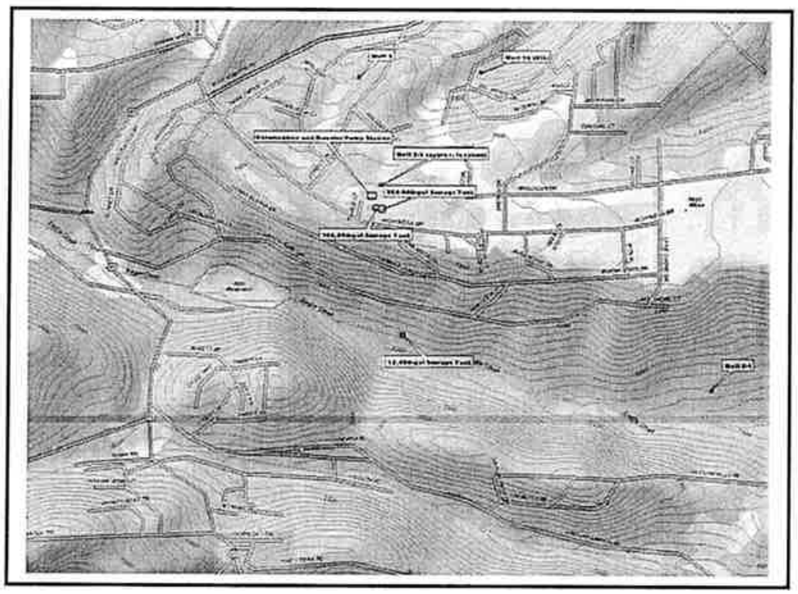
Alto Lakes Water Corporation

WATER AND WASTEWATER SYSTEM MASTER PLAN

May 2004



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0.0 EXECUTIVE SUMMARY

This Master Plan evaluates the water and wastewater systems of the Alto Lakes Water Corporation (ALWC) for the forty-year planning period 2004 – 2044. Current ALWC water demands are approximately 539 acre-feet per year (afy), and are expected to grow to around 626 afy in twenty years, and up to about 635 afy by year 2044. Existing groundwater supplies are diminishing, and assumed to be depleted to 200 afy by year 2044. A water budget is presented and indicates that new water supplies in the amount of up to 435 afy are needed by year 2044 to meet future demands. Various water supply development alternatives are recommended for both the short-term (2004 – 2012) and long-term periods (2012 – 2044), and include the following:

Short-term water supply development alternatives (2004 – 2012):

- Existing Reclaimed Water Irrigation
- Deepen ALWC Well E-2
- Deepen Well ALWC E-4
- Deepen Other ALWC Cretaceous Formation Wells

Long-term water supply development alternatives (2012 – 2044):

- Expanded Reclaimed Water Irrigation
- San Andres Well Field
- Regional Water Projects

The water quality of the ALWC wells was evaluated. The ground water contains high levels of total-dissolved-solids (TDS) and hardness. Additionally, the ground water contains high levels of iron and manganese, which causes "red" water problems in the distribution system. It is recommended that the domestic water supply be treated by reverse-osmosis to reduce the TDS and hardness levels, and remove iron and manganese.

The water distribution system was evaluated and a computer model hydraulic analysis performed. To meet ISO recommended fire flows it is recommended that the water system be replaced with 6-inch distribution piping. Also, 180,000 gallons of additional water storage is recommended by year 2024. A plan to re-zone the water system for more efficient operation and distribution is also presented, along with some operational recommendations.

The wastewater system was also evaluated, and recommended that the sewer collection and treatment system be expanded to include all of the Alto Lakes community. Additionally, improvements to the existing wastewater collection and treatment system are discussed, along with operational recommendations.

Finally, a Capital Improvement Plan (CIP) for accomplishing the various project recommendations is presented, along with estimated costs and implementation schedule. Total water system CIP is just over twelve million dollars over the next 20-years, and the wastewater system CIP approaches thirteen million dollars for the same period.

Lastly, a discussion on ownership and funding sources is presented. This recommends conversion of ALWC to a Water and Sanitation District in order to more easily provide funding for the needed improvements.

1.0 INTRODUCTION

1.1 Purpose of Master Plan

The purpose of this Water and Wastewater Master Plan (Plan) is to identify water and wastewater system improvements necessary to adequately serve the Alto Lakes Water Corporation (ALWC) service area at build-out and to provide a 40-year water supply. The Plan addresses water quality and quantity, wastewater collection, treatment and disposal and financial and operational issues. The Plan evaluates the water supply of the ALWC used for both domestic and golf course irrigation, for the current need as well as future (to year 2044) conditions. Various alternatives for new or additional water supplies are presented, as well as an analysis of water rights. The Plan also evaluates the water distribution system, and presents recommendations for infrastructure improvements. In addition, the existing wastewater collection and treatment system is reviewed, and recommendations for improvements and expansion of the system are presented. This Master Plan spans a 40-year planning period from year 2004 to 2044. This Alto Lakes Water Corporation 40-Year Water and Wastewater Master Plan is submitted pursuant to NMSA Section 72-1-9 (B) (1985).

1.2 Alto Lakes Water Corporation

The Alto Lakes Water Corporation (ALWC) is a private water supply system, developed to provide water and wastewater services to the Alto Lakes community. All stock in the Corporation is owned by the Alto Lakes Golf and Country Club. Its legal authority operates as a private company regulated by the New Mexico Public Regulatory Commission. The ALWC serves approximately 1,100 water accounts and about 80 sewer accounts, with an annual operating budget of $1,100,000 for water operations and $80,000 for the sewer operations ($1,000/account per year).

Staff of the ALWC consists of a General Manager, Executive Assistant, Billing Clerk and four field crew (operators).

1.3 Service Area

The Alto Lakes Water Corporation serves an area of approximately 3.8 square miles (1,689 acres), extending almost 3.3 miles east west and about 2.3 miles north-south. The service area includes the residential community of Alto Lakes subdivision and the Alto Lakes Golf and Country Club. The customer base includes a high number of vacation homes which seasonally utilize the golf course and country club facilities. Currently, the Alto Lakes subdivision is approximately 50% built-out, with about 1,000 of the 2,200 lots occupied. The ALWC also serves domestic water to two areas outside of the subdivision: the Kokopelli Golf and Country Club area which includes about 10 lots currently (120 total obligation), and the Eagle Creek development which includes about 8 lots currently (25 total obligation). Refer to **Figure 1.1** for a map of the service area.

1.4 Previous Studies

Previous studies for the Alto Lakes Water Corporation include a 1990 report entitled *Geohydrologic and Engineering Report, Alto Village Services Corporation Water System*, August 1990, Atkins Engineering Associates (Atkins, 1990). This report describes in detail the current water rights held by the ALWC, and provides a hydraulic analysis of the water distribution system. The water rights are discussed in Section 2.0 of this Plan. The 1990 report recommended pipeline upsizing and additional booster pumping and storage, as well as the need for additional water rights prior to build-out. This Plan replaces the 1990 report.

Regionally, the *Lower Pecos 40-Year Regional Water Plan,* May 2001 by Balleau and Associates (Regional Plan) discusses the water resources of the Lower Pecos groundwater basin, and includes present and future regional water supply and demands to the year 2040. The ALWC is not specifically identified in the Regional

Plan; however, it is presumed that the ALWC demands are inherently included in the Lincoln County rural domestic water uses. The Regional Plan is useful for general hydrogeologic and climatic information, as well as overall potential competition for future water use in the region, but is not specific for ALWC. Some of the Regional Plan recommendations are:

1. Promote water conservation for agricultural and domestic uses;
2. Promote watershed restoration and enhancement;
3. Develop new water supplies for the region from desalination of brackish groundwater.
4. Investigate potential for water trades with City of Alamogordo for Bonito Lake water.

Another local regional water plan is the Tularosa Basin and Salt Basin Regional Water Plan 2000 – 2040 by Livingston Associates, P.C. and John Shomaker and Associates, Inc., May 2002 (Tularosa Plan). The Tularosa Plan discusses the future water needs of the Tularosa and Salt Basins. Included as recommendations in the Tularosa Plan which may have importance to the ALWC are:

1. Promote water conservation for agricultural and domestic uses;
2. Promote watershed restoration and enhancement;
3. Develop new water supplies for the region from desalination of brackish groundwater.

Each of these regional plans contains numerous references to other relevant studies.

1.5 Mapping

Mapping was developed for the entire ALWC service area. In July 2003, an aerial survey was conducted by Rollag and Associates, Inc., and included photographic background, ground elevation contours and digitized physical features (streets, buildings, etc.). Ground control for the mapping was provided by D.T. Collins and Associates. Prior to obtaining the aerial data, ALWC personnel marked water system components (valves, hydrants, etc.) and sewer manholes with white paint for identification on the photographic background. Using the aerial survey as base maps, current water system mapping was developed by Livingston Associates, P.C. Existing water system piping information was provided by Mr. Gene Wilson of the ALWC, and included as-built drawings and verbal information. The mapping (consisting of nine 24-inch by 36-inch size sheets) shows current waterline locations, pipe size and type, and hydrant and valve locations and the sewer collection system. Half-scale drawings (11-inch by 17-inch) of the mapping are contained in this Plan as **Figures 9.2 through 9.10**.

