3. Geological and Soil Conditions

Flows of basalt at varying depths and widths run through the Plan Area. Six lava flows have been identified that issued from volcanic fissures related to the subsidence of the Albuquerque basin approximately 190,000 years ago. (See **Exhibit 7, *Lava Flows***) Successive flows decreased in temperature and increased in viscosity. Superimposition of the flows can be seen in the Geologic Windows.

According to the National Park Service report, *Albuquerque West Mesa Petroglyph Study*, June 1987, "Soil has formed on West Mesa as the rocks have slowly weathered. The common parent materials are basalt and fine alluvial silt and sand. Sand is common in this environment and, if not part of the parent rock, is soon added by the wind. On the mesa top, soil varies in depth from 0 on the escarpment rim and volcanic cones to more than 5 feet in broad areas of little slope." Generally in the western portions of the Plan Area at higher elevations closer to the volcanic cones, soil is thinner and basalt is closer to the surface.

Soil conditions are mapped on **Exhibit 8, *Soil Series*** using information from the *Northwest Mesa Escarpment Plan* (NWMEP). Information regarding geology and soils was obtained from the Soil Survey of Bernalillo County and Parts of Sandoval and Valencia Counties as cited in the NWMEP.

According to the NWMEP, four types of soils overlie the basalt along the upper edge of the volcanic escarpment and mesa. As shown on the map, the predominant type is Alameda sandy loam at 0-5% slopes. Moderately deep and well drained, runoff is medium and water erosion is slight. The second most prevalent soil type is Madurez-Wink, which is deeper, well drained and gently sloping. Wind erosion is moderate to severe. Akela-Rock outcrop at 1-9% slope occurs near the escarpment edge and in the western portion of the Plan Area. It is a cobbly sandy loam, with a shallow depth to bedrock. According to the NWMEP, the underlying basalt is exposed throughout 20% of this complex. Runoff is very rapid and water erosion moderate.

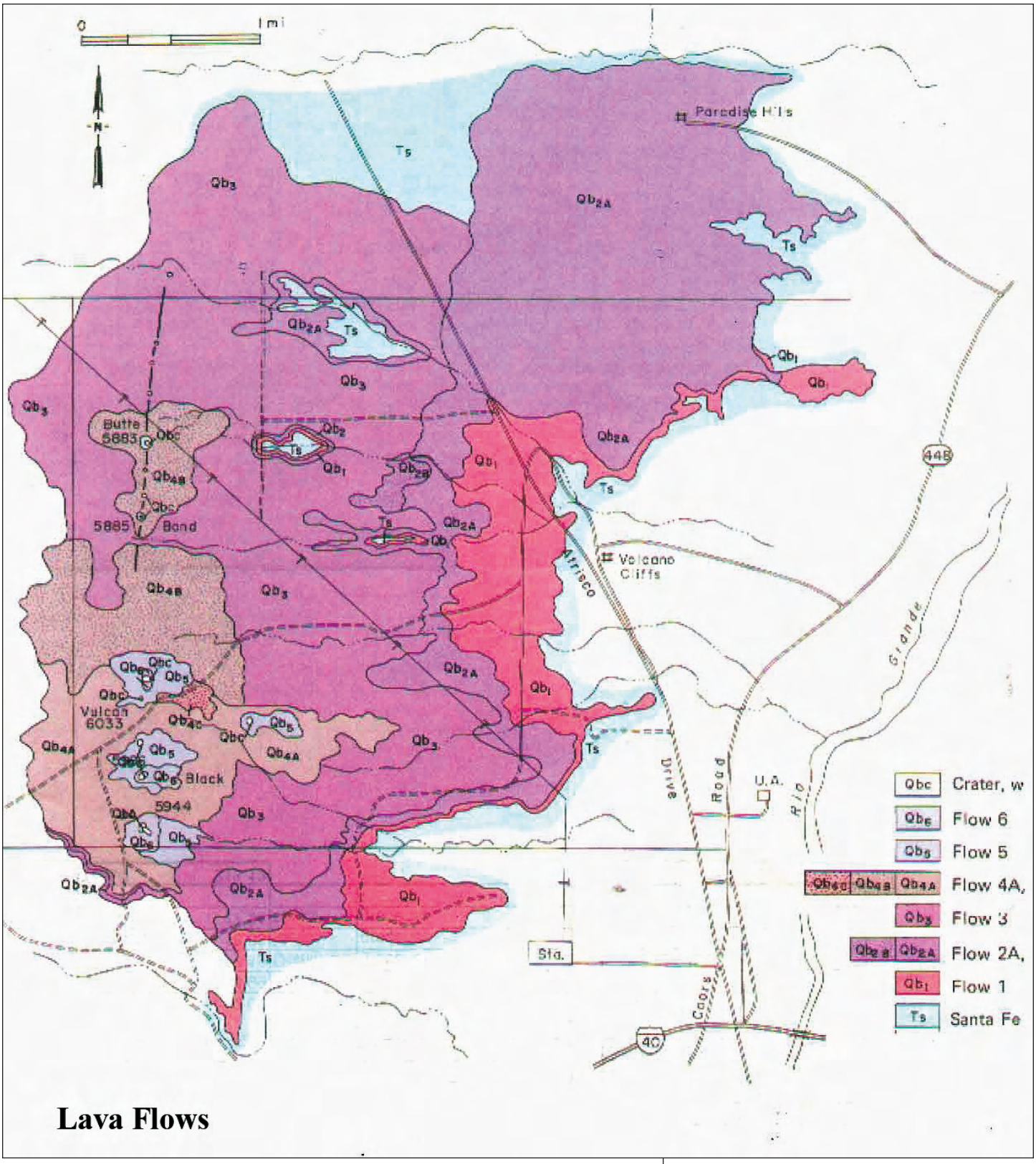
The Kokan-Rock outcrop association characterizes the face of the volcanic escarpment and the area within and surrounding the Northern Geologic Window. Basalt boulders cover 40% of the escarpment face. Runoff is rapid. Shallow depth to bedrock, steep slopes, small stones, and inability to maintain cut slopes in the outcrop severely limits use of the complex for excavations and dwellings.

Much of SAD 227 consists of Latene sandy loam at 1-5% slopes. This soil type is comparatively deep and well drained. Engineers describe conditions of approximately two feet of soil in this area that needed little fill.

Development and Engineering Considerations

Retention of the natural landscape is a key goal of this Plan and of previously adopted City policies. Importing large amounts of fill, as developments in the area have done, is not a desirable solution because this type of treatment masks the natural terrain and geological conditions that make the area unique, desirable, and of value to residents and the larger community.

