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Transcript Exhibit(s)

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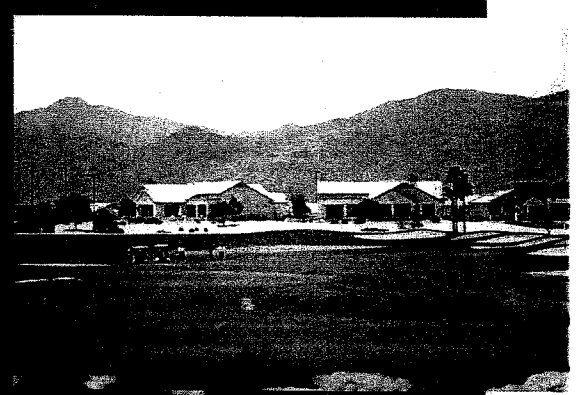
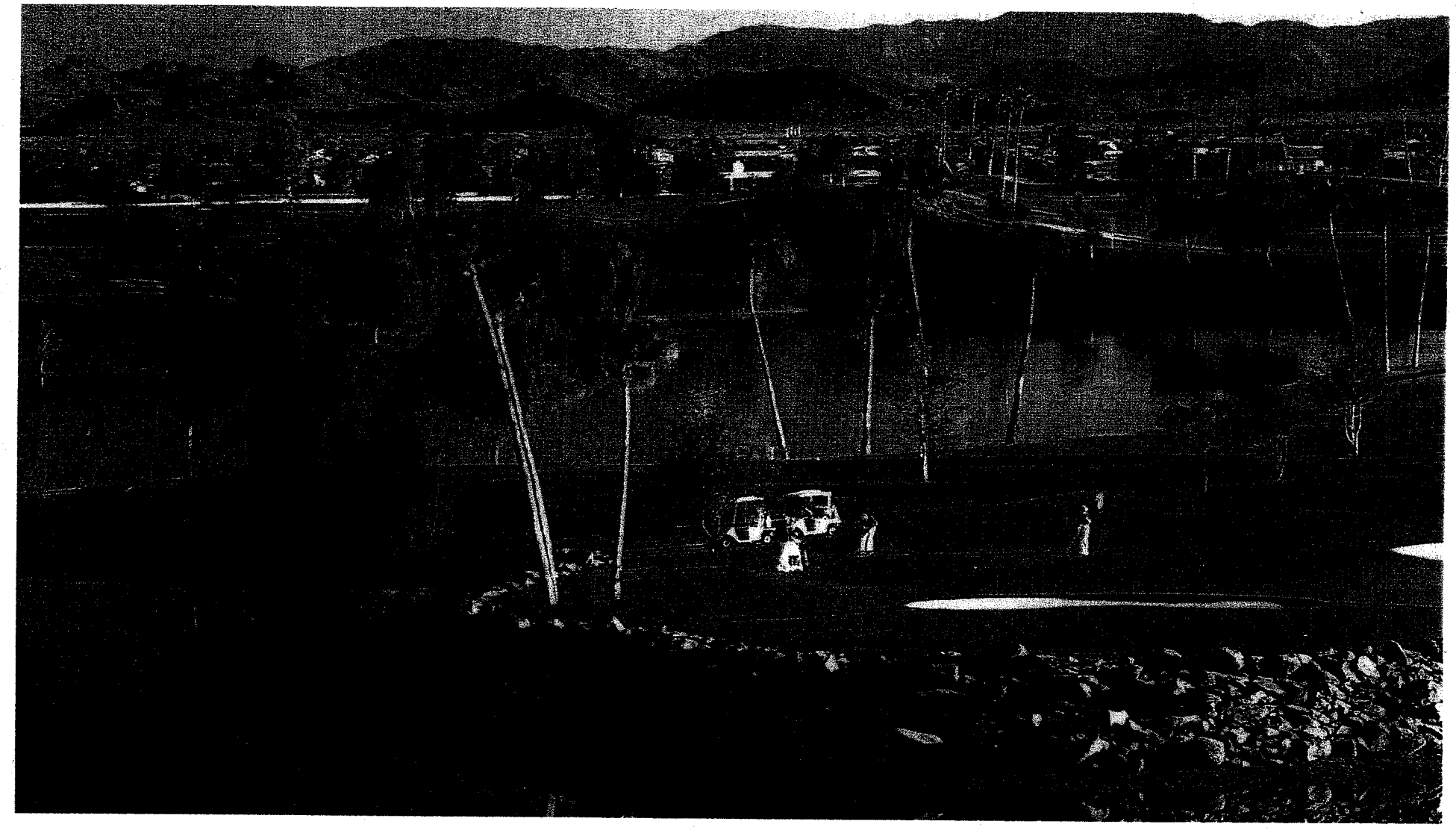
SW-02334A-98-0577

Exhibit # : A-1,2,3,4,5,6,7,8,9,10,11,12

EXHIBIT
A-1
Attorney





CITIZENS
water resources

Sun City/Sun City West/Youngtown Groundwater Savings Project

Preliminary Engineering Report

Registered Professional Engineer (Civil)
CERTIFICATE NO.
15268
DAVID W.
BURAS
Date Signed 7/26/00
ARIZONA, U.S.A.

HDR

July 2000

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TABLE OF CONTENTS

PART A – REPORT OVERVIEW A-1

1 Project Purpose A-1

2 Background Information A-1

3 Groundwater Savings Project with Local Golf Courses as Recommended by the CAP Task Force A-2

4 Project Participants A-3
- Consulting Team A-3
- CAP Technical Advisory Committee A-3
- Other Critical Project Participants A-4

5 Organization of Report A-5

PART B – GOLF COURSE ASSESSMENTS AND OPERATING PARAMETERS B-1

1 Facility-specific Parameters B-1
- Operator Surveys B-1
- Water-handling Schematics B-5

2 Historical Water Use B-10
- Historical Annual Totals B-10
- Estimated Monthly Usage B-10
- Peak Demand B-12

3 Theoretical Water Use B-12
- Methodology for Predicting Irrigation Needs B-12
- Theoretical Facility Irrigation Requirements B-14

4 Water Delivery Capabilities of the System B-15
- CAP Allocations to Sun City West and Sun City West Participating Facilities B-15
- Relationship Between Delivery Capability and Demand B-15
- Delivery Profile B-15
- Summary B-17

5 Water Quality B-17
- Current Well Water B-17
- CAP Water B-17
- Projected Blending Ratios and Corresponding Water Quality Parameters B-17
- Salt Leaching B-17
- Projected Changes in Specific Ions B-18
- City of Scottsdale Experience B-18
- Survey of RWDS Users B-18
- Conclusions - Water Quality B-19

6 Treatment Systems B-19

PART C – FEASIBILITY OF A JOINT TRANSMISSION FACILITY WITH THE AGUA FRIA DIVISION C-1

1 Introduction C-1

2 Agua Fria Division Master Plan C-1

3 City of Surprise Pipeline Project C-2

4 Joint Facility Description C-2

5 Joint Facility Location C-3
- CAP Review of Design Plans C-3
- CAP Easement Requirements and Right-of-Way C-3
- CAP Operations C-3
- Joint Facility Route C-3
- GSP Alternative D Alignment C-4
- GSP Alternative E Alignment C-4

6 Joint Facility Cost C-4

7 Joint Facility Timeline C-6

8 Conclusion C-6

PART D – ANALYSIS OF MAJOR ELEMENTS OF THE GROUNDWATER SAVINGS PROJECT D-1

1 Introduction D-1
- CAP Trunk Pipeline D-1
- Pumping Systems D-1
- Storage Reservoirs D-1
- Treatment Systems D-1
- Distribution System D-1
- Control Systems (SCADA) D-1

2 CAP Trunk Pipeline D-1
- Criteria for Evaluation D-1
- Common Elements D-3
- Regulatory Considerations D-6
- Site Characterization D-8
- Geotechnical Summary D-8
- Geotechnical Conclusions D-9
- Maricopa Water District D-9
- Salt River Project Water Division D-9
- Salt River Project Electric Division D-9
- US West Communications D-9
- Southwest Gas D-9
- El Paso Natural Gas D-9
- Cox Communications D-10
- Arizona Public Service D-10
- Alternate A – Lake Pleasant Road Route D-10
- Alternate B – 115th Avenue Route D-13
- Alternate C – El Mirage Road Alignment D-15
- Alternative D Soils Considerations D-17
- Alternate E – Through Sun City West D-18
- Summary Evaluation of Alternate Routes D-45

3 Pumping Systems D-48

4 Storage Systems D-48

5 Treatment Systems D-50

6 Distribution Systems D-51
- Sun City West Distribution System D-51
- Sun City Distribution System D-57
- Distribution System Summary D-61

7 Peak Day CAP Water Delivery Schedule Control Systems D-61
- Introduction D-61
- Need for SCADA Telemetry for Proposed Groundwater Savings Project D-61
- Existing Citizens Utilities SCADA Systems D-61
- Typical Telemetry System Communication Components D-62
- Radio D-62
- Cost D-62

PART E - RECOMMENDED PLAN E-1

1 Introduction E-1

2 Alternatives Analyzed E-1

3 Recommended Plan Major Plan Components E-2
- CAP Trunk Pipeline E-2
- Pumping Station E-2
- Storage E-2
- Treatment E-2
- Sun City West Distribution System E-2
- Sun City Distribution System E-2
- Supervisor Control and Data Acquisition System E-2

4 Cost E-2

5 Schedule E-5

6 Groundwater Savings Plan Summary E-5

PART A – REPORT OVERVIEW

1 Project Purpose

The Sun Cities/Youngtown Groundwater Savings Project (GSP) is a conceptual water use plan developed by a community based task force called the CAP Task Force. The mission of the Task Force was to develop consensus on the best plan for the use of Central Arizona Project or CAP water in the Sun Cities and Youngtown. The Task Force recommended that the CAP water be used to replace groundwater pumping at local golf courses using either of two legal mechanisms: a groundwater savings project or a water exchange.

In order to bring the CAP water to local golf courses for the purpose of replacing groundwater pumping, the Task Force recommended that a non-potable pipeline be constructed from the CAP Canal to Citizens' water campus located north of Sun City and east of Sun City West. From the water campus, the CAP water would then be distributed through the existing effluent distribution system to golf courses in Sun City West and to a newly constructed distribution system to golf courses in Sun City.

On January 25, 2000, the Arizona Corporation Commission (ACC) approved the CAP Task Force's conceptual water use plan and recorded its order in Decision No. 62293. In its order, the ACC required Citizens to conduct a preliminary design and updated cost estimate for the GSP. In accordance with Decision No. 62293, the purpose of this Preliminary Engineering Report is to document a preliminary design and updated cost estimate for the GSP. Specifically the ACC required the preliminary design and updated cost estimate to consider two primary concerns raised during the proceedings before the ACC.

1. The feasibility of a joint transmission facility with the Agua Fria Division including the timeframe for as such joint transmission facility be investigated.

2. The need for all major elements of its proposed plan be justified.

The purpose of this Preliminary Engineering Report is to document the results of the preliminary design and updated cost estimate and to specifically address the two concerns raised in Decisions No. 62293.

2 Background Information

Since the early 1900s, groundwater levels have declined by approximately 300 feet in northwest Maricopa County. The Arizona Department of Water Resources (ADWR) and others have concluded that, over the next twenty-five years, water levels will decline another 300 feet if groundwater pumping is not curtailed in the area. In recent years, groundwater overdraft has been estimated at over 50,000 acre-feet per year for the northwest valley including the utilities operated by Citizens Water Resources that serve Sun City, Sun City West and Youngtown.

The purpose of the Sun Cities/Youngtown Groundwater Savings Project is to reduce a portion of this overdraft by meeting 6,561 acre-feet of demand in Sun City, Sun City West and Youngtown with CAP water instead of mined groundwater.

In 1985, Citizens secured a subcontract for CAP water for use in the Sun Cities. In 1993, the CAP was determined substantially complete and the CAP began assessing holding charges for the construction of the canal. In addition to making numerous requests to recover holding charges since 1985, Citizens also studied methods for using its CAP allocation. Most notably, Citizens prepared a study in 1994 that analyzed 20 options for using CAP water. This study concluded that storing water at the Agua Fria Recharge Project was the best option.

In 1995, within the context of a larger rate proceeding before the ACC, Citizens proposed storing its CAP allocation at the Agua Fria Recharge Project. In ACC Decision No. 60172, the Commission rejected this proposal. As a part of this proceeding, Citizens was strongly criticized for failing to consider the views of the community.

In response to this criticism, Citizens facilitated a task force to study the issue of whether or not the CAP allocation should be retained, and if retained, how the allocation should be used and paid for. Subsequent to its formation in early 1998, the CAP Task Force considered seven options including recharge projects, water treatment plants and groundwater savings projects. In the end, the Task Force concluded that the allocation should be retained. The Task Force also concluded that the best option for using the CAP water is to partner with local golf courses on a groundwater savings project. This conceptual water use plan is discussed generally in section 3, and it is the focus of this entire report.

In October of 1998, Citizens forwarded the Task Force's recommendation to the ACC in the form of an application. This application requested four approvals from the ACC:

1. Approval of the concept to use the golf courses as a groundwater savings project;

2. Approval to implement an interim groundwater savings project with a local irrigation district;

3. Approval to collect a groundwater savings fee to pay for past and ongoing holding charges; and

4. Approval to pay for delivery of CAP water to the interim project.

During the proceedings before the ACC, Sun City Taxpayers Association (SCTA) witnesses raised concerns about the need for some of the major components of the project. In addition, SCTA argued the possibility of developing a regional transmission main from the CAP Canal to the Sun Cities that could be used by Citizens' Agua Fria Division in addition to being used by Sun City Water Company and Sun City West Utilities Company. Under this proposal, SCTA envisioned approximately 65% of the costs to construct the transmission main being apportioned to customers in Agua Fria relieving customers in Sun City, Sun City West and Youngtown from certain costs.

On January 25, 2000, the ACC (Decision No. 62293) approved all of the requests made in the application. As part of its approval of the concept to use the golf courses as a groundwater savings project and in consideration of the issues raised by SCTA, the ACC ordered Citizens to conduct a preliminary design and updated cost estimate that would specifically address the following three items:

1. The feasibility of a joint transmission facility with the Agua Fria Division including a timeframe for any such joint facility.

2. The need for all major elements of the proposed plan (e.g. storage and booster stations).

3. Binding commitments from the golf courses, public and private, and the term and conditions related thereto.

In February of 2000, Citizens retained HDR Engineering, Inc. to conduct the preliminary design and updated cost estimate study. To assist the engineers in preparing their report and to solicit views from the community, Citizens formed a Technical Advisory Committee to review the progress of the study. This report directly addresses the first two points raised in Decision No. 62293: a joint transmission main with Agua Fria and the need for all major elements of the plan.

This report does not address the binding commitments from local golf courses as such commitments are financial and policy related and not engineering related. Instead, agreements with each Recreation Center and any participating private golf courses have been prepared and are awaiting approval by their respective Boards. Citizens will transmit these agreements to the ACC, under separate cover, upon execution by the participating parties.

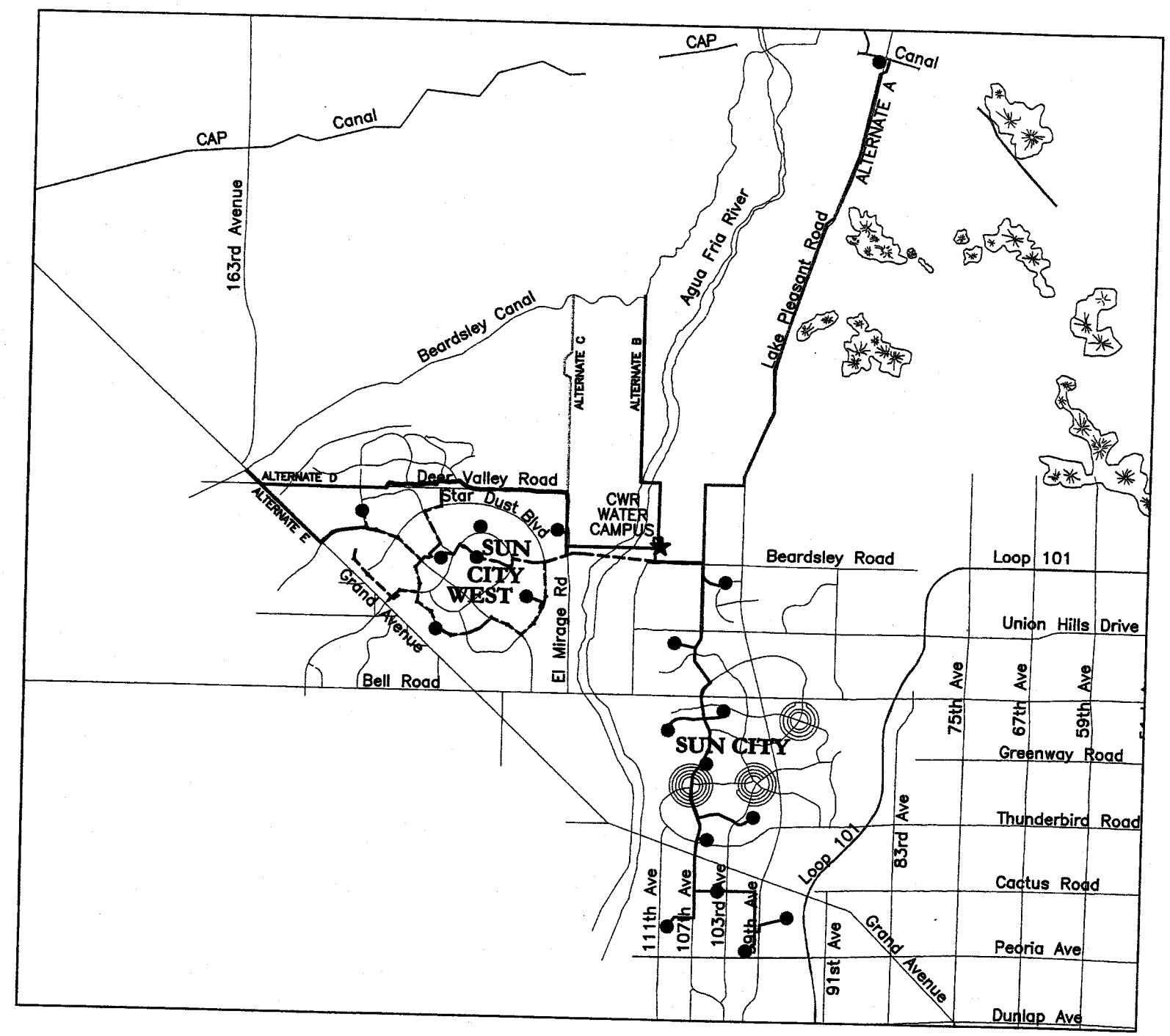
3 Groundwater Savings Project with Local Golf Courses as Recommended by the CAP Task Force

The Sun Cities/Youngtown Groundwater Savings Project (GSP) is a water exchange project where Sun City Water Company and Sun City West Utilities Company will exchange their CAP water for groundwater being used by local golf courses. As a part of the project, a water transmission main will be constructed to bring raw CAP water from the Hayden-Rhodes Aqueduct to the water campus where the Sun City West Utilities Company waste water treatment plant and effluent recharge basins are located. The Task Force's recommendation plus the alternative transmission main routes are depicted in **Figure A.1**.

From the water campus, the raw CAP water will be delivered through a smaller distribution system to participating golf courses in Sun City. Deliveries to participating golf courses in Sun City West will be made through the existing effluent distribution system owned and operated by the Recreation Centers of Sun City West. The proposed and existing irrigation distribution systems are shown on **Figure A.1**.

The transmission pipeline described above will branch to a smaller irrigation distribution system, the raw CAP water will be delivered directly to each participating golf course at a specified delivery point. The golf courses will then curtail their groundwater pumping and instead take the raw CAP water. As a part of the exchange, the golf courses will legally be using groundwater and the two utilities will legally be using CAP water.

Figure A.1



GENERAL VICINITY MAP

4 Project Participants

Due to the complexity of the project, Citizens retained a multi-disciplined consulting team to conduct the preliminary design and updated cost estimate and to prepare this report. Citizens retained HDR Engineering, Inc. as the lead consultant due to HDR's expertise in developing a similar system for the City of Scottsdale. In addition to retaining a multi-disciplined consulting team, Citizens established a community input group, and finally, Citizens included other organizations critical to the construction and implementation of the project.

Consulting Team

HDR Engineering, Inc.

HDR Engineering, Inc. was selected as the lead consultant based on their extensive expertise working on the Irrigation Water Distribution System (IWDS) in the city of Scottsdale. The IWDS is a project identical in many respects to the GSP. When complete, the IWDS will deliver untreated CAP water through a series of pump stations and pipelines to golf courses in the north Scottsdale area. The project will parallel an existing system, the Reclaimed Water Distribution System (RWDS) which has been providing this same function for the past eight years. Working closely with the City and golf courses, HDR's familiarity and understanding of delivering untreated CAP water to golf courses is unmatched.

Turf Science, Inc.

Dr. Harold Howard, Ph.D., proprietor of Turf Science, Inc. conducted the golf course assessment for the project. Dr. Howard was selected as a member of the consulting team because he served as Director of Golf Courses for the Recreation Centers of Sun City West, Inc. from 1986 to 1993. In that capacity, he was responsible for operation and maintenance of what was then six Recreation Center golf courses.

As a part of this project Dr. Howard was responsible for collecting background data on existing irrigation practices including water usage records, electrical usage records, facility layouts, and operating preferences of the individual maintenance personnel. In addition, Dr. Howard's responsibilities included:

- investigating irrigation requirements for each golf course:
- determining how the CAP supply can best meet those irrigation requirements:
- determining what impacts the use of CAP water may have on golf course operation; and
- determining what mitigation measures will need to be implemented to account for the difference in water quality between the existing groundwater supply and the CAP water.

DCI, Inc.

Mr. Leonard Duecker, P.E., president of DCI, Inc., provided technical expertise and quality control reviews to ensure that this report considers and addresses any "fatal flaws" in the preliminary design of delivering CAP water to the golf course.

Prior to becoming a consultant, Mr. Duecker was General Manager for the City of Scottsdale's Water Resources Department. In his capacity with Scottsdale, he developed and implemented the Reclaimed Water Distribution System (RWDS). The RWDS is a 14-mile reclaimed water distribution system designed to transport up to 20 million gallons of effluent to golf courses for irrigation. Initially, the RWDS distributed CAP water to the golf courses until sufficient effluent flows were available to deliver effluent to the golf courses. The RWDS was the predecessor of the Irrigation Water Distribution System (IWDS) that serves CAP water to golf courses in Scottsdale.

Universal Field Services

Universal Field Services collected county assessor maps for the general area and identified individual property owners along each potential route of the raw water pipeline. They produced exhibits showing all individual property owners, easements, and public rights-of-way along each route. They also determined the new permanent and temporary easements required for each alignment alternative.

Universal Field Services has also prepared estimated valuations of the right-of-way and easement costs for public and private ownership, along with estimated time frames and possible difficulties associated with acquiring the easements for each alignment alternative.

Terrane Engineering Corporation

Terrane Engineering Corporation is a geotechnical exploration and consulting firm. To support the evaluation of the alternative routes for the raw CAP water line, Terrane conducted field test pit examinations of the soil conditions and prepared a report summarizing the character of the soil conditions encountered, along with recommendations as to the constructibility and trenching requirements needed for pipeline construction.

Archeological Consulting Services

Specialty subconsultant, Archeological Consulting Services, conducted a literature search of documented cultural resource sites in the general area of the alternative routes for the raw CAP water line to avoid disturbing any known cultural resources. In addition, they collected documentation that will be used to secure federal 404 permits for future construction of the project.

BJ Communications

Suzanne Pfister, Vice-President of Environmental and Community Relations, was retained to organize the Technical Advisory Committee meetings and to provide community relations support to the engineering team. Ms. Pfister was retained because of her experience working with the CAP Task Force during the task force process and at the proceedings before the ACC.

CAP Technical Advisory Committee

At the conclusion of the CAP Task Force, Citizens committed to establish a smaller community group to participate in future phases of the project. To this end, the CAP Technical Advisory Committee (CAP TAC) was established to participate in the development of the preliminary design and updated cost estimate specifically for the purpose of providing operational and technical guidance to the consulting team.

To form the CAP TAC, Citizens asked the Recreation Centers of Sun City and the Recreation Centers of Sun City West to select two individuals from their organizations to represent the Recreation Center golf courses. In addition, Citizens asked each non-Recreation Center golf course to select one representative each to represent the non-Recreation Center courses. Finally, Citizens asked the Property

Owners and Residents Association (PORA), the Sun City Homeowners Association and the Sun City Taxpayers Association (SCTA) to select one individual each to represent their respective organizations. The TAC was then formed with twelve members. The organizations invited to participate in the TAC selected the following individuals to represent the interests of their organization on the CAP TAC:

CAP Technical Advisory Committee Members	
Member	**Representing**
John Powell	Recreation Centers of Sun City
Jerry Swintek	Recreation Centers of Sun City
Bob Jones	Recreation Centers of Sun City West
Dess Chappelear	Recreation Centers of Sun City West
Ernie Miller	Palmbrook Country Club
Jim Sander	Briarwood Country Club
Jeff Schuld	Hillcrest Golf Club
Jay Blackburn	Sun City Country Club
Gene Zylstra	Sun City Homeowners Association
Robert McCurdy	Sun City West Property Owners & Residents Association
Raymond Dare	Sun City Taxpayers Association
Donald Needham	Town of Youngtown

Other Critical Project Participants

In order to effect the GSP and to address the concerns raised in Decision No. 62293, Citizens enlisted the support of several organizations critical to successful construction and implementation of the project. Most critical to successful implementation is the involvement of the Recreation Centers of Sun City and Sun City West. Another critical participant is the Central Arizona Water Conservation District (CAWCD). Finally, in order to determine the need for a water transmission main and to determine the potential for the joint transmission main with Agua Fria, Citizens consulted with the Maricopa Water District (MWD).

Recreation Centers of Sun City

The Recreation Centers fulfills several important functions in this project. The Recreation Centers operate the majority of the golf courses in Sun City. Additionally, the Recreation Centers will partner with Citizens through a contractual agreement to effect the GSP.

There are ten golf courses located in Sun City. The Recreation Centers of Sun City operates seven of these golf courses. Without these golf courses, there is not sufficient golf course demand to use 100% of the CAP allocation intended for use in Sun City. As a part of the ACC proceedings, the ACC ordered Citizens to consider the participation of non-Recreation Center courses in the GSP. Upon commencing negotiations with the Recreation Centers of Sun City, the Recreation Centers expressed a desire to have exclusive rights to exchange the CAP water with Sun City Water Company.

Since the project cannot be effected without the Recreation Center courses, Citizens was compelled to respect the wishes of the Recreation Centers. Based on the premise that the Recreation Centers would be entitled to exclusive use of the CAP water, the assessment presented in this report assumes the delivery of CAP water only to Recreation Center courses. To that end, the consulting team and golf course management personnel for the Recreation Centers worked together to develop a preliminary operational procedure for the Recreation Center courses only.

Recreation Centers of Sun City West

The Recreation Centers of Sun City West fulfills several important functions in this project. Like the Recreation Centers of Sun City, the Recreation Centers of Sun City West operates the majority of the golf courses in Sun City West. Again like Sun City, the Recreation Centers of Sun City West will partner with Citizens through a contractual agreement to effect the GSP. In addition to the above-mentioned functions, the Recreation Centers of Sun City West owns and operates a non-potable distribution system that connects to all of the original golf courses in Sun City West.

There are nine golf courses in Sun City West. The Recreation Centers operates seven of those courses. Two of the seven courses operated by the Recreation Centers are reliant on effluent recharged at Citizens water campus and recovered from wells located on the golf courses. These courses cannot participate in the GSP because they do not have groundwater rights.

In addition to operating the majority of the courses, the Recreation Centers operates a non-potable distribution system originally intended for delivering treated effluent to Recreation Center courses. Past attempts to make these deliveries produced irrigation water quality unfavorable to golf course operations and resulted in the abandonment of this concept. Since that time, only small amounts of groundwater have been transported through the non-potable distribution system.

As a part of the ACC proceedings, the ACC ordered Citizens to consider the participation of non-Recreation Center courses in the GSP. Unlike Sun City, the Recreation Centers of Sun City West did not request an exclusive use of CAP water on Recreation Center courses. And in fact, as determined by the analysis conducted by the consulting team and presented in this report, without the participation of the two private courses in Sun City West, the GSP will not be operationally feasible.

Hillcrest Golf Club and Briarwood Country Club

Hillcrest Golf Club and Briarwood Country Club play important roles in the Sun City West portion of the GSP. Golf course demands in Sun City West are not large enough to allow for 100% use of the CAP allocation intended for use in Sun City West based on the timing of demands and the limitations of the non-potable distribution system. Like the Recreation Centers, Hillcrest and Briarwood will need to partner with Citizens through a contractual agreement to effect the GSP.

Central Arizona Water Conservation District (CAWCD)

The CAWCD or CAP is the entity that operates the CAP aqueduct. Each year, Citizens will coordinate annual delivery schedules with CAP. During the year, Citizens will communicate daily with CAP regarding deliveries to the GSP. During construction, Citizens will work with CAP to construct a connection between the CAP and the water transmission main. To the extent CAP can provide existing facilities, Citizens will enter into agreements with CAP to maximize the use of such facilities.

There are a number of operational issues associated with the CAP. Since the operation of the CAP affects all the potential alternatives to bringing CAP water to the Sun Cities, these operational issues will be discussed in section 2 of Part D under common elements.

Maricopa Water District (MWD)

The Maricopa Water District (MWD) is an irrigation district to the west and south of the Sun Cities. MWD operates the Beardsley Canal. The Beardsley Canal interconnects with the CAP Canal at roughly the CAP Canal and the Agua Fria River. Due to the geographic layout of the Beardsley Canal, this report analyzes the possible advantages of utilizing this canal as a means of delivering CAP water closer to the project area before transferring the water to a closed pipe system.

As a part of this assessment, the consulting team worked with MWD to determine the costs and procedures associated with using the Beardsley Canal in the GSP.

There are a number of operational issues associated with the Beardsley Canal. Since the operation of the Beardsley Canal affects several potential alternatives to bringing CAP water to the Sun Cities, these operational issues will be discussed in section 2 of Part D under common elements.

5 Organization of Report

In addition to this overview, this report has four additional chapters. Part B presents the findings of the golf course assessment. This assessment determines how much golf course demand is required to use 100% of the CAP allocation and determines the preliminary operation of the project. Part C addresses the feasibility of a joint transmission facility with the Agua Fria Division as specifically ordered in Decision No. 62293.

Part D presents the evaluation of all major components of the project. Specifically, the assessment determines whether a water transmission pipeline is needed and if so what is the best route for such a transmission pipeline. In addition, the assessment determines if pumping, storage and treatment are required to operate the project. Part D also describes the distributions systems required to move the CAP water from Citizens' transmission pipeline to the golf courses. Finally, Part D describes the needed control system to manage the GSP. This section of Part D analyzes the various control system alternatives available for the GSP.

Part E presents the results of the analysis conducted in Parts C and D and recommends a preliminary design for the GSP. Part E also establishes plan components, costs and a schedule for completion as specified in Decision No. 62293.

PART B - GOLF COURSE ASSESSMENTS AND OPERATING PARAMETERS

1 Facility-specific Parameters

In order to develop a water delivery system that will satisfy the objectives of this project, it was necessary to become thoroughly familiar with the properties to which such deliveries will be made. This was necessary in order to best plan delivery points, system hydraulics, delivery flow patterns, etc. Also, it was essential to gain an understanding from the facility operators of the individual operational needs of each golf course. Thereby, the system would be designed to satisfy not only the water deliveries, but do so in a manner consistent with those operational needs.

Operator Surveys

During the course of this study, the golf course maintenance superintendents were met with collectively in Sun City and Sun City West. Few concerns regarding impact of the project were expressed. Those that were expressed were related to daily delivery timing, salinity, intrusion during construction, and ongoing costs.

Each superintendent was interviewed privately to obtain facility-specific information and discuss issues of concern. Also, the water-handling schematics of each facility were reviewed and pumping stations inspected. The staff at each golf course indicated provided the following information.

Legend	
G	Greens
T	Tees
F	Fairways
R	Rough

Lakes East Golf Course
Shirley Gaines, Superintendent (623) 876-3037

DWR Allocation (acre-feet)	516.21
DWR Well Registration #	59-609015
APS Well Account #	379750287
APS Well Meter #	375593
Well HP	200
Well Flow Rate (gpm)	900
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	N/A
Reservoir Area (acres)	Dawn Lake = 37.11
Distribution Station Motor HPs	10, 40, 60
Irrigation Control System	Toro 8000
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:00 p.m. / 7:00 p.m.
Sprinkler Head Model	Toro 655 & 674
Average Sprinkler Spacing	80 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F (26 acres)

Lakes West Golf Course
Shirley Gaines, Superintendent (623) 876-3037

DWR Allocation (acre-feet)	876.30
DWR Well Registration #	59-609021
APS Well Account #	
APS Well Meter #	A92646
Well HP	200
Well Flow Rate (gpm)	900
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	N/A
Reservoir Area (acres)	Viewpoint Lake = 31.94
Distribution Station Motor HPs	40, 100, 100
Irrigation Control System	Toro 8000
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:00 p.m. / 7:00 p.m.
Sprinkler Head Model	Toro 655 & 674
Average Sprinkler Spacing	80 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F (27 acres)

North Golf Course
Brian Weir, Superintendent (623) 876-3038

DWR Allocation (acre-feet)	675.98
DWR Well Registration #	55-507850
APS Well Account #	276071287
APS Well Meter #	A37738
Well HP	150
Well Flow Rate (gpm)	1400
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	56 inches
Reservoir Area (acres)	2.52
Distribution Station Motor HPs	10, 25, 50,100, 100
Irrigation Control System	RB Nimbus
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:00 p.m. / 7:00 p.m.
Sprinkler Head Model	RB 47,51 & Eagle
Average Sprinkler Spacing	60 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks, practice (31 acres)

Quail Run Golf Course
Don Souser, Superintendent (623) 876-3039

DWR Allocation (acre-feet)	252.38
DWR Well Registration #	55-609019
APS Well Account #	388601288
APS Well Meter #	348226
Well HP	125
Well Flow Rate (gpm)	1200
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	50"
Reservoir Area (acres)	1.37
Distribution Station Motor HPs	20, 50, 50
Irrigation Control System	Toro 8000
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:00 p.m. / 7:00 p.m.
Sprinkler Head Model	Toro 730, 750, 760, & 785
Average Sprinkler Spacing	60 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F (14 acres)

Riverview Golf Course
Chuck Manning, Superintendent (623) 876-3043

DWR Allocation (acre-feet)	700.92	
DWR Well Registration #	East	55-506072
	West	55-509014
APS Well Account #	East	086820285
	West	856820283
APS Well Meter #	East	A93101
	West	A67045
Well HP	East	250
	West	200
Well Flow Rate (gpm)	East	2200
	West	1800
Vertical Turbine or Submersible	East	V.T.
	West	V.T.
Reservoir Drawdown Height	East	(Couldn't Determine)
	West	66 inches
Reservoir Area (acres)	East	0.87
	West	1.06
Distribution Station Motor HPs	East	60,75,100
	West	25, 75
Irrigation Control System	Toro 8000	
Flow Management Capability (Y/N)	Yes	
Irrigation Start Times (Summer/Winter)	8:00 p.m. / 6:00 p.m.	
Sprinkler Head Model	Toro 750 & 780	
Average Sprinkler Spacing	70 feet	
Areas over-seeded (G, T, F, R, & acres)	G, T, F, banks, (50 acres)	

South Golf Course
Michael Miller, Superintendent (623) 876-3045

DWR Allocation (acre-feet)	905.66	
DWR Well Registration #	East	55-609013
	West	55-609012
APS Well Account #	East	424361286
	West	749990287
APS Well Meter #	East	A93101
	West	A67045
Well HP	East	200
	West	100
Well Flow Rate (gpm)	East	1800
	West	1000
Vertical Turbine or Submersible	East	V.T.
	West	V.T.
Reservoir Drawdown Height	East	50 inches
	West	52 inches
Reservoir Area (acres)	East	2.36
	West	1.79
Distribution Station Motor HPs	East	25, 50, 50, 100
	West	25, 50, 50, 100
Irrigation Control System	RB Nimbus	
Flow Management Capability (Y/N)	Yes	
Irrigation Start Times (Summer/Winter)	7:30 p.m. / 11:00 p.m.	
Sprinkler Head Model	RB 47 & 51	
Average Sprinkler Spacing	60 feet	
Areas over-seeded (G, T, F, R, & acres)	G, T, F, banks, (52 acres)	

Palmbrook Country Club
Ernie Miller, Superintendent (623) 933-1591

DWR Allocation (acre-feet)	682.96	
DWR Well Registration #	North	55-603236
	South	55-603269
APS Well Account #	North	279180280
	South	914180287
APS Well Meter #	North	920433
	South	800002
Well HP	North	200
	South	200
Well Flow Rate (gpm)	North	650
	South	1000
Vertical Turbine or Submersible	North	V.T.
	South	V.T.
Reservoir Drawdown Height	80 inches	
Reservoir Area (acres)	2.03	
Distribution Station Motor HPs	10, 75, 75, 75 VFD	
Irrigation Control System	RB Maxi 5	
Flow Management Capability (Y/N)	Yes	
Irrigation Start Times (Summer/Winter)	7:30 p.m. / 7:00 p.m.	
Sprinkler Head Model	RB 51 & Eagle PC	
Average Sprinkler Spacing	65 feet	
Areas over-seeded (G, T, F, R, & acres)	G, T, F (65 acres)	

Sun City Country Club
Jim Trikoff, Superintendent (623) 933-2276

DWR Allocation (acre-feet)	590.94	
DWR Well Registration #	East	55-800409
	West	55-800408
APS Well Account #	East	081422285
	West	933421287
APS Well Meter #	East	D26964
	West	855368
Well HP	East	75
	West	125
Well Flow Rate (gpm)	East	600
	West	Varies
Vertical Turbine or Submersible	East	V.T.
	West	V.T.
Reservoir Drawdown Height	East	No Vault
	West	No Reservoir
Reservoir Area (acres)	2.62	
	No Reservoir	
Distribution Station Motor HPs	40, 100	
	Direct connection to well	
Irrigation Control System	RB Maxi 5	
Flow Management Capability (Y/N)	Yes	
Irrigation Start Times (Summer/Winter)	7:00 p.m. / 9:00 p.m.	
Sprinkler Head Model	RB 47 & 51	
Average Sprinkler Spacing	70 feet	
Areas over-seeded (G, T, F, R, & acres)	G, T, F, some R (90 acres)	

Union Hills Country Club
Scott McCall, Superintendent (623) 977-0926

DWR Allocation (acre-feet)	679.72	
DWR Well Registration #	North	55-604718
	South	55-604717
APS Well Account #	North	1602713400
	South	1620013040
APS Well Meter #	North	851579
	South	A66643
Well HP	North	200
	South	200
Well Flow Rate (gpm)	North	850
	South	850
Vertical Turbine or Submersible	North	V.T.
	South	V.T.
Reservoir Drawdown Height	North	Couldn't Determine
	South	Couldn't Determine
Reservoir Area (acres)	North	1.14
	South	1.94
Distribution Station Motor HPs	North	10, 30, 100
	South	10, 30, 100
Irrigation Control System	Rainbird Numbus	
Flow Management Capability (Y/N)	Yes	
Irrigation Start Times (Summer/Winter)	7:45 p.m. / 6:00 p.m.	
Sprinkler Head Model	RB Eagle	
Average Sprinkler Spacing	65 feet	
Areas over-seeded (G, T, F, R, & acres)	G, T, F, some R (90 acres)	

Willowbrook Golf Course
Thomas Sibray, Superintendent (623) 876-3047

DWR Allocation (acre-feet)	1168.70 (w/ Willowcreek)
DWR Well Registration #	55-609017
APS Well Account #	238310280
APS Well Meter #	431244
Well HP	200
Well Flow Rate (gpm)	1000
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	N/A (No vault)
Reservoir Area (acres)	1.36
Distribution Station Motor HPs	40, 60, 200
Irrigation Control System	Toro 8000
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:00 p.m. / 7:00 p.m.
Sprinkler Head Model	Toro 750, 760, & 780
Average Sprinkler Spacing	69 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks, practice (14 acres)

Willowcreek Golf Course
Thomas Sibray, Superintendent (623) 876-3047

DWR Allocation (acre-feet)	1168.70 (w/ Willowbrook)
DWR Well Registration #	55-609016
APS Well Account #	508310281
APS Well Meter #	15375276
Well HP	200
Well Flow Rate (gpm)	1200
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	N/A (No vault)
Reservoir Area (acres)	1.70
Distribution Station Motor HPs	40, 60, 150
Irrigation Control System	Toro 8000
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:00 p.m. / 7:00 p.m.
Sprinkler Head Model	Toro 750, 760, & 780
Average Sprinkler Spacing	69 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks, practice (44 acres)

Deer Valley Golf Course
Dan Maurer, Superintendent (623) 546-8959

DWR Allocation (acre-feet)	546.62
DWR Well Registration #	55-536231
APS Well Account #	429732285
APS Well Meter #	A33736
Well HP	200
Well Flow Rate (gpm)	1300
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	60 inches
Reservoir Area (acres)	3.08
Distribution Station Motor HPs	10, 40, 100 100, VFD
Irrigation Control System	RB Maxi 5
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:30 p.m. / 6:00 p.m.
Sprinkler Head Model	RB 47 & 51
Average Sprinkler Spacing	60 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks (52 acres)

Echo Mesa Golf Course
Pete Sagasta, Superintendent (623) 584-2919

DWR Allocation (acre-feet)	456.62
DWR Well Registration #	55-612961
APS Well Account #	682681288
APS Well Meter #	920403
Well HP	250
Well Flow Rate (gpm)	1000
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	50 inches
Reservoir Area (acres)	2.64
Distribution Station Motor HPs	25, 50, 100
Irrigation Control System	RB Maxi 5
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:30 p.m. / 6:00 p.m.
Sprinkler Head Model	RB 700 & 750
Average Sprinkler Spacing	60 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks (33 acres)

Pebblebrook Golf Course
Brad Ackerman, Superintendent (623) 584-3100

DWR Allocation (acre-feet)	690.68
DWR Well Registration #	55-610212
APS Well Account #	622630284
APS Well Meter #	373787
Well HP	200
Well Flow Rate (gpm)	1300
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	90 inches
Reservoir Area (acres)	1.32
Distribution Station Motor HPs	10, 20, 100, 100
Irrigation Control System	RB Maxi 5
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:30 p.m. / 6:00 p.m.
Sprinkler Head Model	RB 47 & 51
Average Sprinkler Spacing	60 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks (57 acres)

Desert Trails Golf Course
Dan Maurer, Superintendent (623) 546-8959

DWR Allocation (acre-feet) (not yet assigned)	405.54
DWR Well Registration #	55-612960
APS Well Account #	591542280
APS Well Meter #	A65743
Well HP	200
Well Flow Rate (gpm)	1200
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	100 inches
Reservoir Area (acres)	2.80
Distribution Station Motor HPs	25, 50, 100
Irrigation Control System	RB Maxi 5
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:30 p.m. / 6:00 p.m.
Sprinkler Head Model	RB 47 & 51
Average Spacing	60 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks (35 acres)

Grandview Golf Course
Patrick Burgess, Superintendent (623) 584-2286

DWR Allocation (acre-feet)	784.16
DWR Well Registration #	55-604494
APS Well Account #	506722289
APS Well Meter #	885665
Well HP	250
Well Flow Rate (gpm)	1200
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	90 inches
Reservoir Area (acres)	1.41
Distribution Station Motor HPs	25, 50, 100, 100
Irrigation Control System	RB Maxi 5
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:30 p.m. / 6:00 p.m.
Sprinkler Head Model	RB 700 & 750
Average Sprinkler Spacing	60 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks (67 acres)

Stardust Golf Course
Pete Sagasta, Superintendent (623) 584-2919

DWR Allocation (acre-feet)	480.46
DWR Well Registration #	55-610211
APS Well Account #	760820285
APS Well Meter #	373398
Well HP	250
Well Flow Rate (gpm)	1200
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	70 inches
Reservoir Area (acres)	1.56
Distribution Station Motor HPs	10, 20, 75, 75
Irrigation Control System	Toro Osmac
Flow Management Capability (Y/N)	No
Irrigation Start Times (Summer/Winter)	7:30 p.m. / 6:00 p.m.
Sprinkler Head Model	RB 700 & 750
Average Sprinkler Spacing	60 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks (33 acres)

Trail Ridge Golf Course
Brad Ackerman, Superintendent (623) 584-3100

DWR Allocation (acre-feet)	546.64
DWR Well Registration #	55-612962
APS Well Account #	208802284
APS Well Meter #	A66070
Well HP	200
Well Flow Rate (gpm)	1200
Vertical Turbine or Submersible	Submersible
Reservoir Draw-down Height	100 inches
Reservoir Area (acres)	2.91
Distribution Station Motor HPs	25, 50, 100
Irrigation Control System	Maxi 5
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	7:30 p.m. / 6:00 p.m.
Sprinkler Head Model	RB 700 & 750
Average Sprinkler Spacing	60 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, banks (50 acres)

Briarwood Country Club
Jim Sander, Superintendent (623) 546-8484

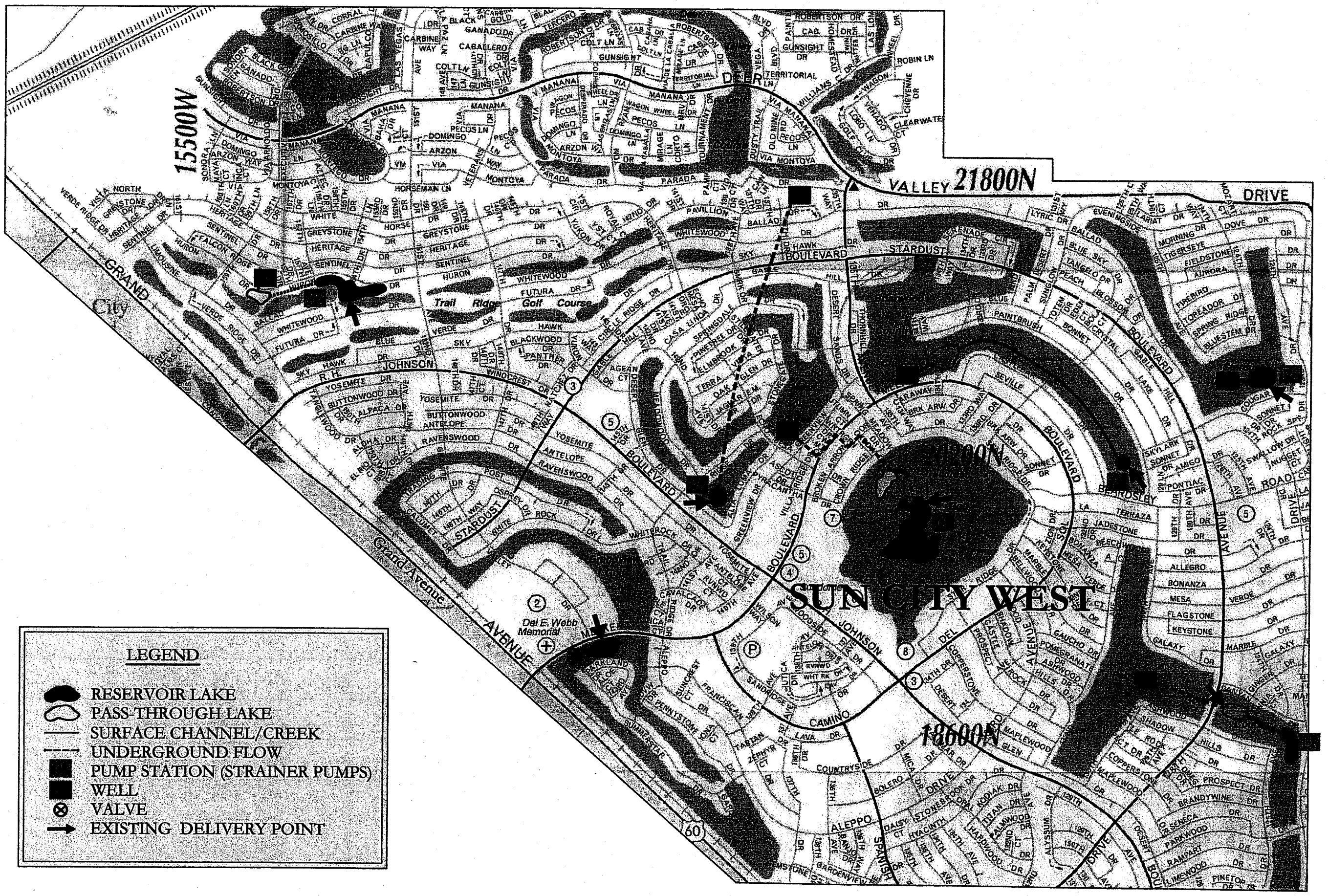
DWR Allocation (acre-feet)	714.82
DWR Well Registration #	
APS Well Account #	
APS Well Meter #	
Well HP	
Well Flow Rate (gpm)	
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	60 inches
Reservoir Area (acres)	1.51
Distribution Station Motor HPs	
Irrigation Control System	RB Maxi 5
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	8:00 p.m. / 7:00 p.m.
Sprinkler Head Model	RB 47 & 51
Average Sprinkler Spacing	65 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F, R (106 acres)

Hillcrest Golf Course
Jeff Schuld, Superintendent (623) 584-3320

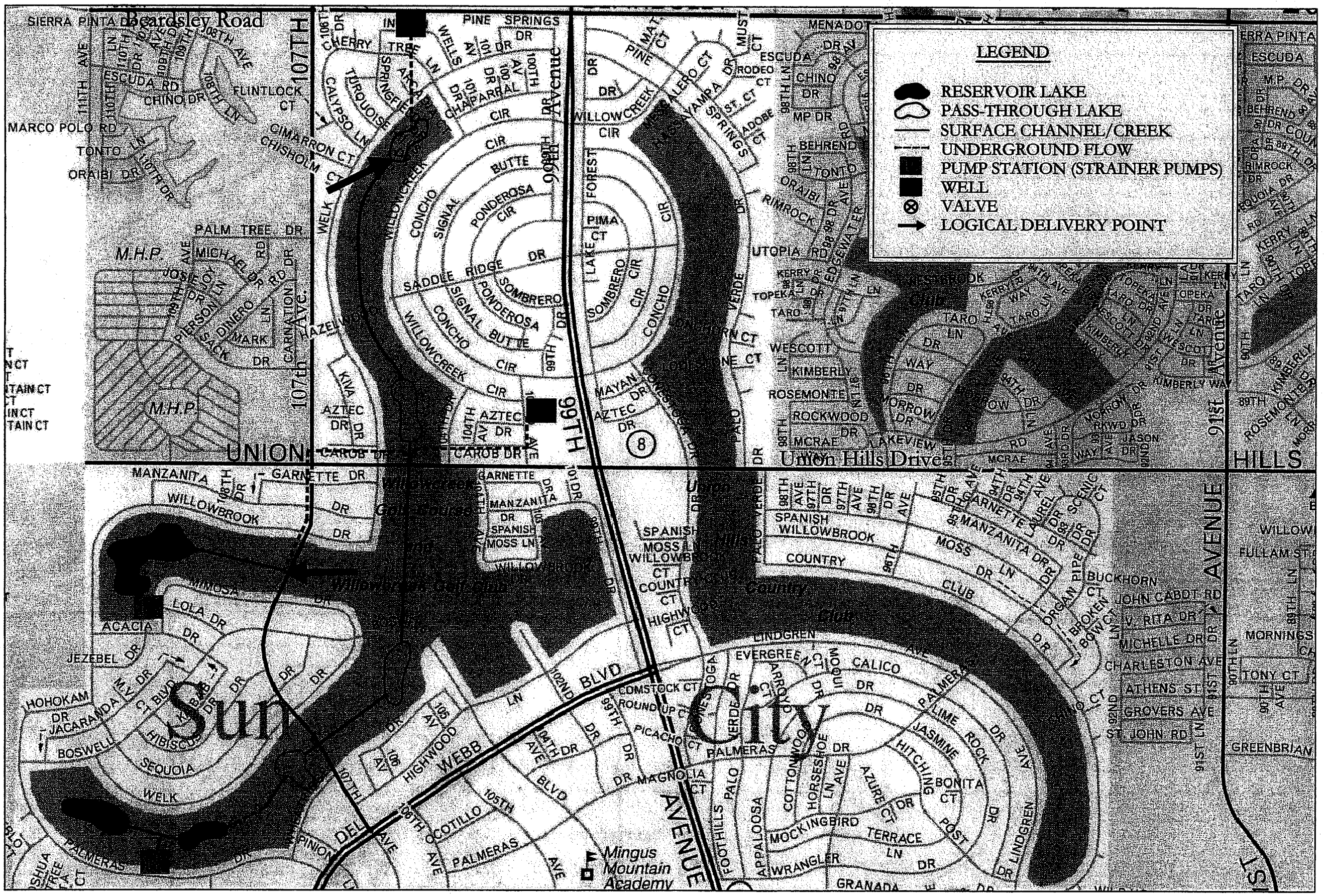
DWR Allocation (acre-feet)	843.94
DWR Well Registration #	55-610216
APS Well Account #	267702280
APS Well Meter #	915907
Well HP	300
Well Flow Rate (gpm)	240
Vertical Turbine or Submersible	V.T.
Reservoir Draw-down Height	50 inches
Reservoir Area (acres)	18.71
Distribution Station Motor HPs	40, 75, 125
Irrigation Control System	RB Maxi 5
Flow Management Capability (Y/N)	Yes
Irrigation Start Times (Summer/Winter)	8:00 p.m. / varies
Sprinkler Head Model	RB 47 & 51
Average Sprinkler Spacing	76 feet
Areas over-seeded (G,T,F,R & acres)	G, T, F (68 acres)

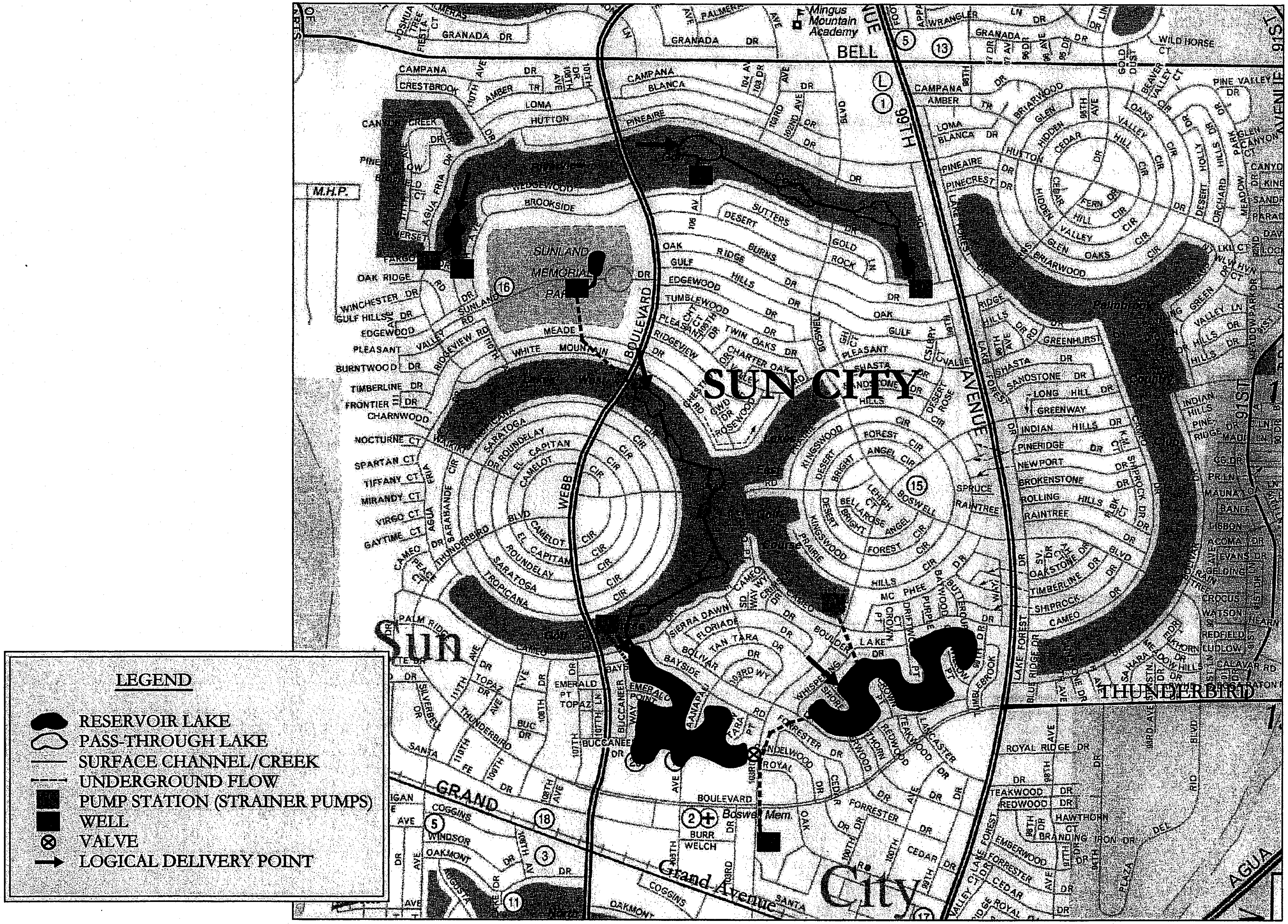
Water-handling Schematics

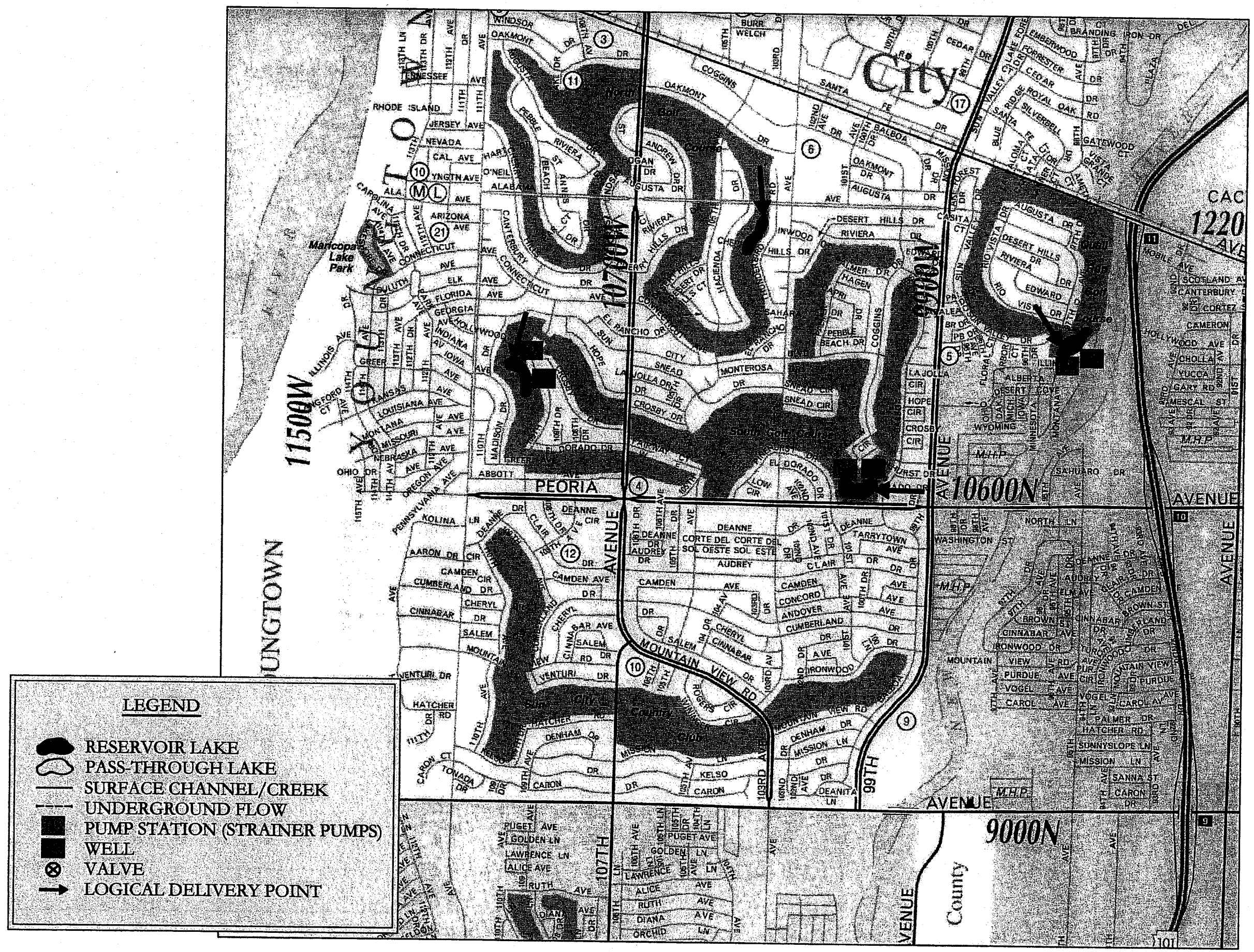
During the Superintendent interviews and site inspections, the current relationship between well-water delivery equipment, creeks, reservoirs, pumping systems, valving, etc. was determined for each facility. This information was essential in planning system delivery points and delivery daily programming. These relevant relationships are illustrated as follows.



15500W
21800N
18600N
SUN CITY WEST
Trail Ridge Golf Course
Del E. Webb Memorial
GRAND AVENUE
Grand Avenue
VALLEY DRIVE
DEER
BOULEVARD
STARDUST
JOHNSON
CAMINO
ALEPPO
SPANISH
DRIVE
AVENUE
ROAD
LEGEND
RESERVOIR LAKE
PASS-THROUGH LAKE
SURFACE CHANNEL/CREEK
UNDERGROUND FLOW
PUMP STATION (STRAINER PUMPS)
WELL
VALVE
EXISTING DELIVERY POINT


LEGEND
RESERVOIR LAKE
PASS-THROUGH LAKE
SURFACE CHANNEL/CREEK
UNDERGROUND FLOW
PUMP STATION (STRAINER PUMPS)
WELL
VALVE
LOGICAL DELIVERY POINT
Beardsley Road
Union Hills Drive
Sun City
UNION HILLS
107th Ave.
99th Avenue
91st Avenue
Mingus Mountain Academy
Willowbrook Golf Course
Willowbrook Golf Club
Union Hills Country Club
M.H.P.


SUN CITY
Sun City
BELL
AVENUE
BOULEVARD
WEBB
THUNDERBIRD
GRAND
Grand Avenue
SUNLAND MEMORIAL PARK
LEGEND
RESERVOIR LAKE
PASS-THROUGH LAKE
SURFACE CHANNEL/CREEK
UNDERGROUND FLOW
PUMP STATION (STRAINER PUMPS)
WELL
VALVE
LOGICAL DELIVERY POINT


LEGEND
RESERVOIR LAKE
PASS-THROUGH LAKE
SURFACE CHANNEL/CREEK
UNDERGROUND FLOW
PUMP STATION (STRAINER PUMPS)
WELL
VALVE
LOGICAL DELIVERY POINT
City
County
PEORIA
AVENUE
MOUNTAIN VIEW RD
10600N
9000N
11500W
10700W
9900W
Maricopa Lake Park
M.H.P.

2 Historical Water Use

Historical irrigation water usage records from each golf course in the Glendale and Peoria area were gathered, analyzed and utilized, in order to predict the future water usage for irrigation of the Sun City and Sun City West golf courses. From this data, the future peak flows and annual consumptions can be predicted.

Historical Annual Totals

Each year, every golf course within the Phoenix AMA that consumes non-effluent irrigation water is required to file an annual report with the Arizona Department of Water Resources. These reports contain annual water consumption totals and were the information source for the following information (**Appendix D.1**). Except where noted, the data represents 6-year averages (1993 – 1998).

Facility Annual Totals

Facility	Acre-feet/year*
Sun City Rec Center:	
Lakes East/Dawn Lake	594
Lakes West/Viewpoint Lake	863
North GC	623
Quail Run GC	231
Riverview GC	447
South GC	819
Willowcreek/Willowbrook	1329
Sun City Private Clubs:	
Palmbrook CC	613
Sun City CC	533
Union Hills CC	729
Youngtown:	
Maricopa Lake****	15
Sun City West Rec Center:	
Deer Valley GC**	546
Desert Trails GC***	469
Echo Mesa GC**	592
Grandview GC	761
Pebblebrook GC	689
Stardust GC	429
Trail Ridge GC	539
Sun City West Private Clubs:	
Briarwood CC	725
Hillcrest GC	769
TOTAL	**12,315**

* - 6-year data (93-98)
** - 4-year data (95-98)
*** - 3-year data (96-98)
**** - 2-year data (96&99)
Data source – Arizona Dept of Water Resources

Estimated Monthly Usage

The demand for irrigation water follows a diurnal cycle throughout the year. Specifically, demand is low in the winter and high in the summer. Knowledge of this monthly use pattern is necessary in planning the design and operational concept for the system. Prior experience over a period of several years with the SCW golf courses has provided information upon which to base a monthly model of irrigation water consumption. By applying that model to each of the facility historical annual totals listed above, the facility consumptions can be estimated for each month of the year. Those estimations are as follows:

Estimated Monthly Use Pattern
(Data in Acre-feet)

	Ann. Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sun City Rec Center:													
Lakes East/Viewpoint Lake	594	9	13	15	43	90	88	105	66	56	69	29	11
Lakes West/Dawn Lake	863	13	19	22	62	131	128	153	96	82	99	42	16
North GC	623	9	14	16	45	94	93	110	69	59	72	30	12
Quail Run GC	231	4	5	6	17	35	34	41	26	22	26	11	4
Riverview GC	447	7	10	11	32	68	67	79	50	42	51	22	8
South GC	819	12	18	21	59	124	122	145	91	78	94	40	15
Willowcreek/Willowbrook	1329	20	29	33	96	201	198	235	148	126	153	65	25
Sun City Private Clubs:													
Palmbrook CC	613	9	13	16	44	93	92	108	68	58	71	30	11
Sun City CC	533	8	12	13	39	81	79	94	59	51	61	26	10
Union Hills CC	729	11	16	18	53	110	108	129	81	69	84	36	14
Youngtown: Maricopa Lake	15	0	0	0	1	2	2	3	2	2	2	1	0
Sun City West Rec. Center:													
Deer Valley GC	546	8	12	14	39	83	81	96	61	52	63	27	10
Desert Trails GC	469	7	10	12	34	71	70	83	52	44	54	23	9
Echo Mesa GC	592	9	13	15	43	90	88	104	66	56	68	29	11
Grandview GC	761	12	16	19	55	115	113	135	85	72	88	37	14
Pebblebrook GC	689	11	15	17	50	104	102	122	77	65	79	34	13
Stardust GC	429	6	9	11	31	65	64	76	48	41	49	21	8
Trail Ridge GC	539	8	12	14	39	82	80	95	60	51	62	26	10
Sun City West Private Clubs:													
Briarwood CC	725	11	16	18	52	110	108	128	81	69	83	35	14
Hillcrest GC	769	12	17	19	55	116	114	136	86	73	89	38	14
TOTAL	**12315**	**186**	**269**	**310**	**889**	**1865**	**1831**	**2177**	**1372**	**1168**	**1417**	**602**	**229**

Peak Demand

As illustrated above, the system demand is not constant throughout the year. In order to evaluate the supply system design versus demand, it is necessary to estimate the peak demand. The peak demands listed below occur during the month of July. It is recognized that demand is not constant throughout the month due to weather fluctuations, operational issues and operator preferences. The data presented represents an average demand for the peak usage month of the year. The following estimates of peak demand are calculated from the average daily demand during the month of July times a correction factor of 1.05.

Facility Peak Demand

Facility	Peak daily usage*
Sun City Rec Center:	**(Ac-Ft/Day)**
Lakes East/Dawn Lake	3.56
Lakes West/Viewpoint Lake	5.17
North GC	3.73
Quail Run GC	1.38
Riverview GC	2.68
South GC	4.91
Willowcreek/Willowbrook	7.96
Sun City Private Clubs:	
Palmbrook CC	3.67
Sun City CC	3.19
Union Hills CC	4.37
Youngtown: Maricopa Lake	0.09
Sun City West Rec Center:	
Deer Valley GC	3.27
Desert Trails GC	2.81
Echo Mesa GC	3.55
Grandview GC	4.56
Pebblebrook GC	4.13
Stardust GC	2.57
Trail Ridge GC	3.23
Sun City West Private Clubs:	
Briarwood CC	4.34
Hillcrest GC	4.61
TOTAL	**73.78**

* - average July daily usage X 1.05

3 Theoretical Water Use

The purpose of this sub section is to demonstrate the relative efficiency of irrigation water usage on the golf courses of Sun City and Sun City West as compared to the best theoretical prediction of usage available. Performing this calculation and comparison with historical wager usage provides some measure of assurance that the CAP water delivered to these courses will be used efficiently.

As demonstrated in the following text and tables showing the actual historical irrigation usage, all golf courses in Sun City and Sun City West either closely approximates or is less than the theoretical water consumption calculated.

Many researchers have studied methods of predicting the theoretical water use by turfgrass. This information is of particular interest during facility design for predicting water demand. It is also of interest to regulatory agencies in formulation of allocations. To date, prediction of water requirements for culture of turfgrass has not been an exact science. Rather, predictions are based on calculations derived from weather parameters, crop coefficient multipliers, and a variety of assumptions. These variables tend to reduce confidence in the accuracy of the predictions such that further research will be necessary for predictions to be highly reliable. The methodology for predicting turfgrass water needs and application of current methodology to the SC and SCW golf courses are as follows.

Methodology for Predicting Irrigation Needs

Turfgrass Water Consumption

The amount of water that evaporates from the soil surface and leaf tissue (evapotranspiration) may be referred to as the water consumption by that stand of turfgrass. It does not take into consideration the other loss factors detailed below. The prediction of turfgrass water consumption is based on historical records of weather data from a local monitoring site. Several of these monitoring sites are operated by the University of Arizona as part of the AZMET system and are located throughout the state. From this weather data, the consumption is calculated by using the "modified Penman equation". The turfgrass weather monitoring site nearest to Sun City is the Greenway station located at the Cave Creek Golf Course at 23rd Avenue and Greenway and was used as the source for the data listed below (**Appendix D.2**).

The data below was derived from the Greenway weather data and was calculated using the Penman equation. The coefficients used were appropriate for a high-quality bermudagrass fairway turf that has been overseeded with perennial ryegrass for the winter season. Also listed is data for non-overseeded turf. This data assumes that non-overseeded turf consumes water quantities similar to overseeded turf except that the non-overseeded consumption during the dormant months (December – March) is one-half that of the overseeded turf (estimation from U of A).

Turfgrass Water Consumption (inches, Greenway AZMET Station)

Month	Overseeded	Non-overseeded
Jan	1.8	0.9
Feb	2.4	1.2
Mar	4.1	2.1
Apr	5.9	5.9
May	7.3	7.3
Jun	7.5	7.5
Jul	7.8	7.8
Aug	7.4	7.4
Sep	5.6	5.6
Oct	4.4	4.4
Nov	2.6	2.6
Dec	1.7	0.9
Total	**58.5** (4.88 AF/Acre)	**53.6** (4.47 AF/Acre)

Averages of years 1988 to 1999

Leaching Fraction

In order to remove salts from the rootzone and prevent their accumulation to detrimental levels, excess water must be applied which passes out the bottom of the rootzone profile. This leachate carries salts out the bottom of the rootzone profile along with it. This water which is applied in excess of the turfgrass water consumption is referred to as the leaching fraction.

Unfortunately, irrigation water applied to a turfgrass area from sprinkler heads is not applied uniformly. In order to ensure that salts are successfully leached from the weaker areas of the sprinkler pattern, excessive leaching water must be applied to the turf area

throughout the sprinkler pattern. The result is that the volumes of water necessary for satisfactory leaching exceed those from theoretical calculations. It is generally accepted in scientific literature that a leaching fraction of 15% of the turfgrass water consumption is the *minimum* necessary for successful salt leaching from most turfgrass areas. This value of 15% shall be used as the leaching fraction in the calculations later in this section.

Scheduling Coefficient

As mentioned above, irrigation water applied through sprinklers to a turfgrass area is not applied uniformly. Some areas receive water in excess of the average application rate and some other areas receive less than the average application rate. In order to satisfy the irrigation needs of most of the weak areas of the sprinkler pattern, surplus water must be applied to the turf area in general. Hence, in order to compensate for less-than-perfect sprinkler uniformity, irrigation water in excess of calculated amounts must be applied. The magnitude of the excess water requirement is dependent upon the uniformity of the sprinkler pattern, the greater the uniformity, the lesser the requirement for excess water application. Because of this situation, when inferior golf course irrigation systems are replaced with quality modern systems, not only does turf quality improve but water consumption usually goes down also.

The uniformity of an irrigation system may be quantified and expressed in terms of a scheduling coefficient. This scheduling coefficient is a multiplier factor, which when multiplied times the desired water application rate, results in the calculation of application rate necessary to avoid inadequate irrigation of the weak areas in the sprinkler pattern. A state-of-the-art irrigation system considered to be of excellent uniformity would typically have a scheduling coefficient of 1.2. This value will be used for subsequent calculations.

Overseed Germination

When a turfgrass area is overseeded (usually in October), the fresh seedbed must be kept very wet for approximately two weeks. This moisture enables the ryegrass seeds to germinate and the seedlings to survive. In order to maintain this wet condition, irrigation water must be applied far in excess of the turfgrass water consumption. It is generally accepted that the process of overseed germination and its subsequent culture require approximately 6 inches of water in excess of the turfgrass water consumption. However, the annual leaching fraction (15%) is greater than this overseed germination requirement. Hence, the overseed germination water constitutes a portion of the annual leaching requirement. For this reason, no additional water for the sole purpose of overseed germination shall be included in the following calculations.

Lake Water Surface

The golf course properties each have one or more lakes that serve reservoir and/or aesthetic functions. The water supplied to these lakes is comingled with the irrigation system water and, hence, must be considered in predictions of irrigation water requirements. The AZMET system reports a weather-data-derived value termed "reference ET" for each of its monitoring sites. This value is an accurate estimate of the water loss by evaporation from a medium-to-large golf course lake (U of A). As in an earlier section, the Greenway monitoring site was selected as most representative of the SC and SCW locations (**Appendix D.3**). Data from this location indicates that water evaporation from a lake surface in this area will account for 76.43 inches (6.34 feet per acre) per year. This value will be used in the calculations later in this section.

Irrigated Desert Landscape

Three golf courses in SCW have substantial acreage as desert landscape rather than turfgrass. This desert landscape is planted with low-water-use plant species that are served with drip irrigation. There is presently no good methodology for predicting the irrigation water requirements of such a landscape. These requirements are highly variable and are dependent upon several factors such as plant type, plant density and cultural treatment. The Arizona Department of Water Resources allocates 1.5 feet of water per year for irrigation of desert landscape. However, it is generally accepted that this value overestimates the actual water requirement. For purposes of calculating irrigation requirements later in this section, a value of 1.0 foot of water per year will be used.

Rainfall

Water derived from rainfall contributes to the soil moisture, hence, reduces the requirement for irrigation water. A portion of the incident rainfall soaks into the soil and is of beneficial use. The remainder of the incident rainfall runs off from the turf surface to drainage systems and is not of beneficial use. Prediction of the portion of the incident rainfall that is beneficial is both site specific and event specific, thus not possible to enumerate without a great deal of research. It shall be assumed in the calculations below that 50% of the incident rainfall soaks into the soil and is of beneficial use.

Historical records (1988 to 1999) from the Greenway AZMET station indicate that the annual precipitation at that site is 9.28 inches per year (**Appendix D.4**). Assuming that 50% of that rainfall soaks into the soil, then the beneficial rainfall will be assumed in the following calculations to be 4.64 inches (0.39 feet) per year.

Summary of Water Use Prediction Factors

The above factors and their influence upon the irrigation water requirements calculated in the section below are as follows;

Factor	Influence (per year)
1. Overseeded turf	4.88 acre-feet / acre
2. Non-overseeded turf	4.47 acre-feet / acre
3. Leaching fraction	0.15 times items 1 and 2
4. Scheduling coefficient	0.20 times items 1 and 2
5. Lake surface	6.34 acre-feet per acre
6. Irrigated desert	1.0 acre-feet per acre
7. Rainfall	Minus 0.39 acre-feet times total facility acreage

Theoretical Facility Annual Usage

Facility	Historical Usage* (acre-feet)	Total turf (acres)*	Lake Surface Area (acres)*	Irrigated desert (acres)*	Over-seeded turf (acres)**	Non-OS turf (acres)**	Theoretical usage*** (acre-feet)
Sun City Rec Center:							
Lakes East/Dawn Lake	594	57.90	37.50		26	31.90	564
Lakes West/Viewpoint Lake	863	140.70	37.50		27	113.70	1032
North GC	623	139.60	5.90		31	108.60	840
Quail Run GC	231	50.80	1.40		14	36.80	303
Riverview GC	447	143.20	7.60		50	93.20	881
South GC	819	199.50	4.30		52	147.50	1180
Willowcreek/Willowbrook	1329	238.50	8.50		70	168.50	1436
Sun City Private Clubs:							
Palmbrook CC	613	141.50	5.80		65	76.50	869
Sun City CC	533	123.30	2.70		90	33.30	762
Union Hills CC	729	141.00	5.60		90	51.00	879
Youngtown: Maricopa Lake	15						
Sun City West Rec Center:							
Deer Valley GC	546	101.37	7.64	50.22	52	49.37	677
Desert Trails GC	469	79.00**	5.00**	19.00**	35	44.00	507
Echo Mesa GC	592	100.80	7.60		33	67.80	633
Grandview GC	761	163.70	7.80		67	96.70	1008
Pebblebrook GC	689	142.50	6.40		57	85.50	874
Stardust GC	429	96.30	2.30		33	63.30	576
Trail Ridge GC	539	81.60	14.87	81.44	50	31.60	626
Sun City West Private Clubs:							
Briarwood CC	725	152.10	4.10		106	46.10	942
Hillcrest GC	769	154.00	23.70		68	86.00	1048
TOTAL	**12315**						**15636**

Data source:
* – Arizona Dept of Water Resources (Appendix D.1 and D.5)
** – facility operators
*** – calculated (Appendix D.6)

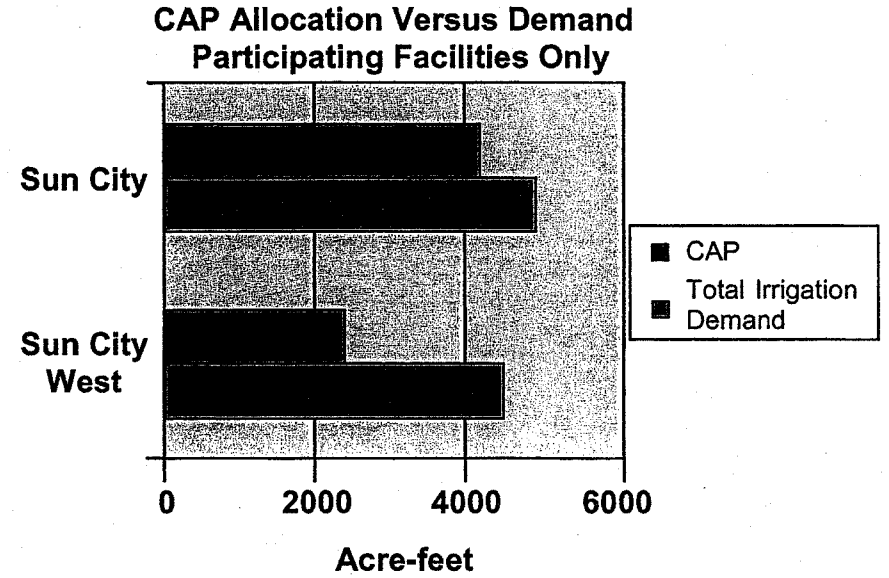
4 Water Delivery Capabilities of the System

The objective of the proposed project is to deliver the full annual allocations of CAP water to Sun City West and Sun City West for use in irrigation of golf courses. However, the CAP allocation will not be sufficient to fulfill all the irrigation needs of those golf courses. Thus, when the system is in full operation, operators of the facilities will use a combination of CAP and well water to fulfill those irrigation needs.

CAP Allocations to Sun City West and Sun City West

As mentioned above, the CAP allocations (4,189 acre-feet per year to Sun City and 2,372 acre-feet per year to Sun City West) will be insufficient to serve the irrigation needs of the participating golf courses in either community. The portions of the needs that will be fulfilled by CAP water from the proposed system are as follows.

Participating Facilities



Not all golf courses in Sun City West will be included in the GSP delivery program for reasons indicated in Part A of this report. Likewise, in Sun City West, two golf courses will not be included because of legal issues that require the utilization of effluent. The participating facilities are listed below.