The maps were delivered to the ALWC under separate cover, and include the following:

1. One set of mylar reproducible maps with background photograph;
2. One set of paper reproducible maps with background photograph;
3. One set of mylar reproducible maps without background photograph;
4. One set of paper reproducible maps without background photograph;
5. One set of paper maps without background photograph, laminated and mounted on foam board for use as wall maps.

2.0 EXISTING CONDITIONS

2.1 Current Population and Water Service Areas

The ALWC currently serves water to approximately 1,010 residential accounts, 20 small commercial accounts, 2 large commercial accounts (Alto Lakes Golf and Country Club and Kokopelli Golf Course Country Club) and the Alto Lakes Golf Course. Additionally, two areas outside of the subdivision are also served with domestic water use: Kokopelli and Eagle Creek (**Figure 2.1**). Assuming approximately 1.7 persons per residential account, this would equate to an existing service population of about 2,000 people on average, and over 3,000 persons during the peak season. Section 9.0 discusses in detail the water distribution system.

2.2 Current Water Demands

The ALWC provides water for residential domestic, commercial and golf course irrigation use. Records for historical water consumption were obtained from the ALWC office, for the years 2000, 2001, 2002 and 2003. Typical total annual water demands have averaged 430 acre-feet per year (afy) over this period, with approximately 40% (172 afy) used for domestic, 4% (17 afy) for commercial, and 56% (241 afy) used for the golf course irrigation. (see **Appendix** for historical use charts).

2.2.1 Annual Residential Demands

For residential demands, the current (year 2003) average consumption is 180 afy, (58.7 million gallons per year) or about 162,000 gallons per day (gpd). Based on 1010 active residential accounts, the domestic demands average 0.18 acre-feet per account each year, or 160 gallons per day (gpd). According to a recent survey (Earl Adamy, 2003) approximately 34% of the residents reside in Alto

Lakes 5 to 6 months during the year (considered *semi-permanent residents*) and about 21% spend 8 to 12 months per year living in Alto Lakes (considered *permanent residents*). The balance of the residents (approximately 45%) are assumed to spend less than 5 months residing at Alto Lakes, and are considered *seasonal residents* for the purpose of this Plan. Based on the foregoing, the total annual use per residential account will vary with the amount of time the resident spends in Alto Lakes, as well as the timing of the stay. However, for this analysis it is assumed that seasonal water use fluctuations are averaged among all users. For projecting future water demands, water use may also be expressed in terms of "full-time equivalent" use. This represents the total water use by account if the residents were year-round. The current average full-time equivalent water use per account would therefore be approximately 0.36 afy (320 gpd).

2.2.2 Peak Daily Residential Use

Peak daily water use occurs during the summer months. For current residential demand, the peak daily use is approximately 200% of the average daily use. Therefore, peak day residential demands are currently about 324,000 gpd, or an equal average flow rate of 220 gallons per minute (gpm).

2.2.3 Commercial Demands

Current commercial water demands include the Alto Lakes Golf and Country Club Clubhouse and Kokopelli Mesa Clubhouse. The total commercial use is 15 afy (13,000 gpd). Peak day use is estimated at 200% of average day use or 26,000 gpd.

2.2.4 Golf Course Irrigation Demands

Irrigation for the Alto Lakes Golf and Country Club accounts for approximately 60% of all current water demands, and equaled an average of 270 afy (241,000 gpd) for 2003. This average day use equates to a pumping rate of about 150 gpm. The irrigated area of the golf course is about 143 acres, so average water use for the turf area is approximately 1,530 gallons per acre per day (gpad). Peak month irrigation use is approximately 200% of average month use, and equals about 482,000 gpd (3,060 gpad), which equates to an average peak day pumping rate of about 340 gpm. The ALWC is committed to provide the Golf Course with irrigation water in the amount of 260 afy (85 MGY).

2.2.5 Unaccounted-for Water Loss

Unaccounted-for water loss includes various demands which cannot be measured. These include distribution system leakage, meter inaccuracies, and fire hydrant flushing activities. These averaged approximately 11% in 2003, or about 53 afy (47,000 gpd). These demands do not generally have a peaking factor, however.

Table 2.1 below summarizes the current (2003) water demands.

Table 2.1 – Total ALWC Average and Peak Day Water Demands, 2003

Use	Demand afy	Demand gpd	Demand gpm	Peak Day Demand gpd	Peak Day Demand gpm
Residential	180	161,000	110	324,000	220
Commercial	15	13,000	9	26,000	18
Golf Course	270	241,000	170	482,000	340
Unaccount.	53	47,000	32	47,000	32
Total	**518**	**462,000**	**320**	**877,000**	**610**

Refer to **Figure 2.2** for a graph of the current water use by month.

2.3 Current Water Rights

An extensive discussion of the ALWC water rights is contained in the 1990 report (Atkins, 1990) and is summarized in a letter from Atkins Engineering Associates, Inc. (Atkins, 2003). Current ground water rights available for consumption use total 558.74 afy from all sources, for domestic and subdivision use, as shown in the following **Table 2.2**:

Table 2.2 – ALWC groundwater rights, H-719 et al.

Owner	Diversion	Consumptive Use	Priority
Alto Lakes Water Corp.	67.4 afy	67.4	1865
Alto Lakes Water Corp.	434.54 afy	434.54	1964
Alto Lakes Golf & CC	113.75 afy	56.8	1866
Total	**615.69 afy**	**558.74**	

It should be noted that the ALWC leases the 113.75 afy (56.8 afy consumptive use) from the Alto Lakes Golf & Country Club.

2.4 Water Quality

The water quality of the ALWC complies with the USEPA Safe Drinking Water Act (SDWA) primary drinking water quality standards. The ALWC submits water quality reports in compliance with the regulations, and issues an annual Consumer Confidence Report (CCR) which describes the public water source and quality, and to note any variance with the standards. The quality in the distribution system varies with each well. Overall, the average level of total-dissolved-solids (TDS) for the last two years is around 2,200 mg/L. Fresh water (as defined by the USGS) contains less than 1,000 mg/L TDS. The New Mexico Environment Department (NMED) secondary standard for potable water is 500 mg/L TDS.

Secondary water quality standards are not regulated by either the USEPA or the State of New Mexico Environment Department. These are primarily aesthetic in nature (from a taste and odor standpoint) and produce no known toxic effects. Some of the secondary water quality constituents include total-dissolved-solids (TDS), sulfates, chlorides, fluoride, iron, manganese and others. Typically, elevated levels of these may cause taste concerns, plumbing fixture scaling and staining of sinks. Although the secondary parameters are not regulated, the USEPA and NMED have adopted recommended maximum levels, to minimize the potential for taste and plumbing concerns.

The following **Table 2.3** lists the ALWC wells and select secondary water quality constituent levels, and the NMED recommended limits.

Table 2.3 Summary of secondary water quality concentrations for ALWC wells and the NMED secondary maximum constituent concentration

well name/ constituent	TDS (mg/L)	SO4 (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Manganese (mg/L)
1-A	2,050	1,020	220	0.4	35.0	0.28
E-1	1,250	554	154	0.4	ND	0.04
E-4	3,270	2,050	51	1.5	1.04	0.12
E-5	1,320	594	176	0.6	1.12	0.04
Well 6	1,520	688	233	0.4	0.55	0.13
Well 9	1,130	490	151	0.4	ND	0.05
Well 12	2,230	984	384	0.4	0.05	ND
Well 16	2,040	893	400	0.4	36.5	0.22
Well 13	1,510	721	296	0.2	68.4	0.69
NMED limit	**500**	**250**	**250**	**2.0**	**0.30**	**0.05**

As can be seen from the above table, all of the ALWC wells exceed the recommended secondary limit for total dissolved solids (TDS) and sulfates. Chlorides are exceeded in well nos. 12, 13 and 16. Iron limits are exceeded in all but well nos. E-1, 9 and 12, and manganese limits are exceeded in all but well Nos. E-1, E-5, 9 and 12. The wells producing the highest quality water (TDS less than about 1,500 mg/L) include E-1, E-5, 6, 9 and 13. A complete water chemistry analysis for each well is contained in the **Appendix**.

Many of the residents in the Alto Lakes community use water softeners to improve the quality of the water by removing the "hardness" components from the water (calcium and magnesium, iron also is removed). These systems use excessive amounts of water when they regenerate the resins. One of the ALWC goals, as will be discussed later, is to improve overall water quality delivered to the consumer.

2.5 Conservation

The ALWC has recently studied the water uses and has found that 5% of the residential customers use 26% of the total water supplied to residential customers. Other customer classes were also studied to determine how water was being used. As a result of these studies, a rate adjustment has been obtained through the NM Public Regulatory Commission (NMPRC) which greatly increases the cost to high water users. In addition, system water losses are being trimmed by meter replacements and leak repairs.

A water conservation plan has been adopted by the ALWC as required by the NM Public Utility Commission. The conservation plan outlines fives phases of water supply severity which triggers certain conservation actions related to outdoor watering. The criteria apply to both domestic (residential) customers and the golf course irrigation. The following **Table 2.4** summarizes the conservation trigger points and watering action.