Surface water. According to the NWMEP, "Mesa top soils impose certain constraints on development. Vertical joints along the rim of the escarpment are planes of weakness,



Lava Flows

Exhibit 7
Lava Flows

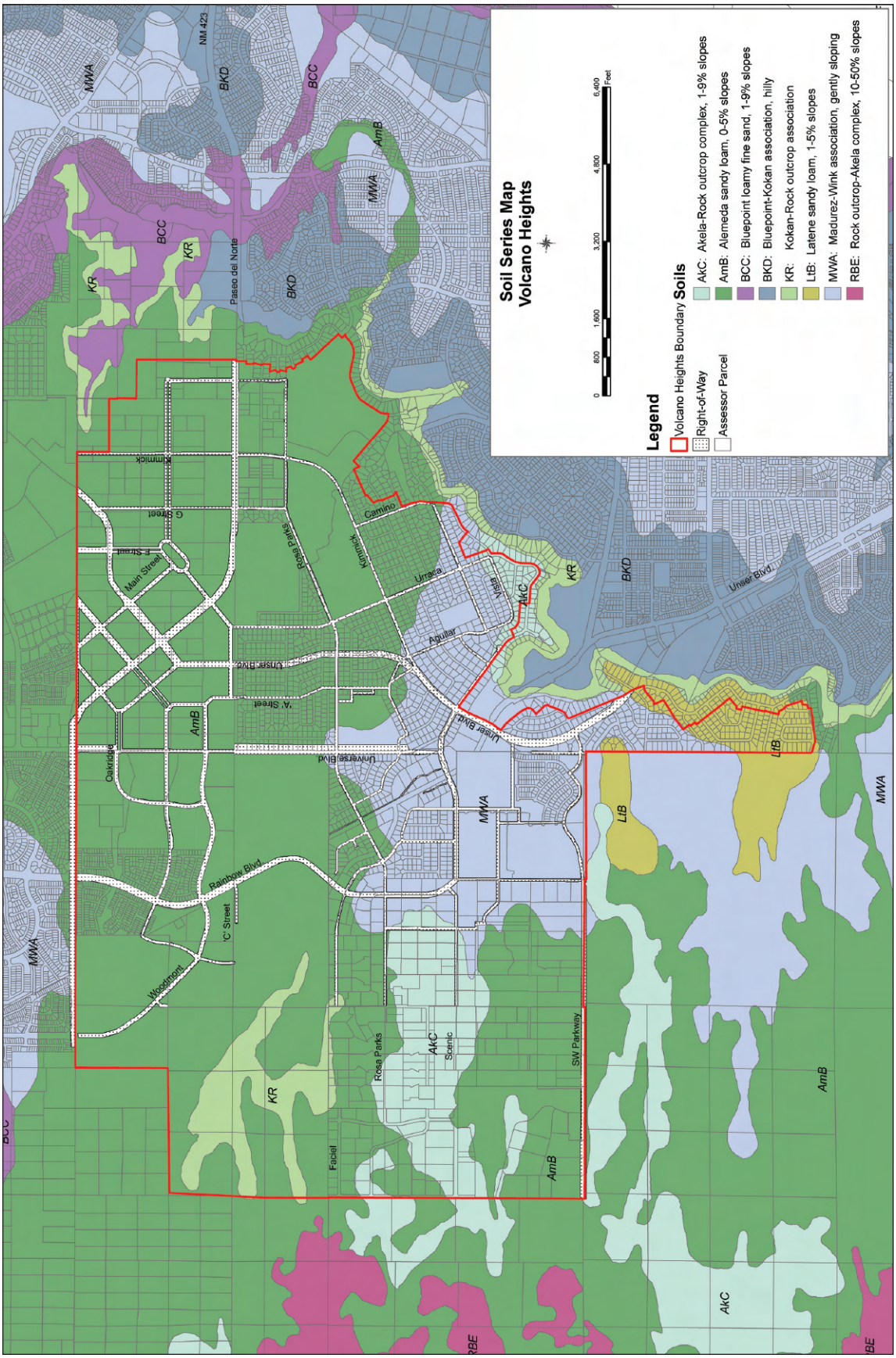


Exhibit 8
Soil Series

and as the soft sediments below the basalt are weakened by water passing down the joints, blocks of rock detach and roll down the slope. This instability would be increased by indiscriminate use of explosives and by utility line trenches channeling surface water into the joints. Care should be taken in the use of explosives and in trenching for utility lines to avoid channeling surface water into the joints. Back from the rim where the soil is deep enough to bury utility lines without disturbing bedrock, development would have less impact and would be less costly. An additional problem is low soil density and therefore low bearing strength. To correct this problem, the soil should be precompacted before constructing streets and building foundations."

Depth of soil / depth to basalt. Engineering firms familiar with development in the area describe depth of soil as tremendously variable, ranging from areas where the basalt is exposed, areas with intermittent rock, and areas that have several feet of soil.

Interviews with engineering firms that have experience with development in the Plan Area also indicated that the first layer of basalt—up to five feet in depth—is fractured and porous and can normally be excavated with earth moving equipment. The deeper layer of solid rock requires blasting or trenching.

Trenches about 5 feet in depth and 4 miles in length were dug to place water and sewer lines between the water reservoir and pump station on the east side of the Plan Area to Double Eagle II airport on the west side. The consultant engineer reported that basalt was found in about 70-75% of this reach. He estimated that about 20% of the length was friable and the remaining 50% was solid basalt.

Cost of trench excavation. In much of the Plan Area, trenching will be required for utility extensions. A special diamond-tooth trencher has been used successfully to trench through hard basalt layers where necessary. Utility trenches are about 5 to 5 1/2 feet in depth.

Utility lines were laid in trenches along the roads within SAD 227, excavated by blasting. These costs were included in the Special Assessment District charges, which net assessments averaged $32,000 per parcel (total land development cost including all utilities, soft costs, etc.).

Costs are variable depending on the strength and depth of the basalt and the continuous or discontinuous nature of the trenching work. The cost for the Double Eagle II trenches was $15 to $20 per lineal foot. These costs were incurred in 2003. The cost to trench a small reach through solid basalt near the Escarpment was estimated as $80 to $100 per lineal foot. A local engineer provided an average cost at about $35 to $50 per lineal feet for a large scale project associated with digging trenches for an entire subdivision.

More detailed engineering analysis of soil conditions should precede detailed plans (subdivision plats, Special Assessment Districts, Private Infrastructure Districts, master plans for activity centers, etc.). General soil testing, including depth to bedrock, should provide information useful to contractors and city engineers concerned with the expense of installing utilities.

4. Treatment of Natural Features

Drainage Channels

The Monument and affiliated City open space create a major natural ecosystem for Albuquerque. At the heart of the ecosystem are the Boca Negra / Mariposa arroyos, making up a 21 square-mile watershed. **Exhibit 9, *Parks and Natural Drainages*** shows the natural arroyos and drainage systems traversing the area. The watershed is generally bounded by the Calabacillas Arroyo basin on the north and the San Antonio arroyo basin on the south. The developed watershed channel extends to a small area below the escarpment and into the Mariposa Detention Basin.