Sun City Golf Courses

Participating	Not Participating
Lakes East GC	Palmbrook Country Club
Lakes West GC	Sun City Country Club
North GC	Union Hills Country Club
Riverview GC	
South GC	
Quail Run GC	
Willowcreek GC	
Willowbrook GC	

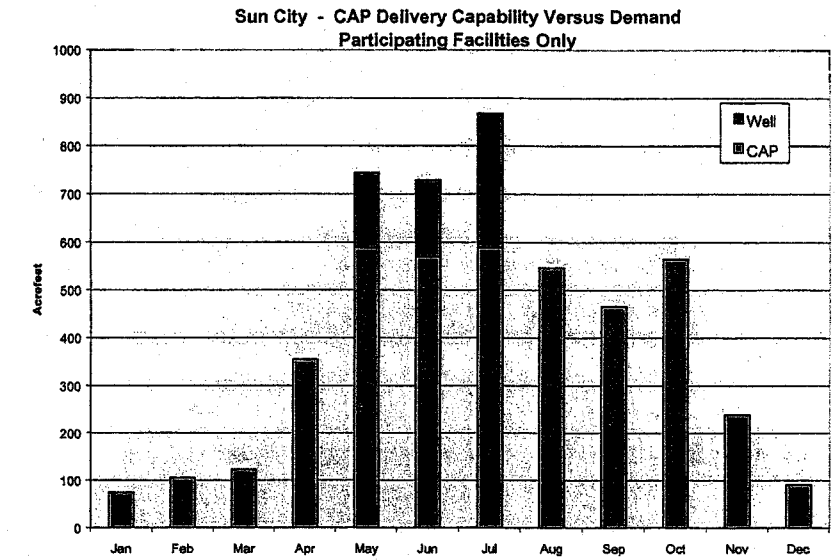
Sun City West Golf Courses

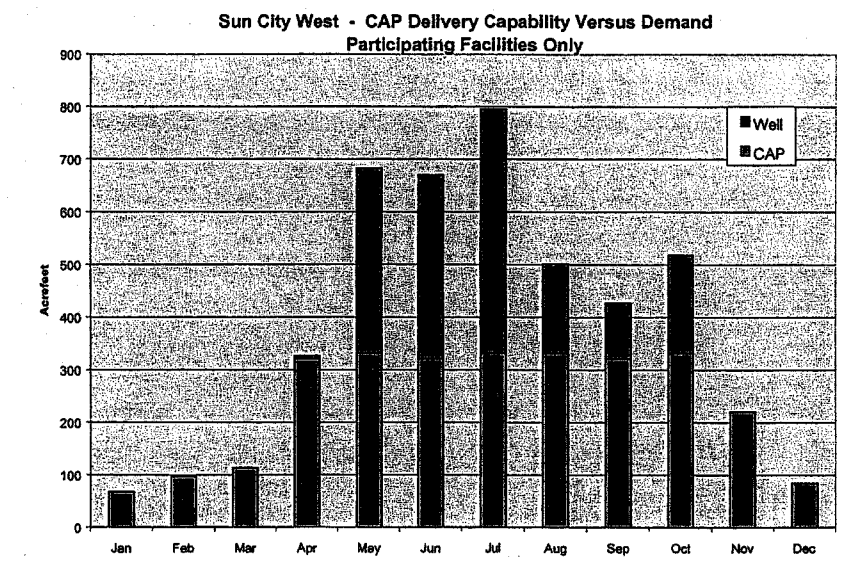
Participating	Not Participating
Echo Mesa GC	Deer Valley GC
Grandview GC	Desert Trails GC
Pebblebrook GC	
Stardust GC	
Trail Ridge GC	
Briarwood Country Club	
Hillcrest Golf Club	

Relationship Between Delivery Capability and Demand

The demand for irrigation water follows a diurnal cycle throughout the year, which approximately follows the annual temperature cycle. Demand is low in the winter and high in the summer. As an operating procedure, all demand will be met by utilizing CAP water at each of the facilities unless demand exceeds the CAP system delivery capability or after the point in each year when the CAP allocation of the particular community has been fully consumed. Only then will well water be utilized to augment the CAP deficiencies. Hence, in the cooler months, the water source will be the proposed CAP system. In warmer months, the water utilized by the facility operator for irrigation will be a blend of CAP and well water.

The following graphs illustrate the irrigation water demand for Sun City and Sun City West through an annual cycle. They also illustrate the requirements for blending. The data was derived from historical water use data (section 2b).

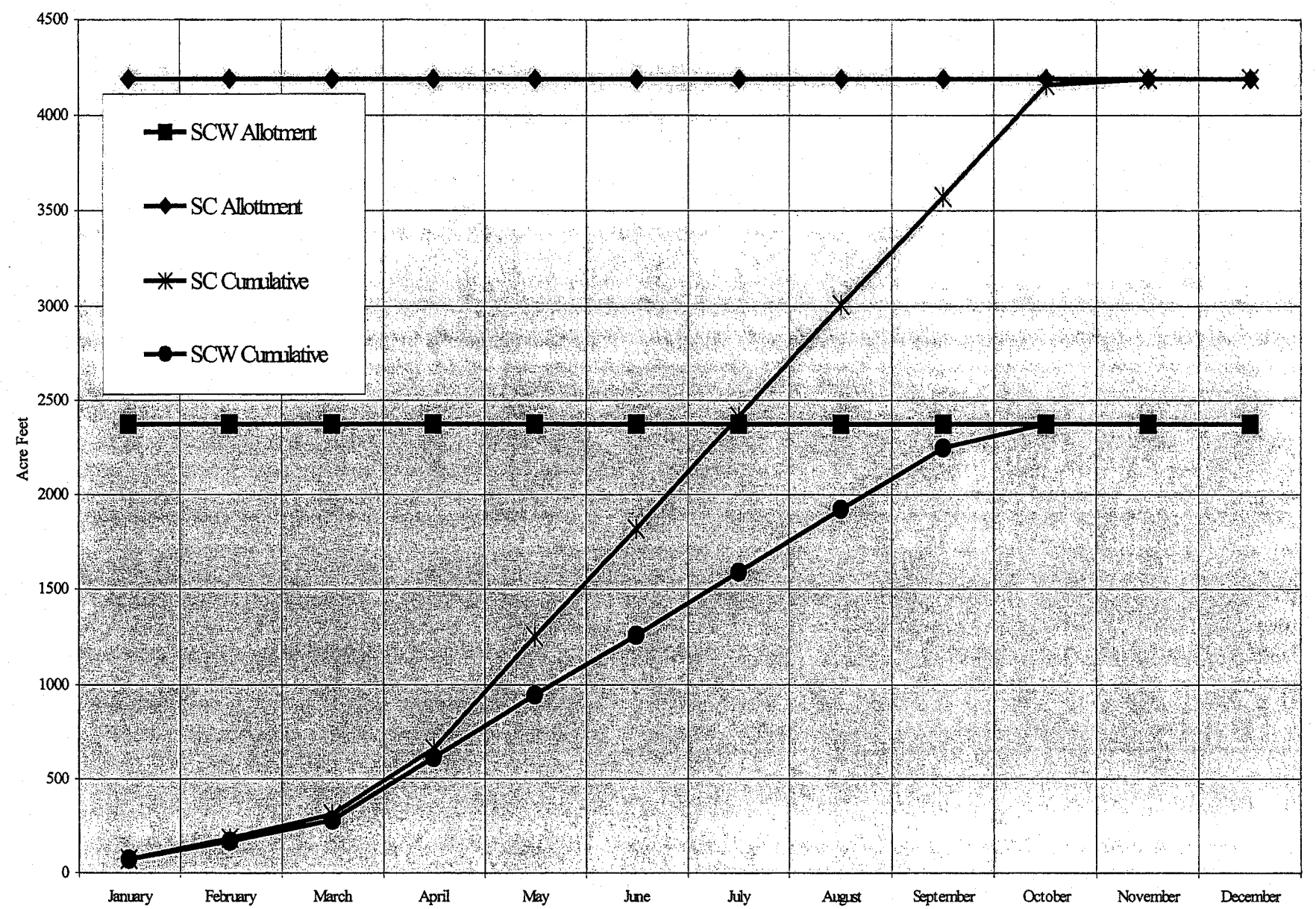




Delivery Profile

As mentioned above, CAP water will be utilized in preference to well water unless the demand exceeds the supply capacity. This is necessary to ensure that the entire CAP allocation will be consumed by the end of the calendar year. Given this operational policy, it is anticipated that the CAP allocation will not be fully consumed until quite late in the year. The following graphics illustrate the anticipated CAP delivery versus time profile and assume consistent operations. Operational complications and/or years with above average rainfall would have the effect of extending the date of full allocation delivery beyond the dates illustrated here.

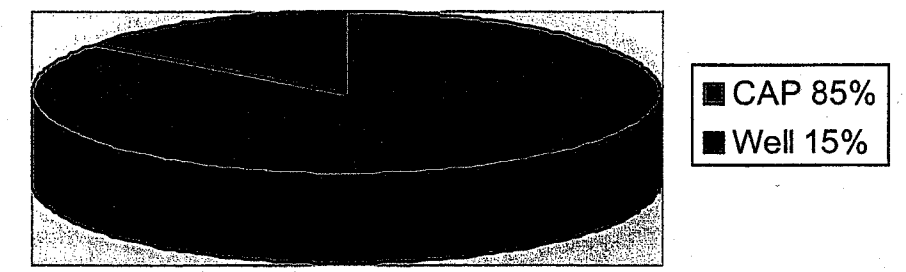
Sun City & Sun City West Supply & Demand



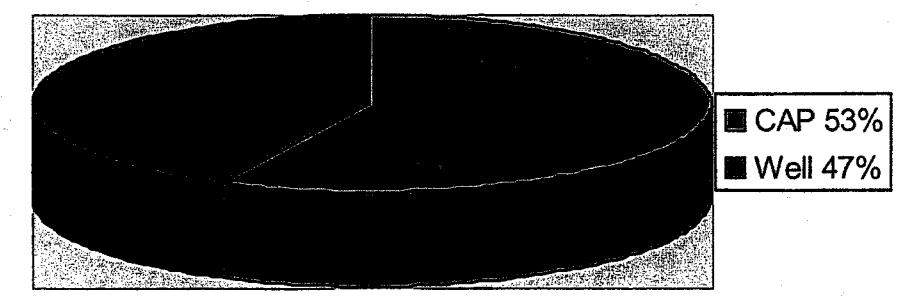
CAP / Well Water Blending

The anticipated annualized blending ratios based on historical golf course irrigation usage for SC and SCW are as follows.

Sun City
Annualized Blending Ratio
(participating facilities)



Sun City West
Annualized Blending Ratio
(participating facilities)



Summary

In conclusion, the proposed system will be capable of fulfilling the objectives of the project. Provided that well water is utilized only when the CAP system is incapable of fulfilling the demand, then the entire CAP allocations will be utilized.

5 Water Quality

Water quality is an essential element of successful agriculture. When considering water quality of groundwater or surface water, salinity and the concentration of sodium and calcium ions have the greatest impact.

To evaluate the impacts of using CAP water in conjunction with well water, instead of the current well water sources, water quality issues were evaluated for each of the two water sources. Those results are presented here.

Current Well Water

To evaluate the quality issues of the existing well water sources, June 1999 analytical data for each Recreation Centers of Sun City West golf course was obtained from Todd Patty, Recreation Centers of Sun City West golf course manager (**Appendix D.7**). It will be assumed that this data is typical and representative of all of the golf courses. Please note that water salinity is measured as electrical conductivity (EC) and expressed in the units, dS m^{-1}.

Water Analysis from Recreation Centers of Sun City West June 1999

Golf course	pH	EC	Ca (ppm)	Na (ppm)
Pebblebrook	9.5	0.356	17	69
Stardust	8.2	0.425	24	53
Grandview	9.2	0.490	8	95
Echo Mesa	8.2	0.616	30	112
Trail Ridge	9.9	0.506	15	119
Deer Valley	9.8	0.566	13	131
Desert Trail	10.2	0.450	6	93
Average	**9.3**	**0.487**	**16**	**96**

CAP Water

Data on the water-quality parameters listed above were also acquired for CAP water. The CAP organization routinely samples water from several locations within the system and laboratory analyses are performed on those samples and the results recorded. In general, waters are sampled weekly, although not all parameters are analyzed each week. The 1999 weekly data were obtained from CAP for the 99th avenue sampling location. Average values for the 1999 data are presented below:

Water Analysis from CAP (99th Ave) Average of 1999 weekly data

Golf course	pH	EC	Ca (ppm)	Na (ppm)
Average	8.5	0.891	71	80

Projected Blending Ratios and Corresponding Water Quality Parameters

The water used for golf course irrigation will come from well water, CAP water, or a blend of the both. The actual quality of the irrigation water will likely fluctuate within the limits of the original well and CAP sources as the water blend ratio fluctuates. Because the salt and specific ion influx are additive, instantaneous water quality parameters within the above limits are not of critical importance. Instead, the values of primary importance are the annual averages of the quality parameters.

The annual well/CAP ratios for both Sun City and Sun City West were given in an earlier section. These ratios assume that each of the Sun Cities will utilize their entire CAP allotments. Based on these ratios and the water quality information listed above, the average water quality values in a given year for each parameter (with the exception of pH) can be calculated. They are presented below:

Projected Average Water Quality

	Well*	CAP*	Ratio	EC**	Calcium***	Sodium***
SC	717	4189	1:5.84	0.830	63	82
SCW	2132	2372	1:1.11	0.701	45	88

* - acre-feet/year
** - electrical conductivity (dS $^{m-1}$)
*** - ppm

Because pH is a logarithmic rather than linear representation of hydrogen ion concentration, the values for the parent waters cannot be averaged, as was done above for the salinity and ion concentration parameters, and the anticipated pHs of proposed blends cannot be projected. It can be concluded, however, that the resulting pHs of the proposed blends will be lower, and therefore more favorable, than the pH of the existing well water.

Salt Leaching

As indicated above, switching from the current well water to a well/CAP water blend will cause the salinity of the irrigation waters to increase. All irrigation water contains salts which, if unmanaged, can accumulate in the rootzone to detrimental levels. These salts can be managed successfully by leaching them out of the bottom of the rootzone via application of water in excess of that required for evapotranspiration from the turf surface. The additional water necessary for adequate leaching is referred to as the leaching requirement and is expressed as a percentage of the total requirement for turf evaporation and leaching. If the salt content of the irrigation water is increased, additional leaching will be required. Leaching requirements for any irrigation water can be calculated as follows:

$$LR = EC_w / 5(EC_e) - EC_w, \quad \text{where}$$

ECw - salinity of the irrigation water
ECe - salinity of a soil extract that is tolerated by the turf plants (3 for ryegrass)

When the above equation is applied to the projected water salinities, the following minimum leaching requirements are calculated.

Calculated Minimum Leaching Requirement (%)

Water	LR (%)
Well	3.4
CAP	6.3
SC blend	5.9
SCW blend	4.9

The meteorological staff at the University of Arizona has determined that the annual water consumption (evapotranspiration) from turf in the northwest valley is approximately 60 inches per year. Applying the above leaching requirement percentages to the 60-inch-per-year value results in the following calculations of minimum leaching requirements, expressed as inches-per-year.

Calculated Minimum Leaching Requirement (inches per year)

Water	LR (in/yr)
Well	2.0
CAP	3.8
SC blend	3.5
SCW blend	2.9

The difference between the leaching requirements for the current well water and the projected blends is an estimation of the additional irrigation water that will be required to compensate for the higher salinity of the projected blends. These values will reflect an increased annual water consumption by the turf facilities.

Increased Water Consumption for Leaching (inches per year)

Users	Inches per year
SC	1.5
SCW	0.9

Increased Water Consumption for Leaching (acre-feet per year)

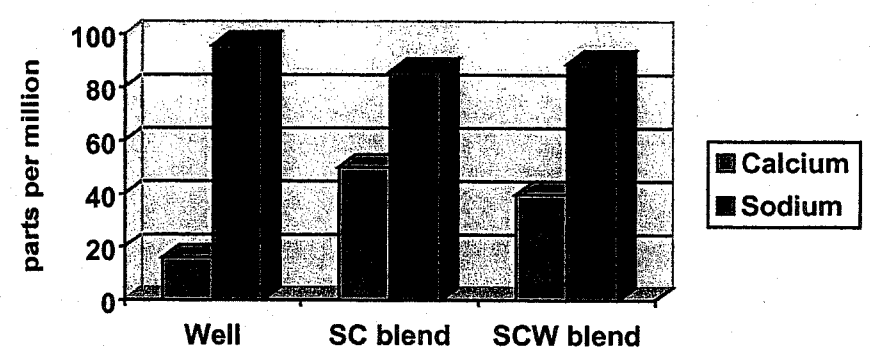
Users	Inches per year
SC	123
SCW	68

Projected Changes in Specific Ions

Water salinity is a non-specific term referring to the total ion concentration in water. This parameter is important because it reflects the total amount of salts in a given volume of water and, therefore, the requirements for leaching water. However, specific ions vary in their negative (and positive) impacts on agriculture. For example, fertilizer elements added to a soil or to irrigation water are ions that contribute to salinity. Of particular interest in agriculture is calcium, which has a positive impact on soil structure and is often added in the form of gypsum, and sodium, which has a detrimental effect on soil structure.

As discussed earlier, the existing well water differs significantly from CAP water with regard to concentrations of calcium and sodium.

Specific Ion Concentrations



When the projected well/CAP water blends are utilized for irrigation, the concentrations of these ions will change accordingly.

As indicated in the graph above, the inclusion of CAP water in the irrigation blends will result in a slight decrease in the sodium application to the turf, a desirable outcome. In addition, there will be an increase in the calcium applied, also a desirable outcome. Therefore, with reference the specific concentrations of calcium and sodium, the two ions of greatest impact on agriculture, the conversion from well water to either of the two blends will result in a more favorable situation.

City of Scottsdale Experience

There is a significant precedent regarding the use of CAP water for irrigation of golf courses in the Phoenix metropolitan area. For approximately eight years, the City of Scottsdale supplied 100 percent CAP water to 20 golf courses in north Scottsdale (north of Bell Road) via the RWDS. In anticipation of utilizing a blend of partial CAP water in the Sun Cities, the experiences of these Scottsdale facilities may offer insight into potential impacts. An informal telephone survey of seven individuals who managed these facilities during the time of the 100% CAP utilization was conducted. The comments offered by these individuals are as follows:

Survey of RWDS Users

Question: What problems or complications did you encounter when using CAP water prior to the addition of effluent?

1. Shawn Emerson (Desert Mountain Properties)
   a. The salt content was higher in the winter than in the summer months.
   b. It was like having two different waters at different times of the year.
   c. We compensated for the salt by leaching occasionally.
   d. It did not pose any real problems.
   e. It may have caused a little more salt staining on hardscape.

2. Ed Shimkus (Troon North, Legend Trail)
   a. Any problems that people talked about at the time were blown out of proportion.
   b. We didn't have any problems with it.
   c. The water quality was pretty good.
   d. It wasn't a big deal.

3. Carl Rygg (The Estansia Club)
   a. No problems at all.
   b. Quality wasn't bad, actually, it was quite good.
   c. We tested it continuously and the ions were in a good balance.

4. Scott McCall (The Boulders)
   a. Salts usually run at 400 – 600 (ppm) but can creep up as high as 900 (ppm).
   b. No real problems.
   c. You have to leach away the excess salts.
   d. We treated with acid.

5. Ernie Pock (Terravita, Grayhawk)
   a. We had no problem at all, nobody had any problems before effluent was incorporated.
   b. They may be better off than before because CAP has so little sodium in it.
   c. TDSs are higher but you make up for it with more flushing on bentgrass greens.
   d. Rye and bermudagrass wouldn't require any changes.
   e. It is very manageable.
   f. You would want to treat for the high bicarbonates.

6. Paul Ellwood (Terravita, TPC)
    a. No problems whatsoever, any reports of problems were sensationalized.
    b. Dissolved salts were a little higher than well water.
    c. Compared to what I'm using now (effluent), it was fabulous.

7. Kevin Smith (Troon Country Club)
    a. We didn't have any problems.
    b. The salts were a little high but leaching wasn't an issue.

Conclusions - Water Quality

The inclusion of CAP water with the existing well water will result in an increase in the total salinity of the irrigation water as compared to the existing well-water sources. However, this increase will be manageable. Management of this additional salt influx will require the additional application of approximately 1.5 inches of irrigation water to the turf areas on an annual basis, less than 3% of the annual consumption.

Changing to the CAP blends will also alter the balances of specific ions applied to the turf. It is anticipated that the application of sodium (a detrimental salt ion) will decrease slightly, whereas the application of calcium (a favorable salt ion) will increase substantially. Thus, with regard to the specific ions of primary interest in agriculture, the ion balance situation will improve.

To evaluate the potential impacts of CAP water usage for irrigation, facility managers with experience using CAP water for irrigation were surveyed. Of the seven individuals polled, there were no significant negative comments. Comments were either neutral or positive.

In summary, it is concluded that the use of CAP water to supplement golf course irrigation in the Sun Cities will not cause any substantial difficulties related to water quality. Minor difficulties that may arise can be overcome with additional leaching via the application of slightly increased irrigation water quantities.

6 Treatment Systems

The purpose of this section is to discuss the possible need to provide treatment of the CAP water prior to it being delivered to golf courses for turf irrigation. The use of untreated CAP water for golf course irrigation has been common practice in the Phoenix metropolitan area since the CAP Canal began delivering water. The best example of this has been the City of Scottsdale's Reclaimed Water Distribution System (RWDS). For approximately eight years, the RWDS has delivered untreated CAP water to 20 golf courses in the north Scottsdale area.

The RWDS system consists of a series of five major pump stations and pipelines (16- to 30-inch diameter) that take water from the CAP Canal and deliver it north along Pima Road approximately 13 miles. Various golf courses tie-in to the transmission main along its route for delivery of water to their irrigation reservoirs. The RWDS provides no treatment to the CAP water prior to being delivered to the golf courses. There is, however, an 8-million gallon (MG) storage pond at the RWDS main pump station. This pond was initially installed at the request of and payment by the golf courses for storage capacity in emergency situations (e.g. if pump stations are out of service). As it has been operating, the storage capacity function has not been necessary since the golf courses already have on-site storage and the RWDS pump stations have not been out of service for extended periods. The storage pond has, indirectly, provided some level of treatment to the CAP water, particularly during low demand months. In those months, water is retained in the storage pond long enough to allow some settlement of particulates. During high demand months when the RWDS is delivering 20 MGD, the 8 MG pond is essentially a flow-through pond and little settlement occurs. In that case, the golf courses are receiving approximately the same quality water that is taken directly from the CAP Canal.

Initially, strainers were installed at the RWDS pump station nearest the CAP Canal. The strainers were installed to remove algae and other particles not removed by the bar screen at the CAP turn-out. The City experienced severe operational difficulties with the strainers due to excessive clogging. The strainers were taken out of service shortly after commissioning and the RWDS has been delivering the untreated CAP water for essentially the eight years it has been in operation.

With the completion of the City's Water Campus, which is an advanced wastewater treatment plant, the RWDS is now beginning to deliver treated effluent to the golf courses. Depending on the time of year and subsequent demand, the treated effluent will supplement or take the place of the CAP water.

As part of this project, seven of the golf courses using CAP water delivered in the RWDS were contacted to discuss their experience. All of seven courses reported neutral to favorable experience in using the untreated CAP water.

Some of the golf courses which utilize CAP water for at least a portion of their irrigation needs as of 1998 are; (Source ADWR)

- Red Mountain Ranch
- Raven
- TPC
- Viewpoint RV and Golf Resort
- Gold Canyon Golf Resort
- 500 Club
- Apache Sun
- Rancho Manana
- Johnson Ranch Golf Club
- Happy Trails
- Sunland Village
- Traditions
- Fiesta Lakes

It is also worth noting that most golf courses in the SRP service area are using untreated SRP water for the irrigation of their courses. The source of water for SRP is the Salt and Verde Rivers, and the quality is similar to that conveyed in the CAP Canal. In fact, in many cases, SRP water has a higher occurrence of algae than the CAP Canal.

Based on the well-established historical successes of using untreated CAP water for golf course irrigation in the Phoenix metropolitan area, no treatment of the CAP water is recommended for this project.

PART C – FEASIBILITY OF A JOINT TRANSMISSION FACILITY WITH THE AGUA FRIA DIVISION

1 Introduction

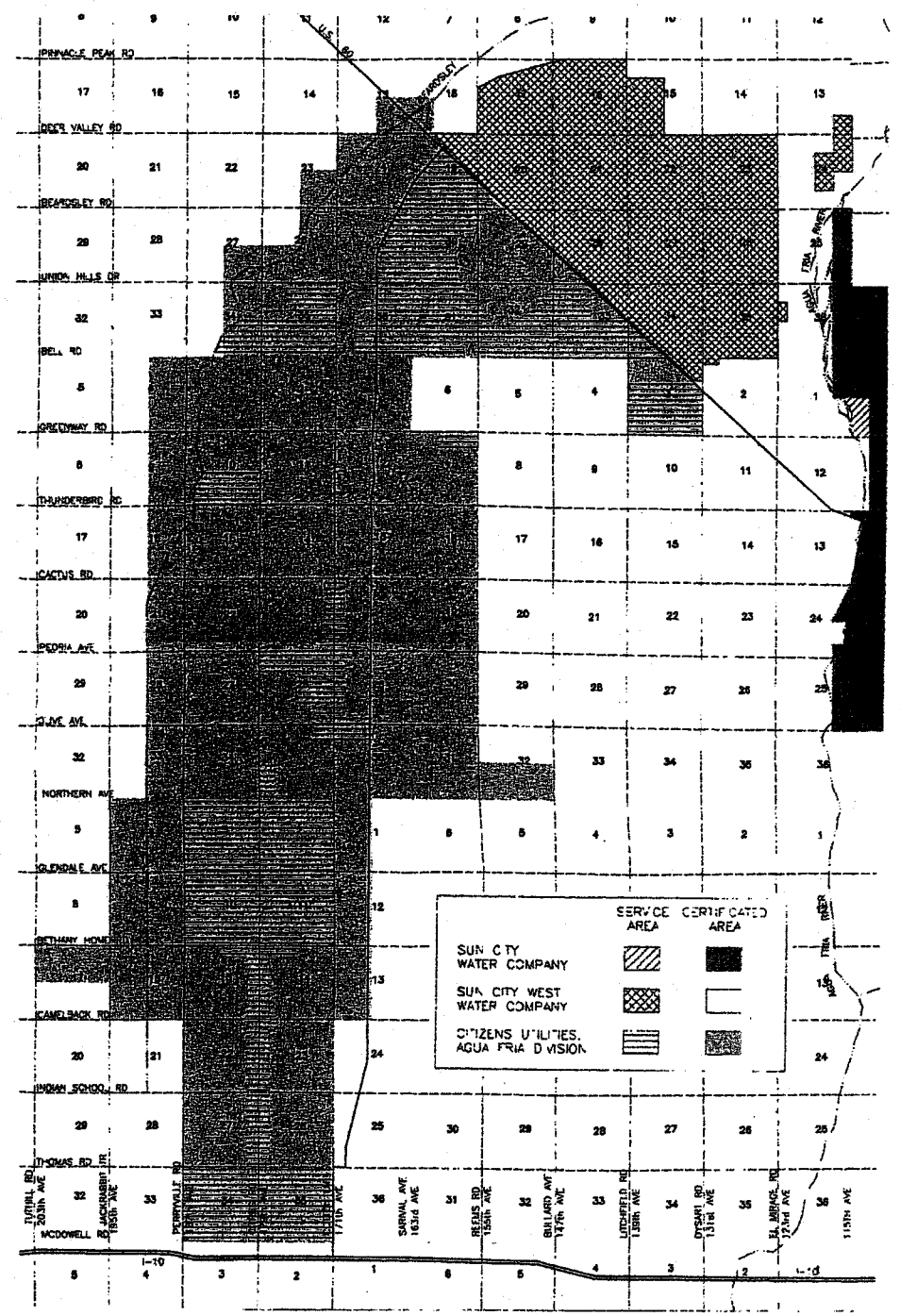
This section of this report investigates and reports on the feasibility of combining the Groundwater Savings Project with a project for Citizens' Agua Fria Division. The Agua Fria Division is a service area of Citizens Water Resources that generally comprises the area surrounding the town of Surprise and some adjoining County land, as shown in **Figure C.1**.

Currently, the Agua Fria Division has a CAP water allocation for an annual allotment of 11,093 acre-feet. A portion of the allocation (2100 ac-ft) is presently being used to recharge the aquifer by way of the Maricopa Water District's groundwater savings facility. The current plan is to increase the use of Agua Fria's CAP water allotment annually by 1100 ac-ft increments. In the future, as the demand increases in the Agua Fria Division and a CAP water treatment plant is required, the volume recharged into the Maricopa Water District's groundwater savings facility will be reduced to account for the CAP water being delivered to the future CAP water treatment plant. The water is currently being conveyed to the recharge facility through the Beardsley Canal. Thus the present method of utilizing the Agua Fria Division's CAP water allocation does not require a separate pipeline conveyance facility.

2 Agua Fria Division Master Plan

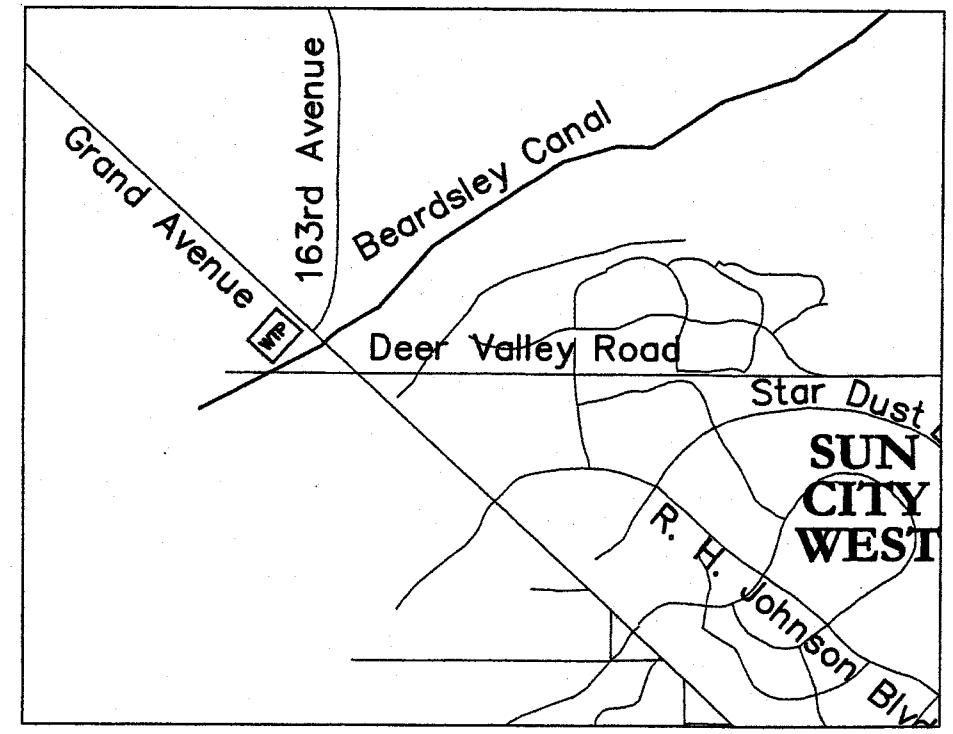
A Master Plan[1] has been prepared for the Agua Fria Division that provides both a short-term and a long-term strategy for water supply and distribution in Citizens' Central Agua Fria service area. The master plan investigates a planning horizon of the year 2020. Included in the master plan is an implementation plan and schedule that describes the phased implementation of facilities during the 20-year planning period, that are necessary to serve the demands of the area.

Figure C.1



The recommended alternative in the master plan for meeting future demands calls for the first phase of a water treatment plant to be in service by the year 2005. The plant is to be located somewhere south of Greenway Road near the Beardsley Canal. The initial plan is to supply the WTP by "wheeling" CAP water through the Beardsley Canal. The capacity of the plant will be expanded over time to meet the forecasted demands of the service area. Prior to the construction of the WTP described above, customers are being served by the use of groundwater wells.

Figure C.2



[1] Brown and Caldwell, *Citizens Water Resources, Central Agua Fria Master Plan Draft*, June 2000.

If, over time, the capacity of the plant cannot be fed by the Beardsley Canal, or if the Beardsley Canal annual dry-up period becomes an operational problem, or if the wheeling costs make the use of the Beardsley Canal economically prohibitive, a pipeline conveyance project from either the CAP Canal or Lake Pleasant to the WTP may become necessary. However, if required, this pipeline conveyance project will not be constructed until after year 2005, well after the completion of the first phase of the WTP. In fact, since the actual necessity of this pipeline conveyance project to the Agua Fria Division is unknown, the construction of this pipeline conveyance project was not projected within the Agua Fria Division's 20 year planning horizon through the year 2020.

The current CAP allotment contract secured by the Agua Fria Division amounts to 11,093 acre-feet. There are no plans to acquire additional CAP water, so the total future anticipated flow to the Agua Fria Division service area would remain at 11,093 acre-feet.

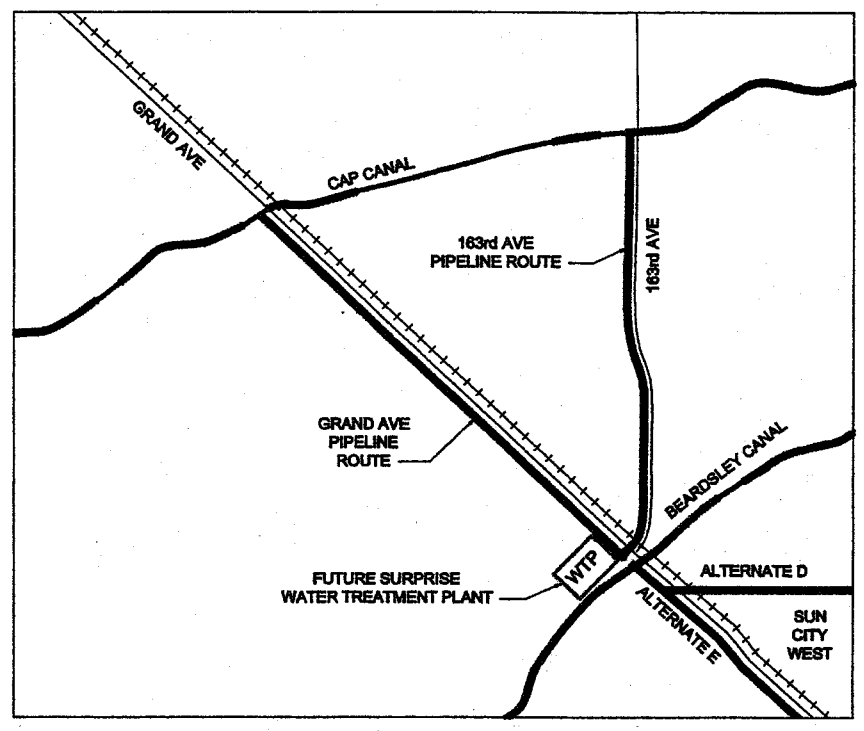
3 City of Surprise Pipeline Project

During the course of researching a possible joint project with the Agua Fria Division, it was discovered that the city of Surprise has long-range plans to construct a CAP raw water transmission line from the CAP Canal to the future site of a water treatment plant. The plant may be located at the southwest corner of Grand Avenue and 163rd Avenue (Sarival Avenue). This project is projected to be in service in 2007.

The pipeline route proposed by the city of Surprise has not yet been established, but it is likely to follow either the existing alignment of Grand Avenue or 163rd Avenue. The Grand Avenue route is approximately 6.0 miles long while the 163rd Avenue route would be approximately 5.0 miles long. See **Figure C.3**.

The current CAP allotment contract secured by the city of Surprise amounts to 7,373 acre-feet. The city plans to acquire an additional allotment of 2,608 acre-feet of CAP water bringing the total anticipated flow in the city of Surprise pipeline to 9,981 acre-feet.

Figure C.3



4 Joint Facility Description

As a part of this Groundwater Savings Project study, the Agua Fria Master Plan has been reviewed together with the city of Surprise concept for the possibility of combining a joint facility pipeline project. The concept of a joint facility project would be to minimize infrastructure cost for all parties. The possible combinations for a joint facility pipeline includes:

- Groundwater Savings Project / Agua Fria Division
- Groundwater Savings Project / Agua Fria Division / City of Surprise
- Groundwater Savings Project / City of Surprise

For a joint facility to be feasible, it will have to be sized to accommodate the combined flow rates of the respective partners. For purposes of estimating the pipe size, the following assumptions have been made:

- Flow in the pipeline will be by gravity.
- Velocity will be approximately 5 feet per second.
- Flow rate will be based on the annual allotment times a peaking factor of 1.5

Using these assumptions, the size of a joint pipeline facility, based on the contributing partners, would be:

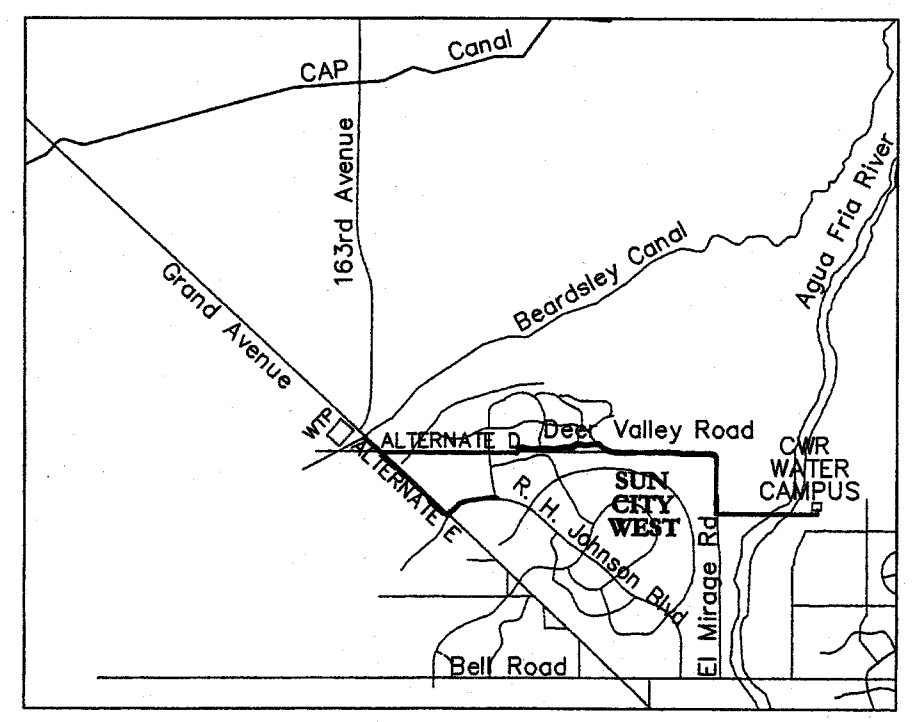
Joint Facility Pipe Size

Contributing Partners	Pipe Diameter (in.)
Groundwater Savings Project Agua Fria Division	36
Groundwater Savings Project Agua Fria Division City of Surprise	48
Groundwater Savings Project City of Surprise	36

A complete hydraulic investigation would have to be performed to determine if the operating pressure zone requirements and other delivery conditions of each of the parties to the joint facility would be met.

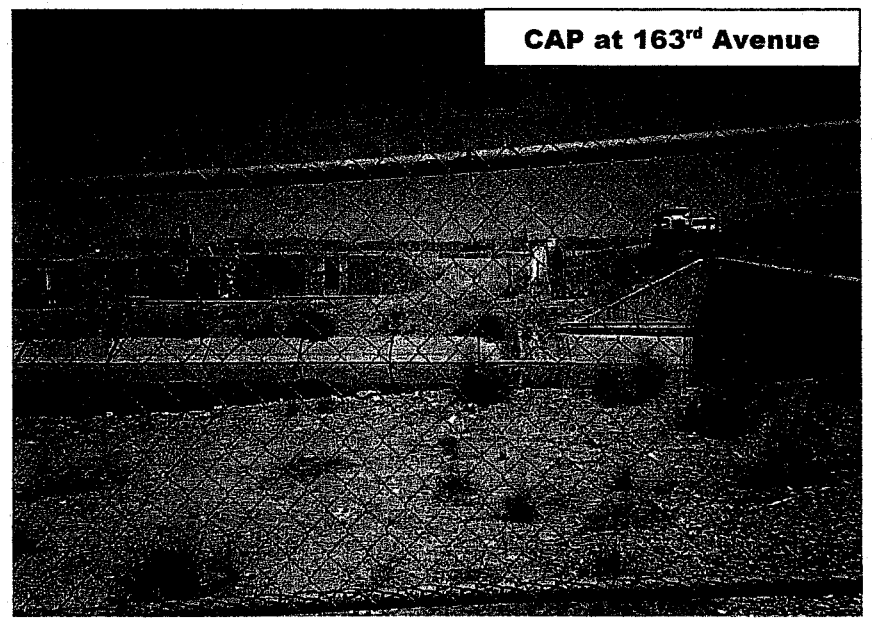
The joint pipeline facility would take delivery of CAP water from a new turnout on the CAP Canal, which would be constructed under this project. Ultimately, the joint facility pipeline would connect to the GSP through one of several routes. These possible routes are very similar to the Alternative D and Alternative E alignments, respectively, that are described in Section D.2

Figure C.4



5 Joint Facility Location

The joint pipeline system could start at a new turnout structure on the CAP, to be constructed either at Grand Avenue or at 163rd Avenue. No existing turnout is available at either of these locations. Because CAP does not have an annual canal dry-up, the tie-in process would have to be accomplished in the wet condition. This is done by placing cofferdams around the work area and can typically be quite expensive.


CAP at 163rd Avenue

CAP Review of Design Plans

The engineering department at CAP will coordinate the review of construction design plans required for installation of the new turnout structure. CAP requires approximately two weeks for the review of each plan set, with the cost of these reviews applied to the project.

The new turnout to be constructed on the CAP Canal would be on the south side of the canal. It would include a screen flush with the lining and a manual gate at the opening to a 36 to 48-inch diameter concrete cylinder iron pipe (RCCP). An open meter box, intended for measurements in feet of water, will need to be constructed about 28 feet from the canal. The entire turnout is to be constructed on CAP right-of-way and enclosed by a chain link fence, but access can be provided to CWR for monitoring equipment maintenance. Plans for a typical turnout are included in **Appendix E**.

A short piece of pipe, or spool piece, containing a water meter for measuring flow in the pipe, will be installed in the meter box. An acoustic meter, will be the revenue meter for CAP and will connect to a Measure Control Unit (MCU) that transmits the information to CAP to a check structure downstream from the turnout. The MCU can be hardwired or radio transmitted to the RTU at the check structure. I/O ports are available for these connections. Power will be required to operate the flowmeter and MCU, and although there is currently none at the site of the turnout, power is close by.

Everything inside the fence becomes property of CAP, who will operate and maintain the facilities. CAP will clean the grate at the inlet and provide maintenance to the telemetry and measurement systems. CAP can provide access to the meter box area for CWR and will provide a courtesy signal from its RTU to CWR, although CWR will be required to provide its own telemetry.

CAP Easement Requirements and Right-of-Way

Because the turnout will be new, some permanent easement may be required. Before construction begins, a Land Use application and $500 application fee must be filed. The applicant is responsible for additional costs, including those for inspection and oversight, and plan review costs incurred by CAP until construction ends. The application, along with insurance documents, will be reviewed before granting a "Construction Period Land Use License." CAP personnel have issued the Groundwater Savings Project a project number and are aware of the status of the project. Copies of the application, relevant information sheets, and a right-of-way map are included in the **Appendix E**.

CAP Operations

The CAP Canal has continuous, year round flow and does not schedule regular dry-up times for maintenance. Construction in the canal will have to be done "in the wet." There are times when the water surface falls below the control water surface. Customers affected by this situation will be notified and difficulties worked out in advance of low water surfaces.

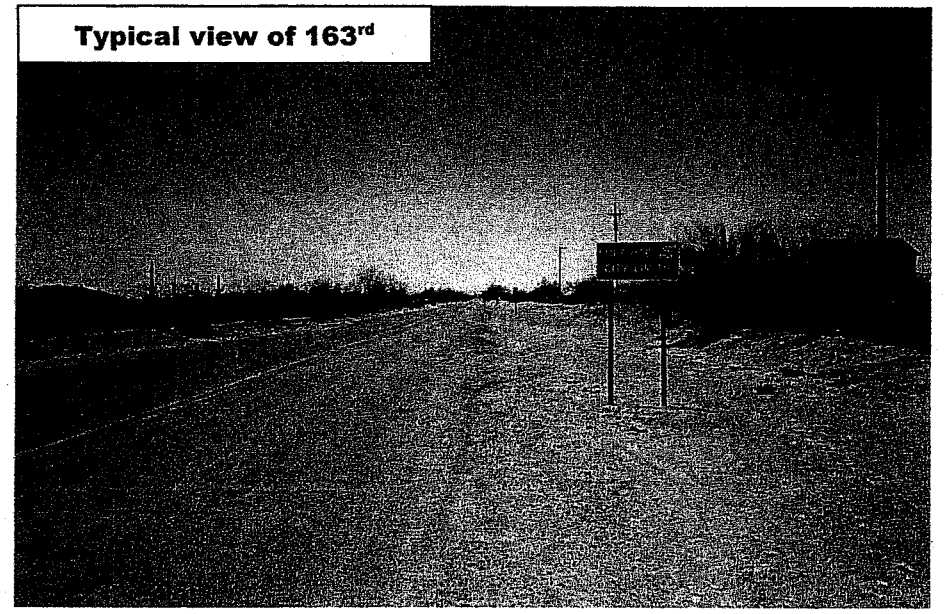
CAP customers are allowed two flow rate adjustments per 24 hours, which must be called in by 9:00 a.m. the previous day.

For annual order estimates, the CAP has a peak averting measure called the "eleven percent rule", applied when the peak flows predicted by annual water orders exceed the ability of CAP to deliver those flows. The rule permits CAP to limit a subcontractors monthly order (not its allocation) to 11% of their annual allocation, thereby easing canal operations during high-use periods. In such a case, CAP notifies M & I customers, which include this project, of the invocation of the rule. Customers may then revise their forecast for water accordingly. Flow changes are implemented only after customer notification. While this rule has yet to be invoked, it remains a tool for CAP Canal management. Peak GSP flows are predicted during the months of May through October. These months could be affected by the 11% rule if it is invoked.

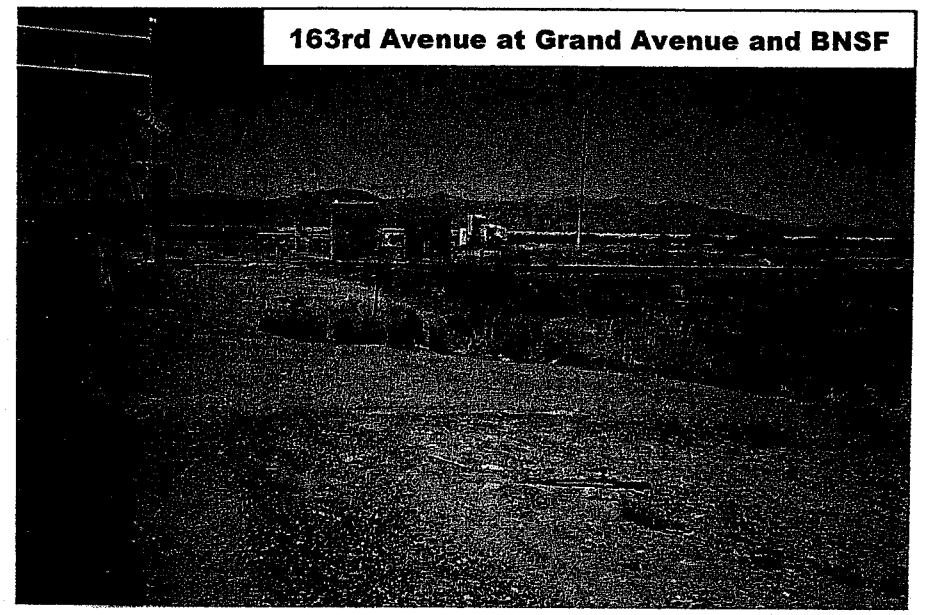
Other measures which could be invoked by the CAP during high demand periods include cutting daily water orders on peak demand days to meet as much demand as possible for all customers. In these cases however, Native American Community and M & I water allocations have the highest priority. Since CWR has water considered as M&I use they would have the highest priority and as with the 11% rule, flow changes would be implemented only after notification

Joint Facility Route

After reviewing the possible options for the joint pipeline system, the 163rd Avenue route appears the most direct alignment. Either side of 163rd Avenue could accommodate the pipeline within the existing roadway right-of-way. It is anticipated that the pipeline would be placed outside of the existing area of pavement. The only apparent underground utilities that may be in conflict with the alignment are telephone lines. Fiber optic lines run parallel to the railroad at Grand Avenue. Overhead power is available.


Typical view of 163rd

There are numerous stormwater cross culverts on 163rd Avenue from Grand to Jomax. North of Jomax Road the drainage crosses in roadway dip sections. Drainage along Grand Avenue is conveyed by cross culverts. Either route may require a crossing of the Burlington Northern, Santa Fe railroad that parallels the north side of Grand Avenue. Typically crossing a railroad with a utility adds time to the design phase of a project because the railroad will review the design and require a construction license and an operating license.



GSP Alternative D Alignment

The Alternative D pipeline route for connecting the joint facility to the Groundwater Savings Project begins at the split from the joint facility near the future city of Surprise WTP. The alignment parallels Grand Avenue southeasterly for approximately 0.4 miles, then turns east for 4.8 miles, on a Deer Valley Road extended centerline alignment through Sun City West, until reaching El Mirage Road. There the pipeline turns south for one mile to Beardsley Road, then east one mile to Citizens Water Resource's SCW wastewater treatment plant.

Along its alignment, the route passes through a residential area of Sun City West, Deer Valley Golf Course, the existing McMicken Dam Outlet Wash and the Agua Fria River. From Grand Avenue the pipeline follows an existing concrete-lined channel east until reaching the golf course. From the golf course, the alignment moves back onto the Deer Valley Road alignment and continues east to El Mirage Road.

The hydraulic grade line (HGL) elevation available in the joint facility pipeline is used as the basis for the hydraulics design of the Alternative D pipeline. The HGL elevation, which can be translated into pressure at the delivery point in the Sun City Area, is calculated by subtracting the losses incurred in the pipeline from the CWS elevation at the CAP Canal. The major portion of the losses in the pipeline will be from friction. There are minor losses when valves or bends in the pipe are encountered, but these are typically insignificant. Vacuum relief valves and air release valves will be required on the pipeline at high points and other locations, and valves will be included to allow the pipeline to be isolated for one-mile segments.

The pressure required in the Alternative D pipeline at the delivery point near the CWR water campus is 70 psi. This pressure is required in order to operate the Sun City West CAP water distribution system and the Sun City CAP water distribution system by gravity.

The preliminary hydraulics analysis for the Alternative D pipeline has determined that a 24-inch diameter transmission pipeline best serves the hydraulic requirements of this project. The resulting pressures not adequate to supply the normal operating range of pressures for this system, requiring the use of a booster pump station. The use of pressure reducing valves along route of the joint facility will not be required to control excess pressure.

GSP Alternative E Alignment

The Alternative E pipeline routes begin at the split off the joint facility pipeline. The alignment parallels Grand Avenue southeasterly for approximately one-and-a-half miles, turning east on R.H. Johnson Boulevard to Granite Valley Drive, where it can be joined to the existing Recreation Centers of SCW irrigation network.

The hydraulic grade line (HGL) elevation available in the joint facility pipeline is used as the basis for the hydraulics design of the Alternative E pipeline. The HGL elevation, which can be translated into pressure at the delivery point in the Sun City West area, is calculated by subtracting the losses incurred in the pipeline from the CWS elevation at the CAP Canal. The major portion of the losses in the pipeline will be from friction. There are minor losses when valves or bends in the pipe are encountered, but these are typically insignificant. Vacuum relief valves and air release valves will be required on the pipeline at high points and other locations, and valves will be included to allow the pipeline to be isolated for one-mile segments.

The preliminary hydraulics analysis for the Alternative E pipeline assumed the use of a 24-inch DIP. The delivery pipeline from Alignment E was assumed to connect to the existing SCW effluent delivery system. Because the closest point of connection is on the downstream end of the system, the pipes are relatively small diameter. These small diameter pipes require high pressure to drive the flows back to the Aqua Fria crossing and into Sun City. Calculations indicate that the existing SCW effluent system is inadequate to carry the required flows back to and across the river, without increasing the pressure in the pipeline via a new pumping system. The pressure required would exceed the physical limits of the existing pipe and could potentially produce excessive leakage and pipe breaks. The delivery pressure produced by gravity flow in the Alternative E pipeline is not adequate to provide flows at the various discharge locations. It will, therefore, not be possible to deliver water from the joint facility pipeline via the Alternative E pipeline.

The SCW effluent irrigation system is owned by the Recreation Centers of Sun City West. The Recreation Centers has indicated to CWR that the pipeline crossing of the Agua Fria River cannot be used to convey CAP from west to east (the direction of flow required for the Alternative E alignment) because of their obligation to provide effluent to Sun City West Recreation Center golf courses in an east to west direction.

The use of GSP Alternative E will not be considered as a delivery method for CAP water to the GSP due to the hydraulic and legal reasons stated in the two preceding paragraphs.

6 Joint Facility Cost

The transportation and delivery of CAP water through a joint facility pipeline project adds a pro-rated portion of the joint facility cost to those costs already determined for either Alternative D or Alternative E.

For purposes of comparing alternatives, the cost of a joint pipeline facility serving the Groundwater Savings Project and the Agua Fria Division may be reasonably estimated to be:

Joint Pipeline Facility
Agua Fria Division & Groundwater Savings Project

Item Description	Unit	Quantity	Unit Price	Amount
Pipeline				
Mobilization @ 5%	Ea.	5%	$217,386	$217,386
RCCP 36", (Class 150)	L.F.	26,400	$147.66	$3,898,224
36" Butterfly Valve w/ Bypass	Ea.	10	$15,000	$150,000
Pavement Replacement	S.Y.	50	$30	$1,500
Railroad Crossing	L.F.	300	$65	$19,500
Traffic Control	L.F.	26,000	$7	$182,000
Combination AirVac Valve (3")	Ea.	3	$5,000	$15,000
R/W Costs (New CAP Turnout)	S.F.	10,000	$1	$10,000
CAP Turnout				
Headwall	Ea.	1	$20,000	$20,000
Slide Gate	Ea.	1	$2,500	$2,500
Construction License	Ea.	1	$500	$500
Accusonic Flowmeter	Ea.	1	$32,000	$32,000
MCU	Ea.	1	$15,000	$15,000
Connection to CAP SCADA	Ea.	1	$1,500	$1,500
			Subtotal	**$4,565,110**
Engineering Design	8%	1	$365,209	$365,209
Construction Administration	12%	1	$547,813	$547,813
Admin./Legal/Financial	10%	1	$456,511	$456,511
Contingency	25%	1	$1,141,278	$1,141,278
			Total Capital Cost	**$7,075,921**

O&M Life Cycle Costs*	Annual Cost	Present Worth
36" Pipeline O&M (50 yr) (26,400 L.F. at $0.50/ft/yr)	$13,200	$216,159
	Total Life Cycle Cost	**$7,292,080**

Pro-rated Cost per Participant (Based on Annual Allotment)	
Groundwater Savings Project (6,561 ac-ft)	$2,710,057
Agua Fria Division (11,093 ac-ft)	$4,582,024
Total Joint Facility Life Cycle Cost	**$7,292,080**

*8.73% Discount Rate Applied, Inflation Factor 3%

If the city of Surprise is added as a partner to the joint pipeline facility, the pipeline would be increased in size. The cost for this option is listed below. The pro-rated cost for each participant, based on annual allotment is also shown:

Joint Pipeline Facility
Agua Fria Division & Groundwater Savings Project With City of Surprise

Item Description	Unit	Quantity	Unit Price	Amount
Pipeline				
Mobilization @ 5%	Ea.	5%	$280,906	$280,906
RCCP 48", (Class 150)	L.F.	26,400	$193.63	$5,112,624
48" Butterfly Valve w/ Bypass	Ea.	10	$20,000	$200,000
Pavement Replacement	S.Y.	50	$30	$1,500
Railroad Crossing	L.F.	300	$65	$19,500
Traffic Control	L.F.	26,000	$7	$182,000
R/W Costs (New CAP Turnout)	S.F.	10,000	$1	$10,000
Combination AirVac Valve (4")	Ea.	3	$7,000	$21,000
CAP Turnout				
Headwall	Ea.	1	$20,000	$20,000
Slide Gate	Ea.	1	$2,500	$2,500
Construction License	Ea.	1	$500	$500
Accusonic Flowmeter	Ea.	1	$32,000	$32,000
MCU	Ea.	1	$15,000	$15,000
Connection to CAP SCADA	Ea.	1	$1,500	$1,500
			Subtotal	**$5,899,030**
Engineering Design	8%	1	$471,922	$471,922
Construction Administration	12%	1	$707,884	$707,884
Admin./Legal/Financial	10%	1	$589,903	$589,903
Contingency	25%	1	$1,474,758	$1,474,758
			Total Capital Cost	**$9,143,497**

O&M Life Cycle Costs*	Annual Cost	Present Worth
48" Pipeline O&M (50 yr) (26,400 L.F. at $0.50/ft/yr)	$13,200	$216,159
	Total Life Cycle Cost	**$9,359,656**

Pro-rated Cost per Participant (Based on Annual Allotment)	
Groundwater Savings Project (6,561 ac-ft)	$2,222,135
Agua Fria Division (11,093 ac-ft)	$3,757,071
City of Surprise (9,981 ac-ft)	$3,380,450
Total Life Cycle Cost	**$9,359,656**

*8.73% Discount Rate Applied, Inflation Factor 3%

The option of combining the Groundwater Savings Project with the city of Surprise as the partner to a joint facility, without the Agua Fria Division, is reported below:

Joint Pipeline Facility
Groundwater Savings Project & City of Surprise

Item Description	Unit	Quantity	Unit Price	Amount
Pipeline				
Mobilization @ 5%	Ea.	5%	$217,386	$217,386
RCCP 36", (Class 150)	L.F.	26,400	$147.66	$3,898,224
36" Butterfly Valve w/ Bypass	Ea.	10	$15,000	$150,000
Pavement Replacement	S.Y.	50	$30	$1,500
Railroad Crossing	L.F.	300	$65	$19,500
Traffic Control	L.F.	26,000	$7	$182,000
Combination AirVac Valve (3")	Ea.	3	$5,000	$15,000
R/W Costs (New CAP Turnout)	S.F.	10,000	$1	$10,000
CAP Turnout				
Headwall	Ea.	1	$20,000	$20,000
Slide Gate	Ea.	1	$2,500	$2,500
Construction License	Ea.	1	$500	$500
Accusonic Flowmeter	Ea.	1	$32,000	$32,000
Geomation MCU	Ea.	1	$15,000	$15,000
Connection to CAP SCADA	Ea.	1	$1,500	$1,500
			Subtotal	**$4,565,110**
Engineering Design	8%	1	$365,209	$365,209
Construction Administration	12%	1	$547,813	$547,813
Admin./Legal/Financial	10%	1	$456,511	$456,511
Contingency	25%	1	$1,141,278	$1,141,278
			Total Capital Cost	**$7,075,921**

O&M Life Cycle Costs*	Annual Cost	Present Worth
36" Pipeline O&M (50 yr) (26,400 L.F. at $0.50/ft/yr)	$13,200	$216,159
	Total Life Cycle Cost	**$7,292,080**

Pro-rated Cost per Participant (Based on Annual Allotment)	
Groundwater Savings Project (6,561 ac-ft)	$2,892,234
City of Surprise (9,981 ac-ft)	$4,399,846
Total Life Cycle Cost	**$7,292,080**

*8.73% Discount Rate Applied, Inflation Factor 3%.

These cost estimates are approximate. No engineering calculations have been performed to verify that the hydraulic assumptions noted will acceptable to the Agua Fria Division or to the city of Surprise, because no concept currently exists for an Agua Fria Division pipeline and the city of Surprise pipeline concept is at the very early stages of development.

The cost may range from $2.0 million to $2.6 million in addition to the cost for either Alternative D or Alternative E. However, as will be demonstrated in Section D.2, the use of the Alternative E alignment cannot be pursued because of ownership conflicts together with hydraulic inadequacies.

The cost to the Groundwater Savings Project of using a joint facility with the city of Surprise, or with the City of Surprise and the Agua Fria Division, would therefore need to include the cost of an Alternative D pipeline:

Cost of Alternative D Pipeline

Item Description	Unit	Quantity	Unit Price	Amount
Pipeline				
Mobilization @ 5%	Ea.	1	$218,358	$218,358
Ductile Iron Pipe (24", Class 200)	L.F.	39,139	$88.45	$3,461,845
24" Resilient Wedge Gate Valves	Ea.	7	$13,500	$94,500
Pavement Replacement	S.Y.	13,000	$20	$260,000
Combination Air/Vac Valve (2")	Ea.	5	$4,000	$20,000
R/W Costs	S.F.	200,000	$1	$200,000
Permitting & Compliance	L.S.	1	$23,150	$23,150
Booster Pump Station				
Pump Station Capital Costs	L.S.	1	$307,660	$307,660
			Subtotal	**$4,585,513**
Engineering Design	8%	1	$366,841	$366,841
Construction Administration	12%	1	$550,262	$550,262
Citizens (Admin./Legal/Financial)	10%	1	$458,551	$458,551
Pipeline Contingency	10%	1	$426,247	$426,247
Pump Station Contingency	25%	1	$80,761	$80,761
			Total Capital Cost	**$6,468,175**
O&M Life Cycle Costs*			Annual Cost	Present Worth
Pump Station O&M (50-yr) (See Estimate, Page D-47)			$68,273	$1,114,527
36" Pipeline O&M (50 yr) (39,139 L.F. at $0.50/ft/yr)			$19,570	$320,464
Total Life Cycle Cost, Alternate D				**$7,903,166**

*8.73% Discount Rate, Inflation Factor 3%

The total cost to the Groundwater Savings Project of a joint facility with the Agua Fria Division may therefore be the pro-rated share of the joint facility pipeline plus the Alternative D pipeline modified to connect to the joint facility. This amount is:

Agua Fria Division & Groundwater Savings Project

Joint Facility Cost Estimate	
GSP Share of Joint Facility	$2,710,057
Alternative D Cost	$7,903,166
Total Cost to GSP	**$10,613,223**

The total cost to the Groundwater Savings Project of a joint facility with the Agua Fria Division and the city of Surprise may therefore be the pro-rated share of the joint facility pipeline plus the Alternative D pipeline modified to connect to the joint facility. This amount is:

Agua Fria Division & Groundwater Savings Project With City of Surprise

Joint Facility Cost Estimate	
GSP Share of Joint Facility	$2,222,135
Alternative D Cost	$7,903,166
Total Cost to GSP	**$10,125,301**

Likewise, the total cost to the Groundwater Savings Project of a joint facility with the city of Surprise may be pro-rated share of the joint facility pipeline plus the Alternative D pipeline modified to connect to the joint facility. This amount is:

Groundwater Savings Project & City of Surprise

Joint Facility Cost Estimate	
GSP Share of Joint Facility	$2,892,234
Alternative D Cost	$7,903,166
Total Cost to GSP	**$10,795,400**

7 Joint Facility Timeline

The new Agua Fria Division water treatment plant is programmed to be in service in 2005. Some time after that, as demand and economic conditions dictate, a transmission pipeline project may be necessary. However, a transmission pipeline to serve the needs of the Agua Fria Division is not currently projected within the 20 year planning horizon through the year 2020. The City of Surprise pipeline is not programmed to be in service until the year 2007.

The project schedules indicated above conflict with the Groundwater Savings Project goal of being in service in the year 2003, making a joint project with either the Agua Fria Division or a joint project with the city of Surprise and the Agua Fria Division neither timely nor cost effective as compared to the alternatives presented in Part D of this report. See Part E for a full comparison of all alternative costs.

8 Conclusion

A joint facility between the Groundwater Savings Project and either the Agua Fria Division or the city of Surprise should not be pursued because the timing of the needs for the Groundwater Savings Project and the Agua Fria Division and city of Surprise do not coincide. Furthermore, a joint facility project is not the least cost alternative for this GSP as is demonstrated in Part E.

PART D – ANALYSIS OF MAJOR ELEMENTS OF THE GROUNDWATER SAVINGS PROJECT

1 Introduction

The Arizona Corporation Commission order, Part B; defines the main purpose of this section of the report, it is to complete a preliminary design and update of the estimated cost including determining "the need for all major elements of its proposed plan (e.g. storage and booster stations)." This section develops the option recommended in the CAP Task Force Study into a concept-level engineering plan by investigating and evaluating the various parameters that will affect the feasibility, constructability, and cost of building the recommended option. Specifically, the elements investigated include:

CAP Trunk Pipeline

The trunk pipeline will carry CAP water into the Sun Cities. This pipeline will convey water from the source at the CAP Hayden-Rhodes Aqueduct to the distribution systems in Sun City and Sun City West. This section discusses the investigations that took place and the various alternatives for routing of the pipeline that have been examined to ensure the most economical and expeditious design. Various criteria are discussed including a cost estimate for each alternative. **Figure D.1** shows the alternate alignments investigated by this study. Concept level plan and profile sheets for each alternate are provided at the end of the section discussing each route.

Pumping Systems

Several of the alternative routes investigated do not have sufficient elevation to produce the pressures required to deliver water to all of the golf course delivery locations by gravity. In this case a booster pump station would be required to provide adequate delivery pressure for these alternatives.

Storage Reservoirs

Storage reservoirs are required if hydraulic calculations revealed an economic advantage in lowering the size of the transmission pipeline (described above) so as to convey less than the average daily flow demand. Storage would then be used to store water during low demand times and use it later when the demand is high. Reservoirs would also be required if system-wide golf course lake volume is insufficient to attenuate the system-wide flows that are suddenly not needed due to factors such as unusually long rain storms or pipe breaks or service down time. Distribution systems such as those proposed for the golf courses in Sun City and Sun City West use large quantities of water and would most likely require reservoir storage rather than tank storage.

Treatment Systems

Water quality differences exist between the groundwater currently being pumped to irrigate the golf courses and CAP water. The possibility of applying some form of treatment to the CAP water prior to its use has been investigated.

Distribution System

A distribution system is required to take the water from the GSP main line to the various delivery points at each golf course. The systems will consist of an arrangement of pipe networks and valves to convey the water to the golf courses in Sun City and Sun City West, sized to fully utilize the water allotment. An existing effluent water distribution system is in place in Sun City West that will be reassigned by its owners as the CAP distribution system within the Sun City West Community. A new distribution system will be constructed to serve the Sun City Area.

Control Systems (SCADA)

With 15 golf courses taking water in two distribution systems at various times throughout a 24-hour period, a very accurate control system must be in place to ensure the total use of the annual CAP allotment going to Sun City and Sun City West. To control the deliveries, a Supervisory Control and Data Acquisition (SCADA) system will be employed. Several possible methods for implementing a SCADA system are discussed.

2 CAP Trunk Pipeline

The Groundwater Savings Project (GSP) CAP main pipeline will be used to convey the CAP water from either the Hayden-Rhodes Aqueduct or the Beardsley Canal to the distribution systems for Sun City and Sun City West. Various alternatives for routing and construction of the pipeline are possible. To ensure the most economical design, several different routes were investigated.

Criteria for Evaluation

The following is a discussion of the criteria used for selecting the best possible route.

Cost

This report presents the conceptual level cost estimates for various parts of the project. Each alternative route was brought to a concept level design (i.e. component size was calculated to meet hydraulic needs and physically laid out on a large scale area map), and the components of the system priced using common methods of cost estimating, including the application of bid tabulations from similar projects in the area and by obtaining price quotes from manufacturer representatives.

Hydraulic Investigations

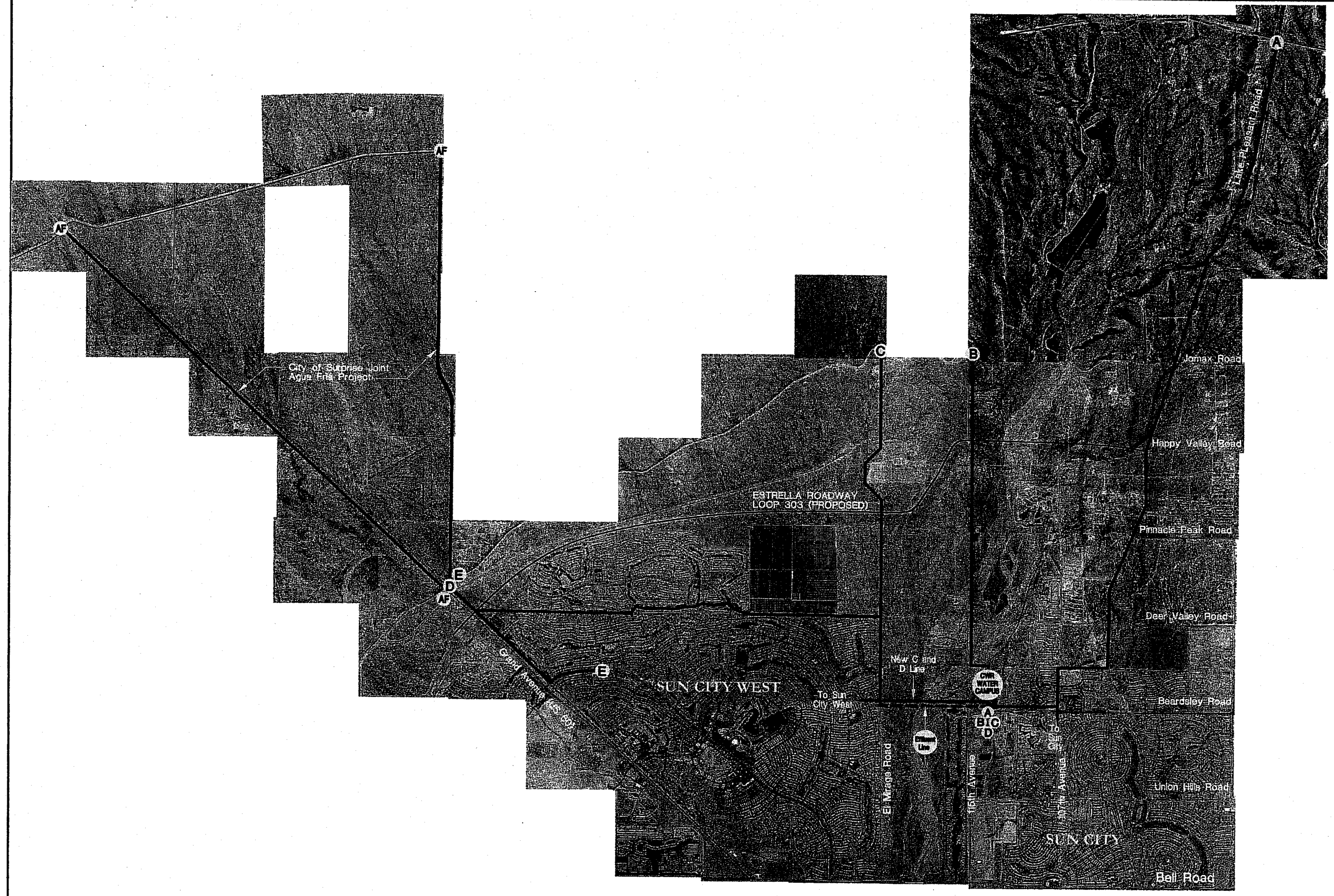
Preliminary hydraulic calculations determine the size of the various components of the transmission and distribution systems, including pipe size, pumping requirements, storage requirements, and the number, size, and location of various appurtenant equipment such as pressure reducing stations, air release and vacuum relief valves, and other flow control considerations.

Community Disruption

The preparation of concept level plans also allowed for an examination of the community disruption that may occur during construction. Where the alternate routes are in desert areas, little or no disruption is expected. However as the pipeline enters the developed areas of the communities, disruption during construction could be a consideration. Community disruption could include the blocking of residential or business driveways, detours on roads and streets, noise, dust, etc. Public acceptance is preferred and lesser community disruption helps achieve that goal.

CITIZENS water resources

SUN CITY/SUN CITY WEST/YOUNGTOWN GROUND WATER SAVINGS PROJECT



PIPELINE ROUTE SURVEY
ALTERNATIVE ROUTE ANALYSIS

Figure D.1

Easements/Right-of-Way Acquisition

The ownership of existing easements and rights-of-way and the need to acquire new easements and rights-of-way (if available), have a direct impact on both the cost and the construction time of the project. Land ownership along several of the alternative routes includes the Arizona State Land Department. There is a lengthy acquisition process associated with acquiring right-of-way from the ASLD.

Environmental/ Regulatory Considerations

Literature and field reviews to identify threatened and endangered species, cultural and/or archeological sites, and other environmental considerations have been documented to ensure that the various routes examined avoid, or at least minimize, the potential for conflicts during construction.

Any permits that may be required for this project (federal, state, county or other) have been identified, along with costs, associated processing times, and other requirements (such as public notification) to ensure the project will be in regulatory compliance.

While the cost of permits may be minimal, the cost of non-compliance could be enormous considering the time that the project could be delayed if the proper clearances and permits are not in place at the time of construction.

Geotechnical Considerations

Various geotechnical factors affect selection of the pipe material and of appropriate construction techniques. Sampling of in-field soil borings and test-pits, and laboratory analysis of the samples allowed the project geotechnical engineer to provide recommendations for construction techniques and pipe material. Specifically soil conditions affecting pipe-laying operations (such as rock), and corrosion protection measures were investigated.

Operation of Canals and Water Delivery

The CAP, through the Hayden-Rhodes Aqueduct, conveys water from the Colorado River to the GSP. The alternative routes investigated include the possibility of utilizing the Beardsley Canal at various locations along its length to convey the GSP CAP allocation closer to the end users of the water (Sun City and Sun City West golf courses) than does the CAP canal. This shortens the length of the pipe conveyance required. The Beardsley Canal is owned and operated by the Maricopa Water District. The MWD must receive the water allocation from the CAP and then "wheel" the water to the CWR turnout location downstream for distribution to the golf courses. The operation of either or both of the canal systems has a large impact on the operation of the GSP.

Utility Coordination

Several local utility companies have facilities in the area of the trunk line alternative routes. Each existing utility may have an impact on the project. Possible utility conflicts with the proposed alternatives are reported and resolution to the conflicts, either avoidance or re-location, are noted.

Ownership Considerations

The consideration of ownership of some of the components of the various alternatives is a criterion for route selection. This is particularly true of those components that interface with the delivery canals. Complete ownership is preferred, but negotiated operating agreements with the owners of the canals may also be acceptable depending on the cost and conditions of operation.

Common Elements

Many common features are found when evaluating the various alternatives for route locations. Items that are common to all the various alternative routes examined are reported in this section to reduce repetition in the detailed discussion of each alternative route that follows.

Central Arizona Project (CAP) and Maricopa Water District (MWD) Canal Operations Elements

CAP Water Deliveries

The CAP Canal has continuous, year round flows in the Hayden-Rhodes Aqueduct and does not schedule dry-up times for maintenance. The *normal water surface elevation* (NWS) in the CAP is the elevation of the water that the canal carries most of the time. The *control water surface elevation* (CWS) is slightly lower. While the CAP guarantees the CWS for most times, in an emergency the water surface may drop below the CWS. Customers affected are notified as soon as possible regarding such occurrences.

CAP water users with individual turnouts are allowed two (2) flow rate adjustments per 24 hours, which must be prearranged with the CAP by 9:00 a.m. the previous day. This allows CAP operators to manage the water balance in the CAP canal on a day to day basis.

For annual order estimates, the CAP has a peak averting measure called the "eleven percent rule," applied when the peak flows predicted by annual water orders exceed the ability of CAP to deliver those flows. The rule permits CAP to limit a subcontractors monthly order (not its allocation) to 11% of their annual allocation, thereby easing canal operations during high-use periods. In such a case, CAP notifies M&I customers, which include this project, of the invocation of the rule. Customers may then revise their forecast for water accordingly. Flow changes are implemented only after customer notification. While this rule has yet to be invoked, it remains a tool for CAP Canal management. Peak GSP flows are predicted during the months of May through October. These months could be affected by the 11% rule if it is invoked.

Other measures which could be invoked by the CAP during high demand periods include cutting daily water orders on peak demand days to meet as much demand as possible for all customers. In these cases however, Native American Community and M&I water allocations have the highest priority. Since CWR has water considered as M&I use they would have the highest priority and as with the 11% rule, flow changes would be implemented only after notification.

MWD Water Wheeling Policy

MWD does not presently "wheel water" for none-district members but has recently published a "Policy For Wheeling Non-District Water" enabling it to respond to possible requests such as this GSP to convey "non-district" waters to locations along the Beardsley Canal. This policy would apply to all water carried for the GSP, Routes B, C, D, and E. Because MWD does not currently wheel any non-district water, the policy has not been tested. The policy is located in the **Common Elements** section as side bar text.

The alternatives associated with the Beardsley Canal and MWD will carry additional costs as a result of the water wheeling policy. Anticipated costs could include those costs for system improvements in the Beardsley Canal necessary for wheeling non-district water, wheeling fees on a per-acre-foot basis, and shared costs for overall system improvements within the MWD system. Because MWD is still developing the accounting of the policy, no fees have been established.

The costs for system improvements to accommodate water delivery for the alternatives are particular to the alternative and are discussed in the corresponding section.

It should be noted that the **Draft Report "Beardsley Canal Capacity Study,"** dated September 10, 1999, states that "No capital improvements will be required to deliver an additional 50,000 acre-feet per year…at Cactus Road." The district board discussed the per-acre-foot costs and district management suggested that the fee for the per-acre-foot wheeling of the water might be approximately $20 to $30. For the purposes of this study, a $25 amount will be used. Costs for future system-wide improvements to the Beardsley Canal to be constructed by MWD will be based on all the current customers and the amount of delivery each receives. These costs will be minimal for the GSP due to the relatively small amount of water conveyed and are not covered in this study.

There are other impacts associated with using the system owned and operated by MWD. Some of the more significant are listed below:

- MWD historically dries up the canal when water orders drop below 35 cfs and does not reactivate the canal until water is required again. This dry up typically begins around the end of October and lasts until the end of February or beginning of March. Because the peak order for the GSP is less than 35 cfs and does not come during the dry up, the GSP alone will not provide sufficient flow to keep the Beardsley Canal flowing during the during the dry up period. MWD has indicated that the annual dry up period may be eliminated in the future in order to facilitate water wheeling.

  Since the Beardsley Canal will not convey water during four months of the year, the GSP will have to use all of its allotment in eight months instead of twelve. This scenario would require an increased trunk pipe size and an increase in the size of pumps at the booster pump station required for all of the Beardsley Canal alternates, above that which was estimated in this study. This enlarged system would then be inactive for four months of the year. **This effectively eliminates these alternates as long as the MWD continues to undergo an annual dry-up in the Beardsley Canal.**

- MWD requires advance water orders and allows only minimal changes. CAP also has similar requirements for ordering water. MWD will receive all orders for CAP water being wheeled and the make the order to CAP. CWR would contact MWD instead of CAP. Estimated annual orders are required for water balancing and planning by the MWD and the CAP.

- Water losses in the Beardsley Canal, currently estimated at 0.5% per mile, are the result of evaporation and infiltration in areas of earthlined channel. At 0.5% per mile, as much as 123 acre-feet of the total GSP allotment would be lost in transmission through the MWD facilities and would not be available to replace groundwater.

- There is no discussion in the policy regarding the term length for a wheeling agreement. Because of the possibility of wheeling price increases each time the board meets and discusses contract renewal, a longer term for the wheeling of GSP water would be better. This is particularly important in this case because the GSP must pay for improvements to the canal in order to take delivery of wheeled water. The canal improvement costs would be better realized if they are amortized over a greater length of time. It is reasonable to assume that for the purposes of this study the water wheeling rates will increase at, at least, the rate of inflation.

MWD Review of Design Plans

The MWD engineer will coordinate the review of construction design plans for the connection to the Beardsley Canal. MWD requires approximately 30 days for the review of each plan set, with the cost of these reviews applied to the project.

MWD Easement Requirements and Right-of-Way

Right-of-way agreements and temporary construction easements are necessary prior to construction and would be negotiated with the MWD administrative manager.

Final plans and insurance documents must be reviewed by MWD before granting a "Construction Period Land Use License." MWD has been informed of the concept of the GSP.

MWD Tie-In Process

Tie-in to the Beardsley Canal must take place during the November to March dry-up period to facilitate construction of the tie-in and water distribution operations of the canal. Following its final review of the tie-in, MWD will license the project to begin operation. MWD representatives will be on site during construction for oversight and coordination.

MWD Turnout Construction

The existing Beardsley Canal is a shotcrete-lined channel. A new turnout will include a screen or grate placed flush with the channel lining in addition to a manual gate at the beginning of the pipe. The turnout pipe and gate diameter will be sized to match the trunk pipeline, which will pass through the meter box or manhole constructed behind the canal. This will be the revenue meter for MWD, connecting to an MCU that records measurements from the flowmeter and transmits the information to MWD and CWR.

No established CWS exists because the new turnout would be located where no other turnouts exist. Construction of a check structure similar to the one near Grand Avenue in the Beardsley Canal will be necessary to provide a CWS. The check structure design will incorporate two radial gates with electric actuators, which will require automated control to allow for flow changes to keep the CWS as constant as possible. Overflow weirs allowing the passage of the maximum canal flow might also be a design requirement. This structure will be constructed in the vicinity of the CWR turnout and be connected to the same MCU for supervisory command and control.

Large gates with electric actuators typically require three-phase power. There is currently no power at the possible sites of this new turnout and, because this type of electrical power is not close by, it will have to be brought to the site by Arizona Public Service (APS).

The entire turnout and check structure will be constructed on MWD right-of-way. The canal at the location under consideration has no fencing. Protection from vandalism must be a consideration in the design of the meter box area. Access would be provided to CWR.

All newly constructed improvements within MWD right-of-way will become property of MWD. MWD is responsible for operation and maintenance, including cleaning the grate at the inlet and maintaining the telemetry and measurement systems provided for the control of their system. MWD would provide necessary access to the meter box area for CWR. CWR would be required to provide the telemetry to send the flow monitoring signal to the site it chooses.

MWD Operations

As previously discussed MWD dries up the Beardsley Canal when flow drops below 35 cfs. Maintenance and/or construction is typically carried out during this annual dry-up. At other times, the water surface

MARICOPA WATER DISTRICT
POLICY FOR WHEELING NON-DISTRICT WATER

BACKGROUND AND INTRODUCTION

Maricopa Water District (MWD) recognizes that west Salt River Valley entities will require additional renewable water supplies in order to meet their water demands now and in the future. MWD has determined that the Beardsley Canal has capacity available to convey (wheel) non-District water to entities in the west Salt River Valley. MWD wishes to assist west Salt River Valley users by providing the use of the Beardsley Canal to encourage efficient regional water management practices. MWD has developed the following policy statement and wheeling principles to govern wheeling agreements.