Table 2.4 – ALWC Water Conservation Plan

Conservation Phase	Well Production Capacity	Residential Watering Schedule	Golf Course Irrigation (% reduction)
I No Emerg.	505	Odd-Even	10
II Moderate	460	Odd-Even 5-9 am 5-9 pm	20
III Serious	370	Odd Thurs. Even Thurs. 5-9 pm	40
IV Severe	235	Odd 1st and 3rd Wed. Even 2nd and 4th Wed. 5-9 pm	70
V Extreme	100	No outdoor watering	100

According to the American Water Works Association (AWWA), a water conservation program can achieve 10% to 20% reduction in demands over a 20-year period. For this Plan, it is assumed that an initial 3% reduction will occur the first year (2004) with an additional 15% reduction over the 20-year period to 2024, and remain at a total of 18% through the Plan period to 2044.

2.6 Water Rates

Water rates are developed for the utility to not only satisfy water system operation and maintenance (O&M) expenses, but to develop a capital fund for system expansion and development. The current water rate structure for the ALWC is summarized in the table below:

Table 2.5 – ALWC Water Rates Basic Charge per 1,000 gallons

Residential/Small Commercial	
Basic Charge $26.00 per month plus use	
Gallons Used	Cost per 1,000 gals
0 – 5,000	$2.50
5,001 – 10,000	$3.75
10,001 – 25,000	$5.00
25,001 – 50,000	$7.50
50,001+	$25.00
Country Club/Large Commercial	
Basic Charge $75.00 per month plus use	
Gallons Used	Cost per 1,000 gals
0 – 175,000	$4.50
175,001 – 350,000	$9.00
350,001 +	$25.00
Golf Course Irrigation	
Basic Charge $11,000.00 per month plus use	
Gallons Used	Cost per 1,000 gals
0 – 6,660,000	$2.50
6,660,001 – 13,000,000	$4.50
13,000,001 +	$25.00

2.7 Wastewater System

The current domestic wastewater collection and treatment system is limited to the Alto Lakes Country Club clubhouse and approximately 80 Alto Lakes condominium customers. Approximately 12,000 gallons of domestic and commercial sewage is collected and treated on an average day (Refer to **Figure 2.3**). Peak days include weekends and holidays, and as much as 30,000 gallons per day are treated. Currently, the average domestic sewage is estimated to be approximately 90% of the domestic/commercial (indoor) water use. This percentage would decrease to less than 70% if all single family residences were served. Current wastewater rates are shown in **Table 2.6**.

Table 2.6 – ALWC Monthly Sewer Rates

Location	Flat Rate
ALG&CC CLUBHOUSE	$1,000.00
SITE A TOWNHOUSES, SITE B CONDOS CART BARN AND TURF BARN	$20.00
SITE C TOWNHOUSES AND ACCT. No. 8720	$22.00
DEER PARK WOODS TOWNHOUSES	$23.00

A detailed analysis of the wastewater collection and treatment system is presented in Section 10.0.

3.0 EXISTING WATER SUPPLY

3.1 Regional Groundwater Hydrology

3.1.1 Structural Geology

The ALWC service boundary and well locations are shown for discussion reference on **Figure 3.1** and selected ALWC wells and other regional wells are shown with TDS data as **Figure 3.2**.

The geology of the Alto-Ruidoso area is structurally complex, but can be simplified by grouping the region into two different areas separated by a large, unnamed fault zone that lies just east of the Alto property and trends northeast-southwest (**Figure 3.3 and 3.4**). Rocks to the west of the fault zone are younger at the surface in comparison to rocks on the east side, and in general tend to tilt westward, especially closest to the fault zone. In contrast, rocks on the east side are either flat-lying or dip much more shallowly. The Alto Lakes property lies almost entirely on a thick section of Cretaceous rocks described below.

3.1.2 Water-bearing Formations

Several rock formations produce water in the greater Alto-Ruidoso area. The oldest is the Permian-age Yeso Formation (Py), tapped by wells east of the main fault zone. The Yeso consists of interbedded layers of sandstone, siltstone, dolomite and gypsum. The gypsum present in the Yeso gives the produced water high concentrations of sulfate (SO_4) and total dissolved solids (TDS). Sulfate concentrations may range from 650 to 1,000 milligrams per liter (mg/L) and TDS from 1,500 to 1,700 mg/L (**Table 3.1**). Maximum stratigraphic thickness of the Yeso in this area is up to 1,400 feet, but it thins southeast of Ruidoso

(Kelley, 1971). In the Alto Lakes property, 2,000 vertical feet of saturated Yeso are obtainable below 1,800 feet bgl in the east and below approximately 3,000 feet bgl in the west (**Figure 3.4**). (Saturated thickness is greater than stratigraphic thickness because the beds are dipping.) The Yeso is known to produce water at rates of 200 to 600 gallons per minute in the area. No Alto Lakes wells currently produce from the Yeso.

The Permian-age San Andres Formation (Psb and Psr) is a dolomite-limestone-and-sandstone unit that lies stratigraphically above the Yeso. The San Andres is relatively free of gypsum, and therefore generally produces better-quality water than that produced from the Yeso, but only where there is limited hydraulic communication between the underlying Yeso and the overlying Permian Grayburg Formation (Pag), which is also rich in gypsum, as evidenced by Alto Lakes well H-719-S-19 (Alto Lakes Well E-4). In the study area, the San Andres is most likely in hydraulic communication with the Yeso, however, as shown by water-quality data from wells producing from the San Andres, such as the Rainmaker wells H-1122-S-5 and S-6 wells (**Table 3.2**). Therefore the San Andres, like the Yeso, also produces water with elevated concentrations of TDS and SO_4 in the area. Wells completed in the San Andres tend to produce ground water at relatively high yields, ranging from 80 to over 250 gpm. The potentially high production rates and relatively good water quality make this formation a primary target aquifer beneath the Alto Lakes area. Maximum thickness of the San Andres in this area is approximately 600 feet (Kelley, 1971), and because the beds are dipping in the Alto Lakes area, the measured saturated thickness is slightly greater. Saturated thickness of the San Andres is present between depths of 1,200 and 1,850 feet bgl in the southeastern part of the Alto Lakes property, and between approximately 2,000 and 2,650 feet bgl in the west (**Figure 3.4**).

The Permian-age Grayburg Formation, consisting of about 400 feet of interbedded dolomite, sandstone, siltstone and gypsum, is present above the San Andres

(Kelley, 1971). The saturated thickness of the Grayburg is between approximately 750 and 1,150 feet bgl in the southeast part of the Alto Lakes property (**Figure 3.4**) and between approximately 2,000 and 2,400 feet bgl in the west. The Alto Lakes E-4 well produces from the Grayburg Formation. The estimated yield on the New Mexico Office of the State Engineer (NMOSE) well record for E-4 well is 100 gpm, but TDS concentration is very high at 3,270 mg/L.

Above the Grayburg are two Triassic-age formations that are not water-producing in this area: These two units are the Chinle Shale and the Santa Rosa Formation, which consists of interbedded sandstone and pebble conglomerate, and have a combined thickness of about 350 feet (Kelley, 1971).

Above the Triassic strata is the Cretaceous-age Dakota Formation, a sandstone-shale-conglomerate mixture that on its own is generally not permeable enough to produce significant amounts of ground water. Where it is fractured, however, the Dakota becomes a viable aquifer, producing at yields of about 100 to 200 gpm.

Water quality for the Dakota in the area is unknown, but TDS concentration is probably above 1,000 mg/L, and iron and manganese levels may be elevated. The Alto E-2 (H-719-S-17) well produced partly from the Dakota Formation before it was taken off line over two years ago. Total vertical thickness of the Dakota Formation is 250 feet (Kelley, 1971), all of which is saturated in the Alto Lakes property. This saturated Dakota is present between 250 and 500 feet bgl in the southeastern part of the property (**Figure 3.4**), and between approximately 2,000 and 2,500 feet bgl in the west.

The Mancos Shale, present above the Dakota Formation, is not considered a good aquifer. TDS levels are between 1,200 and 2,300 mg/L and local yields reported at less than 40 gpm, and with estimated maximum yields of several tens of gallons per minute (**Table 3.1**). Alto Lakes wells producing from the Mancos include the

H-719-S-11 (well 12), H-719-S-13 (well 13), H-719-S-6 (well 6), and H-719-S-18 (E-3) wells. The H-719-S-20 (E-5) and H-719-S-16 (E-1) wells also produce from the Mancos and have yields of 180 and 75 gpm, respectively, but these wells are drilled near or into faults (**Figure 3.3**) that greatly increase the yield above that which the Mancos would normally provide (**Table 3.3**). The Mancos is approximately 700 feet thick in this area (Kelley, 1971). None of it is present below the water table in the far southeast part of the Alto Lakes property, but in the west its vertical saturated thickness is present between approximately 600 and 1,300 feet below ground level (**Figure 3.4**).

Another producing aquifer in the area is the Cretaceous-age Mesaverde Formation (Kmv). The Mesaverde is dominantly sandstone with some shale, coal and conglomerate beds, and is locally known to produce water with concentrations of TDS between 1,100 and 2,300 mg/L. Alto well H-719-S-15 (well 16) produces water from the Mesaverde with a TDS concentration of 2,040 mg/L, and Alto well H-719 (well 1-A) produces water with a TDS concentration of 2,050 mg/L. Nearby reported yields from the Mesaverde are generally range between 8 and 12 gpm, but the Alto well 16 well record reports an estimated yield of 150 gpm, and a pumping test from November 2003 estimated that Alto well H-719-S-6 (well 6) is capable of producing at a maximum rate of 150 gpm. These data indicate that where the rock is fractured, well yields can increase significantly. Total thickness of the Mesaverde Formation in the area is between 500 and 1,500 feet (Kelley, 1971). None of the Mesaverde is present below the water table in the southern part of the Alto Lakes property, but it is saturated from approximately 500 feet to 1,300 feet bgl in the west (**Figure 3.4**).

