664	11,280
Other Corridors	4,920	11,280
Simple Total	13,584	22,560
Corridor Total—no double counting	11,000	27,000
Ratio of Corridor to Total Ridership	68.01%	55%*
Estimated Total Ridership	16,174	49,091

* Projected

Trend Population and Employment Projections = 80% of Corridors in Downtown Scenario

Land use is not the only factor contributing to this ridership estimate. All three bus systems assume the same size bus fleet—314 buses—and the same portion of operating cost recovery from passenger fares—30%. Taking this analysis to its logical conclusion, it can be determined that the transit fares paid by the riders in the Trend Scenario will be higher than in either the Balanced or the Downtown Scenarios.

For long-range planning purposes, a High Capacity Transportation system is assumed to be needed in each scenario in 2020, although the exact nature of this system has yet to be determined. The operating cost estimates for this system, based on the cost estimates developed for the proposed Regional Transit Authority in 1998, are projected at $8,600,000 in 2020. Capital costs for the High Capacity Transportation system were also estimated. These total $275,200,000 based on Regional Transit Authority cost estimates. Neither the capital nor the operating costs of High Capacity Transportation are included in the transit cost estimates here.

The transit operating cost for all of the scenarios assumes the utilization of a 314-vehicle fleet. The operating costs for the Balanced and Downtown Scenarios were estimated by expanding the existing fleet cost in direct proportion to the number of buses. For the Trend Scenario, 5% was added to this direct proportion to reflect the longer trip lengths under this scenario (Table 78).

Table 78 Estimated Transit System Annual Operating Costs, 2020

Cost	Scenario: Trend	Balanced	Downtown
Annual Bus Public Operational Costs	$25,839,465	$24,609,014	$24,609,014
Private Bus Operating Cost - Fares	$11,074,056	$10,546,720	$10,546,720
Total Annual Cost	$36,913,521	$35,155,734	$35,155,734

SunTran Operating Cost for 1999 = $14,331,000.

2020 Downtown, Balance and Trend assume larger bus fleets than 1995 and are adjusted proportionally.

Trend bus operating cost adjusted 5% to reflect increased miles of travel.

Assumes 30% Recovery of Operational Cost from Fee or Fares.

Transit capital cost estimates were derived for buses and bus facilities consistent with the cost estimates developed for the proposed Regional Transit Authority (Avid Engineering and Parsons Brinckerhoff 1998). The cost of a bus is estimated to be $335,000. It is assumed that an expanded bus system will need an estimated $210,000 per bus in transit-related facility capital costs such as bus shelters. Finally, it is assumed that the existing bus fleet of 128 buses, which is assumed as part of all three scenarios, will need to be replaced twice during the time period 1999–2020 in the Balanced and Downtown Scenarios and three times in the Trend Scenario. This replacement assumption is based on the Federal Transit Authority recommendation of replacing buses every 12 years. The new buses required to support all scenarios will be added incrementally as they are needed, and the bus fleets will reach their projected levels by 2020.

The Middle Rio Grande Connections Major Transportation Investment Study is an analysis of potential High Capacity Transportation systems in the Albuquerque area. This study is being conducted by the New Mexico State Highway and Transportation Department and the City of Albuquerque. The type of High Capacity Transportation system, nature of the necessary improvements, and exact location of the High Capacity Transportation service is unknown at this time. The High Capacity Transportation could be a Light Rail Transit line, a Bus Rapid Transit line, or an extensive system of High Occupancy Vehicle facilities. As previously noted, the capital and operating costs of a High Capacity Transportation system have not been included here.

Thus, the capital costs for the Trend Scenario would be $323 million for the bus fleet and related transit facilities. The capital costs for the Balanced and the Downtown Scenarios would be $249 million. The estimation of these costs is shown in Table 79.