POLICY STATEMENT

MWD finds that it is in the best interest of the District and other west Salt River Valley water users to develop arrangements to use the Beardsley Canal to convey non-District water to west Salt River Valley entities who will benefit from such conveyance. It is the policy of MWD to:

1) Develop partnership agreements with west Salt River Valley entities to use the Beardsley Canal to improve regional water resource management through wheeling non-District water through the Beardsley Canal.
2) Provide benefits to District members from wheeling partnerships by increasing the use of available canal capacity and sharing operational costs with wheeling partners.
3) Provide an economical alternative for conveyance of CAP water to west Salt River Valley entities.

WHEELING PRINCIPLES

1. MWD may provide capacity in the Beardsley Canal for the conveyance and delivery of non-District water to the extent that capacity is available in the Beardsley Canal so that District water is not displaced nor District deliveries impaired by wheeling.

2. MWD will make reasonable efforts to deliver wheeled water but will not guarantee wheeling deliveries. Spills or loss of wheeled water will not be replaced by MWD.

3. MWD will own, operate, and maintain all conveyance and delivery facilities within the Beardsley Canal right-of-way.

4. MWD will recover all costs incurred by the District associated with system improvements necessary for wheeling. System improvements include but are not limited to turnouts, gates, meters, and controls. Recovery of costs for such improvements will be in addition to wheeling fees charged by the District. If later wheeling partners accrue benefits from these system improvements, the wheeling entity may recover some portion of the system improvement costs pursuant to provisions and conditions in a wheeling agreement.

5. MWD will be responsible for design (or approval of design pursuant to provisions and conditions in a wheeling agreement), construction (or inspection and approval of construction pursuant to provisions and conditions in a wheeling agreement), and operation and maintenance of any system improvements necessary for wheeling.

6. Wheeling fees will be charged per acre-foot of wheeled water exclusive of delivery location. An annual administrative fee will be assessed for each wheeling delivery point. The wheeling fee and annual administrative fee will be adjusted annually based on an appropriate inflation factor.

7. Wheeling fees may vary to reflect specific conditions of delivery and use including but not limited to the following (subject to wheeling agreement provisions):

   a) Commitment to wheel water on a non-interruptible (firm) basis, other than emergency outages;
   b) Commitment to provide higher than normal peaking factors;
   c) Long-term contracts; and
   d) Wheeling for use on non-District lands.

8. Additional costs may be incurred by the District or overall system improvements. Wheeling partners will share in the cost of system improvements based on their pro-rata use of MWD system deliveries or on a case-by-case basis, as appropriate.

9. Canal losses will be shared proportionately between District and non-District water. At present, losses are estimated at 0.5 percent per mile of conveyance per month. As improvements are made to the Beardsley Canal, the loss factor may be adjusted as appropriate.

10. The quality of non-District water wheeled through the Beardsley Canal should be consistent with the general water quality of District water and Central Arizona Project water, subject to approval by MWD.

11. MWD will not enter into agreements that would trigger District compliance with Reclamation Reform Act provisions.

12. MWD and its wheeling partners shall establish contract renewal terms and conditions for reopening, such as significant canal improvements or destruction, significant changes in law or environmental regulations, or changes in technology.

MWD WHEELING POLICY 09/14/9

may be lowered below the control water surface for repair or maintenance activities. Customers affected by this situation are notified and difficulties resolved as far in advance as possible.

MWD customers are allowed one flow change per 24 hours, communicated to the MWD office by 12:00 p.m. the previous day. Because MWD is merely "wheeling" CAP water, a layer of bureaucracy is added to the water orders. This is mitigated somewhat because the GSP turnout would be located in the very upstream reaches of the Beardsley Canal and because the flows demanded by GSP would be a small part of the canal's total flow. Thus flow changes by the GSP minimally impact the much larger Beardsley Canal and more than one adjustment per day might be tolerated.

The CAP's "eleven percent rule" (described above) would still apply to GSP even though the water is delivered through the Beardsley Canal.

Right-of Way Elements

Right-of-Way route and requirements for the various alignments has been evaluated. An overview of the ROW is discussed in the following paragraphs.

It is estimated that land values in the proposed project area will range from $0.25 per to $1.00 per square foot. This range is established by such factors as parcel size, zoning, land usage, and ownership of a particular parcel.

Since calculations indicate that a 24" diameter trunk pipeline will be required, a utility easement of 20 feet was selected to help establish costs estimates for the pipelines.

The costs of the utility easement can range from one half of the purchase value to the full purchase value of the land. Each alternative route crosses several individual parcels that will require easements. Each parcel requires a separate appraisal.

Further information on parcels and Right-of Way ownership is found in Appendix G.

Environmental Elements

This overview of environmental considerations summarizes the preliminary requirements that must be addressed during the final design phase. Specifically the project should evaluate cultural, biological, hazardous materials, socioeconomic impacts as well as impacts to the waters of the U.S. The considerations will be the same for each alternative proposed.

During project planning and conceptual design, consideration was given to the requirements of the National Environmental Policy Act (NEPA), Endangered Species Act (ESA), the Migratory Bird Treaty, the Native Plant Law, the Clean Water Act (CWA), the Clean Air Act (CAA), Resource Conservation Recovery Act (RCRA), and the National Historic Preservation Act. This section details the environmental components that apply to the proposed project and its alternatives. Depending on the scope and impact of the project, the following regulatory acts may be addressed in varying degrees in order to comply with environmental issues.

Biological Evaluation

In coordination with the U.S. Fish and Wildlife Service and the Arizona Game and Fish Department, biological resources within the project area, including vegetation communities, aquatic resources, and habitat, have been documented for all alternatives. Based on habitat requirements and natural features in the project area, the project's effect on federally listed plants and animal species and their habitats will be determined. A Biological Evaluation (BE) summarizing the findings of the field work described above will be prepared.

Native Plants

The Arizona Department of Agriculture (ADA) must be contacted prior to the start of construction regarding intended destruction and/or salvage of native plants occurring within the project area. The Department must be contacted at least 20 days before plants are destroyed over an area less than one acre, 30 days before for an area less than 40 acres, and 60 days before for over an area of 40 acres or more. The notification allows authorized companies to salvage and relocate native plants.

Air Quality

Deterioration of air quality may be expected during construction due to the operation of construction equipment, but this will be a localized condition and will discontinue when the project is completed. Fugitive dust generated during construction must be controlled in accordance with Maricopa County Rule 310, Open Fugitive Dust Sources, which requires the preparation and submission of an earth-moving permit and a fugitive dust control plan for the construction site.

Jurisdictional Waters of the U.S.

A preliminary jurisdictional delineation will be performed for the selected alternative to determine if jurisdictional waters of the U.S.,

which include ephemeral drainage channels found throughout the proposed project areas, will be impacted by the project. A Pre-construction Notification (PCN) will be prepared at the same time. If the delineation shows that waters of the United States (i.e., natural drainage channels such as the Agua Fria River) are impacted by the proposed project, a CWA Section 404 Permit will be required from the U.S. Army Corps of Engineers. It should be noted that, on a state level, a Section 401 State Water Quality Certification Permit from the Arizona Department of Environmental Quality (ADEQ) is necessary prior to the 404 Permit. Section 401 requires the review of any federal permits, actions, and approvals that may result in a discharge to waters of the state to ensure compliance with state water quality standards. It should be further noted that the 404 Permit to the U.S. Army Corps of Engineers and Section 401 Certification for the ADEQ could be submitted concurrently.

A Section 402 permit, National Pollution Discharge Elimination System (NPDES), issued from the U.S. Environmental Protection Agency (EPA) is necessary if the project involves grading or disturbing five or more acres of land. NPDES is designed to improve water quality by establishing a permit system to reduce erosion potential, minimize sedimentation, and eliminate non-stormwater discharges from construction sites.

Hazardous Materials

A preliminary site investigation assessment will be performed during the design phase of this project on the selected trunk pipeline. This will involve a data search of the federal, state, and local environmental lists and databases for the alignment selected and the typical search radius of one mile to half-a-mile to determine if regulatory sites are within the project area. A document will be prepared summarizing any regulatory sites including, the site description and location, type of regulated substance or waste at the site, extent of contamination, the status of the site, the responsible party and the potential impacts to the project. Should the preliminary investigation indicate the need for further investigation, a Phase I/II environmental site assessment would be required to evaluate the potential problems for the project.

Cultural Resources

This project will require involvement with the Bureau of Reclamation (BOR) for Alignment A and the Army Corps of Engineers for Alignments B and C, and therefore will be considered an undertaking subject to review under Section 106 of the National Historic Preservation Act (NHPA).

A literature search of previous archaeological projects and recorded sites within and adjacent to the project area has been completed (see Appendix J). All three alignments have been partially surveyed. Alternative C has the best coverage and will require the least additional survey, whereas Alternative A contains the least amount of surveyed land. Alternative C has two previously identified sites situated immediately adjacent to the project area but none directly within the proposed alignment. Alternatives A and B both contain sites directly within the path of the proposed pipeline easement that will require some type of mitigation.

The remaining un-surveyed portions of the alignments will need to be assessed. In addition, portions with previously identified sites within or immediately adjacent to the project area will need to be reassessed so that the site boundaries can be accurately reestablished. Given the proximity of the project area to the Aqua Fria River, a major water corridor used extensively both prehistorically and historically, there is a high probability of encountering archaeological sites throughout the project area. It is therefore likely that the remaining areas to be surveyed will yield additional sites.

Regulatory Considerations

The following is a summary of regulatory considerations and applicable permits that are likely to be required for each alternative. Contact names are included; further information may be obtained from these contacts when a final design and alternative is selected.

Maricopa Water District
Contact: Mr. Jim Sweeney - (623) 546-8266

Central Arizona Water Conservation District
Contact: Ms. Jodie Gould - (623) 869-2333

The MWD and the Central Arizona Water Conservation District (CAWCD) were contacted to obtain information regarding regulatory issues that may require resolution if water is transferred from either the CAP Canal or Beardsley Canal. MWD and CAWCD have jurisdiction over the Beardsley Canal and CAP Canal, respectively. Regulatory agreements that address water transfers from the CAP Canal are currently in place. At the present time, Citizens Water Resources will not need to address environmental issues for the transfer of water from the Beardsley Canal (MWD per. comm. to HDR, 2000). Water transfers from the CAP Canal will require that the environmental clearances are in place and/or updated (see following).

Environmental Assessment

U.S. Bureau of Reclamation
Contact: (602) 216-3863

Environmental considerations would expand if the project falls under federal jurisdiction such as the U.S. Army Corps of Engineers or U.S. Bureau of Reclamation becoming involved in the proposed project. The Bureau of Reclamation currently has federal authority over the CAP Canal and, because the Bureau of Reclamation will be associated with the project, all CAP contracts require NEPA compliance.

An Environmental Assessment (EA) was prepared by the Bureau of Reclamation for activities involving the CAP Canal. The Bureau of Reclamation can, however, request that an update be prepared in the event that Alternative A is selected and significant impacts are associated with the project. If Alternative A is selected, the Bureau of Reclamation will be contacted during the design phase for consultation. Because Alternatives B,C, and D do not involve the CAP canal, the same process will not be necessary.

Section 404 Permit
U.S. Army Corps of Engineers
Contact: Ms. Sally MacGuire - (602) 640-5385

The applicant must notify the U.S. Army Corps of Engineers if the proposed project will impact more than one-tenth of an acre of U.S. jurisdictional waters. In addition, if the proposed activity impacts less than one-tenth acre but occurs in jurisdictional waters found within a 100-year floodplain, a PCN must be submitted to the U.S. Army Corps of Engineers. The type of Section 404 Permit (Nationwide or Individual) required for this project will depend on the amount of disturbance resulting from construction activities within waters of the U.S. A 404 permit will not be needed at all if (1) construction activities take place in jurisdictional waters that are only temporarily impacted and later brought back to their natural grade with no impact to water flow and (2) that work does not take place within a 100-year floodplain. An Individual 404 Permit will be required if the impacted area exceeds one-half acre.

Section 401 Permit
Arizona Department of Environmental Quality
Contact: Ms. Theresa Pella - (602) 207-4480

Section 401 Water Quality Certification (401 Certification) is mandatory for any activity requiring a Nationwide Section 404 Permit and prior to discharging any dredged or fill material into waters of the U.S. In Arizona, the ADEQ grants 401 Certification to all projects that comply with the terms and conditions of a Section 404 Nationwide permit.

Section 402 Permit
U.S. Environmental Protection Agency
Contact: EPA Region IX (San Francisco) - (415) 744-1906

An NPDES Permit is mandatory if five or more acres will be graded or disturbed. A Notice of Intent (NOI) form must be completed by the owner/operator and submitted to EPA at least 48 hours prior to construction. Copies of the form must also be sent to the ADEQ. A Storm Water Pollution Prevention Plan (SWPP) must be prepared prior to the NOI submittal and kept on site. It is not submitted to the EPA or ADEQ unless requested. A Notice of Termination must be sent to EPA and ADEQ by the permittee when the project is complete.

Earth Moving Permit
Maricopa County Environmental Services, Air Quality
Contact: (602) 506-6700

An Earth Moving Permit will be required from the Maricopa County Control Officer if more than one-tenth of an acre of ground disturbance takes place. Pursuant to Maricopa County Rule 310, a dust control plan must be submitted with the permit application, typically applied for by the construction contractor during the pre-construction phase.

Notice of Intent to Clear Land
Arizona Department of Agriculture
Contact: Mr. Jim McGinnis (602) 542-3292

The Arizona Native Plant Law categorizes protected plants as Highly Safeguarded and Salvage Restricted. Destruction of Highly Safeguarded plants is subject to review by the ADA. It is unlawful to collect, transport, transplant, or kill protected native plants without a permit or without following specific regulatory procedures. Such regulation also applies to protected plants on private lands. The law does not prevent the destruction of protected plants on private lands as long as (1) the plants are not transported from the land or offered for sale and (2) the landowner notifies the ADA of the intended destruction. The ADA must be contacted at least 60 days before construction and a plant survey must be performed before construction. Destruction of protected native plants may not begin until a confirmation has been received from the ADA.

State Historic Preservation Office
Contact: (602) 542-4174

Cultural resources work must be completed in accordance with guidelines provided under the National Historic Preservation Act and through coordination with the State Historic Preservation Office (SHPO) regulations. The SHPO should be contacted for concurrence after a final cultural resources literature search and survey takes place. The SHPO concurrence is issued when the state agency agrees with the survey findings that no eligible sites or cultural resources are affected. The SHPO office could also determine if a testing phase would be necessary.

Environmental Costs and Timeline

Costs for permits are nominal, with costs associated with permits totaling $36.00. At a minimum, a cultural resource survey, biological survey, and hazardous materials report will be required for any of the pipeline alternatives. Applications and documentation associated with environmental clearances will be based on two survey documents and the fees associated with preparation of a 404 Nationwide or Individual application. Following are estimated costs for survey and documents that may be necessary during the environmental clearance process for this project.

Biological Estimate

A biological survey will be conducted and a report prepared indicating the vegetation type and wildlife in the area. Coordination with the Arizona Game and Fish for a listing of special status species and a review of Threatened and Endangered species occurring within Maricopa County will be evaluated for impacts to habitat and sensitive species. The cost of preparing this report is estimated at between **$2,700** and **$4,000**. A Biological Assessment is estimated to take 45 days from notification to proceed. Should native vegetation be impacted, the Arizona Department of Agriculture must be notified by the lead agency 60 days prior to construction. This estimate does not include costs for species specific surveys necessary if threatened and endangered species are involved, consultation with the U.S. Fish and Wildlife Service, the inventory of native plants, the salvage of native plants, or for mitigation plans where necessary.

Cultural Estimate

A Class III cultural resources survey and Section 106 consultation with SHPO will be required for any of the alignments selected because of the high probability of encountering historical sites. Depending on the size of the area to be surveyed, along with the high probability of encountering sites, the estimated cost for the cultural survey will be between **$8,700** and **$11,500**. Upon notification to proceed the cultural resources survey report will be expected within 120 days and completion of the SHPO consultations will be expected within 180 days. If eligibility testing or data recovery excavations are required, months could be added to the project.

Hazardous Materials Report

The hazardous materials report for the preliminary site investigation assessment (PISA) consists of searching regulatory lists and databases. A general field observation of the project area identifying general land use, confirming the database information, and noting any storage areas or drums of materials or unusual soil staining would be noted. The PISA estimate would be between **$2,000** and **$2,750**. Should a Phase I Environmental Site Assessment be recommended it is anticipated that this would cost between **$2,500** and **$4,500** or higher should sampling and laboratory analysis be necessary.

404 Permit or PCN

An estimated cost of **$5,500.00** to **$6,200.00** is expected if either a 404 Nationwide Permit application or Pre-Construction Notice (PCN) is necessary. This includes the cost for the 401 Certificate, obtained from the ADEQ, assuming that there is no pre-application meeting with the U.S. Army Corps of Engineers, no mitigation measures are necessary, and no special aquatic resources are present. An authorization letter from the U.S. Army Corps of Engineers will be expected within three to six months from the time a delineation is conducted, with the understanding that the 60% design plans are completed and the area of impact can be determined.

If an individual 404 Permit is necessary, costs range from **$13,000.00** to **$16,000.00**, with a nine-month to one-year schedule extension before authorization is issued. As the scope of the project now stands an Individual 404 Permit is not anticipated.

National Environmental Protection Act (NEPA) Document

The NEPA document carries the greatest cost range due to the number of variables involved (Federal Agency, scoping process, public involvement, EA or Categorical Exclusion, length of process, number of stakeholders, issues, and impacts). Costs for a Categorical Exclusion are estimated at **$1,750.00** to **$2,500.00.** Depending on the number of issues and potential impacts to the environment, an EA can cost **$20,000** or more and take 9 to 15 months to complete.

Geotechnical Considerations

This section presents the results of a preliminary geotechnical exploration of pipeline route alternatives for the GSP.

The field exploration program consisted of obtaining public utility clearances, obtaining permits for exploration in road right-of-ways, site reconnaissance by a field engineer, excavating and sampling 17 test pits with a rubber-tired backhoe, and performing field resistivity tests near the test pit locations. The test pits were excavated outside of the roadway and advanced to a depth of 10 feet or practical refusal, whichever occurred first, then backfilled with excavated soils upon completion. The field engineer logged the test pits, obtained grab samples of soils encountered for review by other project team members, and performed the field resistivity tests. There were seven test pits along Alternative A, four test pits along Alternative B, and six test pits along Alternative C. The approximate location of each test pit is shown on a map in Appendix H. Alternatives D and E occur in previously suburban development areas, therefore no geotechnical investigation was conducted along these routes since typical developed right-of-way construction conditions and techniques can be anticipated.

Site Characterization

Information regarding topography, geology, and surface and near-surface soil conditions is presented in this section. The preliminary information presented here is based on cursory reconnaissance along each route, U.S. Geological (USGS) surveys, shallow test pits along the alternative routes, and U.S. Soil Conservation Service (SCS) soil surveys.

Topography

Cursory reconnaissance indicated that most of the land along each route is undeveloped and in native condition. In developed areas, land usage includes agricultural, commercial, industrial, and residential, with residential usage denser in the southern and eastern parts of the alternative routes.

The USGS Calderwood Butte and Baldy Mountain Quadrangles indicate that drainage in the area bounded by the alternative routes is generally southward, following the Agua Fria River. Elevations at the ends of the routes are – 1,200 feet at the Sun City WWTP, 1,500 feet at the north end of Alternative A, 1,350 feet at the north end of Alternative B, and 1,340 at the north end of Alternative C. Surface grades along the routes were generally less than 1%, although surface grades in the north part of Alternative B were closer to 3%. Each route crosses several washes and, in addition, Alternative A crosses the Marinette Heading Canal, and Alternatives B and C cross the Agua Fria River.

Test Pit and Laboratory Summary

A summary of observations for each alternative is presented in this section. More detailed logs of test pit findings are in Appendix H.

Along Alternative A, sandy lean clays (CL) were the predominant soils to the full depth of exploration. Clayey sands with gravel (SC) were encountered in Test Pits A1, A3, and A4 below depths of 5, 6, and 1 feet, respectively. Practical backhoe refusal was encountered in Test Pits A4 through A7 at depths of 3, 7, 2, and 3 feet, respectively. Heavy calcareous cementation was encountered in each of the test pits, generally about 2 feet below the surface, but the depth to heavy cementation varied from less than 1 foot to 5 feet. Field resistivities at a depth of 10 feet ranged from 9,000 to 57,000 ohms/cm.

Along Alternative B, clayey sands with varying gravel and cobble percentages were the predominant surface and near-surface soils. Sandy lean clay was encountered at the surface in Test Pit B1. In and along the Agua Fria River (Test Pits B1 through B3), well-graded sands and gravels with cobbles (SW and GW) were encountered below depths of 3 to 5 feet. In Test Pit B4, heavy calcareous cementation was encountered at a depth of 3 feet and practical refusal was encountered at a depth of 5 feet. Field resistivities at a depth of 10 feet ranged from 30,000 to 42,000 ohms/cm.

Along Alternative C, interbedded sandy lean clays and clayey sands with varying gravel and cobble percentages were the predominant soils to the full depth of exploration. Silty sands with gravel (SM) were encountered in Test Pits C5 and C6 below a depth of 3 feet. Practical backhoe refusal was encountered in Test Pits C2, C3, C4, and C6, all at a depth of 5 feet. Heavy calcareous cementation was encountered in each of the Test Pits C2 through C6 at depths of 2 to 3 feet. Field resistivities at a depth of 10 feet ranged from 9,000 to 36,000 ohms/cm.

Geotechnical Summary

Most of the land along each alternative is undeveloped and in native condition. In developed areas, land usage include agricultural, commercial, industrial, and residential, with residential usage denser in the southern and eastern parts of the area bounded by the routes. Drainage in the area is generally southward, following the Agua Fria River, with elevation range from 1,200 to 1,500. Surface grades along the routes ranged from less than 1% to about 3%. Each Alternative crosses several washes and, in addition, Alternative A crosses the Marinette Heading Canal, and Alternatives B and C cross the Agua Fria River.

The routes are in valley materials between the mountains above bedrock and consist of late Tertiary and Quaternary soil deposits, and the primary landforms in the area bounded by the routes are valley fill, alluvial fans, and alluvium.

Other than in and along the Agua Fria River, clayey sands and sandy lean clays were the predominant soils encountered. Heavy calcareous cementation was encountered in these soils from depths of less than 1 foot to 5 feet, and practical backhoe refusal was encountered in 9 of the 14 test pits in these soils at depths of 2 to 7 feet. In and along the Agua Fria River, uncemented to lightly cemented, well-graded sands and gravels with cobbles were encountered below depths of 3 to 5 feet. The largest particle size observed in and along the Agua Fria River was on the order of 12 inches. Field resistivities along the alternative routes near pipeline invert depth ranged from 9,000 to 57,000 ohms/cm, indicating low corrosion potential.

Low moisture contents and heavy cementation are suspected to have contributed to the high field resistivity measurements. Laboratory measurements of minimum resistivity are likely to be significantly lower than the field measurements and more representative of conditions to which the pipeline will be subjected. Accordingly, SCS

estimates of corrosive potential are considered more suitable for the alternative evaluation process.

Mapped soils in the study area vary from fat clays (CH) to well-graded gravels with silt (GW-GM). In reference to natural and compacted permeability, reported characteristics agree with geotechnical theory: granular and non-plastic soils have moderate to high permeabilities, and fine-grained and plastic soils have moderate to low permeabilities.

Agreement with geotechnical theory was also reported with respect to compacted shear strength and susceptibility to piping: granular and well-graded soils have higher shear strengths than fine-grained and poorly graded soils, and fine-grained soils are commonly susceptible to piping. Natural erosion risk was slight for most soils, but increased to moderate for some soils because of slope. The risk of corrosion for uncoated steel ranged from low to high and was high in 12 of the 15 soil series mapped along the routes. The risk of corrosion for concrete ranged from low to moderate and was low for 10 of the 15 soil series mapped along the routes. Corrosion estimates were not provided for two soil series because of their variability. Calcareous soils, cobbly soils, and hardpan were also reported in some soil series.

Geotechnical Conclusions

Based on our project understanding, excavation conditions and corrosivity are the primary geotechnical factors of concern for evaluation of the three alternatives. Preliminary exploration data indicate that soil conditions along the alternative routes can be placed in two general groups – (1) those not related to the Agua Fria River, which include most of Alternatives A and C and the northern portion of Alternative B, and (2) those near and in the Agua Fria River, which include most of Alternative B.

In the first group, soils with calcareous cementation and high corrosion risk soils will commonly be encountered. Calcareous cementation is expected to cause difficult excavation conditions that will require heavy or specialized equipment for excavation. To a large extent, soils in this group will have an OSHA classification of "Type A," for which OSHA provides a maximum allowable slope of ¾:1 (53°) for excavations less than 20 feet deep.

In the second group, cohesionless soils, soils with cobbles and boulders, and soils with low to moderate corrosion will commonly be encountered. Excavation conditions are not anticipated to be as difficult in uncemented and lightly cemented, cohesionless soils and soils with cobbles and boulders; however, sloughing and less stable slopes are anticipated. To a large extent, soils in this group will have an OSHA classification of "Type C," for which OSHA provides a maximum allowable slope of 1½:1 (34°) for excavations less than 20 feet deep.

Utility Coordination

Local utility companies were contacted regarding existing facilities within or adjacent to the pipeline corridors for the considered alternatives. Utility maps were obtained from each company to verify and document the location of existing facilities and determine if any conflicts or issues were present. All existing facilities will be shown on the final construction plans, based on the best available information from the utility companies and additional sources. Exact location and depth of utility facilities must be verified in the field prior to any construction.

Maricopa Water District

The Maricopa Water District has identified the project site as either outside their service area or does not provide irrigation service within the project site.

Salt River Project Water Division

SRP water division does not provide irrigation service within the project site.

Salt River Project Electric Division

SRP water division does not provide irrigation service within the project site or no conflicts were identified.

US West Communications

US West maps for telephone service facilities were evaluated. The following areas were identified as possible conflicts. These will preferably be protected or otherwise replaced.

Alternative A: This alternative crosses US West Communication facilities in four locations. Telephone lines run parallel to the proposed alignment for the major part of the stretch until reaching Sta. 193+00 just north Jomax Road. The telephone lines cross again at approximately Sta. 207+00 and head east on Happy Valley Road. Two other conflicts occur at the intersections of Lake Pleasant Road with Pinnacle Peak Road and Deer Valley Road.

Alternatives B and C: No conflicts are present.

Alternative D: Existing telephone lines cross the proposed alignment at three locations. US West facilities adjacent to Grand Avenue cross alternative D at approximately Sta. 26+50. In addition, Sta. 143+20 and 179+00 were identified as conflicts.

Alternative E: Existing telephone lines parallel to Grand Avenue cross this alternative at one location (approximately Sta. 26+50).

Southwest Gas

Southwest Gas provided maps of their facilities within the project site. The following items were found to be in conflict with the considered alternatives.

Alternatives A, B, C, and E: No conflicts are present.

Alternative D: A Southwest Gas facility crosses this proposed alignment at one location (approximately Sta. 180+00). This 4-inch line runs along Deer Valley Road and measures for protection of this line will be taken during the design process if alternative D is selected

El Paso Natural Gas

El Paso Natural Gas was contacted to obtain the location of existing gas lines within the project site. The following El Paso Natural Gas facilities appear to present conflicts with the considered alternatives. Note that the following items will preferably be protected or otherwise replaced.

Alternative A: The proposed alignment for alternative A crosses a 20-inch El Paso Natural Gas line (running from San Juan line to Phoenix area) at two locations (approximately Stations135+00 and 362+00). This is the only alternative that presents a conflict with El Paso Natural Gas facilities.

Alternatives B, C, D, and E: No conflicts are present.

Cox Communications

Maps of cable TV facilities provided by Cox Communications were evaluated. The following facilities were found to conflict with the proposed alternatives. These will preferably be protected or replaced.

Alternative A: The alignment for alternative A crosses an underground fiber optic line at approximately Sta. 420+00. Due to the nature of this line, it will be protected during the design of the pipeline if alternative A is selected.

Alternatives B, C, D, and E: No conflicts are present.

Arizona Public Service

APS existing facilities were evaluated from utility maps provided by their company. APS facilities in conflict with the proposed alternatives are as follows. Note that these facilities will preferably be protected or otherwise replaced.

Alternative A: APS facilities present a conflict with this alternative at one location (approximately Sta. 420+00). This is an electric line and standard measures will be taken to protect it.

Alternatives B and C: No conflicts are present.

Alternative D: The proposed alignment for this alternative presents conflict with APS facilities at two locations. One line runs along 115th Avenue at approximately Sta. 99+00 and the other is located at Deer Valley Road at approximately Sta. 180+00.

Alternate A – Lake Pleasant Road Route

The Lake Pleasant Road pipeline route begins at an existing CAP Canal turnout located approximately 8 miles north-northeast of Sun City. The pipeline route then follows Lake Pleasant Road southerly to Rose Garden Lane where it turns west for 0.5 miles to approximately 107th Avenue. The pipeline then turns south and extends to Beardsley Road alignment. From here the trunk line ends and the division of Sun City and Sun City West allocation is split. Sun City distribution system continuing south on 107th and the Sun City West pipeline turning west and connecting to the 20" effluent pipeline near the water campus. The alignment will be mostly contained within public right-of-way either Maricopa County or City of Peoria. The City of Peoria is currently planning to obtain new right-of-way along the Lake Pleasant Road from the ASLD. Route A alignment would likely be within Peoria's new right-of-way at the time of construction.

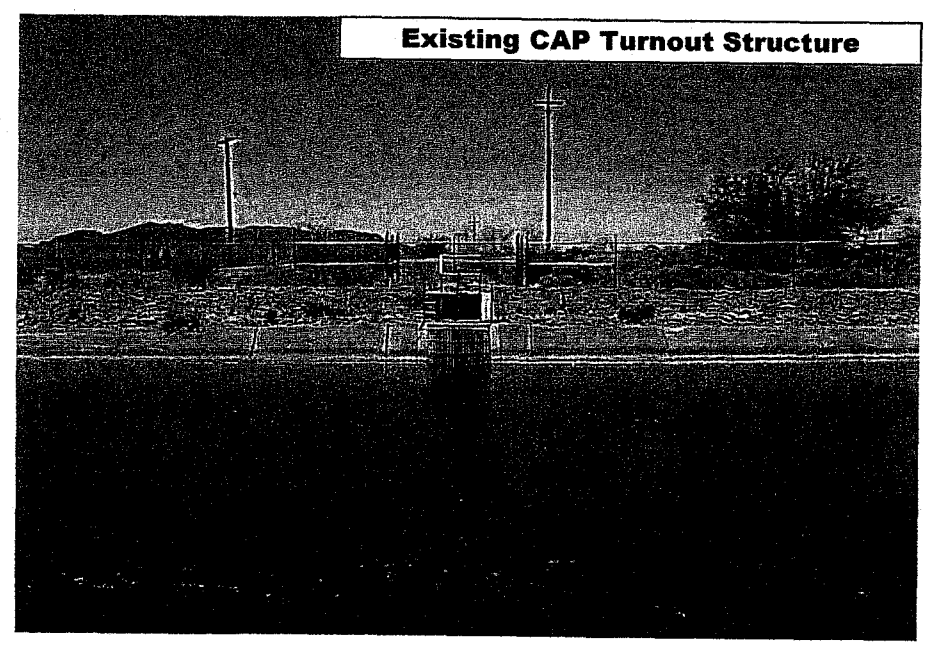
Looking South on Lake Pleasant Road

CAP Review Of Turnout Design Plans

The engineering department at CAP will coordinate the review of construction design plans required for the connection to Reach 9 of the Hayden-Rhodes Aqueduct. CAP requires approximately two weeks for the review of each plan set, with the cost of these reviews applied to the project.

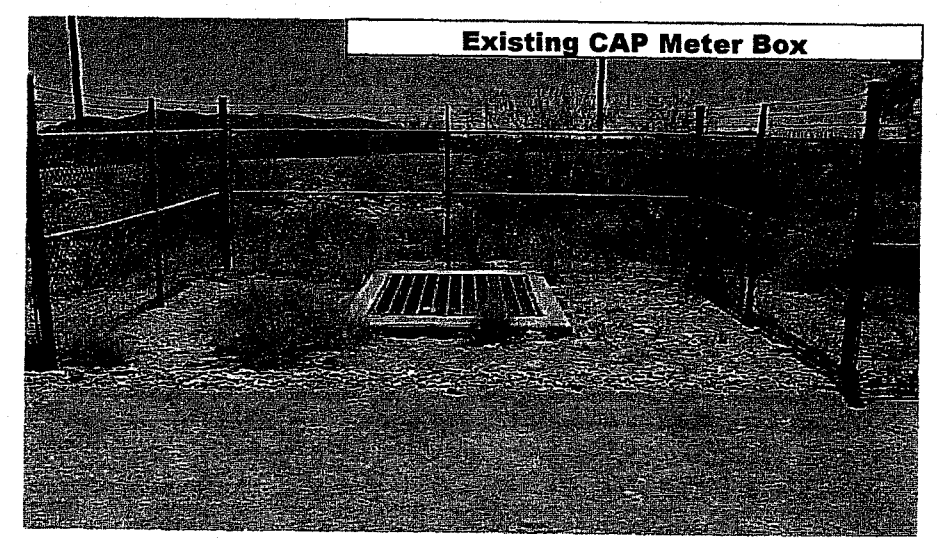
CAP Tie-In Process

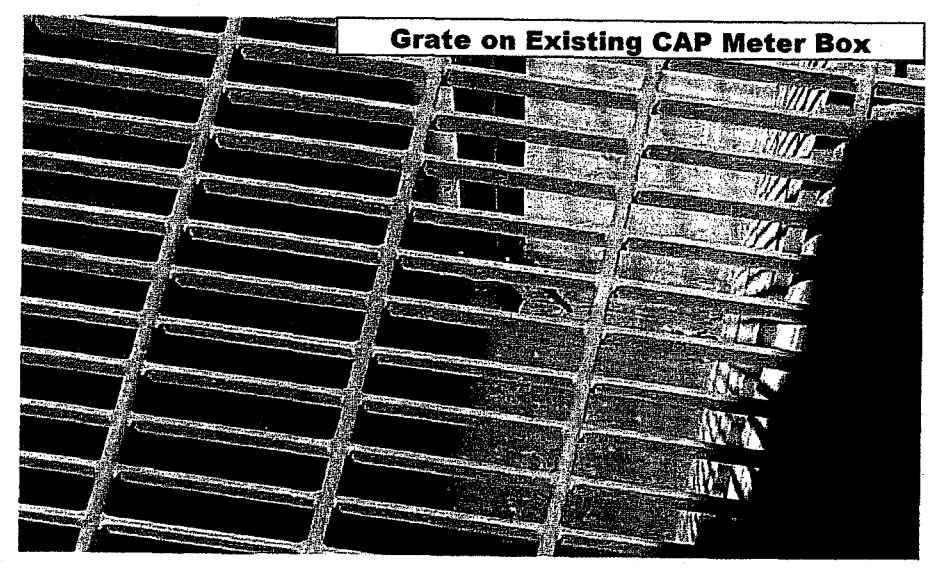
The CAP does not have an annual canal dry-up, thus the tie-in process is typically quite expensive. An existing turnout located approximately 140 feet east of Lake Pleasant Road on the south side of the canal, may be utilized for this project and will mitigate that expense. The existing turnout was built during canal construction for the Sunrise Water Company that had an allocation for CAP water. CAP would like to make use of the turnout and, because it views the GSP as a good opportunity, will allow a connection to the turnout using the existing stub-out.


Existing CAP Turnout Structure

Existing CAP Turnout

The existing canal turnout is at Reach 9 Station 869+00 on the south side of the canal. It includes a screen flush with the lining and a manual gate at the opening of a 12-inch diameter asbestos-cement (AC) pipe. An open meter box, intended for measurements in feet of water, has been constructed about 28 feet from the canal. A section pipe is stubbed out approximately 20 feet beyond the meter box and plugged with a plywood bulkhead. The entire turnout is constructed on CAP right-of-way and enclosed by a chain link fence. Pictures of the turnout and meter box and the surrounding area are shown in this section. Plans for the turnout are included in the Appendix E "Miscellaneous CAP Plans and Related Items."

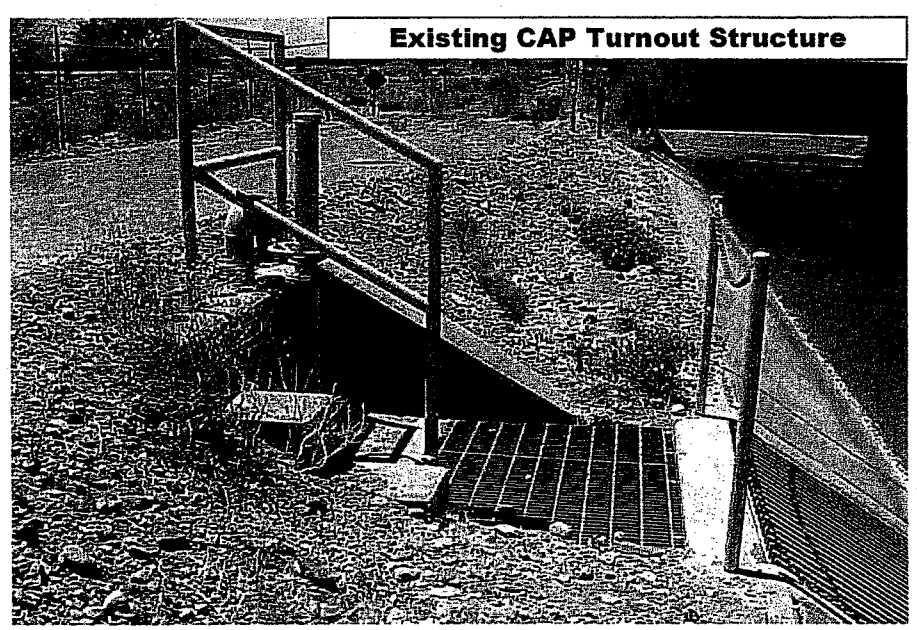

Existing CAP Meter Box


Grate on Existing CAP Meter Box

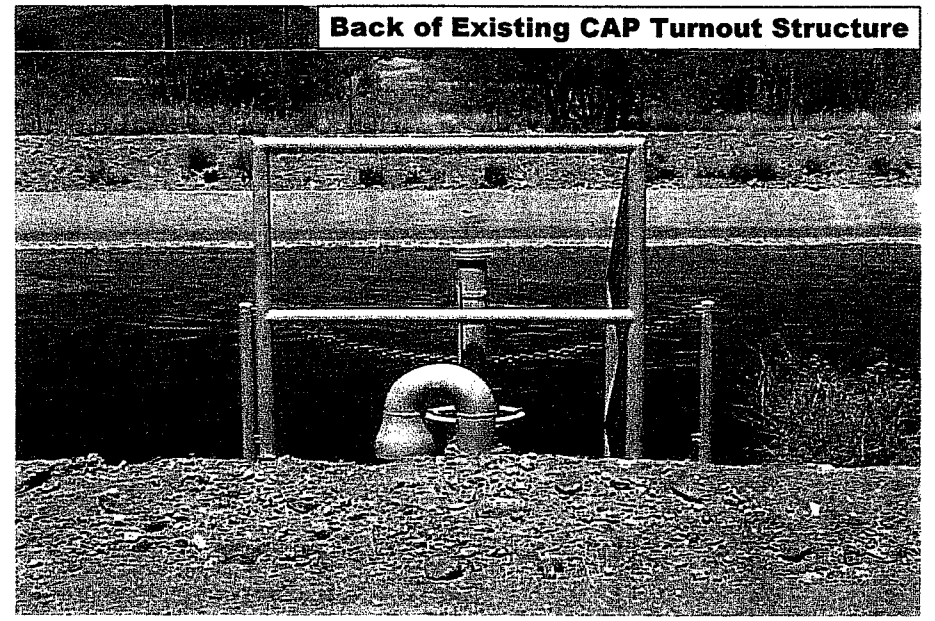
CAP Turnout Modifications

The turnout includes a 12-inch pipe, intended originally to deliver water to the Sunrise Water Company at an average delivery flowrate of 3 cfs, about one-third the average flowrate for the GSP (see the Granite Reef Turnout sheet provided by CAP in the Appendix). Reconstruction of the 12-inch pipe is possible if necessary, although preliminary hydraulic calculations indicate that the pipe will be able to convey the flow required by the GSP.

A water meter for measuring flow will be installed in the existing meter box. The meter, required by CAP to be an **Accusonic Technologies Inc.** acoustic meter, will be the revenue meter for CAP and will connect to a **Geomation** Measure Control Unit (MCU) that transmits information to a CAP check structure approximately one-quarter mile downstream from the turnout. The MCU can be hardwired or radio transmitted to the RTU at the check structure. Power will be required to operate the flowmeter and MCU, and although there is currently none at the site of the turnout, power is available adjacent to Lake Pleasant Road. The final modification at the turnout will connect the new raw water pipeline to the existing pipe at the turnout.


Existing CAP Turnout Structure

The CAP will own, operate, and maintain the facilities within its ROW. CAP will clean the grate at the inlet and provide maintenance to the telemetry and measurement systems. CAP can provide access to the meter box area for CWR and will provide a courtesy signal from its RTU to CWR, although CWR will be required to provide its own telemetry.


Back of Existing CAP Turnout Structure

CAP Easement Requirements and Right-of-Way

No new permanent easements from CAP are required if the existing turnout structure is utilized. Before construction begins, a Land Use application and $500 application fee must be filed. The applicant is responsible for additional costs, including those for inspection and oversight, and plan review costs incurred by CAP until construction ends. The application, along with insurance documents, will be reviewed before granting a "Construction Period Land Use License." CAP personnel have issued the GSP a tracking number and are aware of the project. Copies of the application, relevant information sheets, and a right-of-way map are included in the Appendix E.

CAP Operations

The CAP Canal operates continuously year round and does not schedule dry-up times for maintenance. At times, due to construction, the water surface falls below the control water surface. CAP deliveries affected by this situation are notified and difficulties worked out in advance of low water surfaces.

CAP customers with individual turnouts are allowed two flow rate adjustments per 24 hours, which must be received by 9:00 a.m. the previous day. The meter installed with this project is the revenue meter CAP uses to determine deliveries.

For annual order estimates, the CAP has a peak averting measure called the "eleven percent rule," applied when the peak flows predicted by annual water orders exceed the ability of CAP to deliver those flows. The rule permits CAP to limit a subcontractors monthly order (not its allocation) to 11% of their annual allocation, thereby easing canal operations during high-use periods. In such a case, CAP notifies M&I customers, which include this project, of the invocation of the rule. Customers may then revise their forecast for water accordingly. Flow changes are implemented only after customer notification. While this rule has yet to be invoked, it remains a tool for CAP Canal management. Peak GSP flows are predicted during the months of May through October. These months could be affected by the 11% rule if it is invoked.

Other measures which could be invoked by the CAP during high demand periods include cutting daily water orders on peak demand days to meet as much demand as possible for all customers. In these cases however, Native American Community and M&I water allocations have the highest priority. Since CWR has water considered as M&I use they would have the highest priority and as with the 11% rule, flow changes would be implemented only after notification.

Alternative A Hydraulics

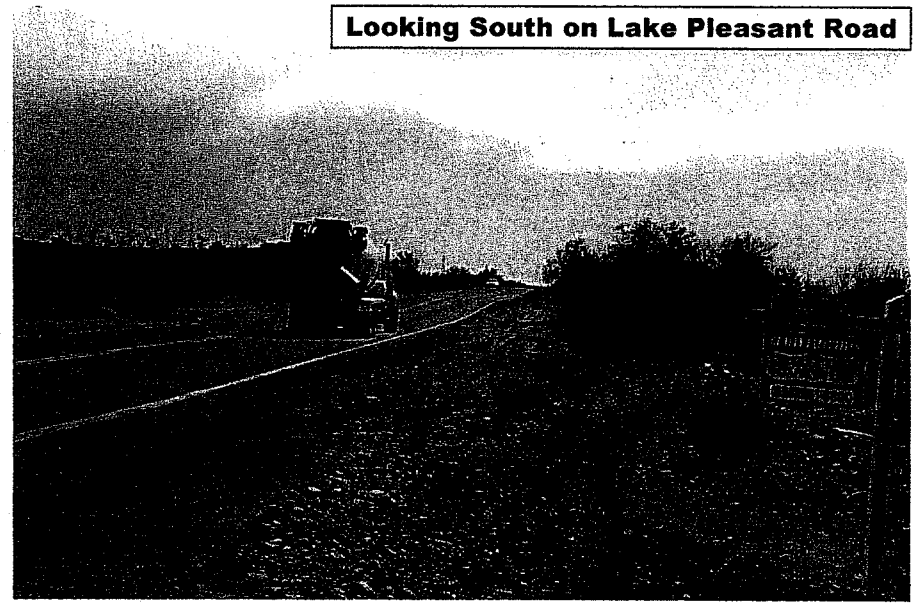
CAP provided information detailing the design water surface elevations for the inlet to the Alternative A pipeline. At the turnout, the *normal water surface elevation* (NWS) is 1,520.87, and the *control water surface elevation* (CWS) is 1,517.10. While CAP guarantees the CWS the majority of the time, in an emergency the water surface may drop below the CWS.

The CWS was used for the hydraulics design of the pipeline. The water surface elevation, which can be translated into pressure at the delivery point in the Sun City Area, is calculated by subtracting all losses for the pipeline from the CWS. The major portion of the losses in most pipelines results from friction or transmission. There are minor losses when valves or bends in the pipe are encountered, but these are typically insignificant. Vacuum relief valves and air release valves will be required on the pipeline at high points and other locations, and isolation valves will be included to allow the pipeline to be isolated for one-mile segments.

The preliminary hydraulics analysis indicates that a 24-inch diameter pipe will be required to deliver water a flow rates and pressure to adequately serve Sun City West and Sun City distribution systems. Because the static pressure for this system is approximately 130 psi, pressure-reducing valves will be required to reduce the pressure prior to reaching the delivery system so as not to exceed the hydraulic design of the piping materials and their joint systems.

The pressure requirements for operation of the water distribution systems in Sun City West and in Sun City can be met when the Alternative A pipeline is connected to them as shown in the hydraulic model. The pressure required for operation of the Sun City West water distribution system is 70 psi (at the CWR water campus location). Pressure required for the Sun City water distribution system is 70 psi. Since the delivery pressure of water in the Alternative A trunk pipeline meets or exceeds the required operating pressures of Sun City and Sun City West distribution systems, a pump station will not be required to deliver water from the CAP Canal via Alternative A.

Looking South on Lake Pleasant Road



Alternative A Utility Coordination

Alternative A crosses US West Communication facilities in four locations. Telephone lines run parallel to the proposed alignment for the major part of the reach until approximately Sta. 193+00 just north Jomax Road. The telephone lines cross again at approximately Sta. 207+00 and continue east on Happy Valley Road. Two other possible conflicts occur at the intersections of Lake Pleasant Road with Pinnacle Peak Road and Deer Valley Road.

Alternative A has no known crossings of Southwest Gas facilities.

The Alternative A alignment crosses a 20-inch El Paso Natural Gas line (running from San Juan line to Phoenix area) at two locations (approximately Stations135+00 and 362+00).

The alignment for alternative A crosses a Cox Communications underground fiber optic line at approximately Sta. 420+00.

The proposed Alternative A alignment presents a possible conflict with APS facilities at two locations. One line runs along 115th Avenue at approximately Sta. 99+00 and the other is located at Deer Valley Road at approximately Sta. 180+00.

Alternative A Easement and Right-of-Way

The City of Peoria is currently engaged in an effort with the State Land Department to obtain fee simple right-of-way, to a 150 foot width within the current Lake Pleasant Road alignment from Beardsley at the south to the junction of State Route 74 on the north. Peoria is developing plans to upgrade the road to a divided 4-lane roadway with a center median with city utilities within the ROW. The Alternative A pipeline will be allowed to be in the right-of-way after an amendment to the franchise agreement between Citizens and Peoria.

If Peoria were to be successful in obtaining the right-of-way from the State land Department, the right-of-way would be greatly simplified as Alternative A will then consist of mostly one owner. Currently costs for Alternative A range from $152,000 to $555,000 for right-of-way and easements. If Peoria becomes the owner of the ROW the costs drops to around $50,000 due to the parcels along Rose Garden Lane and the vacant land near the CWR Water Campus.

For the purposes of this report ands cost estimate it will be assumed the city of Peoria will be successful in its attempts to secure the ROW described above.

Alternative A Environmental Considerations

The Central Arizona Water Conservation District (CAWCD) was contacted to obtain information regarding regulatory issues that may require resolution if water is transferred from the CAP Canal. CAWCD has jurisdiction over the CAP Canal. Regulatory agreements that address water transfers from the CAP Canal are currently in place. Water transfers from the CAP Canal will require that the environmental clearances be in place and/or updated.

The Bureau of Reclamation previously prepared an Environmental Assessment (EA) for activities involving the CAP Canal. The Bureau of Reclamation can request that an update be prepared in the event that Alternative A is selected and significant impacts are associated with the project.

Alternative A does not require crossing an ephemeral drainage impacting more than 1/10 acre, but the location of the treatment plant is near the Agua Fria River and it is possible that construction activities involved in the connection of the pipeline to the treatment plant may occur within the 100-year floodplain. In that case, a PCN or a Nationwide 404 Permit #12: Utility Line Activities may be required. The Nationwide Permit application process is not as extensive as the Individual 404 Permit process. The appropriate Section 404 permit needed for Alternative A will be determined after a jurisdictional delineation is conducted and an estimate of the required construction easement is made.

The cultural resources report has determined that there have been five sites found in or near Alternative A. The sites include historic and prehistoric resources. One site, the Marinett Canal, is eligible for the National and State Register. Two sites were recommended not eligible and two sites have not been evaluated. Part of Alternative A has been surveyed, but a majority has not. It is recommended that all of Lake Pleasant Road, north of Pinnacle Peak Road, as well as Rose Garden Lane should be surveyed.

Alternative A Soils Considerations

Excavation conditions and corrosivity are the primary geotechnical factors of concern for evaluation of the alternatives. Preliminary exploration data indicate that soil conditions along most of Alternative A are in the group of soils which are not related to the Agua Fria River.

In this group, soils with calcareous cementation and high corrosion risk will commonly be encountered. Calcareous cementation is expected to cause difficult excavation conditions that will require heavy or specialized equipment for excavation.

The southernmost end of Alternative A is in the group of soils that are cohesionless soils, soils with cobbles and boulders, and soils with low to moderate corrosion risk will commonly be encountered. Excavation

conditions are not anticipated to be as difficult in uncemented and lightly cemented, cohesionless soils and soils with cobbles and boulders; however, sloughing and less stable slopes are anticipated.

Since encountering soils difficult for excavation are anticipated, the cost of pipe installation will be increased. Corrosion is a factor in some of the soils along the route and wrapping or coatings on the pipe will protect the pipe material.

Alternative A Estimate of Probable Costs and Time of Construction

An estimate of probable cost has been prepared for this alternative. The costs are shown below:

Alternative Route A – Lake Pleasant Road Opinion of Probable Life Cycle Costs				
Item Description	**Unit**	**Quantity**	**Unit Price**	**Amount**
Pipeline				
Mobilization @ 5%	Ea.	1	$238,594	$238,594
Ductile Iron Pipe (24" Class 200)	L.F.	42,936	$92.56	$3,974,156
24" Gate Valve	Ea.	9	$13,500	$121,500
PRV Vault Station	Ea.	2	$48,000	$96,000
Pavement Replacement	S.Y.	3,540	$20	$70,800
Combination AirVac Valve (2")	Ea.	5	$4,000	$20,000
Traffic Control	L.F.	41,038	$7	$287,266
Permitting & Compliance	L.S.	1	$23,150	$23,150
R/W Costs	S.F.	100,000	$1.00	$100,000
CAP Turnout				
Remove bulkhead/connect to CAP	Ea.	1	$6,500	$6,500
Meter Box, Power hookup (APS)	Ea.	1	$5,000	$5,000
Accusonic Flowmeter	Ea.	1	$32,000	$32,000
Geomation MCU	Ea.	1	$15,000	$15,000
Connect to CAP SCADA	Ea.	1	$20,000	$20,000
Construction License	Ea.	1	$500	$500
			Subtotal	**$5,010,466**
Engineering Design	8%	1	$400,837	$400,837
Construction Administration	12%	1	$601,256	$601,256
Citizens (Admin./Legal/Financial)	10%	1	$501,047	$501,047
Contingency	10%	1	$501,047	$501,047
			Total Capital Cost	**$7,014,653**
O&M Life Cycle Costs			**Annual Cost**	**Present Worth**
24" Pipeline O&M (50 yr) (42,936 L.F. at $0.50/L.F./yr)			$21,468	$351,554
PRV Station O&M (50 yr) (1.5% of Station/yr)			$1,440	$23,581
			Total O&M Life Cycle Cost	**$375,135**
			Total Life Cycle Cost, Alternative A	**$7,389,787**

The life cycle costs were determined using common cost elements applied to anticipated annualized costs. The annual costs were calculated by summing each annual cost element. These were then determined as a present worth value.

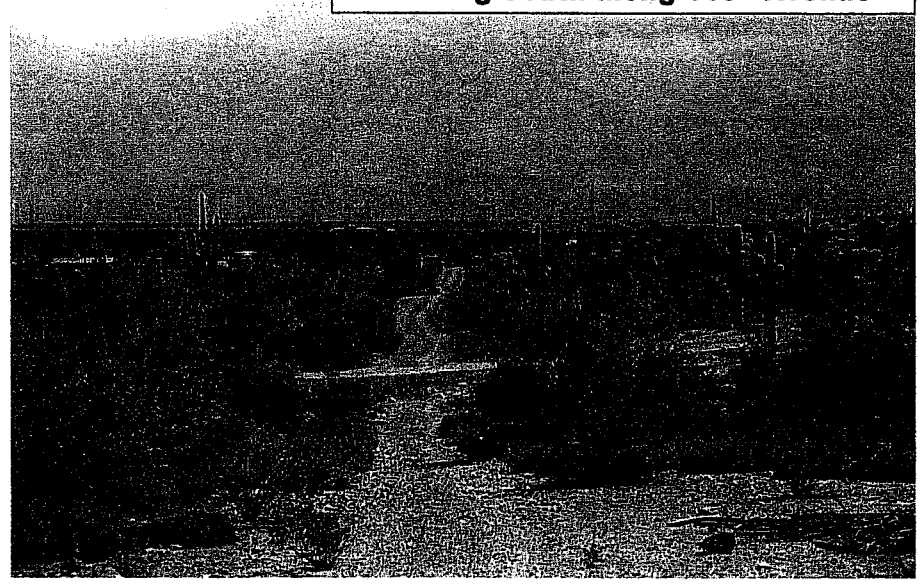
A differential interest rate of 5.73% was used for calculations. This rate was based on the weighted cost of capital at 8.73%, minus an inflation rate of 3%. The weighted cost of capital at 8.73% for Citizens Water Resources is based on Arizona Corporation Commission Decision 60172. The inflation rate of 3.0% is based on an assumed average inflation rate over past number of years.

It is anticipated that this route will take approximately 190 working days to construct (approximately 9 months).

Alternate B – 115th Avenue Route

The Alternative B pipeline begins near the northeast corner of Section 1, T4N, R1W, at a proposed Beardsley Canal turnout. The pipeline route proceeds directly south along the section line (115th Avenue alignment) to the CWR Water Campus for a total length of approximately 3.75 miles. Maricopa County roadway right-of-way is intermittent along the alignment.

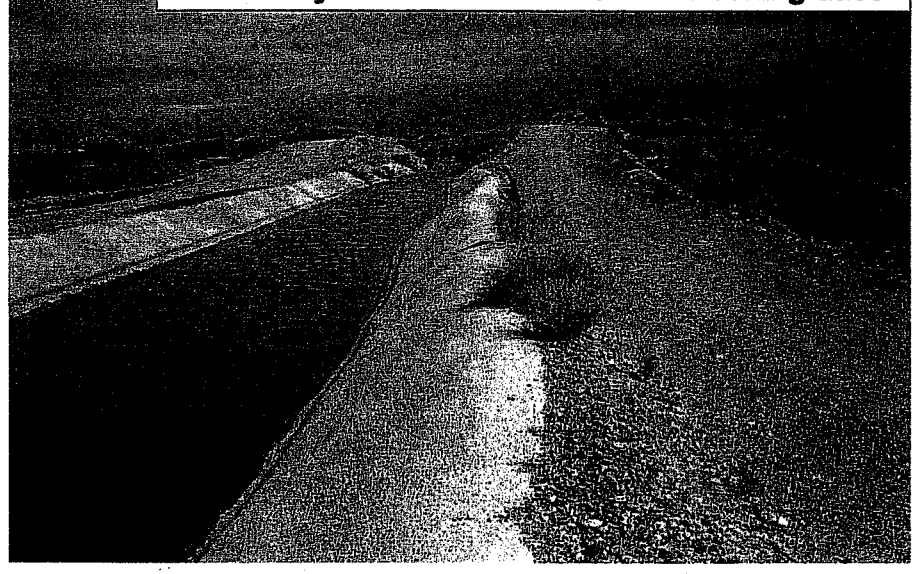
Looking South along 115th Avenue



Over the length of the alignment, the pipeline will cross (in north to south sequence) existing Twin Buttes Wash, future Estrella Roadway, unimproved Hatfield Road (which serves as access to the SRP substation), the Agua Fria River, and at least one sand and gravel operation in the riverbed.

Beardsley Canal Turnout Location Looking West

Beardsley Canal Turnout Location Looking East



Alternative B Hydraulics

According to information provided by MWD regarding estimated design water surface elevation for the inlet to the Alternative B pipeline, the NWS at the turnout is 1,344.2, while the CWS, the most consistent elevation provided at the canal, is estimated at 1,345.0. Although MWD guarantees the CWS the majority of the time, in an emergency the water surface may drop below the CWS.

The CWS elevation is used as the basis for the hydraulics design of the pipeline. The water surface elevation, which can be translated into pressure at the delivery point in the Sun City Area, is calculated by subtracting the losses incurred in the pipeline from the CWS elevation at the Beardsley Canal. The major portion of the losses in the pipeline will be from friction. There are minor losses when valves or bends in the pipe are encountered, but these are typically insignificant. Vacuum relief valves and air release valves will be required on the pipeline at high points and other locations, and isolation valves will be included to allow the pipeline to be isolated for one-mile segments.

The preliminary hydraulics analysis indicates that a 24-inch diameter pipe will be required to deliver water a flow rates and pressure to adequately serve Sun City West and Sun City distribution systems. Because the static pressure for this system is approximately 56 psi, pressure-reducing valves will not be required to reduce the pressure prior to reaching the delivery system.

The pressure required for operation of the Sun City West water distribution system is 70 psi (at the CWR water campus location). Pressure required for the Sun City water distribution system is 70 psi. Because the delivery pressure of water in the Alternative B pipeline cannot meet these operating pressures by gravity, a pump will be required to deliver water from the Beardsley Canal. This pressure (70 psi at the water campus) will allow deliveries to be made to each of the participating golf courses connected to the distribution systems.

The Beardsley Canal currently does not convey water during four months of the year. Until this changes, the GSP will have to use all of its allotment in eight months instead of twelve. This scenario would require an increased trunk pipe size and an increase in the size of pumps at the booster pump station required for all of the Beardsley Canal alternates, above that which was estimated in this study. This enlarged system would then be inactive for four months of the year. **This effectively eliminates Alternate B as long as the MWD continues to undergo an annual dry-up in the Beardsley Canal.**

Alternative B Utility Coordination

US West maps showed no facilities in conflict with the Alternative B pipeline.

Southwest Gas maps indicated no conflicts with their facilities within the Alternative B corridor.

El Paso Natural Gas has no gas lines within the project site for Alternative B.

No Cox Communication facilities were found to be in conflict with the Alternative B alignment.

Existing power facilities were evaluated from utility maps provided by Arizona Public Service. Alternative B appeared to have not conflicts.

Alternative B Easement and Right-of-Way

Alternative B is estimated to require approximately 21,120 square feet of surface area for Right-of-way or easement. This area currently consists of parcels owned by 46 individual owners that would require a separate appraisal.

The projected costs for easement or right-of-way acquisition for Alternative B range from $49,000 to $68,000.

Alternative B Environmental Considerations

The MWD was contacted to obtain information regarding regulatory issues that may require resolution if water is transferred from the Beardsley Canal. MWD has jurisdiction over the Beardsley Canal. At the present time, this project would not be required to address environmental issues for the transfer of water from the Beardsley Canal.

Alternative B requires crossing the Agua Fria River floodplain thus it is possible that construction activities involved in the construction of the pipeline will require a PCN or a Nationwide 404 Permit #12: Utility Line Activities. The Nationwide Permit application process is not as extensive as the Individual 404 Permit process. The appropriate Section 404 permit needed for Alternative B can be determined after a jurisdictional delineation is conducted and an estimate of the required construction easement is made.

The cultural resources report has determined that there are two sites found in or near Alternative B. One is a prehistoric habitation locus that is potentially eligible for National and State Register. The other is a historic canal system of unknown age and function. It is recommended that all of this route, including Rose Garden Lane should be surveyed since sites were found within previously surveyed portions.

Alternative B Soils Considerations

Excavation conditions and corrosivity are the primary geotechnical factors of concern for evaluation of the three alternatives. Preliminary exploration data indicate that soil conditions along most of Alternative B are in the group of soils that are related to the Agua Fria River.

In this group, cohesionless soils, soils with cobbles and boulders, and soils with low to moderate corrosion risk will commonly be encountered. Excavation conditions are not anticipated to be as difficult in uncemented and lightly cemented, cohesionless soils and soils with cobbles and boulders

Since encountering soils not difficult for excavation are anticipated, the cost of pipe installation will be for normal installation of pipelines. Moderate corrosion potential, however is still a factor in some of the soils along the route and wrapping or coatings on the pipe will protect the pipe material.

Alternative B Estimate of Probable Costs and Time of Construction

An estimate of probable cost has been prepared for this alternative. The costs are shown in below.

Alternative Route B – 115th Avenue
Opinion of Probable Life Cycle Costs

Item Description	Unit	Quantity	Unit Price	Amount
Pipeline				
Mobilization @ 5%	Ea.	1	$133,421	$133,421
Ductile Iron Pipe (24" Class 200)	L.F.	21,897	$88.49	$1,937,666
24" Gate Valve	Ea.	3	$13,500	$40,500
Pavement Replacement	S.Y.	722	$20	$14,440
Combination AirVac Valve (2")	Ea.	1	$4,000	$4,000
Permitting & Compliance	L.S.	1	$23,150	$23,150
R/W Costs	S.F.	116,000	$1.00	$116,000
MWD Improvements (Turnout Structure)				
Headwall	Ea.	1	$10,000	$10,000
Slide Gate	Ea.	1	$2,500	$2,500
Connect to MWD Turnout	Ea.	1	$5,000	$5,000
Meter Box, Power hookup (APS)	Ea.	1	$45,000	$45,000
Flowmeter	Ea.	1	$5,000	$5,000
MCU	Ea.	1	$25,000	$25,000
Telemetry to CWR	Ea.	1	$2,000	$2,000
Construction License	Ea.	1	$500	$500
MWD Improvements (Check Structure)				
Structure A (concrete & steel)	Ea.	1	$100,000	$100,000
Radial Gate (4'W x 6'H)	Ea.	2	$10,000	$20,000
Flowmeter	Ea.	1	$5,000	$5,000
Connection to MWD SCADA	Ea.	1	$5,000	$5,000
Booster Pump Station				
Pump Station Capital Cost	L.S.	1	$307,660	$307,660
			Subtotal	**$2,801,837**
Engineering Design	8%	1	$224,147	$224,147
Construction Administration	12%	1	$336,220	$336,220
Pipeline Contingency	10%	1	$247,879	$247,879
Pump Station Contingency	25%	1	$80,761	$80,761
Citizens (Admin,/Legal/Financial)	10%	1	$280,184	$280,184
			Total Capital Cost	**$3,971,028**
O&M Life Cycle Costs			**Annual Cost**	**Present Worth**
24" Pipeline O&M (50 yr) (21,897 L.F. at $0.50/ft/yr)			$10,949	$179,289
Pump Station O&M (50 yr) (See Estimate, Page D-50)			$7,692	$125,954
MWD Water Losses (50 yr) (148 ac-ft at $106/ac-ft)			$15,688	$256,902
MWD Wheeling Cost (50 yr) (6,561 ac-ft at $25/ac-ft)			$164,025	$2,686,025
			Total O&M Life Cycle Cost	**$3,997,272**
			Total Life Cycle Cost, Alternate B	**$7,968,300**

The life cycle costs were determined using common cost elements applied to anticipated annualized costs. The annual costs were calculated by summing each annual cost element. These were then determined as a present worth value.

A differential interest rate of 5.73% was used for calculations. This rate was based on the weighted cost of capital at 8.73%, minus an inflation rate of 3%. The weighted cost of capital at 8.73% for Citizens Water Resources is based on Arizona Corporation Commission Decision 60172. The inflation rate of 3.0% is based on an assumed average inflation rate over past number of years.

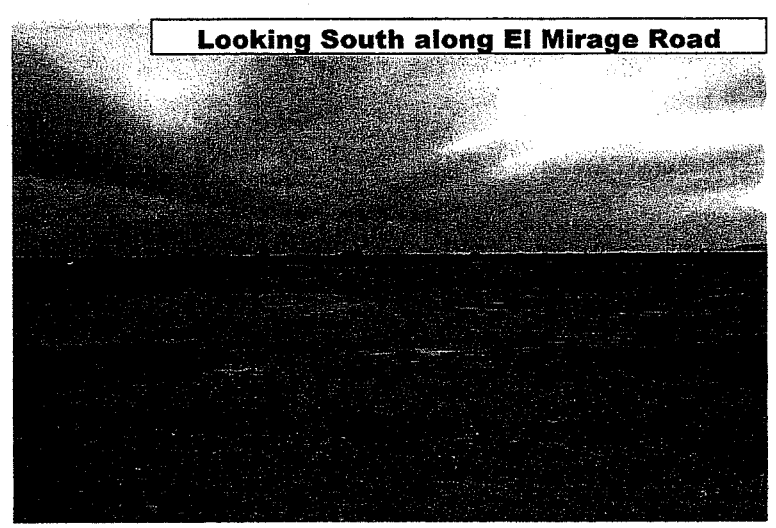
It is anticipated that this route will take approximately 130 working days to construct (approximately 6 months) using separate contractors for the pump station and the trunk pipeline.

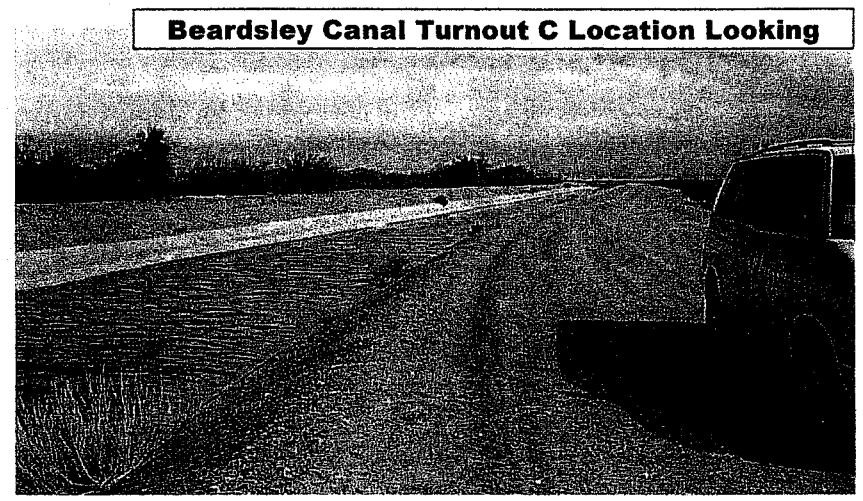
Alternate C – El Mirage Road Alignment

The Alternative C pipeline route begins near the northeast corner of Section 2, T4N, R1W at a proposed Beardsley Canal turnout. The route proceeds southerly along the section line (El Mirage Road alignment) for approximately 3.8 miles to the extended east-west centerline of Beardsley Road. From there the pipeline proceeds east along Beardsley Road to the CWR Water Campus.

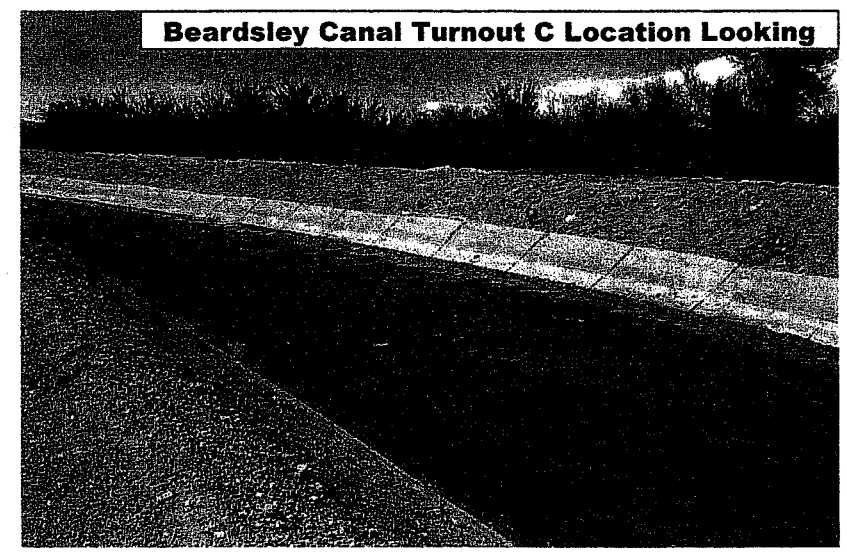
This route is fairly clear of major natural and man-made obstacles. The pipeline will cross the future Estrella Roadway and, depending on the precise alignment, the existing McMicken Dam Outlet Wash as well. Along unimproved Beardsley Road, the pipeline must cross the Agua Fria River and pass through extensive sand and gravel operations within the riverbed.

Alternative C Hydraulics





According to information provided by MWD regarding estimated design water surface elevation for the inlet to the Alternative C pipeline, the NWS at the turnout is 1,341.0, while the CWS, the most consistent elevation provided at the canal, is estimated 1,342.0. Although MWD guarantees the CWS the majority of the time, in an emergency the water surface may drop below the CWS.



The CWS elevation is used as the basis for the hydraulics design of the pipeline. The water surface elevation, which can be translated into pressure at the delivery point in the Sun City Area, is calculated by subtracting the losses incurred in the pipeline from the CWS elevation at the Beardsley Canal. The major portion of the losses in the pipeline will be from friction. There are minor losses when valves or bends in the pipe are encountered, but these are typically insignificant. Vacuum relief valves and air release valves will be required on the pipeline at high points and other locations, and isolation valves will be included to allow the pipeline to be isolated for one-mile segments, but these additions will add little to the losses calculated for this preliminary hydraulics analysis.

The preliminary hydraulics analysis indicates that a 24-inch diameter pipe will be required to deliver water a flow rates and pressure to adequately serve Sun City West and Sun City distribution systems. Because the static pressure for this system is approximately 55 psi, pressure-reducing valves will not be required to reduce the pressure prior to reaching the delivery system.

The pressure required for operation of the Sun City West water distribution system is 70 psi (at the CWR water campus location). Pressure required for the Sun City water distribution system is 70 psi. Because the delivery pressure of water in the Alternative C pipeline cannot meet these operating pressures by gravity, a pump will be required to deliver water from the Beardsley Canal. This pressure (70 psi at the water campus) will allow deliveries to be made to each of the participating golf courses connected to the distribution systems.

The Beardsley Canal currently does not convey water during four months of the year. Until this changes, the GSP will have to use all of its allotment in eight months instead of twelve. This scenario would require an increased trunk pipe size and an increase in the size of pumps at the booster pump station required for all of the Beardsley Canal alternates, above that which was estimated in this study. This enlarged system would then be inactive for four months of the year. This effectively eliminates Alternate C as long as the MWD continues to undergo an annual dry-up in the Beardsley Canal.

Alternative C Utility Coordination

US West maps showed no facilities along the Alternative C pipeline.

Southwest Gas maps indicated no conflicts with their facilities within the Alternative C project site.

El Paso Natural Gas has no gas lines within the project site for Alternative C.

No Cox Communication facilities were found to be in conflict with the Alternative C pipeline.

Existing power facilities were evaluated from utility maps provided by Arizona Public Service. Alternate C appeared to have no conflicts.

Alternative C Easement and Right-of-Way

Alternative C requires the skirting of an APS/SRP power substation as well as the McMicken Dam Outfall Channel owned and operated by the Flood Control District of Maricopa County.

The projected costs for easement or Right-of-Way for Alternative C will range from $60,000 to $90,000.

Alternative C Environmental Considerations

The MWD was contacted to obtain information regarding regulatory issues that may require resolution if water is transferred from the Beardsley Canal. MWD has jurisdiction over the Beardsley Canal. At the present time, this project will not be required to address environmental issues for the transfer of water from the Beardsley Canal.

The cultural resources report has determined that there are three sites found in or near Alternative Route C. One site is recommended as not eligible and testing is required to determine a recommendation for the other two sites. Nearly the entire route for Alternative C has been surveyed. It is recommended that all of the route between Beardsley Road and the Sun City West WWTP should be surveyed since sites were found within previously surveyed portions.

Alternative C Soils Considerations

Based on excavation conditions and corrosivity are the primary geotechnical factors of concern for evaluation of the this alternative. Preliminary exploration data indicate that soil conditions along most of Alternative C are in the group of soils that are not related to the Agua Fria River.

In this group, soils with calcareous cementation and high corrosion risk will commonly be encountered. Calcareous cementation is expected to cause difficult excavation conditions that will require heavy or specialized equipment for excavation.

The southernmost end of Alternative C, and where it crosses the Agua Fria River, is in the group of soils that are cohesionless soils, soils with cobbles and boulders, and soils with low to moderate corrosion risk to uncoated steel will commonly be encountered. Excavation conditions are not anticipated to be as difficult in uncemented and lightly cemented, cohesionless soils and soils with cobbles and boulders.

Since encountering soils difficult for excavation are anticipated, the cost of pipe installation will be increased. Corrosion is a factor in some of the soils along the route and wrapping or coatings on the pipe will protect the pipe material.

Alternative C Estimate of Probable Costs and Time of Construction

An estimate of probable cost has been prepared for this alternative. The costs are shown below.

Alternative Route C – El Mirage Road
Opinion of Probable Life Cycle Costs

Item Description	Unit	Quantity	Unit Price	Amount
Pipeline				
Mobilization @ 5%	Ea.	1	$170,676	$170,676
Ductile Iron Pipe (24" Class 200)	L.F.	28,259	$90.76	$2,564,779
24" Gate Valve	Ea.	5	$13,500	$67,500
Pavement Replacement	S.Y.	722	$20	$14,440
Combination AirVac Valve (2")	Ea.	4	$4,000	$16,000
Permitting & Compliance	L.S.	1	$23,150	$23,150
R/W Costs	S.F.	150,000	$1.00	$150,000
MWD Improvements (Turnout Structure)				
Headwall	Ea.	1	$10,000	$10,000
Slide Gate	Ea.	1	$2,500	$2,500
Connect to MWD Turnout	Ea.	1	$5,000	$5,000
Meter Box, Power hookup (APS)	Ea.	1	$90,000	$90,000
Flowmeter	Ea.	1	$5,000	$5,000
MCU	Ea.	1	$25,000	$25,000
Telemetry to CWR	Ea.	1	$2,000	$2,000
Construction License	Ea.	1	$500	$500
MWD Improvements (Check Structure)				
Structure A (concrete & steel)	Ea.	1	$100,000	$100,000
Radial Gate (4'W x 6'H)	Ea.	2	$10,000	$20,000
Flowmeter	Ea.	1	$5,000	$5,000
Connection to MWD SCADA	Ea.	1	$5,000	$5,000
Booster Pump Station				
Pump Station Capital Cost	L.S.	1	$307,660	$307,660
			Subtotal	**$3,584,205**
Engineering Design	8%	1	$286,736	$286,736
Construction Administration	12%	1	$430,105	$430,105
Pipeline Contingency	10%	1	$326,116	$326,116
Pump Station Contingency	25%	1	$80,761	$80,761
Citizens (Admin./Legal/Financial)	10%	1	$358,421	$358,421
			Total Capital Cost	**$5,066,344**

O&M Life Cycle Costs	Annual Cost	Present Worth
24" Pipeline O&M (50 yr) (28,259 L.F. at $0.50/ft/yr)	$14,130	$231,381
Pump Station O&M (50 yr) (See Estimate, Page D-50)	$7,692	$125,954
MWD Water Losses (50 yr) (180 ac-ft at $106/ac-ft)	$19,080	$312,448
MWD Wheeling Cost (50 yr) (6,561 ac-ft at $25/ac-ft)	$164,025	$2,686,025
Total O&M Life Cycle Cost		**$4,104,910**
Total Life Cycle Cost, Alternate C		**$9,171,254**

The life cycle costs were determined using common cost elements applied to anticipated annualized costs. The annual costs were calculated by summing each annual cost element. These were then determined as a present worth value.

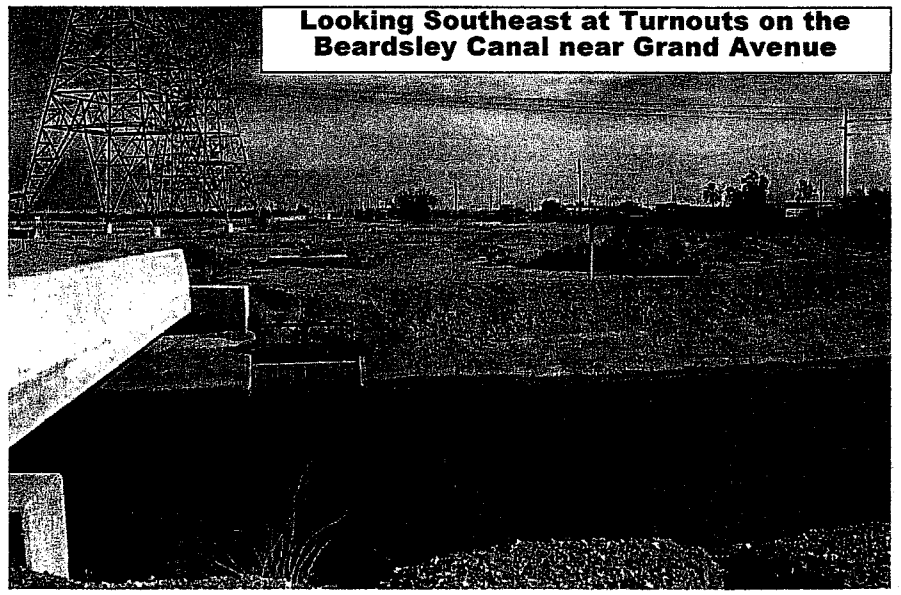
A differential interest rate of 5.73% was used for calculations. This rate was based on the weighted cost of capital at 8.73%, minus an inflation rate of 3%. The weighted cost of capital at 8.73% for Citizens Water Resources is based on Arizona Corporation Commission Decision 60172. The inflation rate of 3.0% is based on an assumed average inflation rate over past number of years.

It is anticipated that this route will take approximately 145 working days to construct (approximately 7 months) using separate contractors for the pump station and the trunk pipeline.

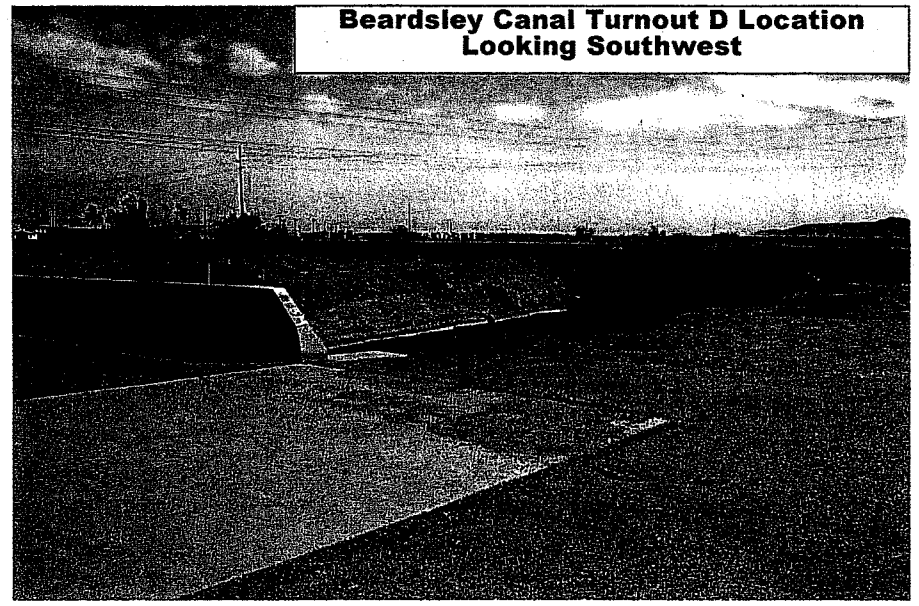
Alternate D – Deer Valley Road Alignment

The Alternative D pipeline route begins at a proposed Beardsley Canal turnout east of both Grand Avenue and the railroad. The alignment parallels Grand Avenue southeasterly for approximately 0.4 miles, then turns east for 4.8 miles on a Deer Valley Road extended centerline alignment through Sun City West until reaching El Mirage Road. There the pipeline turns south for one mile to Beardsley Road, then east one mile to the CWR Water Campus.

Looking Southeast at Turnouts on the Beardsley Canal near Grand Avenue



Along its alignment, the route passes through an area of developed Sun City West, Deer Valley Golf Course, the existing McMicken Dam Outlet Wash and the Agua Fria River. From Grand Avenue the pipeline follows an existing concrete-lined channel east until reaching Desert Hills golf course. Continuing through Deer Valley golf course, the alignment moves back onto the Deer Valley Road alignment and continues east to El Mirage Road.