The AMAFCA master plan for stormwater drainage provides for a regional detention basin at Unser and Universe, but does not detail all stormwater facilities. **Exhibit 10, *Stormwater Infrastructure*** shows the constructed drainage facilities. While some of the area's stormwater runoff will need to flow to engineered pipes and channels, some parts of the different Boca Negra arroyos courses can continue to act as natural drainage facilities. The arroyos may function as stormwater facilities so long as the preserved swath is wide enough to carry 100-year flows. In addition, AMAFCA requires management and maintenance of the arroyos so that no alterations reduce the flow capacity the arroyos have been planned to carry.

Drainage channels have played an important cultural role for prehistoric communities, connecting ceremonial sites on the volcanic mesa through the Escarpment to former Pueblo villages along the Rio Grande.

While the key geologic and cultural features have been set aside as public open space, urbanization around these wilderness areas will dramatically change them. Urbanization that disconnects or destroys the interconnected arroyos and rivers reduces the viability of plant and animal species. Preserving the arroyos not only maintains the richest habitat, but also the very features that ecologically link the largest expanses of open space to each other. To the east, the ecosystem is largely cut off in Taylor Ranch. However, to the west, the opportunity still remains to link the ecosystem to the Rio Puerco wilderness.

The open space that exists within and adjacent to the Plan does not have a fully developed formal trail system that links open space into a consolidated network. Under current plans, drainage channels are not being used to their potential as walking and biking trails that could link the natural open areas.

Open Space Edge Treatment

The Monument has miles of edge and adjacent private lands are in a natural state. Currently people access the open space anywhere along the edge and can take in exceptional views of the volcanoes, the Rio Grande valley and the Sandia Mountains, much as people have done for thousands of years. New development could block this physical access and the views, greatly reducing the value of the open space amenity to the public at-large. The open space is best preserved as a public amenity by designing scenic trails and roads along open space edges. Design standards for developments built adjacent to the open space edge will help to achieve visual harmony with the high desert landscape.