The Tertiary-age Cub Mountain Formation is present above the Mesaverde. It consists of interbedded layers of sandstone, mudstone and conglomerate (Kelley, 1971). No data were found on quality of water produced from the Cub Mountain, but it is likely to not have the elevated levels of TDS and SO_4 that water from the

Permian and Cretaceous-age rocks have. Wells completed in the Cub Mountain have yields of about 10 to 150 gpm, with yields being greater where the rock is fractured. Total thickness of the Cub Mountain Formation is approximately 500 feet in this area. It is only present at the surface in the far-western part of the Alto Lakes property, and none of it lies below the water table (**Figure 3.4**).

The youngest of the producing aquifers near Alto Lakes is the Oligocene-age Sierra Blanca Formation, a volcanic rock unit present west of the Alto Lakes property in the Eagle Creek area. Water is present in fractures in the volcanic rocks, and well yields are greater in areas where the rocks are more fractured. Well yields from the Sierra Blanca volcanic rocks range from 10 to 1,000 gpm. The concentration of TDS in water produced from these rocks should be relatively low due, and is likely less than 1,000 mg/l. Total thickness of the Sierra Blanca volcanic rocks is highly variable in the western Alto/Ruidoso area, between 0 to more than 1,000 feet (Thompson, 1966). None of these rocks are saturated within the Alto Lakes property (**Figure 3.4**).

Table 3.1 Summary of estimated well yields, TDS concentrations, and saturated thickness of primary aquifers in the Alto-Ruidoso area, New Mexico.

Aquifer	Estimated Well Yield (gpm)	Estimated TDS Range (mg/L)	Vertical Saturated Thickness Within Alto Lakes property (feet)
Yeso	200 to 600	1,500 to 1,700	>1,500
San Andres	80 to >250	1,300 to 1,400	650
Grayburg	100	3,000 to 3,500	400
Dakota	100 where fractured	>1,000	250
Mancos	<40	1,200 to 2,300	700
Mesaverde	8 to 150	1,100 to 2,300	0 to 800
Cub Mountain	10 to 150	<1,000	0
Sierra Blanca volcanics	10 to 1,000	<1,000	0

gpm: gallons per minute; mg/l: milligrams per liter

As alluded to above, water-quality data from wells in the Alto-Ruidoso area indicate that most aquifers in the region produce water exceeding the aesthetic standards of the New Mexico Drinking Water Bureau (NMDWB) for total dissolved solids (TDS) and sulfate (SO_4). The NMDWB standards for TDS and SO_4 are 500 mg/L and 250 mg/L, respectively. All of the primary aquifers in the Alto/Ruidoso-area , with the exception of the Sierra Blanca volcanic rocks, yield water with TDS and SO_4 concentrations which exceed the aesthetic standard by more than double. Wells on the Alto Lakes property produce water with relatively high TDS and SO_4 concentrations, primarily from Cretaceous-age rocks. Well E-4 produces water with very high concentrations of TDS and SO_4, primarily from the Permian-age Grayburg Formation (**Table 3.2**). The San Andres and Yeso Formations produce water with concentrations of TDS between 1,300 and 1,700. A representative selection of these data is presented as **Table 3.2**, with locations on **Figure 3.2**.

Table 3.2 Summary of total dissolved solid (TDS) and sulfate (SO_4) concentrations for selected wells in the Alto-Ruidoso area.

Owner	NMOSE Permit Number	Common Well Name	TDS (mg/L)	SO4 (mg/L)	Aquifer(s)
ALTO LAKES	H 00719	1-A	2,050	1,020	Mesaverde
	H 00719 S16	E-1	1,250	554	Mancos + fault
	H 00719 S19	E-4	3,270	2,050	Grayburg
	H 00719 S120	E-5	1,320	594	Mancos + fault
	H 00719 S6	well 6	1,520	688	Mancos/Mesaverde
	H 00719 S8	well 9	1,130	490	Mesaverde
	H 00719 S11	well 12	2,230	984	Mancos/Mesaverde
	H 00719 S15	well 16	2,040	893	Mesaverde
	H 00719 S13	well 13	1,510	721	Mancos
(1) CDS Rainmakers	H 01122 S4	H-3409	1,300	530	San Andres
	H 01122 S5	1-A (H-3263)	1,400	540	San Andres
VILLAGE OF RUIDOSO	H 272 S	Hollywood	1,522	673	Yeso

3.2 Alto Lakes Water Corporation Wells

Water production from all of the Alto Lakes Corporation wells (**Figure 3.1** and **3.3**) is currently restricted to the Cretaceous, Mancos and Mesaverde Formations, with the exception of well E-4, which produces from a combination of the Mancos Shale, Dakota Sandstone, Triassic-age rocks, and the Permian Grayburg Formation.

The combined San Andres and Yeso aquifers are desirable in that yields are generally higher than from the Cretaceous rocks and water quality is slightly better. To produce from these formations, wells in the southeastern part of the Alto Lakes Corporation property would need to be completed between depths of about 1,250 and 3,000 feet bgl. Outside the property boundary across the large fault zone to the east, wells would need to be completed between about 100 feet and 2,000 feet bgl to produce from the San Andres/Yeso aquifer. However, it must be considered that any new request to take water from the San Andres may be met with great scrutiny by the NMOSE, because of its hydrologic connection with the Pecos River. Therefore, section 5.0 presents an alternative of deepening wells to produce from the Cretaceous rocks, in order to limit potential permitting problems.

Water level decline was calculated for the primary Alto Lakes Water Corporation wells from existing water-depth data (**Figure 3.5**). However, these are only general and qualitative predictions of declines in well production, for two reasons. The first is that there are no pumping test data to help evaluate the aquifer characteristics near each well. Second, the specific interval from which each well produces is unknown and it is unlikely that the production occurs equally throughout the entire borehole, and, therefore, declines in water levels are not likely to precisely correspond with declines in production rates.

The following table and figures summarize the change in non-pumping water level data from the existing wells owned by the Alto Lakes Water Corporation.

Table 3.3 Selected non-pumping water levels and corresponding change in water levels; quantity of water produced from January through December 2003; and 2003 yield data for Alto Lakes Water Corporation wells.

Alto Lakes well # (*NMOSE well #: H-719-*)	Well depth (ft bgl)	Non-pumping water level (ft bgl)	date (mo-yr)	non-pumping water level (ft bgl)	date (mo-yr)	change in water level[1] (ft/year)	YTD Aug 2003 prod. (ac-ft)	2003 reported peak yield (gpm)
E-1 (*S-16*)	675	48	May-83	340	Mar-02	15.4	53.4	75
E-2 (*S-17*)	648	22	May-83	311	Jul-03	14.5	0	0
E-3 (*S-18*)	540	55	Oct-95	291	Jan-02	39.3	0	0
E-4 (*S-19*)	1,240	173	Nov-02	181	Apr-03	16	126.8	200
E-5 (*S-20*)	430	80	Mar-98	358	Jul-03	50	121.8	180
1-A (*H-719*)	1,000	50	Jun-72	115	Feb-03	2.1	3.0	22
9 (*S-8*)	573	80	Sep-67	411	Jan-01	9.7	17.0	30
12 (*S-11*)	342	92	Feb-81	108	Mar-02	0.8	34.5	65
13 (*S-13*)	282	35	Feb-81	194	Jul-03	7.2	0	10
S-6 (*S-6*)	1,460	541	Oct-02	705	Jul-03	328	33.6	106
16 (*S-15*)	946	503	Mar-02	575	Jul-03	72	127.8	110
Total							518	**800**

[1]: calc. from observed data over well-specific periods of data collection

3.3 Projected Well Field Production

Based on the limited existing water level data for Alto Lakes wells (**Table 3.3**), historic water level decline has varied from 0.8 to 328 ft/yr. This broad range can qualitatively be explained by limited storage in isolated fracture zones, variation in pumping rates, varied length of observation time and sporadic data collection. The lack of consistent data and geologic complexity leads to estimate a continued average decline of 15 feet per year, plus or minus 10 feet per year, for the ALWC wells.

Based on an average 15 feet per year water level decline, after 20 years of continued well field pumping, local groundwater levels will have declined by almost 300 feet. Unless deepened, many of the ALWC wells would go dry prior to this. A rough estimate of well field production decline can be made, by assuming that after 20 years of pumping, only those wells with a minimum water column of 300 feet remain in service. Only wells E-1, E-4, 1-A and S-6 have an existing water column of more than 300 feet. The combined current production capacity of these four wells is about 250 afy.

Therefore, assuming a current (2003) well field production capacity of 520 afy, by year 2024 the well field capacity will be only about 250 afy (assumed remaining capacity from wells E-1, E-4, 1-A and S-6), an approximate 50% decline (13 afy per year). By year 2044 (40 years) the groundwater levels are assumed to have declined to the point that well production capacity is only about 200 afy.

The assumed ALWC existing well field production capacity (without deepening) to year 2044 is shown graphically as **Figure 3.6**.