Alternative D Hydraulics

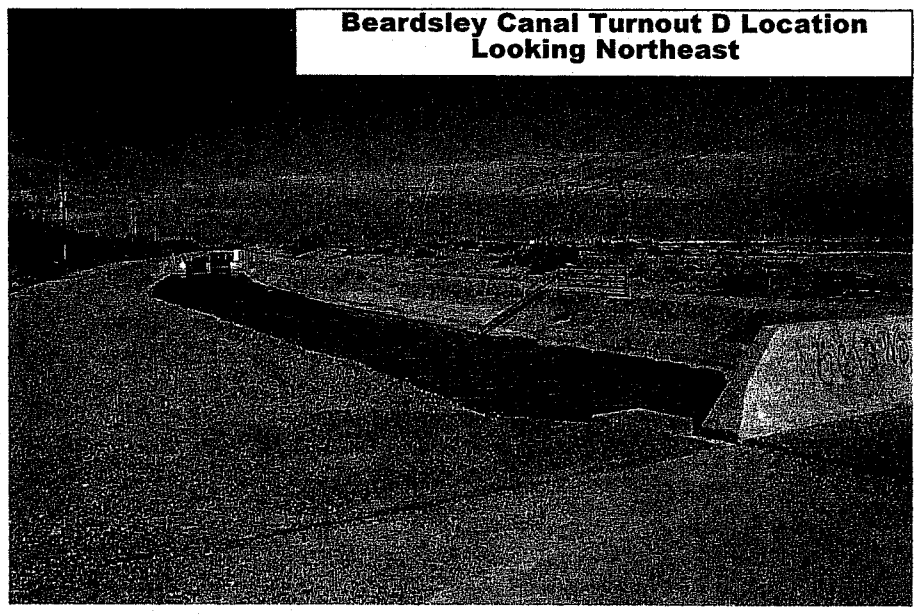
The estimated NWS at the Beardsley Canal is approximately 1,336.0. The estimated design water surface elevation for the inlet to the Alternative D pipeline will be approximately 1,338.0, which will be the CWS, the elevation that the Beardsley Canal will provide most consistently. Although MWD guarantees the CWS the majority of the time, in an emergency the water surface may drop below the CWS.

The CWS elevation is used as the basis for the hydraulics design of the pipeline. The water surface elevation, which can be translated into pressure at the delivery point in the Sun City Area, is calculated by subtracting the losses incurred in the pipeline from the CWS elevation at the Beardsley Canal. The major portion of the losses in the pipeline will be from friction. There are minor losses when valves or bends in the pipe are encountered, but these are typically insignificant. Vacuum relief valves and air release valves will be required on the pipeline at high points and other locations, and isolation valves will be included to allow the pipeline to be isolated for one-mile segments, but these additions will add little to the losses calculated for this preliminary hydraulics analysis.

The preliminary hydraulics analysis indicates that a 24-inch diameter pipe will be required to deliver water a flow rates and pressure to adequately serve Sun City West and Sun City distribution systems. Because the static pressure for this system is approximately 55 psi, pressure-reducing valves will not be required to reduce the pressure prior to reaching the delivery system.

The pressure required for operation of the Sun City West water distribution system is 70 psi (at the CWR water campus location). Pressure required for the Sun City water distribution system is 70 psi. Because the delivery pressure of water in the Alternative D pipeline cannot meet these operating pressures by gravity, a pump will be required to deliver water from the Beardsley Canal. This pressure (70 psi at the water campus) will allow deliveries to be made to each of the participating golf courses connected to the distribution systems.

The Beardsley Canal currently does not convey water during four months of the year. Until this changes, the GSP will have to use all of its allotment in eight months instead of twelve. This scenario would require an increased trunk pipe size and an increase in the size of pumps at the booster pump station required for all of the Beardsley Canal alternates, above that which was estimated in this study. This enlarged system would then be inactive for four months of the year. **This effectively eliminates Alternate D as long as the MWD continues to undergo an annual dry-up in the Beardsley Canal.**



Alternative D Utility Coordination

US West facilities adjacent to Grand Avenue cross Alternative D at approximately Sta. 26+50. In addition, Sta. 143+20 and 179+00 were identified as possible conflicts.

A Southwest Gas facility crosses this proposed alignment at one location (approximately Sta. 180+00). This 4-inch line runs along Deer Valley Road and measures for protection of this line will be taken during the design process if Alternative D is selected

El Paso Natural Gas was contacted to obtain the location of existing gas lines within the project site. No conflicts with El Paso Natural Gas lines are present on Route D

Alternate D has no conflicts with Cox Communications.

The proposed alignment for Alternative D presents possible conflicts with APS facilities at two locations. One line runs along 115th Avenue at approximately Sta. 99+00 and the other is located at Deer Valley Road at approximately Sta. 180+00.

Alternative D Easement and Right-of-Way

Alternative D requires the use of a drainage easement and two golf courses in the Sun City West expansion area. After leaving the golf courses the pipeline route follows along the Deer Valley road alignment to the El Mirage Road Alignment. The pipe then turns south and extends to the Beardsley Road alignment and the existing effluent line. The pipe then turns across the Aqua Fria River and connects to the Sun City Distribution System.

The project costs for easement or Right-of-Way for Alternative D will range from $80,000 to $120,000.

Alternative D Environmental Considerations

The MWD was contacted to obtain information regarding regulatory issues that may require resolution if water is transferred from the Beardsley Canal. MWD has jurisdiction over the Beardsley Canal. At the present time, Citizens Water Resources will not need to address environmental issues for the transfer of water from the Beardsley Canal.

Alternative D Soils Considerations

A field investigation (soil borings) for Alternative D was not performed for its alignment.

The easternmost end of Alternative D however is near the investigations done for Alternative C. The soils for this portion of the pipeline are considered to be the same as those results for the purposes of this report.

Alternative D Estimate of Probable Costs and Time of Construction

An estimate of probable cost has been prepared for this alternative. The costs are shown below.

Alternative Route D – Deer Valley Road
Opinion of Probable Life Cycle Costs

Item Description	Unit	Quantity	Unit Price	Amount
Pipeline				
Mobilization @ 5%	Ea.	1	$225,858	$225,858
Ductile Iron Pipe (24" Class 200)	L.F.	39,139	$88.45	$3,461,840
24" Gate Valve	Ea.	7	$13,500	$94,500
Pavement Replacement	S.Y.	13,000	$20	$260,000
Combination AirVac Valve (2")	Ea.	5	$4,000	$20,000
Permitting $ Compliance	L.S.	1	$23,150	$23,150
R/W Costs	S.F.	200,000	$1.00	$200,000
MWD Improvements (Turnout Structure)				
Headwall	Ea.	1	$10,000	$10,000
Slide Gate	Ea.	1	$2,500	$2,500
Connect to MWD Turnout	Ea.	1	$5,000	$5,000
Meter Box, Power hookup (APS)	Ea.	1	$90,000	$90,000
Flowmeter	Ea.	1	$5,000	$5,000
MCU	Ea.	1	$25,000	$25,000
Telemetry to CWR	Ea.	1	$2,000	$2,000
Construction License	Ea.	1	$500	$500
Remove Bulkhead	Ea.	1	$5,000	$5,000
Connection to MWD SCADA	Ea.	1	$5,000	$5,000
Booster Pump Station				
Pump Station Capital Cost	L.S.	1	$307,660	$307,660
			Subtotal	**$4,743,008**
Engineering Design	8%	1	$379,441	$379,441
Construction Administration	12%	1	$569,161	$569,161
Pipeline Contingency	10%	1	$441,997	$441,997
Pump Station Contingency	25%	1	$80,761	$80,761
Citizens (Admin./Legal/Financial)	10%	1	$474,301	$474,301
			Total Capital Cost	**$6,688,669**
O&M Life Cycle Costs			**Annual Cost**	**Present Worth**
24" Pipeline O&M (50 yr) (39,139 L.F. at $0.50/ft/yr)			$19,570	$320,464
Pump Station O&M (50 yr) (See Estimate, Page D-50)			$7,692	$125,954
MWD Water Losses (50 yr) (398 ac-ft at $106/ac-ft)			$42,188	$690,858
MWD Wheeling Cost (50 yr) (6,561 ac-ft at $25/ac-ft)			$164,025	$2,686,025
			Total O&M Life Cycle Cost	**$4,572,403**
			Total Life Cycle Cost, Alternate D	**$11,261,072**

The life cycle costs were determined using common cost elements applied to anticipated annualized costs. The annual costs were calculated by summing each annual cost element. These were then determined as a present worth value.

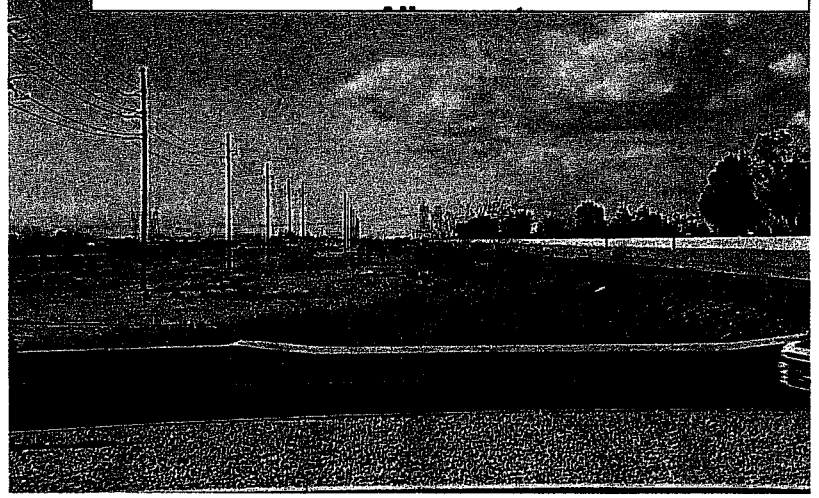
A differential interest rate of 5.73% was used for calculations. This rate was based on the weighted cost of capital at 8.73%, minus an inflation rate of 3%. The weighted cost of capital at 8.73% for Citizens Water Resources is based on Arizona Corporation Commission Decision 60172. The inflation rate of 3.0% is based on an assumed average inflation rate over past number of years.

It is anticipated that this route will take approximately 190 working days to construct (approximately 9 months) using separate contractors for the pump station and the trunk pipeline.

Alternate E – Through Sun City West

The Alternative E pipeline routes begin at a proposed Beardsley Canal turnout east of both Grand Avenue and the railroad. The alignment parallels Grand Avenue southeasterly for approximately one-and-a-half miles, turning east on R.H. Johnson Boulevard to Granite Valley Drive, where it would be connected to the existing irrigation network owned and operated by the Recreation Centers of Sun City West (Rec Centers).

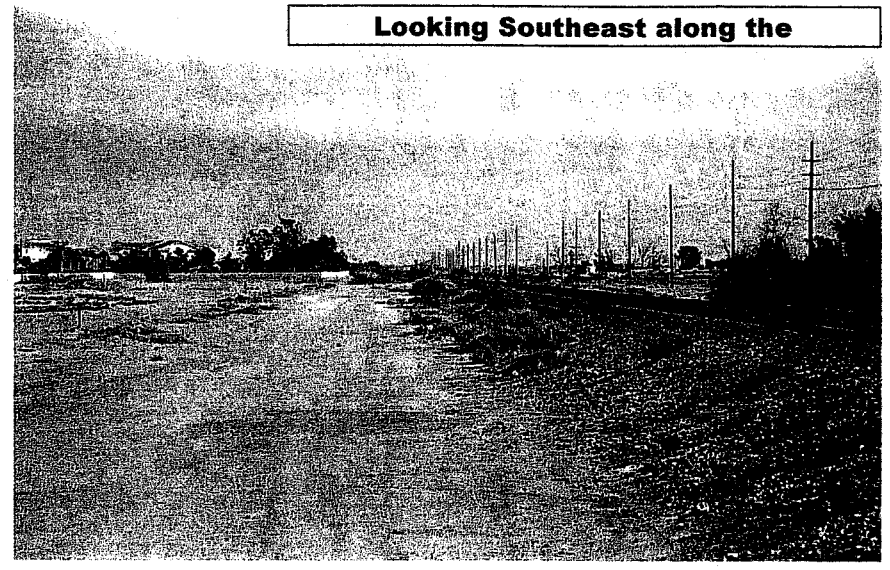
Looking Northwest along the SR60/UPRR



Alternative E Hydraulic Profile

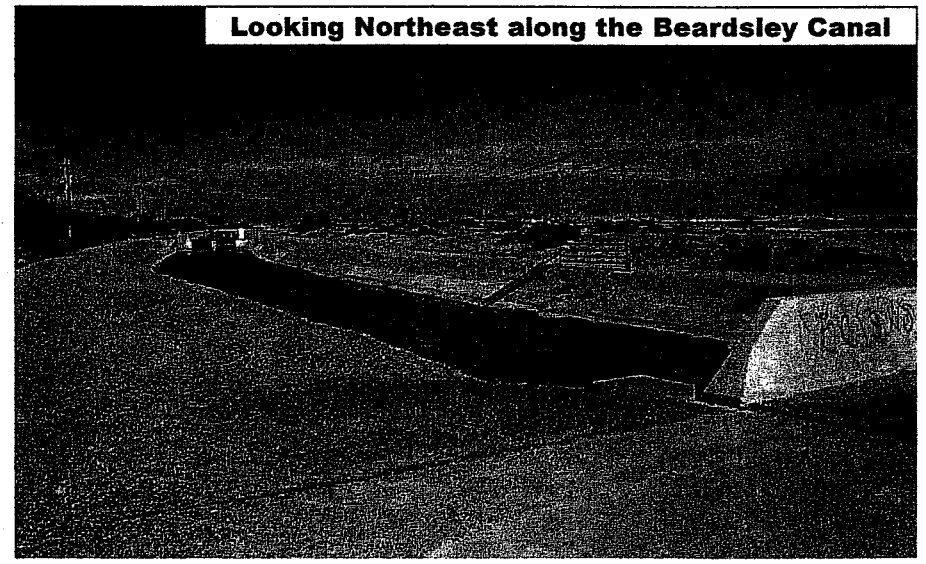
The estimated NWS at the Beardsley Canal is approximately 1,336.0. The estimated design water surface elevation for the inlet to the Alternative E pipeline will be approximately 1,338.0, which will be the CWS, the elevation that the Beardsley Canal will provide most consistently. Although MWD guarantees the CWS the majority of the time, in an emergency the water surface may drop below the CWS.

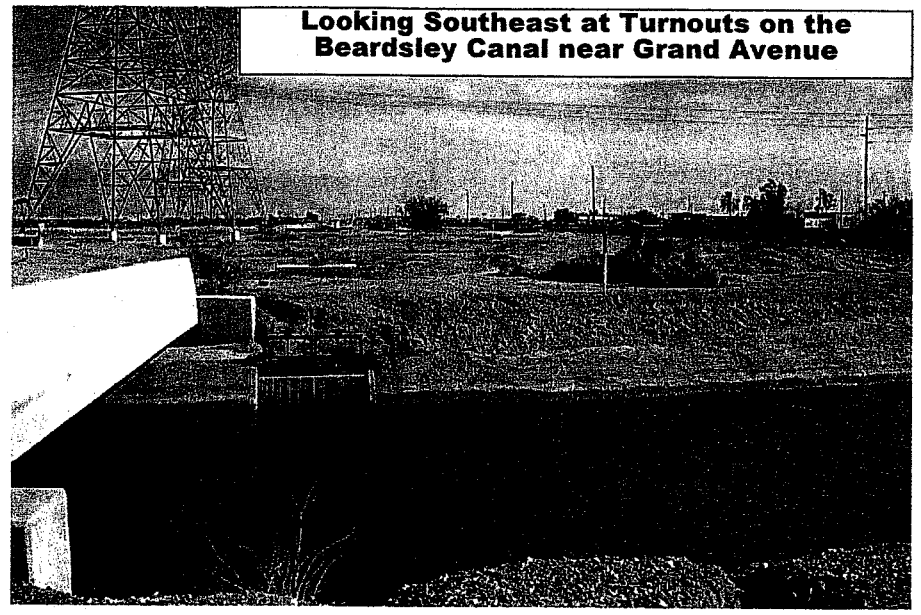
Looking Southeast along the



The CWS elevation is used as the basis for the hydraulics design of the pipeline. The water surface elevation, which can be translated into pressure at the delivery point in the Sun City Area, is calculated by subtracting the losses incurred in the pipeline from the CWS elevation at the Beardsley Canal. The major portion of the losses in the pipeline will be from friction. There are minor losses when valves or bends in the pipe are encountered, but these are typically insignificant. Vacuum relief valves and air release valves will be required on the pipeline at high points and other locations, and isolation valves will be included to allow the pipeline to be isolated for one-mile segments.

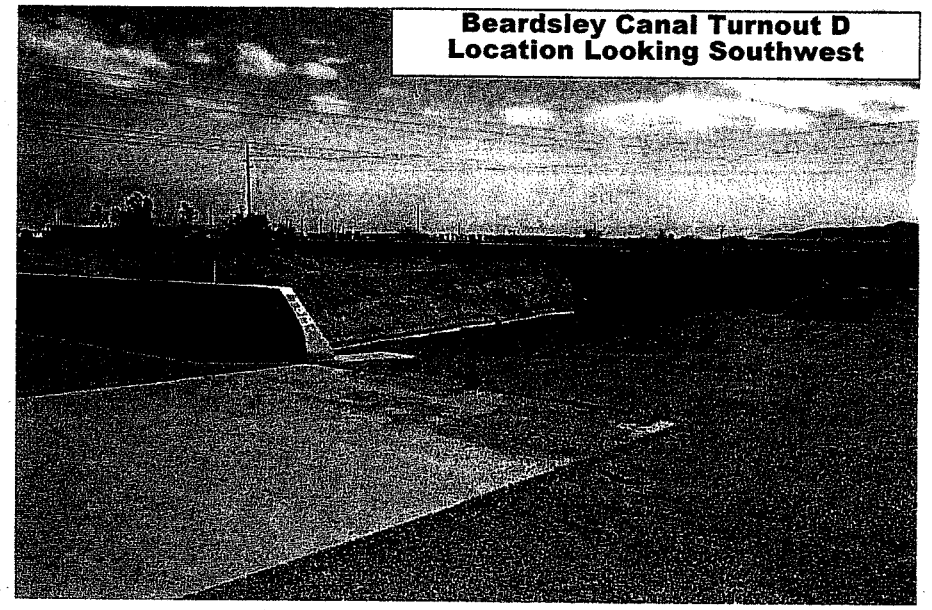
Looking Northeast along the Beardsley Canal



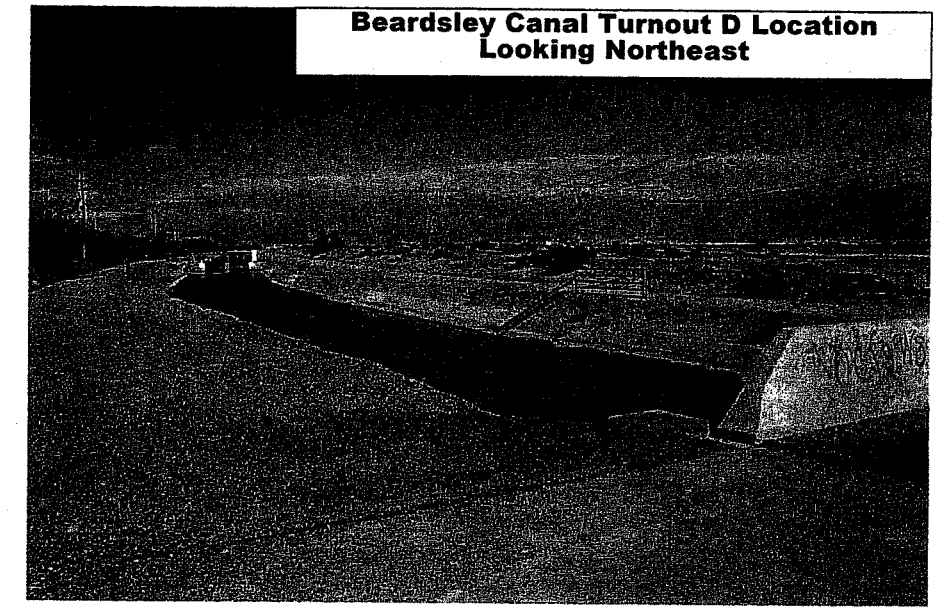

Looking Southeast at Turnouts on the Beardsley Canal near Grand Avenue

The preliminary hydraulics analysis indicates that a 24-inch diameter pipe will be required to deliver water a flow rates and pressure to adequately serve Sun City West and Sun City distribution systems. Because the static pressure for this system is approximately 55 psi, pressure-reducing valves will not be required to reduce the pressure prior to reaching the delivery system.

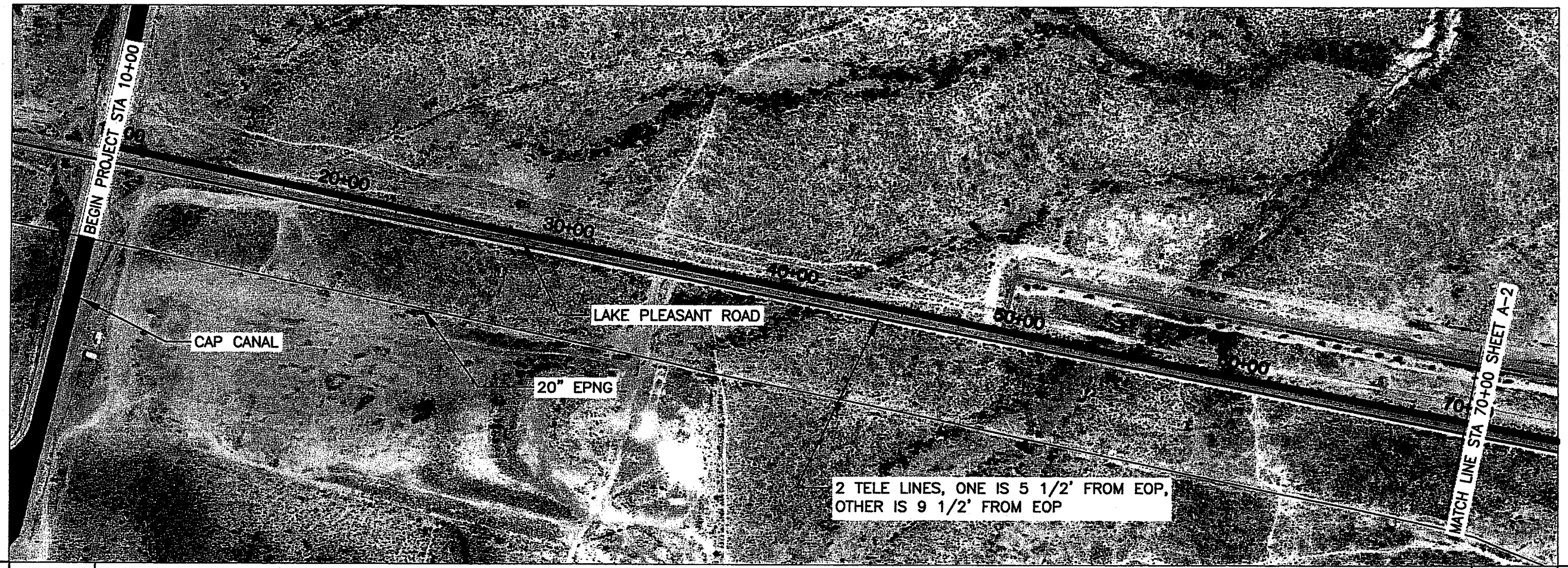
The delivery pipeline from Alignment E was assumed to connect to the existing SCW effluent delivery system. Because the closest point of connection is on the downstream end of the system, the pipes are relatively small diameter. These small diameter pipes require high pressure to drive the flows back to the Aqua Fria crossing and into Sun City. Calculations indicate that the existing SCW effluent system is inadequate to carry the required flows back to and across the river, without increasing the pressure in the pipeline via a new pumping system. The pressure required would exceed the physical limits of the existing pipe and could potentially produce excessive leakage and pipe breaks. The delivery pressure produced by gravity flow in the Alternative E pipeline is not adequate to provide flows at the various discharge locations. It will, therefore, not be possible to deliver water from the joint facility pipeline via the Alternative E pipeline.

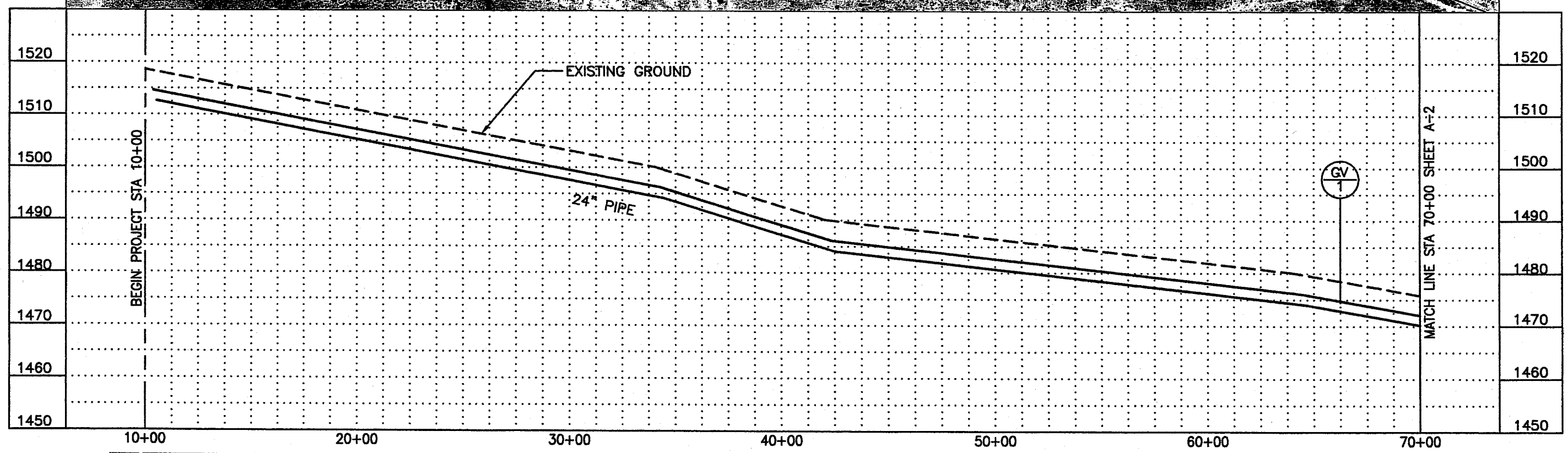

Beardsley Canal Turnout D Location Looking Southwest

The SCW effluent irrigation system is owned by the Recreation Centers of Sun City West, Inc.. The Recreation Centers has indicated to CWR that the pipeline crossing of the Agua Fria River cannot be used to convey CAP from west to east (the direction of flow required for the Alternative E alignment) because of their obligation to provide effluent to Sun City West Recreation Center golf courses in an east to west direction.


Beardsley Canal Turnout D Location Looking Northeast

The use of GSP Alternative E will not be considered as a delivery method for CAP water to the GSP due to the hydraulic and legal reasons stated in the two preceding paragraphs.





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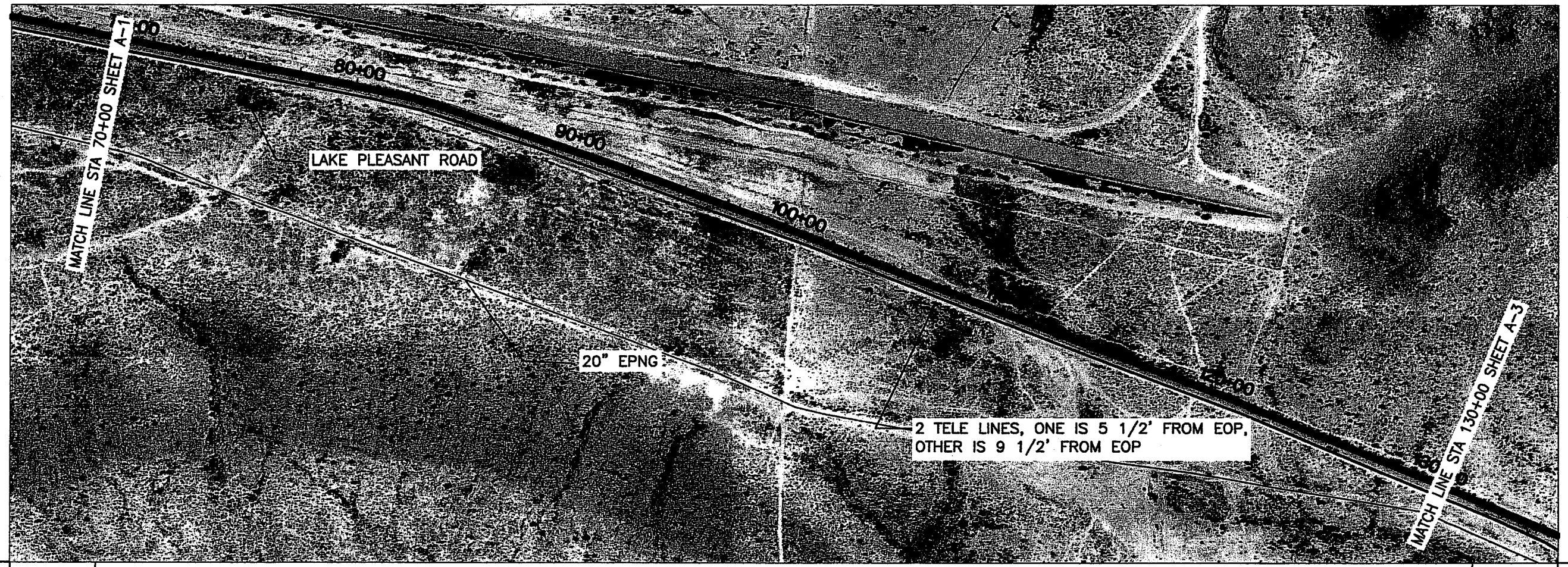
SHEET A-1



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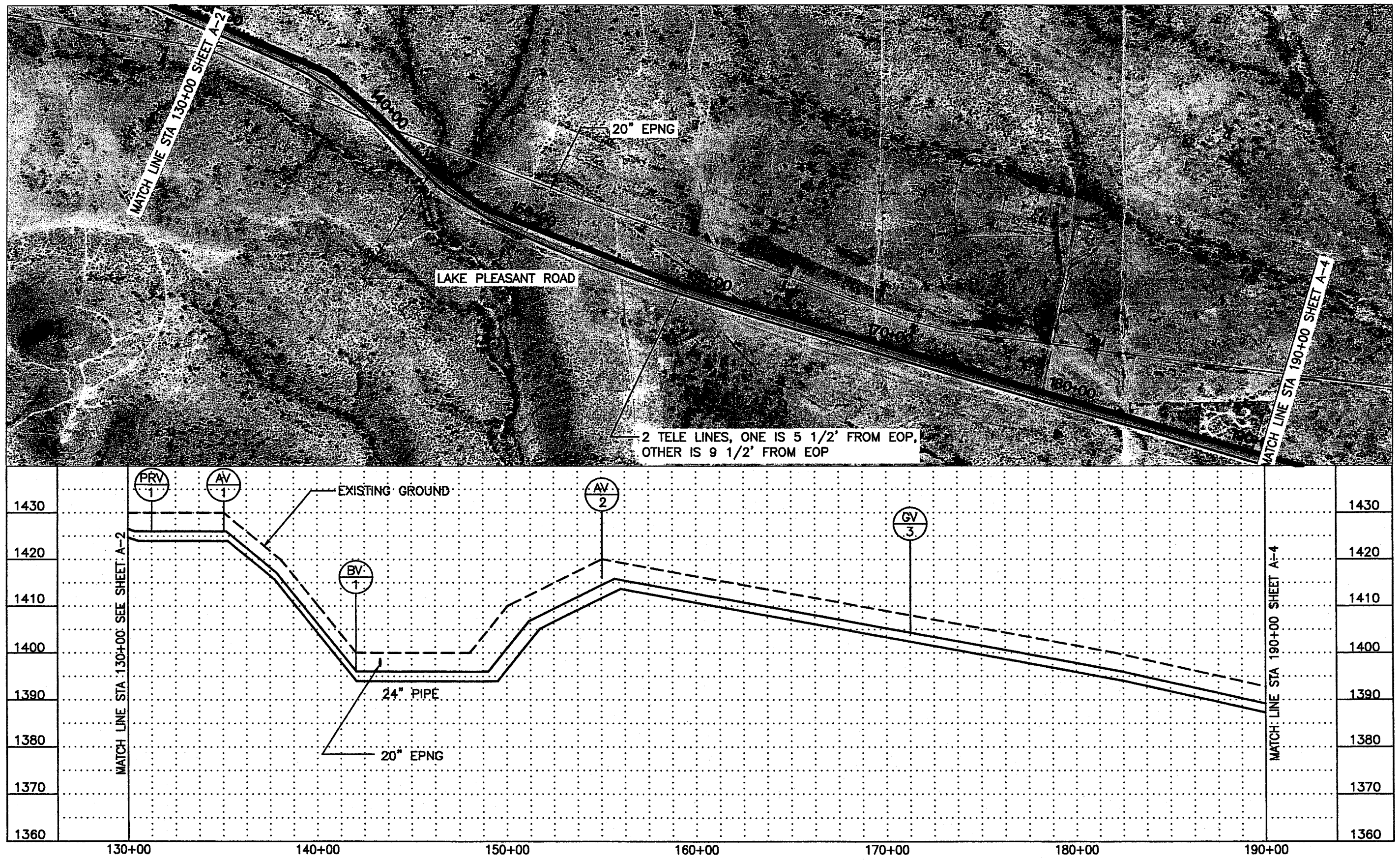

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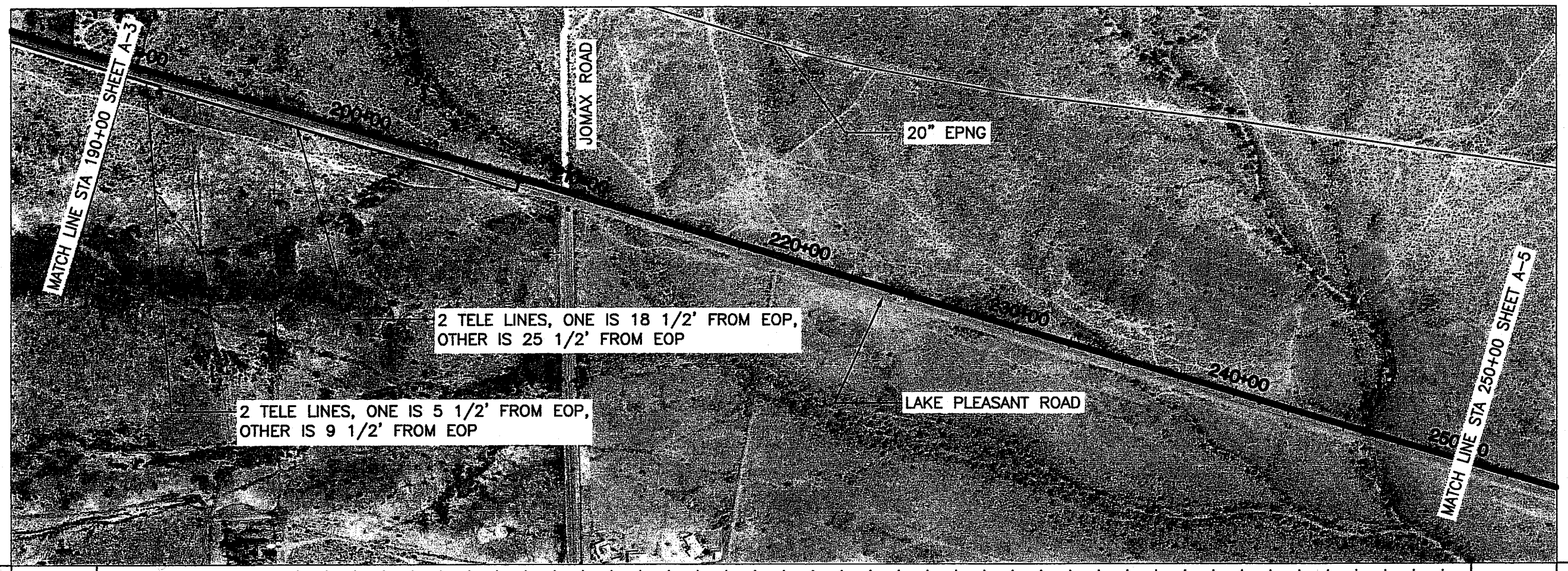

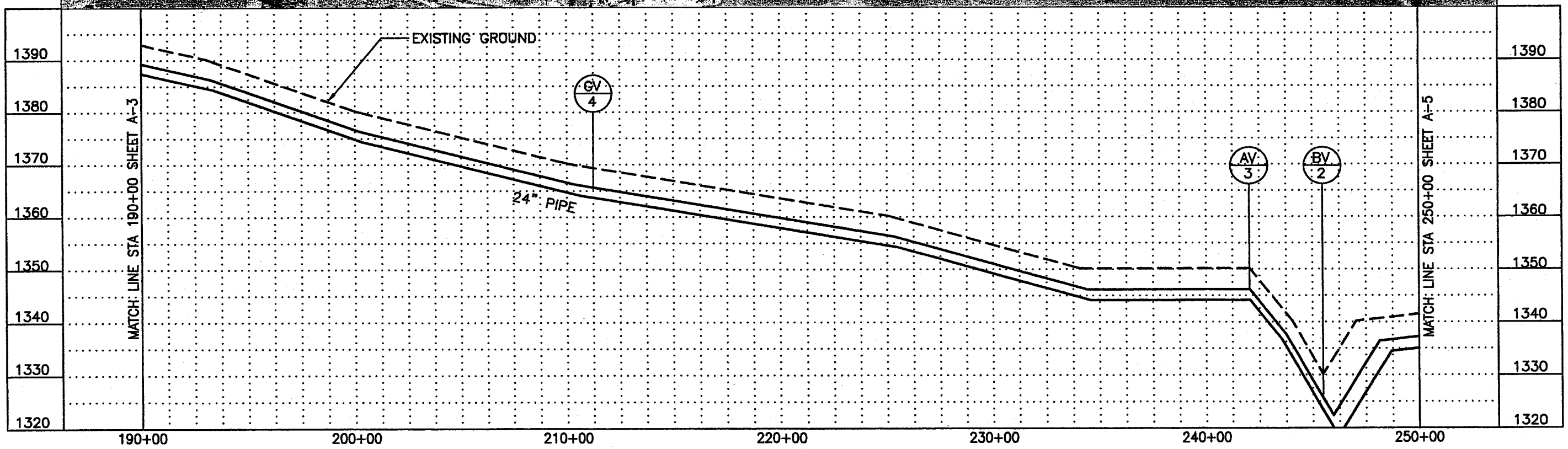

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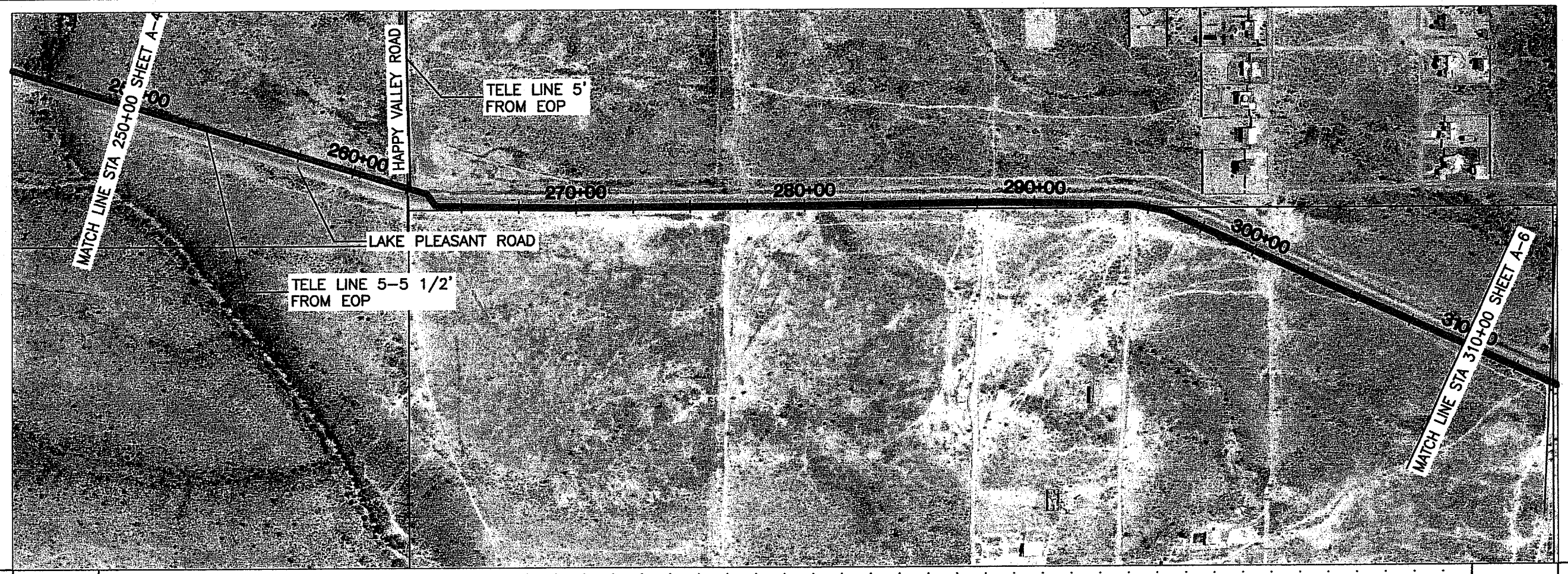

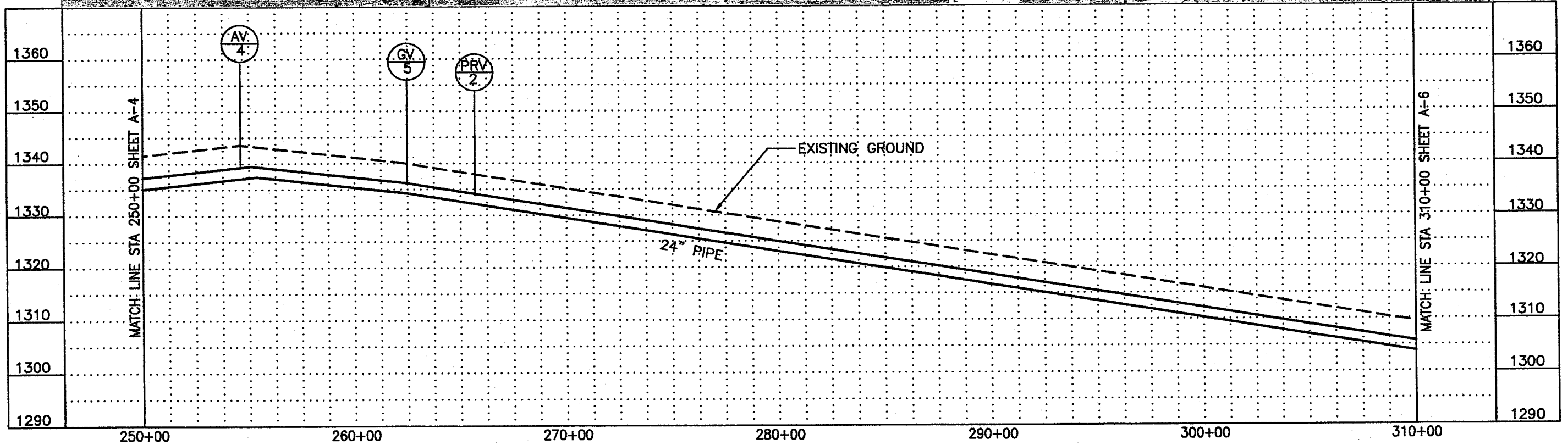

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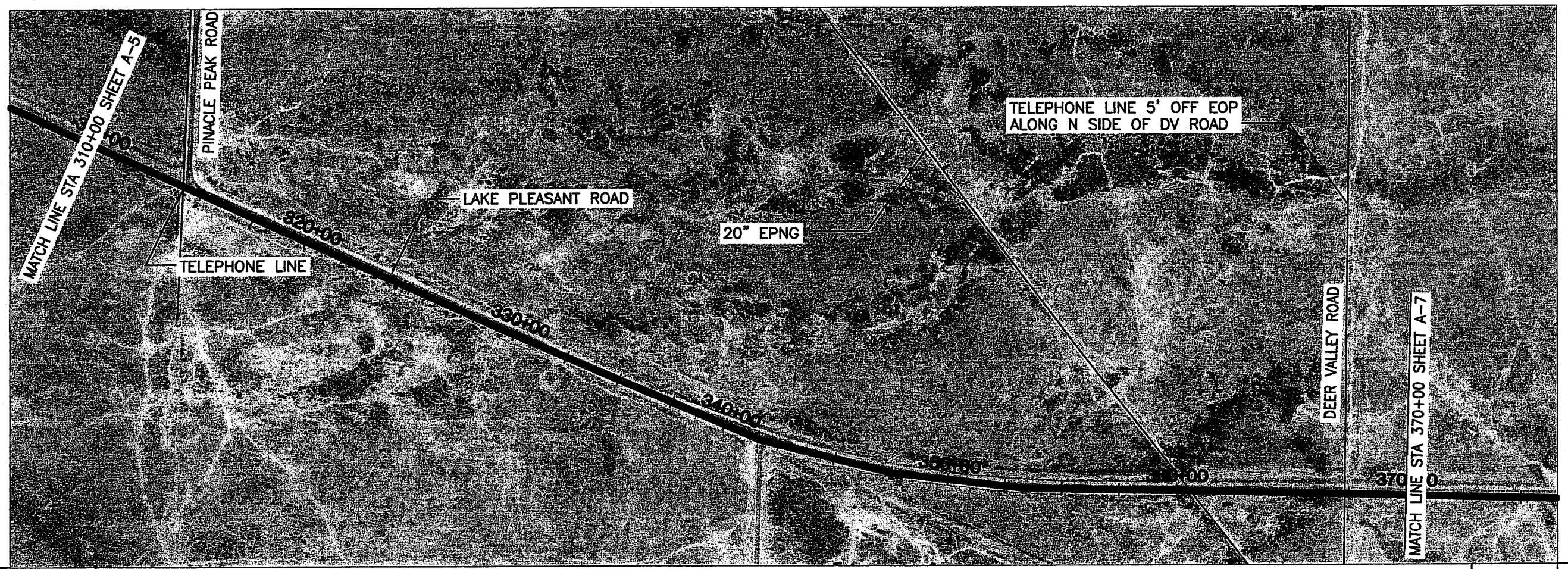

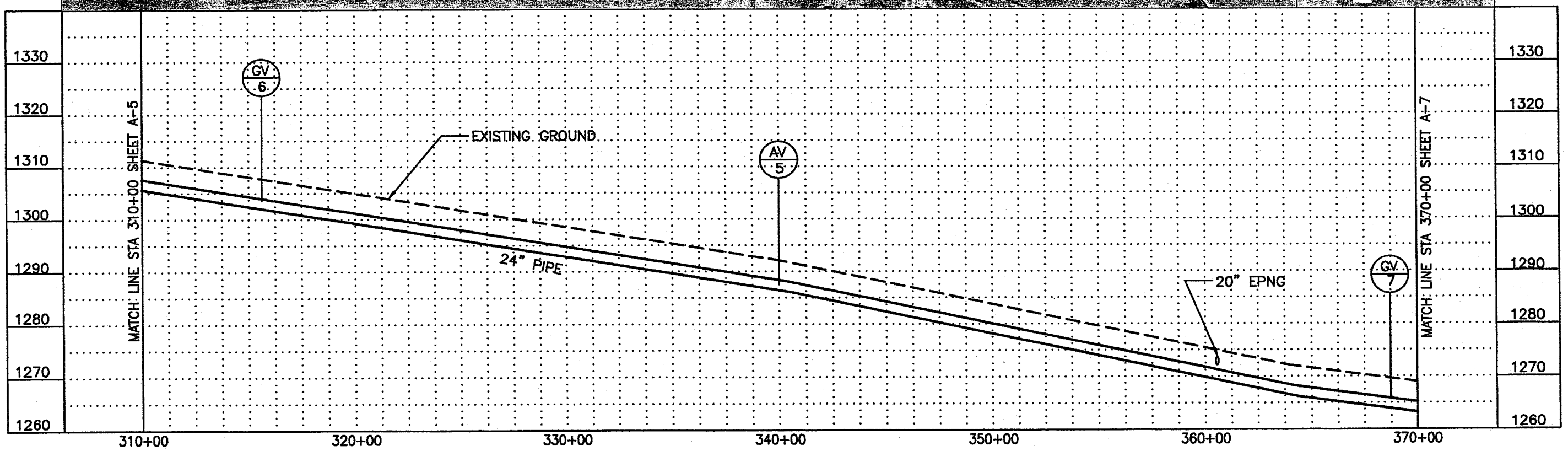

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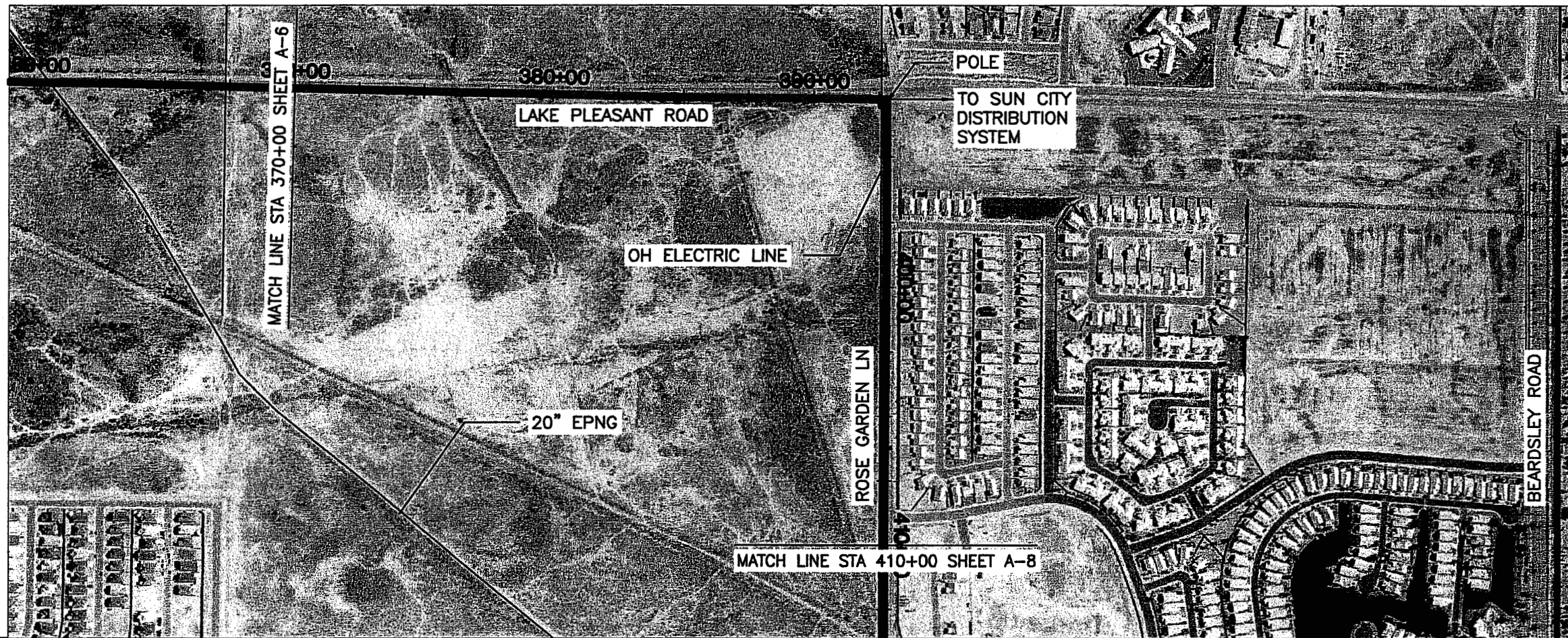

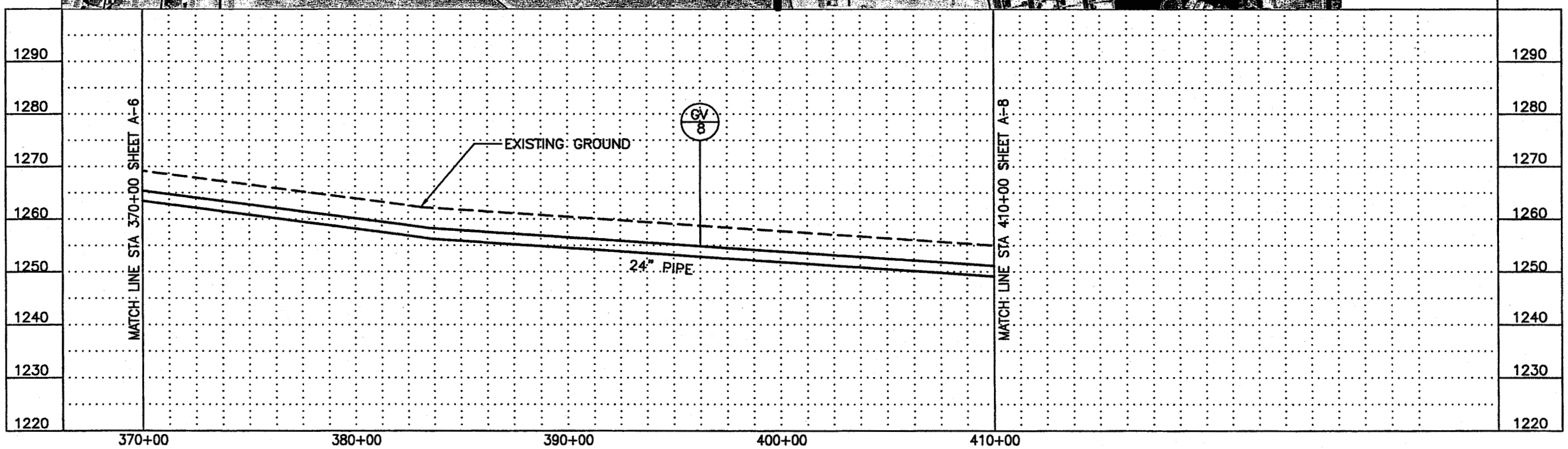

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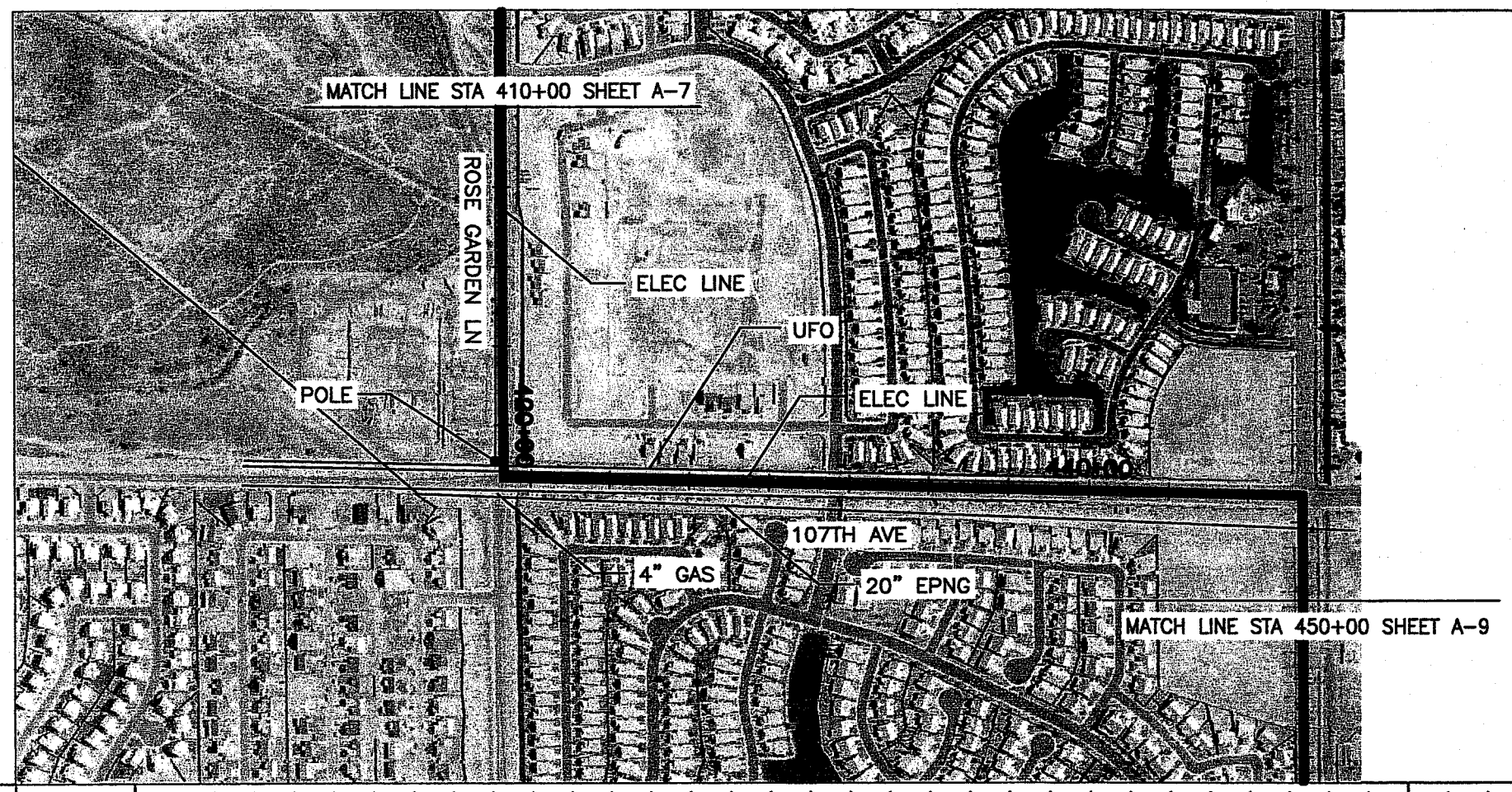

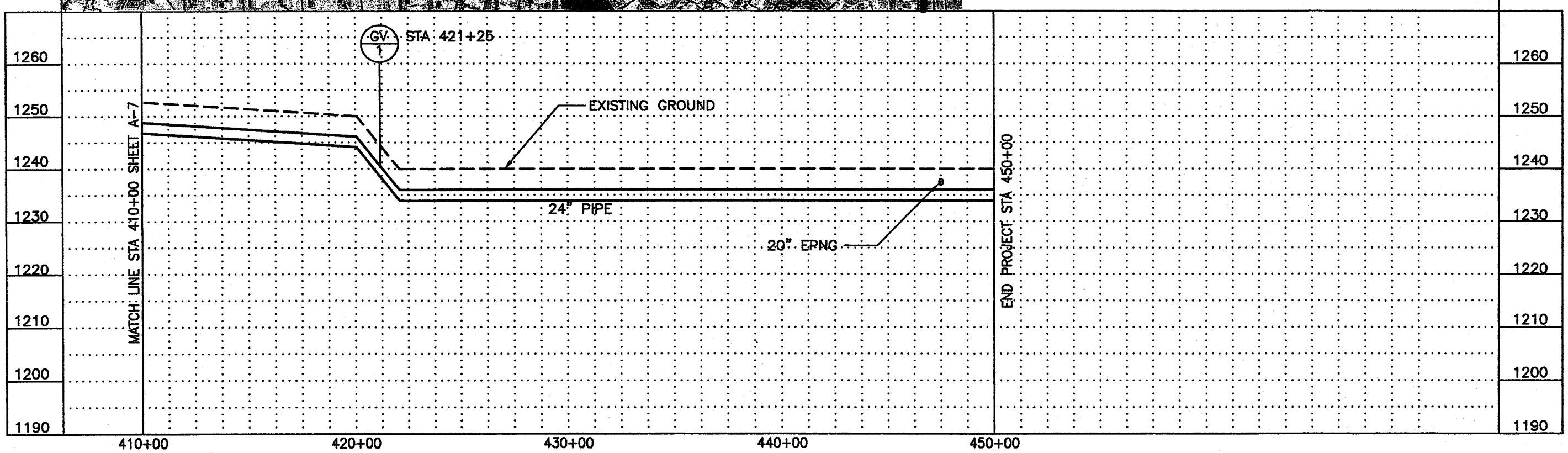

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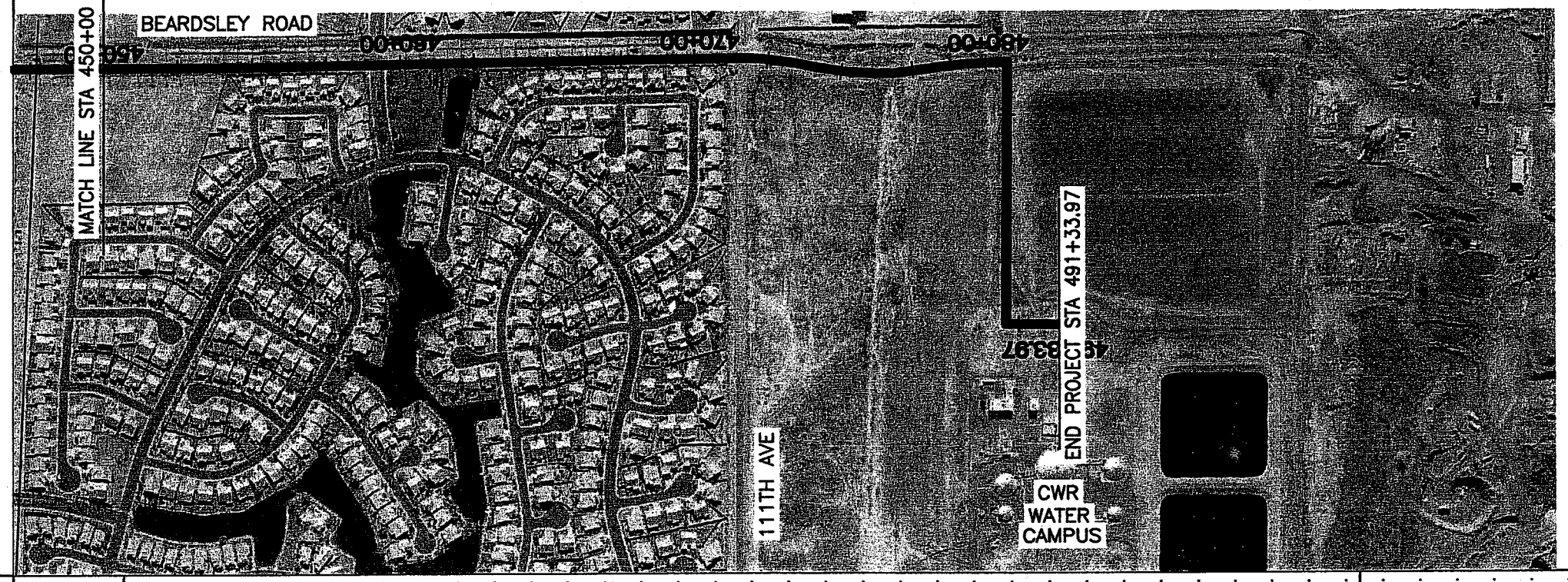
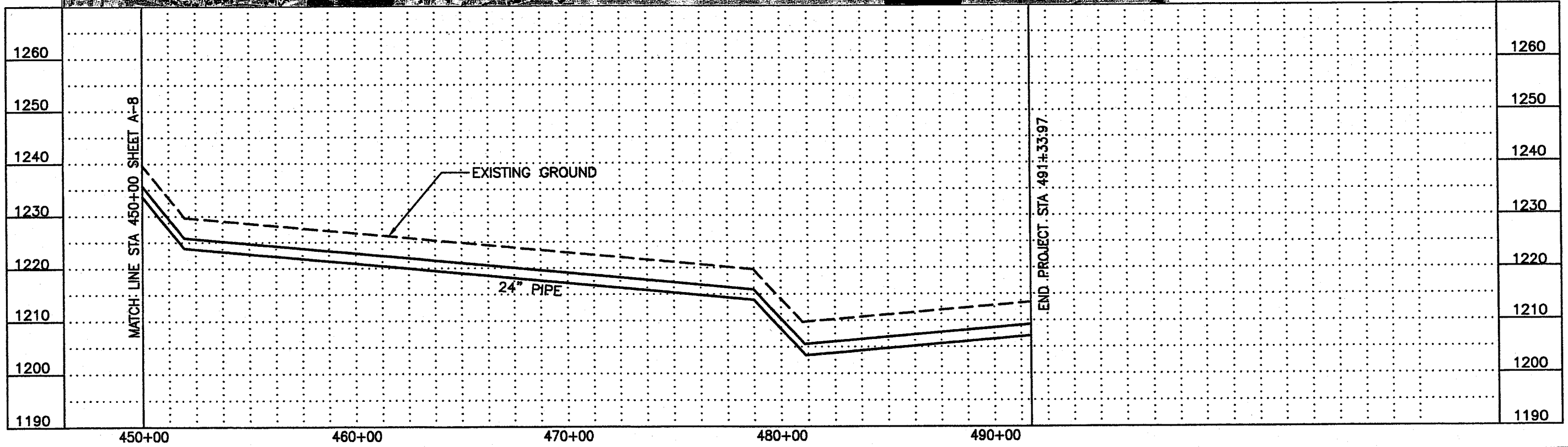
SHEET A-8





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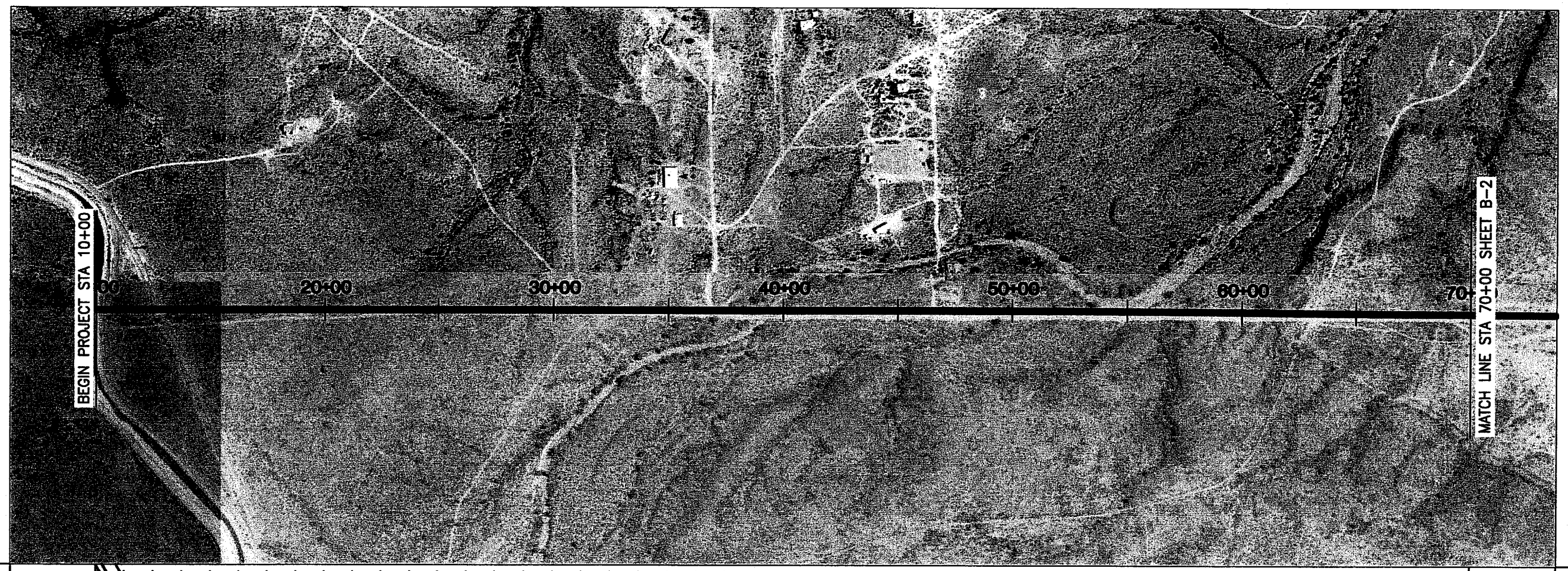

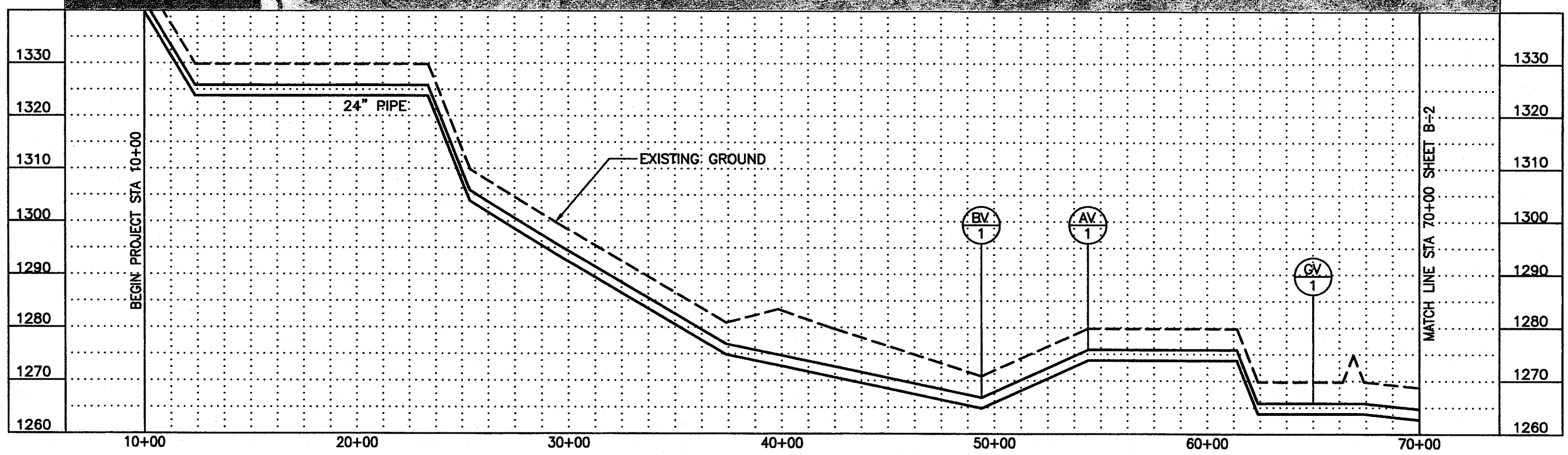

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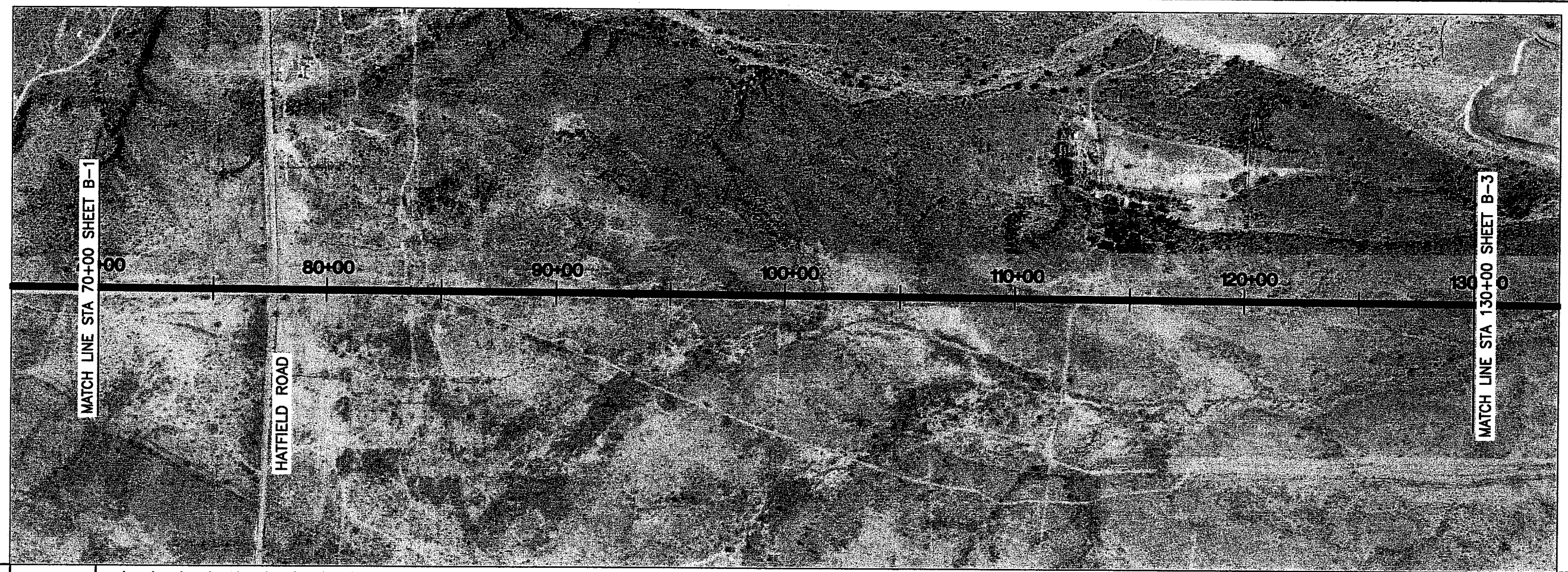

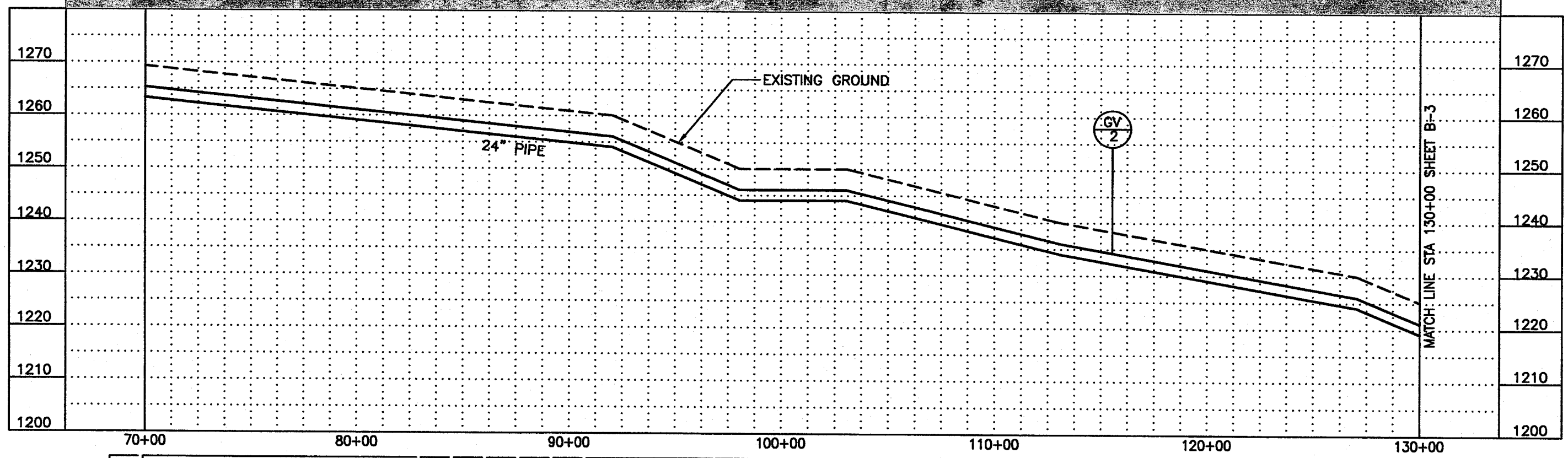

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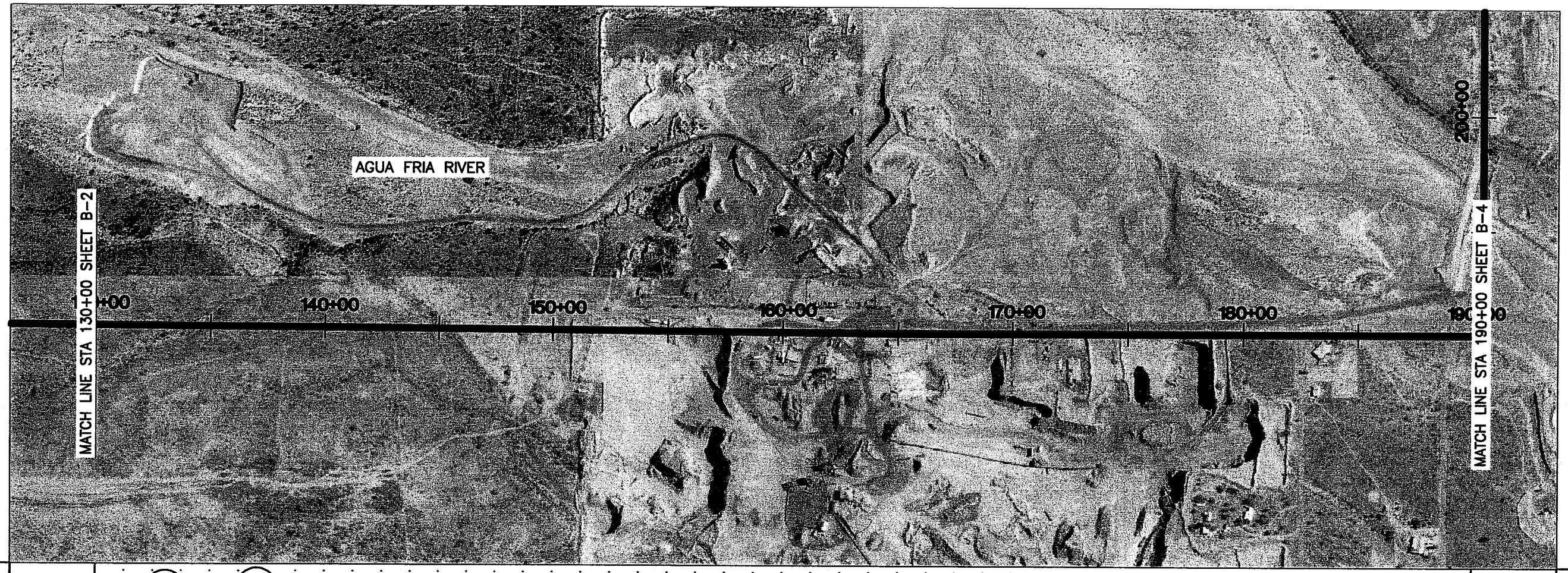

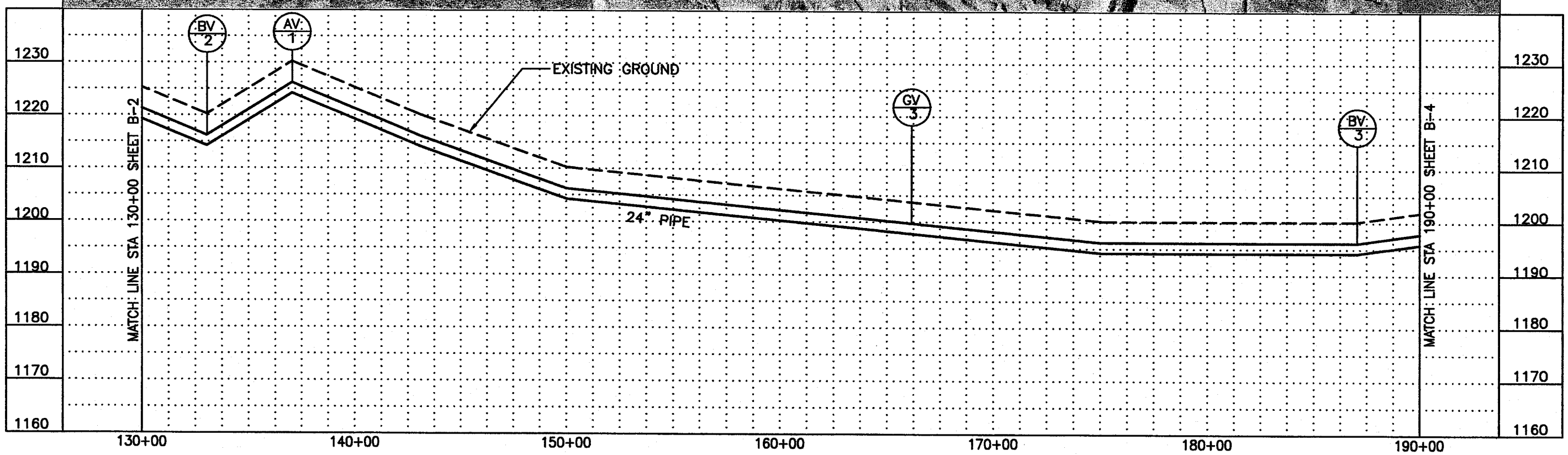

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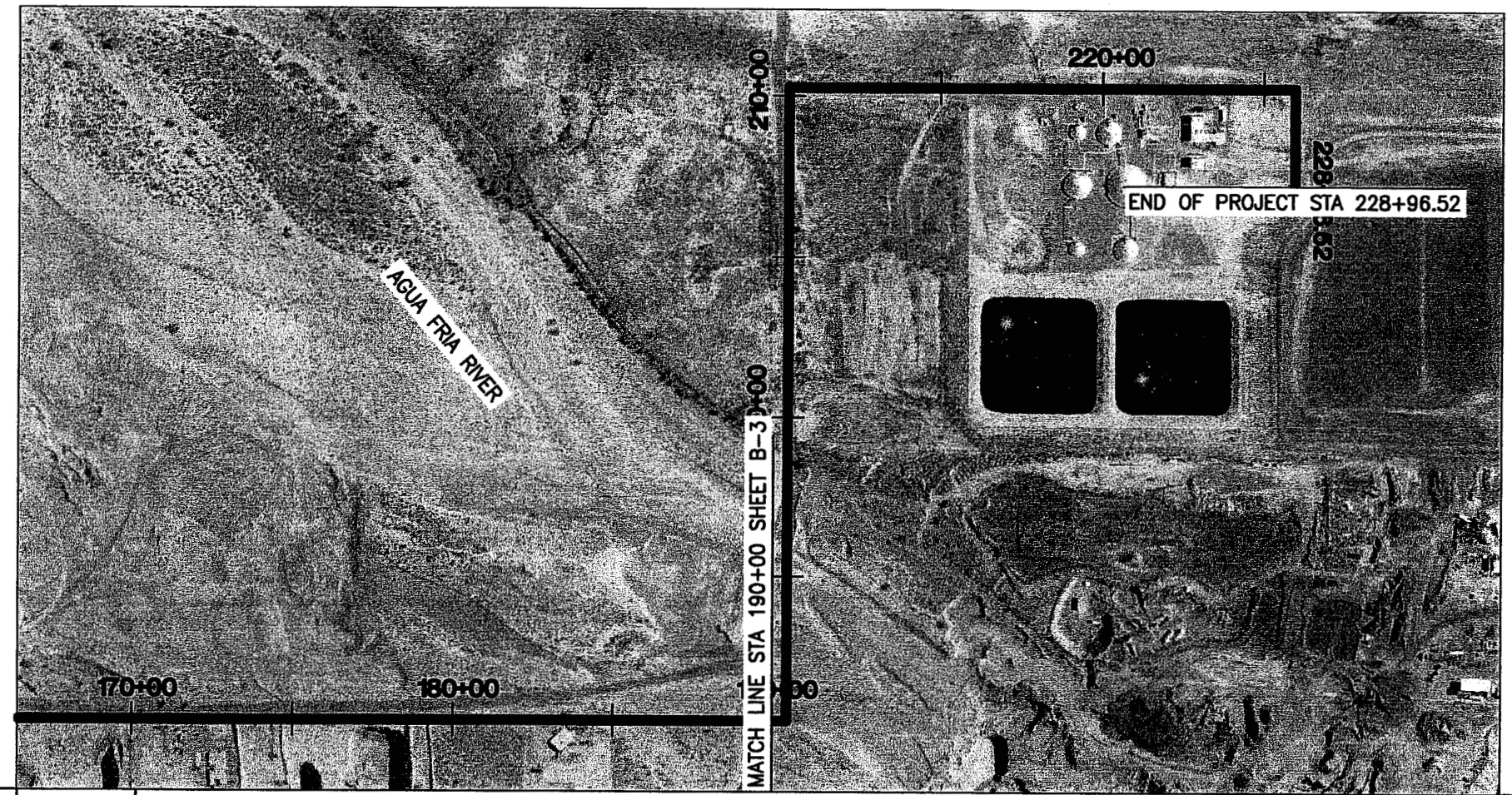

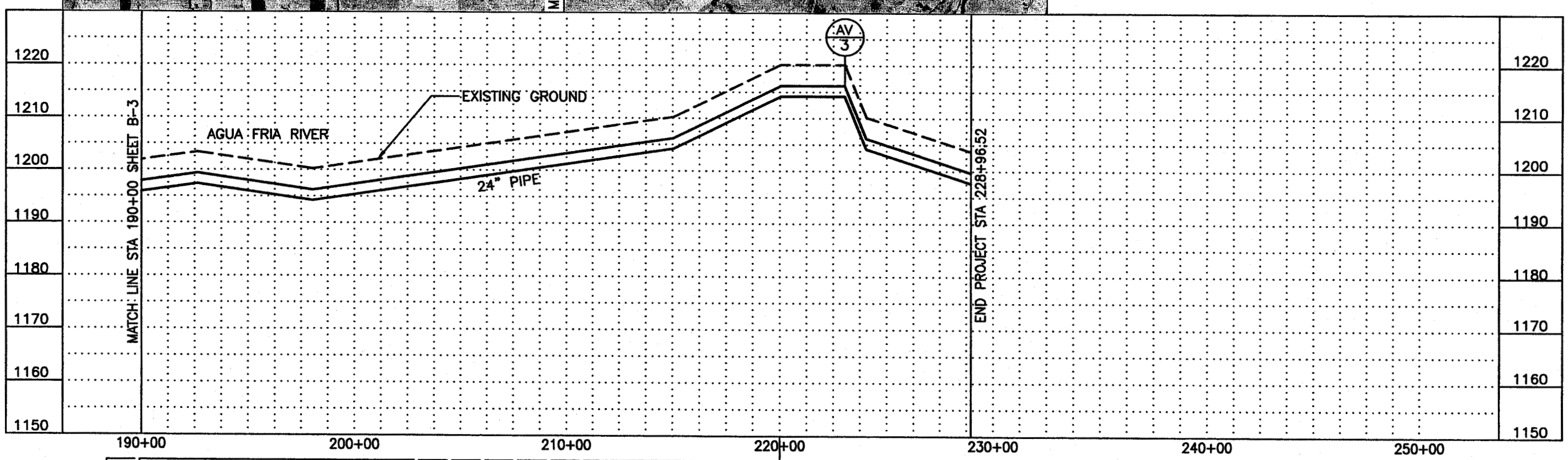

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Revision No.	Description	Date	Drawn	Chkd.	Dsgn. Engr.	Proj. Engr.