Table 79 Projected Transit Capital Cost

	Scenario		
	Trend*	**Balanced****	**Downtown****
Replace Existing Buses	$128,640,000	$85,760,000	$85,760,000
Additional Buses to Meet Demand	186	186	186
Average Cost Per Bus	$335,000	$335,000	$335,000
New Bus Capital Cost	$155,775,000	$124,620,000	$124,620,000
New Transit Facilities for New Buses- Shelters, Bus Stops Etc.			
Average Cost Per New Bus	$210,000	$210,000	$210,000
New Transit Facilities	$39,060,000	$39,060,000	$39,060,000
Total Capital Cost	$323,475,000	$249,440,000	$249,440,000

* Assumes bus replacement every 10 years
** Assumes bus replacement every 12 years
Source: Parsons Brinckerhoff

4.5.7 Full Cost of Travel

The full cost of travel is an important part of the transportation costs of alternative land use scenarios. Most people think of the cost of travel in terms of the direct monetary costs to make a specific trip. Automobile drivers usually think that this cost includes the cost of gasoline and other direct costs such as parking. Transit riders view this cost as the transit fare, and pedestrians and bicyclists usually view their trip as being free. But the cost of travel actually includes substantial additional monetary costs. The higher the total travel costs, the greater the impacts on the local economy. Conversely, if the cost of travel is lower, more economic resources are available for other activities.

The estimation of the "full cost of travel" has received much attention recently. Various cost accounting procedures have been the topic of several studies during the last decade. A useful cost accounting approach (Apogee Research, Inc. 1994) was developed for Boston, Massachusetts, and Portland, Maine, which classifies all costs into three categories: User Costs, Governmental Costs, and Societal Costs. Additional research was conducted on the cost of travel by the Victoria Policy Institute (Litman 1995) and Mark Delucchi (Delucchi 1997), and on cost issues associated with land development patterns (Burchell et al. 1998). This cost of travel methodology has been used recently to estimate the cost of travel in Boulder, Colorado (Parsons Brinckerhoff July 1996) and to develop a prototype full cost model (Parsons Brinckerhoff 1998) for the Federal Highway Administration. These examples represent only a portion of the work that has been done on the subject of travel costs.

A complete cost of travel analysis looks at costs in three broad categories, which are described below.

User Costs: User costs include more than the gas and parking mentioned previously. In addition, it includes the cost of oil, tires, repairs, maintenance, and depreciation. These costs account for most of the direct out-of-pocket expenses that users pay. Additional out-of-pocket expenses include insurance, registration, licensing, and taxes levied by state or local governments on individual cars. Indirect user costs can include variables such as the cost of providing a parking space/garage at home and the average cost of accidents not covered by insurance. Finally there is the issue of user travel time cost. The cost of travel time can substantially increase the total cost of travel per mile.

Government Costs: Governmental costs include a wide range of expenditures that are not paid by gas taxes or other direct user fees. Government costs also include the local (City/County) cost associated with the transportation system that are paid from general funds, such as police traffic enforcement, traffic court, and fire/EMS service in response to accidents. These costs can also include the portion of accident costs that are not covered by the users or by insurance. Capital costs associated with the construction of state or local transportation system that are not paid by the gas tax and deferred investment for transportation facilities can also be included in this category. For transit, government cost is the net cost after transit fares have been deducted.

Societal Costs: Societal costs are typically what economists call "external" costs. Societal costs include air pollution, waste, water pollution, and noise. Numerous studies have estimated the cost of these externalities. In addition, this category can include the cost of building and maintaining parking spaces away from home.

The travel cost analysis conducted for this report uses a conservative set of user costs to estimate the annual cost of travel for vehicle operations (gas, oil, tires, maintenance, repairs, and depreciation) and for user travel time.

A recent analysis of Cost Benefit models conducted for the California Department of Transportation examined the components of vehicle operating cost per mile used by six transportation models; HERS[2]; Cal B/C[3]; STEAM[4]; RailDEC[5]; Rail B\C[6], and StratBENCOST[7]. These six models use the same or similar cost components and estimate that the range of vehicle operating costs is between $0.18–$0.32 per vehicle mile traveled in 1995. For purposes of this analysis, the cost data have been updated to current dollars using the Consumer Price Indicator—All Urban Consumers. The resultant high and low vehicle operating costs per mile are shown in Table 80.