4.0 FORCASTED WATER DEMANDS

4.1 Future Demands

The future water demands were projected to the year 2044. For the residential demand, a method was developed to project demands based on the amount of time the residents spend at Alto Lakes. Based on the previously discussed survey (Section 2.2) the projected amount of time residents will spend at Alto Lakes will continue to increase between now and the next 40 years (**Figure 4.1**). By the year 2044, approximately 32% of the residents will be considered permanent (average stay of 10 months), about 58% will be considered semi-permanent (average 6 month stay) and approximately 10% will be considered seasonal (average 3 month stay) (**Figure 4.2**). To determine the future residential water demand, the full-time equivalent water use developed in Section 2.2 is combined with the residence time and percentage of accounts in each of the three residence time categories. A future average residential water use per account was then determined for each year. (Refer to the **Appendix** for calculations). Using approximately 2,000 total residential accounts at build-out in year 2024, and an average water use per account of 0.226 afy at that time, the projected residential water use in 2024 is about 452 afy. This will continue to increase as the residence time increases and more become permanent or semi permanent, to an average use per account of 0.231 afy in year 2044, which equates to a total residential demand for 2,000 accounts of 462 afy.

The projected golf course irrigation demand of 85 MGY (260 afy) is assumed to remain constant throughout the Planning period. Commercial demands (which include the Alto Lakes condominiums and Alto Lakes Golf and Country Club clubhouse) are projected to remain constant at the current level of about 15 afy.

The unaccounted for water loss is assumed to decrease from 10% currently (2004) to 5% by 2024, and remain at 5% to 2044. Therefore, the total future projected water demands for the ALWC are estimated to be around 774 afy. Water conservation efforts are assumed to increase from 3% currently (2004) to 18% by 2024, then remain constant through 2044. With conservation, the total future projected water demands for the ALWC are approximately 635 afy.

Table 4.1 below summarizes the projected future year 2044 water demands, and **Figure 4.3** is a graphical representation of the total projected future water demands by month.

Table 4.1 ALWC Projected Water Demands for Year 2044, by Use and Total

Use	Demand afy	Demand gpd	Demand gpm	Peak Day Demand gpd	Peak Day Demand gpm
Residential	462	412,000	286	824,000	572
Commercial	15	13,000	9	26,000	18
Golf Course	260	232,000	161	464,000	322
System Loss	37	33,000	23	33,000	23
Conservation	(139)	(124,000)	(86)	(248,000)	(172)
Total	**635**	**567,000**	**393**	**1,099,000**	**763**

As is indicated in the table above, by the year 2044 the ALWC will require about 635 acre-feet of water supply, with an average production system delivery capacity of 393 gpm, and up to 763 gpm for peak periods of the year. This assumes the planned water conservation efforts are successful.

As can be seen on **Figure 4.4**, the demand for water increases sharply through year 2024 at 626 afy, then slowly increases through year 2044 to about 635 afy.

4.2 Water Budget

The water supply for the ALWC must satisfy the projected future water demands of 626 afy by 2024 and 635 afy by year 2044. As developed in Section 3.3, the production capacity of the ALWC existing well field is projected to decrease with time. Comparing the projected water supply to the projected future demands, it can be seen that a deficit in supply occurs, and continues through the Plan period.

The water budget is summarized in **Table 4.2** and shown graphically as **Figure 4.5**.

Table 4.2 – Water Budget for ALWC from year 2004 to 2044 (in afy)

Year	Demand	Supply	Deficit
2004	539	520	**19**
2008	560	466	**94**
2012	583	412	**171**
2016	600	358	**242**
2020	613	304	**309**
2024	626	250	**376**
2028	628	240	**388**
2032	629	230	**399**
2036	631	220	**411**
2040	633	210	**423**
2044	635	200	**435**

As the above table indicates, an additional water supply of 435 afy is required to meet current and future demands to year 2044. Approximately 10 afy to 15 afy of additional new water supply is required for each year throughout the 40-year Plan.

5.0 SHORT-TERM WATER SUPPLY ALTERNATIVES (2004 to 2012)

5.1 Introduction

As discussed in Section 4.0, additional water supply resources are needed for the ALWC over the next 40-year planning period. Various water supply development alternatives for meeting the short-term and long-term water demands of the ALWC are presented. The short-term water supply alternatives were developed to meet the water demands over the next 8-years, from years 2004 to 2012, and it is assumed that these can be implemented in a relatively short time frame. The short-term water supply development alternatives considered feasible include the following:

- Existing Reclaimed Water Irrigation
- Deepen Well E-2
- Deepen Well E-4
- Deepen other Cretaceous Formation Wells

These short-term alternatives are presented in this section.

The long-term water supply alternatives were developed to meet the water demands over the following 32-years, from years 2012 to 2044. It is assumed that these alternatives will require a longer planning and implementation period. The long-term water supply development alternatives considered feasible include the following:

- Expanded Reclaimed Water Irrigation
- San Andres Well Field
- Regional Water Projects

These long-term alternatives are presented in the following section.

5.2 Existing Reclaimed Water Irrigation

As will be discussed in detail in Section 10.0, the ALWC wastewater treatment plant (WWTP) treats an average of 12,000 gallons of domestic sewage each day, and up to 28,000 gallons on peak days. The sewage is generated from the condominiums and Alto Lakes Golf and Country Club, the only areas currently with a sewer collection system. Recently, the NMED published guidelines for re-using the treated sewage effluent, or reclaimed water, for irrigation. The NMED requires additional treatment to reduce total solids and disinfection. Class 1A reclaimed water may be used where public access is unrestricted, such as golf courses and parks. By treating the WWTP effluent to Class 1A reclaimed water quality and using it for golf course irrigation, an equivalent amount of potable water is conserved. Limited by the capacity of the WWTP of 30,000 gpd, a maximum of about 30 afy of reclaimed water can be used, with a corresponding reduction in potable water requirements.

To accomplish this, tertiary filtration will be added to the WWTP, along with ultraviolet (UV) disinfection, and the reclaimed water pumped into Lake No. 1 for subsequent irrigation use. To maximize the WWTP capacity of 30,000 gpd (30 afy) continuous, two things need to be accomplished. First, because the average flows to the WWTP are only 12,000 gpd, there remains about 18,000 gpd excess treatment capacity. An additional 18,000 gpd of wastewater flows can be generated from approximately 160 residences. A small low-pressure (or vacuum) sewage collection system can be installed to serve 160 existing residences, and connected to the WWTP. This will generate an annual average of approximately 30,000 gpd (30 afy) reclaimed water. Second, because peak daily sewage flows can be more than two times the average flows, an equalization basin should be constructed upstream of the WWTP to "equalize" the peak flows to a maximum of 30,000 gpd. Refer to **Figure 5.1** for the conceptual area that could be sewered.

This short-term alternative may produce (conserve) up to 30 afy of new water.

5.3 Deepen Well E2

ALWC well E-2 is currently completed at a total depth of 648 feet bgl, in the Cretaceous Dakota Formation. Deepening this well to about 1,750 feet bgl will allow the well to produce water from approximately 400 feet of saturated San Andres Formation. The San Andres Formation has the potential to provide water of a better quality (by reduced TDS), as well as increased production capacity from the well and a long-term production. The anticipated production for a well completed at this depth is several hundred gallons per minute. For this Plan, it will be assumed that a deepened Well E-2 will produce about 100 gpm (peak), and will result in an overall 60 afy of new water supply (producing for 60% of the time). This alternative may satisfy the short-term deficit to about year 2008.

Water quality from the San Andres formation is anticipated to improve, with an expected TDS of around 1,300 mg/L.

This short-term alternative may produce up to an additional 150 afy of new water.

5.4 Deepen Well E-4

The ALWC Well E-4 is currently completed to a depth of 1,240 feet bgl, in the Permian-age Grayburg Formation. Deepening this well to around 1,700 feet will allow this well to produce water from approximately 500 feet of saturated San Andres Formation. Similar to the deepening of Well E-2, it is assumed that increased production from Well E-4 may result. It is assumed for this Plan, that the production from Well E-4 will be increased to 60 afy. More importantly, deepening of this well (as also Well E-2) will extend the useful life of the ALWC well-field. Although the results of deepening these wells is unknown at this time, the benefits to the ALWC are very high if proved to be successful, and makes this alternative worthy of pursuing. However, this alternative will only be pursued if the deepening of Well E-2 is successful.

5.5 Deepen Other Cretaceous Formation Wells

Other options for deepening existing ALWC wells involve maximizing penetration of the Cretaceous rocks, thereby increasing the potential production interval. This scenario avoids any potential problems with requesting permits for wells which would be deepened into the San Andres. **Table 5.1** summarizes wells that could be deepened into more of the Cretaceous aquifer. Wells penetrating the Cretaceous formations typically have relatively low yields except where the rocks are fractured. Wells E-1 and E-5 appear to be drilled into faults which have fractured the aquifer material, thereby allowing wells to yield greater quantities of water from the aquifer than would normally be expected (**Tables 3.2 and 3.3**). Deepening of Well 13 is likely to also penetrate a fault, thus providing the possibility of increased yield. The other five wells have a chance of penetrating rocks that were fractured by nearby faulting, and have a slight chance of penetrating a fault, depending on the orientation of the fault (**Table 5.1**).

Table 5.1 Existing Alto Lakes Water Corporation wells that could be deepened into the Cretaceous aquifers and approximate depth to be deepened.