Project Manager
Architect | Elec
Civil | Mechanical
Structural | Structural
Finance | Drawn By

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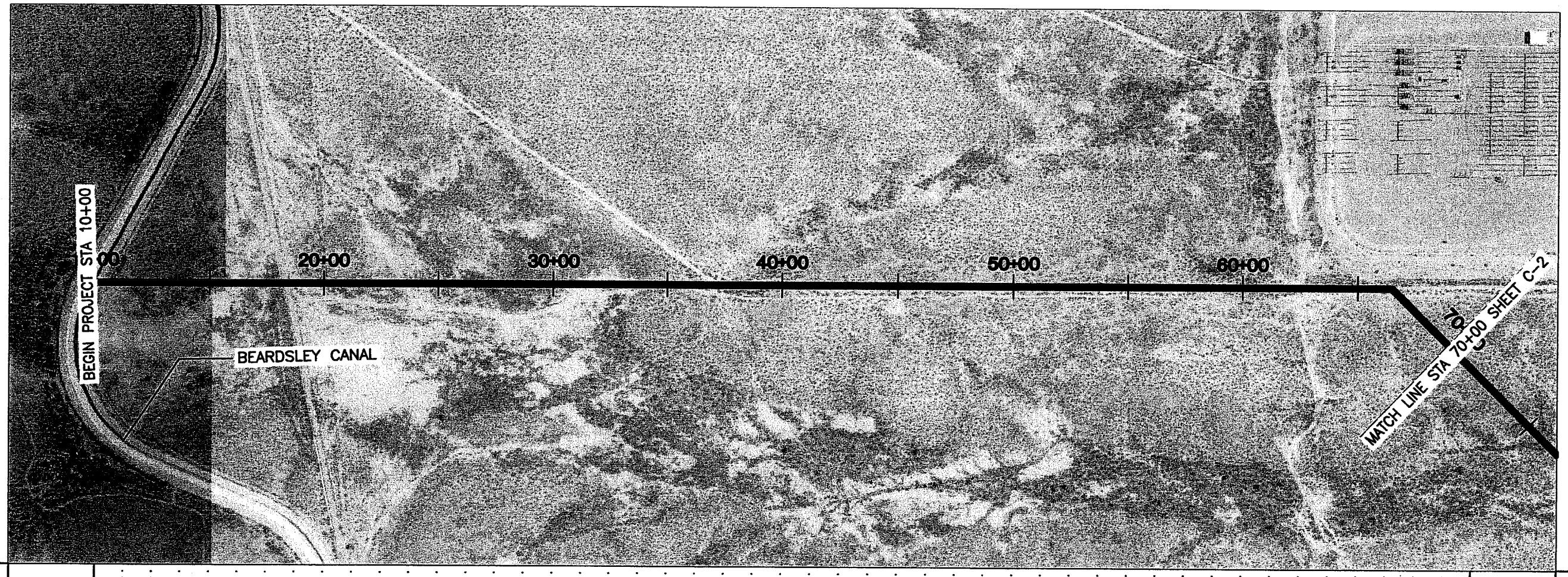
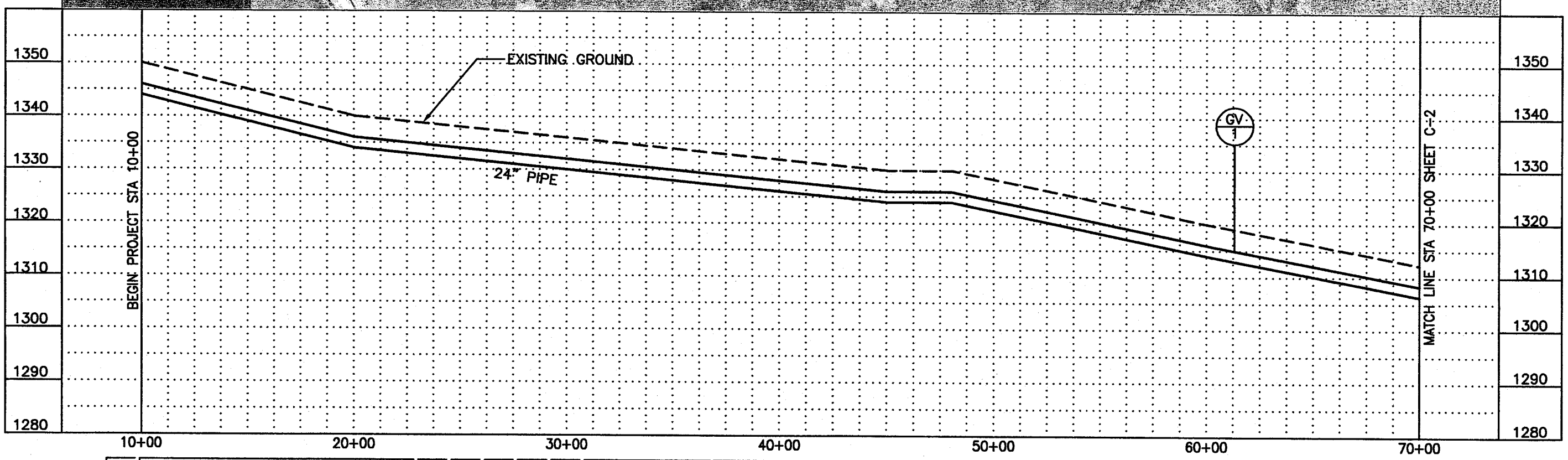
Drawing No. SHEET B-4
Issue





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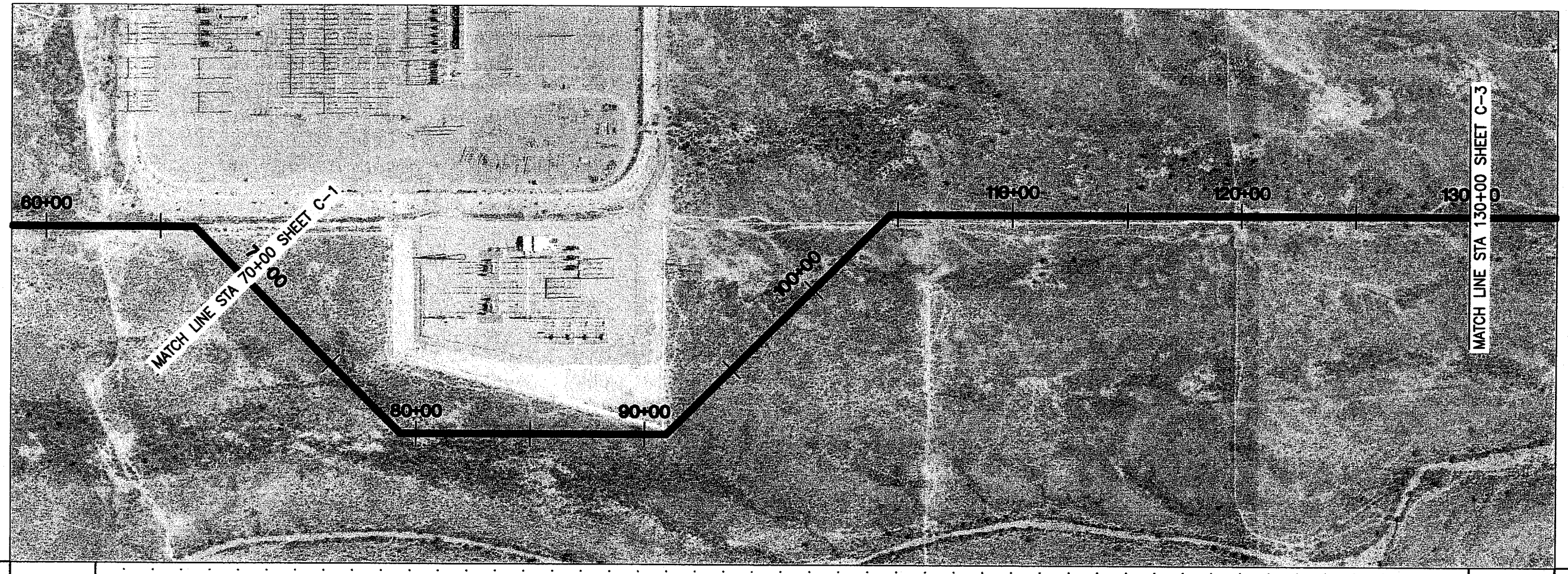

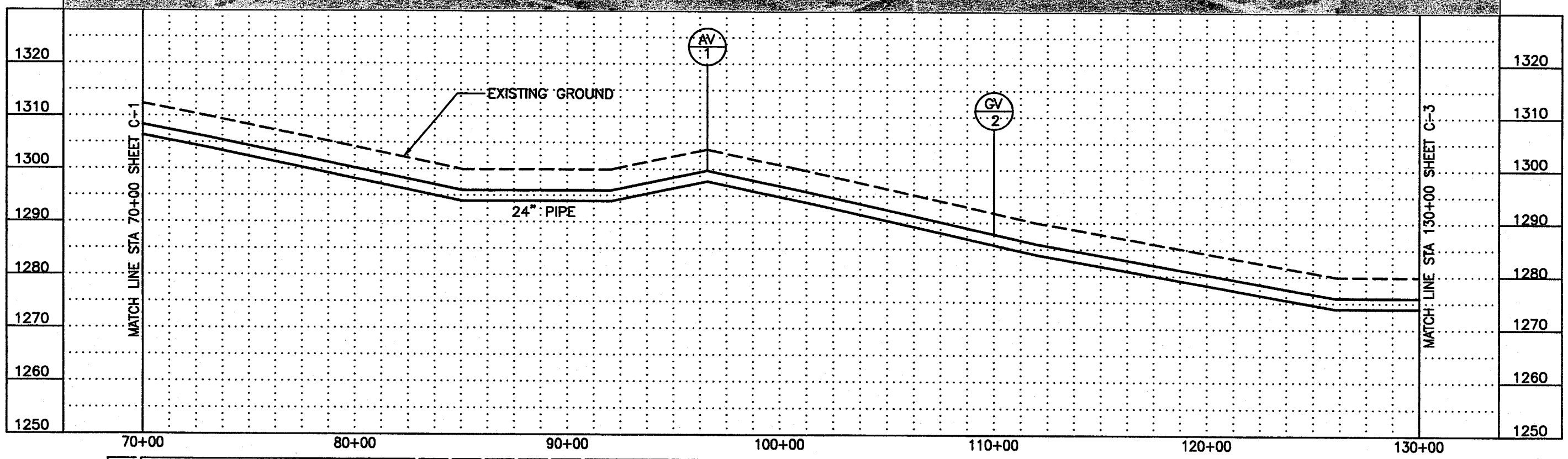

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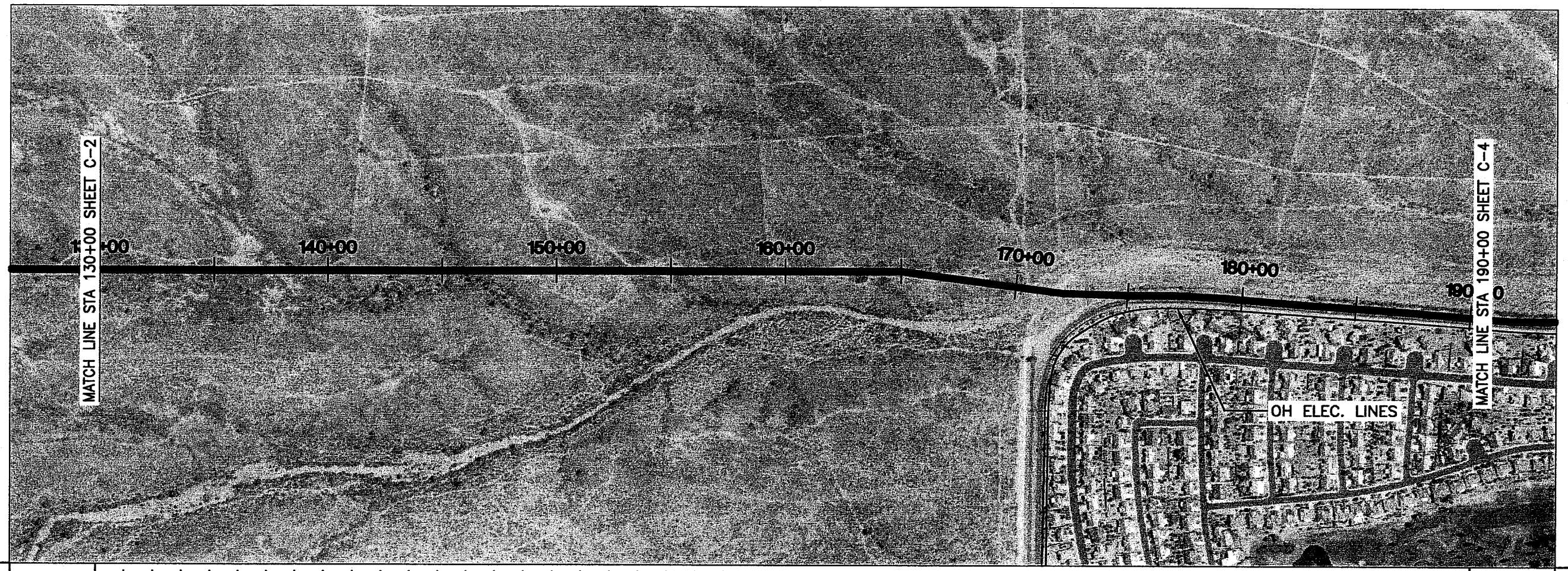

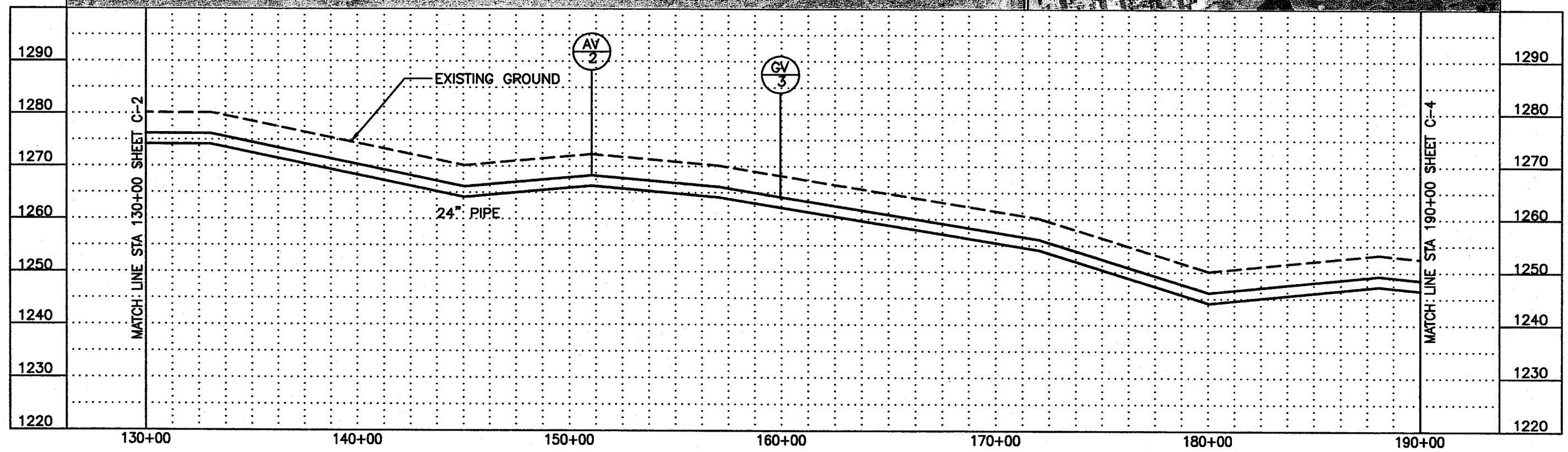

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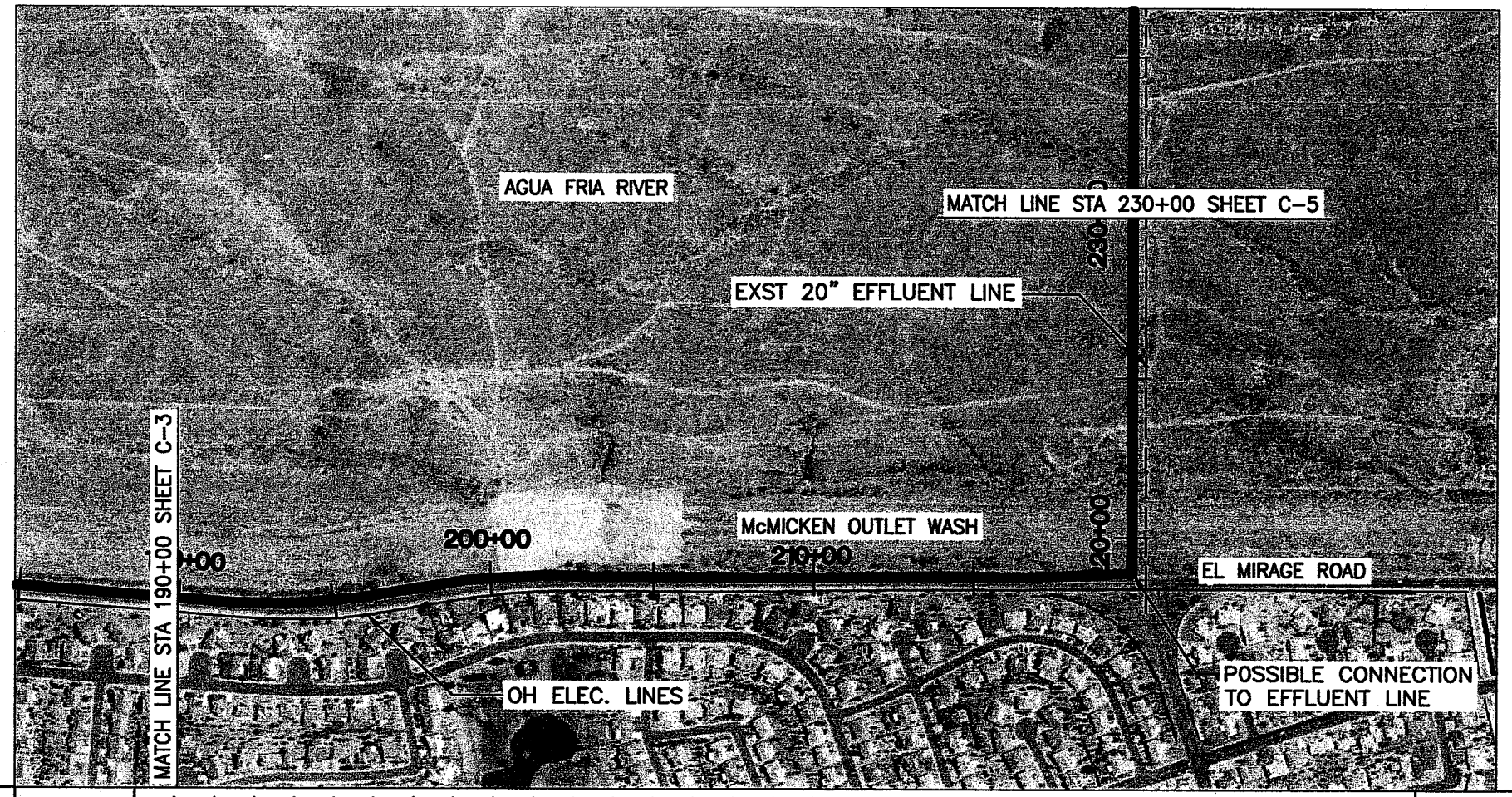

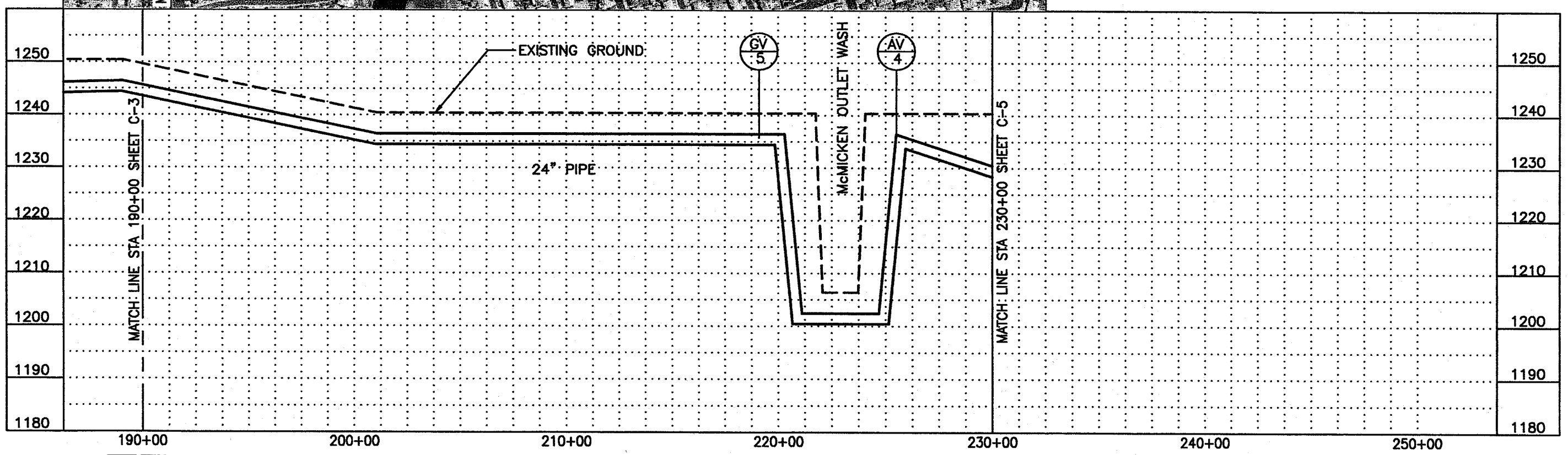

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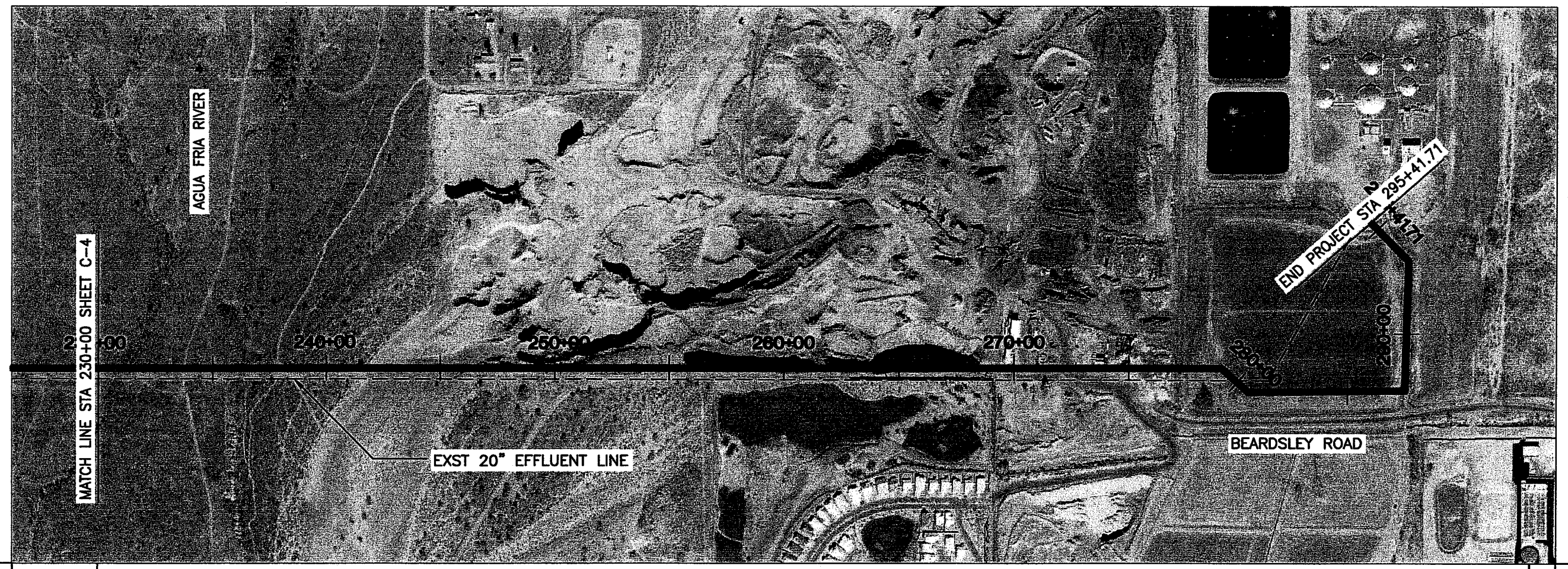

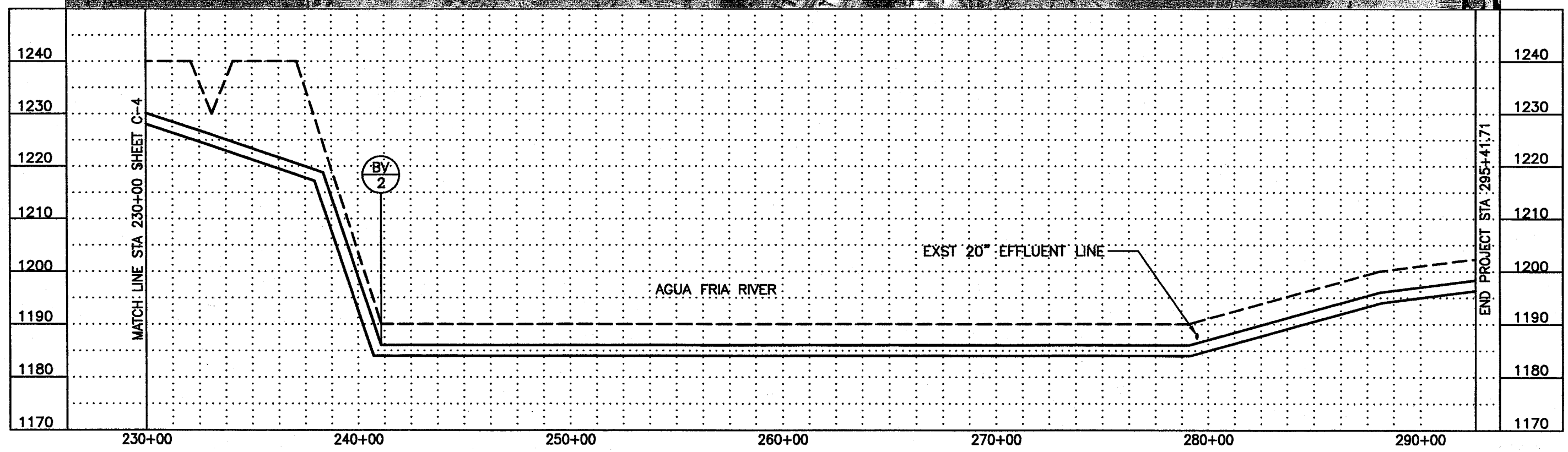

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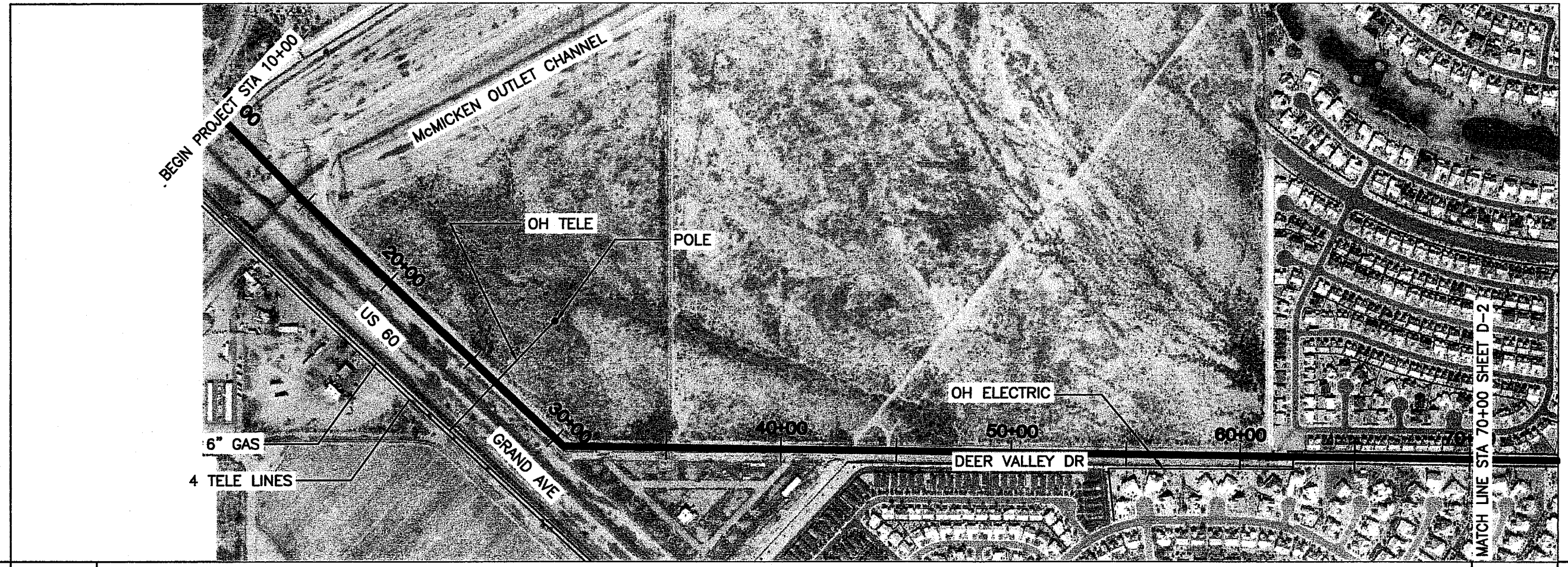

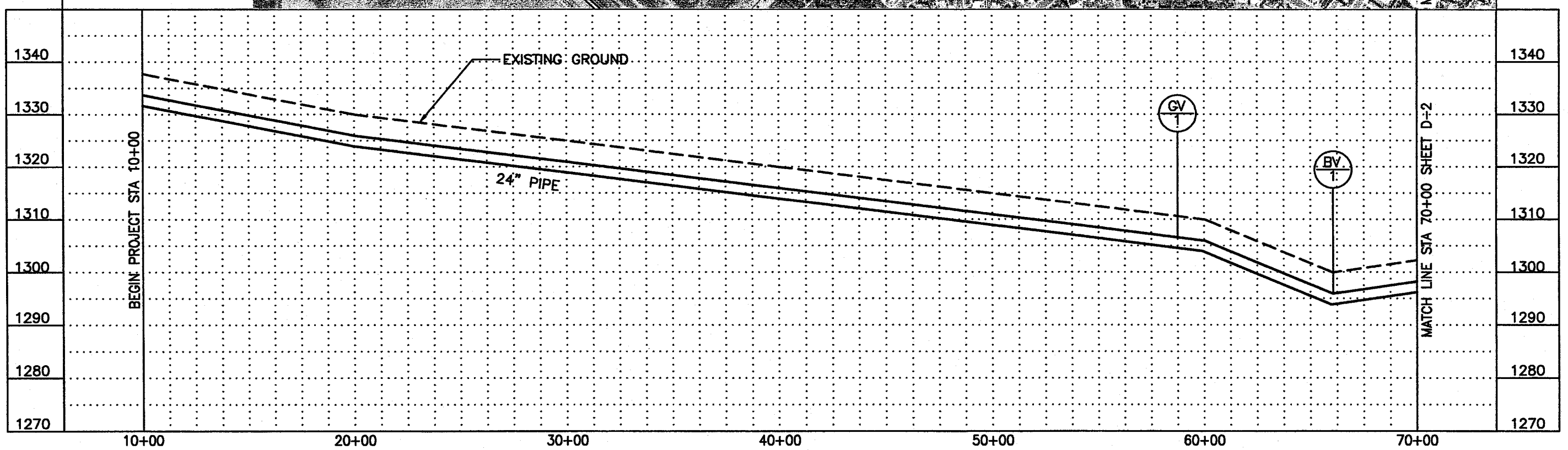

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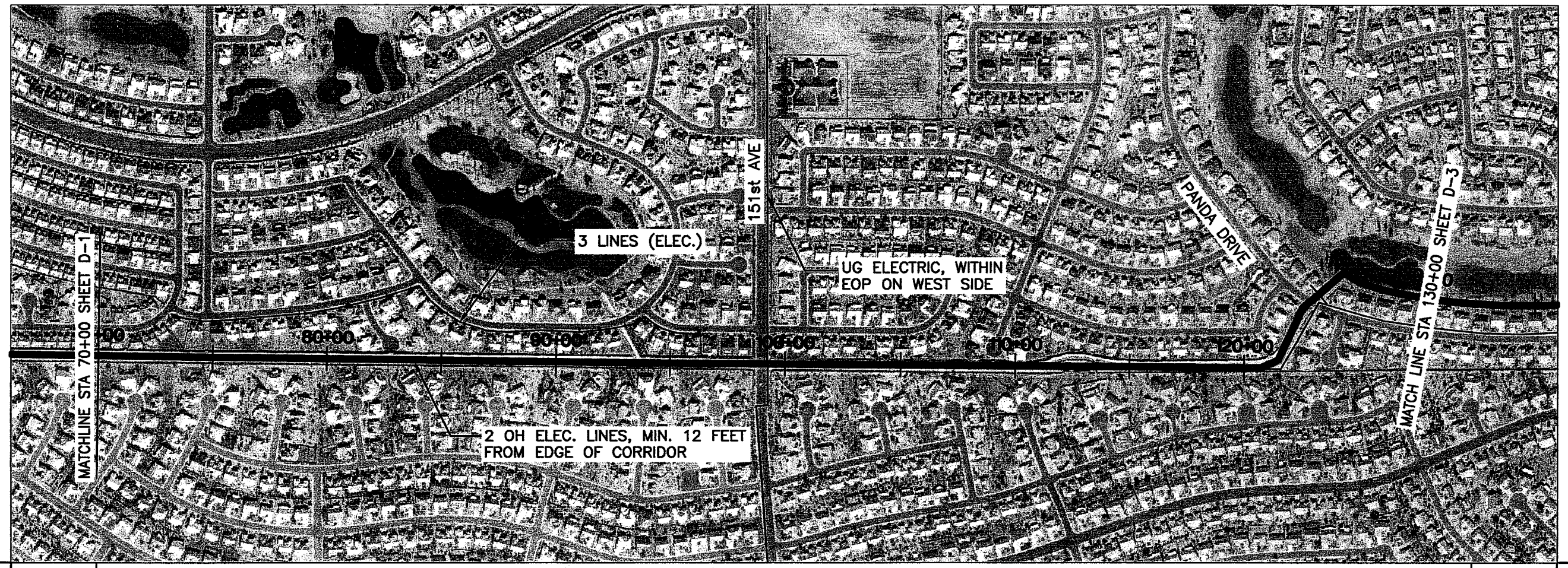
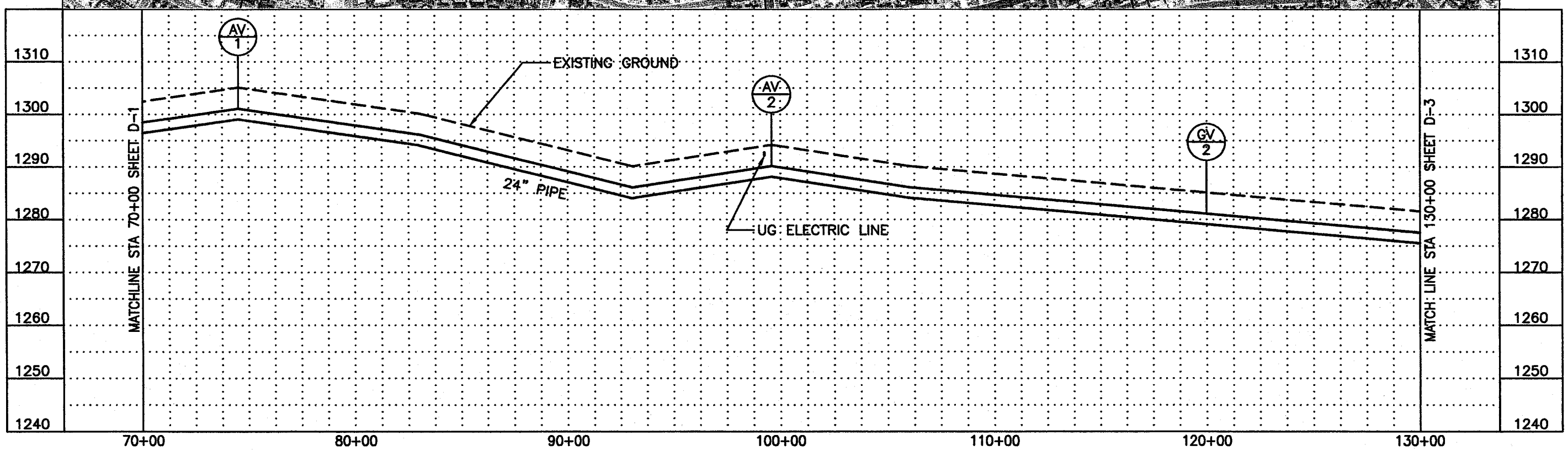
1"=500'

SHEET D-1





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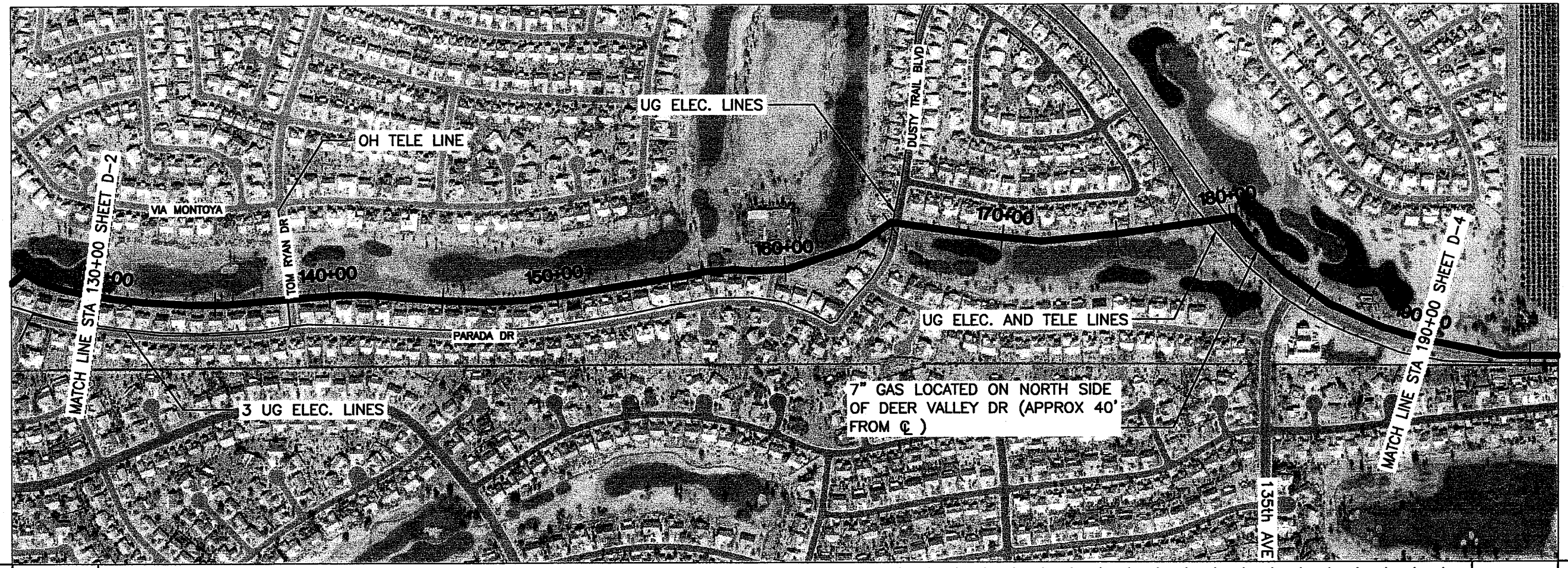
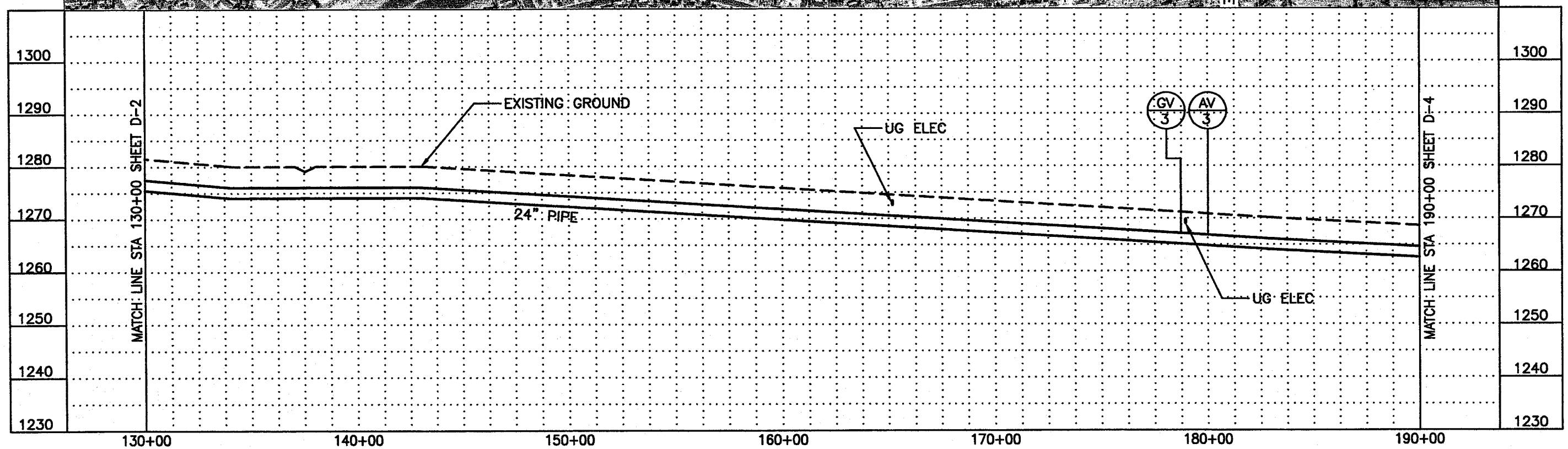
1"=500'

SHEET D-2





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1"=500'

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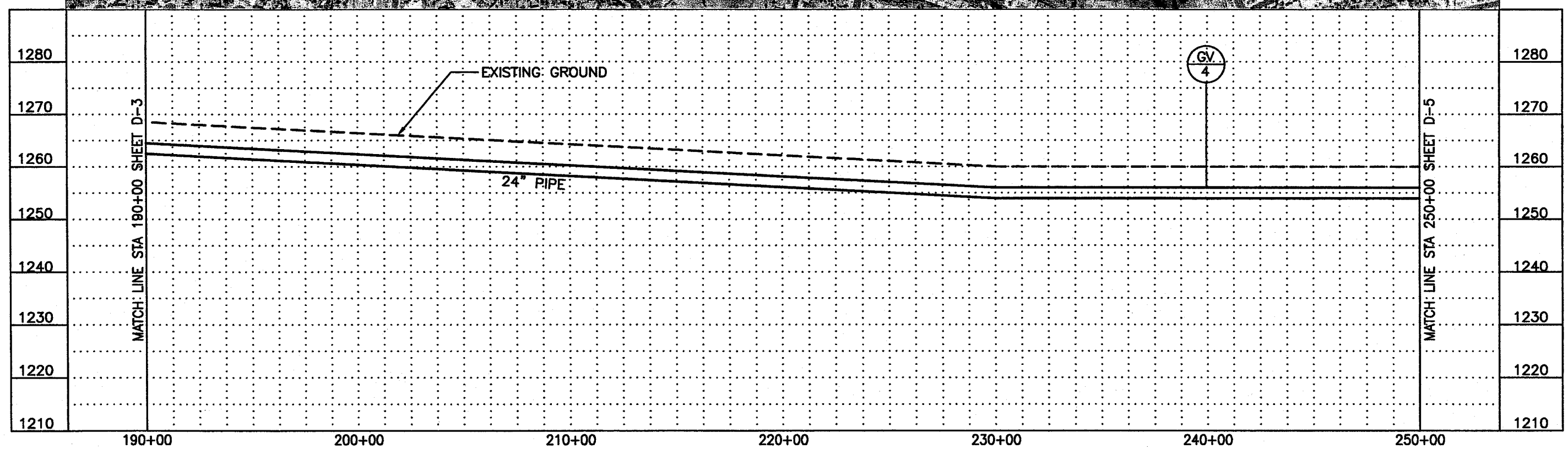

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1"=500'

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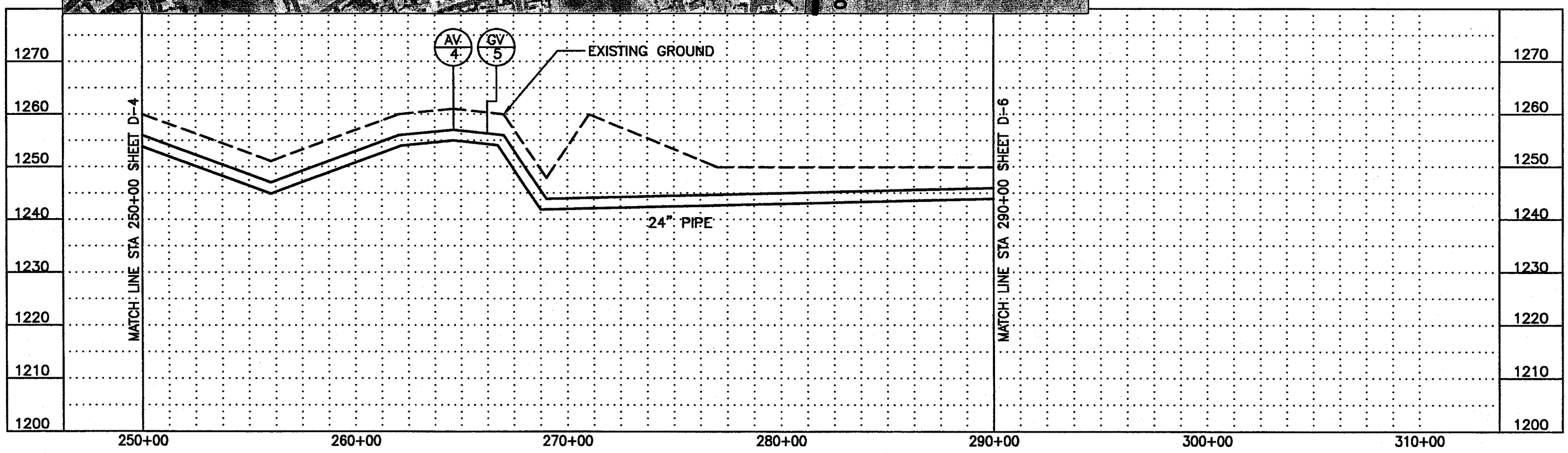

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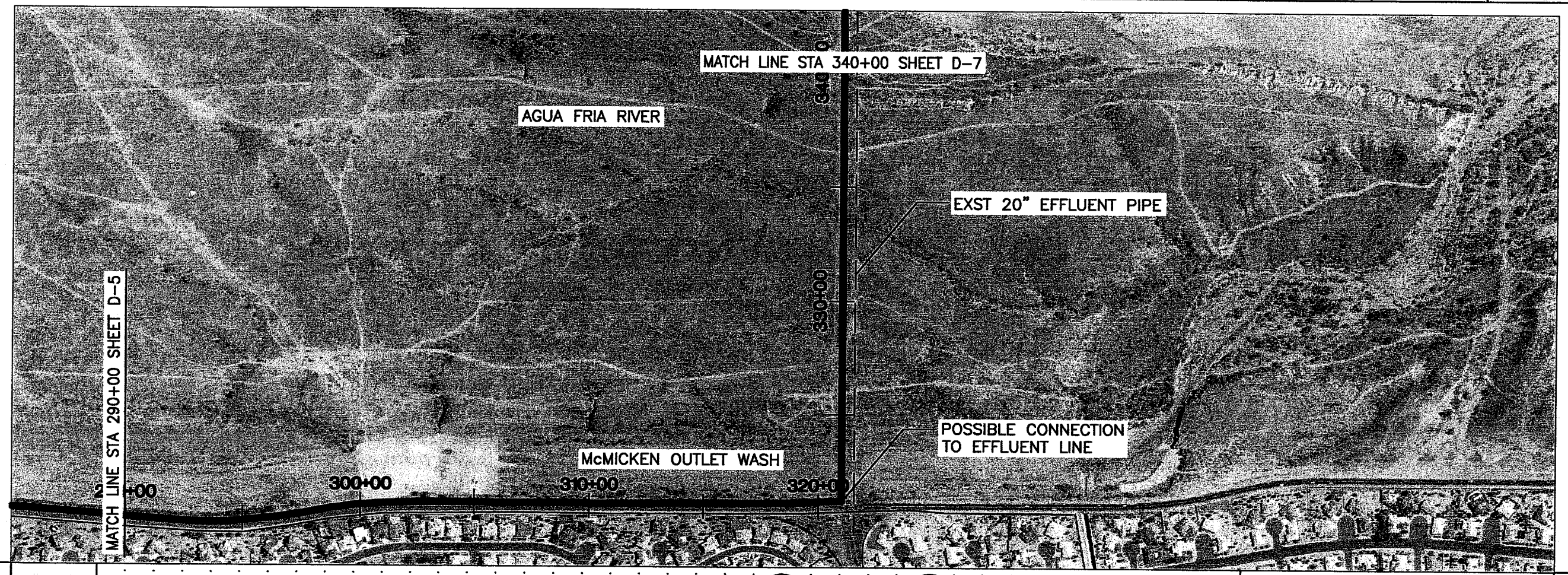

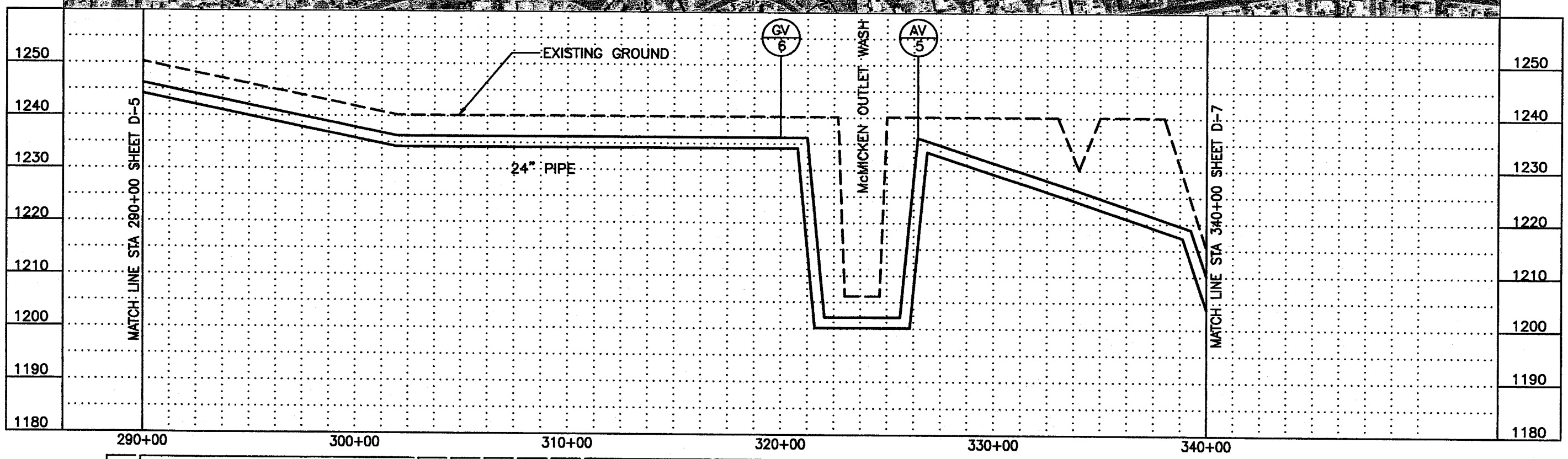

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Scale 1"=500'

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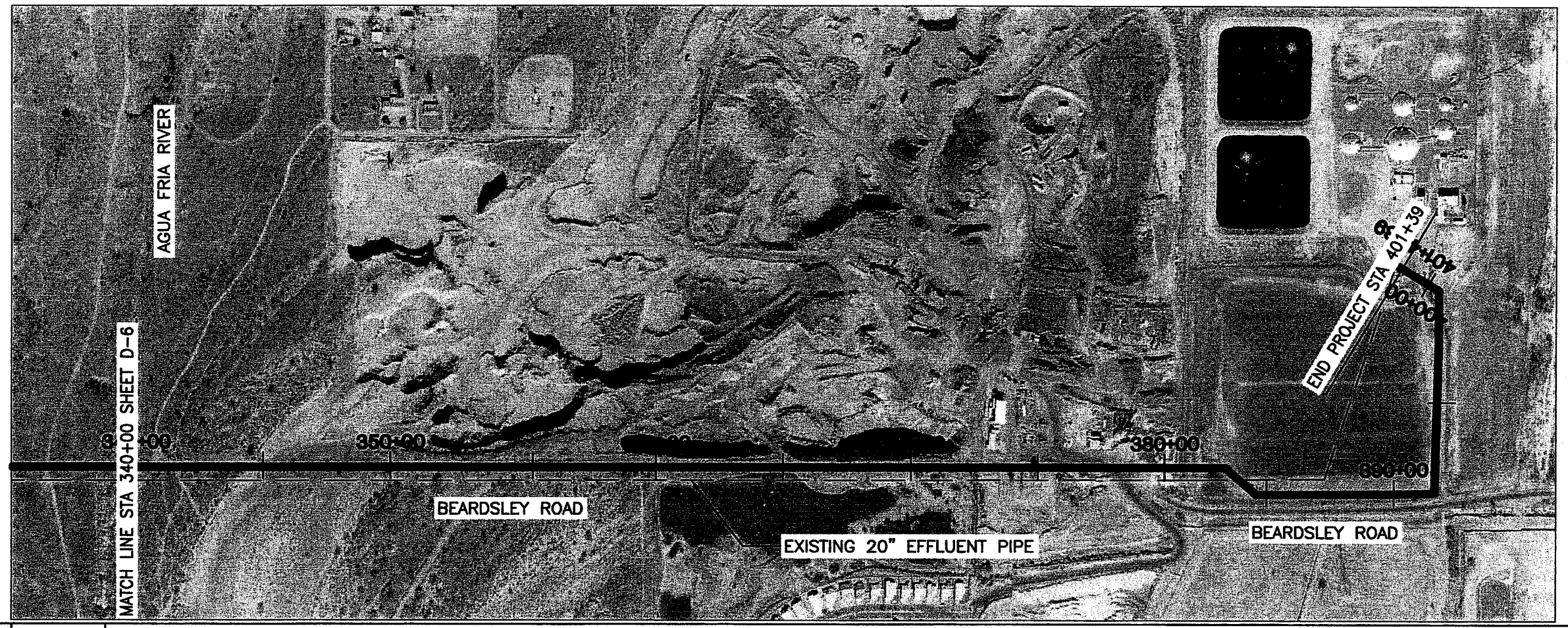

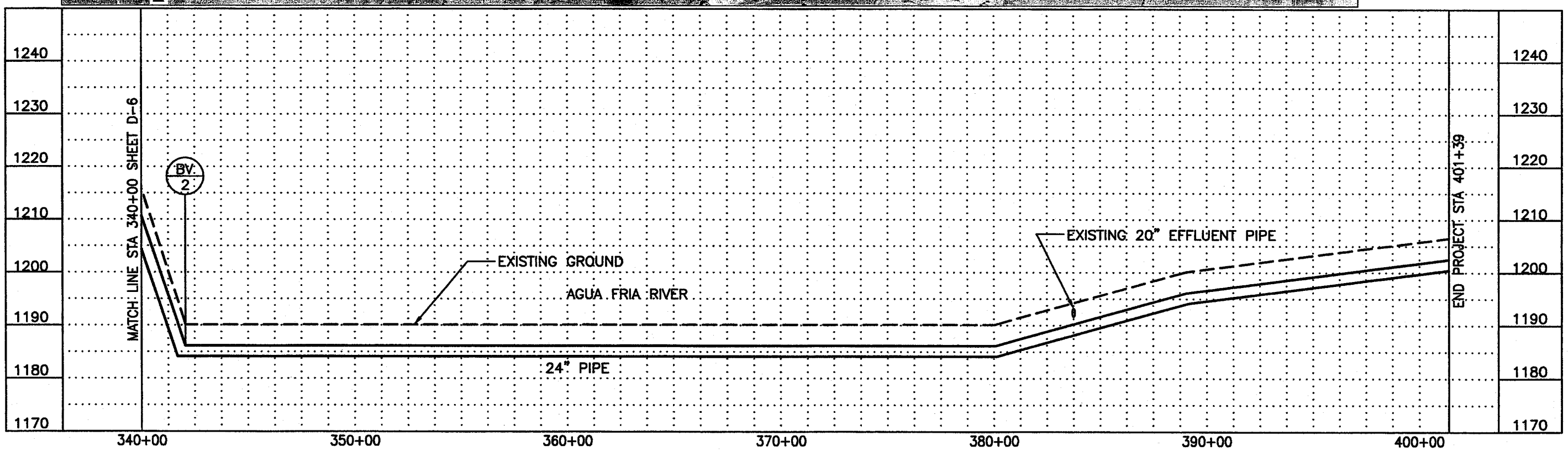

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NOT FOR CONSTRUCTION

1"=500'

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Summary Evaluation of Alternate Routes

This section summarizes the advantages and of each CAP transmission pipeline Alternative Route.

The criteria put forth includes the cost, hydraulics, operations of CAP or MWD, community disruption during construction, easements/ROW, gravity/pump station, environmental issues, utility coordination, and ownership consideration.

Alternative Route A
Advantages
- Lowest overall cost of the routes studied.
- Uses existing turnout on the CAP Canal.
- Gravity flow provides sufficient pressure to deliver water to each golf course connected to the distribution systems in Sun City and Sun City West.
- Direct source connection to CAP Canal minimizes agency coordination.
- No annual canal dry-up period to disrupt water supply.
- Minimal Sun City and Sun City West community disruption.
- City of Peoria majority control of ROW simplifies requirements for utility coordination and access across existing utility line easements.
- No ephemeral stream or rivers crossed.
- CAP will own, operate and maintain the turnout facilities and equipment within CAP right-of-way.

Disadvantages
- CAP may require environmental study update prior to project construction.
- Cultural survey is recommended due to existence of several known sites along alignment.
- Some calcareous cementation will require heavy or specialized equipment for excavation of soils in the upper portions of the alignment.
- Several utilities to cross, including El Paso Natural Gas lines.
- High right-of-way costs if City of Peoria is not successful in obtaining the Lake Pleasant Road right-of-way.

Alternative Route B

Advantages
- Shorter length of pipeline than other Alternative Routes.
- Utility conflicts minimal or non-existent.
- Minimal cultural sites expected along Route B.
- No excessively heavy equipment required for excavation.
- MWD will own, operate and maintain the turnout facilities and equipment within MWD right-of-way.

Disadvantages
- More costly than Alternate A.
- Construction of new turnout required.
- Booster pump station required to achieve sufficient pressure for deliveries.
- Beardsley Canal requires 4-month annual dry-up period. This may eliminate Alternative B as an option if a dry-up period cannot be avoided.
- Turnout directly from MWD canal adds intermediate layer of coordination between GSP and CAP.
- Requires Wheeling Agreement with MWD.
- Canal water transmission losses.
- Requires construction of check structure in Beardsley Canal.
- Requires the importation of APS power to the site for a distance of approximately one mile.
- Requires a new crossing of Agua Fria River for Sun City distribution system.
- Requires the appraisal and acquisition of 46 parcels for right-of-way.

Alternative Route C

Advantages
- Utility conflicts minimal or non-existent.
- Minimal cultural sites expected along alignment.
- MWD will own, operate and maintain the turnout facilities and equipment within MWD right-of-way.

Disadvantages
- More costly than either Alternate A or B.
- Construction of new turnout required.
- Booster pump station required to achieve sufficient pressure for deliveries.
- Requires Wheeling Agreement with MWD.
- Beardsley Canal requires 4-month annual dry-up period. This may eliminate Alternative C as an option if a dry-up period cannot be avoided.
- Necessitates canal transmission losses.
- Turnout directly from MWD canal adds intermediate layer of coordination between GSP and CAP.
- Requires construction of check structure in Beardsley Canal.
- Requires the importation of APS power to the site for a distance of approximately two miles.
- New crossing of Agua Fria River.
- Some calcareous cementation will require heavy or specialized equipment for excavation of soils in the upper portions of the alignment.

Alternative Route D

Advantages
- Uses existing turnout on the Beardsley Canal.
- Minimal cultural sites expected along alignment.
- MWD will own, operate and maintain the turnout facilities and equipment within MWD right-of-way.
- Uses mostly public right-of-way.

Disadvantages
- Most costly of the Alternative Routes.
- Booster pump station required to achieve sufficient pressure for deliveries.
- Beardsley Canal requires 4-month annual dry-up period. This may eliminate Alternative D as an option if a dry-up period cannot be avoided.
- Requires Wheeling Agreement with MWD.
- Canal water transmission losses.
- Turnout directly from MWD canal adds intermediate layer of coordination between GSP and CAP.
- Requires construction of check structure in Beardsley Canal.
- Requires new delivery of APS power service to the site.
- New crossing of Agua Fria River.

Alternative Route E

This alternative has been found to be not feasible for two major reasons:

1. Hydraulic modeling has indicated that conveying water from the Beardsley Canal to the westernmost end of the existing effluent delivery system in Sun City West would not produce sufficient pressure for water deliveries without a booster pump station. A booster pump station however, would likely cause pipe failure in the existing effluent system if the system were subjected to required pressure levels. This alternative requires connecting the trunk line to relatively small diameter pipes that cannot convey the amount of water required at reasonable operating pressures. Nearly a complete reconstruction of the entire system would be required to make this option work.

2. Furthermore, the Recreation Centers of Sun City West, Inc. which owns and operates the existing delivery system declined to allow reverse flow through the existing crossing of the Agua Fria River. This is because it may be necessary to utilize the pipeline in the future to convey wastewater treatment plant effluent as the system was designed.

Pipeline Corridor – Summary of Issues

CONCEPT	ALTERNATIVE	MAJOR COST	COMMUNITY DISRUPTION	RIGHT-OF-WAY	RIVER CROSSING ISSUES	GRAVITY FLOW	OWNERSHIP
Take delivery of CAP allotments directly from CAP facility (Hayden-Rhodes Aqueduct).	A) Pipeline from an existing, unused turnout on the CAP Canal, directly south along the edge of Lake Pleasant Road, south to Rose Garden Lane, then into Sun City.	• ± 9.25 miles of new pipeline • Some difficult excavation	• Disrupt ± 1900 feet along Rose Garden Lane.	• Route would follow within R/W of Lake Pleasant Parkway (if Peoria obtains from ASLD) • Possible temporary construction easements will be required	• Makes use of existing SCW Recreation Center river crossing to distribute flow to golf courses.	• Flow in transmission or trunk pipeline will be by gravity • Makes maximum use of available head (eliminates need for pumping options)	• CAP will own, operate and maintain the turnout (no cost to CWR) • CWR will own, operate and maintain the pipeline
Take delivery of CAP allotment from the Beardsley Canal (MWD) north of SC and SCW. Take advantage of the existing canal conveyance system.* ***Alternatives B and C would have to be increased in size if 4 month annual dry-up is not eliminated.**	B) Pipeline from a new turnout on the Beardsley Canal, directly south along the 115th Avenue alignment.	• ± 3.75 miles of new pipeline • "Water wheeling" costs with MWD • New turnout construction • New canal control check structure	• Minimal Community Disruption along private property owners along 115th Avenue	• New right-of-way must be acquired	• Requires new crossing of the Agua Fria River	• Flow in pipeline is by gravity • Pumping will be required for distribution to golf courses in SC and SCW.	• MWD will own, operate and maintain the turnout (no cost to CWR) • CWR will own, operate and maintain the pipeline
	C) Pipeline from a new turnout on the Beardsley Canal, directly south along the El Mirage Road alignment.	• ± 3.8 miles of new pipeline • "Water wheeling" costs with MWD • New turnout construction • New canal control check structure	• Minimal Community Disruption along Deer Valley and El Mirage Roads.	• New right-of-way would need to be acquired	• Requires new crossing of the Agua Fria River	• Flow in pipeline is by gravity • Pumping will be required for distribution to golf courses in SC and SCW.	• MWD will own, operate and maintain the turnout (no cost to CWR) • CWR will own, operate and maintain the pipeline
Take delivery of CAP allotment from the Beardsley Canal (MWD) west of SCW. ** **** Alternative D would have to be increased in size if annual 4 month dry-up is not eliminated.** **Alternative E is unworkable due to hydraulic and ownership considerations**	D) Pipeline from an existing turnout on the Beardsley Canal, near Grand Avenue. New pipeline would route east, generally along Deer Valley Road alignment, through existing development in SCW.	• ± 7.2 miles of new pipeline • "Water wheeling" costs with MWD • No turnout construction	• Moderate disruption through SCW including areas the Deer Valley GC, Deer Valley Rd., and El Mirage Road under pavement, landscape, and drainageways.	• New right-of way would need to be acquired for portions of the pipeline, although significant portions could be built in existing drainage easement areas.	• Requires new crossing of the Agua Fria River	• Flow in pipeline is by gravity • Pumping will be required for distribution to golf courses in SC and SCW.	• MWD will own, operate and maintain the turnout (no cost to CWR) • CWR will own, operate and maintain the pipeline
	E) Pipeline from an existing turnout on the Beardsley Canal, near Grand Avenue. Connect as soon as possible to the existing SCW effluent delivery system.	• Unworkable – Would require reconstruction of the entire existing SCW distribution system.			• Requires new crossing of the Agua Fria River. (Rec. Centers declined use of the crossing in favor of their future planned use.)	• Would require extensive re-construction of existing SCW effluent system. • Pumping will be required for distribution to golf courses in SC and SCW.	• SCW Recreation Center owns the effluent delivery system.

3 Pumping Systems

Alternate CAP trunk pipelines other than Alternative A will require a booster pump station to achieve the level of service required to deliver CAP allocation water to the Sun City and Sun City West participating golf courses. A pressure of approximately 70 psi is the pressure required at the CWR water campus location in order to distribute irrigation water to the most distant golf courses.

A concept design for the proposed booster pump station is based on a horizontal split case pump design with the suction and discharge headers on the 24-inch water mains buried below grade. The booster pumps would boost pressure about 20 to 25 PSI from about 50 to 75 psi. The required firm pumping capacity of the booster pump station is 15 cfs (or 6800 gpm). Three 3400 gpm, 75 Hp pumps are proposed for the booster pump station with the third pump serving as standby. The booster pumps would be controlled to turn on when pressure falls below a preset pressure of 55 psi and turn off when pressure reaches 75 psi. It is anticipated that the summer demands and the seasonal new growth of winter turf in the fall will require two of the 3400 gpm pumps to run continuously 24 hours a day to meet demand for about significant portion of the year. Winter demands are anticipated to require only one 3400 gpm pump to run almost continuously for the remainder of the year. The layout for the proposed booster pump station is shown in **Figure D.2**.

The opinion of probable capital costs and Present Worth O&M / Salvage costs for a 50 year life for the proposed booster pump station are shown below.

Booster Pump Station
Opinion of Probable Life Cycle Costs

Item Description	Unit	Quantity	Unit Price	Amount
Concrete Base Slab & Excavation	C.Y.	30	$350	$10,500
Pumps 3400 GPM, 75 hp	EA.	3	$36,400	$109,200
Electrical and Control Equipment	L.S.	1	$38,000	$38,000
Electrical Feed	L.S.	1	$9,000	$9,000
10" Pump Control Valves	EA.	3	$4,390	$13,170
10" Cushioned Check Valves	EA.	3	$6,990	$20,970
16" Gate Valve	EA.	3	$6,580	$19,740
14" Gate Valve	EA.	3	$3,800	$11,400
2" Air Release Valves	EA.	3	$650	$1,950
Miscellaneous Piping	L.S.	1	$34,400	$34,400
Site Grading & 2" D.G.	S.Y.	990	$7	$6,930
8' High Block Wall	L.F.	372	$50	$18,600
20' Sliding Gate	L.S.	1	$1,800	$1,800
Property Costs	S.F	12000	$1	$12,000
			Total Capital Cost	**$307,660**

O&M Life Cycle Costs	Annual Cost	Present Worth
Power Costs @ $0.07/kwh	$45,745	$749,102
O&M Labor Costs @ 0.5 hrs/day for $30,000/yr salary	$1,875	$30,704
O&M Costs @ 1% of Structure & 2.5% of Equipment/ Year	$4,367	$71,513
Salvage Value of Structure	-	($1,906)
	Total O&M Life Cycle Cost	**$849,413**
	Total Life Cycle Cost	**$1,157,073**

Note: Power Costs were computed by assuming 2 pumps run continuously 3/4 of the year and 1 pump will run continuously the remaining 1/4 of the year.

The life cycle costs were determined using common cost elements applied to anticipated annualized costs. The annual costs were calculated by summing each annual cost element. These were then determined as a present worth value.

A differential interest rate of 5.73% was used for calculations. This rate was based on the weighted cost of capital at 8.73%, minus an inflation rate of 3%. The weighted cost of capital at 8.73% for Citizens Water Resources is based on Arizona Corporation Commission Decision 60172. The inflation rate of 3.0% is based on an assumed average inflation rate over past number of years.

4 Storage Systems

Storage is sometimes necessary in irrigation systems to allow the flexibility a system needs to make deliveries in an orderly manner.

Storage may be required in the irrigation system unconsideration to on of both of the following reasons:

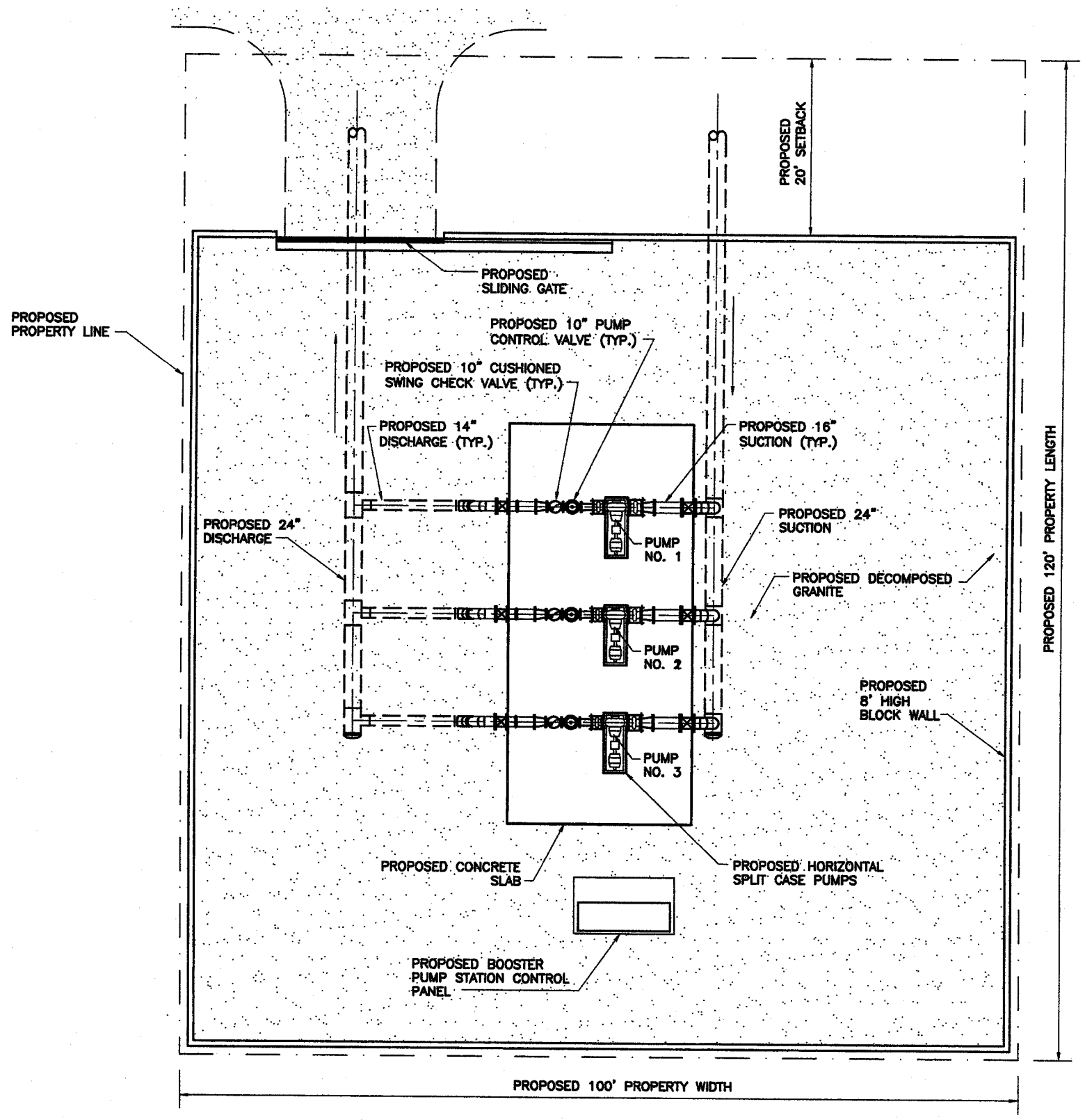
1. If the calculations indicate an economic advantage in delivering water from the Cap canal at a lower flow rate than the golf course demand and storing the water for use at high demand times thus lowering the trunk pipeline size.

2. If little or no storage existed in the individual golf course lakes thus making flow balancing into and out of the lakes difficult or impossible, alternate storage would be required. This is known as the "wide spot in the pipe principal."

Analysis of the distribution systems hydraulic models and of the participating golf courses for the Sun City and Sun City West indicate that all individual golf course lakes have adequate volume for flow balancing throughout the daily diurnal flow cycle.

CITIZENS water resources

SUN CITY / SUN CITY WEST/ YOUNGTOWN
GROUND WATER SAVINGS PROJECT



CONCEPT PLAN
SCALE: NTS

PROPOSED BOOSTER PUMP STATION

HDR

Figure D.2

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Furthermore, due to the need to convey flow on an essentially round-the-clock schedule, to meet the operational needs of the participating golf courses and to assure complete consumption of the annual CAP allotment, the opportunity to convey bulk flow in a small trunk main for storage and use at peak periods is not available.

To ensure the annual allocation can be completely consumed, a large capacity lake was identified in both systems act as a buffer should system operational problems arise or a golf course has problems and can not take water from the distribution system. In such a case the lakes identified would absorb the average daily allocation not consumed and utilize the stored water during high demand periods. Hillcrest Lake, the largest capacity lake in Sun City West, provides for the volumetric flexibility needed to account for daily fluctuations in system demands for Sun City West. In Sun City, Dawn Lake and Viewpoint Lake are identified for this purpose.

5 Treatment Systems

Transmission of CAP Water

Treatment of CAP water for transmission and for use as irrigation water is a much-studied issue. It is not as complicated as it may seem. Treatment for transmission is discussed in the following paragraphs. Treatment for use on golf courses is discussed later in this Section.

CAP water is surface water conveyed from the Colorado River via the Central Arizona Project Canal. This water is pumped from the river at Lake Havasu into the Hayden-Rhodes Aqueduct. Before it reaches the proposed CWR turnout at the Lake Pleasant Road the water passes through a total of four pumping plants, hundreds of miles of canal, and several miles of pipeline. Water is also added to the CAP canal system from Lake Pleasant via the Waddel Canal. Lake pleasant is filled with CAP water during portions of the year and contributes stored CAP water and impounded surface water from the Aqua Fria River system to the canal during other times of the year.

Sediment, algae, and pH are the major items of concern with the transmission of raw water. Each of these items could cause problems with the trunk pipeline. However, based on the experience in the area, and the information of water quality from the CAP, none of these items will be of concern to the ability of the pipeline to function as proposed.

Sediment - Generally CAP water has traveled great distances prior to reaching the proposed pipeline. The flow in the canal is at a velocity that will cause most sediment to settle out in the canal long before it approaches the CWR turnout. The velocity of flow in the pipeline during a large part of the year will be near 5 cfs. This velocity is more that sufficient to clean any sediment in the line that collects during lower flow periods. There have been instances of high sediment loads in the CAP canal due to unusually high surface runoff to Lake Pleasant. Should sediment loads in the canal become excessive, this project can be temporarily taken out of service (the golf courses would utilize wells) until the water quality reruns to normal.