Table 80 Vehicle Operating Cost Per Mile

Year	Cost per vehicle mile traveled: Low	Cost per vehicle mile traveled: High
1995	$0.18	$0.32
Adjusted Current Cost	$0.20	$0.35

It should be noted that the vehicle operating cost estimates produced for this report represent a low estimate of the total cost of travel. Research (Parsons Brinckerhoff 1997) has shown that the cost of travel is directly related to the land use patterns, vehicle ownership patterns, and vehicle mode choice decisions. In a transit-oriented land use pattern, the percentage of trips made by walk/bike is twice the level of a traditional suburban area. There is also a greater use of transit and a reduced use of single occupancy vehicles. The interconnection of land use and transportation affect the average vehicle miles traveled per household and can affect transportation costs to an even greater extent by reducing the need for some households to have a second car.

The annual cost of travel is estimated for the year 2020 and is expressed in current year dollars. The Bernalillo County Public Works Department, using the travel model developed by MRGCOG, estimated the total vehicle miles traveled for each of the three land use scenarios in 2020. These data are expressed in terms of peak and non-peak hour weekday vehicle miles traveled and are shown in Table 81(pg.186). The travel model uses the transportation network developed for the Albuquerque area. This travel network was adjusted to reflect the new road links assumed to be part of each of the 2020 land use scenarios.

The travel model estimates automobile travel but does not model vehicle mode choice decisions and does not model transit ridership. Therefore, it is necessary to

Table 81 Total Vehicle Miles Traveled by Development Scenario, 2020

	Scenario		
	Trend	Balanced	Downtown
A.M. Peak	4,380,627	4,287,400	4,315,548
P.M. Peak	5,978,556	5,866,073	5,884,507
Off Peak	13,424,888	13,204,926	13,101,100
Total	23,784,072	23,358,400	23,301,156

Source: Parsons Brinckerhoff

make adjustments to the total vehicle miles traveled for the Downtown and Balanced Scenarios that reflect changes in transit ridership associated with compact land use patterns. An analysis of these changes was developed as part of the Albuquerque Transportation Evaluation Study and is contained in the paper entitled “Comparison of Trend Alternatives and Alternative Future Place Image Concept (TES Alternative)” prepared by Parsons Brinckerhoff (March 1997). Adjustments to the total 2020 daily vehicle miles traveled based on projected increases in High Occupancy Vehicle trips and transit ridership were taken from that memo. The High Occupancy Vehicle adjustments reduce the number of vehicle miles of travel because the percentage of trips made by High Occupancy Vehicles increases while the population remains the same. This reduction in vehicle miles traveled is partially offset by an increased trip length for High Occupancy Vehicle trips. High Occupancy Vehicle trips are assumed to be 10% longer than single occupancy vehicle trips because of the need to pick up additional passengers (Source: Parsons Brinckerhoff). The vehicle miles traveled reduction attributable to High Occupancy Vehicle is estimated at 77,562 vehicle miles per day.

For the compact development scenarios, we assume the increase in the number of transit trips shown in Table 82, and a corresponding decrease in the number of single occupancy vehicle trips. This is estimated to reduce the single occupancy vehicle miles traveled by an additional 128,638 miles per day for the Downtown Scenario and 82,768 miles per day for the Balanced Scenario based on an average trip length of seven miles. The total reduction in daily vehicle miles traveled in the Downtown Scenario is 206,200 and in the Balanced Scenario it is 160,330. The resultant estimates of daily vehicle miles traveled for the three land use scenarios are shown in the Tables 82 and 83 (pg.189).