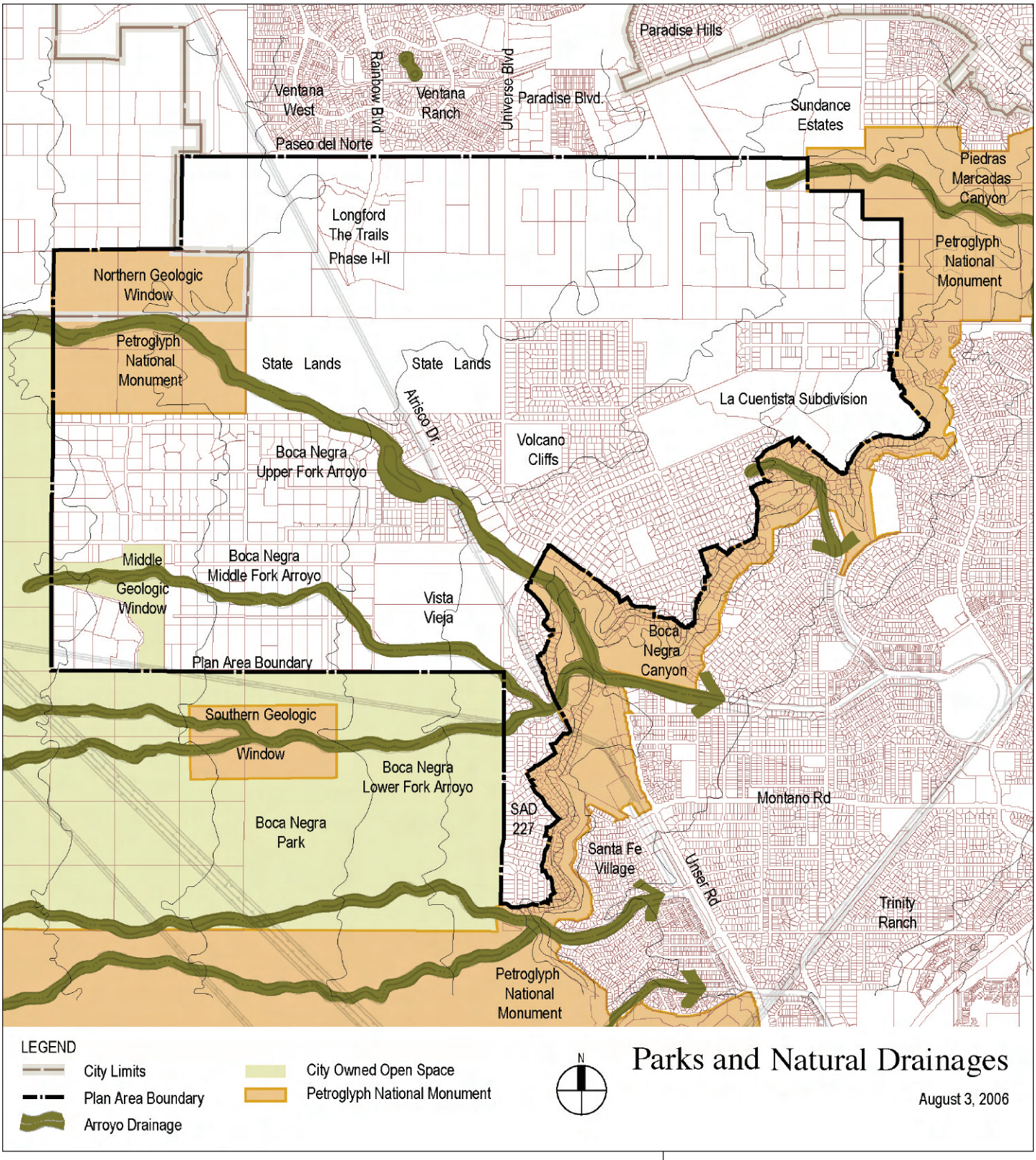


Exhibit 9
Parks and Natural Drainages

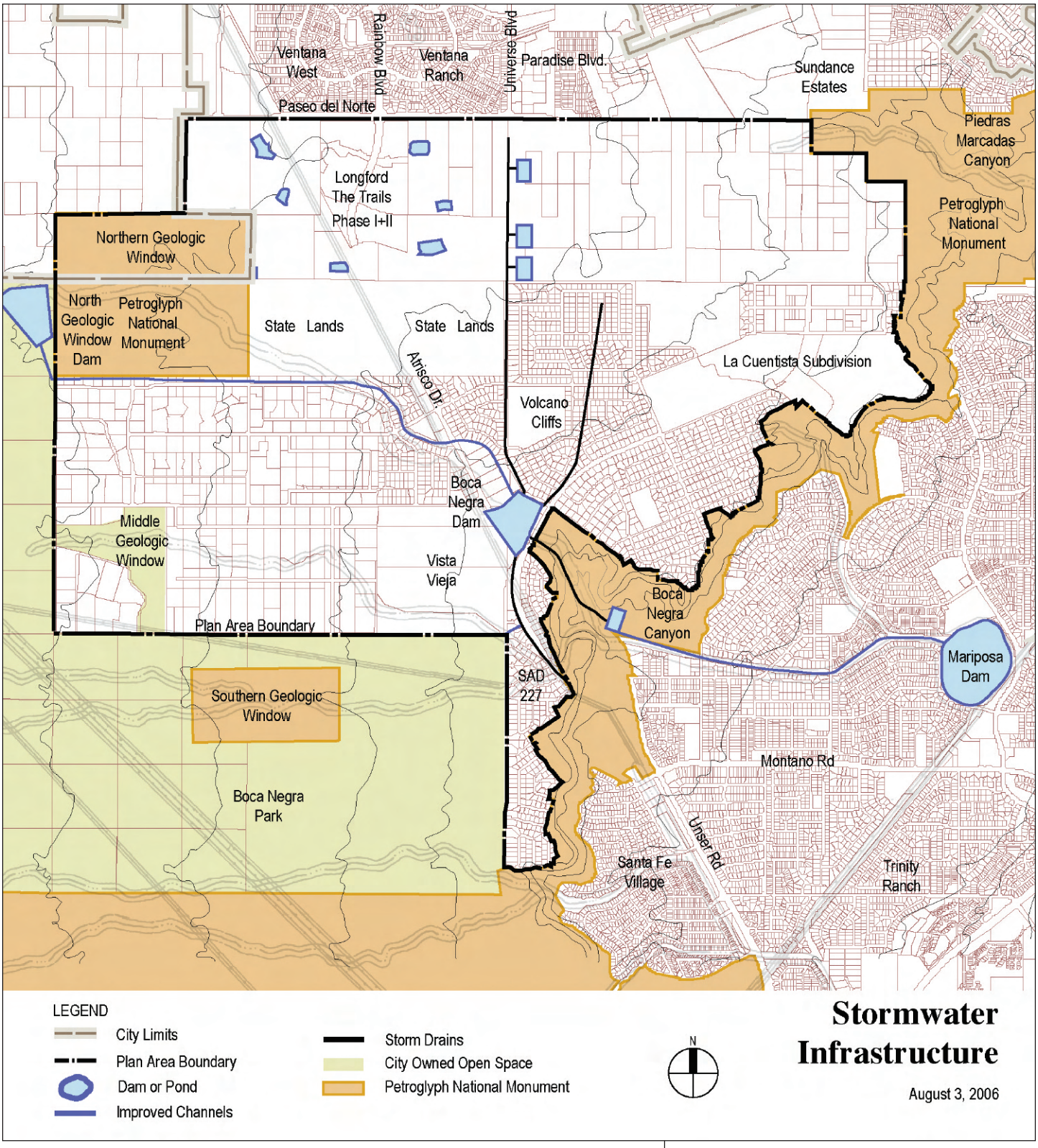


Exhibit 10
Stormwater Infrastructure

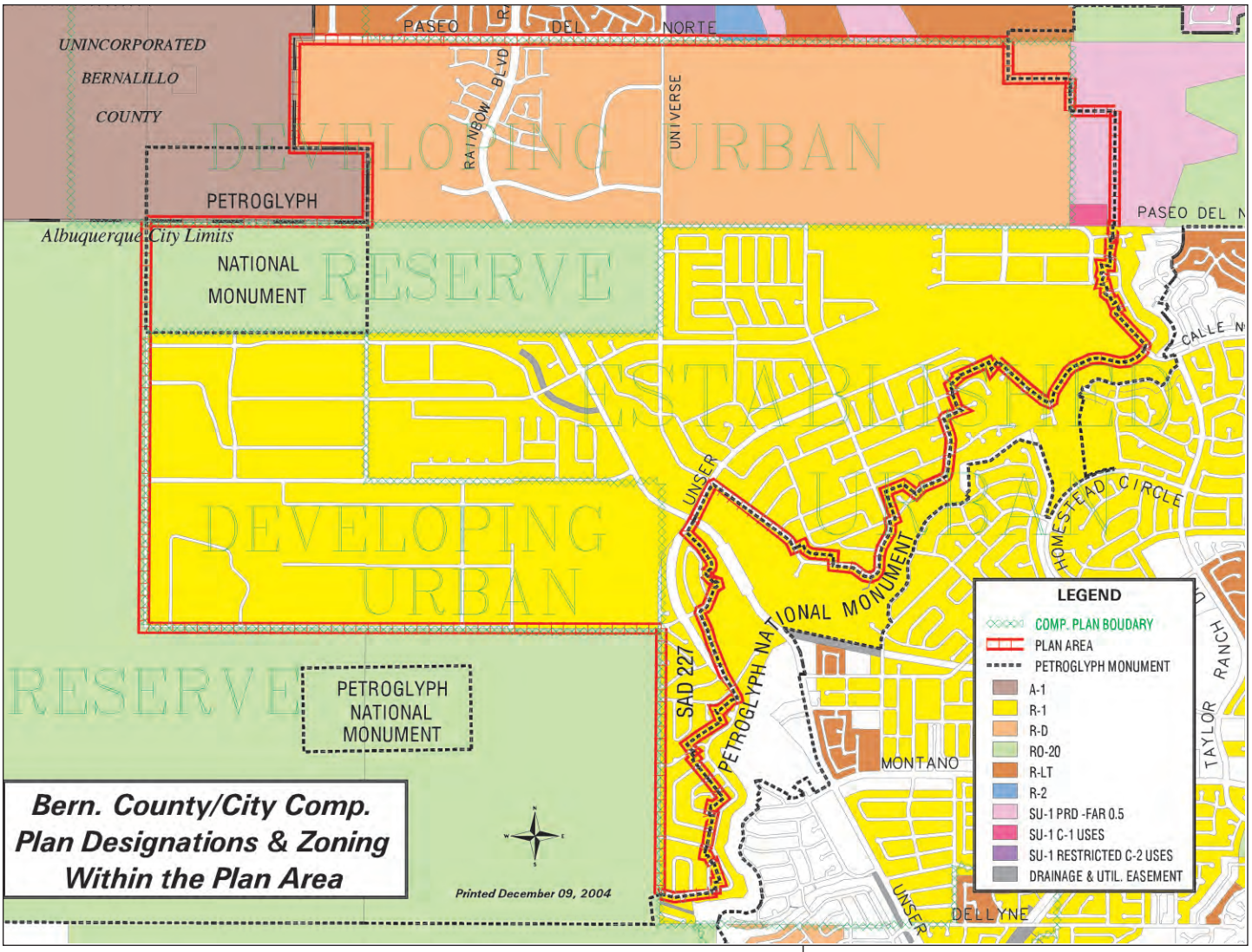


Exhibit 11
Comprehensive Plan Designations and Zoning

5. Platting and Zoning

Between the northernmost volcanoes and the escarpment lie approximately 1700 small vacant lots in a subdivision platted in the 1960s known as "Volcano Cliffs." These lots were sold to individual investors during the 1960s and '70s according to a 1967 master plan, and in 1981 the City annexed the Volcano Cliffs subdivision. Approximately 1400 of these lots are under 1 acre in size.