Algae - Each pumping station along the CAP canal screens out any floating or suspended objects to prevent pump damage. The inlet to the turnout of this project will also have a trash rack to screen large floating or suspended objects from the flow prior to entering the pipe. The CAP will monitor the flow into the pipe and clean the grate as often as necessary. The CAP also has preventative measures for algae and other canal vegetation that prevents large amounts of growth. Because of the short amount of time water spends in the pipeline algae growth will be negligible. Algae growth is further hindered because light is not available in the pipe and because the amount of oxygen available within the pipe is limited.

pH - The problem pH poses to a pipeline is corrosion. The proposed pipeline material for this project is cement coated DIP and PVC plastic pipe. CAP water being very near neutral, poses little threat for corrosion. PVC Plastic pipe has no susceptibility to the pH of water in the acidic or basic range of CAP water.

Golf Course Application of CAP Water

The following paragraphs discuss the possible need to provide treatment of the CAP water prior to it being delivered to golf courses for turf irrigation. The use of untreated CAP water for golf course irrigation has been common practice in the Phoenix metropolitan area since the CAP Canal began delivering water. The best example of this has been the City of Scottsdale's Reclaimed Water Distribution System (RWDS). For approximately eight years, the RWDS has delivered untreated CAP water to 20 golf courses in the north Scottsdale area.

The RWDS system consists of a series of five major pump stations and pipelines (16- to 30-inch diameter) that take water from the CAP Canal and deliver it north along Pima Road approximately 13 miles. Various golf courses tie-in to the transmission main along its route for delivery of water to their irrigation reservoirs. The RWDS provides no treatment to the CAP water prior to being delivered to the golf courses. There is, however, an 8-million gallon (MG) storage pond at the RWDS main pump station. This pond was initially installed at the request of and payment by the golf courses for storage capacity in emergency situations (e.g. if pump stations are out of service). As it has been operating, the storage capacity function has not been necessary since the golf courses already have on-site storage and the RWDS pump stations have not been out of service for extended periods. The storage pond has, indirectly, provided some level of treatment to the CAP water, particularly during low demand months. In those months, water is retained in the storage pond long enough to allow some settlement of particulate matter. During high demand months when the RWDS is delivering 20 MGD, the 8-MG pond is essentially a flow-through pond and little settlement occurs. In that case, the golf courses are receiving approximately the same quality water that is taken directly from the CAP Canal.

Initially, strainers were installed at the RWDS pump station nearest the CAP Canal. The strainers were installed to remove algae and other particles not removed by the bar screen at the CAP turnout. The City experienced severe operational difficulties with the strainers due to excessive clogging. The strainers were taken out of service shortly after commissioning and the RWDS has been delivering the untreated CAP water for essentially the eight years it has been in operation.

With the completion of the CWR's Water Campus, which is an advanced wastewater treatment plant, the RWDS is now beginning to deliver treated effluent to the golf courses. Depending on the time of year and subsequent demand, the treated effluent will supplement or take the place of the CAP water.

As part of this project, seven of the golf courses using CAP water delivered in the RWDS were contacted to discuss their experience. All of seven courses reported neutral to favorable experience in using the untreated CAP water.

Some of the golf courses which utilize CAP water for at least a portion of their irrigation needs as of 1998 are: (Source ADWR)

- Red Mountain Ranch,
- Raven,
- TPC,
- Viewpoint RV and Golf Resort,
- Gold Canyon Golf Resort,
- 500 Club,
- Apache Sun,

- Rancho Manana,
- Johnson Ranch Golf Club,
- Happy Trails,
- Sunland Village,
- Traditions, and
- Fiesta Lakes.

It is also worth noting that most golf courses in the SRP service area are using untreated SRP water for the irrigation of their courses. The source of water for SRP is the Salt and Verde Rivers, and the quality is similar to that conveyed in the CAP Canal. In fact, in many cases, SRP water has a higher occurrence of algae than the CAP Canal.

Based on the well-established historical successes of using untreated CAP water for golf course irrigation in the Phoenix metropolitan area, no treatment of the CAP water is recommended for this project.

6 Distribution Systems

Figure D.3 shows the existing effluent distribution system in Sun City West and the proposed irrigation water distribution system for Sun City. The Sun City West effluent system will be used to distribute CAP irrigation water.

The Cybernet modeling package by Hastead Methods Inc. was used to analyze the alternative trunk pipeline and distribution network. The program performs steady state analysis and extended time models, allowing for variation in delivery rates and times. The model is used to assist in sizing pipes, locating pumps, valves and other system devices, and determining the most efficient use of the CAP water. If necessary, it also analyzes pump and storage requirements and characteristics.

Sun City West Distribution System

The existing effluent distribution system in Sun City West conveys flow to the Recreation Center of Sun City West golf courses as well the country club courses. The system, originally constructed around 1981 is owned and operated by the Recreation Center of Sun City West, Inc. The pipe was sized to deliver 2 - 3.14 mgd (3.1 - 4.85 cfs) from the CWR Sun City West Water Campus. Pipe sizes ranging from 12" to 20" in diameter as well as locations, sizes and pipe material acquired from as-built plans and previous reports. The existing system is shown in dashed lines on **Figure D.4.** Golf Courses connected to the system in the Sun City West include:

- Briarwood Country Club,
- Echo Mesa Golf Course,
- Grandview Golf Course,
- Hillcrest Golf Club,
- Pebblebrook Golf Course,
- Stardust Golf Course, and
- Trail Ridge Golf Course.

Water is typically delivered to golf course lakes. Hillcrest Lake will provide volumetric flexibility to balance the daily system demands against system limits for all the courses in Sun City West. The table on the following page summarizes the Sun City West system characteristics.

Figure D.5 illustrates the ability of the system to deliver the entire CAP allotment for Sun City West according to the demands for each golf course and the optimization of the trunk line. From the monthly breakdowns of demand, the peak demand flow of July was used to simulate the maximum golf course demand for the computer simulations. The computer model allowed for the analysis of the distribution of allotted water. The model demonstrated that the existing system is adequate. With flows distributed throughout the year, the peak flow rate in the distribution system is very close to the design flow of the effluent system.

The peak flow to Sun City West is approximately 5.5 cfs. This represents the practical hydraulic limits of the existing piping system. Transmission of CAP water is via the Alternative A alignment for the model simulations. The table titled **Peak Day CAP Water Delivery Schedule** illustrates the simulated golf course demands for the Cybernet model.

Distribution System Alternatives – Significant Issues

System	System	Cost	Allotment Utilization	Impact On Pumping	Impact On Storage	Impact On Operations
Sun City West	• Distribute to Recreation Center Golf Courses and to Country Club Courses	• Cost regarding the existing effluent system would be for control system at delivery points.	• The entire SCW allotment is be used and distributed to both the Rec. Center Courses and the Country Club Courses.	• No major impact on system pumping requirements as the flow characteristics for the existing system remain the same, whether or not delivery is made to the Country Club Courses	• Hillcrest Lake in Sun City West provides the volumetric flexibility needed to account for daily fluctuations in system demands.	• Entire system is coordinated to deliver to each course according to its demands as closely as possible. During peak demands, well will still be utilized to keep lakes full.
Sun City / Youngtown	• Distribute to Recreation Center Golf Courses only	• Savings in distribution pipeline costs realized by not extending the system to serve the County Club Courses	• The entire SC allotment is used by distributing to the Rec. Center Courses only. • Delivery is both north and south of Grand Avenue.	• No major impact on system pumping requirements as the system was designed using the flow characteristics of the transmission pipeline.	• Dawn Lake and Viewpoint Lake in Sun City provides the volumetric flexibility needed to account for daily fluctuations in system demands.	• Entire system is coordinated to deliver to each course according to its demands as closely as possible. During peak demands, well will still be utilized to keep lakes full.

Peak Day CAP Water Delivery Schedule

Facility Annual Totals

Time Distribution

Sun City Rec Center Courses	July Peak Daily Usage ac-ft/day	% of Demand	Hours of Delivery	Peak Demand ft^3/day per Hour of Delivery	Peak Demand cfs per Hour of Delivery	Priority	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Calculated Total	Ac-ft/day
Lakes East	3.56	0.75	16	7252	2.01	Low – overflow	0.00	0.00	0.00	1.70	1.36	1.46	0.00	0.00	1.25	2.42	2.42	2.42	1.58	1.68	1.52	1.78	1.69	2.53	2.63	1.63	2.76	0.43	0.43	0.54	32.23	2.66
Lakes West	5.17	0.61	16	8604	2.39	Low	1.89	2.80	2.37	2.42	0.00	0.00	2.20	2.36	2.42	2.42	2.42	2.42	2.42	2.42	2.42	0.00	2.42	2.42	0.00	0.00	0.00	0.00	0.00	2.42	38.24	3.16
North GC	3.73	0.67	12	9087	2.52	Med	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	0.00	0.00	2.33	0.00	0.00	2.33	2.33	2.33	30.29	2.50
Quail Run GC	1.38	0.62	14	2664	0.74	Low	0.00	0.74	0.00	0.74	0.00	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	10.36	0.86
Riverview GC (West)	1.34	0.62	12	3024	0.84	Mid	0.00	0.84	0.84	0.84	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.84	0.84	0.00	0.00	0.84	0.84	0.84	0.84	0.84	10.08	0.83
Riverview GC (East)	1.34	0.62	10	3636	1.01	High	0.00	0.00	0.00	0.00	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.10	0.83
South GC (West)	2.45	0.62	14	4716	1.31	Med-Low	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.31	1.31	1.31	1.31	1.31	1.31	18.34	1.52
South GC (East)	2.46	0.62	14	4752	1.32	Med-Low	1.32	1.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.32	1.32	1.32	1.32	1.32	0.00	1.32	1.32	1.32	0.00	0.00	1.32	1.32	1.32	1.32	18.48	1.53
Willowcreek	3.98	0.62	12	8964	2.49	Med	2.49	0.00	2.49	2.49	2.49	2.49	2.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.49	2.49	2.49	2.49	2.49	2.49	0.00	0.00	0.00	0.00	29.88	2.47
Willowbrook	3.98	0.62	12	8964	2.49	Med	2.49	2.49	2.49	0.00	2.49	2.49	2.49	2.49	2.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.49	2.49	2.49	2.49	0.00	29.88	2.47
Total							**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.46**	**9.46**	**9.46**	**9.50**		

Sun City West Rec Center Courses	July Peak Daily Usage ac-ft/day	% of CAP Demand	Hours of Delivery	Peak Demand ft^3/day per Hour of Delivery	Peak Demand cfs per Hour of Delivery	Priority	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Calculated Total	Ac-ft/day
Echo Mesa GC	3.55	0.43	14	4744	1.32	Med	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	0.00	18.45	1.52
Grandview GC	4.56	0.40	10	7956	2.21	High	2.21	2.21	2.21	2.21	2.21	2.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.21	2.21	2.21	2.21	22.10	1.83
Pebblebrook GC	4.13	0.40	10	7200	2.00	High	0.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	1.65
Stardust GC	2.57	0.40	12	3744	1.04	Med	0.00	0.00	0.00	0.00	0.00	0.00	1.04	1.04	1.04	0.00	0.00	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	0.00	0.00	0.00	0.00	12.48	1.03
Trail Ridge GC	3.23	0.40	14	4032	1.12	Low	1.12	1.12	1.12	1.12	0.00	0.00	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.12	15.68	1.30
Sun City West Private Clubs																																
Briarwood CC	4.34	0.40	10	7560	2.10	High	2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	21.00	1.74
Hillcrest GC	4.61	0.40	14	5763	1.60	Low-overflow	0.07	0.17	0.17	0.17	1.29	1.29	1.34	1.34	0.11	1.15	1.15	2.11	2.11	2.11	2.11	1.13	1.13	1.13	1.13	1.13	0.00	0.00	0.00	0.07	22.41	1.85
																															360.00	
TOTAL	**56.38**						**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.50**	**5.54**	**5.54**	**5.54**	**5.50**	**132.12**	
SYSTEM TOTAL							**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**		

Sun City Sized for 11.5 cfs – CAP flow to be approximately 9.5 cfs
Sun City West CAP flow to be approximately 5.5 cfs

CITIZENS water resources

SUN CITY / SUN CITY WEST / YOUNGTOWN GROUND WATER SAVINGS PROJECT

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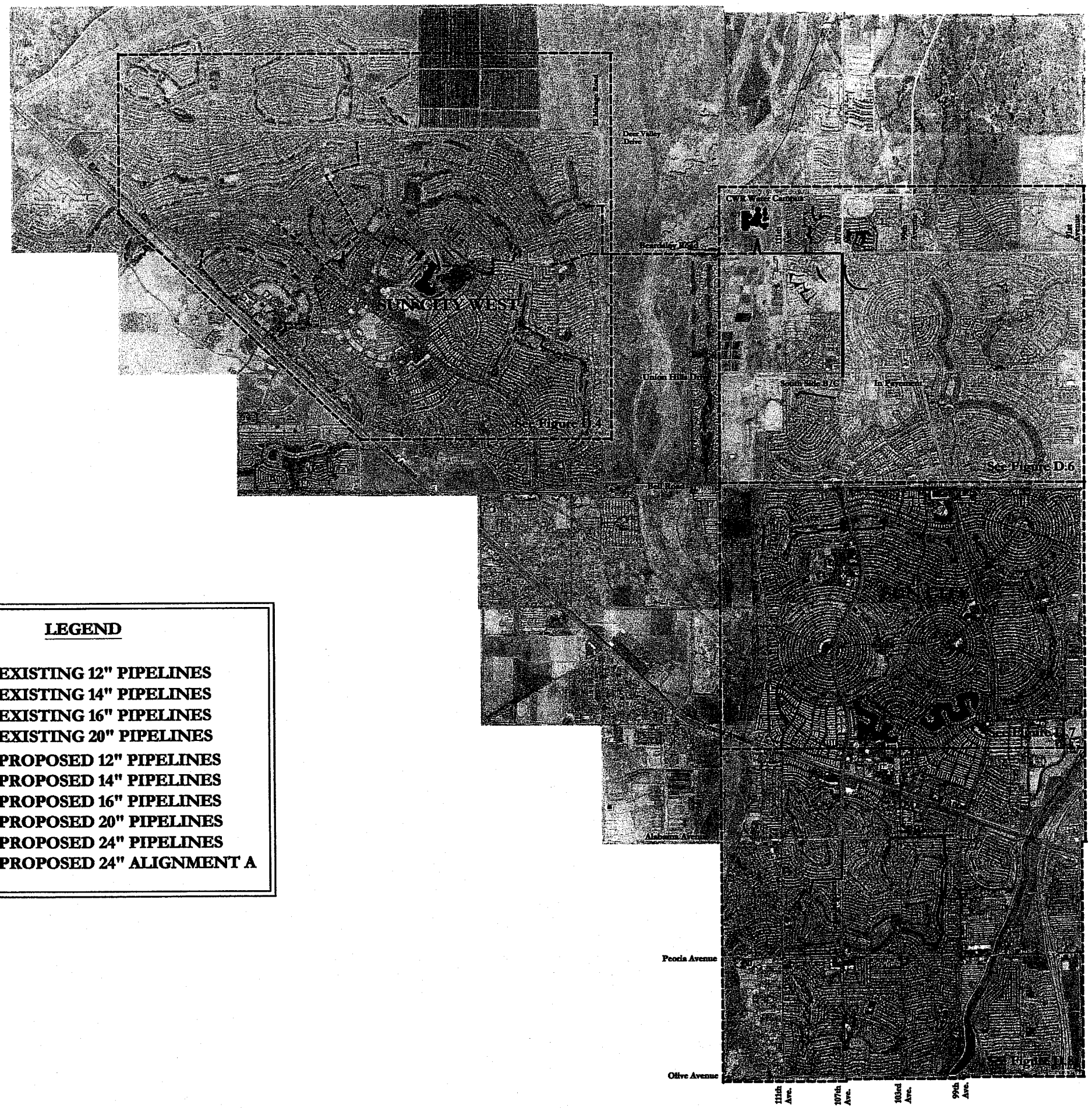


LEGEND

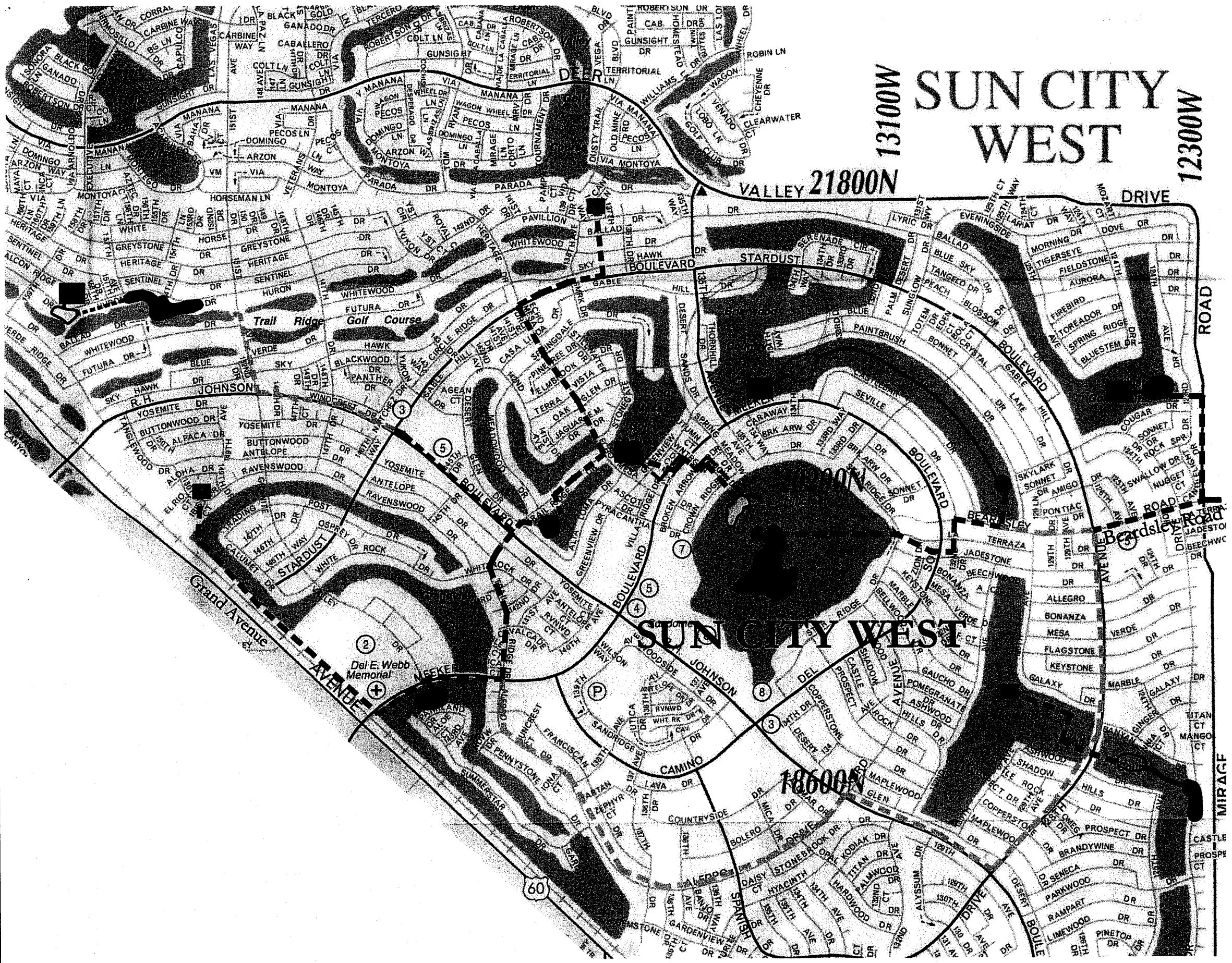
- EXISTING 12" PIPELINES
- EXISTING 14" PIPELINES
- EXISTING 16" PIPELINES
- EXISTING 20" PIPELINES
- PROPOSED 12" PIPELINES
- PROPOSED 14" PIPELINES
- PROPOSED 16" PIPELINES
- PROPOSED 20" PIPELINES
- PROPOSED 24" PIPELINES
- PROPOSED 24" ALIGNMENT A

IRRIGATION DISTRIBUTION SYSTEM

Figure D.3

CITIZENS water resources

SUN CITY / SUN CITY WEST/YOUNGTOWN GROUND WATER SAVINGS PROJECT



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LEGEND

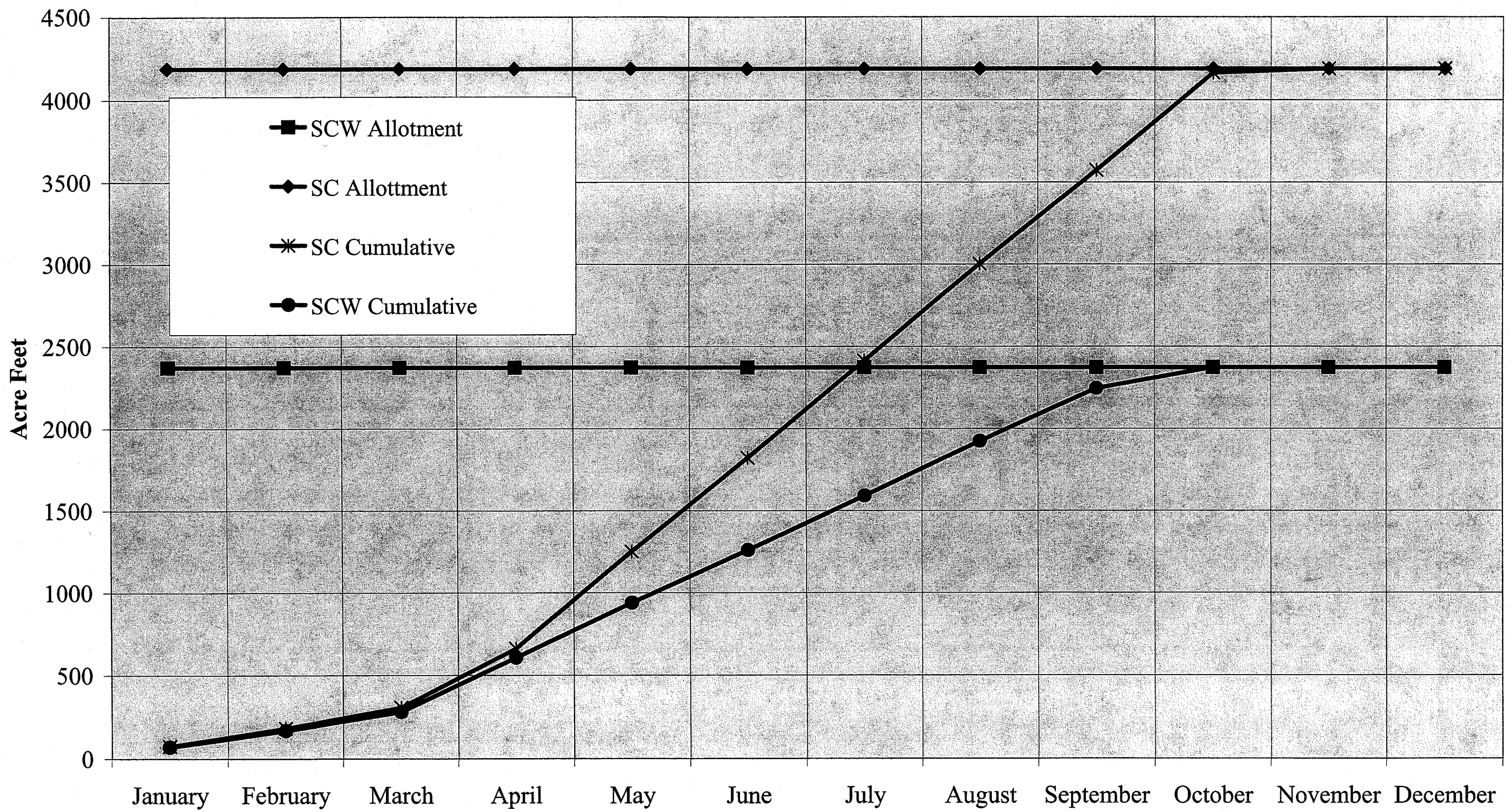
- EXISTING 12" PIPELINES
- EXISTING 14" PIPELINES
- EXISTING 16" PIPELINES
- EXISTING 20" PIPELINES
- WELL
- RESERVOIR LAKE

Sun City West

EXISTING DISTRIBUTION NETWORK

Figure D.4

Figure D.5 - Sun City & Sun City West Supply & Demand



The model simulates the existing systems at approximately 40% of July (peak) daily demand. Maximum and minimum pressure results from the model are summarized in the following table as well as flow through the trunk line and HGL at start of the Sun City West system. Cybernet output is also included in Appendix D for each model.

Summary of Cybrernet Model Results

	Minimum	Maximum
CAP Flow Through Alignment Pipe A (cfs)	13.5	15.5
HGL @ Bifurcation (ft)	1372.3	1405.6
Sun City West		
Stardust Delivery Pressure (psi)	49.1	50.6
Briarwood Delivery Pressure (psi)	44.2	46.8
Hillcrest Delivery Pressure (psi)	31.4	34.4
Pebblebrook Delivery Pressure (psi)	54.9	59.7
Echo Mesa Delivery Pressure (psi)	23.8	33.5
Grandview Delivery Pressure (psi)	25.5	36.1
Trail Ridge Delivery Pressure (psi)	8.5	19.3

Numbers based on approximately 40% July Peak Daily Demand for Sun City West. All new pipe designed as DIP.

Due to the methodical operation of water delivery required for proper system operation, a control system must be added to the discharge pipe at each golf course.

Sun City Distribution System

Possible routes for water delivery systems to golf courses within Sun City were developed as part of this project. Routes will be located within streets and through the golf course properties and other possible open easement areas. Critical points are the points of access between the public right-of-way and/or easements and the golf course lakes. Least disruptive routes were also investigated as a means to lessen the traffic control requirement. Development of the proposed concept route location included input from received from CWR, TAC members, and others. The proposed network is shown in **Figures D.6, D.7, and D.8.** The delivery points for the golf courses are located at storage reservoirs or lakes allowing for flow along water features to storage lakes.

The proposed Sun City Distribution System is designed to deliver irrigation flow only to the Recreation Centers of Sun City Inc. golf courses. **Figure D.5** demonstrates the ability of the system to deliver the entire Sun City CAP allocation during the calendar year. The distribution system in Sun City and the CAP trunk pipeline were design to deliver as much of the daily demand as possible while minimizing the pipeline sizes. This allowed for meeting the total demand for flows in the off-peak periods and a portion of the demand during peak periods. In Sun City the allotment can be used entirely by the Recreation Center golf courses. Golf Courses in the Sun City system include:

- Lakes East Golf Course(Dawn Lake),
- Lakes West Golf Course,
- North Golf Course,
- Quail Run Golf Course,
- Riverview Golf Course,
- South Golf Course,
- Willowbrook Golf Course, and
- Willowcreek Golf Course.

Water deliveries typically are made to the golf course lakes. Dawn Lake and Viewpoint Lake will provide volumetric flexibility to balance the daily system demands for all the courses in Sun City.

From the monthly breakdowns of demand, the peak demand flow of July was used to simulate the maximum golf course demand for the computer simulations. The model was adjusted until the desired flow rate was achieved.

The peak flow to Sun City is approximately 9.5 cfs. Transmission of CAP water is via the Alternative A pipeline for the model simulations. The table titled **Peak Day CAP Water Delivery Schedule** illustrates the simulated golf course demands used for the Cybernet model.

The model simulates the existing systems at approximately 65% of July daily demand. Maximum and minimum pressure results from the model are summarized in the following table as well as flow through the transmission line and HGL at start of the Sun City system. Cybernet output is also included in Appendix D for each model.

Summary of Cybrernet Model Results

	Minimum	Maximum
CAP Flow Through Alignment Pipe A (cfs)	13.5	15.5
HGL @ Bifurcation (ft)	1372.3	1405.6
Sun City/ Youngtown		
Lakes East(Dawn Lake) Delivery Pressure (psi)	21.1	70.0
Lakes West (View Point Lake) Delivery Pressure (psi)	31.3	72.7
North Delivery Pressure (psi)	16.1	69.6
Quail Run Delivery Pressure (psi)	13.2	70.0
Riverview (West) Delivery Pressure (psi)	43.0	73.8
Riverview (East) Delivery Pressure (psi)	42.2	74.0
South (West) Delivery Pressure (psi)	18.6	67.9
South (East) Delivery Pressure (psi)	11.5	69.6
Willowbrook Delivery Pressure (psi)	72.2	86.1
Willowcreek Delivery Pressure (psi)	72.8	89.1

Numbers based on approximately 60% July Peak Daily Demand for Sun . All new pipe designd as DIP.

CITIZENS water resources

SUN CITY / SUN CITY WEST / YOUNGTOWN GROUND WATER SAVINGS PROJECT

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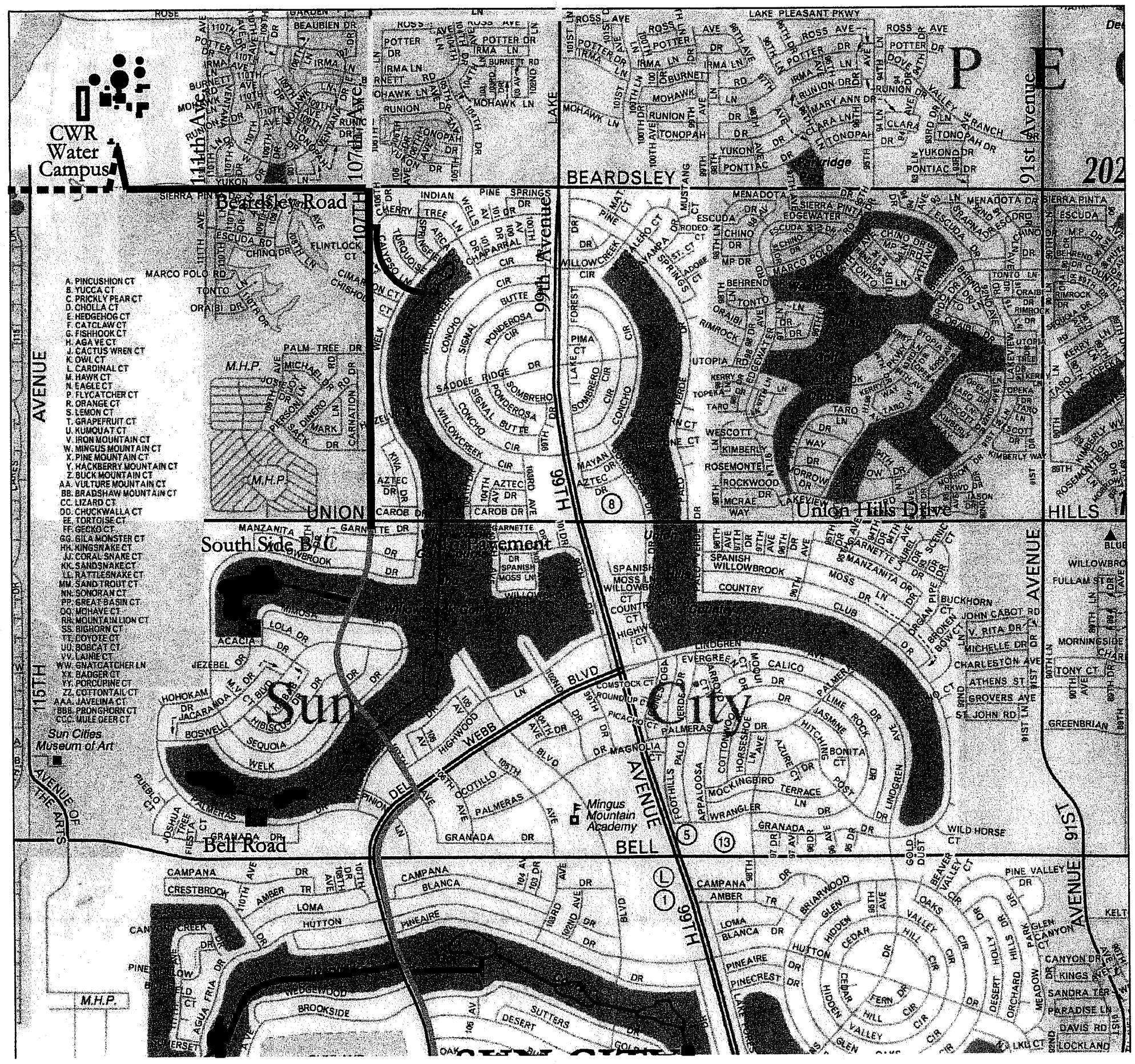


(SEE FIGURE D.7)

LEGEND

- PROPOSED 12" PIPELINES
- PROPOSED 16" PIPELINES
- PROPOSED 20" PIPELINES
- PROPOSED 24" PIPELINES
- PROPOSED 24" MAINLINE
- PUMP STATION
- RESERVOIR LAKE

Sun City

PROPOSED DISTRIBUTION NETWORK

Figure D.6

(SEE FIGURE D.6)

(SEE FIGURE D.8)

CITIZENS water resources

SUN CITY / SUN CITY WEST / YOUNGTOWN GROUND WATER SAVINGS PROJECT

N

LEGEND

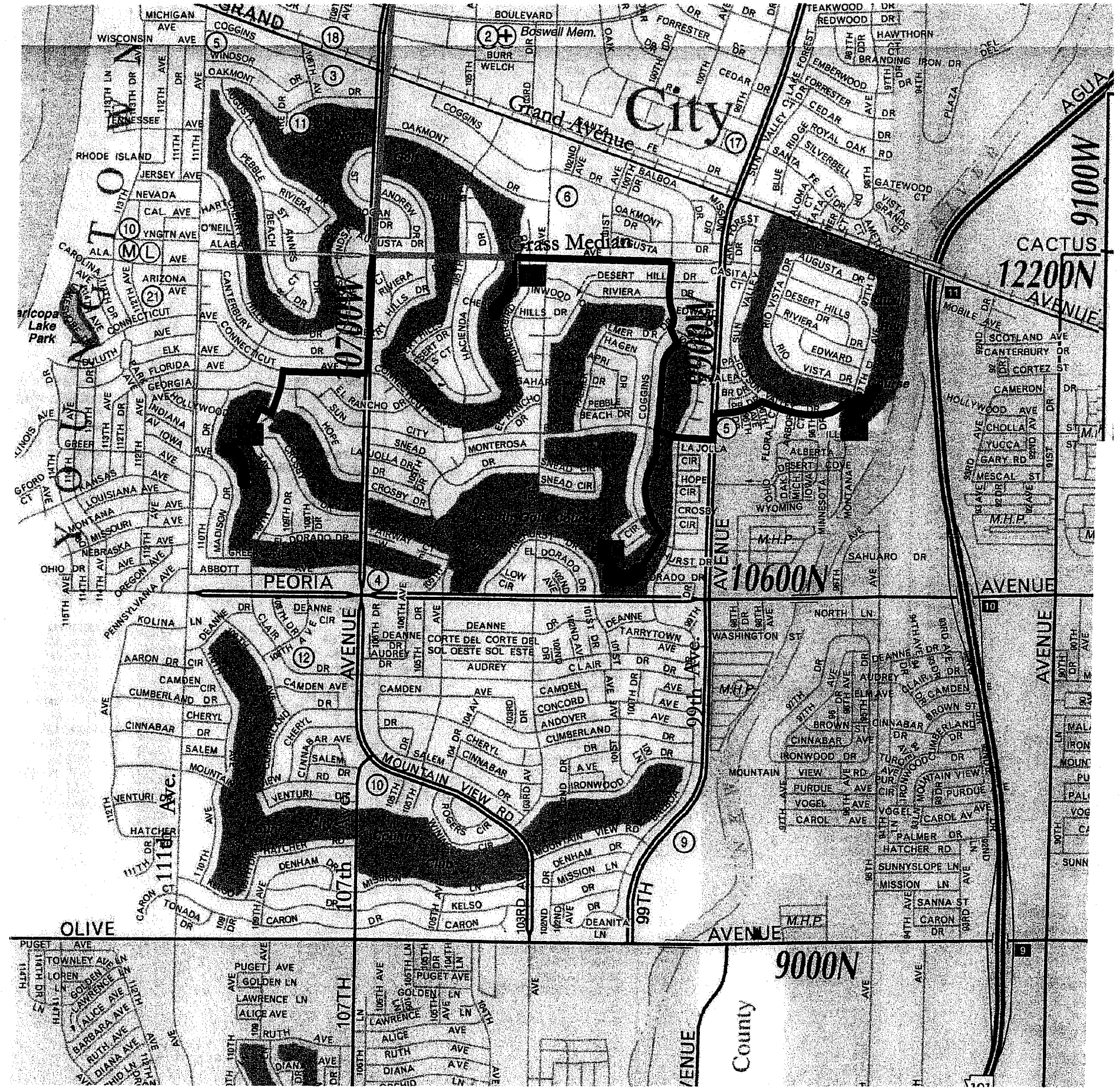
- PROPOSED 12" PIPELINES
- PROPOSED 16" PIPELINES
- PUMP STATION
- RESERVOIR LAKE

Sun City

PROPOSED DISTRIBUTION NETWORK

Figure D.7

(SEE FIGURE D.7)



CITIZENS water resources

SUN CITY / SUN CITY WEST / YOUNGTOWN GROUND WATER SAVINGS PROJECT

N

LEGEND

- PROPOSED 12" PIPELINES
- PROPOSED 16" PIPELINES
- PUMP STATION
- RESERVOIR LAKE

Sun City

PROPOSED DISTRIBUTION NETWORK

Figure D.8

For design, the peak demands at each golf course were increased approximately 20% to allow for operational flexibility. The normal peak inflow to the Sun City system of 9.5 cfs was increased to approximately 11.5 cfs to size the pipes only. The actual flow of approximately 9.5 cfs is used for the final operational model.

Cost for the Sun City distribution system is as shown below.

Sun City Distribution System
Opinion of Probable Life Cycle Costs

Description	Unit	Quantity	Unit Price	Amount
Mobilization @ 5%	Ea.	1	$230,314	$230,314
PVC Pipe (12",C-900, Class 150)	L.F.	27,418	$40.35	$1,106,316
PVC Pipe (16", C-905, Class 165)	L.F.	26,245	$55.48	$1,456,073
Ductile Iron Pipe (20", Class 250)	L.F.	4,962	$80.00	$396,960
Ductile Iron Pipe (24", Class 200)	L.F.	5,280	$90.00	$475,200
12" Gate Valve	Ea.	23	$1,800	$41,400
16" Gate Valve	Ea.	10	$6,600	$66,000
20" Gate Valve	Ea.	1	$10,950	$10,950
24" Gate Valve	Ea.	4	$13,500	$54,000
Pavement Replacement	S.Y.	29,555	$20	$591,098
Golf Course Turf Restoration	Ac.	4.53	$19,600	$88,788
Combination AirVac Valve (2")	Ea.	2	$4,000	$8,000
Combination AirVac Valve (2")	Ea.	3	$3,000	$9,000
Traffic Control	L.F.	20,000	$7	$140,000
36" Jack & Bore (Grand Ave. & RR)	L.F.	250	$650	$162,500
			Subtotal	**$4,863,599**
Engineering Design	8%	1	$389,088	$389,088
Construction Administration	12%	1	$583,632	$583,632
Citizens (Admin./Legal/Financial)	10%	1	$483,660	$483,660
Contingency	10%	1	$483,660	$483,660
			Total Capital Cost	**$6,803,639**
O&M Life Cycle Costs			**Annual Cost**	**Present Worth**
Pipeline O&M (50 yr) (63,905 L.F. at $0.50/ft/yr)			$31,953	$523,245
			Total O&M Life Cycle Cost	**$523,245**
			Total Life Cycle Cost, Distribution System	**$7,326,884**

The life cycle costs were determined using common cost elements applied to anticipated annualized costs. The annual costs were calculated by summing each annual cost element. These were then determined as a present worth value.

A differential interest rate of 5.73% was used for calculations. This rate was based on the weighted cost of capital at 8.73%, minus an inflation rate of 3%. The weighted cost of capital at 8.73% for Citizens Water Resources is based on Arizona Corporation Commission Decision 60172. The inflation rate of 3.0% is based on an assumed average inflation rate over past number of years.

It is anticipated that installation of the Sun City Distribution System would be broken into three separate construction contracts which would be completed in approximately 6 months.

Additional complications may occur due to the crossing of Grand Avenue and the Burlington Northern, Santa Fe railroad. Typically crossing a railroad with a utility adds time to the design phase of a project because the railroad will review the design and require a construction license and an operating license.

Distribution System Summary

The existing and proposed distribution systems for Sun City West and Sun City have been analyzed/modeled. The results of that analysis have shown that the distribution of the CAP allocation can be achieved. The final model combines the Sun City design model and the Sun City West Model allowing the distribution from transmission pipeline Route A to two distribution systems. The system must operate using an organized and methodical approach to deliveries each day. This will ensure that CWR can:

- Consume the entire CAP allocation of both communities.
- Maintain a peak flowrate of approximately 15 cfs in the transmission pipeline. This corresponds to the hydraulic limits of a system optimized for economy.
- Meet as much of each golf course's daily demand as possible within the hydraulic limits of the pipeline system.

The existing Sun City West system is adequate to deliver its allocation to the golf courses involved in this project. The existing asbestos cement pipes range in size from 12" to 20" in diameter. During peak periods, wells must be utilized to supply full golf course demand.

A new distribution system is proposed for Sun City. The proposed system utilizes PVC pipe in sizes ranging in size from 12" to 16" in diameter and ductile iron pipe for sizes 20 inch to 24 inch. Conceptual routes have been designed along roadways, golf courses and other easements to minimize community impact. Wells must be utilized during peak demand times to fully supply golf course demands. The Sun City distribution system requires a crossing of the Burlington Northern, Santa Fe railroad that parallels the north side of Grand Avenue. This will need to be accomplished by a jack and bore operation and will add time to the design phase of a project due to railroad involvement.

7 Peak Day CAP Water Delivery Schedule Control Systems

Introduction

Need for SCADA Telemetry for Proposed Groundwater Savings Project

The proposed GSP would involve telemetry communication to as many as 18 remote sites throughout the participating golf courses in Sun City and Sun City West (7 sites in Sun City West, 10 sites in Sun City) and the remote site at the CAP Canal. Each of these golf course remote sites would have an electronic control valve, water meter, and a level sensor to determine lake water levels. Irrigation water would be delivered to each of these golf courses on a daily cycle with varying delivery times and durations.

Each site will communicate via telemetry to a central supervision, control and data acquisition (SCADA) control system. Monitoring and control functionality would be provided from the SCADA control center for each remote site as follows:

Monitoring	Control
Valve position indication	Remote operation of irrigation valve
Pond water level indication (some continuous, some point levels)	Preprogrammed irrigation start and stop times for each participating golf course
Flow rate indication	
Flow totalization	

Existing Citizens Utilities SCADA Systems

Shaw Butte Mountain, located in the area of the North Mountain Preserve area near 19th Avenue and Thunderbird Road, serves as a repeater radio site for Citizens Water Resources, currently using an MDS model 2000 radio, which operates on fixed transmit and receive frequency pair licensed by the FCC. The Shaw Butte radio repeater station could possibly be used as a radio repeater site to relay radio signals from the SCADA control center to the various remote golf course sites, etc. A line-of-sight study must be performed during the detailed design phase of this project to investigate the ability of the Shaw Butte radio repeater sight to properly communicate with all of the proposed remote RTU/ radio sites.

Currently, Citizens Water Resources uses almost exclusively Allen Bradley controllers and a mix of either Modicon or Allen Bradley DH Plus communication protocols at their existing water and wastewater facilities for telemetry. CWR has in use both spread spectrum and fixed frequency radios in their telemetry systems.

The proposed CWR SCADA master control system will be located at Citizen Water Resource's Water Campus operations building due to its central location.

Typical Telemetry System Communication Components

A typical telemetry system includes the following possible subsystems and components.

Remote Terminal Units (RTUs)

RTUs are microprocessor-based remote measurement and control devices that can be integrated into a communication/control system through direct connection, telephone line, or radio link. They typically provide radio modem, private-line modem, leased-line modem, or dial-up modem (communication) connections. RTUs usually support both polled and report-by-exception information exchange and can use any of several communication protocols including Modicon or Allen Bradley DH Plus, both popular versions currently used by CWR.

Programmable Logic Controllers (PLCs)

PLCs are industrially hardened computers with the capability to interface with field devices and to communicate with remote devices. PLCs can be integrated into a communication/control system through direct connection, telephone line, or radio link and are frequently interfaced with third party control systems using a variety of communication options. Radio modems or leased-line modems can be utilized to support remote communications.

Radio

Many utilities have selected radio as a medium for communication with remote sites. Utilizing radio can provide several advantages.

Flexibility

New remote radio sites can easily be added within the range of an existing repeater or base station. The installation of new leased lines or communication cable is not required, and as long as Federal Communications Commission (FCC) rules are met, a SCADA radio can be installed independent of other utilities or communications companies.

Maintenance Control

Utilizing radio communications allows a utility to employ in-house maintenance and avoid reliance on the telephone company or third-party technicians. Retaining control of the communications system maintenance can result in more immediate system restoration in the event of a problem.

Reliability

A radio telemetry system is considered to be reliable when well engineered and maintained. While leased telephone company circuits are also normally reliable, retaining in-house control of the telemetry equipment maintenance provides the opportunity to improve system reliability with proper preventative maintenance procedures.

Cost

Utilizing radio-based telemetry systems can provide a cost saving over cable, where the cost to install and/or lease the cable is prohibitive. The opinion of probable cost for a MDS 2000 radio and antennae at each remote site is approximately $4,400.

Leased Telephone Lines

Leased telephone lines are frequently used for telemetering data, and normally provide reliable service. Monthly lease rates normally range from $77 to $125 per leased line and have a one-time normal installation fee of $225. Lease rates depend on a number of factors including mileage, number of central telephone offices involved, distance to the nearest pre-existing phone service, bandwidth, whether half duplex (2 wire) or full duplex (4-wire), and type of line utilized (voice grade versus analog or digital). Installation costs may vary, depending on availability and proximity of existing telephone service.

In addition to the installation and monthly leasing costs associated with leasing a telephone communications line, disadvantages of using telephone lines include the potential for damage from excavation, corrosion, water, or rodents. There is no direct control over the installation and maintenance of leased lines. The cost of leased telephone lines compared to radio equipment is shown on the following page. There are a total of 19 sites which would be linked to the SCADA system, seven which would be at golf courses in Sun City West, ten at golf courses in Sun City, one at the CAP Canal site, and one at the main control SCADA center. This cost analysis is based on the fact that the CAP Canal remote site would require a radio system to communicate with the SCADA control center and there would be 17 remote RTU sites along with a RTU at the SCADA control center, therefore, two sites (the CAP site and the SCADA control center) would require RTUs with radios. The cost analysis assumes that for the lease lines system there would be approximately half of the sites which would require installation of a new cable to the site for an approximate cost of $5,000. From this cost analysis, it is evident that radio equipment is less costly.

Cost Comparison of Leased Telephone Lines to Radio Equipment

The following table compares telemetry SCADA costs of telephone vs. radio:

SCADA System Cost Comparison Telephone Leased Lines vs. Radio/ Antennae Equipment				
Telephone Leased Lines System Costs				
Description	**Unit**	**Quantity**	**Unit Price**	**Amount**
Present Worth of Leasing Lines over 25 years (17 golf course sites and Master SCADA Site = 18 sites @ $77 per site per month)	L.S.	1	$168,863	$168,863
Installation Fee per Site	Ea.	18	$225	$4,050
9 sites assumed to have additional costs for initial cable construction	Ea.	9	$5,000	$45,000
RTU Controls at Golf Courses	Ea.	17	$19,450	$330,650
2 Sites with RTUs with radios (CAP Canal Meter site and Master SCADA Control Center site)	Ea.	2	$24,000	$48,000
Telephone Leased Lines System - Total Cost				**$596,563**
Radio / Antennae Equipment System Costs				
Radio/ RTU Equipment for 19 Sites (17 golf course sites, CAP Canal Meter site, and Master SCADA Control Center site)	Ea.	19	$24,000	$456,000
Radio / Antennae Equipment System- Total Cost				**$456,000**

For the cost comparison of leased telephone lines verses radio equipment a 25 year life cycle was used since both of these technologies would be at the end of their normal life at 25 years and would require an equipment evaluation study before being replaced with similar equipment.

The cost comparison of telephone leased lines versus radio equipment clearly shows that the radio equipment alternative is less costly. The costs for leased lines actually could be substantially more since the monthly leased lines cost used in this analysis is $77 but could be as much as $125 per month per site.

Utility Owned Communications Cable

Rather than leasing telephone communication circuits, CWR could use their own communications cable to directly link remote sites. In addition to saving monthly leased-line costs, this option allows CWR to retain control of system maintenance. Buried communications cable normally provides a reliable means of communication between sites, although buried cables do have the potential for damage from corrosion or excavation.

Linking sites via hard wire can provide cost savings if the sites are relatively close together, i.e. less than 1,000 to 1,500 feet apart. The cost for buried cable is approximately $6 per lineal foot. In this scenario, most of the sites are a mile or more apart from the next nearest site. In addition, the golf course sites within the Sun City West area already have the effluent distribution pipelines in place which makes it cost prohibitive to install these communication cables compared to the proposed irrigation distribution pipelines for the Sun City area where the communication cables may be placed in the same trench as the new pipelines.

The cost of one mile of buried cable at $6/L.F. is $31,680 whereas the cost for the radio/antennae unit is approximately $3,500. Clearly, for the distances involved between sites, it is cost prohibitive to use communications cable rather than radio.

Telemetry Alternatives

Figure D.9 displays the approximate locations of SCADA remote sites used to control valves to turn water off and on to golf courses and to record the water flow from the CAP Canal. The main control center the remote site would be located at Citizens Water Resources' administration building at the CWR Water Campus.

Proposed Groundwater Savings Project SCADA System

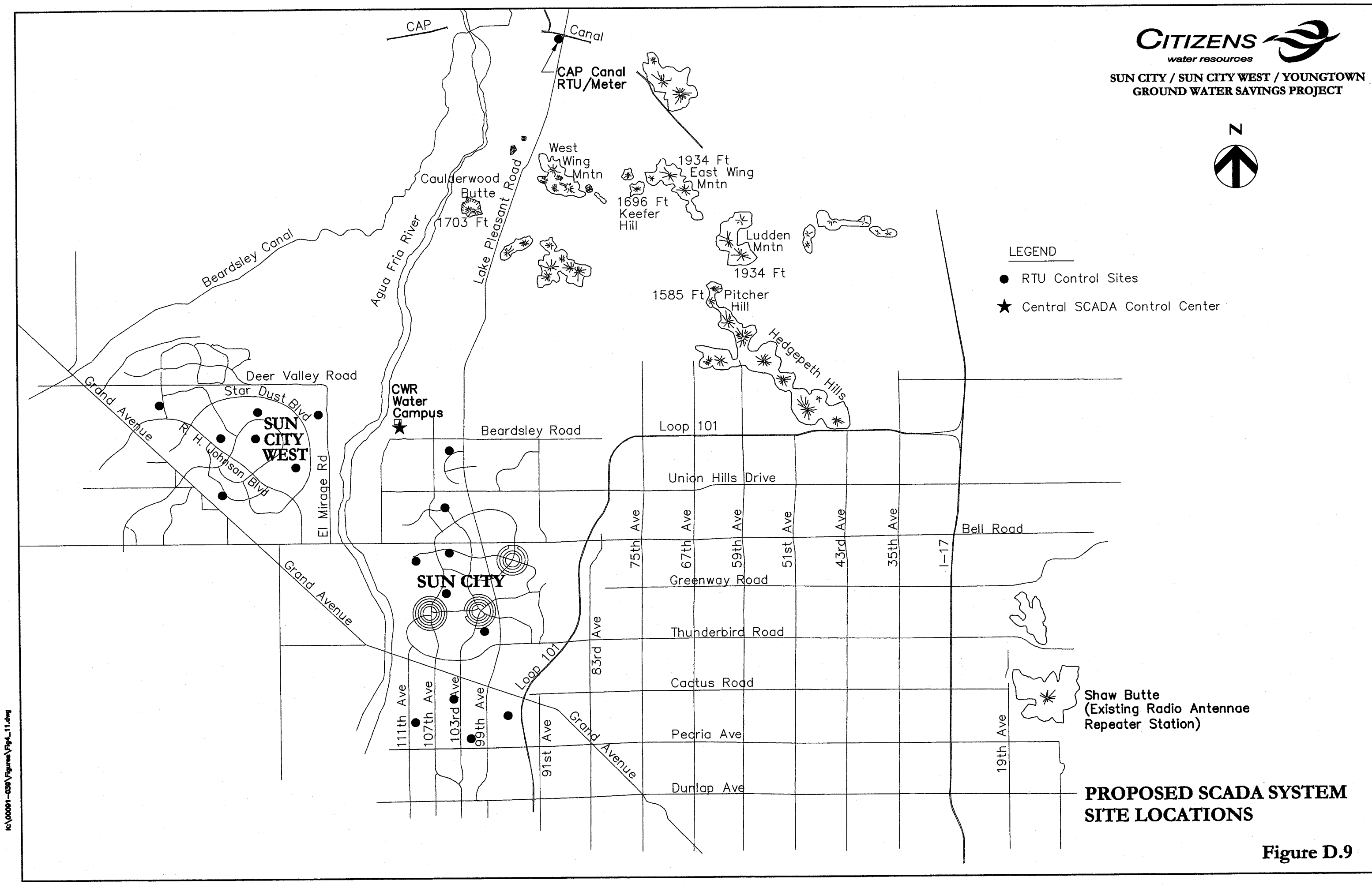
The proposed CAP Water SCADA system for distribution of irrigation water to the golf courses would use a dedicated radio frequency system. All of the remote sites for the golf courses would be outfitted for a radio/antennae system along with an RTU. The installed cost for a RTU radio/antenna system at each remote site is approximately $24,000. An overview schematic of the proposed telemetry system is shown in **Figure D.10**.

The radio line-of-sight investigation study may recommend a new radio repeater station be located somewhere on top of the mountains in the area of 59th Avenue north of the Loop 101 freeway or somewhere on the eastside of the White Tank Mountains, if there are line-of-sight problems with Shaw Butte or with sighting an omni-directional antennae at Citizens Water Resources Water Campus. Either of the possible new radio repeater sites would give CWR a repeater station with a very strong, non-interfered site which would serve to reach all the west valley and points north to the CAP Canal.

The site at the CAP Canal may require a relay repeater radio site between its site and the central SCADA control center since it appears there may line-of-sight problems over to the Shaw Butte radio repeater site. A radio signal test investigation would need to be performed at the CAP Canal site to verify that it will transmit properly with the Shaw Butte radio repeater site.

The connection of the water transmission main to the distribution systems to Sun City and Sun City West will be at a tee near the Citizens Water Resources Water Campus. Water meters will be provided at this location so as to totalize the amount of water being supplied to the Sun City West system and the Sun City system. The purpose of these meters is to determine the full utilization of the CAP allotments for Sun City and Sun City West. These meters will be connected to the SCADA system via hard wire to the SCADA control center at the Citizens Water Resources Water Campus.

Should CAP water allotments for either Sun City or Sun City West not be completely used by the end of the year due to unforeseen factors such as excessive rainfall the remaining allotment amounts will be diverted to the percolation ponds at Citizens Water Resources Water Campus so this water can serve to recharge the groundwater tables. A pipe connection to the percolation ponds can be attained easily by teeing off the CAP water transmission main. There will be an 8-inch electronic flow control valve, which will be controlled remotely by the SCADA system along with a water meter for totalizing flow to the percolation ponds from the water transmission main. This flow control valve and meter will be connected to the SCADA system via hard wire to the SCADA control center at the Citizens Water Resources Water Campus.



PROPOSED SCADA SYSTEM SITE LOCATIONS

Figure D.9

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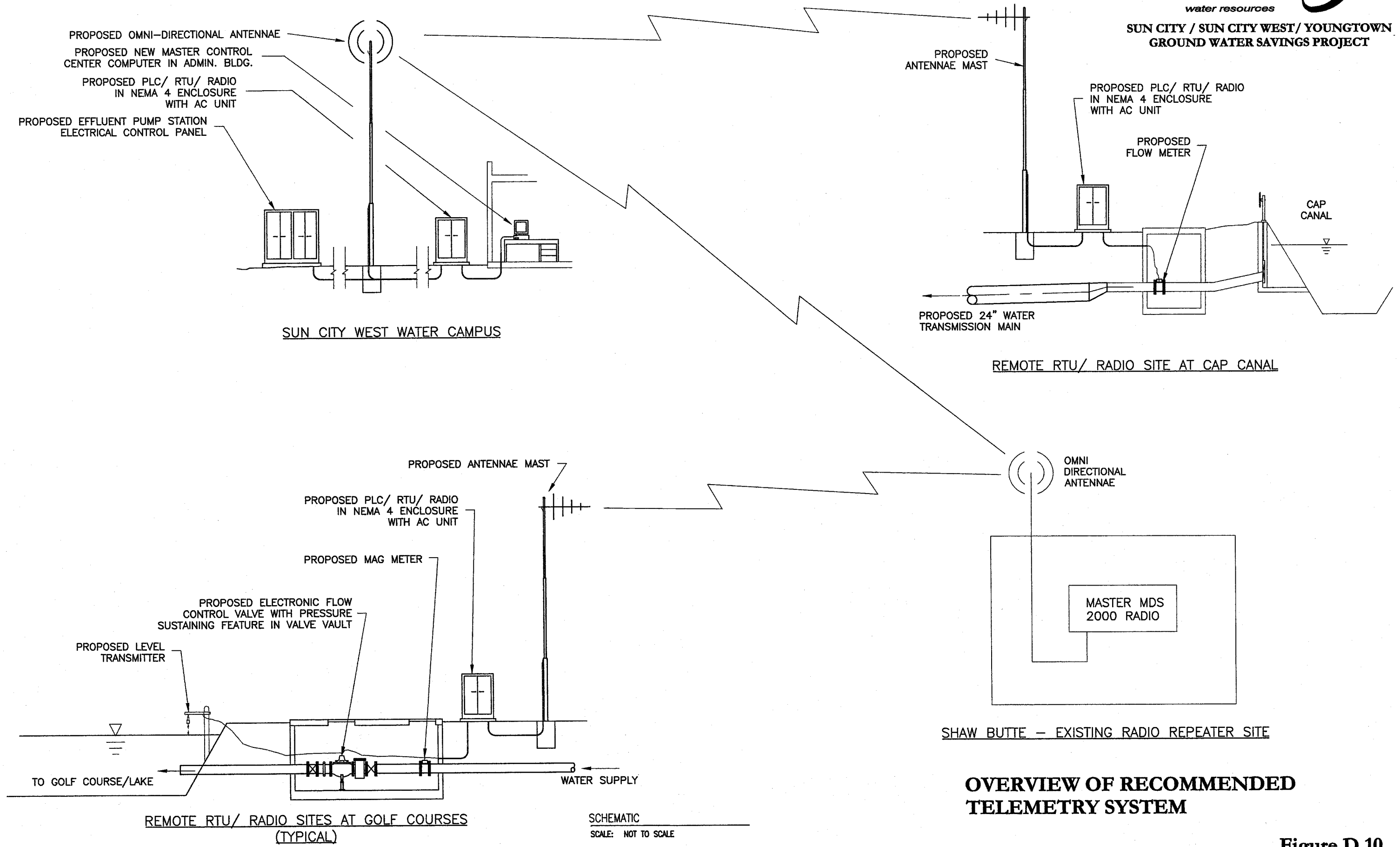
CITIZENS water resources

SUN CITY / SUN CITY WEST/ YOUNGTOWN GROUND WATER SAVINGS PROJECT



OVERVIEW OF RECOMMENDED TELEMETRY SYSTEM

Figure D.10

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The opinion of probable construction costs for the proposed SCADA system to serve Sun City and Sun City West is as follows:

SCADA System for Sun City and Sun City West
Opinion of Probable Life Cycle Costs

Description	Unit	Quantity	Unit Price	Amount
Mobilization @ 5%	Ea.	1	$58,019	$58,019
Remote RTU/Radio Sites	Ea.	17	$24,000	$408,000
Vault w/ Control Valve Meter & Level Transmitter	Ea.	17	$32,120	$546,040
Remote RTU/Radio/Meter @ CAP	Ea.	1	$41,150	$41,150
SCADA Master Control Center @ CWR Water Campus	L.F.	1	$52,000	$52,000
SCW – 16" Propeller Meter Station Vault	L.S.	1	$37,960	$37,960
SC – 18" Propeller Meter Station Vault	L.S.	1	$45,200	$45,200
Percolation Ponds – 8" Elect. Control Valve Vault Meter Station	L.S.	1	$28,300	$28,300
Radio Line of Sight Path Study	L.S.	1	$1,400	$1,400
FCC License Application Fee	L.S.	1	$330	$330
			Total Capital Cost	**$1,218,399**
O&M Life Cycle Costs			Annual Cost	Present Worth
Power Cost (%Hp @ $0.07/kwh)			$2,287	$37,455
O&M Labor (2.0 hrs./day for $30,000/yr salary)			$7,500	$122,818
O&M (1% of Structure & 2.5% of Equipment/year)			$22,427	$367,258
			Total O&M Life Cycle Cost	**$527,531**
			Total Life Cycle Cost, SCADA System	**$1,745,930**

The seven proposed golf courses in the Sun City West area to be served by the GSP which will have SCADA control equipment are as follows:

- Briarwood Country Club,
- Echo Mesa Golf Course,
- Grandview Golf Course,
- Hillcrest Golf Course,
- Pebblebrook Golf Course,
- Stardust Golf Course, and
- Trail Ridge Golf Course.

That portion of the total costs for the proposed SCADA system to serve only the Sun City West area is as follows:

SCADA System for Sun City West
Opinion of Probable Life Cycle Costs

Description	Unit	Quantity	Unit Price	Amount
Mobilization @ 5%	Ea.	1	$24,076	$24,076
Remote RTU/Radio Sites	Ea.	7	$24,000	$168,000
Vault w/ Control Valve Meter & Level Transmitter	Ea.	7	$32,120	$224,840
SCW – 16" Propeller Meter Station Vault	L.S.	1	$37,960	$37,960
Portion of Common SCADA Elements for Complete System (7/17)x(41,150+52,000+28,300+ 1,400+330)	L.S.	1	$50,721	$50,721
			Total Capital Cost	**$505,597**
O&M Life Cycle Costs			Annual Cost	Present Worth
Power Cost (%Hp @ $0.07/kwh)			$942	$15,423
O&M Labor (2.0 hrs./day for $30,000/yr salary)			$3,088	$50,572
O&M (1% of Structure & 2.5% of Equipment/year)			$9,235	$151,225
			Total O&M Life Cycle Cost	**$217,220**
			Total Life Cycle Cost, Sun City West SCADA System	**$722,817**

The eight proposed golf courses in the Sun City area to be served by the GSP which will have SCADA control equipment are as follows:

- Lakes East Golf Course (Dawn Lake),
- Lakes West Golf Course,
- North Golf Course,
- Quail Run Golf Course,
- Riverview Golf Course (two outlets - both with SCADA controls),
- South Golf Course (two outlets - both with SCADA controls),
- Willowbrook Golf Course, and
- Willowcreek Golf Course.

Thus, there are 10 SCADA control equipment locations among the golf course in Sun City.

That portion of the total costs for the proposed SCADA system to serve only the Sun City area is as follows:

SCADA System for Sun City
Opinion of Probable Life Cycle Costs

Description	Unit	Quantity	Unit Price	Amount
Mobilization @ 5%	Ea.	1	$33,943	$33,943
Remote RTU/Radio Sites	Ea.	10	$24,000	$240,000
Vault w/ Control Valve Meter & Level Transmitter	Ea.	10	$32,120	$321,200
SC – 18" Propeller Meter Station Vault	L.S.	1	$45,200	$45,200
Portion of Common SCADA Elements for Complete System (10/17)x(41,150+52,000+28,300+ 1,400+330)	L.S.	1	$72,459	$72,459
			Total Capital Cost	**$712,802**
O&M Life Cycle Costs			Annual Cost	Present Worth
Power Cost (%Hp @ $0.07/kwh)			$1,345	$22,032
O&M Labor (2.0 hrs./day for $30,000/yr salary)			$4,412	$72,246
O&M (1% of Structure & 2.5% of Equipment/year)			$13,192	$216,033
			Total O&M Life Cycle Cost	**$310,311**
			Total Life Cycle Cost, Sun City SCADA System	**$1,023,113**

The life cycle costs were determined using common cost elements applied to anticipated annualized costs. The annual costs were calculated by summing each annual cost element. These were then determined as a present worth value.

A differential interest rate of 5.73% was used for calculations. This rate was based on the weighted cost of capital at 8.73%, minus an inflation rate of 3%. The weighted cost of capital at 8.73% for Citizens Water Resources is based on Arizona Corporation Commission Decision 60172. The inflation rate of 3.0% is based on an assumed average inflation rate over past number of years.

PART E - RECOMMENDED PLAN

1 Introduction

This part of the report summarizes the various components and elements that make up the recommended improvements to be constructed under this Groundwater Savings Plan. An overall plan view of the recommended major components is shown in **Figure E.1**. Specific engineering details for each component have been discussed in the previous sections of this report.

2 Alternatives Analyzed

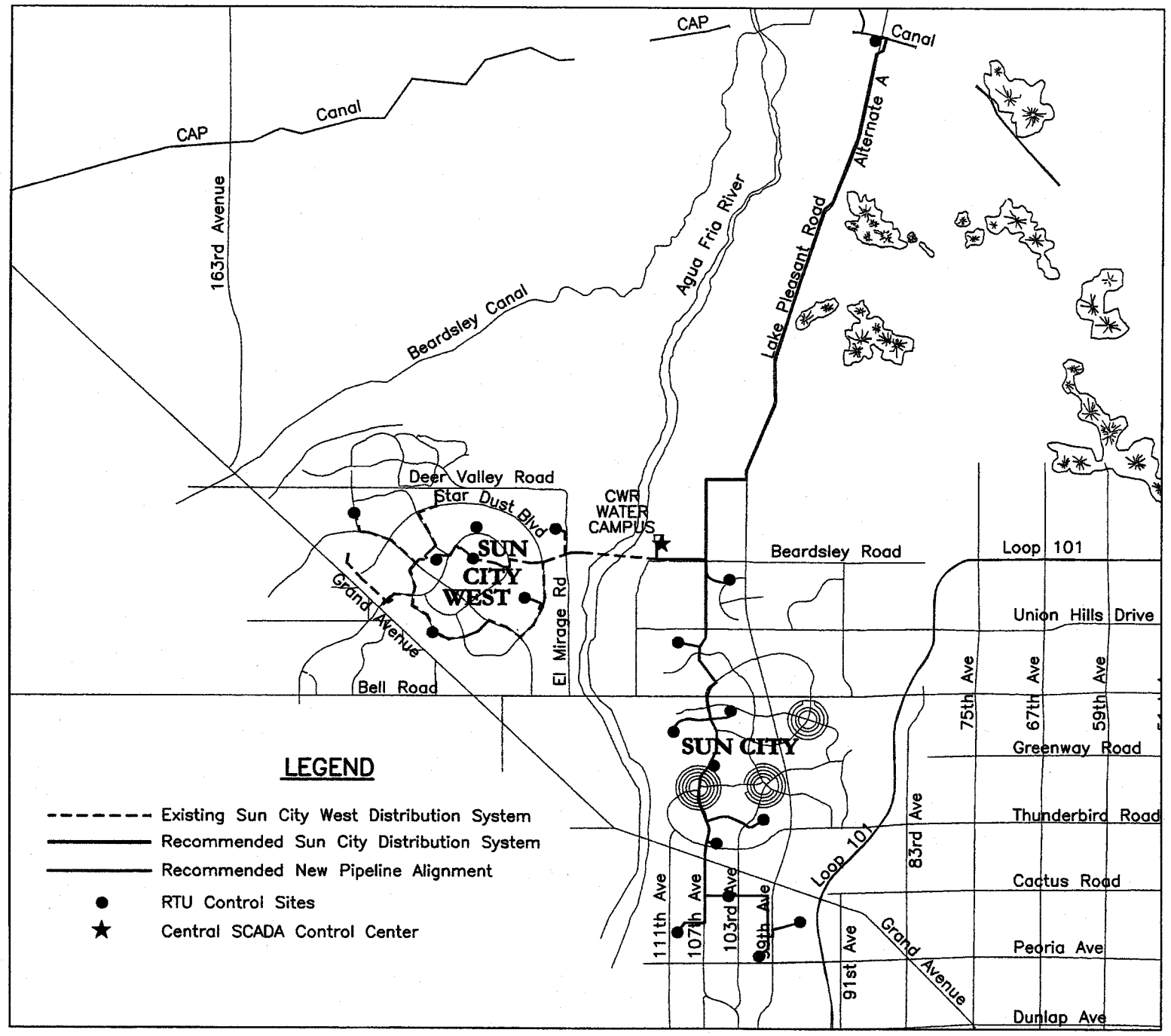
The alternatives analyzed have included:

- Alternative routes for the CAP water transmission pipeline,
- Taking delivery via the Beardsley Canal,
- Using the existing SCW distribution piping for CAP water transmission,
- Combining the Groundwater Savings Project into a joint facility with the Agua Fria Division and/or others,
- Various combinations of Recreation Centers and Country Club golf courses,
- Booster pumping station alternatives,
- Reservoir and/or tank storage alternatives,
- Golf course lake storage alternatives,
- CAP water treatment requirements,
- Alternative routing of the distribution piping,
- SCADA telemetry alternatives, and
- Pipe material alternatives.

The various alternatives have been evaluated on the basis of capital cost, ease of construction, Federal, state and local permitability, environmental consequences, right-of-way requirements, construction duration, operation and maintenance cost, annual costs, and how well the alternative achieves the goal of groundwater savings.

Most of the evaluation criteria have been quantified in terms of present value dollars. Some qualitative judgement is necessary however to evaluate the criteria of achieving the groundwater savings goal. While a cost figure has not been prepared specifically for these criteria, it is obvious that the trunk line alternatives that take delivery of the CAP water via the Beardsley Canal are not as desirable because the water lost through conveyance of that facility is lost to evaporation and leakage and does not serve to replace pumped groundwater.

Figure E.1



3 Recommended Plan Major Plan Components

The major components of the recommended plan consists of the following items:

- CAP Trunk Pipeline,
- Sun City West Distribution System,
- Sun City Distribution System, and
- Control (SCADA) System.

A full description of each of these plan components is included in Part D of this report. A brief description of each component is included below:

CAP Trunk Pipeline

The Alternative A alignment for the CAP water transmission pipeline is the recommended alternative. This corresponds to the Lake Pleasant Road alignment recommended by the CAP Task Force committee. The pipe size will be 24 inches in diameter. For estimating purposes the pipe material was assumed to be ductile iron, mortar lined and polyethylene wrapped. Concept plan and profile drawings of the Alternative A grade and alignment are included in Part D. A plan view of the Alternative A route is shown in **Figure E.1**.

Pumping Station

Calculations presented in Part D of the report indicate that pumping of the CAP water is not required in the recommended plan. The recommended alignment for the CAP trunk pipeline, Alternative A, operates by gravity and is able to deliver CAP water to the golf courses with sufficient pressure without having to boost the pressure by pumping.

Storage

Calculations presented in Part D of this report indicate that a dedicated reservoir or tank for storage of the CAP water is not required in the recommended plan. The recommended plan system is capable of delivering the annual allotment of Sun City and Sun City West by using the storage volume already available in the lakes on each golf course.

Treatment

Experience with numerous golf courses in Maricopa County irrigating with CAP water over several years leads to the conclusion that treatment of the CAP water is not required in the recommended plan. The quality of the CAP water is different from the groundwater being pumped at the golf courses. The difference that affects turf irrigation centers on salinity. This difference will require management practices, specifically some increased watering to achieve additional leaching, to properly utilize the CAP water on turf. An analysis of the chemical constituents in the CAP water shows no levels requiring treatment. The recommendation for no treatment of the CAP water for turf irrigation is supported by the present use of CAP water for other golf course facilities around the Valley.

Sun City West Distribution System

The Sun City West distribution component of the Groundwater Savings Project essentially consists of the existing effluent irrigation system owned by the Recreation Centers of Sun City West. The only modifications required for the use of the existing system to function as a component of the Groundwater Savings Project is the installation of flow control/metering vaults and a control (SCADA) system at each participating golf course. No significant improvements or upgrades to the existing piping system are anticipated. Cost for any minor work that may be required, such as the potential replacement of a stuck valve, would be covered as a contingency item of the recommended plan. The existing SCW distribution system is shown in **Figure E.1**.

Golf courses to be served by the SCW distribution system include:

- Briarwood Country Club,
- Echo Mesa Golf Course,
- Grandview Golf Course,
- Hillcrest Golf Club,
- Pebblebrook Golf Course,
- Stardust Golf Course, and
- Trail Ridge Golf Course.

Sun City Distribution System

An all-new distribution system is proposed to serve Sun City as no current facility exists. The route for the distribution system is presented in detail in Part D and is summarized in **Figure E.1**. Routes will be located within streets and through the golf course properties and other possible open easement areas. Critical points are the points of entry into golf course properties between the public right-of-way and/or easements and the golf course lakes. Least disruptive routes were also investigated as a means to lessen the traffic control requirement. Development of the proposed concept route location included input from received from CWR, TAC members, and others. The delivery points for the golf courses are located at storage reservoirs or lakes allowing for flow along water features to storage lakes.

The proposed Sun City Distribution System is designed to deliver only to the Recreation Center of Sun City Inc. golf courses, specifically:

- Lakes East Golf Course(Dawn Lake),
- Lakes West Golf Course,
- North Golf Course,
- Quail Run Golf Course,
- Riverview Golf Course,
- South Golf Course,
- Willowbrook Golf Course, and
- Willowcreek Golf Course.

The distribution system will use PVC pipe in sizes ranging in size from 12" to 16" in diameter and ductile iron pipe for sizes 20 inch to 24 inch. The Sun City distribution system requires a crossing of the Burlington Northern, Santa Fe railroad that parallels the north side of Grand Avenue.

Supervisor Control and Data Acquisition System

An all new SCADA system will be included as a part of the Groundwater Savings Project involving as many as 18 remote sites throughout the participating golf courses in Sun City and Sun City West. Each of these remote sites would have an electronic control valve, water meter, and a level sensor to determine lake water levels. Irrigation water would be delivered to each of these golf courses on a daily cycle with varying delivery times due to the amount of water ordered by each user. Each site will communicate via telemetry to a central SCADA control system. Monitoring and control functionality will be provided from the central SCADA control center for each remote site.

4 Cost

Costs have been estimated for each alternative of each component of the Groundwater Savings Project. These costs include initial capital cost for items such as design, construction and right-of-way, as well as annual costs over the life of the project. The life of the project has been assumed to be 50 years, to represent the practical life of the materials and equipment being considered. Annual costs include those for operation, maintenance and for conveyance charges for the use of the Beardsley Canal. These costs vary significantly from alternative to alternative.

The annual costs have been converted to present worth value to allow for equal comparison in terms of year 2000 dollars. An inflation rate of 3% has been assumed over the life of the annual costs, as documented in **Appendix I**. A present worth discount rate of 8.73 % was used also as documented in **Appendix I**.

Construction Costs

A summary of the construction costs for the major components of the recommended plan are shown in the table to the right, as well as costs for the other alternatives analyzed.

A construction cost estimate for Alternative E was not prepared because the route was found to be not feasible both hydraulically, because of the very limiting existing pipe sizes, and because of conflicts with the direction of flow required to meet effluent delivery obligations with the Recreation Centers of Sun City West.

Note that a contingency of 10% has been applied to the construction cost estimates to allow for items unknown at this level of design. The contingency has been increased to 25% for the joint facility portion of the each joint facility alternative. This is to allow for uncertainty of the requirements for a proposed joint facility system.

Summary of Construction Costs

Alternative	Joint Facility	CAP Trunk	Booster Pump Station	Storage	Treatment	Distribution	SCADA	Total
A – Lake Pleasant Road (Recommended Plan)	-	**$7,014,653**	-	-	-	**$6,803,639**	**$1,218,399**	**$15,036,691**
B - 115th Avenue	-	$3,494,155	$476,873	-	-	$6,803,639	$1,218,399	$11,993,066
C – El Mirage Road	-	$4,589,471	$476,873	-	-	$6,803,639	$1,218,399	$13,042,382
D – Deer Valley Road	-	$6,211,796	$476,873	-	-	$6,803,639	$1,218,399	$14,664,707
E – Through SCW	-	-	-	-	-	-	-	-
Joint Facility w/ Agua Fria Division	$2,629,723	$5,991,302	$476,873	-	-	$6,803,639	$1,218,399	$17,073,936
Joint Facility w/ Agua Fria Division & City of Surprise	$2,170,815	$5,991,302	$476,873	-	-	$6,803,639	$1,218,399	$16,615,028
Joint Facility w/ City of Surprise	$2,806,500	$5,991,302	$476,873	-	-	$6,803,639	$1,218,399	$17,250,713
Cost Estimate Presented to CAP Task Force	-	**$6,826,132**	**$540,945**	**$1,774,732**	-	**$5,851,191**	-	**$14,993,000**

Operation and Maintenance Costs

The estimated costs for the operation and maintenance of each of the various alternatives are summarized in the table to the right. Many of the costs are the same from alternative to alternative for the major components. The only differences are in the length of the CAP trunk lines and whether or not a booster pump station is required. The recommended alternative has the highest O & M costs for the CAP trunk pipeline, since it is the longest. However, it has the lowest overall O & M cost because no booster pump station is required.

Summary of Operation & Maintenance Costs

Alternative	Joint Facility	CAP Trunk	Booster Pump Station	Storage	Treatment	Distribution	SCADA	Present Worth
A – Lake Pleasant Road (Recommended Plan)	-	**$375,135**	-	-	-	**$523,245**	**$525,858**	**$1,424,238**
B - 115th Avenue	-	$179,289	$1,114,527	-	-	$523,245	$525,858	$2,342,919
C – El Mirage Road	-	$231,381	$1,114,527	-	-	$523,245	$525,858	$2,395,011
D – Deer Valley Road	-	$320,464	$1,114,527	-	-	$523,245	$525,858	$2,484,094
E – Through SCW	-	-	-	-	-	-	-	-
Joint Facility w/ Agua Fria Division	$80,334	$320,464	$1,114,527	-	-	$523,245	$525,858	$2,564,428
Joint Facility w/ Agua Fria Division & City of Surprise	$51,320	$320,464	$1,114,527	-	-	$523,245	$525,858	$2,535,414
Joint Facility w/ City of Surprise	$85,734	$320,464	$1,114,527	-	-	$523,245	$525,858	$2,569,828
Cost Estimate Presented to CAP Task Force *	-	**$308,797**	**$1,312,398**	**$1,441,062**	-	-	-	**$3,062,257**

* O&M Costs presented to Task Force were computed on an annual basis (total = $187,000) and have been converted to present worth for comparison purposes.

Costs Due to Use of the Beardsley Canal

The recommended plan, as well as the joint facility plans, would receive the CAP water directly from the CAP Canal. The remaining alternatives would take delivery of the CAP water through the Maricopa Water District's Beardsley Canal and therefore have annual costs associated with them for water conveyance losses and water wheeling. The conveyance losses, transmission and evaporation, are charged at one half of one percent of the annual allotment per mile of transmission. The figure shown in the cost estimate at the right is based on cost of the water at $106 per acre-foot as per the year 2000 cost of Citizen's M & I contract with CAP.

Water wheeling costs are estimated at $25 per acre-foot for 50 years, converted to present worth.

Summary of Costs Due to Use of Beardsley Canal

Alternative	Transmission & Evaporation Costs	Water Wheeling Costs	Present Worth
A – Lake Pleasant Road (Recommended Plan)	-	-	-
B – 115th Avenue	$256,902	$2,686,025	$2,942,927
C – El Mirage Road	$312,448	$2,686,025	$2,998,473
D – Deer Valley Road	$690,858	$2,686,025	$3,376,883
E – Through SCW	-	-	-
Joint Facility w/ Agua Fria Division	-	-	-
Joint Facility w/ Agua Fria Division & City of Surprise	-	-	-
Joint Facility w/ City of Surprise	-	-	-
Cost Estimate Presented to CAP Task Force	-	-	-

Life Cycle Cost Estimate

The total of the previous three estimates; construction cost, operation and maintenance costs, and costs for water losses are combined in the table to the right to represent the total life cycle cost for the recommended plan, Alternative A, as well as for the other alternatives investigated. This comparison justifies the selection of the recommended alternative as having the least cost over the life of the project.

Summary of 50 Year Life Cycle Costs

Alternative	Joint Facility	CAP Trunk	Booster Pump Station	Storage	Treatment	Distribution	SCADA	Total
A – Lake Pleasant Road (Recommended Plan)	-	**$7,389,787**	-	-	-	**$7,326,884**	**$1,744,257**	**$16,460,928**
B - 115th Avenue	-	$6,616,371	$1,591,400	-	-	$7,326,884	$1,744,257	$17,278,912
C – El Mirage Road	-	$7,287,338	$1,591,400	-	-	$7,326,884	$1,744,257	$17,949,879
D – Deer Valley Road	-	$9,909,143	$1,591,400	-	-	$7,326,884	$1,744,257	$20,571,684
E – Through SCW	-	-	-	-	-	-	-	-
Joint Facility w/ Agua Fria Division	$2,710,057	$6,311,766	$1,591,400	-	-	$7,326,884	$1,744,257	$19,684,364
Joint Facility w/ Agua Fria Division & City of Surprise	$2,222,135	$6,311,766	$1,591,400	-	-	$7,326,884	$1,744,257	$19,196,442
Joint Facility w/ City of Surprise	$2,892,234	$6,311,766	$1,591,400	-	-	$7,326,884	$1,744,257	$19,866,541
Cost Estimate Presented to CAP Task Force*	-	**$7,134,929**	**$1,853,343**	**$3,215,794**	-	**$5,851,191**	-	**$18,055,257**

5 Schedule

Attached as sheet E-6 is a proposed schedule for the design and construction of the Groundwater Savings Project. The schedule is based on an anticipated start date of January 1, 2001. Twelve months is shown as the duration for engineering design. This includes efforts for data collection (as-builts and utility maps), field survey, geotechnical investigation, preliminary and final design. Also the acquisition of permits, licenses and miscellaneous right-of-way for the pipeline will take place during this period. The franchise agreement between the city of Peoria and Citizens Water Resources will also be amended during this period.