Table 82 Adjustments to Total Vehicle Miles Traveled

	Scenario		
Adjustment	**Trend**	**Balanced**	**Downtown**
Single occupancy vehicle trips shifted to high occupancy vehicle	0	12,400	12,400
Average single occupancy vehicle trip length	7.08	6.95	6.95
Change in single occupancy vehicle miles traveled	0	(86,180)	(86,180)
Increased vehicle miles traveled due to longer high occupancy vehicle trips (+10%)	0	8,618	8,618
Net vehicle miles traveled reduction—high occupancy vehicle	0	(77,562)	(77,562)
Single occupancy vehicle trips shifted to transit			
Increase in number of trips (Trend = 49,091)	0	11,909	18,509
Net vehicle miles traveled reduction—transit	0	(82,768)	(128,638)
Total Net Vehicle Miles Traveled Adjustment	0	(160,330)	(206,200)

Source: Parsons Brinckerhoff

Table 83 shows the adjusted vehicle miles traveled estimates, assuming 90% of the change occurs in A.M. and P.M. Peak Hours (Source: Parsons Brinckerhoff). Reductions in total vehicle miles traveled shown above equal about 3% of the projected vehicle miles traveled. While this number is relatively small in comparison to the total vehicle miles traveled, most of the change occurs in peak hour travel time, which reduces congestion on key road links.

Table 83 Adjusted Total 2020 Daily Vehicle Miles Traveled by Scenario

	Scenario		
	Trend	Balanced	Downtown
A.M. Peak	4,380,627	4,215,252	4,222,758
P.M. Peak	5,978,556	5,793,925	5,791,717
Off Peak	13,424,888	13,188,893	13,080,480
Total	23,784,071	23,198,069	23,094,955

The conversion of daily vehicle miles traveled to annual vehicle miles traveled is based on the assumption that there will be 250 days each year with an average level of traffic, and 115 days where vehicle miles traveled will be 70% of average.

Daily user costs of travel for the three scenarios are shown in Table 84 . The differences between the Trend, Downtown, and Balanced Scenarios range from $125,000–$241,000 per day depending on the user cost per mile.

Table 84 Daily Cost of Travel by Scenario, 2020

	Scenario		
	Trend	Balanced	Downtown
Projected Vehicle Miles Traveled			
Daily A.M. Peak	4,380,627	4,215,252	4,222,758
Daily P.M. Peak	5,978,556	5,793,925	5,791,717
Daily Off Peak	13,424,888	13,150,744	13,080,480
Daily Total	23,784,071	23,159,920	23,094,955
Vehicle Operating Cost—Low Estimate			
A.M. Peak Hour Cost	$876,125	$843,050	$844,552
P.M. Peak Hour Cost	$1,195,711	$1,158,785	$1,158,343
Off Peak Cost	$2,684,978	$2,630,149	$2,616,096
Total Daily Cos t	$4,756,814	$4,631,984	$4,618,991
Difference from Trend Scenario		$(124,830)	$(137,823)
Vehicle Operating Cost—High Estimate			
A.M. Peak Hour Cost	$1,533,219	$1,475,338	$1,477,965
P.M. Peak Hour Cost	$2,092,495	$2,027,874	$2,027,101
Off Peak Cost	$4,698,711	$4,602,760	$4,578,168
Total Daily Cost	$8,324,425	$8,105,972	$8,083,234
Difference from Trend Scenario		$(218,453)	$(241,190)

Value of Time

Everyone values their time. This is one reason why we dislike being stuck in traffic. Regional land use patterns that reduce the amount of time spent traveling in cars offer an important benefit to the citizens of the region. This section of the transportation cost report quantifies this benefit.

Travel model forecasts developed by Bernalillo County include forecasts of the number of hours of daily travel in 2020 associated with each of the scenarios. These estimates are shown in Table 85.