The Plan Area, consisting of more than 3500 acres, is zoned almost entirely for single-family development (R1 and RD) at average suburban densities of 5 dwelling units per acre. R1 is the underlying zoning for Established Urban areas designated in the Comprehensive Plan and RD is the underlying zoning for Developing Urban areas. (See **Exhibit 11, *Comprehensive Plan Designations and Zoning.***) Re-zoning from R1 or RD to RLT is often sought by single-family residential developers in order to obtain more flexibility in lot sizes and greater density. For the RD zone, townhomes are permitted if a site development plan is approved by the Planning Director. Inclusion of multi-family or commercial uses requires a full sector development plan, but the amount of commercial cannot exceed 15% of the RD zone covered by the sector plan.

6. Water Utilities

Many small landowners in the Volcano Cliffs subdivision have held their property for 30-40 years, relying on platting executed in 1967 and anticipating that the City of Albuquerque would provide services. However, the basalt layer covering the volcanic escarpment and the expense of extending utilities above the escarpment have until now discouraged the area's development.

The City of Albuquerque in its 1997 Decade Plan identified a need and intention to construct a water pump station and associated transmission line to provide water service to areas identified as Volcano Trunk Zones 3WR/4W. (See **Exhibit 12, *Water Pressure Zones***) In 1998, the city approved a development agreement (EC-35) that authorized a water pump station to be constructed above the escarpment. The pump station was paid for by property owners, to be reimbursed with enterprise fund development fees over time as other projects are connected. EC-35 set conditions and requirements to be met by future developers in order to receive water services through connection to the pump station.

Construction of the water facility has provided water availability to serve development in the Volcano Cliffs area. According to a 2003 design analysis performed by Wilson & Company, expansion of the existing pressurized system (closed loop system) installed pursuant to the 1998 agreement can serve up to 5,200 dwelling units above the escarpment, with 2,800 units for zone 3WR and 2,400 units for Zone 4W. Pressure reduction valves are required for the units in 3WR. (The decision to connect the high school currently being designed within the Plan Area will reduce the number of dwellings that can receive water service.)

According to the Albuquerque / Bernalillo County Water Authority's Utility Development Section, the closed loop 4W/3WR system should be considered as a temporary interim system until the Water Authority can construct a permanent 4W/3WR reservoir in accordance with the Water Master Plan. At such time that approximately 3000 dwelling units have been developed, the amount of utility charges collected and contributions from development agreements should be adequate to fund the reservoir. The pump station and closed loop system will serve the entire 5200 units, but its energy use will be high and not very cost effective. With the reservoir, the cost of pumping will be reduced.

In order for urban services to be provided in Zone 5, another pump station will be needed to create a pressurized system in that zone.

New Mexico Utilities, a privately owned utility company, provides water service and wastewater collection to the large Longford Homes subdivision now being developed south of Paseo del Norte and to other areas north of the service boundary of the Albuquerque / Bernalillo County Water Authority.