Well	Current Depth (feet)	Projected amount to deepen To penetrate full Cretaceous section (feet)	Approximate total depth after deepening (feet)	Comments
E-1 (S-16)	675	700	1,400	will possibly penetrate fault
9 (S-8)	573	1,700	2,300	will possibly penetrate fault
12 (S-11)	342	1,200	1,550	will possibly penetrate fault
13 (S-13)	282	1,300	1,600	Likely to penetrate fault, which may increase yield
16 (S-15)	946	850	1,800	will possibly penetrate fault

The likely production rate from wells deepened into the Cretaceous aquifer is assumed to be a maximum of 100 gpm for the purpose of this Plan. Deepening Well nos. E-1, 9, 12, 13 and 16 may produce an additional average of 250 gpm (400 gpm operating approximately 60% of the time) at a water quality of around 1,500 mg/L to 2,000 mg/L TDS. Any additional water produced from the Cretaceous aquifers will be treated to reduce the TDS.

This short-term alternative may produce an additional 50 afy of new water per well initially, however, the production from the deepened wells will decrease over time. It is assumed that the decline occurs over a twenty-year period, to one-half capacity. **Figure 5.2** indicates a potential total well field capacity after deepening.

6.0 LONG-TERM WATER SUPPLY ALTERNATIVES (2012 to 2044)

6.1 ALWC Workshops

A series of working sessions were held with the ALWC Board during the summer and fall of 2003, which evaluated a number of potential water development projects. After developing an initial list of approximately ten alternatives, the following were determined to be the most feasible as potential long-term water supply alternatives.

6.2 Expanded Reclaimed Water Irrigation

As discussed in Section 5.4 above, reclaimed water can be utilized for irrigation of the golf course. The total golf course irrigation requirement is 260 afy. Assuming an approximate 70% return flow to the WWTP from domestic uses, then about 370 afy of domestic/commercial water consumption would be required to supply all of the golf course irrigation needs with reclaimed water. If about 1,700 residential accounts (85% of build-out), and the existing commercial accounts, were connected into a sewer collection system and treated at the WWTP to reclaimed water, then this could be accomplished. Refer to **Figure 6.1** for the relationship between irrigation demands and potential reclaimed water.

In addition, the regulations regarding individual septic tank and drain fields for sewage disposal are in the process of changing. Draft regulations by the NMED are proposing a minimum ¾ acre lot for allowing conventional septic systems. Lots smaller than ¾ acre will be required to use treatment systems or connect to a community collection and treatment plant. These new regulations are scheduled to be promulgated this year (2004) without a grandfather provision. This will have a great impact on the ALWC. Approximately 1,380 lots (68%) in the Alto Lakes community are less than ¾ acre, about 210 (10%) are ¾ acre, and about 430 (21%) are greater than ¾ acre. Because these are scattered throughout the development, a collection and treatment system will be required to cover the entire community.

One of the largest demands on the potable water system, from a peaking standpoint, is the golf course irrigation. Annually, the demands total about 260 afy, or an average pumping rate of 160 gpm. During peak summer months, the required pumping rate can exceed 320 gpm. A dedicated well field production capacity of at least 320 gpm is required to satisfy peak irrigation requirements. If sufficient storage can be developed, then the required dedicated production capacity for the golf course irrigation can be reduced to around 160 gpm. Approximately 25 acre-feet (16 MG) of equalizing storage will be required to allow a continuous production rate of 160 gpm. Additional lake storage may be used to develop the added storage capacity, however, evaporation and leakage losses should be minimized. Storage can also be added at the new WWTP, to store reclaimed water. **Figure 6.4** shows the relationship of seasonal irrigation demands, constant production capacity and required storage.

Additionally, some wells may be dedicated to golf course irrigation, then phased out as reclaimed water is phased in. In this scenario, well nos. 12, 13 and 16 may be isolated and dedicated for golf course use. These are currently pumped through the booster stations and pipeline along Deer Park Drive to the storage tanks. Their combined current production capacity is about 185 gpm. In this case, storage would allow these wells to serve the irrigation requirements, and as their production capacity diminished, reclaimed water would replace their supply.

This long-term alternative may produce (reclaim) up to 260 afy of new water.

6.3 San Andres Well Field

Hydrogeologically, the optimal location to develop water outside of the Alto Lakes property is eastward, across the main fault zone that lies just east of Alto Lakes (**Figure 6.2**), and farther into the Hondo and Roswell basins (**Figure 6.3**). Between this fault zone and the Pecos River, the San Andres and Yeso Formations are exposed from the surface to perhaps 1,000 or 2,000 feet bgl and dip gently westward (Kelley, 1971). Well yield can be expected to be between 100 and 500 gpm (NMOSE WATERS database). Between the Pecos River and a line approximately 60 miles east of Alto Lakes (**Figure 6.3**), the San Andres is an artesian aquifer, and yields are likely to be in the higher end of that range there (Welder, 1983).

Developing wells east of Alto Lakes as close to major roads with easements that will support construction of pipelines is recommended. Buying existing water rights would be the most advantageous method of acquiring additional water supplies. Permit applications would have to be submitted to the NMOSE for changing the purpose and place of use of the water. If a new well were to also be drilled, a permit to change the point of diversion would also be required. These permits would be subject to review by the NMOSE, and public protests. The primary advantage of purchasing existing water rights and piping the water to Alto Lakes is that upstream water rights holders are not adversely impacted, because the point of diversion for water does not change.

6.3.1 Within 1 mile distance

Within the Alto Lakes property boundary, the southeastern portion is the optimum location to target the combined San Andres and Yeso aquifers (**Figure 6.2**). Here the aquifer is saturated between approximately 1,250 and 3,500 feet bgl. Outside the Alto Lakes property, the best place to access the San Andres / Yeso is eastward and southeastward across the fault zone, where it is saturated between approximately 200 and 2,500 feet bgl. Wells in this area would need to be completed to depths of about 600 to 1,000 feet in order to penetrate at least 300 feet of aquifer.

6.3.2 Within 10 miles distance

The optimal site for water production in this distance range is east of the main fault zone where the San Andres and Yeso Formations are present (**Figure 6.3**). Beyond this, no site has been identified which is hydrologically preferred over another, so the ideal locations identified at this point in the investigation are closest to roads, where pipelines can be built.

6.3.3 Within 100 miles distance

At this level of hydrogeologic investigation, there is no area that stands out as better than another with respect to water production from the ubiquitous San Andres / Yeso aquifer east of Alto Lakes. The first place to look is eastward along roads, where pipelines can more easily be built along existing easements. As distance increases from Alto Lakes, of course, the cost of transporting water increases. However, well yields are likely to be higher where the aquifer is artesian closer to Roswell along the Pecos River where well yields of 1,000 gpm or more are common (**Figure 6.3**).

This long-term alternative may produce up to an additional 400 afy of new water.

6.4 Regional Water Projects

6.4.1 City of Alamogordo

The City of Alamogordo is currently developing a regional water supply project in the Tularosa basin, located approximately 26 miles north of Alamogordo. As recommended in the Tularosa Basin and Salt Basin Regional Water Plan 2000-2040 (Livingston and Shomaker, 2002) up to 10,000 afy of brackish groundwater (2,500 mg/L TDS) will be treated by desalination technology to produce 800 mg/L potable water. This new regional water supply will be utilized by the City of Alamogordo, the Village of Tularosa, HAFB and possibly others in the Tularosa Basin. Once in place, (as recommended in the Regional Plan) the ALWC may propose to "purchase" project water from the desalination facility, and possibly trade for closer, City of Alamogordo owned Bonito Lake water. However, discussions held with the City indicated that until such time as the project is in place, and other regional users have opportunity to participate, the City of Alamogordo is not entertaining any proposals.

It is unknown at this time how much additional new water this long-term alternative may produce.

6.4.2 Village of Ruidoso

The Village of Ruidoso is also considering developing additional water supplies, as recommended in their recent 40-Year Plan. One area under consideration is a proposed well field near Carrizozo, in the Tularosa Basin. Inter-basin transfers would have to be accomplished, and the project is only conceptual and possibly years down the road. Discussions with the Village of Ruidoso indicated that there is a potential for regional water supply partners as the project moves forward.

It is unknown at this time how much additional new water this long-term alternative may produce.

6.4.3 Regional Project Participation

Besides the ALWC, there are 35 other water purveyors in the Ruidoso area (NMED records, 2003) with a service population of more than 20,000. All of these community systems will need additional water supplies in the future. The NM

Interstate Streams Commission (ISC) is the state agency responsible for developing the State Water Plan, and the Regional Water Plans. The ISC provides funding for studies to develop regional water supplies, in accordance with the Regional Water Plan. One study under development is the Upper Hondo Watershed Study, where regional water supplies for Ruidoso, Ruidoso Downs, Hollywood and Capitan are considered. The ALWC should initiate the formation of a regional water supply study with the 35 other water purveyors, and obtain funding from the ISC.

7.0 EVALUATION OF ALTERNATIVES

7.1 Introduction

This section evaluates the water supply development alternatives. Two brainstorming sessions were held with the ALWC Board of Directors during the summer and fall of 2003, where a preliminary list of alternatives was developed for further evaluation. The preliminary water supply alternatives were screened based on quantity of water produced, feasibility of implementation, legal/environmental issues, project economics potential for regional project and timing of implementation. Those potential alternatives which could be implemented sooner, with a high feasibility and reasonable cost of water analysis were ranked highest. This section discusses the initial alternatives considered, and summarizes the final short-term and long-term water supply development alternatives.