Table 85 2020 Projected Vehicle Hours of Travel by Scenario

	Scenario		
	Trend	**Balanced**	**Downtown**
Daily Hours Traveled			
A.M. Peak Hour	162,701	155,447	163,386
P.M. Peak Hour	234,876	227,044	236,689
Off Peak Hour	341,943	338,074	338,295
Daily Total	739,520	720,565	738,370
Daily Difference from Trend Scenario		(18,955)	(1,150)
Annual Hours Traveled			
A.M. Peak Hour	53,772,681	51,375,234	53,999,073
P.M. Peak Hour	77,626,518	75,038,042	78,225,715
Off Peak Hour	113,012,162	111,733,457	111,806,4 98
Annual Total	244,411,360	238,146,733	244,031,285
Annual Difference from Trend Scenario		(6,264,628)	(380,075)

We can use the daily hours of vehicle travel to calculate the number of hours traveled annually in 2020 by assuming that there will 250 days when the hours of travel are equal to the model estimates and 115 days when the hours of travel will be equal to 70% of the model estimates. These annual hours of travel estimates are also shown in Table 85.

Lastly, we need to apply an estimate of the value of travelers' time. Naturally, people value their time differently. They may value time more highly when traveling to work than when traveling for leisure, for example. It is commonly assumed that a reasonable value for travelers' time is one-half their hourly wage. This is the value used in benefit-cost analyses supported by the United States Federal Highway Administration.

For Albuquerque, we have assumed the value of travel time to be $6.71 per hour, based on one-half the 1997 average wage for the Albuquerque metropolitan area as reported by the Bureau of Labor Statistics and adjusted to current dollars using the Consumer Price Indicator—All Urban Consumers. Multiplying this value of travel time by the annual vehicle hours of travel produces estimates of the user cost of travel time as shown in Table 86.

Table 86 Projected User Cost of Travel Time by Scenario

	Scenario		
Daily	**Trend**	**Balanced**	**Downtown**
A.M. Peak Hour Vehicle Hours of Travel	$1,090,950	$1,042,310	$1,095,543
P.M. Peak Hour Vehicle Hour of Travel	$1,574,901	$1,522,386	$1,587,058
Off Peak Hour Vehicle Hours Traveled	$2,292,812	$2,266,869	$2,268,351
Daily Total	$4,958,664	$4,831,566	$4,950,952
Daily Difference from the Trend Scenario		($127,098)	($7,711)
Annual			
A.M. Peak Hour Vehicle Hours of Travel	$360,559,051	$344,483,579	$362,077,069
P.M. Peak Hour Vehicle Hour of Travel	$520,504,900	$503,148,531	$524,522,660
Off Peak Hour Vehicle Hours Traveled	$757,774,344	$749,200,316	$749,690,071
Annual Total	$1,638,838,295	$1,596,832,427	$1,636,289,799
Annual Difference from the Trend Scenario		($42,005,869)	($2,548,496)

It should be noted that these travel time benefits, on first examination, do not take into account the separately calulated travel time of people using transit. We have previously estimated the number of miles traveled by transit, and the associated costs and benefits. The regional travel model does not have procedures to estimate, in any economical manner, the travel time by other modes. Thus we need another approach for taking these benefits and costs into consideration.

We note that each time a person chooses to take transit, they make their own calculation of the costs and benefits of using that mode relative to other modes. By choosing transit, they implicitly conclude that it offers benefits in excess of costs. While there may be additional benefits to transit users (as well as people who change their mode of travel from auto to pedestrian, for example), we do not estimate or include them here. Rather, we assume, for purposes of this analysis, either that the user's travel time is the same, or that he/she values it the same as they would the trip in the automobile. Therefore the change in automobile hours of travel for each of the scenarios is a reasonable estimate of the total changes in travel time associated with all trips made in 2020 by all modes.

We thus conclude that the Balanced Scenario will afford the region's residents a user travel time benefit of $42,005,869 in the year 2020, compared with the Trend Scenario. The Downtown Scenario will afford a benefit of $2,548,496 in travel timesaving in comparison to the Trend Scenario. We include these benefits in our overall estimate of transportation costs and benefits at the end of this chapter.