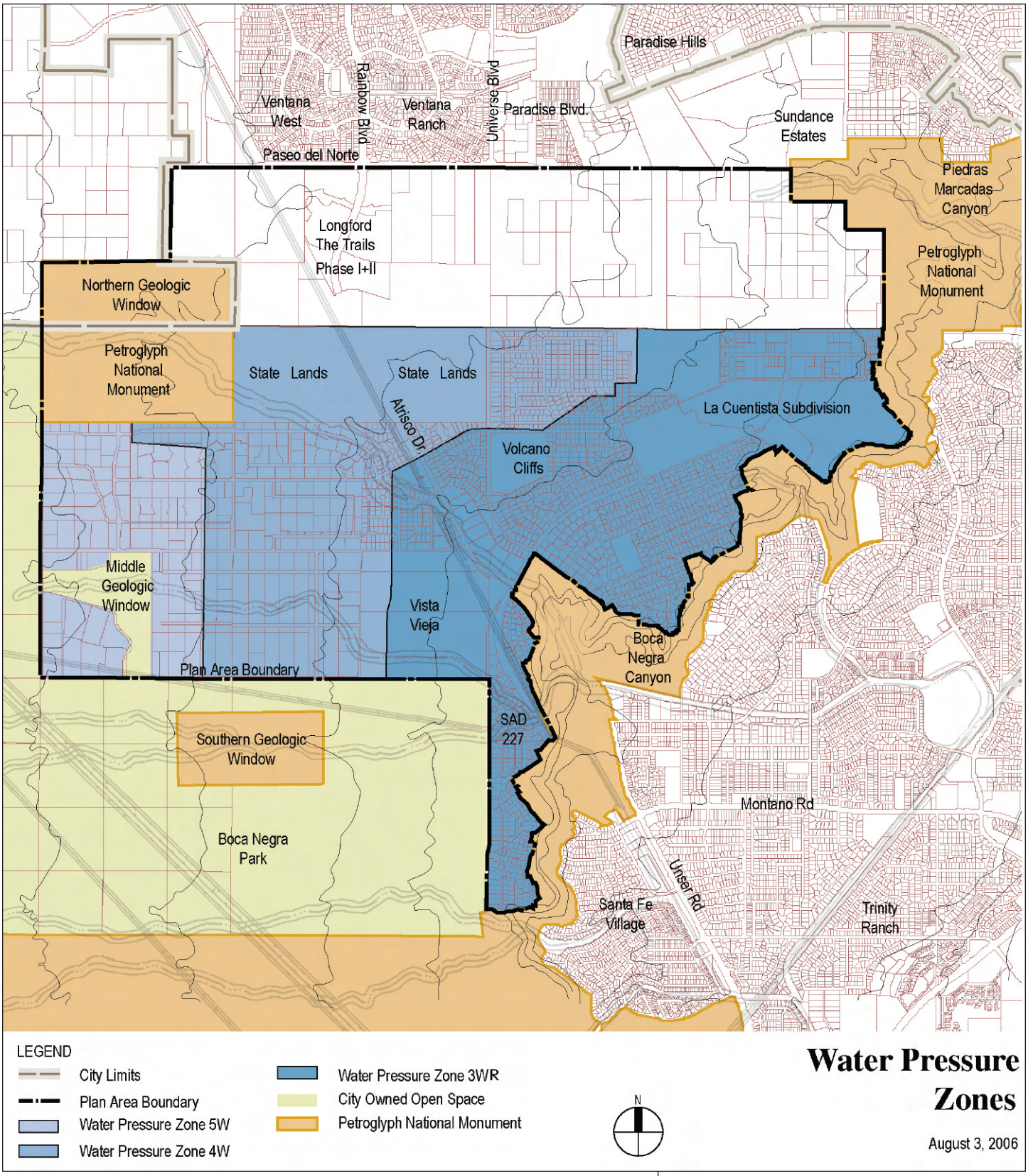


Exhibit 12
Water Pressure Zones

7. Development Trends

The promise of water service has enabled property owners and developers to begin the development process pursuant to current residential zoning. Recently, small property owners have begun to cooperate in assembling land for subdivisions, paying over time for local infrastructure—roads, water, sewer and hydrology service—through special assessments. In 2002 property owners petitioned and formed SAD 227 and development is beginning in Units 2, 5 and 24. Property owners are interested in continuing the process of private assembly to create additional SADs for areas within the Volcano Cliffs subdivision north of SAD 227.

In many other areas developers are actively acquiring contiguous tracts and developing master plans. Longford Homes, Vista Vieja and La Cuentista are examples of subdivisions approved or in the approval process with the City of Albuquerque. The La Ventana subdivision is in the development review process with Bernalillo County.

Table 1
Trend Scenario Assumptions*
(All figures are approximate)

Use	Average Gross Density	Dwelling Units
Current Subdivisions	4.5 du/ac	3,800
Volcano Cliffs Lots under 1 acre		1,400
Mixed Use (new)	12 du/ ac	1,700
Urban Residential (new)	12 du/ ac	2,300
Suburban Residential (new)	4.5 du/ac	2,800
Total Units		12,000

*Source: Taecker UDP

Table 1, *Trend Scenario Assumptions* show that the expected total build-out for the plan area under current zoning, including the four subdivisions, the individual platted lots and the commercial areas adjacent to Paseo del Norte and Unser, is roughly 12,000 dwelling units.

Of the 3,800 dwelling units planned for current subdivisions, 2,700 are already "in the pipeline" with vested development rights, according to the City of Albuquerque, and are exempt from development moratoriums. (See **Exhibit 2, *Built or Approved Projects***) A population of over 30,000 residents within the plan area is projected under current zoning.

Adjacent development

Directly to the northwest lies Quail Ranch, a major development currently within the City of Rio Rancho. Zoning for Quail Ranch consists of approximately 53% single-family residential (3.5-6 DU/acre), 5% estate residential (1 DU/acre), 4% multi-family residential (20 DU/acre), 15% commercial and light manufacturing, 15% open space, and 8% public facilities. The future development of Quail Ranch and the current and future development of Ventana Ranch together result in approximately 75,000 additional residents, for a total population of 107,000 within and directly impacting the plan area.

Considerations

Single-family residential subdivisions are the pattern for new development in the study area. Not only is there an immediate market for homes, the current single-use residential zoning prohibits integrating a mix of other uses which could make neighborhoods more walkable and convenient (e.g. neighborhood services) by requiring an extra step in the city approval process—preparation of a sector plan for anything other than suburban residential development. Under the current zoning, it is certain that a desirable jobs / housing balance will not be achieved.

Table 2
Employment Deficits Under Different Alternatives
(All figures are approximate)

	Units	Population	Workforce need 1.25/unit	Jobs provided	Job deficit or Surplus	Commercial sq ft
PIPELINE PROJECTS	2,700					
Plan Alternatives*						
TREND	12,000	30,000	15,000	2,000	(13,000)	1,000,000
TOWN CENTER	12,000	30,000	15,000	18,000	+3,000	5,000,000
VILLAGE	8,000	20,000	10,000	500	(9,500)	350,000
Impact Projects NW of Plan Area						
VENTANA RANCH	5,000	13,000	6,000	500	(5,500)	na
QUAIL RANCH	23,000	62,000	29,000	23,000	(6,000)	na
NW Totals	28,200	75,600	35,000	23,500	(11,500)	
TREND TOTALS for Plan Area and Vicinity	40,200	105,600	50,000	25,500	(24,500)	

* The Alternatives are described in III Planning Process, 2 Land Use Scenarios below.

Assuming a workforce need of 1.25 jobs per dwelling means a deficit of 13,000 jobs within the Plan Area under current trends. (See **Table 2, *Employment Deficits Under Different Alternatives***) Including the major Quail Ranch and Ventana West developments to the northwest, which are zoned for approximately 23,500 jobs, there is still a deficit of around 24,000 additional jobs needed to provide an adequate job base serving the anticipated population of the plan area and vicinity.

Build-out exclusively with single-family residential subdivisions will increase jobs / housing imbalances on the West Side, adding to traffic demands and increasing the burden on West Side and east-west transportation systems. Without adequate provision of employment, greater trip internalization, and more emphasis on transit-supportive land uses and road systems on the West Side, traffic congestion and demand for expanded river crossings will increase.

8. Transportation and Transit

Portions of Unser Boulevard, Atrisco Drive, Universe and the western segment of Paseo del Norte are the only primary paved roads presently serving the Plan Area. Major roadway improvements are anticipated by the Albuquerque Metropolitan Planning Area's (AMPA's) ***Long Range Roadway System*** shown on **Exhibit 13**. Most notably, extensions to Unser Boulevard and Paseo del Norte (PdN) are planned for completion by 2011, but not in the configuration shown in the VHSDP. AMPA defines Unser and PdN as "limited access roadways" designed to carry high volumes of regional traffic. To maintain travel speeds, intersection spacing would be restricted. Construction on the segment of Unser that moves up the escarpment from the south has been completed.

Increasing regional traffic demands have occurred against a backdrop of rapid suburban growth and increasing travel. In 1970, per capita vehicle-miles traveled were 12.4 miles per day (per Albuquerque Metropolitan Planning Area); by 2000, per capita vehicle-