7.2 Initial Alternatives Considered

The preliminary list of water supply development alternatives included the following:

- Water Conservation
- Wastewater Treatment and Aquifer Storage and Recovery
- Reducing Unaccounted Water Loss
- Purchase or Lease Bonito Lake Water (Regional)
- Participate in Village of Ruidoso - Carrizozo Well project (Regional)
- Potential Water Lease project
- San Andres Well Field (Regional)
- Deep Wells and Desalination

- Large Water Storage project
- Reclaimed Water for Golf Course Irrigation

7.3 Summary of Alternatives

Based on the previous sections 5.0 and 6.0, the following section evaluates the alternatives in greater detail and includes estimated capital costs, O&M costs and present worth value based on a 20-year life and a 6-percent interest rate. Finally, an overall cost to develop the alternative in terms of dollars per acre-foot/per year of capacity is given.

The following recommended short- and long-term water supply development alternatives are listed in order of proposed implementation.

7.3.1 Short-Term Alternatives

The first short-term water supply development alternative recommended for implementation is reclaiming the existing wastewater treatment plant effluent for use as irrigation water for the golf course. This project has a dual benefit in that not only will it provide an additional 15 afy of irrigation water, but the recent NMED regulations reducing or eliminating the use of septic systems will require alternative disposal.

The costs for this alternative include improvements to the wastewater treatment plant, tertiary effluent filtration and disinfection, and lift station and piping to the golf course lake. This project was ranked first because the resource is available and the NMED Discharge Permit for the effluent disposal is currently under renewal, and continued use of the drain fields for disposal is not likely.

The second short-term alternative recommended for implementation is to deepen ALWC Well E-2 into the San Andres formation, to increase production and possibly improve water quality. A permit from the NMOSE has been applied for, and is awaiting approval. Costs include well drilling and equipping. This project, after approval of the permit, can be implemented in a short time. If successful, then the third alternative will be to deepen ALWC Well E-4.

Finally, the fourth short-term water supply alternative is the deepening of other ALWC wells into the Cretaceous formation, to increase short-term productivity and extend the life of the well field. Costs include drilling and equipping.

7.3.2 Long-Term Alternatives

The first long-term water supply development alternative recommended is the expansion of the reclaimed water system. The dual benefits associated with this project, both from the potential need to provide alternative waste water disposal for lots ¾ acre and less, as well as providing irrigation water for the golf course makes this alternative the top ranking. Costs for this project include a subdivision-wide sewage collection system, new wastewater treatment plant (WWTP) including tertiary filtration and disinfection and piping back to the golf course lakes. The full implementation and realization of the additional irrigation water will occur as the Alto Lakes community develops to build-out by 2024.

The development of an off-site (San Andres) well field may provide substantial additional groundwater supply. This project, whether within 1 mile or as distant as 100 miles, should be viewed as a regional water supply project. Potential for outside funding exists because the project would have the benefit of supplying other water users in the region. Costs include well drilling and equipping, pump stations, storage tanks and delivery piping.

The Alamogordo and Ruidoso Regional projects are long-term potentials and should be pursued with the respective municipality. Costs for these were not developed, as level of participation is unknown at this time.

The following **Table 7.1** summarizes the recommended short-term and long-term water development alternatives.

Table 7.1 – Summary of Water Development Alternatives

Alt. No.	System	Alternative Description	New Water Capacity	Capital Costs	O&M Costs	Total PW	$/afy Capacity **
Short-Term							
1Sa	WW	Existing Reclaimed	15 afy	$0.2M	$6K	$0.3M	$20K
1Sb	WW	Additional Reclaimed	15 afy	0.7M	$25K	$1.4M	$90K
2S	W	Deepen E-2	60 afy	$0.2M	$6K	$0.3M	$5K
3S	W	Deepen E-4	60 afy	$0.1M	$3K	$0.2M	$3K
4S	W	Deepen wells	250 afy	$0.9M	$30K	$1.1M	$5K
Long-Term							
1L	WW	Expand Reclaimed	260 afy	$14M	$0.5M	$20M	$80K
2La	W	San Andres - 1 mi.	400 afy	$4M	$0.02 M	$5M	$12K*
2Lb	W	San Andres - 10 mi.	400 afy	$9M	$0.1M	$9M	$20K*
2Lc	W	San Andres - 100 mi.	400 afy	$17M	$0.5M	$23M	$60K*
3L	W	Alamogordo Regional	N/A	N/A	N/A	N/A	N/A
4L	W	Ruidoso Regional	N/A	N/A	N/A	N/A	N/A

* - includes cost of water rights at $4,000 afy
** - Alternative development cost for comparison purposes, expressed as Present Worth dollars per unit New Water Capacity (not cost per AF).

8.0 WATER DEVELOPMENT PLAN

8.1 Short-Term Recommendations (2004 to 2012)

For the immediate and short-term period over the next eight years, additional water supplies of approximately 180 afy are needed to augment existing ground water supplies and provide for drought protection. The short-term water development alternatives are designed to provide additional water in as short a time period as possible. The immediate short-term recommendations are: .

8.1.1 Existing Reclaimed Water System

Year 2004: Convert the existing WWTP effluent to reclaimed water, and use for irrigation of the golf course. Add tertiary treatment to the WWTP, UV disinfection and a lift station and 3-inch piping to pump the treated reclaimed water to golf course Lake No. 1. Total additional water produced: 15 afy.

Year 2005-06: Add equalization basin to WWTP and initiate development of small sewer collection system to add 160 residences to WWTP. Total Additional water produced: 15 afy. This will depend upon public acceptance of partially sewering Alto.

8.1.2 Deepen Well E-2

Year 2004: Obtain permit to deepen from NMOSE and commence deepening of Well E-2 approximately 1,720 feet. Total additional water produced: 150 afy.

8.1.3 Depending on success of Well E-2, deepen Well E-4. Obtain permit to deepen from NMOSE and commence deepening of Well E-4 approximately 500 feet. Total additional water produced: 150 afy.

8.1.4 Deepen Additional Wells

Depending on success of Well E-2, begin well drilling program to deepen additional ALWC wells:

Year 2005: Deepen Well E-1 approximately 700 feet, to a total depth of 1,400 ft.
Year 2006: Deepen Well 9 approximately 1,700 feet to a total depth of 2,300 ft.
Year 2009: Deepen Well 12 approximately 1,200 feet to a total depth of 1,550 ft.
Year 2010: Deepen Well 16 approximately 850 feet to a total depth of 1,800 ft.
Year 2012: Deepen Well 13 approximately 1,300 feet to a total depth of 1,600 ft.
Total additional water produced: 250 afy.

These short-term water development alternatives may produce up to an additional 250 afy or more of new water, with a quality of 1,500 mg/L to 2,000 mg/L TDS. These should provide an adequate water supply for the ALWC through the year 2012.

8.2 Long-Term Recommendations (2012 to 2044)

For the long-term period from the next eight to forty years, additional water supplies of approximately 435 afy are needed to augment existing ground water supplies and provide for drought protection. The long-term water development alternatives are provided for developing a long-term water supply. The long-term water supply development recommendations are:

8.2.1 Expanded Reclaimed Water System

Expand the reclaimed water system to include the entire Alto Lakes community, to ultimately replace the golf course irrigation supply of 260 afy. The implementation of this alternative should be timed to correspond with 75% of subdivision build-out; or as required by the NMED liquid-waste disposal regulations.

Year 2012: Phase 1 – Construct 0.125 MGD WWTP at Deer Valley; construct main sewer collection system and connect existing clubhouse and condominiums and approximately 500 residential customers.
Year 2016: Phase 2 – Expand WWTP to 0.187 MGD construct additional collection system and connect approximately 500 residential customers;
Year 2020: Phase 3 - Expand WWTP to 0.250 MGD construct additional collection system and connect approximately 500 residential customers.
Year 2024: Phase 4 - construct additional collection system and connect approximately 340 remaining residential customers.

Refer to Section 10 for prioritized phasing plan.

8.2.2 Develop San Andres Well Field

Year 2007: Initiate hydrogeological study to identify areas to develop San Andres wells. Identify site for developing exploratory well within 10 miles of ALWC; begin permitting and drill exploratory well.
Year 2008 – 2012: Begin acquisition of San Andres water rights and development of up to 400 afy of San Andres water, possibly as a regional water supply project.

8.2.3 Participate in Regional Water Supply Project

Year 2005: Begin participation in regional water supply study with other local water purveyors.

These long-term water development alternatives may produce up to an additional 400 afy or more of new water, with a quality of 1,500 mg/L TDS. These should provide (in conjunction with the short-term alternatives) an adequate water supply for the ALWC through the year 2044. Refer to **Figure 8.1** for a summary of the short and long term water supply alternatives and to **Figure 8.2** for a water balance including the recommended water supply alternatives.