The schedule assumes that at least two design firms are engaged to design the Groundwater Savings Project. One firm would design the CAP trunk pipeline and the SCADA system. The other firm would design the distribution system. The SCADA system design could be broken out into a third design package. This would require Citizens to coordinate two or three design contracts along the same timeline.

The construction schedules for each of the three construction packages, CAP trunk pipeline, distribution system, and SCADA system, would be staggered to allow for the contractor selection processes not to overlap. All construction packages would be scheduled to end at the same time, however, so the entire system could be tested and approved as a unit.

Again, this would require that Citizens manage 3 different contractors at the same time. Because the contractors will mostly be working in geographically distinct areas, this should not be a problem, and in fact should help to expedite the construction phase.

The schedule shows that CAP could start to be delivered to the golf courses as early as December 2002.

6 Groundwater Savings Plan Summary

The recommended plan for the Groundwater Savings Project is essentially the concept originally proposed by the CAP Task Force. The cost estimates prepared for this report compare favorably with those previously reported to CWR. The recommended plan will achieve the goal of groundwater savings by reducing the need for pumped groundwater at the golf courses.

A joint project with the Agua Fria Division is possible, but would increase costs to the Groundwater Savings Project. Also the timing of the need for a pipeline for the Agua Fria Division is unknown, but certainly not before 2007 (assuming that city of Surprise builds their contemplated pipeline), some three years after the groundwater Savings Project is scheduled to go into service.

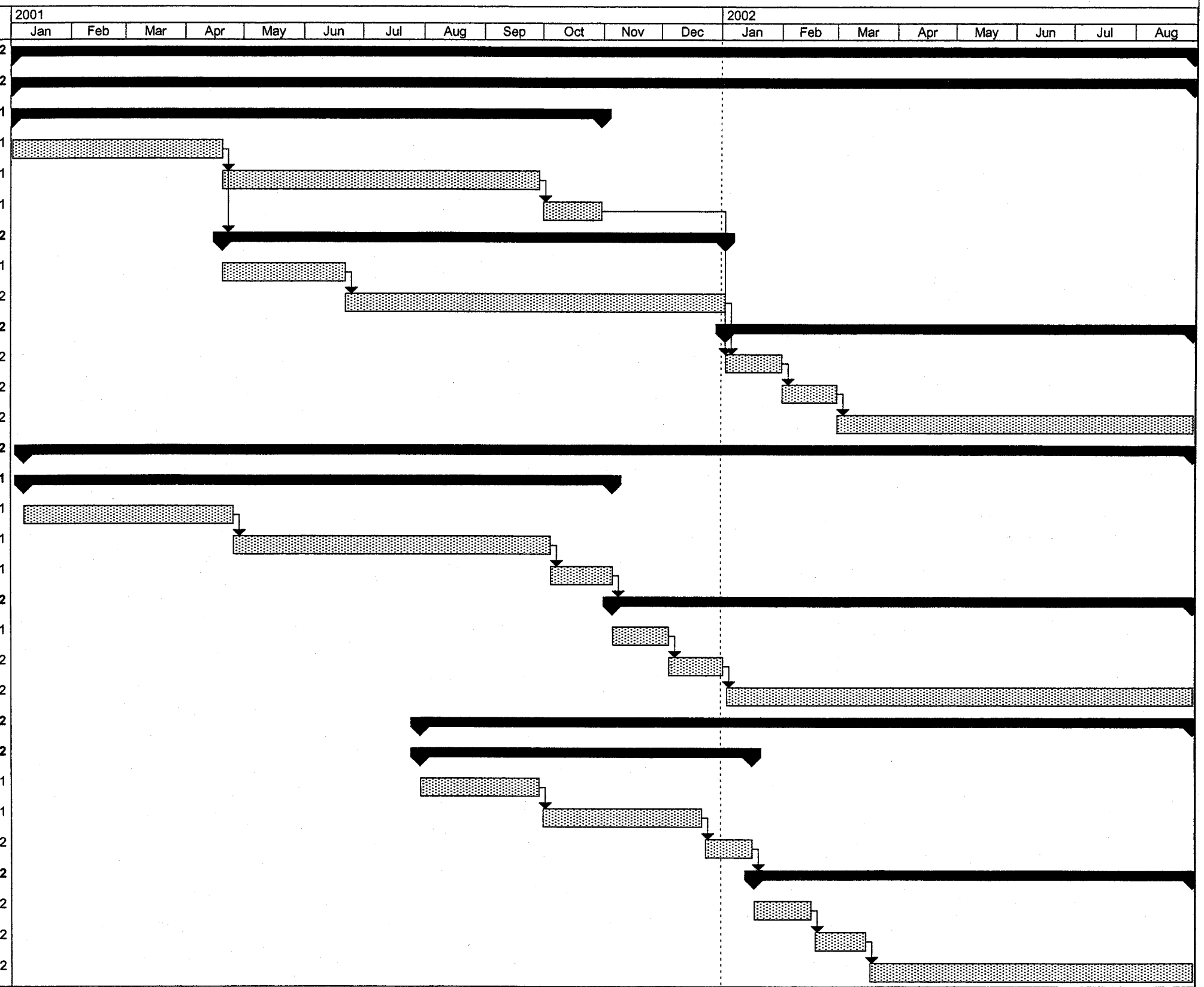
The need for the major components of the project have been thoroughly evaluated and documented. Pumping, storage and treatment are not required for the recommended plan. The need for pumping has been eliminated by taking advantage of the elevation difference between the CAP Canal and the golf course lakes. The need for any reservoir or tank storage has been eliminated by taking advantage of the storage available in the delivery lakes on the golf courses, and by use of a SCADA system that will control the timing and rate of delivery to the golf course lakes. There is no need to treat CAP water for use as golf course irrigation. The use of raw, untreated CAP water for golf course irrigation in the Phoenix metropolitan area is well documented.

The Sun City West distribution system will be essentially the existing system originally constructed to deliver treated effluent from the SCW wastewater treatment plant.

A new distribution system to serve the Recreation Center golf courses in Sun City has been sized to optimally deliver the required flows to use the annual CAP allotment, while maintaining enough flexibility to allow for seasonal and annual variations.

Groundwater Savings Project
Proposed Design & Construction Schedule

ID	Task Name	Duration	Start	Finish
1	**GROUNDWATER SAVINGS PROJECT**	**434 days**	**Tue 1/2/01**	**Fri 8/30/02**
2	**Lake Pleasant Road Pipeline**	**434 days**	**Tue 1/2/01**	**Fri 8/30/02**
3	**Pipeline Design**	**216 days**	**Tue 1/2/01**	**Tue 10/30/01**
4	Preliminary Design Documents (30%)	78 days	Tue 1/2/01	Thu 4/19/01
5	Final Design I (95%)	116 days	Fri 4/20/01	Fri 9/28/01
6	Final Design II (100%)	22 days	Mon 10/1/01	Tue 10/30/01
7	**Right-of-Way Acquisition**	**184 days**	**Fri 4/20/01**	**Wed 1/2/02**
8	Right-of-Way Plans	45 days	Fri 4/20/01	Thu 6/21/01
9	Right-of-Way Acquisition	139 days	Fri 6/22/01	Wed 1/2/02
10	**Pipeline Construction**	**172 days**	**Thu 1/3/02**	**Fri 8/30/02**
11	Advertise for Bids	21 days	Thu 1/3/02	Thu 1/31/02
12	Bid Opening	20 days	Fri 2/1/02	Thu 2/28/02
13	Construction Period	131 days	Fri 3/1/02	Fri 8/30/02
14	**Distribution System**	**430 days**	**Mon 1/8/01**	**Fri 8/30/02**
15	**Distribution System Design**	**216 days**	**Mon 1/8/01**	**Mon 11/5/01**
16	Preliminary Design Documents (30%)	78 days	Mon 1/8/01	Wed 4/25/01
17	Final Design I (95%)	116 days	Thu 4/26/01	Thu 10/4/01
18	Final Design II (100%)	22 days	Fri 10/5/01	Mon 11/5/01
19	**Distribution System Construction**	**214 days**	**Tue 11/6/01**	**Fri 8/30/02**
20	Advertise for Bids	21 days	Tue 11/6/01	Tue 12/4/01
21	Bid Opening	20 days	Wed 12/5/01	Tue 1/1/02
22	Construction Period	171 days	Fri 1/4/02	Fri 8/30/02
23	**SCADA System**	**285 days**	**Mon 7/30/01**	**Fri 8/30/02**
24	**SCADA System Design**	**123 days**	**Mon 7/30/01**	**Wed 1/16/02**
25	Preliminary Design Documents (30%)	45 days	Mon 7/30/01	Fri 9/28/01
26	Final Design I (95%)	60 days	Mon 10/1/01	Fri 12/21/01
27	Final Design II (100%)	18 days	Mon 12/24/01	Wed 1/16/02
28	**SCADA System Construction**	**161 days**	**Fri 1/18/02**	**Fri 8/30/02**
29	Advertise for Bids	21 days	Fri 1/18/02	Fri 2/15/02
30	Bid Opening	20 days	Mon 2/18/02	Fri 3/15/02
31	Construction Period	120 days	Mon 3/18/02	Fri 8/30/02



Groundwater Savings Project
Citizens Water Resources

Task | Progress | Summary | Rolled Up Split | Rolled Up Progress | Project Summary
Split | Milestone | Rolled Up Task | Rolled Up Milestone | External Tasks

EXHIBIT
A-2
Admitted

BEFORE THE ARIZONA CORPORATION COMMISSION

WILLIAM A. MUNDELL
CHAIRMAN
JIM IRVIN
COMMISSIONER
MARC SPITZER
COMMISSIONER

IN THE MATTER OF THE JOINT APPLICATION OF SUN CITY WATER COMPANY AND SUN CITY WEST UTILITIES COMPANY FOR APPROVAL OF CENTRAL ARIZONA PROJECT WATER UTILIZATION PLAN AND FOR AN ACCOUNTING ORDER AUTHORIZING A GROUNDWATER SAVINGS FEE AND RECOVERY OF DEFERRED CENTRAL ARIZONA PROJECT EXPENSES.	Docket Nos.: W-01656A-98-0577 SW-02334A-98-0577

GALLAGHER & KENNEDY, P.A.
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PHOENIX, ARIZONA 85016-9225
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REBUTTAL TESTIMONY OF

RONALD JACKSON, P.E.

ON BEHALF OF

SUN CITY WATER COMPANY AND

SUN CITY WEST UTILITIES COMPANY

TABLE OF CONTENTS

I. INTRODUCTION AND QUALIFICATIONS *1*

II. BRIEF SUMMARY OF REBUTTAL TESTIMONY *2*

III. CITIZENS' PER COMPLIES FULLY WITH DECISION NO. 62293 ..... *3*

IV. THE PER ADEQUATELY ANALYZED ALL NECESSARY ELEMENTS OF THE GSP AND POSSIBLE JOINT PROJECTS *13*

I. INTRODUCTION AND QUALIFICATIONS.

Q. PLEASE STATE YOUR NAME, COMPANY, TITLE AND BUSINESS ADDRESS?

A. My name is Ronald Jackson, P.E. My business address is 12425 West Bell Road, Suite C306, Surprise, Arizona 85374. I am the Supervisor of Planning and Special Projects for Citizens Water Resources. I am also the Project Manager of the Groundwater Savings Project (GSP) design team. I have been employed by Citizens Water Resources for approximately 2 and one half years.

Q. WHAT ARE YOUR JOB DUTIES AND RESPONSIBILITIES?

A. As the Supervisor of Planning and Special Projects, I perform and manage preparation of planning policies and studies regarding future improvement and expansion of Citizen's water and wastewater treatment, collection and conveyance systems. I also design and manage large and special capital improvement projects.

Q. WHAT IS YOUR RELEVANT EDUCATION, TRAINING AND EXPERIENCE?

A. I am a graduate of Syracuse University with a Bachelors of Science in Civil Engineering and a graduate of Broome Community College with an Associates of Science in Engineering Sciences. I am a member of the American Water Works Association, the Water Environment Federation, and the International Association for Water Quality. I was a practicing professional consulting engineer for 12 years before coming to work for Citizens. During my previous employment, I designed and managed projects involving water and wastewater

treatment, storage and conveyance; residential and commercial site design; industrial process design; and storm water management and pollution control. I am a Licensed Professional Engineer in the states of Arizona, New York and New Jersey.

Q. WHAT WAS YOUR ROLE AND INVOLVEMENT REGARDING THE GROUNDWATER SAVINGS PROJECT IN THE SUN CITIES?

A. I have served as Citizens Water Resources Project Manager for the Ground Water Savings Project since February 2000. I have ultimate responsibility over most aspects of the project including assembling and managing the design team, preparation and submission of the PER and facilitation of the Technical Advisory Committee.

II. BRIEF SUMMARY OF REBUTTAL TESTIMONY.

Q. PLEASE SUMMARIZE THE PURPOSE AND SCOPE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. I am testifying on behalf of Sun City Water Company and Sun City West Utilities Company. My testimony rebuts the direct testimony of Mr. Dennis Hustead on behalf of the Sun City Taxpayers Association. Under Commission Decision No. 62293, the focus of this proceeding is whether Citizens' Preliminary Engineering Report (PER) adequately addresses three topics--(1) "the feasibility of a joint facility with the Agua Fria Division including the timeframe for any such joint facility;" (2) "the need for all major elements of [the] proposed plan (e.g., storage and booster stations);" and (3) "binding commitments from golf courses, public and private, and terms and conditions related thereto." I disagree with Mr. Hustead's criticisms of the PER on these issues. In my professional opinion, the PER adequately and properly supports the GSP on the engineering issues. As set forth below, the PER fully complies with Decision

No. 62293. It also should be mentioned that Mr. Hustead's testimony goes beyond those limited PER issues. The bulk of Mr. Hustead testimony doesn't address the specific engineering issues involved in this proceeding under Decision No. 62293.

III. CITIZENS' PER COMPLIES FULLY WITH DECISION NO. 62293.

Q. THROUGHOUT HIS TESTIMONY, MR. HUSTEAD ASSERTS THAT THE PER AND SUPPLEMENTAL PER ARE NOT COMPLETE, ARE INACCURATE AND FAIL TO COMPLY WITH DECISION NO. 62293. DO YOU AGREE?

A. I very strongly disagree with Mr. Hustead's opinions regarding the validity and accuracy of the PER. Mr. Hustead misstates the purpose and scope of the PER. It was specifically written and formatted to comply with Decision No.62293. In Decision No. 62993 (issued February 1, 2000), the Commission approved the concept of the GSP as a means for Citizens to utilize its CAP water allocations in the Sun Cities. As part of that decision, the Commission required Citizens to submit a preliminary engineering report focusing on three issues: (1) the feasibility of a joint facility with Citizens' Agua Fria division; (2) the need for all major elements of the project; and (3) binding commitments from the golf courses. See Decision No. 62293, pp. 20-21. That was the scope and purpose of the PER. Mr. Hustead misstates the goals and objectives of the PER. As a result, Mr. Hustead's testimony deviates from those engineering issues.

Contrary to Mr. Hustead's testimony, the focus and scope of the PER was not whether to implement the GSP, minimize ratepayer costs or quantify benefits to the aquifer. Rather, the PER focused on whether the GSP should include a joint facility with the Agua Fria division, whether elements of the GSP were justified and whether sufficient binding commitments from

the golf courses have been obtained to support the GSP. Mr. Hustead's testimony goes well beyond those issues.

In his testimony, for example, Mr. Hustead complains that the PER focus is too narrow because it examined only the GSP and didn't consider other options to use CAP water in the Sun Cities. But that testimony misconstrues Decision No. 62293 and the scope of the PER. In that Decision, the Commission approved the GSP concept as recommended by the CAP Task Force. The PER was not intended to cover other possible CAP water plans. Mr. Hustead simply ignores the limited scope of the PER as ordered by the Commission in Decision No. 62293.

Another example is Mr. Hustead's suggestion that the PER is flawed because it should study recharge concepts. The ACC and CAP Water Task Force already addressed and rejected the recharge concept. The purpose of the PER was not to reconsider CAP water options. In Decision No. 62293, the Commission evaluated recharge as an interim solution. See Decision No. 62293, p. 6 (characterizing recharge as "short-term" solution). By contrast, the Commission concluded that the GSP is the permanent, long-term solution. Id. at p. 16. The PER was not designed or intended to reconsider recharge versus the GSP as the permanent CAP water use plan. Mr. Hustead's testimony on those issues has no bearing on the PER issues.

Mr. Hustead's testimony is full of these types of non-issues. On page 4 of his testimony, Mr. Hustead states that "…..the PER examines only whether the Alternative is capable of delivering 2,372 acre feet ("ft") to Sun City West golf courses and 4,189 af to the Sun City golf courses and the relative cost thereof." Mr. Hustead uses that statement as a criticism of the PER. But that specific inquiry specifically was what was ordered by the Commission. In short, Mr.

Hustead raises no valid engineering criticisms of the PER. The PER is complete and accurate, and complies fully with Decision No. 62293.

Q. ON PAGE 4 OF HIS TESTIMONY, MR. HUSTEAD ARGUES THAT THE PER DID NOT "...REVIEW ALL ALTERNATIVES, WHICH WOULD MAXIMIZE THE GOAL (I.E. THE BENEFITS TO THE AQUIFER UNDERLYING THE SUN CITIES WHILE MINIMIZING THE COSTS), AND COMPARE THE ALTERNATIVES BASED UPON THEIR RELATIVE COSTS TO ACHIEVE THE GOAL." MR. HUSTEAD ALSO ARGUES THAT THE PER DID NOT "ATTEMPT TO MAXIMIZE THE USE OF EXISTING FACILITIES, MINIMIZE THE NEED FOR NEW FACILITIES, OBTAIN PARTNERS TO SHARE THE COSTS AND ELIMINATE COMPONENTS THAT ARE EITHER UNNECESSARY OR ARE TOO COSTLY IN RELATION TO THE GOAL OF BENEFITING THE AQUIFER." DO YOU AGREE?

A. No, I do not agree with Mr. Hustead's assertions. His testimony is flawed on several fronts. First and foremost, to the point of maximizing the benefit to the aquifer beneath the Sun Cities, that issue already has been reviewed at length by the CAP Task Force and ruled on by the Commission. In Decision No. 62293, the Commission determined that the use of CAP water in the Sun Cities was necessary to prevent "groundwater depletion of the aquifer, land subsidence and other environmental damage." See Decision No. 62293, p. 18. The Commission also determined that the "Groundwater Savings Project will provide direct benefits to the Sun City areas." Id. at p. 19. Finally, the Commission considered various "rate shock" and cost-related arguments, and approved the GSP concept recommended by the CAP Task Force. Id. at p. 16. Those issues are not the subject of the PER as I have already indicated.

Second, in order to comply with Decision No. 62293, the PER examined five (5) alternatives to bring CAP water to the Sun Cities. Our engineering team determined that those five (5) alternatives were the most likely candidates to minimize cost and achieve all the goals of the Groundwater Savings Project.

Third, the alternative which was found to have the lowest life cycle cost was the alternative recommended by the PER. The PER clearly demonstrates in the "Summary of 50 Year Life Cycle Costs" on page E-4 that the recommended Alternative "A" is has the lowest cost of all the alternatives investigated.

Fourth, to the point of maximizing use of existing facilities, the PER proposes to make use of the existing Sun City West Effluent Delivery System in all of the alternatives investigated. Although not part of the chosen alternative, four of the five alternatives investigated the use of the Beardsley Canal to convey CAP water part of the distance between the CAP canal and the Sun Cities. Beyond those systems, there are no other existing facilities available to the Groundwater Savings Project.

Fifth, to the point of seeking partners for the Groundwater Savings Project, the PER addressed three (3) alternatives for partnering the GSP with Citizens Communications - Agua Fria Division, the City of Surprise or both in which all partners would share costs. The costs and technical considerations of such a partnership are presented in Section C of the PER. Mr. Hustead's testimony that the PER did not address these considerations is incorrect.

Q. DO YOU AGREE WITH MR. HUSTEAD'S ASSERTION REGARDING THE PER THAT "THERE ARE SIGNIFICANT FACTORS THAT ARE EITHER ASSUMED AS NECESSARY COMPONENTS OF THE PLAN OR REJECTED WITHOUT SUFFICIENT EVALUATION OR EXPLANATION"?

A. No, I very strongly disagree with Mr. Hustead's assertion. In his testimony, for example, Mr. Hustead contends that the use of existing facilities was not maximized. But his testimony overlooks the fact that there are no other existing facilities beyond the Sun City West Effluent Delivery piping system and the Beardsley Canal which could have been utilized as part of the GSP. The PER adequately addresses use of both options. Section D of the PER details the proposed use of the Sun City West Effluent Delivery System (starting on page D-50)and the Beardsley Canal (starting on page D-3). The recommended alternative proposes to make use of the SCW Effluent Delivery System. Four other alternatives investigated use of the Beardsley Canal, but these alternatives either were not the least cost alternative or were not viable.

Q. DOES MR. HUSTEAD RAISE ANY VALID ENGINEERING CRITICIMS OF THE PER?

A. No. As set forth below, Mr. Hustead's testimony contains numerous erroneous and unsupported conclusions and opinions. Mr. Hustead raises issues that either aren't supported or have no bearing on the PER. I've addressed the flaws in Mr. Hustead's testimony below.

Mr. Hustead criticizes the PER because he believes that the Recreation Centers of Sun City have "no right" to demand exclusive rights to use Sun City's allocation of CAP water. While this may be Mr. Hustead's opinion, it is certainly the "right" of the Recreation Centers of Sun City not to participate in the project. Should the RCSC not participate in the GSP,

approximately 497 acre feet of the allotment could not be utilized in Sun City due to lack of sufficient turf area at the remaining three golf courses. That would prevent the GSP from achieving one of its main objectives--complete consumption of Citizen's entire annual allotment of CAP water allocated to the Sun Cities and Youngtown. Portions of the annual CAP allocation that are not withdrawn for the CAP facilities cannot be credited to future years and to make matters worse, they must still be paid for--whether they are used or unused.

Also, Mr. Hustead states in his testimony that two of the three Sun City country club courses are north of Bell Road. This is incorrect. Only Union Hills Country Club is north of Bell Road; Palmbrook and Sun City County Clubs are south of Bell Road. In fact, the Sun City Country Club is the most southerly of all Sun City golf courses. These facts might tend to alter Mr. Hustead's thinking that the participation of these country clubs would reduce piping cost of the overall project.

Mr. Hustead also takes issue with the premise that the Sun Cities CAP allocation must be used on golf courses. As I indicated above, the choice of a CAP water usage concept is not the subject of the PER. The subject of the PER is an engineering report on the Commission approved CAP usage concept.

Q. DOES MR. HUSTEAD RAISE ANY VALID ISSUES REGARDING RECHARGE?

A. No. In his testimony, Mr. Hustead asserts that recharge was entirely ignored and should have been the focus of the PER. That testimony is not well-taken because recharge was not part of the community chosen and Commission approved CAP water usage concept. The CAP Task Force examined a number of options for use of the Sun Cities/Youngtown's annual

CAP allotment. The concept of recharging the CAP allocation was examined. The conclusion of the CAP Task Force, which included members of the organization Mr. Hustead represents, was that the GSP would be most beneficial. The goal was a GSP to pipe CAP water to the Sun Cities' golf courses in order to reduce groundwater water usage on a gallon for gallon basis.

Q. ARE MR. HUSTEAD'S OPINIONS REGARDING USE OF THE BEARDSLEY CANAL VALID?

A. No. Mr. Hustead argues that the Beardsley Canal four month long, annual dry-up period was assumed to create insurmountable operational problems. This is an incorrect statement. Nowhere in text of the PER does it state that the operational problems created by the annual dry-up are insurmountable. The most significant operational problem created by the annual dry-up, as stated on Page D-4 of the PER, is that even if the pipeline and pump station components of Alternative B, C and D were sized so as to deliver the entire CAP allotment in an 8 months time period, the participating golf courses need 10 to 11 months to absorb the entire CAP allotment (as shown on page B-16 of the PER). Thus, a portion of the Sun Cities CAP water would go unused each year that the Beardsley Canal dry-up occurred. As page D-4 of the PER indicates: "This effectively eliminates these alternatives as long as the MWD continues to undergo an annual dry-up in the Beardsley Canal".

However, in order to present a true comparison with the other alternatives presented, Alternatives B, C, D are sized and their respective costs estimated assuming that the Beardsley Canal is in year round operation and that the annual winter dry-up has been discontinued. Monthly water delivery schedules are shown graphically on page B-15 of the PER. There are no months in the annual schedule in which CAP water is not delivered.

The charges for wheeling water through the Beardsley Canal presented in the PER were approximate rates given to Citizens by officials of the Maricopa Water District. Citizens was not invited to negotiate nor do we have any indication that Citizens has negotiation power with MWD. Furthermore, Mr. Hustead's assertion that the fact that wheeling rate negotiations were not carried out and, thus, served to skew the PER to Alternative A is a highly unsupported statement. The rates presented to Citizens by MWD were presented in good faith in hopes of building a future partnership and those rates were used in the PER.

Q. DO YOU AGREE WITH MR. HUSTEAD'S TESTIMONY REGARDING USE OF THE SUN CITY WEST DISTRIBUTION SYSTEM?

A. No. Mr. Hustead asserts that Citizens accepted the Recreation Centers of Sun City West's denial of the request to allow CAP water to be transported from west to east though their existing Effluent Delivery System without analysis or evaluation. That statement is incorrect.

As stated on page D-19 of the PER regarding Alternative E (which examines flow from west to east), "Calculations indicate that the existing SCW effluent delivery system is inadequate to carry the required flows back to and across the river without increasing the pressure in the pipeline via a new pumping system. The pressure required would exceed the physical limits of the existing pipe and could potentially produce excessive leakage and pipe breaks. The delivery pressure produced by gravity flows in the Alternative E pipeline is not adequate to provide flows at the various discharge locations." Also, as indicated in the letter contained in Appendix C to the PER, the Recreation Centers of Sun City West (RCSCW) may exercise their contractual right to purchase treated effluent from the Sun City West Water Reclamation Facility and deliver said

effluent to the RCSCW golf courses via the existing effluent delivery system pipelines. The flow in the existing pipeline under this circumstance would be from east to west. If the existing Sun City West effluent delivery system were utilized as the GSP CAP trunk main to convey CAP water from west to east, particularly to Sun City, the flow of CAP water from west to east would preclude any flow of treated effluent to Sun City West in the opposite (east to west) direction.

Q. DOES THE PER ADEQUATELY CONSIDER THE POSSIBLE USE OF THE SUN CITY WEST DISTRIBUTION SYSTEM?

A. Yes. Mr. Hustead asserts that the existing Recreation Centers of Sun City West Effluent Delivery System was considered without evaluation of any improvements. This is a broad and incorrect statement. The PER fully and adequately addressed the possible use of the Sun City West Distribution System.

As I have already indicated, the use of the existing effluent delivery system was considered as part of every Alternative evaluated by the PER including the recommended Alternative. Analysis of the recommended Alternative "A" indicates that the existing piping system can be used without modification other than end of pipe controls and valving at each discharge point.

The analysis of Alternative "E" indicated that it is not hydraulically possible to deliver the flow rate required by this project through the existing piping system in a west to east direction. Therefore, Alternative "D" analyzed the possibility of improving the existing piping system by utilizing a new trunk pipeline from the Beardsley Canal through Sun City West to allow for east to west flow through the existing piping system.

Q. IS THE PER AN ACCURATE AND COMPLETE ENGINEERING ANALYSIS OF THE GSP ON THE THREE ISSUES RAISED BY DECISION NO. 62293?

A. Yes. Mr. Hustead raises several arguments against the PER. But he has no valid engineering support for such testimony. For example, Mr. Hustead asserts that the individual and cumulative summaries (presumably meaning cost estimates) do not correlate with regard to booster station and right-of-way costs resulting in skewing the recommendation toward Alternative A. Mr. Hustead's accusation is incorrect and unsupported. Mr. Hustead presents no evidence to support his claim.

Citizens and HDR investigated the so called "lack of correlation" regarding the pump station and right-of –way acquisition costs. The only true "lack of correlation" we have found was the failure to replace the text of part of the cost calculation table on page D-47 (which reports the annual costs of the booster pump station) with the text of the final calculation. However, the costs represented in the "Summary of Operations & Maintenance Costs" on page E-3 of the PER are the accurate and final costs and thus the summary cost comparison upon which the PER's conclusions are reached are completely accurate.

Q. DO YOU AGREE WITH MR. HUSTEAD'S ASSERTION THAT THE PER SHOULD HAVE INCLUDED A HYDROLOGIC ANALYSIS?

A. No, I do not agree. I assume Mr. Hustead is referring to a hydro-geological analysis. A hydro-geological analysis would be performed to assess the movement of groundwater through an aquifer which is not relevant here. All the CAP water applied to the golf course turf will be consumed by the turf grass for growth and will not enter the aquifer. The "groundwater savings" associated with the "Groundwater Savings Project" comes from the

replacement of water that the golf courses would have pumped from the aquifer via wells with CAP water. Thus, the GSP saves groundwater which is already present in the aquifer.

Q. DO YOU AGREE WITH MR. HUSTEAD'S ASSERTION THAT THE PER SHOULD HAVE INCLUDED A STUDY OF THE INTEGRATION OF THE EXISTING SUN CITY WEST WATER RECLAMATION FACILITY AND ITS UNDERGROUND STORAGE FACILITY AS PART OF THE GSP?

A. No, I do not agree. As I have indicated several times, Mr. Hustead seems to be determined to ignore Commissions Decision No. 62293 which approved the concept of the GSP "as presented" by the CAP Task Force. The "integration" debate simply is not part of the PER. The CAP Task Force and the Commission considered a Citizens only recharge project and participation in a joint recharge project and rejected these options in favor of the GSP.

IV. THE PER ADEQUATELY ANALYZED ALL NECESSARY ELEMENTS OF THE GSP AND POSSIBLE JOINT PROJECTS.

Q. IN YOUR OPINION, DOES THE PER SUPPORT AND ADDRESS ALL NECESSARY ELEMENTS OF THE GSP?

A. Yes. The PER provides a complete and thorough review of all necessary elements of the GSP. Mr. Hustead has raised no valid engineering criticisms of the PER in analyzing necessary elements of the project.

Q. DOES THE PER ADEQUATELY ADDRESS AND CONSIDER POSSIBLE JOINT PROJECTS WITH CITIZENS' AGUA FRIA DIVISION?

A. Yes. The entirety of Section C is devoted to this subject.

Q. DO YOU AGREE WITH MR. HUSTEAD'S ASSERTION THAT THE PER'S TREATMENT OF THE BEARDSLEY CANAL REFLECTS A BASIC FLAW WITH THE PER?

A. No, I do not agree. In fact, it is very difficult to follow Mr. Hustead's logic on this point (on page 20 of his testimony). Mr. Hustead raises several issues that have no relation to this project's use of the Beardsley Canal. Mr. Hustead begins by saying that "this aspect of the PER illustrates the adverse impacts created by assuming certain golf courses will not participate and the system must be designed to ensure that every acre foot of CAP water can be delivered every year to the designated golf courses and used proportionately on participating golf courses." But Mr. Hustead doesn't elaborate on that statement.

Instead, Mr. Hustead says "the system should be designed to optimize CAP water deliveries while minimizing costs to Citizen's ratepayer." The PER clearly recommends the lowest cost alternative while delivering the entire annual allotment of CAP water to the Sun Cities. Every alternative examined by the PER--including the chosen alternative--proposes to utilize the existing Sun City West Effluent Delivery system. CAP water is delivered to every golf course that could or would take the water and the annual allocation is consumed.

Mr. Hustead also says "the Agua Fria Recharge Facility should be integrated into the Plan to minimize oversizing and provide operational flexibility." The Agua Fria Recharge Facility has nothing to do with the PER.

Q. DO YOU AGREE WITH MR. HUSTEAD'S ASSERTION THAT THE PER'S ANALYSIS IS INADEQUATE AND INSUFFICIENT TO JUSTIFY ELIMINATING ALTERNATIVE "E"?

A. No, I do not agree. The basis for this statement by Mr. Hustead appears to be his statement that "no attempt was made to identify the impacts of specific improvements to the existing system or alternative connection points in an effort to address the constraints to moving water from west to east." But the very improvement he is proposing was presented as Alternative "D." As I have already discussed, our engineering team verified that use of the Sun City West Effluent Delivery System to deliver GSP flow in the west to east direction is not possible. Therefore, carrying forward the concept of utilizing the existing piping system with minimal improvements and cost, the design team conceived Alternative "D" which proposed to install a single new trunk pipeline from the Beardsley Canal, through Sun City West, beneath the Agua Fria River and connecting at the eastern end of the existing system.

Q. IN HIS TESTIMONY, MR. HUSTEAD CONTENDS THAT NEW PIPING ADDED TO THE SUN CITY WEST EFFLUENT DELIVERY SYSTEM WILL "....SIGNIFICANTLY IMPROVE THE EXISTING SYSTEM HYDRAULICS MAKING ALTERNATIVE "E" A VIABLE ALTERNATIVE." DOES MR. HUSTEAD PROVIDE ANY SUPPORT FOR THAT STATEMENT?

A. No. Mr. Hustead does not present, and in fact admits (on page 23 of his testimony) that he has not performed a hydraulic analysis to validate his assumptions and has not presented cost estimates to allow comparison to the PER's alternatives.

Q. DO YOU AGREE WITH MR. HUSTEAD'S ASSERTION THAT THE SCADA SYSTEM PROPOSED BY THE PER IS NOT MANDATORY?

A. I strongly disagree. The basis of Mr. Hustead's assertion seems to be based on his experience with the RWDS project in the City of Scottsdale. Mr. Hustead admits on page 3 of his testimony that the RWDS includes "two storage reserves and five pump stations." If this is Mr. Hustead's point of reference, he's doing the proverbial comparison of apples to oranges. By utilizing storage reservoirs and pumping stations, a system can essentially provide volume and pressure on demand. Here, our engineering team has displayed a high degree of skill by designing the recommended alternative in the PER which does not require storage reservoirs or pumping stations.

The trade off, however, is that the proposed system cannot provide pressure nor volume on demand to every customer on the system at all times. Thus, water deliveries must be orchestrated from a central point in order to maintain proper pressure and flow rate in the system as each customer receives their flow requirements in turn. If the GSP system was subject to individual golf course control, there would be times when some customers would require water and it would not be available at their tap. The other reason that the system must be coordinated by a computerized SCADA system is to enforce the Central Arizona Project requirement that no more than two adjustments of flow rate from the CAP canal be made per day. If individual customers were allowed to take water at any time, flow adjustment would happen continuously and Citizens would be in violation of its contract with the Central Arizona Project.

SCADA (Supervision, Control and Data Acquisition) is merely an acronym that has evolved for a computerized method of aiding operators of complex systems in tasks that were

formally conducted manually. All complex systems whether they be factory processes or water delivery systems have always had SCADA systems whether they are manual or automated.

The flow meters, level sensors and valves indicated in Section D, Part 7 of the Preliminary Engineering Report (PER) are required for billing and regulatory compliance and must be part of any SCADA system, manual or automated. This is part of the Control and Data Acquisition portion of the SCADA system. The computers and radios are proposed to automate the system and allow the supervision part of SCADA to be performed remotely and with a greatly reduced workforce.

The GSP proposes to construct a piping network which spans approximately 4.5 miles east to west and approximately 7 miles north to south. The system will supply water (at times constantly) to 15 bodies of water, all of which have unique individual needs for timing and volume of water supply. For example, some lakes are small and are drained by their associated golf course watering systems quickly. Thus, theses lakes must be filled more frequently. Other lakes are large and do not require filling as often. Some lakes have ornamental streams associated with them which require that the lake be filled during the daylight hours so as to retain the intent of the landscape design.

As the acronym suggests, the major purpose of the SCADA system contemplated by the GSP is to allow monitoring and control of the GSP from one central point. The system described in the PER is fairly modest. The system proposed includes a small, limited function remote computer at each body of water associated with the GSP. The computer has three functions: to open and close a valve which allows CAP to fill the water body; to monitor lake level; and, to monitor flow rate and pressure of the water flow into the water body. The computer is attached

to a radio which sends data and receives instructions from the central monitoring point. In addition to the computers described above, one additional computer will be located at the CAP turnout on Lake Pleasant Road in order to monitor flow rate in the GSP trunk main. This monitor is necessary in order to enforce the CAP requirement that no more than two adjustments of flow rate from the CAP canal be made per day and for billing by the CAP.

Q. IN HIS TESTIMONY, MR. HUSTEAD QUESTIONS THE CREDIBILITY OF THE PER BECAUSE OF DISCREPENCIES BETWEEN THE PER AND SUPPLEMENTAL PER REGARDING PARTICIPATION OF THE PRIVATE GOLF COURSES. CAN YOU EXPLAIN THAT ISSUE?

A. Yes. Both Mr. Buras of HDR Engineering (who signed and sealed the PER) and myself (who sealed the Supplemental PER) were part of the engineering team that prepared the PER. The Supplement was prepared internally by Citizens as a matter of expedience. There is no contradiction between the two reports--just a reanalysis of the engineering data.

The reason for the reanalysis is explained in this excerpt from page 1 of the Supplemental Report: "The current version of the Groundwater Savings Plan Preliminary Engineering Report indicated (on Page A-4) that without the participation of the two private courses in Sun City West, the GSP will not be operationally feasible. This supplemental report takes a closer look at the data to determine if the Groundwater Savings Plan could be operationally feasible without the participation of Hillcrest Country Club."

There were two factors studied which led to the Supplemental PER. The first factor is the need to fully consume the entire quantity of CAP water allotted to Sun City West on an annual basis. The second factor is need for volumetric flexibility. Volumetric flexibility is a

safety mechanism designed into the system by which excess water can be stored or diverted from its intended destination should that destination become unavailable, either suddenly or over an extended period, to receive that water.

After reviewing the engineering data, I concluded in the Supplemental PER that it is operationally feasible to operate the GSP without the participation of Hillcrest Golf Club. HDR's statement in the original PER does not impact the engineering calculations. Mr. Hustead offers no criticism of the actual analysis.

Q. DO YOU AGREE WITH MR. HUSTEAD'S ASSERTION THAT EVALUATION OF THE FEASIBILITY OF A JOINT PARTICIPATION WITH THE AGUA FRIA DIVISION AND THE CITY OF SURPRISE REFLECTED IN THE PER IS NOT AN IN DEPTH ANALYSIS?

A. No. Mr. Hustead makes the statement that the study presented indicates that the participation of one or both of the partners proposed would substantially reduce the cost of bringing CAP water to the Sun City West service area as compared to constructing the Alternative "A" trunk line. This is incorrect and has no basis in fact. The PER makes no claim of that nature. The only claim that the PER makes regarding cost of a joint project (as indicated on page E-4) is that, depending on the partners, the 50 life cycle cost to the GSP would be between $2.22 million and $2.89 million and the total GSP cost of such alternatives would be between $19.20 million and $19.87 million. This is compared to the total 50 year life cycle cost of Alternative "A" of $16.46 million which is at least $2.74 million less than the joint project cost.

Mr. Hustead argues that the PER should have evaluated a joint option limiting CAP deliveries to those that could be made utilizing the existing effluent system in a west to east direction. But the objective of the GSP was to deliver the "entire" annual CAP allotment to the Sun Cities, not just portions of the allotment. Page C-4 of the PER indicates that Alternative "E" was considered as a component of the joint project but for hydraulic reasons and due to the system owners' needs the Alternative is not feasible.

Along the same lines, Mr. Hustead argues that the booster pump station (required as a component of both Alternatives "D" and "E") should have been analyzed as a part of the cost sharing of the joint facility. That statement makes no sense. Both the Agua Fria and City of Surprise joint projects would have taken delivery of CAP water by gravity flow as explained on page C-2 of the PER. Therefore, only the GSP would require the use of a booster pump station to deliver its CAP water and would be the only party in the partnership paying the cost of the booster pump station.

Q. DOES THAT CONCLUDE YOUR TESTIMONY?

A. Yes.

3099-0043/943289v2

EXHIBIT
A-3
Admitted

Supplemental Engineering Report Upon the Effect of the Non Participation of Hillcrest Country Club in the Sun City/Sun City West/Youngtown Groundwater Savings Plan

December 18, 2000

Prepared By:
Citizens Water Resources
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Surprise, AZ 85374
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Registered Professional Engineer (Civil)
CERTIFICATE NO. 32484
RONALD C. JACKSON
Date Signed 12/18/00
ARIZONA, U.S.A.

1. Purpose

The current version of the Groundwater Savings Plan Preliminary Engineering Report indicated (on Page A-4) that "without the participation of the two private courses in Sun City West, the GSP will not be operationally feasible". This supplemental report takes a closer look at the data to determine if the Groundwater Savings Plan could be operationally feasible without the participation of Hillcrest Country Club.

There were two factors studied which led to the statement in the current report indicated above.

The first factor is the need to fully consume the entire quantity of CAP water allotted to Sun City West on an annual basis.

The second factor is need for volumetric flexibility. Volumetric flexibility is a safety mechanism designed into the system by which excess water can be stored or diverted from its intended destination should that destination become unavailable, either suddenly or over an extended period, to receive that water.

Both of these factors have been restudied and the results of that work are explained below.

2. CAP Water Consumption

The annual CAP water allocation to Sun City West is 2,372 acre feet. The average annual irrigation water consumption of all the Recreation Centers of Sun City West golf courses plus Hillcrest and Briarwood County Club golf courses is 4,504 acre feet. The average annual irrigation water consumption of all Recreation Centers of Sun City West and Briarwood golf courses is 3,735 acre feet. See the attached Figure No. 1 for a graphic representation of the above.

The annual CAP water allocation to Sun City West would account for 53% of the total irrigation needs of the Sun City West golf courses should all the Recreation Centers of Sun City West golf courses plus Hillcrest and Briarwood County Club golf courses participate in the Groundwater Savings Plan. Should Hillcrest County Club decide to not participate, the annual CAP water allocation to Sun City West would account for 64% of the total irrigation needs of the Sun City West golf courses participating. This percentage can be compared to the annual CAP water allocation to Sun City which meets 85% of the total irrigation needs of the Recreation Centers of Sun City golf courses.

The proposed average irrigation makeup for Sun City West under the Groundwater Savings Plan is shown on attached Figures No. 2 and 3. Figure No. 2 shows the irrigation makeup with the Recreation Centers of Sun City West golf courses plus Hillcrest and Briarwood County Club golf courses. Figure No. 3 shows the irrigation

Figure No. 1
CAP Allocation Vs. Total Irrigation Demand

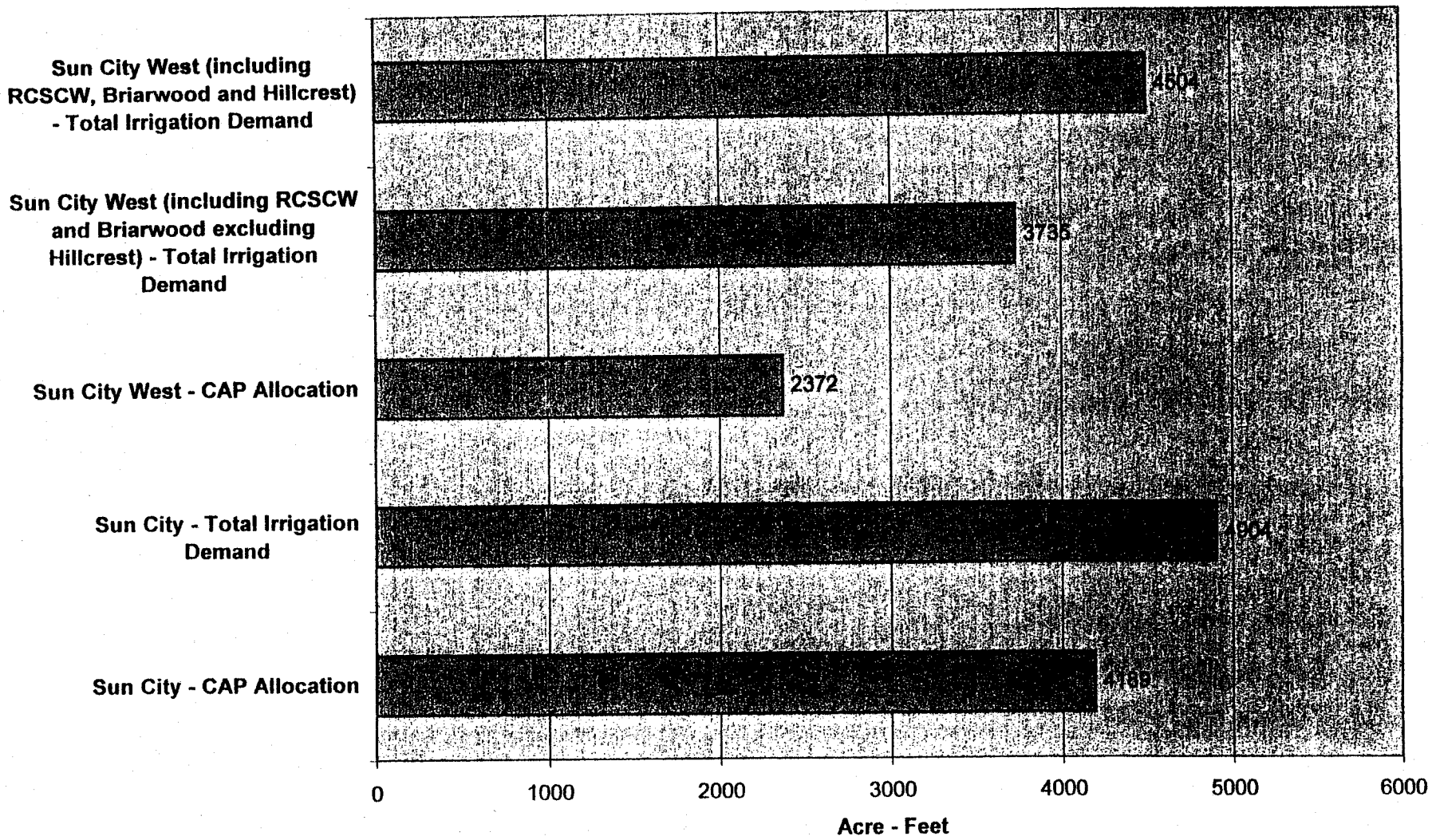


Figure No. 2

Sun City West Irrigation Makeup including RCSCW, Hillcrest & Briarwood

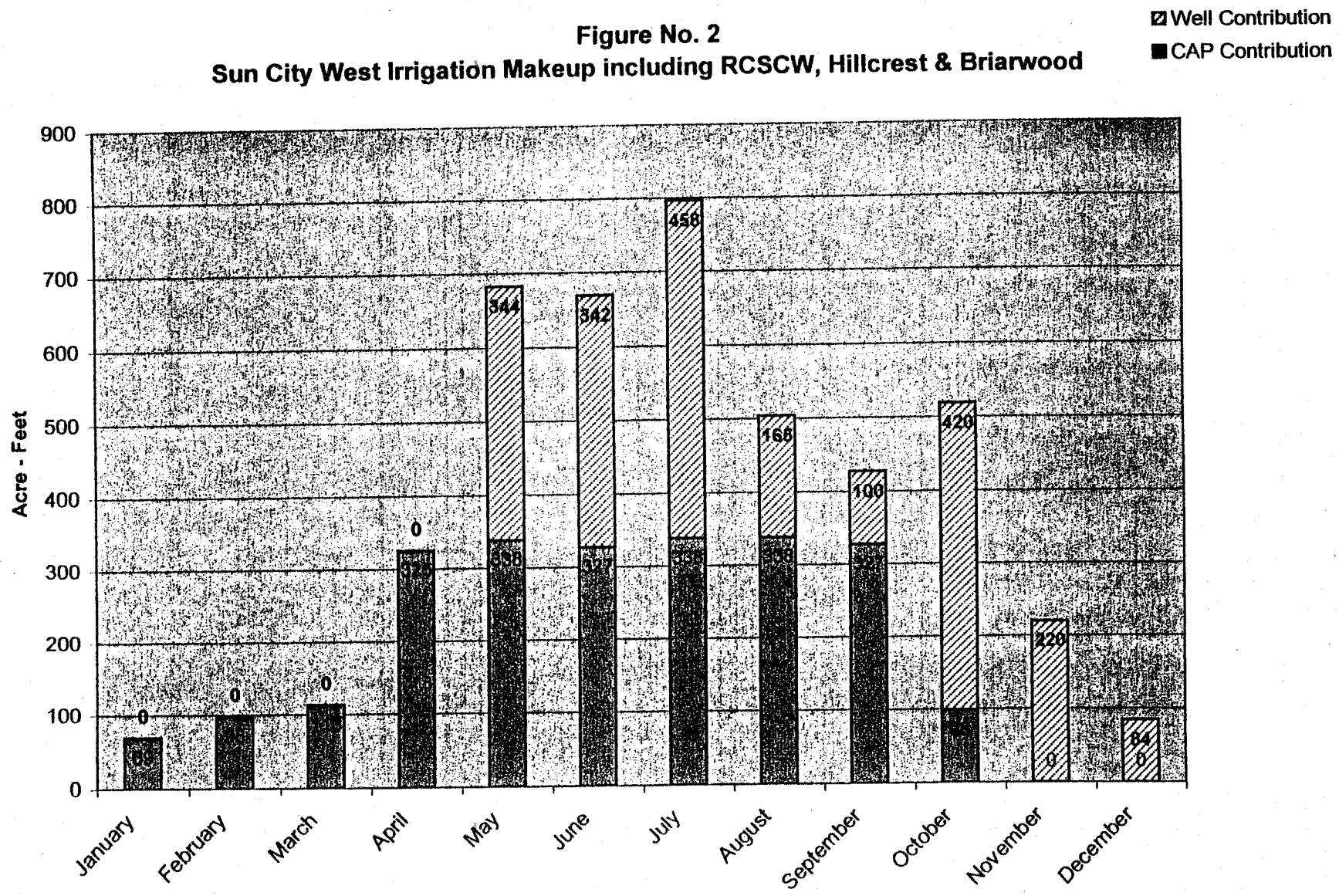
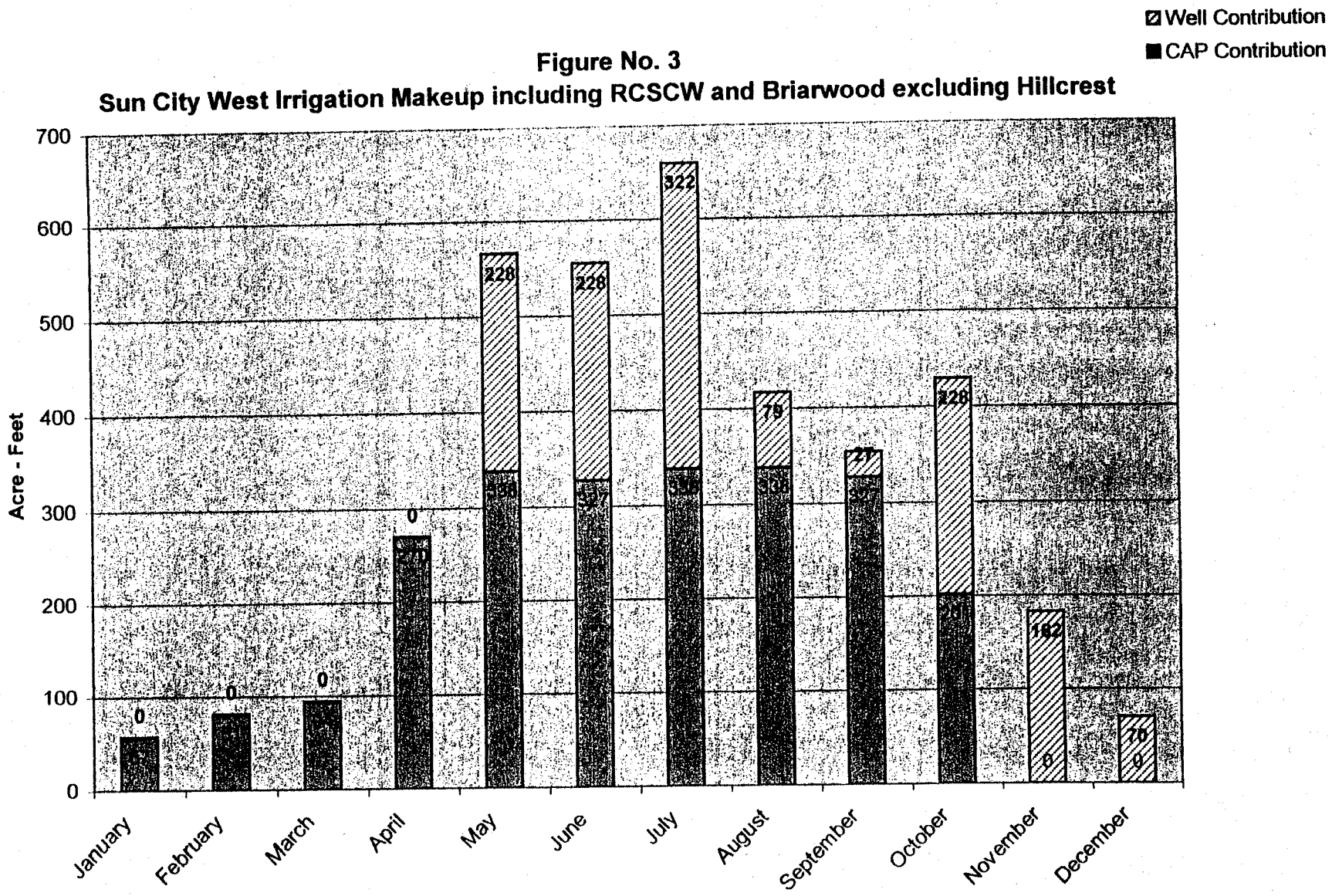


Figure No. 3

Sun City West Irrigation Makeup including RCSCW and Briarwood excluding Hillcrest



makeup with the Recreation Centers of Sun City West golf courses plus Briarwood County Club golf course (i.e. Hillcrest not participating). The figures demonstrate the amount of CAP and well water that will be consumed by all participating golf courses on a month by month basis.

As is shown on the attached figures the entire annual Sun City West CAP allocation will be consumed whether Hillcrest County Club participates or not. Furthermore, in either case the Sun City West CAP allocation is consumed by October each year. This leaves two months at the end of the year to irrigate with CAP water should factors such as high rainfall prevent the full allocation from being consumed by October.

3. Volumetric Flexibility

Volumetric flexibility is a safety mechanism designed into the piping network by which excess water and/or pressure can be stored or diverted from its intended destination should that destination become unavailable, either suddenly or over an extended period, to receive that water.

An example of the need for extended volumetric flexibility would be a period unusually rainy weather. Records indicate that on an average basis golf courses in Sun City West use 0.5 inches or less of irrigation water per day during the heaviest irrigation month of the year (i.e. July). A search of weather records for a rain gauge maintained by Maricopa County at Bell Road near Dysart Road indicates 15 occurrences in the past 5 years of 24 hour rainfall totals of 0.5 inches or more. When a large storm occurs, a golf course will require little or no irrigation water. Should a storm develop suddenly, it is possible that water would have been ordered or the conveyance of that water already begun from CAP for that day. The system operator will then have to store that water, possibly in already full lakes in the system, which will not be using water for possibly a day or more.

An example of the need for sudden volumetric flexibility would be a pipe break (which would require temporary shut down for repair) or a valve sticking closed at any given golf course just as the system operator was conveying water to that course.

In the event of either of the examples given above the water flow must be stored or sent somewhere other than its intended destination so as to prevent the loss of water from a pipe break and/or to prevent the violation of the CAP's flow adjustment rules. These situations are temporary in nature, lasting for a few hours or up to a day, but require immediate, temporary measures to allow the system operator to rebalance the system as a whole.

Major consideration was given to the lake within the Hillcrest Country Club golf course as a facility which lends volumetric flexibility to the Sun City West system. Since the lake has a large surface area (23.70 acres, the largest in Sun City West), a

large quantity of water could be store in or diverted to that lake resulting in only a small rise in surface elevation.

The same consideration was given to the operation of the Sun City West system should Hillcrest Country Club chose to not participate. The lakes in the Recreation Centers of Sun City West golf courses have a total surface area of 51.61 acres and Briarwood Country Clubs lakes have a surface area of 4.10 acres for a total of 55.71 acres. Assuming that no water was used for a 1 day period and that the maximum amount of water that the Sun City West piping system can convey in 1 day (10.91 acre feet) must be stored within all of the participating golf course lakes, that storage would result in a lake surface elevation rise of 2.35 inches in all of the lakes of the participating golf courses. This magnitude of rise is considered tolerable.

It is also possible to temporarily transfer Sun City West's water to lakes in Sun City which have 102.70 acres of lake surface area (including Viewpoint and Dawn lakes which both have surface areas of 37.50 acres). If excess water for Sun City West's allocation was diverted to Sun City lakes, water delivery to Sun City would be throttled back after the event that created the need for the diversion had passed until Sun City West had fully recovered its diverted volume. This would result in no net loss of allocated CAP volume form Sun City West.

The hydraulic capability of existing Sun City West piping system was reevaluated without flow demand from Hillcrest Country Club. Calculations determined that CAP water can be delivered to the Recreation Centers of Sun City West and Briarwood Country Club at the maximum capacity of the existing piping system with sufficient pressure for proper system operation without Hillcrest Country Club participating.

4. Conclusion

Based on calculation and considerations indicated above, the implementation of the Groundwater Savings Plan in Sun City West will be possible should Hillcrest Country Club golf course decide to not participate. Although the participation of the Hillcrest Country Club would lend overall flexibility to the system, it is not necessary for the operation of the Groundwater Savings Project.

The entire annual CAP allocation to Sun City West can be consumed by the Recreation Centers of Sun City West and Briarwood golf courses during the calendar year of the allocation.

The Sun City West conveyance system to will be provided with adequate volumetric flexibility through lake volume to allow for safe and continuous operation.

EXHIBIT 27
A-4
Admitted

BEFORE THE ARIZONA CORPORATION COMMISSION

WILLIAM A. MUNDELL
CHAIRMAN
JIM IRVIN
COMMISSIONER
MARC SPITZER
COMMISSIONER

IN THE MATTER OF THE JOINT APPLICATION OF SUN CITY WATER COMPANY AND SUN CITY WEST UTILITIES COMPANY FOR APPROVAL OF CENTRAL ARIZONA PROJECT WATER UTILIZATION PLAN AND FOR AN ACCOUNTING ORDER AUTHORIZING A GROUNDWATER SAVINGS FEE AND RECOVERY OF DEFERRED CENTRAL ARIZONA PROJECT EXPENSES.	Docket Nos.: W-01656A-98-0577 SW-02334A-98-0577

GALLAGHER & KENNEDY, P.A.
2575 E. CAMELBACK ROAD
PHOENIX, ARIZONA 85016-9225
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REBUTTAL TESTIMONY OF

DAVID BURAS, P.E.

ON BEHALF OF

SUN CITY WATER COMPANY AND

SUN CITY WEST UTILITIES COMPANY

TABLE OF CONTENTS

I. INTRODUCTION & QUALIFICATIONS *1*

II. THE PER IS A COMPLETE AND ADEQUATE ANALYSIS OF THE GSP *2*

EXHIBITS

DB-1 LIFE CYCLE COSTS (OVER 50 YEARS) FOR PROPOSED BOOSTER PUMP STATION

I. INTRODUCTION & QUALIFICATIONS.

Q. PLEASE STATE YOUR NAME, TITLE AND BUSINESS ADDRESS?

A. My name is David Buras, P.E. My business address is 2141 East Highland Avenue, Suite 250, Phoenix, Arizona 85016.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am a vice president at HDR Engineering, Inc (HDR). I am also HDR's Project Manager of the Groundwater Savings Project (GSP) design team.

Q. HOW LONG HAVE YOU BEEN EMPLOYED BY HDR ENGINEERING?

A. I have been employed by HDR Engineering for approximately 17 years.

Q. WHAT ARE YOUR DUTIES AND RESPONSIBILITIES?

A. I am the Manager of HDR's water resources operations in Arizona. Our water resources staff prepares a wide range of engineering studies and design documents related to the collection, control and conveyance of water resources. Additionally, I serve as project manager on select projects, such as this one.

Q. WHAT IS YOUR RELEVANT EDUCATION, TRAINING AND EXPERIENCE?

A. I am a graduate of South Dakota State University, with a Bachelors of Science in Civil Engineering. I have over 20 years experience in Arizona designing systems for the movement of water, such as pipelines, canals, channels, reservoirs, pump stations, detention basins and such. I am a Licensed Professional Engineer and a Registered Land Surveyor in the State of Arizona.

II. THE PER IS A COMPLETE AND ADEQUATE ANALYSIS OF THE GSP.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. I am providing rebuttal testimony to the direct testimony of Mr. Dennis Hustead who testified on behalf of the Sun City Taxpayers Association.

Q. RESPONDING DIRECTLY TO MR. HUSTEAD'S ALLEGATIONS ON PAGES 6 AND 7 OF HIS TESTIMONY, DID YOU OR ANY MEMBER OF YOUR PROJECT TEAM ATTEMPT TO "SKEW" DATA OR CALCULATIONS REGARDING COSTS OF WATER WHEELING THROUGH THE BEARDSLEY CANAL, CONSTRUCTION OR OPERATION COSTS OF A BOOSTER PUMP STATION AND/OR RIGHT-OF-WAY COSTS IN FAVOR OF ANY ALTERNATIVE PRESENTED IN THE GSP?

A. Absolutely not. No attempt was made in any way to skew data or calculations regarding costs of water wheeling through the Beardsley Canal, construction or operation costs of a booster pump station and/or right-of-way costs in favor of any alternative presented in the GSP. We wrote the PER as an objective preliminary engineering review of the Groundwater Savings Project.

Q. PLEASE ADDRESS THE QUESTIONS ABOUT THE BOOSTER PUMP STATION'S COSTS RAISED BY MR. HUSTEAD IN HIS TESTIMONY ON PAGE 21?

A. On pages 21-22 of his testimony, Mr. Hustead raises concerns about the life cycle costs for the booster pump station contained on pages E-3 and E-4 of the PER as compared to the booster station summary on page D-47 of the PER. Mr. Hustead argues that the summaries on pages E-3 and E-4 are overstated regarding construction and operation & maintenance costs

because they do not coincide with the numbers on page D-47. That issue can be resolved easily and does not detract from the PER.

Basically, the table included on page D-47 of the PER unfortunately includes information and numbers from an earlier draft version of the report. The cost summaries on page E-3 and E-4 were based on the correct final numbers but page D-47 contains the wrong back-up numbers. Page D-47 should have been corrected before issuance of the final version of the PER but we mistakenly left those numbers in the report. It bears emphasis that the ultimate calculations contained on pages E-3 and E-4 were based on the correct numbers. The correct version of Page D-47 is attached as exhibit DB-1. Exhibit DB-1 should have replaced page D-47 in the PER.

The tables on E-3 and E-4 are summary tables and coincide with attached exhibit DB-1. Pages E-3 and E-4 were designed to show simple cost comparisons. As such, we didn't show the individual line items for incidental costs such as engineering, contingencies and construction administration in these numbers and they were not itemized as in the summaries for each alternative. But the summaries contained on pages E-3 and E-4 were calculated from the numbers on exhibit DB-1. Those calculations are correctly summarized on pages E-3 and E-4 and were performed according to accepted engineering calculations and standards. Mr. Hustead's concerns about the validity of the PER are not supported by any valid engineering calculations.

Also, the pumping station capital construction cost and the factors applied to the capital cost including engineering design, construction administration, admin/legal/financial, and contingency (which total to 55% of capital construction cost) are consistent throughout the PER (i.e. Joint Project estimates, and Alternatives B, C, and D). Mr. Hustead simply has pointed out a typo in the report that does not undermine the engineering analysis in any way.

Q. PLEASE ADDRESS THE QUESTIONS ABOUT THE RIGHT-OF-WAY COSTS RAISED BY MR. HUSTEAD IN HIS TESTIMONY ON PAGE 22?

A. The costs reported in the text were from the original investigation done by our subconsultant, Universal Field Services (UFS), and represented only the land costs for the permanent easement. HDR added to the UFS figures to allow for additional real costs associated with property acquisition such as temporary construction easements, title company services, appraisal services, legal descriptions, recording fees, etc. The figures shown in the tables should therefore be used, not those in the text. The costs indicated should have been itemized as a "lump sum" amount rather than the "per square foot" amounts as shown. However the amounts shown are valid for all alternatives.

Alternative	Text Page Reference	Cost Reported in Text	Table Page Reference	Cost Reported in Table
A	D-12	$50,000	D-13	$100,000
B	D-14	$49,000 to $68,000	D-14	$116,000
C	D-15	$60,000 to $90,000	D-16	$150,000
D	D-17	$80,000 to $120,000	D-18	$200,000

Q. ON PAGES 27-28 OF HIS TESTIMONY, MR. HUSTEAD IS CRITICAL OF THE GSP BASED ON THE APPARENT CONTRADICTION BETWEEN PAGE A-4 OF THE PER AND THE SUPPLEMENTAL PER. CAN YOU EXPLAIN THE CIRCUMSTANCES SURROUNDING THE PER'S STATEMENTS REGARDING PARTICIPATION OF HILLCREST AND BRIARWOOD GOLF COURSES?

A. Yes. Page A-4 of the PER states that "as determined by the analysis conducted by the consulting team and presented in this report, without participation of the two private courses in Sun City West, the GSP will not be operationally feasible." Those statements on page A-4 of the PER were based on assumptions that Briarwood and Hillcrest country clubs would be project participants. As mentioned on page A-4 of the PER, the "ACC ordered Citizens to consider the participation of non-Recreation Center courses in the GSP." We were advised that Briarwood and Hillcrest were operational participants in the GSP and that's why page A-4 contains those statements. We simply assumed those courses were necessary.

In his testimony, Mr. Hustead wrongly implies that HDR specifically calculated and analyzed the engineering data regarding operations without Hillcrest Country Club. That is simply not the case. As a result, Mr. Hustead improperly assumes a contradiction between the PER and Supplemental PER. HDR did not evaluate the underlying engineering data regarding project operations without Hillcrest Country Club.

Q. HAVE YOU REVIEWED MR. JACKSON'S SUPPLEMENTAL ENGINEERING REPORT REGARDING THE NECESSITY FOR PARTICIPATION OF BOTH COUNTRY CLUB GOLF COURSES IN SUN CITY WEST?

A. Yes, I reviewed Mr. Jackson's supplemental PER and background data underlying the report.

Q. DO YOU AGREE WITH THE CONCLUSIONS THAT MR. JACKSON REACHED IN HIS SUPPLEMENTAL ENGINEERING REPORT?

A. Yes, in my view, Mr. Jackson's supplemental report correctly analyzes the engineering data regarding the participation of Hillcrest Country Club. Further, the original PER and the Supplemental PER do not conflict on this issue. As Citizens consulting engineer, HDR made the statement regarding participation of both country club golf courses in Sun City West in the GSP as a conservative opinion to ensure that Citizens would meet the expressed goal of always consuming the entire annual CAP allocation and having volumetric flexibility to prevent upsets. Since the calculations presented in the Supplemental PER indicate that the GSP will be viable without the specific participation of Hillcrest Golf Club, those goals still will be realized on the project.

Q. DO THIS CONCLUDE YOUR TESTIMONY?

A. Yes, it does.

3099-0043/944827

REBUTTAL TESTIMONY OF DAVID BURAS, P.E.
W-01656A-98-0577/SW-02334A-98-0577
JULY 31, 2001

EXHIBIT DB-1

LIFE CYCLE COSTS (OVER 50 YEARS)
FOR PROPOSED BOOSTER PUMP STATION

(CORRECTED PAGE D-47 TO CITIZENS' PRELIMINARY ENGINEERING REPORT)

LIFE CYCLE COSTS (OVER 50 YEARS)
FOR PROPOSED BOOSTER PUMP STATION

Item Description	Unit	Quantity	Unit Price	Amount
Concrete Base Slab & Excavation	C.Y.	30	$350	$10,500
Pumps 3400 GPM, 75 hp	EA.	3	$36,400	$109,200
Electrical and Control Equipment	L.S.	1	$38,000	$38,000
Electrical Feed	L.S.	1	$9,000	$9,000
10" Pump Control Valves	EA.	3	$4,390	$13,170
10" Cushioned Check Valves	EA.	3	$6,990	$20,970
16" Gate Valve	EA.	3	$6,580	$19,740
14" Gate Valve	EA.	3	$3,800	$11,400
2" Air Release Valves	EA.	3	$650	$1,950
Miscellaneous Piping	L.S.	1	$34,400	$34,400
Site Grading & 2" D.G.	S.Y.	990	$7	$6,930
8' High Block Wall	L.F.	372	$50	$18,600
20' Sliding Gate	L.S.	1	$1,800	$1,800
Property Costs	S.F	12,000	$1	$12,000
Booster Pump Station Capital Costs Subtotal				$307,660
			Annual Cost	Present Worth
Power Costs Present Worth @ $0.07/kwh			$60,040	$983,196
O&M Manhour Costs PW @ 0.5 hrs/day for $30,000/yr salary			$1,875	$30,704
O&M PW Costs @ 1% of Structure & 2.5% of Equipment/ Yr			$6,308	$103,299
Salvage Value of Structure				($2,673)
Subtotal Present Worth O&M and Salvage Costs				$1,114,527
Total Life Cycle Cost				$1,422,187

Note: Power Costs were computed by assuming 2 pumps run always 3/4 of the year and 1 pump will run always the remaining 1/4 of the year.

Subtotal Equipment	$223,430
Subtotal Structures	$72,230

944829

EXHIBIT
A-5
Admitted

BEFORE THE ARIZONA CORPORATION COMMISSION

WILLIAM A. MUNDELL
CHAIRMAN
JIM IRVIN
COMMISSIONER
MARC SPITZER
COMMISSIONER

IN THE MATTER OF THE JOINT APPLICATION OF SUN CITY WATER COMPANY AND SUN CITY WEST UTILITIES COMPANY FOR APPROVAL OF CENTRAL ARIZONA PROJECT WATER UTILIZATION PLAN AND FOR AN ACCOUNTING ORDER AUTHORIZING A GROUNDWATER SAVINGS FEE AND RECOVERY OF DEFERRED CENTRAL ARIZONA PROJECT EXPENSES.	Docket Nos.: W-01656A-98-0577 SW-02334A-98-0577

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REBUTTAL TESTIMONY OF

KEITH LARSON

ON BEHALF OF

SUN CITY WATER COMPANY AND

SUN CITY WEST UTILITIES COMPANY

TABLE OF CONTENTS

I. INTRODUCTION AND QUALIFICATIONS 1

II. BRIEF SUMMARY OF REBUTTAL TESTIMONY 2

III. MR. HUSTEAD'S TESTIMONY RELATING TO POSSIBLE EXPIRATION OF INDUSTRIAL USE PERMITS POSSESSED BY PARTICIPATING GOLF COURSES IS NOT WELL-TAKEN 3

IV. MR. HUSTEAD'S TESTIMONY RELATING TO OTHER BENEFITS OF THE GSP HAS NO BEARING ON THE SUFFICIENCY OF THE PER OR THE PROJECT... 6

V. MR. HUSTEAD'S TESTIMONY RELATING TO STORED WATER AND WATER CREDITS HAS NO BEARING ON THE GSP OR PER 10

I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME, POSITION, EMPLOYER AND BUSINESS ADDRESS.

A. My name is Keith R. Larson. My business address is 1562 N. Del Webb Boulevard, Sun City, Arizona 85351. I work for Citizens Water Resources ("Citizens") as Water Resources Manager for Citizens' water operations in Maricopa, Mohave, and Santa Cruz counties in Arizona. I've been employed by Citizens since April 2001.

Q. WHAT ARE YOUR DUTIES AND RESPONSIBILITIES AS CITIZENS' WATER RESOURCES MANAGER?

A. As Water Resources Manager, I'm responsible for managing the water resources available to Citizens' water properties in Maricopa, Mohave, and Santa Cruz counties. I also manage the development and implementation of the SAVEH20 water conservation program. My specific duties include ensuring proper and timely filing of annual reports with the Arizona Department of Water Resources (ADWR) associated with assured water supply certificates, annual water withdrawal and use reports. I am responsible for water rights administration, managing Citizens' subcontracts for CAP water, and all short and long-range water resources planning activities.

Q. PLEASE SUMMARIZE YOUR RELEVANT EDUCATION, TRAINING AND PROFESSIONAL EXPERIENCE.

A. In 1978, I obtained a Bachelor of Science Degree in Watershed Science from Utah State University. In 1981, I obtained an M.S. degree in Hydrology from Oregon State University. Prior to my employment at Citizens, I worked for the City of Phoenix Water

Services Department as the city's Principal Water Resources Planner from 1988-2001. My duties essentially were the same as my current responsibilities with Citizens. Prior to working with the City of Phoenix, I was employed by the Arizona Department of Water Resources as Water Resources Planner for a period of approximately three years. I was the Lead Planning Coordinator for the Second Management Plans for Arizona's active management area.

II. BRIEF SUMMARY OF REBUTTAL TESTIMONY.

Q. PLEASE SUMMARIZE THE PURPOSE AND SCOPE OF YOUR REBUTTAL TESTIMONY.

A. Briefly, my testimony rebuts opinions and testimony offered by Dennis Hustead on behalf of Sun City Taxpayers Association related to certain water rights and related issues. Specifically, I address Mr. Hustead's testimony relating to (1) expiration of certain General Industrial Use Permits (GIUPs) possessed by participating golf courses, (2) alleged benefits derived from the Groundwater Savings Project (GSP) unrelated to the Sun City aquifer and (3) stored water and water credits. As set forth below, Mr. Hustead's testimony is not well-taken on these issues. Possible expiration of GIUPS possessed by participating golf courses will have no bearing on the success and sufficiency of the GSP. The golf courses have ample water rights to exchange for Citizens' CAP water. Likewise, Mr. Hustead's testimony relating to other benefit to the golf courses stemming from the GSP has no bearing on the GSP. Finally, Citizens' recovery or use of stored water or water credits does not impact the Preliminary Engineering Report (PER) or GSP.

III. MR. HUSTEAD'S TESTIMONY RELATING TO POSSIBLE EXPIRATION OF INDUSTRIAL USE PERMITS POSSESSED BY PARTICIPATING GOLF COURSES IS NOT WELL-TAKEN.

Q. ON PAGES 8-10 OF HIS DIRECT TESTIMONY, MR. HUSTEAD RAISES ISSUES RELATING TO EXPIRATION OF GENERAL INDUSTRIAL USE PERMITS POSSESSED BY CERTAIN PARTICIPATING GOLF COURSES. DOES MR. HUSTEAD RAISE ANY VALID CONCERNS REGARDING THE VIABILITY OF THE GSP OR PER ON THAT ISSUE?

A. No. This issue has been thoroughly researched and addressed. I have reviewed and analyzed the issues relating to potential expiration of GIUPs. Even if GIUPs possessed by certain participating golf courses are not renewed in 2005 by ADWR, those golf courses may exchange their groundwater for all but only 42.27 acre-feet of Sun City West Utility Company's CAP allocation. That 42.27 acre feet shortfall constitutes merely 1.8 percent of the total CAP allocation for Sun City West and only 0.6 percent of the total combined CAP water allocation for Sun City West and Sun City. While Citizens and the Recreation Centers of Sun City and Sun City West desire to use their entire CAP water allotment, a 42.27 acre-feet or 1.8 percent shortfall will not jeopardize the Groundwater Savings Project.

Q. IN CONSIDERING THE GSP CONCEPT, DID THE PARTIES ANTICIPATE THE POSSIBLE EXPIRATION OF GENERAL INDUSTRIAL USE PERMITS POSSESSED BY THE GOLF COURSES? IF SO, HOW?

A. Yes. The golf courses of the Recreation Centers of Sun City own a total of 6,609 acre-feet of Type II groundwater rights, which exceeds the average annual use of the Sun City golf courses by 1,705 acre-feet per year. That surplus is more than sufficient to make up any minimal water rights deficits incurred by the Sun City West Recreation Centers courses during

years of average or even above average water use. The parties anticipated the need to share surplus water rights, and addressed that issue in the Operating Agreements between Citizens and the Recreation Centers of Sun City and Sun City West, and Briarwood Country Club. Those Operating Agreements require the Recreation Centers and Briarwood to "pool" their water rights to make available, on a year-by-year basis, any surplus rights for use on golf courses that have insufficient rights in the event that any GIUPs are not renewed by ADWR. The water rights pooling provisions of those Operating Agreements ensure that all participating golf courses will have sufficient water supplies and the entire CAP allocations of Sun City and Sun City West are used each year. Mr. Hustead's testimony does not account for these circumstances and lacks merit on these water rights issues.

Q. ARE THERE ANY OTHER MECHANISMS TO ACCOUNT FOR ANY GROUNDWATER RIGHT SHORTFALLS?

A. Yes. Mr. Hustead also fails to address the use of effluent from the Sun City West Water Reclamation plant. The Recreation Centers of Sun City West, by contract, have the first priority right to all effluent from the reclamation plant. This contract was approved by the Commission in Decision No. 61897. Such effluent water could be provided to the Sun City West Recreation Center golf courses through a CAP Water/Effluent water exchange between Citizens and the Recreation Centers. Such an exchange would ensure that all participating golf courses use their existing effluent water rights and ensure that the entire CAP allocation of Sun City West is used by Citizens each year.

Q. WHY IS GROUNDWATER RIGHTS POOLING PREFERRED OVER USE OF THE EFFLUENT?

A. Pooling of groundwater rights by the Recreation Centers is preferable for Citizens ratepayers because it will enable the continued use of effluent credits by the Sun City Water Company and the Sun City West Utilities Company. Use of effluent storage credits allow Sun City and Sun City West to offset potential regulatory actions by ADWR related to compliance with water conservation requirements. Regulatory actions may be mitigated with recovered effluent credits because recovered effluent is not counted against a community's gallons per capita per day (gpcd) conservation target. ADWR compliance actions could include fines imposed on Citizens or requiring Citizens to implement specific water conservation programs. Those actions could result in direct impacts to ratepayers in the form of mandatory water use restrictions, alternative water rate structures to reduce water use, or higher water rates necessary to recover costs for conservation programs or additional groundwater use fees that could be implemented by the legislature in the future, and which are currently a topic of discussion within the Governor's Water Management Commission.

Q. ON PAGE 9 OF HIS TESTIMONY, MR. HUSTEAD OPINES THAT CITIZENS' CHARACTERIZATION OF PUMPED WATER AS CAP WATER WILL NEGATIVELY IMPACT THE AQUIFER. DO YOU AGREE?

A. No. This supposition by Mr. Hustead has no basis in fact. Mr. Hustead's testimony on this issue has nothing to do with Citizens' Preliminary Engineering Report (PER). Fundamentally, the PER was not intended to address benefits to the aquifer. That's because the Commission, in Decision No. 62293, expressly found that the proposed GSP and CAP water/groundwater exchange will positively benefit the aquifer. Mr. Hustead confuses physical

benefits to the aquifer with regulatory benefits associated with compliance with the Groundwater Management Act (GMA). Mr. Hustead simply doesn't understand or overlooks the fact that how the water is characterized from a GMA regulatory perspective cannot result in a negative hydrologic impact on the aquifer. Put simply, the GSP will result in benefits to the Sun Cities aquifer and save groundwater no matter how the water is characterized. Since all water conservation requirements set by ADWR for the Sun City Water Company and the Sun City West Utilities Company service areas remain in effect as long as any portion of the Utility's water deliveries to its customers is groundwater, potable water demand is essentially constant. Likewise, the golf course conservation requirements are unaffected by the water exchange, resulting in a constant non-potable water demand. Therefore, every drop of CAP water physically delivered to the golf courses reduces groundwater pumping by a like amount and benefits the aquifer by the same amount.

IV. MR. HUSTEAD'S TESTIMONY RELATING TO OTHER BENEFITS OF THE GSP HAS NO BEARING ON THE SUFFICIENCY OF THE PER OR THE PROJECT.

Q. ON PAGES 12-13 OF HIS TESTIMONY, MR. HUSTEAD RAISES ISSUES INVOLVING CLAIMED OTHER BENEFITS OF THE GSP UNRELATED TO THE BENEFITS TO THE AQUIFER. DOES THAT TESTIMONY HAVE ANY BEARING ON ADEQUACY OF THE PER?

A. Absolutely not. On pages 12-13 of this testimony, Mr. Hustead implies that the accuracy, validity, and credibility of the PER and GSP should be questioned because the participating golf courses may derive certain other benefits from the GSP. In this testimony, Mr. Hustead does not raise any valid engineering or water rights issues. Instead, Mr. Hustead insinuates that the PER was undertaken to benefit the golf courses and not the Sun Cities' aquifer. Mr. Hustead has no support for those arguments. For example, Mr. Hustead opines that

the Sun City West golf courses must secure a replacement source of water to account for expiration of the GIUPs. But the GSP does not solve the Sun City West golf courses' need to secure water rights to replace the General Industrial Use Permits, should they not be renewed by ADWR in 2005. Pursuant to the binding agreements between Citizens and the Recreation Centers, deliveries of CAP water can only be made pursuant to a water rights exchange. It is a water for water exchange. CAP water doesn't replace the GIUPs. The Sun City West Recreation Centers retains the responsibility to secure and maintain sufficient groundwater withdrawal or other water rights for exchange purposes. And, in fact, as previously explained, the Sun City West Recreation Centers already have secured an alternative supply – effluent water from the Sun City West Water Reclamation Plant. Mr. Hustead also makes mention of the fact that another benefit accruing to the golf courses is that CAP water is being provided at 80% of the cost to pump groundwater. That cost differential does not undermine the GSP or the PER. The lower price is to compensate for the adjustments in golf course operation and maintenance practices necessary with the introduction of a new water delivery system and new water source. The lower price simply offsets additional costs those golf courses will incur.