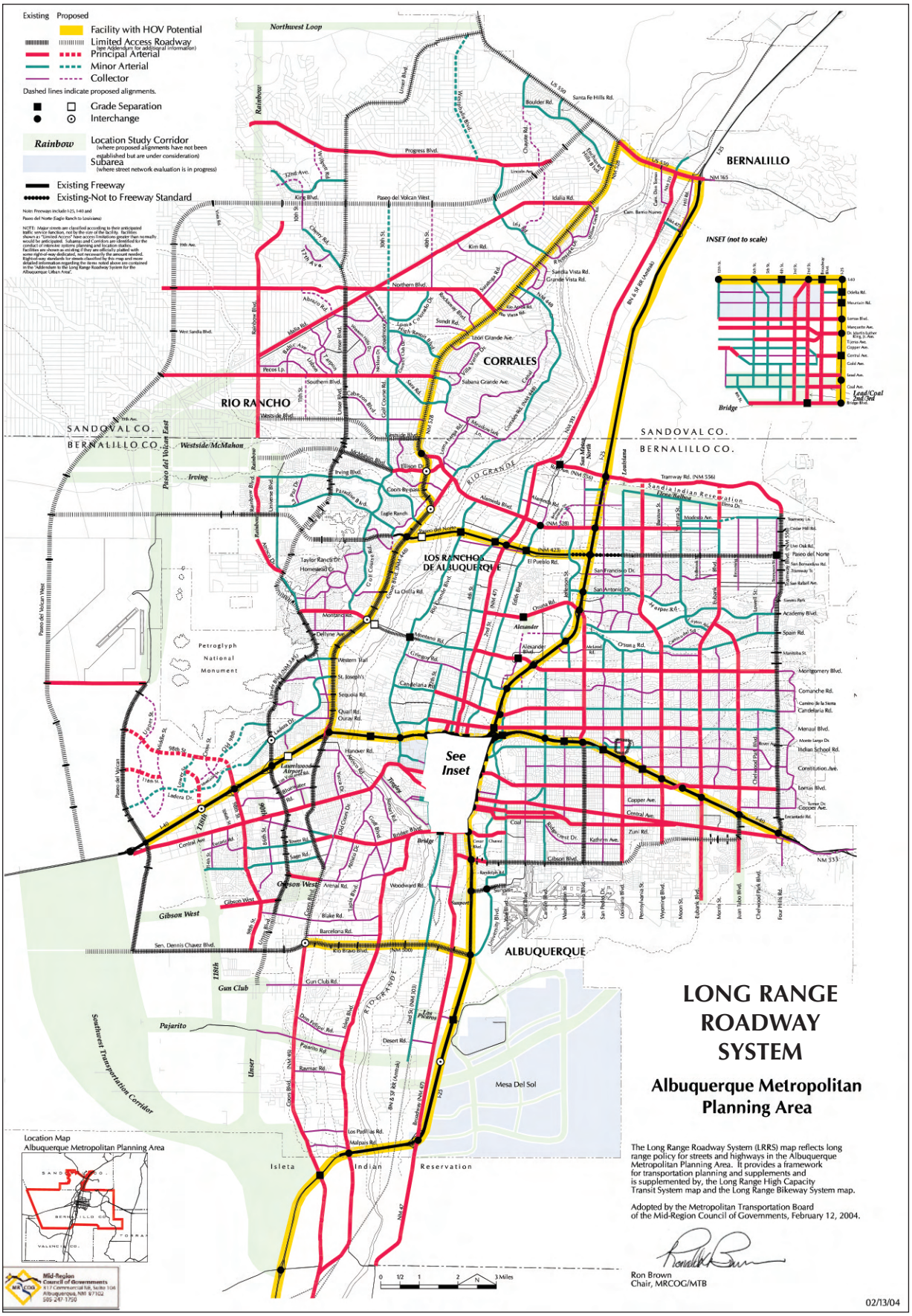


Exhibit 13
Long Range Roadway System

miles had increased to 20.9 miles per day—an increase of 69%. As seen in other metropolitan areas, much of this increase in car travel is attributable to spreading low-density growth, where destinations are spread farther out and walking to destinations is increasingly difficult.

Regional Impacts

Transportation impacts from Volcano Heights development have raised concern among public decision-makers, government agencies, and citizens. The West Side arterial network is strained, with points of frequent congestion on Coors Boulevard, the only continuous north-south arterial currently built west of the Rio Grande. Congestion has increased on many river crossings, most notably on Montaño. Many workers on the West Side must commute to job centers east of the river.

City and regional transportation planners are looking to the planned extensions of Unser and Paseo del Norte (PdN) to alleviate congestion on the West Side, although arterial connections will remain constrained at the Rio Grande and across the Monument escarpment. Near the plan area, Albuquerque, Rio Rancho and Bernalillo County have approved many projects that are moving forward. Low density, single-family residences dominate nearly all of this new growth. Little employment growth has been planned, further contributing to an imbalance of jobs and housing on the West Side, and even greater pressures on the road system.

Transit

Coors Boulevard is designated as the main west side corridor for High Capacity Transit on the MRCOG ***Long Range High Capacity Transit System*** map (**Exhibit 14**). The Albuquerque-Bernalillo County Centers and Corridors Plan shows Unser as an Express Corridor appropriate for limited stop service from Rio Bravo to McMahon north of the plan area. This regional plan designates Unser as a major north-south route, ultimately connecting I-40 to Rio Rancho on the north. The Volcano Heights Plan calls for amendment of this regional plan to provide more detail on high capacity transit routes.

City and regional transportation authorities are considering the establishment of a network of Bus Rapid Transit (BRT) and/or Rapid Bus routes. BRT routes leave open the flexibility of evolving to dedicated lines for light rail in the future. Both BRT and Rapid Bus seek to improve transit travel times to make transit a convenient, sometimes faster, alternative to travel by car. Both BRT and Rapid Bus rely on "signal preemption" that quickly provides buses with a green light at intersections. They also focus on ways to speed boarding by pre-paying fares and platform / bus designs. BRT also provides dedicated lanes for buses and carpoolers, which allow buses to bypass congested traffic, whereas Rapid Bus service mixes with regular traffic. While supportive of the concept, City and regional transportation authorities have not developed guidelines for roadways with dedicated BRT lanes.

Bikeways

Exhibit 15 shows the adopted ***Long Range Bikeway System*** map for the Albuquerque Urban Area. The map shows bike trails along Unser, Paseo del Norte and Rainbow Blvd. The VHSDP recommends amendment of the Long Range Bikeway System. (See Section II.7 "Bicycle Trail Network".)