9.0 WATER SYSTEM EVALUATION AND RECOMMENDATIONS

9.1 Existing Water System Description

9.1.1 Water Distribution System Piping

The Alto Lakes Water Corporation water system consists of more than 30 miles of distribution system piping (Refer to **Figure 9.1 and 9.2 to 9.10**). For more detail see 24" x 36" water system maps, submitted under separate cover (see Section 1.5). The piping ranges in size from 2-inch to 6-inch, and pipe type includes PVC, asbestos cement pipe (AC) and galvanized iron pipe (GI). A tabulation of pipe sizes and approximate lengths follows in **Table 9.1**:

Table 9.1 – Water Distribution System Piping

Pipe Size	Total Pipe Length	Pipe Types
2-in	113,000 feet	PVC, GIP
3-in	6,900 feet	PVC
6-in	51,100 feet	AC, PVC

9.1.2 Wells

The ALWC wells are discussed in detail in Section 3.0.

9.1.3 Water Storage

Current distribution system water storage consists of 460,000 gallons in two storage tanks, located at the highest point in ground elevation (7,540) in the ALWC service area. The water storage tanks serve as suction supply to the booster pumping station adjacent to the golf course (Refer to **Figure 9.1**). The storage tanks are not currently gravity service for any portion of the distribution system.

The total amount of storage a water system requires is based upon a number of factors. The American Water Works Association (AWWA) recommends a minimum amount of two-times average day demands (one peak day demand) for emergency storage. The amount of storage to be used as "equalizing" the flows for peak hourly demand is about 30% of the daily demand. This amount is (or can be) included in the total storage provided as emergency storage, and is not additional.

Storage requirements for fire fighting are established by the Insurance Services Office (ISO) rating criteria. For residential fires, the spacing between the homes dictates the amount of fire flow the water system should provide. For the ALWC, a residential fire flow of 500 gpm to 750 gpm is required (AWWA M31, Table 1-5). The fire flow duration is 2 hours, which results in a residential fire storage amount of 60,000 gallons to 90,000 gallons. The Alto Lakes Golf and Country Club clubhouse has recently installed a fire suppression sprinkler system, rated at 500 gpm. Therefore, the required fire storage amount for the clubhouse is 60,000 gallons. For the condominiums, the required fire flow is assumed to be equal to two-family dwellings in close proximity, or a minimum of 1,500 gpm (AWWA M31, Table 1-5) and storage of 180,000 gallons. (The Bonito Fire District may have requirements additional to these).

According to the AWWA, total required fire storage may be reduced by the available water supply production capacity (AWWA Water Distribution Systems Handbook, 2000, p. 10.14). For the ALWC, the minimum well production capacity will supply peak day demands. Therefore, because the well production capacity plus the provided emergency storage is greater than the maximum required fire storage amounts, then additional storage for fire fighting is not needed. (The Bonito Fire District may have requirements additional to these).

Therefore, the minimum water storage for the ALWC should be at least 395,000 gallons for 2004 and 635,000 gallons for 2024. Hence, the current water storage amount of 460,000 gallons is adequate for the 2004 requirements, and another 175,000 gallons of storage is needed by 2024. When the water distribution system is re-zoned (as discussed in following sections) the total storage requirements may be distributed.

9.1.4 Booster Stations

One booster station at the storage tanks provides distribution system pressure of approximately 60 psi. Three variable speed pumps produce up to about 800 gpm peak flow, and are controlled by system pressure. Two are normally run, with one as stand-by. An emergency generator is also present to run two boosters.

9.1.5 Pressure Reducing Valves

Because of the topography of the ALWC service area, excessive water pressures can develop. Pressure Reducing Valves (PRV's) are used in the distribution system to regulate the current water pressures from around 50 psi to about 150 psi. Currently 20 PRV stations are used throughout the system, and not in a compound configuration where a small PRV is used as a by-pass for the continuous daily flows, and a large PRV used for higher peak flows and fire flows. These are typically a high maintenance item for system operators, and when the settings are off, create pressure problems and water hammer effects can occur. Refer to **Figure 9.11** for the existing system hydraulic profile.

9.1.6 Disinfection

The water is disinfected using sodium hypochlorite (bleach) as the water enters the storage tanks, and receives adequate detention time in excess of 60 min. Free chlorine residuals are measured weekly in the distribution system to ensure proper disinfection is achieved, to maintain a minimum 0.2 mg/L.

9.1.7 Operation

The water system is currently operated by four operators, who check tank levels and well status. The operators drive to the facilities and manually control the wells. Typically, the wells run for approximately 12 to 16 hour cycles daily. The booster station is automatic, and controlled by water distribution system pressure. The pumps operate with variable frequency drive (VFD) motors to maintain constant system pressures of 60 psi at the booster station.

All wells pump directly into the storage tanks (unless diverted to the golf course lakes). Prior to entering the storage tanks, the water is disinfected.

From the storage tanks, water is pumped through the booster station, which pressurizes the upper (top) zone to about 60 psi, then the lower zones are fed via PRV's. Currently, all water not used for golf course irrigation is pumped through the booster station.

9.1.8 Water Quality Problems

Discussions with the ALWC operators indicated that widespread areas in the distribution system experience "red" water occasionally. This is caused by oxidized soluble iron or rusting of water system components (valves, etc.). Typically, areas where flow is slow or stagnate for periods of time encourage red water problems.

The elevated levels of soluble iron and manganese present in the ALWC groundwater cause red water problems, as well as staining of porcelain sinks and laundry. The addition of hypochlorite for disinfection oxidizes these metal ions and causes them to precipitate as "rust". This also causes additional hypochlorite consumption, and some difficulty in maintaining free chlorine residuals in distal parts of the distribution system. These rust particles settle out in the distribution system during typical low flow periods. On weekends and other high use times, the velocity in the distribution system increases and carries the rust to the customers tap. Additionally, if not all of the iron and manganese are oxidized during disinfection, when customers use household bleach during clothes washing, the bleach will complete the oxidation process in the washer and stain the clothes there. Manganese can also accumulate in the water heater during periods of non-use, and flush out when use resumes, causing black water problems.

The solution to the red water problems is to remove the iron and manganese from the water altogether. This will be addressed in the discussion on water treatment.

9.2 Water System Model

A water system computer model was developed to simulate flows and pressures within the distribution system. Cybernet v. 3.0 by Haestad Methods Inc. software was used to develop the model. The existing system piping configuration was modeled for average day demands, peak day demands and peak day demands plus fire flows. Refer to the fold-outs of the water model mapping and the model results included in Volume II of the **Appendix**.

The ultimate water system and demands (year 2044) was also simulated, with a minimum 6-inch pipe size. The ultimate system piping configuration was modeled for average day demands, peak day demands and peak day demands plus fire flows. Refer to the fold-outs of the water model mapping and the model results included in Volume II of the **Appendix**.

9.3 Existing System Deficiencies

The existing water system will provide adequate service for average and peak day flows, under the current demand scenario. For peak flows plus fire flows, the water system is inadequate. Maximum fire flow capability is limited to about 250 gpm in the majority of the system.

9.4 Water System Improvements

Ultimately, to meet ISO fire flow requirements of 750 gpm, the water distribution system piping should be minimum 6-inch diameter. Additionally, the water system should be "re-zoned" to gravity feed zones from storage, and not 100% pumped as in the current configuration. By dividing the water system into 5 pressure zones, only Zone 1 is pressurized by pumping, and the subsequent 4 zones (lower in elevation) are pressurized by gravity head from either the upper storage tanks or dedicated zone storage and/or some PRV stations. Refer to **Figure 9.12 and 9.13** for a plan and hydraulic profile of the recommended zone improvements, and a foldout of the water system model in the **Appendix Vol. II**.

The following Table 9.2 shows the proposed zone elevations, pressures and storage amounts:

Table 9.2 – Proposed Water System Zone Elevations, Pressures and Storage

Zone	Upper service	Lower service	Minimum Press. psi	Maximum Press. psi	2044 Peak Demand	2044 Storage
1	7,565	7,450	50	90	120,000	340,000
2	7,450	7,335	50	100	215,000	
3	7,335	7,220	50	100	180,000	180,000
4	7,220	7,100	50	100	40,000	40,000
5	7,100	6,920	50	125	80,000	80,000
Total					**635,000**	**640,000**

As discussed above, additional distribution storage is required to meet two average day (one peak day) emergency storage volumes and the ISO 2-hour fire flow duration. Approximately 180,000 gallons of additional storage is recommended by year 2024. This can be accomplished at the upper (Zone 2) tank location, or combined with lower zone(s) storage.

9.5 Water Quality Improvements

As previously discussed, distribution system water quality will be improved through TDS and hardness reduction, and elimination of red water problems.

As shown in Section 3.0, the ALWC wells meet the primary drinking water quality standards, and treatment for these is not required. However, it is recommended that the overall water quality be improved, for taste and plumbing considerations. Reduction in the level of total-dissolved-solids (TDS) to an average of 500 mg/L (or parts per million, ppm) was selected by the ALWC as a goal. The NMED recommended secondary maximum TDS level is 500 ppm. A reduction in TDS will have a positive impact on water customers. First, the taste will be substantially improved, as a large component of the existing water quality are sulfates, which impart an unpleasant taste. Secondly, those residents using water softeners will experience less salt consumption for softener regeneration, resulting in a savings in cost. Third, as a result of reduced salt consumption for regeneration, the wastewater will have a higher quality for re-use (discussed in Section 5.0). Fourth, plumbing fixtures will last longer (due to decreased scaling), at a savings to consumers. And last, water system components will require less maintenance and last longer due to the reduction in scale formation, an indirect savings to the consumer.

Besides TDS and sulfate reduction, chlorides, iron and manganese levels will also be reduced. Currently, iron and some manganese levels are being reduced at the tap