Table 87 (pg.190) includes the total public and private transportation operating costs using a range of low and high costs per mile traveled. The annual cost of travel nearly doubles between 1999 and 2020. The annual cost of travel in 2020 includes the cost of the expanded transit system as estimated in the previous section. The range of estimates for the annual cost of travel is between $3.7 billion and $5.0 billion depending on the estimated cost per vehicle mile traveled.

Table 87 Range of Estimates for Annual 2020 Transportation Operating Cost, Public and Private, by Scenario

	Scenario		
	Trend	Balanced	Downtown
Projected Vehicle Miles Traveled			
A.M. Peak	1,447,797,224	1,393,140,688	1,395,621,586
P.M. Peak	1,975,912,758	1,914,892,114	1,914,162,535
Off Peak	4,436,925,484	4,346,320,826	4,323,098,655
Total	7,860,635,466	7,654,353,628	7,632,882,776
Transportation Operating Cost—Low Estimate			
Private A.M. Peak Hour Cost	$289,559,445	$278,628,138	$279,124,317
Private P.M. Peak Hour Cost	$395,182,552	$382,978,423	$382,832,507
Private Off Peak Cost	$887,385,097	$869,264,165	$864,619,731
Public Transit Costs	$25,839,465	$24,609,014	$24,609,014
Private Transit Costs	$11,074,056	$10,546,720	$10,546,720
Private Cost of Time of Travel	$1,638,838,295	$1,596,832,427	$1,636,289,799
Societal Costs	$540,112,328	$525,421,874	$524,168,649
Total	$3,787,991,237	$3,688,280,760	$3,722,190,738
Difference from Trend Scenario		($99,710,477)	($65,800,500)
Transportation Operating Cost—High Estimate			
Private A.M. Peak Hour Cost	$506,729,028	$487,599,241	$488,467,555
Private P.M. Peak Hour Cost	$691,569,465	$670,212,240	$669,956,887
Private Off Peak Cost	$1,552,923,919	$1,521,212,289	$1,513,084,529
Public Transit Costs	$25,839,465	$24,609,014	$24,609,014
Private Transit Costs	$11,074,056	$10,546,720	$10,546,720
Private Cost of Time of Travel	$1,638,838,295	$1,596,832,427	$1,636,289,799
Societal Costs	$540,112,328	$525,421,874	$524,168,649
Total	$4,967,086,557	$4,836,433,805	$4,867,123,154
Difference from Trend Scenario		($130,652,752)	($99,963,403)

The Downtown and Balanced Scenarios cost of travel are approximately 2–3% less than the Trend Scenario. The annual Downtown Scenario cost of travel is estimated to be between $66–$100 million less than the Trend, and the Balanced Scenario is estimated to be between $100–$131 million less than the Trend.

For this analysis, a mid-point between the two estimates, whose value is $0.275 per vehicle mile traveled, has been used. The annual 2020 cost of travel using this value is between $4.38 billion and $4.26 billion. The annual Downtown Scenario cost of travel is estimated to be $83 million less than the Trend Scenario and the Balanced Scenario is estimated to be $115.1 million less than the Trend Scenario (see table 88 (pg.193).

Table 88 Total 2020 Annual Transportation Operating Cost*

	Scenario		
	Trend	Balanced	Downtown
Private A.M. Peak Hour Cost	$398,144,236	$383,113,689	$383,795,936
Private P.M. Peak Hour Cost	$543,376,008	$526,595,331	$526,394,697
Private Off Peak Cost	$1,220,154,508	$1,195,238,227	$1,188,852,130
Public Transit Costs	$25,839,465	$24,609,014	$24,609,014
Private Transit Costs	$11,074,056	$10,546,720	$10,546,720
Private Cost of Time of Travel	$1,638,838,295	$1,596,832,427	$1,636,289,799
Societal Costs	$540,112,328	$525,421,874	$524,168,649
Total Annual Cost	$4,377,538,897	$4,262,357,282	$4,294,656,946
Difference from Trend Scenario		($115,181,614)	($82,881,951)

* Cost at $0.275 per vehicle mile traveled for the year 2020. Intervening years will be proportionally less.