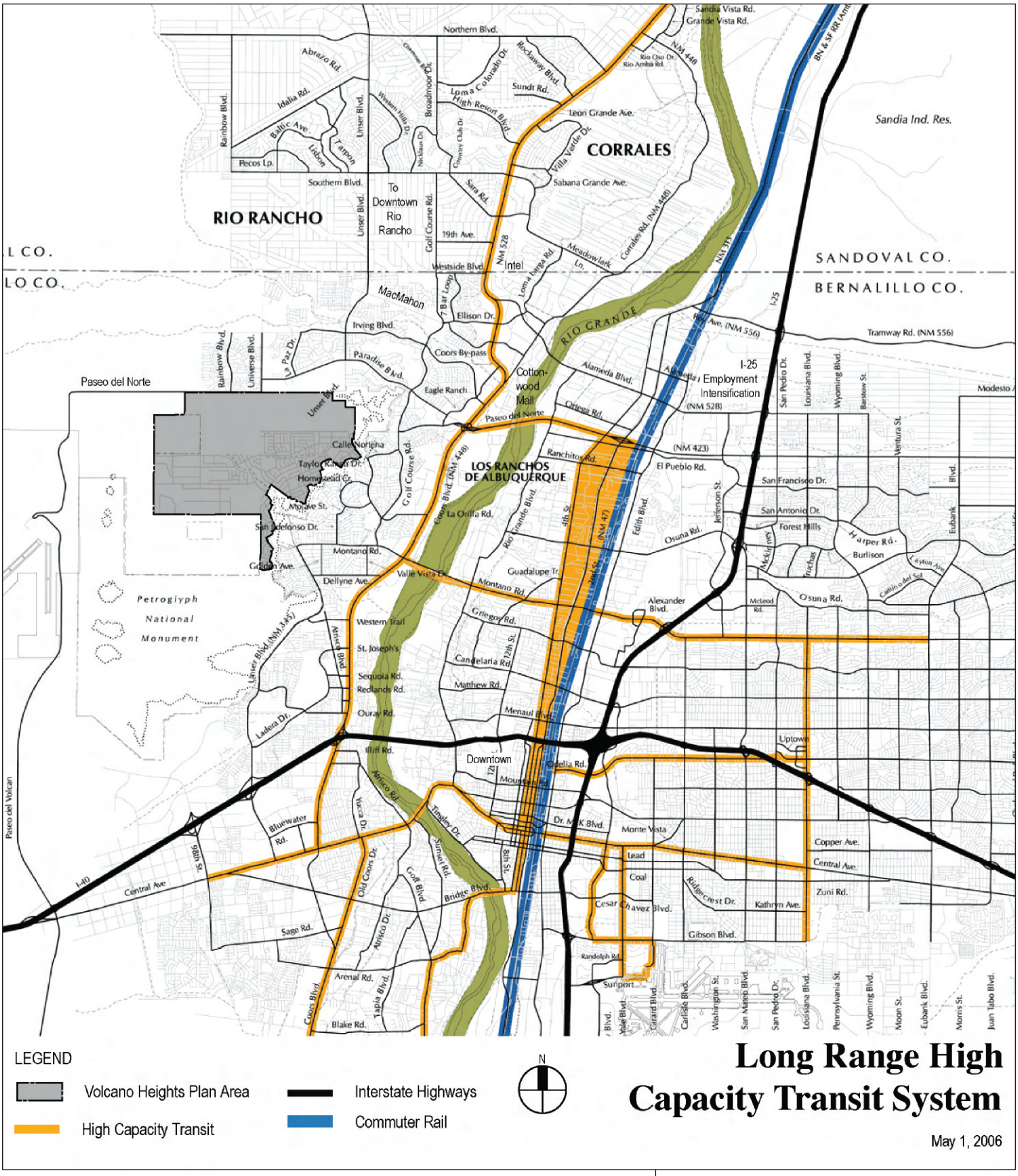


Exhibit 14
Long Range High Capacity Transit System

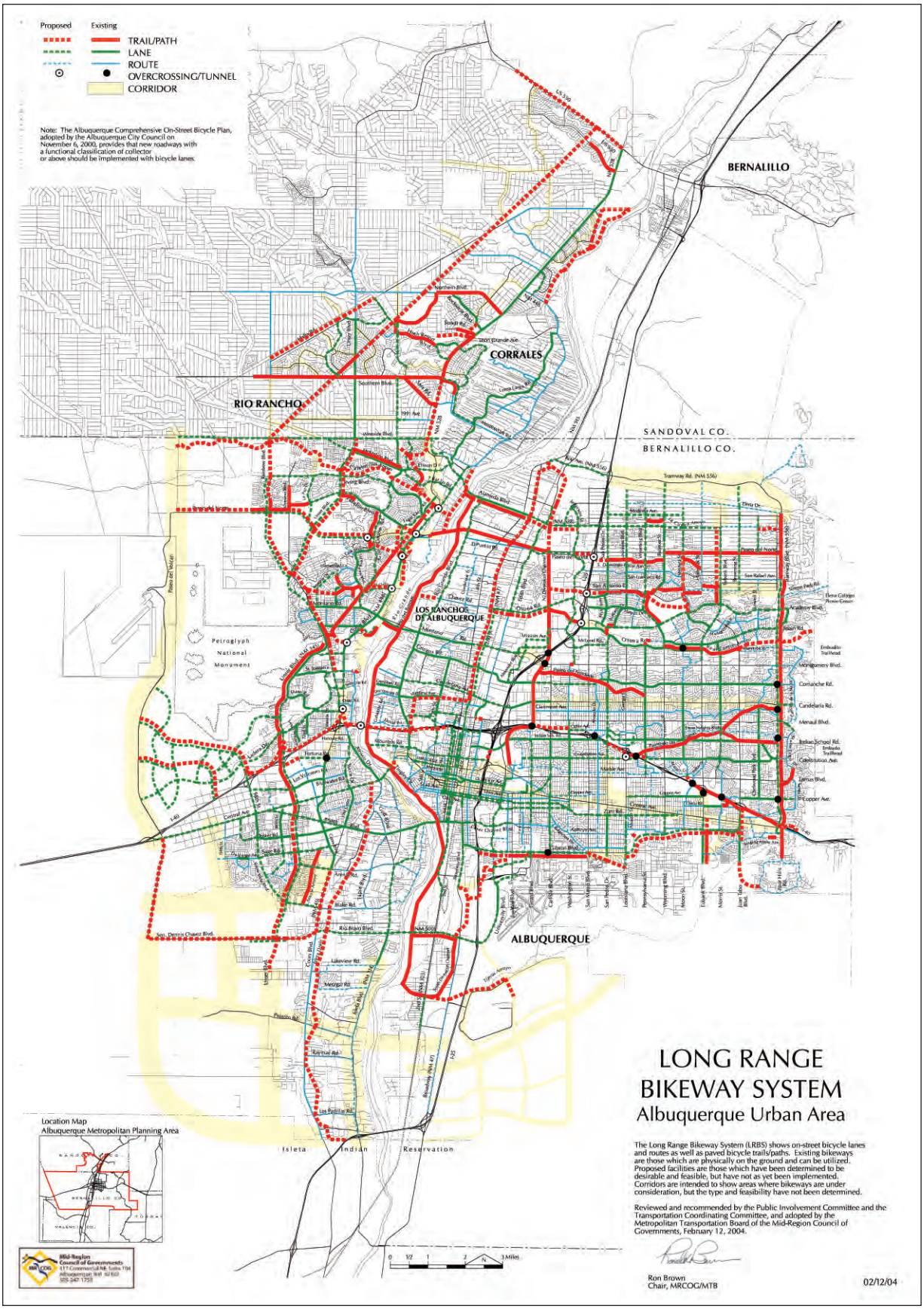


Exhibit 15
Long Range Bikeway System