Non-Motorized Travel

It is important to note that some benefits result from implementing either of the compact land use scenarios (the Balanced and Downtown Scenarios) at a geographic scale that eludes measurement in large regional models and cost estimates. In particular, this is true of the mixed-use neighborhoods, corridors and employment centers proposed for the Balanced and Downtown Scenarios. Extensive research has shown that in such places, the following types of travel behavior occur:

1. A reduction in the number of motorized trips
2. An increase in the number of transit trips
3. An increase in the number of non-motorized trips (e.g., walk trips)
4. A reduction in the average trip length for trips of all kinds

Each of these changes has important consequences for air quality, quality of life, and the efficient operation of transportation systems. The following statistics illustrate the potential impacts of these changes in urban form and urban design on future travel in Albuquerque. All are from well-recognized research studies recently conducted around the United States.

- In a study of neighborhoods in the San Francisco area (Cervero and Kockelman), researchers found that for each 10% point increase in neighborhood density, there was an increase of 4% in the use of modes other than the auto for work trips.
- In the same study, the authors concluded that pedestrian oriented designs, such as buildings that front on the street, rather than being pulled back and replaced by parking, reduces automobile dependence for trips other than work trips. Specifically, for each 10% point reduction in the proportion of businesses with parking in the rear (rather than in the front or side of their store), there was an 11% increase in the probability of travel by non-auto modes for these trip purposes.

- Comparable findings have resulted from work in Seattle (Frank and Pivo), where neighborhood population density increases of 10% are associated with increases of 17% in walk trips for shopping, and 11% increases in walk trips to work.
- Studies of the effects of street design have shown that traditional, connected street networks are associated with dramatic declines in auto travel (Kulash et al. 1990). Where neighborhood streets are connected in a traditional grid, miles traveled for local trips has been shown to decline by 43% over what would occur with the contemporary patterns of cul-de-sacs and wide arterials, such as prevails on Albuquerque's West Side.

The Albuquerque region will have 236,000 pedestrian trips per day in the year 2020, according to the Bernalillo County Public Works Department. These numbers will increase significantly under either of the compact scenarios, for the reasons described.

All of these studies demonstrate the clear benefits of compact, mixed-use, pedestrian friendly corridors and centers. These benefits are in addition to those quantified in the regional analysis above. The changes in neighborhood travel patterns will not only save auto operating costs, but also offer the benefits of improved air quality by eliminating the pollution caused by operating a car at cold engine temperatures, with associated inefficient fuel use. We describe air pollution costs more fully in the section that follows.

4.5.8 Air Pollution Cost of Travel

The full cost of travel estimates should include the environmental or social costs associated with driving. This section is intended to illustrate the magnitude of these costs in the Albuquerque urban area (Table 89).

Substantial research exists on this issue and numerous estimates of these costs have been developed. A frequently quoted source is Transportation Cost Analysis (Litman 1995). In that report the author determined that the best estimate of the cost of air pollution is $0.08 per peak hour vehicle mile traveled and $0.06 per non-peak hour vehicle mile traveled. Using these cost estimates, one can easily estimate the 2020 annual cost of air pollution associated with travel as shown in the table below. As shown in this table, the cost of air pollution would be in excess of $500 million per year. The Downtown and the Balanced Scenarios have annual costs that are approximately 5% lower than the Trend Scenario.

Table 89 2020 Annual Cost of Air Pollution Associated with Vehicular Travel

	Scenario		
	Trend	Balanced	Downtown
	(millions)		
A.M. Peak Hour Cost	$116	$107	$108
P.M. Peak Hour Cost	$158	$149	$149
Off Peak Cost	$266	$261	$259
Total Cost	$540	$516	$516
Difference from Trend Scenario		$24	$25

Estimates based on projected vehicle miles traveled. Urban Peak $0.08 per vehicle mile traveled and Non Peak $0.06 per vehicle mile traveled.
Source: Transportation Cost Analysis, Todd Litman, Victoria Transportat ion Institute.