Q. ON PAGE 12 OF HIS TESTIMONY, MR. HUSTEAD CONTENDS THAT "[I]F ALL THE EFFLUENT GENERATED IN SUN CITY WEST WAS DIRECTLY DELIVERED TO GOLF COURSES, APPROXIMATELY 2,800 AF OF PUMPING COULD BE ELIMINATED AT NO COSTS TO CITIZENS' RATEPAYERS." IS DIRECT DELIVERY OF EFFLUENT TO THE GOLF COURSES A VIABLE OPTION FOR SUN CITY WEST?

A. No. Mr. Hustead's testimony is wrong on these effluent issues because delivering 2,800 acre-feet of effluent directly to the golf courses instead of maintaining the current practice

of recharging effluent for potable use would not benefit the aquifer. The amount of water pumped each year from the aquifer in the Sun Cities area for golf course use and deliveries to Citizens customers would be the same regardless of whether effluent is directly delivered to the golf course or recharged in accordance with current practice. For example, currently, approximately 32,500 acre-feet of groundwater is pumped for golf course and potable use in the Sun Cities and approximately 2,800 acre-feet of effluent is recharged into the aquifer at the at the Sun City West Water Reclamation Plant. The net depletion of the Sun Cities aquifer is 32,500 acre-feet of pumping less the 2,800 acre-feet of recharge for a net depletion of 29,700 acre-feet. Mr. Hustead's proposal would reduce the actual pumping to 29,700 acre-feet. However, it also eliminates the recharge component. The net depletion of the aquifer is still 29,700 acre-feet – exactly the same as it is now. Furthermore, the significant regulatory benefits to Sun City Water Company and Sun City West Utilities Company ratepayers from Citizens' use of the effluent credits to meet potable demand (as earlier described) are lost completely

Q. ON PAGES 13-14 OF HIS TESTIMONY, MR. HUSTEAD RAISES CONCERNS ABOUT THE PER BECAUSE CITIZENS' RATEPAYERS WILL BEAR THE COSTS OF DESIGNING, CONSTRUCTING AND OPERATING THE GSP. ARE THESE VALID CONCERNS WITH THE PER?

A. No. Responsibility for construction and design costs has nothing to do with adequacy and sufficiency of the PER. Mr. Hustead implies that the consulting engineer who performed the PER did not attempt to design a project in which costs were minimized because there was no monetary incentive on the part of the users of the water delivery system. That is an unsupported and improper opinion. The basic parameters of the PER were set by the CAP Task Force and the Commission in Decision No. 62293. The PER meets all of the requirements

placed on it by the Commission. Mr. Hustead also contends that a lack of cost accountability was the reason that use of the existing Sun City West effluent distribution system for west to east deliveries of CAP water was not considered further. Mr. Hustead is wrong. In reality, the Sun City West distribution system simply isn't capable of delivering CAP water west to east; and, Sun City West wouldn't allow a west to east flow because of the potential future need to use the system for effluent deliveries east to west (obviously, the system can't be used for east to west and west to east deliveries at the same time).

Q. DO YOU AGREE WITH MR. HUSTEAD'S STATEMENT ON PAGE 14 THAT CITIZENS' ANNUAL RECOVERY OF EFFLUENT RECHARGED AT THE SUN CITY WEST WATER RECLAMATION FACILITY AND RECOVERY OF CAP WATER STORED AT THE MARICOPA WATER DISTRICT GROUNDWATER SAVINGS FACILITY PRODUCE NO NET BENEFIT TO THE AQUIFER?

A. No. The annual storage and recovery program utilized by Citizens positively benefits the aquifer in many ways. Again, Mr. Hustead misconstrues the physical and regulatory nature of underground storage and recovery operations in Arizona. He wrongly implies that recovering storage credits on an annual basis doesn't benefit the aquifer. The benefits to the aquifer of annual storage and recovery of CAP water are really quite simple to understand and are similar to the example provided previously for effluent storage and recovery. It works like this. Citizens' use of wells to meet customer needs in the Sun Cities service areas is relatively constant from year to year, regardless of whether CAP water is put into the aquifer by Citizens. In 2000, Citizens pumped about 23,500 acre-feet of water from the aquifer to meet it's customers needs. Of that amount, approximately 6,600 acre-feet of the water was recovered credits for CAP water stored at the Maricopa Water District Groundwater Savings Facility. The net

depletion of the aquifer to meet potable water demands was therefore 16,900 acre-feet. If Citizens had not recharged the 6,600 ace-feet of water, the net depletion of the aquifer would have been 23,500 acre-feet. The physical benefit to the aquifer is the act of putting the water into the ground. Clearly, after storage actions are taken, there is more water in the aquifer than there would be had no storage action been taken. However, it should be noted that storage of the Sun Cities CAP water allocations in the Maricopa Water District Groundwater Savings Facility provide much more indirect benefits to the aquifer than the Groundwater Savings Project would because of the Maricopa Water District Facility's more remote location. In should also be emphasized that, in fact, recovery of CAP water storage credits on an annual basis by Citizens is required by state statute (A.R.S. § 45-802.01).

V. MR. HUSTEAD'S TESTIMONY RELATING TO STORED WATER AND WATER CREDITS HAS NO BEARING ON THE GSP OR PER.

Q. ON PAGES 17-18 OF HIS TESTIMONY, MR. HUSTEAD QUESTIONS THE PER AND GSP BECAUSE CITIZENS MAY BE RECOVERING OR TRANSFERRING STORED WATER AND AVOIDING THE ACCRUAL OF WATER CREDITS. DO YOU AGREE?

A. No. As discussed above, Mr. Hustead again wrongly concludes that Citizens' annual recovery of storage credits constitutes "additional pumping" that results in "additional groundwater depletion in the Sun Cities area" and, therefore, violates Decision No. 62293. This testimony misses the mark because physical pumping from Citizens' wells in the Sun Cities service areas is unchanged by the regulatory label applied to the water. Citizens has the rights to and has no choice but to pump every drop of water needed by its customers. This pumping will occur with or without any storage of water. When Citizens stores water, it is clearly a benefit to the aquifer. When Citizens, through annual recovery of the stored water, changes the legal

character of the pumped water (water that must be pumped with or without storage) to recovered CAP water, the hydrologic benefit to the aquifer is unchanged.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes.

3099-0043/944539

EXHIBIT A-6 Admitted

AGREEMENT FOR EXCHANGE OF CAP WATER IN SUN CITY

This Agreement for Exchange of CAP Water in Sun City ("Agreement") is made this 30th day of October, 2000 by SUN CITY WATER COMPANY ("Water Company"), an Arizona corporation, and RECREATION CENTERS OF SUN CITY ("Recreation Centers"), an Arizona non-profit corporation ("the Parties").

I. RECITALS

A. Water Company entered into a contract entitled "Subcontract Among the United States, the Central Arizona Water Conservation District and the Sun City Water Company Providing for Water Service, Central Arizona Project," Contract No. 6-07-30-W0110, dated October 24, 1985 ("the CAP Subcontract"), entitling it to 15,835 acre feet of Central Arizona Project ("CAP") water. Subsequently, Water Company accepted assignment of an additional 380 acre feet of CAP Water from the Town of Youngtown under separate subcontract, Contract No. 8-07-30-W0379.

B. In 1998, Water Company assigned 9,654 acre feet of its entitlement under the CAP Subcontract to Citizens Utilities Company, Aqua Fria Division, resulting in a remaining entitlement of 6,561 acre feet for use in the communities of Sun City, Sun City West and Youngtown.

C. In 1999, Water Company assigned rights to 4,189 acre feet of CAP water under the CAP Subcontract to Sun City West Utilities Company for use in its service area, resulting in Water Company holding rights to 3,809 acre feet of CAP water for use in its service area under Contract No. 6-07-30-W0110. Adding the 380 acre feet of CAP water under Contract No. 8-07-30-W0379, Water Company now has rights to 4,189 acre feet of CAP water for use in its service area.

D. In February of 1998, eight community organizations in Sun City, Sun City West and Youngtown established the CAP Task Force to determine if the 6,561 acre foot allocation of CAP water intended for use in Sun City, Sun City West and Youngtown should be retained, and if so, how the water should be used and paid for.

E. Over a fourteen-week period, the CAP Task Force studied issues such as groundwater declines, the availability of alternative water supplies and the impact of relinquishing the CAP allocations.

F. After studying the options for use of CAP water, the CAP Task Force recommended that CAP water be retained and used through an arrangement with local golf courses. CAP water would be delivered to Sun City and Sun City West through a nonpotable pipeline ("the Pipeline") and used to irrigate golf courses that have historically pumped groundwater. The CAP Task Force submitted its final report by resolution on May 19, 1998.

G. This Agreement is intended to (1) provide CAP water to golf courses to replace their use of groundwater thereby preserving groundwater supplies under Sun City and benefiting the entire community; (2) allow Water Company to utilize its CAP water at substantially less cost than building a treatment plant thereby providing the most direct benefit to rate payers at the lowest possible cost; and (3) legally convert a portion of Water Company's groundwater pumping into surface water through a water exchange thereby significantly reducing the community's historic reliance on groundwater.

H. The Parties to this Agreement intend to implement the project through a water exchange. Water Company will give CAP Water and Recreation Centers will give groundwater in the exchange.

I. Sun City Water Company is an Arizona public service corporation within the meaning of Article 15, § 2 of the Arizona Constitution and is authorized to provide water service within portions of Maricopa County, Arizona ("the Certificated Area") pursuant to a certificate of convenience and necessity granted by order of the Arizona Corporation Commission ("ACC") and is authorized to withdraw groundwater pursuant to its water service area right (56-002038.0000) established under A.R.S. Title 45, Article 6.

J. Recreation Centers withdraws groundwater pursuant to certain non-irrigation grandfathered rights and other withdrawal authorities.

K. Water Company and Recreation Centers desire to enter into an agreement whereby Water Company provides CAP water to Recreation Centers for irrigation of golf courses in exchange for the use of groundwater, and Recreation Centers provides groundwater to Water Company for potable deliveries in exchange for the use of CAP water.

L. Recreation Centers acknowledges that in order to effectuate this Agreement, Water Company or an affiliated entity will construct the Pipeline to deliver CAP water to Recreation Centers' golf courses in reliance on Recreation Centers' commitment to use CAP water pursuant to this Agreement.

M. Water Company desires to use Recreation Centers' existing water distribution system for delivery of CAP water to the golf courses, which will allow Water Company to avoid certain costs of building a distribution system.

NOW, THEREFORE, in consideration of covenants and agreements contained herein, the sufficiency of which is hereby acknowledged, the Parties agree as follows:

II. CAP EXCHANGE AGREEMENT

1. Exchange. Water Company and Recreation Centers hereby agree to exchange annually up to 4,189 acre feet of Water Company's CAP water for an equal amount of

Recreation Centers' groundwater. Pursuant to Arizona law, Water Company will account for the groundwater it receives in the exchange as CAP water and Recreation Centers will account for the CAP water it receives in the exchange as groundwater. Each party may use the water it receives only in the manner in which it may legally use the water it gives in the exchange.

2. Exchange Period. The exchange period is the calendar year.

3. CAP Water Rights. Water Company will exchange up to 4,189 acre-feet of CAP water pursuant to its Municipal and Industrial CAP Subcontract No. 8-07-30-W0379.

4. Groundwater Rights. Recreation Centers will exchange groundwater pursuant to the following water rights:

Type 2 Grandfathered Rights

58-101683.0000	1,433 acre feet
58-101682.0000	848 acre feet
58-101680.0000	1,428 acre feet
58-101681.000	626 acre feet
58-101679.0001	822 acre feet
58-101678.0000	1,145 acre feet
58-0101677.000	307 acre feet

For purposes of satisfying the Arizona Department of Water Resource's requirements for exchanging Type 1 rights, and for purposes of this exchange only, the parties hereby recite that Recreation Centers has the theoretical right to withdraw groundwater at the locations where Water Company will withdraw the exchanged groundwater. This does not allow Recreation Centers to use, have any rights to or in any way interfere with Water Company's use of Water Company's wells.

5. Term of Agreement. The initial term of this Agreement runs from the Effective Date through December 31, 2043, which is the date of expiration of the CAP Subcontract. If the CAP Subcontract term is extended or renewed, this Agreement, if still in effect, will

automatically renew for a period equal to the new term of the CAP Subcontract (together referred to herein as "Term").

6. Termination of Agreement.

6.1 Either party may terminate this Exchange if any of the following pre-conditions has not occurred.

a. The Operating Agreement referenced in section 8 of this Agreement has been executed by both parties no later than December 31, 2000.

b. Arizona Department of Water Resources ("ADWR") has issued all permits or approvals necessary to implement an exchange to enable the use of CAP water on Recreation Centers' golf courses no later than March 31, 2001.

c. Recreation Centers has applied for and obtained sufficient authority to withdraw groundwater to achieve the purpose of this Agreement for the Term of this Agreement no later than December 31, 2000.

d. The preliminary design/cost study ordered by the ACC in Decision and Order No. 62293 has been approved by the ACC.

6.2 Except as provided in section 6.1, Recreation Centers may terminate this Agreement only in the event of a material breach of this Exchange by Water Company.

6.3 Water Company may terminate this Exchange for the following reasons:

a. A material breach by Recreation Centers, including if Recreation Centers remains in arrears in the payment of amounts due under Paragraph 10 of this Exchange for more than 60 days, which termination will be effective 15 days after mailing written notice of termination to Recreation Centers.

b. If Water Company cannot legally continue to deliver CAP water to Recreation Centers golf courses, after having made a good faith effort to maintain and/or obtain the necessary legal authority to do so.

c. If Recreation Centers cannot legally continue to exchange groundwater with Water Company, after having made a good faith

effort to maintain and/or obtain the necessary legal authority to do so.

d. If it becomes necessary for Water Company to use the CAP Subcontract water for potable deliveries to the residents of Sun City. Before Water Company may terminate this Exchange for this purpose, Water Company must give Recreation Centers at least two years notice, consult with the Board of Directors of Recreation Centers and hold a public information meeting to discuss with the community the reasons for changing the use of the CAP water. If such a change is made, Water Company may not use any water under the CAP Subcontract for the benefit of customers located outside of the certificated area of Sun City Water Company.

6.4 If this Agreement is terminated before Water Company has recovered its investment in the Pipeline and the Pipeline is no longer being used to benefit Sun City water ratepayers, it is the parties' understanding that the ACC would ultimately determine whether Water Company could continue to reflect its investment in the Pipeline in water rates.

7. Delivery and Acceptance of CAP Water. Water Company will meter and deliver to Recreation Centers CAP water for use on its golf courses in the amounts determined pursuant to Paragraph 9 of this Agreement. Water Company will deliver the water at the location shown in Exhibit A to this Agreement ("Point of Delivery"). In no event is Water Company obligated to deliver more than 4,189 acre feet of CAP water in any one year. Recreation Centers agrees to accept delivery of the amount of water ordered pursuant to Paragraph 9 of this Agreement and to use the water in accordance with the terms of this Agreement. Water Company's obligation to deliver CAP water is subject to Water Company's ability to receive the CAP water from the Central Arizona Water Conservation District ("CAWCD"). This Agreement is subject to the terms and conditions of the CAP Subcontract and the Master Repayment Contract between the CAWCD and the United States, as amended.

8. Location of Use. The CAP water delivered to Recreation Centers pursuant to this Agreement may be used only at the locations where Recreation Centers has the legal authority to use groundwater pursuant to existing authorities to withdraw held by Recreation Centers or any additional authorities to withdraw that may be acquired in the future.

9. Ordering and Delivery of Water. Recreation Centers will order and Water Company will deliver the CAP water pursuant to the ordering and delivery procedure set forth in the Operating Agreement attached hereto as Exhibit B. The Operating Agreement may be amended from time to time by written agreement of both parties without amending this Agreement. Water Company is not obligated to deliver water to Recreation Centers until such time as construction of the Pipeline is complete. Recreation Centers agrees to use its best efforts to use 4,189 acre feet of CAP water on its golf courses each year, consistent with best golf course management practices and legal requirements. Nothing in this Agreement shall be construed to limit the Association's legal right to pump groundwater pursuant to its permits if Water Company is unable to deliver the amounts of CAP water anticipated by this Agreement.

10. Payment for Exchanged Water. Recreation Centers must pay Water Company a charge per acre foot of water received pursuant to this Agreement ("the Exchange Charge"). The Exchange Charge for the first five years of deliveries will be an amount equal to 80% of Recreation Centers' average per acre foot cost of purchased power for pumping groundwater during the calendar year prior to the first year Water Company delivers CAP water to Recreation Centers. This will be determined by Water Company in an audit of Recreation Centers' power records. Following the end of the fourth full calendar year of deliveries, Water Company will audit Recreation Centers' books and records pertaining to the power costs of pumping groundwater and determine what the Recreation Centers' average per acre foot power cost for

pumping groundwater would have been in the fourth year had it been using 100% groundwater. The Exchange Charge in the sixth through tenth calendar years will be 80% of this per acre foot amount. Recreation Centers agrees to provide any relevant information requested by Water Company for the audit and cost determination. Water Company will perform such an audit and determination every five years and adjust the Exchange Charge accordingly. Water Company will bill Recreation Centers monthly and Recreation Centers must pay the Exchange Charge within 30 days of receipt of a bill. If Recreation Centers does not pay the charge within 45 days of receipt of the bill, Recreation Centers must pay a late charge of 1.5% per month for each day the payment is delinquent beyond the due date.

11. Additional CAP Water. If Recreation Centers acquires additional CAP water after the effective date of this Agreement, Water Company will work with Recreation Centers to either 1) include the additional water in the exchange through an amendment to this Agreement or a separate agreement, or 2) enter into a new agreement for direct delivery of the CAP water to Recreation Centers.

12. Water Quality. Water Company will deliver water to Recreation Centers suitable for use for irrigating golf courses at the Point of Delivery. Recreation Centers is responsible for the quality of water after the Point of Delivery.

13. Water Exchange Notice and Reporting. Water Company will file a Notice of Water Exchange as required by A.R.S. § 45-1051. In addition, both Water Company and Recreation Centers will file annual reports on water exchanged pursuant to A.R.S. § 45-1004 and will exchange water in accordance with the exchange agreement and any other legal requirements applicable to the exchange. In no event will Recreation Centers use the CAP water in a manner in which it was not legally entitled to use the groundwater being exchanged.

14. Dispute Resolution.

14.1 Scope. This section governs the resolution of all disputes arising under this Agreement.

14.2 Good Faith Negotiations. The party that believes a dispute exists under this Agreement will first refer the dispute to the Representatives for resolution. The Representatives of each party will personally meet and attempt in good faith to resolve the dispute. If the Representatives cannot resolve the dispute within 14 days, the matter will be referred to senior management of Recreation Centers and Water Company for resolution. If these persons are unable to resolve the dispute within 7 days thereafter, a party that still believes the dispute requires resolution may avail itself of the provisions of section 14.3.

14.3 Arbitration. If a party still believes a dispute requires resolution, after following the procedures of Paragraph 14.2, that party will first give a detailed written notice of dispute to the other parties setting forth the nature of the dispute. The Parties will then, upon request of any party, be submitted for and settled by binding arbitration administered by AAA before a single arbitrator. The arbitrator must have substantial experience with the water utility industry. The arbitrator has no power to amend or modify this Agreement. Judgment on the award rendered by the arbitrator must be entered in any court with jurisdiction.

14.4 Other Remedies. The preceding subparagraphs of this Paragraph 14 are intended to set forth the primary procedure to resolve all disputes under this Agreement. It is expected that all disputes that would traditionally be resolvable by a law court would be resolvable under this procedures. However, the Parties recognize certain business relationships could give rise to the need for one or more of the Parties to seek equitable remedies from a court that were traditionally available from an equity court, such as emergency, provisional or

summary relief and injunctive relief. Immediately following the issuance of any such equitable relief, the Parties will stay any further judicial proceeding pending arbitration of all underlying claims between the Parties. The Parties also recognize that the ACC has primary jurisdiction over certain issues that may arise among and between the Parties that relate to the provision of public utility service. Accordingly, this Article is not intended to prohibit any party from bringing any such issues to the ACC for resolution or from taking any position at the ACC that would be inconsistent with or barred by this Agreement or by collateral estoppel, *res judicata* or other issues or fact-preclusive doctrines.

14.5 Appeal. Within 30 days after the date of the arbitration award, a party may appeal to the U.S. District Court for the District of Arizona, if such court has jurisdiction, and otherwise to any state court of record in Arizona having jurisdiction, to vacate and remand, or modify or correct the arbitration award for any of the grounds specified in the Federal Arbitration Act.

14.6 Confidentiality. The arbitration proceedings will be conducted in secrecy. Except as otherwise agreed by the Parties in writing, (a) the fact of the pending arbitration will not be disclosed or confirmed by the Parties or the arbitrator to any person who is not a party to, or called to testify at, the proceedings until the arbitration award has been made, (b) the proceedings will not be recorded or transcribed in any manner, and (c) all documents, testimony and records (other than the contract documents out of which the dispute arises) will be received, heard and maintained by the arbitrator in secrecy, available for inspection only by the Parties, their attorneys and by experts who must agree, in advance and in writing, to receive all such information in secrecy. The secret information will not be described in the arbitration award in such manner as to be commercially useful.

15. Indemnification. Water Company is not responsible for the control, carriage, handling, use, disposal or distribution of any water beyond the Point of Delivery. Each party (indemnitor) to this Agreement agrees to indemnify and hold harmless the other party (indemnitee) and its governing bodies, agents, directors, officers and employees for, from and against any loss, damage or liability, including reasonable attorney's fees, caused by a negligent or intentionally willful action or inaction on the part of the indemnitor and its governing bodies, agents, directors, officers and employees, including without limitation, claims for bodily injury, illness, death or damage to property. Each party assumes liability for its own negligent or intentionally willful action or inaction arising out of the terms and conditions of this Agreement.

16. Uncontrollable Forces. Neither party will be considered to be in default in the performance of its obligations under this Agreement (other than obligations to make payments due hereunder) when a failure of performance is due to Uncontrollable Forces. The term "Uncontrollable Force" means any natural or artificial cause beyond the control of a party to this Agreement that renders the party unable to perform its obligations, including but not limited to, failure of or threat of failure of facilities, flood, earthquake, storm, fire, lightning and other natural catastrophes, epidemic, war, riot, civil disturbance or disobedience, strike, labor dispute, labor or material shortage, sabotage, government priorities and restraint by court order or public authority, and action or inaction by, or failure to obtain the necessary authorizations or approvals from, any governmental agency or authority, which by exercise of due diligence the party could not reasonably have been expected to avoid and which by exercise of due diligence it is unable to overcome. Nothing contained herein may be construed to require either party to settle any strike or labor dispute in which it is involved.

17. General Provisions.

17.1 Effective Date. This Agreement is effective upon execution of the Agreement by all parties.

17.2 Recitals Incorporated. All of the recitals made herein are incorporated by reference.

17.3 Authorized Representatives. Within 30 days after execution of this Agreement, each party will designate in writing to the other party an authorized representative ("Representative") and an alternate ("Alternate") to administer the provisions of this Agreement on behalf of the designating parties. An Alternate may act only in the absence of the Representative. Written notice of a change of Representative or Alternate must be provided at least 30 days before such change becomes effective. Arrangements or understandings of the representatives pursuant to this Agreement must be in writing and signed by them, but notwithstanding the foregoing, neither the Representatives nor the Alternates have authority to amend this Agreement.

17.4 Binding Effect. The provisions of this Agreement inure to the benefit of and be binding upon the respective heirs, personal representatives, successors and assigns of the Parties, but no assignment or transfer of this Agreement or any interest therein is valid until approved in writing by the other party. Such approval may not be unreasonably withheld.

17.5 Notices. Any notice given pursuant to this Agreement must be in writing and be personally delivered or deposited in the United States mail, postage prepaid, certified and return receipt requested to the Parties as follows:

To Water Company:	Sun City Water Company P.O. Box 1687 Sun City, Arizona 85372 Attn: General Manager
To Recreation Centers:	Recreation Centers of Sun City 10626 Thunderbird Boulevard Sun City, Arizona 85351

Notices are deemed given when personally delivered or, if mailed, five days after the deposit of the notice in the U.S. mail. If a notice initiates the running of a time period for the performance of, or compliance with, any obligation or duty set forth in this Agreement, the notice must be sent certified, return receipt requested. Any party hereto must give written notice of a change of address to the other party as provided above.

17.6 Good Standing; Authority. Each of the Parties represents and warrants to the other party: (a) that it is duly formed, validly existing and in good standing under all applicable laws; and (b) that the individual(s) executing this Agreement on behalf of the respective parties are authorized and empowered to bind the Parties on whose behalf each such individual is signing.

17.7 Exhibits. Any exhibit hereto is incorporated herein by this reference with the same force and affect as if fully set forth in the body hereof.

17.8 Attorney's Fees. If any action is brought by any party with respect to its rights under this Agreement, the prevailing party or parties are entitled to reasonable attorney's fees and court costs from the other party or parties as determined by the court.

17.9 Entire Agreement. The terms, covenants and condition of this Agreement constitute the entire agreement between the Parties and no understandings or obligations not expressly set forth herein are binding upon them. All prior and contemporaneous agreements,

representations and understandings of the Parties, oral or written, on the subject matter of this Agreement, are hereby superseded and merged herein.

17.10 Further Documentation. Each party agrees in good faith to execute, deliver, acknowledge or record further or additional documents, approvals or consents as are required or desirable in order to fully carry out the intent and purpose of this Agreement.

17.11 Governing Law. This Agreement is made under and is governed by the laws of the State of Arizona. Subject to the provisions of Paragraph 16, all proceedings related to this Agreement will be maintained in the courts of the State of Arizona (including the United States District Court for the District of Arizona), which courts have jurisdiction over those proceedings.

17.12 Counterparts. This Agreement may be executed in any number of counterparts, each of which is an original, but all of which constitute one and the same instrument. The signature pages from one or more counterparts may be removed from such counterparts and attached to a single instrument so that the signatures of all parties may be physically attached to a single document.

17.13 Amendments and Modifications. This Agreement may be modified, amended, rescinded, cancelled or waived, in whole or in part, only by a written instrument executed by all parties.

17.14 Severability. If any provision of this Agreement is held to be invalid, illegal or unenforceable under any applicable statute or rule of law, the provision is deemed null and void, but the remainder of this Agreement remains in full force and effect.

17.15 No Partnerships. The Parties to this Agreement may not be deemed to have formed a partnership or joint venture by their execution of this Agreement. The provisions

of this Agreement are not intended to be for the benefit of any person, firm, organization or corporation not a party hereto and no such person or entity have any rights or cause of action under this Agreement.

17.16 Waiver. No delay in exercising any right or remedy will constitute a waiver thereof, and no waiver by any party of the breach of any covenant of this Agreement may be construed as a waiver of any preceding or succeeding breach of the same or any other covenant or condition of this Agreement.

17.17 Compliance with Laws. Recreation Centers agrees to comply with all applicable local, state and federal laws and permit requirements specifically including all requirements of the Arizona Groundwater Code.

17.18 Books and Records. Recreation Centers must establish and maintain books and records pertaining to use of water under this Agreement, including data on water received and used and any reports filed with ADWR. Subject to applicable laws and regulations, each party to this Agreement has the right during office hours to examine and make copies of each other's books and records relating to this Agreement.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement on the day and year first above written on behalf of Water Company and Recreation Centers by the respective company officials.

SUN CITY WATER COMPANY

Date: 10/30/00

By: Ray L. Jones

Its: Vice President & General Manager

RECREATION CENTERS OF SUN CITY

Date: 10-27-00

By: Robert J Briscoe
Its: President - Board of Directors R.C.S.C

EXHIBIT A

LOCATIONS OF USE AND POINTS OF DELIVERY

EXHIBIT B

OPERATING AGREEMENT

EXHIBIT
A-7
Admitted

AGREEMENT FOR EXCHANGE OF CAP WATER IN SUN CITY WEST

This Agreement for Exchange of CAP Water in Sun City West ("Agreement") is made this 20th day of October, 2000 by SUN CITY WEST UTILITIES COMPANY ("Water Company"), an Arizona corporation, and RECREATION CENTERS OF SUN CITY WEST ("Recreation Centers"), an Arizona non-profit corporation ("the Parties").

I. RECITALS

A. In February of 1998, eight community organizations in Sun City, Sun City West and Youngtown established the CAP Task Force to determine if the 6,561 acre foot allocation of Central Arizona Project ("CAP") water intended for use in Sun City, Sun City West and Youngtown ("the Sun Cities") should be retained, and if so, how the water should be used and paid for.

B. Over a fourteen-week period, the CAP Task Force studied issues such as groundwater declines, the availability of alternative water supplies and the impact of relinquishing the CAP allocations.

C. After studying the options for use of CAP water, the CAP Task Force recommended that CAP water be retained and used through an arrangement with local golf courses. CAP water would be delivered to Sun City and Sun City West through a nonpotable pipeline ("the Pipeline") and used to irrigate golf courses that have historically pumped groundwater. The CAP Task Force submitted its final report by resolution on May 19, 1998.

D. Water Company entered into a contract entitled "Subcontract Among the United States, the Central Arizona Water Conservation District and the Sun City West Utilities Company Providing for Water Service, Central Arizona Project," Contract No. 00XX300002,

dated October 26, 1999 ("the CAP Subcontract"), entitling it to 2,372 acre feet of CAP water use in its service area.

E. This Agreement is intended to (1) provide CAP water to golf courses to replace their use of groundwater thereby preserving groundwater supplies under Sun City and benefiting the entire community; (2) allow Water Company to utilize its CAP water at substantially less cost than building a treatment plant thereby providing the most direct benefit to rate payers at the lowest possible cost; and (3) legally convert a portion of Water Company's groundwater pumping into surface water through a water exchange thereby significantly reducing the community's historic reliance on groundwater in the exchange.

F. The Parties to this Agreement intend to implement the project through a water exchange. Water Company will give CAP water and Recreation Centers will give groundwater in the exchange.

G. Water Company is an Arizona public service corporation within the meaning of Article 15, § 2 of the Arizona Constitution and is authorized to provide water service within portions of Maricopa County, Arizona ("the Certificated Area") pursuant to a certificate of convenience and necessity granted by order of the Arizona Corporation Commission ("ACC") and is authorized to withdraw groundwater pursuant to its water service area right (56-002038.0000) established under A.R.S. Title 45, Article 6.

H. Recreation Centers withdraws groundwater pursuant to certain non-irrigation grandfathered rights and other withdrawal authorities.

I. Water Company and Recreation Centers desire to enter into an agreement whereby Water Company provides CAP water to Recreation Centers for irrigation of golf

courses in exchange for the use of groundwater, and Recreation Centers provides groundwater to Water Company for potable deliveries in exchange for the use of CAP water.

J. Recreation Centers acknowledges that in order to effectuate this Agreement, Water Company or an affiliated entity will construct the Pipeline to deliver CAP water to Recreation Centers' golf courses in reliance on Recreation Centers' commitment to use CAP water pursuant to this Agreement.

K. Water Company desires to use Recreation Centers' existing water distribution system for delivery of CAP water to the golf courses, which will allow Water Company to avoid certain costs of building a distribution system.

NOW, THEREFORE, in consideration of covenants and agreements contained herein, the sufficiency of which is hereby acknowledged, the Parties agree as follows:

II. CAP EXCHANGE AGREEMENT

1. Exchange. Water Company and Recreation Centers hereby agree to a legal arrangement under Arizona law (A.R.S. §45-1001) called an "exchange." Pursuant to Arizona law, Water Company will annually "give" to Recreation Centers up to 2,372 acre feet of Water Company's CAP water, and Recreation Centers will "give" Water Company an equal amount of Recreation Centers' groundwater. In reality, Recreation Centers will use CAP water delivered to it and refrain from pumping groundwater in the amount of CAP water used. In reality, Water Company will continue to pump groundwater from its wells in the same amount as it historically pumped, but it will be able to account for the groundwater as if it was CAP water up to the amount of CAP water delivered to Recreation Centers. The net result will be a reduction in total groundwater pumping as a result of the use of CAP water on Recreation Centers' golf courses. Pursuant to Arizona exchange law, Water Company must account for the groundwater it "receives" in the exchange as CAP water, and Recreation Centers must account for the CAP

water it "receives" in the exchange as groundwater. Each party may use the water it receives only in the manner in which it may legally use the water it gives in the exchange. Therefore, the same acreage and water use restrictions that applied to Recreation Centers before the exchange will continue to apply after the exchange.

2. Exchange Period. The exchange period is the calendar year.

3. CAP Water Rights. Water Company will exchange up to 2,372 acre-feet of CAP water pursuant to its Municipal and Industrial CAP Subcontract No. 00XX300002.

4. Groundwater Rights. Recreation Centers will exchange groundwater pursuant to the following water rights:

Type 1 Grandfathered Rights

58-117269.0003	417.04 acre feet
58-130750.0002	368.50 acre feet
58-111140.0002	306.38 acre feet

Type 2 Grandfathered Right

58-110773	753 acre feet

Groundwater Industrial Use Permits

59-511014.0000	347 acre feet
59-511012.0000	534 acre feet
59-511008.0000	198 acre feet
59-511016.0000	227 acre feet

For purposes of satisfying the Arizona Department of Water Resource's requirements for exchanging Type 1 rights, and for purposes of this exchange only, the parties hereby recite that Recreation Centers has the theoretical right to withdraw groundwater at the locations where Water Company will withdraw the exchanged groundwater. This does not allow Recreation Centers to use, have any rights to or in any way interfere with Water Company's use of Water Company's wells.

5. Term of Agreement. The initial term of this Agreement runs from the Effective Date through December 31, 2043, which is the date of expiration of the CAP Subcontract. If the CAP Subcontract term is extended or renewed, this Agreement, if still in effect, will automatically renew for a period equal to the new term of the CAP Subcontract (together referred to herein as "Term").

6. Termination of Agreement.

6.1 Either party may terminate this Agreement if any of the following pre-conditions has not occurred.

a. The Operating Agreement referenced in section 8 of this Agreement has been executed by both parties no later than December 31, 2000.

b. Arizona Department of Water Resources ("ADWR") has issued all permits or approvals necessary to implement an exchange to enable the use of CAP water on Recreation Centers' golf courses no later than March 31, 2001.

c. Recreation Centers has applied for and obtained sufficient authority to withdraw groundwater to achieve the purpose of this Agreement for the Term of this Agreement no later than December 31, 2000.

d. The preliminary design/cost study ordered by the ACC in Decision and Order No. 62293 has been approved by the ACC.

6.2 Except as provided in section 6.1, Recreation Centers may terminate this Agreement only in the event of a material breach of this Agreement by Water Company.

6.3 Water Company may terminate this Agreement for the following reasons:

a. A material breach by Recreation Centers, including if Recreation Centers remains in arrears in the payment of amounts due under Paragraph 10 of this Exchange for more than 60 days, which termination will be effective 15 days after mailing written notice of termination to Recreation Centers.

b. If Water Company cannot legally continue to deliver CAP water to Recreation Centers golf courses, after having made a good faith

effort to maintain and/or obtain the necessary legal authority to do so.

c. If Recreation Centers cannot legally continue to exchange groundwater with Water Company, after having made a good faith effort to maintain and/or obtain the necessary legal authority to do so.

d. If it becomes necessary for Water Company to use the CAP Subcontract water for potable deliveries to the residents of Sun City West. Before Water Company may terminate this Exchange for this purpose, Water Company must give Recreation Centers at least two years notice, consult with the Board of Directors of Recreation Centers and hold a public information meeting to discuss with the community the reasons for changing the use of the CAP water. If such a change is made, Water Company may not use any water under the CAP Subcontract for the benefit of customers located outside of the certificated area of Sun City West Utilities Company.

6.4 If this Agreement is terminated before Water Company has recovered its investment in the Pipeline and the Pipeline is no longer being used to benefit Sun City West water ratepayers, at the first succeeding rate proceeding the ACC will determine whether Water Company could continue to reflect its investment in the Pipeline in water rates.

7. Delivery and Acceptance of CAP Water. Water Company will meter and deliver to Recreation Centers CAP water for use on its golf courses in the amounts determined pursuant to Paragraph 9 of this Agreement. Water Company will deliver the water at the location shown in Exhibit A to this Agreement ("Point of Delivery"). In no event is Water Company obligated to deliver more than 2,372 acre feet of CAP water in any one year. Recreation Centers agrees to accept delivery of the amount of water ordered pursuant to Paragraph 9 of this Agreement and to use the water in accordance with the terms of this Agreement. Water Company's obligation to deliver CAP water is subject to Water Company's ability to receive the CAP water from the Central Arizona Water Conservation District ("CAWCD"). This Agreement is subject to the

terms and conditions of the CAP Subcontract and the Master Repayment Contract between the CAWCD and the United States, as amended.

8. Location of Use. The CAP water delivered to Recreation Centers pursuant to this Agreement may be used only at the locations where Recreation Centers has the legal authority to use groundwater pursuant to existing authorities to withdraw held by Recreation Centers or any additional authorities to withdraw that may be acquired in the future.

9. Ordering and Delivery of Water. Recreation Centers will order and Water Company will deliver the CAP water pursuant to the ordering and delivery procedure set forth in the Operating Agreement attached hereto as Exhibit B. The Operating Agreement may be amended from time to time by written agreement of both parties without amending this Agreement. Water Company is not obligated to deliver water to Recreation Centers until such time as construction of the Pipeline is complete. Recreation Centers agrees to use its best efforts to use 2,372 acre feet of CAP water on its golf courses each year, consistent with best golf course management practices and legal requirements. Nothing in this Agreement shall be construed to limit the Association's legal right to pump groundwater pursuant to its permits if Water Company is unable to deliver the amounts of CAP water anticipated by this Agreement. Recreation Centers grants Water Company the right to use its existing distribution system. Water Company agrees to maintain the pipes and valves used to deliver CAP water during the Term of the Agreement. For purposes of this paragraph, maintenance means servicing of pipes and valves, repair of leaks, repairs and replacements of individual pipes and valves caused by isolated damage or deterioration, but not including capital replacements of major sections or components of the system needed to address widespread deterioration or failure of the system

due to age, design defects, material failures, subsidence, natural disaster, or other factors which would lead to large-scale replacement of entire sections of piping or classes of components.

10. Payment for Exchanged Water. Recreation Centers must pay Water Company a charge per acre foot of water received pursuant to this Agreement ("the Exchange Charge"). The Exchange Charge for the first five years of deliveries will be an amount equal to 80% of Recreation Centers' average per acre foot cost of purchased power for pumping groundwater during the calendar year prior to the first year Water Company delivers CAP water to Recreation Centers. This will be determined by Water Company in an audit of Recreation Centers' power records. Following the end of the fourth full calendar year of deliveries, Water Company will audit Recreation Centers' books and records pertaining to the power costs of pumping groundwater and determine what the Recreation Centers' average per acre foot power cost for pumping groundwater would have been in the fourth year had it been using 100% groundwater. The Exchange Charge in the sixth through tenth calendar years will be 80% of this per acre foot amount. Recreation Centers agrees to provide any relevant information requested by Water Company for the audit and cost determination. Water Company will perform such an audit and determination every five years and adjust the Exchange Charge accordingly. Water Company will bill Recreation Centers monthly and Recreation Centers must pay the Exchange Charge within 30 days of receipt of a bill. If Recreation Centers does not pay the charge within 45 days of receipt of the bill, Recreation Centers must pay a late charge of 1.5% per month for each day the payment is delinquent beyond the due date.

11. Additional CAP Water. If Recreation Centers acquires additional CAP water after the effective date of this Agreement, Water Company will work with Recreation Centers to either 1) include the additional water in the exchange through an amendment to this Agreement

or a separate agreement, or 2) enter into a new agreement for direct delivery of the CAP water to Recreation Centers.

12. Water Quality. Water Company will deliver water to Recreation Centers suitable for use for irrigating golf courses at the Point of Delivery. Recreation Centers is responsible for the quality of water after the Point of Delivery.

13. Water Exchange Notice and Reporting. Water Company will file a Notice of Water Exchange as required by A.R.S. § 45-1051. In addition, both Water Company and Recreation Centers will file annual reports on water exchanged pursuant to A.R.S. § 45-1004 and will exchange water in accordance with the exchange agreement and any other legal requirements applicable to the exchange. In no event will Recreation Centers use the CAP water in a manner in which it was not legally entitled to use the groundwater being exchanged.

14. Construction Plans. Water Company will submit all construction plans related to connection of the Pipeline to the distribution system for Recreation Centers' approval prior to beginning any construction. The parties agree to cooperate in coordinating construction on the Sun City West distribution system.

15. Dispute Resolution.

15.1 Scope. This section governs the resolution of all disputes arising under this Agreement.

15.2 Good Faith Negotiations. The party that believes a dispute exists under this Agreement will first refer the dispute to the Representatives for resolution. The Representatives of each party will personally meet and attempt in good faith to resolve the dispute. If the Representatives cannot resolve the dispute within 14 days, the matter will be referred to senior management of Recreation Centers and Water Company for resolution. If

these persons are unable to resolve the dispute within 30 days thereafter, a party that still believes the dispute requires resolution may avail itself of the provisions of section 15.3.

15.3 Arbitration. If a party still believes a dispute requires resolution, after following the procedures of Paragraph 15.2, that party will first give a detailed written notice of dispute to the other parties setting forth the nature of the dispute. The Parties will then, upon request of any party, be submitted for and settled by binding arbitration administered by AAA before a single arbitrator. The arbitrator must have substantial experience with the water utility industry. The arbitrator has no power to amend or modify this Agreement. Judgment on the award rendered by the arbitrator must be entered in any court with jurisdiction.

15.4 Other Remedies. The preceding subparagraphs of this Paragraph 15 are intended to set forth the primary procedure to resolve all disputes under this Agreement. It is expected that all disputes that would traditionally be resolvable by a law court would be resolvable under this procedures. However, the Parties recognize certain business relationships could give rise to the need for one or more of the Parties to seek equitable remedies from a court that were traditionally available from an equity court, such as emergency, provisional or summary relief and injunctive relief. Immediately following the issuance of any such equitable relief, the Parties will stay any further judicial proceeding pending arbitration of all underlying claims between the Parties. The Parties also recognize that the ACC has primary jurisdiction over certain issues that may arise among and between the Parties that relate to the provision of public utility service. Accordingly, this Article is not intended to prohibit any party from bringing any such issues to the ACC for resolution or from taking any position at the ACC that would be inconsistent with or barred by this Agreement or by collateral estoppel, *res judicata* or other issues or fact-preclusive doctrines.

15.5 Appeal. Within 30 days after the date of the arbitration award, a party may appeal to the U.S. District Court for the District of Arizona, if such court has jurisdiction, and otherwise to any state court of record in Arizona having jurisdiction, to vacate and remand, or modify or correct the arbitration award for any of the grounds specified in the Federal Arbitration Act.

15.6 Confidentiality. The arbitration proceedings will be conducted in secrecy. Except as otherwise agreed by the Parties in writing, (a) the fact of the pending arbitration will not be disclosed or confirmed by the Parties or the arbitrator to any person who is not a party to, or called to testify at, the proceedings until the arbitration award has been made, (b) the proceedings will not be recorded or transcribed in any manner, and (c) all documents, testimony and records (other than the contract documents out of which the dispute arises) will be received, heard and maintained by the arbitrator in secrecy, available for inspection only by the Parties, their attorneys and by experts who must agree, in advance and in writing, to receive all such information in secrecy. The secret information will not be described in the arbitration award in such manner as to be commercially useful.

16. Indemnification. Water Company is not responsible for the control, carriage, handling, use, disposal or distribution of any water beyond the Point of Delivery. Each party (indemnitor) to this Agreement agrees to indemnify and hold harmless the other party (indemnitee) and its governing bodies, agents, directors, officers and employees for, from and against any loss, damage or liability, including reasonable attorney's fees, caused by a negligent or intentionally willful action or inaction on the part of the indemnitor and its governing bodies, agents, directors, officers and employees, including without limitation, claims for bodily injury,

illness, death or damage to property. Each party assumes liability for its own negligent or intentionally willful action or inaction arising out of the terms and conditions of this Agreement.

17. Uncontrollable Forces. Neither party will be considered to be in default in the performance of its obligations under this Agreement (other than obligations to make payments due hereunder) when a failure of performance is due to Uncontrollable Forces. The term "Uncontrollable Force" means any natural or artificial cause beyond the control of a party to this Agreement that renders the party unable to perform its obligations, including but not limited to, failure of or threat of failure of facilities, flood, earthquake, storm, fire, lightning and other natural catastrophes, epidemic, war, riot, civil disturbance or disobedience, strike, labor dispute, labor or material shortage, sabotage, government priorities and restraint by court order or public authority, and action or inaction by, or failure to obtain the necessary authorizations or approvals from, any governmental agency or authority, which by exercise of due diligence the party could not reasonably have been expected to avoid and which by exercise of due diligence it is unable to overcome. Nothing contained herein may be construed to require either party to settle any strike or labor dispute in which it is involved.

18. General Provisions.

18.1 Effective Date. This Agreement is effective upon execution of the Agreement by all parties.

18.2. Recitals Incorporated. All of the recitals made herein are incorporated by reference.

18.3 Authorized Representatives. Within 30 days after execution of this Agreement, each party will designate in writing to the other party an authorized representative ("Representative") and an alternate ("Alternate") to administer the provisions of this Agreement

on behalf of the designating parties. An Alternate may act only in the absence of the Representative. Written notice of a change of Representative or Alternate must be provided at least 30 days before such change becomes effective. Arrangements or understandings of the representatives pursuant to this Agreement must be in writing and signed by them, but notwithstanding the foregoing, neither the Representatives nor the Alternates have authority to amend this Agreement.

18.4 Binding Effect. The provisions of this Agreement inure to the benefit of and be binding upon the respective heirs, personal representatives, successors and assigns of the Parties, but no assignment or transfer of this Agreement or any interest therein is valid until approved in writing by the other party. Such approval may not be unreasonably withheld.

18.5 Notices. Any notice given pursuant to this Agreement must be in writing and be personally delivered or deposited in the United States mail, postage prepaid, certified and return receipt requested to the Parties as follows:

To Water Company:	Sun City West Utilities Company P.O. Box 1687 Sun City, Arizona 85372 Attn: General Manager
To Recreation Centers:	Recreation Centers of Sun City West 19803 RH Johnson Boulevard Sun City West, Arizona 85375

Notices are deemed given when personally delivered or, if mailed, five days after the deposit of the notice in the U.S. mail. If a notice initiates the running of a time period for the performance of, or compliance with, any obligation or duty set forth in this Agreement, the notice must be sent certified, return receipt requested. Any party hereto must give written notice of a change of address to the other party as provided above.

18.6 Good Standing; Authority. Each of the Parties represents and warrants to the other party: (a) that it is duly formed, validly existing and in good standing under all applicable laws; and (b) that the individual(s) executing this Agreement on behalf of the respective parties are authorized and empowered to bind the Parties on whose behalf each such individual is signing.

18.7 Exhibits. Any exhibit hereto is incorporated herein by this reference with the same force and affect as if fully set forth in the body hereof.

18.8. Attorney's Fees. If any action is brought by any party with respect to its rights under this Agreement, the prevailing party or parties are entitled to reasonable attorney's fees and court costs from the other party or parties as determined by the court.

18.9 Entire Agreement. The terms, covenants and condition of this Agreement constitute the entire agreement between the Parties and no understandings or obligations not expressly set forth herein are binding upon them. All prior and contemporaneous agreements, representations and understandings of the Parties, oral or written, on the subject matter of this Agreement, are hereby superseded and merged herein.

18.10 Further Documentation. Each party agrees in good faith to execute, deliver, acknowledge or record further or additional documents, approvals or consents as are required or desirable in order to fully carry out the intent and purpose of this Agreement.

18.11 Governing Law. This Agreement is made under and is governed by the laws of the State of Arizona. Subject to the provisions of Paragraph 16, all proceedings related to this Agreement will be maintained in the courts of the State of Arizona (including the United States District Court for the District of Arizona), which courts have jurisdiction over those proceedings.

18.12 Counterparts. This Agreement may be executed in any number of counterparts, each of which is an original, but all of which constitute one and the same instrument. The signature pages from one or more counterparts may be removed from such counterparts and attached to a single instrument so that the signatures of all parties may be physically attached to a single document.

18.13 Amendments and Modifications. This Agreement may be modified, amended, rescinded, cancelled or waived, in whole or in part, only by a written instrument executed by all parties.

18.14 Severability. If any provision of this Agreement is held to be invalid, illegal or unenforceable under any applicable statute or rule of law, the provision is deemed null and void, but the remainder of this Agreement remains in full force and effect.

18.15 No Partnerships. The Parties to this Agreement may not be deemed to have formed a partnership or joint venture by their execution of this Agreement. The provisions of this Agreement are not intended to be for the benefit of any person, firm, organization or corporation not a party hereto and no such person or entity have any rights or cause of action under this Agreement.

18.16 Waiver. No delay in exercising any right or remedy will constitute a waiver thereof, and no waiver by any party of the breach of any covenant of this Agreement may be construed as a waiver of any preceding or succeeding breach of the same or any other covenant or condition of this Agreement.

18.17 Compliance with Laws. Recreation Centers agrees to comply with all applicable local, state and federal laws and permit requirements specifically including all requirements of the Arizona Groundwater Code.

18.18 Books and Records. Recreation Centers must establish and maintain books and records pertaining to use of water under this Agreement, including data on water received and used and any reports filed with ADWR. Subject to applicable laws and regulations, each party to this Agreement has the right during office hours to examine and make copies of each other's books and records relating to this Agreement.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement on the day and year first above written on behalf of Water Company and Recreation Centers by the respective company officials.

SUN CITY WEST UTILITIES COMPANY

Date: October 20, 2000

By: Ray L. Jo

Its: Vice President & General Manager

RECREATION CENTERS OF SUN CITY WEST

Date: October 11, 2000

By: Richard A. Cattlin

Its: President

EXHIBIT A

LOCATIONS OF USE AND POINTS OF DELIVERY

EXHIBIT B

OPERATING AGREEMENT

EXHIBIT
A-8
Admitted

AGREEMENT FOR EXCHANGE OF CENTRAL ARIZONA PROJECT WATER ON GOLF COURSE

This Agreement for Exchange of Central Arizona Project Water on Golf Course ("Agreement") is made this 14th day of December, 2000 by SUN CITY WEST UTILITIES COMPANY ("Water Company"), an Arizona corporation, and BRIARWOOD COUNTRY CLUB ("Briarwood"), an Arizona non-profit corporation ("the Parties").

I. RECITALS

A. In February of 1998, eight community organizations in Sun City, Sun City West and Youngtown established the CAP Task Force to determine if the 6,561 acre foot allocation of Central Arizona Project ("CAP") water intended for use in Sun City, Sun City West and Youngtown ("the Sun Cities") should be retained, and if so, how the water should be used and paid for.

B. Over a fourteen-week period, the CAP Task Force studied issues such as groundwater declines, the availability of alternative water supplies and the impact of relinquishing the CAP allocations.

C. After studying the options for use of CAP water, the CAP Task Force recommended that CAP water be retained and used through an arrangement with local golf courses. CAP water would be delivered to Sun City and Sun City West through a nonpotable pipeline ("the Pipeline") and used to irrigate golf courses that have historically pumped groundwater. The CAP Task Force submitted its final report by resolution on May 19, 1998.

D. Water Company entered into a contract entitled "Subcontract Among the United States, the Central Arizona Water Conservation District and the Sun City West Utilities Company Providing for Water Service, Central Arizona Project," Contract No. 00XX300002,

dated October 26, 1999 ("the CAP Subcontract"), entitling it to 2,372 acre feet of CAP water use in its service area.

E. This Agreement is intended to (1) provide CAP water to golf courses to replace their use of groundwater thereby preserving groundwater supplies under Sun City West and benefiting the entire community; (2) allow Water Company to utilize its CAP water at substantially less cost than building a treatment plant thereby providing the most direct benefit to rate payers at the lowest possible cost; and (3) legally convert a portion of Water Company's groundwater pumping into surface water through a water exchange thereby significantly reducing the community's historic reliance on groundwater in the exchange.

F. The Parties to this Agreement intend to implement the project through a water exchange. Water Company will give CAP water and Briarwood will give groundwater in the exchange.

G. Water Company is an Arizona public service corporation within the meaning of Article 15, § 2 of the Arizona Constitution and is authorized to provide water service within portions of Maricopa County, Arizona ("the Certificated Area") pursuant to a certificate of convenience and necessity granted by order of the Arizona Corporation Commission ("ACC") and is authorized to withdraw groundwater pursuant to its water service area right (56-002038.0000) established under A.R.S. Title 45, Article 6.

H. Briarwood withdraws groundwater pursuant to certain non-irrigation grandfathered rights and other withdrawal authorities.

I. Water Company and Briarwood desire to enter into an agreement whereby Water Company provides CAP water to Briarwood for irrigation of golf courses in exchange for the use

of groundwater, and Briarwood provides groundwater to Water Company for potable deliveries in exchange for the use of CAP water.

J. Briarwood acknowledges that in order to effectuate this Agreement, Water Company or an affiliated entity will construct the Pipeline to deliver CAP water to Briarwood's golf courses in reliance on Briarwood's commitment to use CAP water pursuant to this Agreement.

NOW, THEREFORE, in consideration of covenants and agreements contained herein, the sufficiency of which is hereby acknowledged, the Parties agree as follows:

II. CAP EXCHANGE AGREEMENT

1. Exchange. Water Company and Briarwood hereby agree to a legal arrangement under Arizona law (A.R.S. §45-1001) called an "exchange." Pursuant to Arizona law, Water Company will annually "give" to Briarwood up to 818 acre feet of Water Company's CAP water, and Briarwood will "give" Water Company an equal amount of Briarwood's groundwater. In reality, Briarwood will use CAP water delivered to it and refrain from pumping groundwater in the amount of CAP water used. In reality, Water Company will continue to pump groundwater from its wells in the same amount as it historically pumped, but it will be able to account for the groundwater as if it was CAP water up to the amount of CAP water delivered to Briarwood. The net result will be a reduction in total groundwater pumping as a result of the use of CAP water on Briarwood golf courses. Pursuant to Arizona exchange law, Water Company must account for the groundwater it "receives" in the exchange as CAP water and Briarwood must account for the CAP water it "receives" in the exchange as groundwater. Each party may use the water it receives only in the manner in which it may legally use the water it gives in the exchange. Therefore, the same acreage and water use restrictions that applied to Briarwood before the exchange will continue to apply after the exchange.

2. Exchange Period. The exchange period is the calendar year.

3. CAP Water Rights. Water Company will exchange up to 818 acre-feet of CAP water pursuant to its Municipal and Industrial CAP Subcontract No. 00XX300002.

4. Groundwater Rights. Briarwood will exchange groundwater pursuant to the following water rights:

Type 1 Grandfathered Rights

58-117269.0002 484.85 acre feet

Groundwater Industrial Use Permits

59-511010.0000 333 acre feet

For purposes of satisfying the Arizona Department of Water Resource's requirements for exchanging Type 1 rights, and for purposes of this exchange only, the parties hereby recite that Briarwood has the theoretical right to withdraw groundwater at the locations where Water Company will withdraw the exchanged groundwater. This does not allow Briarwood to use, have any rights to or in any way interfere with Water Company's use of Water Company's wells.

5. Term of Agreement. The initial term of this Agreement runs from the Effective Date through December 31, 2043, which is the date of expiration of the CAP Subcontract. If the CAP Subcontract term is extended or renewed, this Agreement, if still in effect, will automatically renew for a period equal to the new term of the CAP Subcontract (together referred to herein as "Term").

6. Termination of Agreement.

6.1 Either party may terminate this Agreement if any of the following pre-conditions has not occurred.

a. The Operating Agreement referenced in section 9 of this Agreement has been executed by both parties no later than December 31, 2000.

b. Arizona Department of Water Resources ("ADWR") has issued all permits or approvals necessary to implement an exchange to enable the use of CAP water on Briarwood's golf courses no later than March 31, 2001.

c. Briarwood has applied for and obtained sufficient authority to withdraw groundwater to achieve the purpose of this Agreement for the Term of this Agreement no later than December 31, 2000.

d. The preliminary design/cost study ordered by the ACC in Decision and Order No. 62293 has been approved by the ACC.

6.2 Except as provided in section 6.1, Briarwood may terminate this Agreement only in the event of a material breach of this Agreement by Water Company.

6.3 Water Company may terminate this Agreement for the following reasons:

a. A material breach by Briarwood, including if Briarwood remains in arrears in the payment of amounts due under Paragraph 10 of this Exchange for more than 60 days, which termination will be effective 15 days after mailing written notice of termination to Briarwood.

b. If Water Company cannot legally continue to deliver CAP water to Briarwood golf courses, after having made a good faith effort to maintain and/or obtain the necessary legal authority.

c. If Briarwood cannot legally continue to exchange groundwater with Water Company, after having made a good faith effort to maintain and/or obtain the necessary legal authority.

d. If it becomes necessary for Water Company to use the CAP Subcontract water for potable deliveries to the residents of Sun City West. Before Water Company may terminate this Exchange

for this purpose, Water Company must give Briarwood at least two years notice.

6.4 If this Agreement is terminated before Water Company has recovered its investment in the Pipeline and the Pipeline is no longer being used to benefit Sun City West water ratepayers, at the first succeeding rate proceeding the ACC would determine whether Water Company could continue to reflect its investment in the Pipeline in water rates.

7. Delivery and Acceptance of CAP Water. Water Company will meter and deliver to Briarwood CAP water for use on its golf courses in the amounts determined pursuant to Paragraph 9 of this Agreement. Water Company will deliver the water at the location shown in Exhibit A to this Agreement ("Point of Delivery"). In no event is Water Company obligated to deliver more than 818 acre feet of CAP water in any one year. Briarwood agrees to accept delivery of the amount of water ordered pursuant to Paragraph 9 of this Agreement and to use the water in accordance with the terms of this Agreement. Water Company's obligation to deliver CAP water is subject to Water Company's ability to receive the CAP water from the Central Arizona Water Conservation District ("CAWCD"). This Agreement is subject to the terms and conditions of the CAP Subcontract and the Master Repayment Contract between the CAWCD and the United States, as amended.

8. Location of Use. The CAP water delivered to Briarwood pursuant to this Agreement may be used only at the locations where Briarwood has the legal authority to use groundwater pursuant to existing authorities to withdraw held by Briarwood or any additional authorities to withdraw that may be acquired in the future.

9. Ordering and Delivery of Water. Briarwood will order and Water Company will deliver the CAP water pursuant to the ordering and delivery procedure set forth in the Operating Agreement attached hereto as Exhibit B. The Operating Agreement may be amended from time

to time by written agreement of both parties without amending this Agreement. Water Company is not obligated to deliver water to Briarwood until such time as construction of the Pipeline is complete. Briarwood agrees to use its best efforts to use the amount of CAP water made available to it on its golf course each year, consistent with best golf course management practices and legal requirements. Nothing in this Agreement shall be construed to limit Briarwood's legal right to pump groundwater pursuant to its permits if Water Company is unable to deliver the amounts of CAP water anticipated by this Agreement.

10. Payment for Exchanged Water. Briarwood must pay Water Company a charge per acre foot of water received pursuant to this Agreement ("the Exchange Charge"). The Exchange Charge for the first five years of deliveries will be an amount equal to 80% of Briarwood' average per acre foot cost of purchased power for pumping groundwater during the calendar year prior to the first year Water Company delivers CAP water to Briarwood. This will be determined by Water Company in an audit of Briarwood' power records. Following the end of the fourth full calendar year of deliveries, Water Company will audit Briarwood's books and records pertaining to the power costs of pumping groundwater and determine what the Briarwood's average per acre foot power cost for pumping groundwater would have been in the fourth year had it been using 100% groundwater. The Exchange Charge in the sixth through tenth calendar years will be 80% of this per acre foot amount. Briarwood agrees to provide any relevant information requested by Water Company for the audit and cost determination. Water Company will perform such an audit and determination every five years and adjust the Exchange Charge accordingly. Water Company will bill Briarwood monthly and Briarwood must pay the Exchange Charge within 30 days of receipt of a bill. If Briarwood does not pay the charge

within 45 days of receipt of the bill, Briarwood must pay a late charge of 1.5% per month for each day the payment is delinquent beyond the due date.

11. Additional CAP Water. If Briarwood acquires additional CAP water after the effective date of this Agreement, Water Company will work with Briarwood to either 1) include the additional water in the exchange through an amendment to this Agreement or a separate agreement, or 2) enter into a new agreement for direct delivery of the CAP water to Briarwood.

12. Water Quality. Water Company will deliver water to Briarwood suitable for use for irrigating golf courses at the Point of Delivery. Briarwood is responsible for the quality of water after the Point of Delivery.

13. Water Exchange Notice and Reporting. Water Company will file a Notice of Water Exchange as required by A.R.S. § 45-1051. In addition, both Water Company and Briarwood will file annual reports on water exchanged pursuant to A.R.S. § 45-1004 and will exchange water in accordance with the exchange agreement and any other legal requirements applicable to the exchange. In no event will Briarwood use the CAP water in a manner in which it was not legally entitled to use the groundwater being exchanged.

14. Dispute Resolution.

14.1 Scope. This section governs the resolution of all disputes arising under this Agreement.

14.2 Good Faith Negotiations. The party that believes a dispute exists under this Agreement will first refer the dispute to the Representatives for resolution. The Representatives of each party will personally meet and attempt in good faith to resolve the dispute. If the Representatives cannot resolve the dispute within 14 days, the matter will be referred to senior management of Briarwood and Water Company for resolution. If these

persons are unable to resolve the dispute within 30 days thereafter, a party that still believes the dispute requires resolution may avail itself of the provisions of section 14.3.

14.3 Arbitration. If a party still believes a dispute requires resolution, after following the procedures of Paragraph 14.2, that party will first give a detailed written notice of dispute to the other parties setting forth the nature of the dispute. The Parties will then, upon request of any party, be submitted for and settled by binding arbitration administered by AAA before a single arbitrator. The arbitrator must have substantial experience with the water utility industry. The arbitrator has no power to amend or modify this Agreement. Judgment on the award rendered by the arbitrator must be entered in any court with jurisdiction.

14.4 Other Remedies. The preceding subparagraphs of this Paragraph 14 are intended to set forth the primary procedure to resolve all disputes under this Agreement. It is expected that all disputes that would traditionally be resolvable by a law court would be resolvable under this procedures. However, the Parties recognize certain business relationships could give rise to the need for one or more of the Parties to seek equitable remedies from a court that were traditionally available from an equity court, such as emergency, provisional or summary relief and injunctive relief. Immediately following the issuance of any such equitable relief, the Parties will stay any further judicial proceeding pending arbitration of all underlying claims between the Parties. The Parties also recognize that the ACC has primary jurisdiction over certain issues that may arise among and between the Parties that relate to the provision of public utility service. Accordingly, this Article is not intended to prohibit any party from bringing any such issues to the ACC for resolution or from taking any position at the ACC that would be inconsistent with or barred by this Agreement or by collateral estoppel, *res judicata* or other issues or fact-preclusive doctrines.

14.5 Appeal. Within 30 days after the date of the arbitration award, a party may appeal to the U.S. District Court for the District of Arizona, if such court has jurisdiction, and otherwise to any state court of record in Arizona having jurisdiction, to vacate and remand, or modify or correct the arbitration award for any of the grounds specified in the Federal Arbitration Act.

14.6 Confidentiality. The arbitration proceedings will be conducted in secrecy. Except as otherwise agreed by the Parties in writing, (a) the fact of the pending arbitration will not be disclosed or confirmed by the Parties or the arbitrator to any person who is not a party to, or called to testify at, the proceedings until the arbitration award has been made, (b) the proceedings will not be recorded or transcribed in any manner, and (c) all documents, testimony and records (other than the contract documents out of which the dispute arises) will be received, heard and maintained by the arbitrator in secrecy, available for inspection only by the Parties, their attorneys and by experts who must agree, in advance and in writing, to receive all such information in secrecy. The secret information will not be described in the arbitration award in such manner as to be commercially useful.

15. Indemnification. Water Company is not responsible for the control, carriage, handling, use, disposal or distribution of any water beyond the Point of Delivery. Each party (indemnitor) to this Agreement agrees to indemnify and hold harmless the other party (indemnitee) and its governing bodies, agents, directors, officers and employees for, from and against any loss, damage or liability, including reasonable attorney's fees, caused by a negligent or intentionally willful action or inaction on the part of the indemnitor and its governing bodies, agents, directors, officers and employees, including without limitation, claims for bodily injury,

illness, death or damage to property. Each party assumes liability for its own negligent or intentionally willful action or inaction arising out of the terms and conditions of this Agreement.

16. Uncontrollable Forces. Neither party will be considered to be in default in the performance of its obligations under this Agreement (other than obligations to make payments due hereunder) when a failure of performance is due to Uncontrollable Forces. The term "Uncontrollable Force" means any natural or artificial cause beyond the control of a party to this Agreement that renders the party unable to perform its obligations, including but not limited to, failure of or threat of failure of facilities, flood, earthquake, storm, fire, lightning and other natural catastrophes, epidemic, war, riot, civil disturbance or disobedience, strike, labor dispute, labor or material shortage, sabotage, government priorities and restraint by court order or public authority, and action or inaction by, or failure to obtain the necessary authorizations or approvals from, any governmental agency or authority, which by exercise of due diligence the party could not reasonably have been expected to avoid and which by exercise of due diligence it is unable to overcome. Nothing contained herein may be construed to require either party to settle any strike or labor dispute in which it is involved.

17. General Provisions.

17.1 Effective Date. This Agreement is effective upon execution of the Agreement by all parties.

17.2. Recitals Incorporated. All of the recitals made herein are incorporated by reference.

17.3 Authorized Representatives. Within 30 days after execution of this Agreement, each party will designate in writing to the other party an authorized representative ("Representative") and an alternate ("Alternate") to administer the provisions of this Agreement

on behalf of the designating parties. An Alternate may act only in the absence of the Representative. Written notice of a change of Representative or Alternate must be provided at least 30 days before such change becomes effective. Arrangements or understandings of the representatives pursuant to this Agreement must be in writing and signed by them, but notwithstanding the foregoing, neither the Representatives nor the Alternates have authority to amend this Agreement.

17.4 Binding Effect. The provisions of this Agreement inure to the benefit of and be binding upon the respective heirs, personal representatives, successors and assigns of the Parties, but no assignment or transfer of this Agreement or any interest therein is valid until approved in writing by the other party. Such approval may not be unreasonably withheld.

17.5 Notices. Any notice given pursuant to this Agreement must be in writing and be personally delivered or deposited in the United States mail, postage prepaid, certified and return receipt requested to the Parties as follows:

To Water Company:	Sun City West Utilities Company P.O. Box 1687 Sun City, Arizona 85372 Attn: General Manager
To Briarwood:	Briarwood Country Club 20800 N. 135th Avenue Sun City West, Arizona 85375 Attn: John Kauffmann, General Manager

Notices are deemed given when personally delivered or, if mailed, five days after the deposit of the notice in the U.S. mail. If a notice initiates the running of a time period for the performance of, or compliance with, any obligation or duty set forth in this Agreement, the notice must be sent certified, return receipt requested. Any party hereto must give written notice of a change of address to the other party as provided above.

17.6 Good Standing; Authority. Each of the Parties represents and warrants to the other party: (a) that it is duly formed, validly existing and in good standing under all applicable laws; and (b) that the individual(s) executing this Agreement on behalf of the respective parties are authorized and empowered to bind the Parties on whose behalf each such individual is signing.

17.7 Exhibits. Any exhibit hereto is incorporated herein by this reference with the same force and affect as if fully set forth in the body hereof.

17.8. Attorney's Fees. If any action is brought by any party with respect to its rights under this Agreement, the prevailing party or parties are entitled to reasonable attorney's fees and court costs from the other party or parties as determined by the court.

17.9 Entire Agreement. The terms, covenants and condition of this Agreement constitute the entire agreement between the Parties and no understandings or obligations not expressly set forth herein are binding upon them. All prior and contemporaneous agreements, representations and understandings of the Parties, oral or written, on the subject matter of this Agreement, are hereby superseded and merged herein.

17.10 Further Documentation. Each party agrees in good faith to execute, deliver, acknowledge or record further or additional documents, approvals or consents as are required or desirable in order to fully carry out the intent and purpose of this Agreement.

17.11 Governing Law. This Agreement is made under and is governed by the laws of the State of Arizona. Subject to the provisions of Paragraph 16, all proceedings related to this Agreement will be maintained in the courts of the State of Arizona (including the United States District Court for the District of Arizona), which courts have jurisdiction over those proceedings.

17.12 Counterparts. This Agreement may be executed in any number of counterparts, each of which is an original, but all of which constitute one and the same instrument. The signature pages from one or more counterparts may be removed from such counterparts and attached to a single instrument so that the signatures of all parties may be physically attached to a single document.

17.13 Amendments and Modifications. This Agreement may be modified, amended, rescinded, cancelled or waived, in whole or in part, only by a written instrument executed by all parties.

17.14 Severability. If any provision of this Agreement is held to be invalid, illegal or unenforceable under any applicable statute or rule of law, the provision is deemed null and void, but the remainder of this Agreement remains in full force and effect.

17.15 No Partnerships. The Parties to this Agreement may not be deemed to have formed a partnership or joint venture by their execution of this Agreement. The provisions of this Agreement are not intended to be for the benefit of any person, firm, organization or corporation not a party hereto and no such person or entity have any rights or cause of action under this Agreement.

17.16 Waiver. No delay in exercising any right or remedy will constitute a waiver thereof, and no waiver by any party of the breach of any covenant of this Agreement may be construed as a waiver of any preceding or succeeding breach of the same or any other covenant or condition of this Agreement.

17.17 Compliance with Laws. Briarwood agrees to comply with all applicable local, state and federal laws and permit requirements specifically including all requirements of the Arizona Groundwater Code.

17.18 Books and Records. Briarwood must establish and maintain books and records pertaining to use of water under this Agreement, including data on water received and used and any reports filed with ADWR. Subject to applicable laws and regulations, each party to this Agreement has the right during office hours to examine and make copies of each other's books and records relating to this Agreement.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement on the day and year first above written on behalf of Water Company and Briarwood by the respective company officials.

SUN CITY WEST UTILITIES COMPANY

Date: 12/14/00

By: Ray L. Jones

Its: Vice President & General Manager

BRIARWOOD COUNTRY CLUB

Date: 12/14/00

By: Daniel G. Bach

Its: President

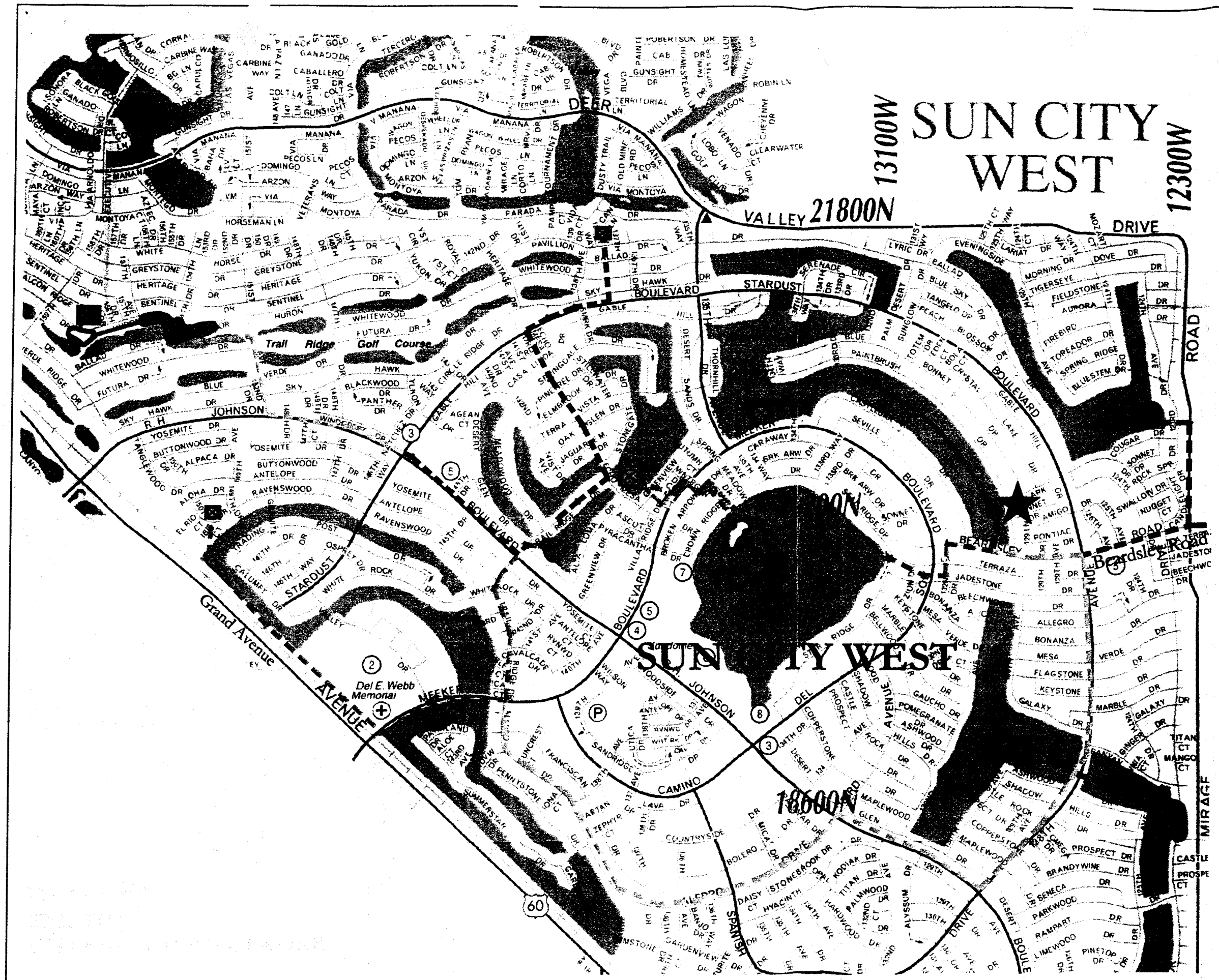
Doc. #255984 v.06

EXHIBIT A

LOCATIONS OF USE AND POINTS OF DELIVERY

CITIZENS water resources

SUN CITY / SUN CITY WEST/YOUNGTOWN GROUND WATER SAVINGS PROJECT



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LEGEND

- EXISTING 12" PIPELINES
- EXISTING 14" PIPELINES
- EXISTING 16" PIPELINES
- EXISTING 20" PIPELINES
- WELL
- RESERVOIR LAKE
- POINTS OF DELIVERY

EXHIBIT A
LOCATIONS OF USE AND POINTS OF DELIVERY

Sun City West
EXISTING DISTRIBUTION NETWORK

EXHIBIT B

OPERATING AGREEMENT

EXHIBIT
A-9
Admitted

OPERATING AGREEMENT

This Agreement for Operating Service in Sun City ("Agreement") is made this 27th day of July, 2001 by SUN CITY WATER COMPANY ("Water Company"), an Arizona corporation, and RECREATION CENTERS OF SUN CITY ("Recreation Centers"), an Arizona non-profit corporation ("the parties").

RECITALS

A. Water Company and Recreation Centers entered into an Agreement for Exchange of CAP Water in Sun City, dated October 30, 2000 ("Exchange Agreement").

B. Water Company has entered into a similar agreement for the Exchange of CAP water in Sun City West with the Recreation Centers of Sun City West (the "Sun City West Exchange Agreement").

C. In order to implement the Exchange Agreement, the Sun City West Exchange Agreement must also be implemented and certain facilities must be constructed and certain operating policies and procedures must be established and coordinated.

D. Water Company or an affiliated entity intends to construct a new pipeline to deliver water from CAP canal to the Water Company's Water Campus ("CAP Trunk Pipeline"), in accordance with recommendations of the engineering report entitled "Sun City/Sun City West/Youngtown Groundwater Savings Project", dated August, 2000.

E. Water Company or an affiliated entity intends to construct a new non-potable water distribution system ("Distribution System") for delivering CAP water from its Water Campus to the points of delivery at various golf courses ("Points of Delivery"), in accordance with recommendations of the engineering report entitled "Sun City/Sun City West/Youngtown Groundwater Savings Project", dated August, 2000.

F. Water Company shall construct a supervisory control and data acquisition system ("SCADA System") to control, regulate, and meter water deliveries to the various golf course Points of Delivery.

G. The CAP Trunk Pipeline, Distribution System, SCADA System, and associated facilities and appurtenances ("Facilities") will together transport CAP water from CAP canal to the Points of Delivery on the golf courses.

H. Water Company and Recreation Center desire to enter into this Agreement to operate the Facilities and to effect the exchange of CAP water.

NOW, THEREFORE, in consideration of covenants and agreements contained herein, the sufficiency of which is hereby acknowledged, the Parties agree as follows:

1. Facilities Operation and Maintenance:

   1.1 Water Company shall operate and maintain the Facilities.

   1.2 Recreation Centers grants Water Company a right of access to Recreation Centers property for the purpose of constructing, operating, and maintaining the Facilities. All such access and maintenance shall be in cooperation with the Recreation Centers in a manner designed to cause minimal interruption to ongoing golf operations.

2. Operating Methodology

   2.1 Recreation Centers shall meet golf course irrigation demands by utilizing available CAP water unless i) demand exceeds the Facilities' delivery capacity of 9.5 cubic feet per second or ii) 4,189 acre feet of CAP water has been delivered during the year.

   2.2 Notwithstanding Paragraph 2.1 above, Recreation Centers may pump groundwater if Water Company is unable to deliver CAP Water due to Facilities outage or other reason and for periodic short-duration pumping for pump testing and maintenance activities.

3. Ordering of Water

   3.1 Each year, not later than September 30, Water Company and Recreation Centers shall jointly prepare and approve a schedule of planned CAP water deliveries for the following year ("Water Schedule").

   3.2 Based upon the Water Schedule, Water Company shall order, schedule and otherwise coordinate CAP water deliveries from the Central Arizona Project.

   3.3 Recreation Centers shall notify Water Company, in a timely manner, of any changes to golf course operations, either planned or unforeseen, which could materially affect the Water Schedule.

4. Delivery of Water

   4.1 CAP water shall be scheduled and delivered by Water Company to the Points of Delivery in accordance with the priority established by the Recreation Centers.

4.2 Water Company shall make CAP water deliveries, based on Recreation Centers requests, on a daily cycle with varying delivery times, flow rates and duration, so that Recreation Center lake levels are maintained within design parameters.

4.3 Water Company shall, through the SCADA System, monitor and record operational parameters for each Point of Delivery, including delivery times, flow rates, and lake level.

5. Limit of Operational Obligations: Water Company's operational obligations under this Agreement end with its delivery of CAP water at Points of Delivery. Subsequent transfer/handling of water for irrigation purpose shall be Recreation Centers' obligation.

6. Water Rights Pooling; Mutual Cooperation: In the event that, after making its best efforts to do so, the Recreation Centers of Sun City West are unable to renew any or all of its General Industrial Use Permits (said "GIUs" being more particularly described on Exhibit A hereto), annually, Recreation Centers shall lease to Water Company, at no cost, that portion of its Type 2 Grandfathered Water Rights (said "Type 2 Rights" being more particularly described on Exhibit B hereto) not used by Recreation Centers for irrigation of Recreation Center golf courses during the calendar year. Water Company will then sublease the leased Type 2 Rights to the Recreation Centers of Sun City West for the sole purpose of providing exchangeable groundwater rights to the Recreation Centers of Sun City West to allow their exchange of groundwater with Water Company or its affiliate providing water service in Sun City West, Arizona in accordance with the Sun City West Exchange Agreement. Water Company shall not use the leased Type 2 Rights for any other purpose than described in this section.

7. Term of Agreement: The initial term of this Agreement runs from the day the Facilities become operational through December 31, 2043, which is the date of expiration of "Agreement for Exchange of CAP Water in Sun City", signed October 30, 2000 by the Water Company and Recreation Centers. If the CAP Exchange Agreement is terminated/extended/renewed, the term of this Agreement will automatically change to equal the new term of the CAP Exchange Agreement.

8. Books and Records:

8.1 The parties shall establish and maintain books and records pertaining to purchase, transfer, reporting, and use of water under this Agreement. Specific records that must be maintained by each party shall include, but are not limited to, the following:

8.1.1 Water Company shall record: (i) CAP water ordered each year/month/day; (ii) CAP water delivered each year/month/day by

Point of Delivery; and (iii) operational parameters required under Paragraph 4.3.

8.1.2 Recreation Centers shall record: (i) Usage of each well pump in its system, including duration of operation, monthly electricity charges and quantities of groundwater pumped.

8.2 Recreation Centers shall provide data collected and recorded by Recreation Centers to Water Company monthly. Water Company shall compile Recreation Center data and Water Company data into a monthly water usage report that shall be provided to Recreation Centers.

8.3 Water Company shall prepare an annual water usage report that shall include all data necessary to determine quantities of water exchanged and any other required data for purposes of annual reporting to the Department of Water Resources. Said report shall be provided to Recreation Centers. If requested by Recreation Centers, Water Company shall prepare annual exchange reports and annual groundwater withdrawal and use reports required by the Arizona Department of Water Resources for the approval and execution by Recreation Centers. Recreation Centers remains responsible for all fees and charges related to its annual water withdrawal and use reports.

8.4 Subject to applicable laws and regulations, each party to this Agreement has the right during office hours to examine and make copies of each other's books and records relating to this Agreement.

9. Dispute Resolution

9.1 Scope. This section governs the resolution of all disputes arising under this Agreement.

9.2 Good Faith Negotiations. The party that believes a dispute exists under this Agreement will first refer the dispute to the Representatives for resolution. The Representatives of each party will personally meet and attempt in good faith to resolve the dispute. If the Representatives cannot resolve the dispute within 14 days, the matter will be referred to senior management of Recreation Centers and Water Company for resolution. If these persons are unable to resolve the dispute within 30 days thereafter, a party that still believes the dispute requires resolution may avail itself of the provisions of section 9.3.

9.3 Arbitration. If a party still believes a dispute requires resolution, after following the procedures of Paragraph 9.2, that party will first give a detailed written notice of dispute to the other parties setting forth the nature of the dispute. The Parties will then, upon request of any party, be

submitted for and settled by binding arbitration administered by AAA before a single arbitrator. The arbitrator must have substantial experience with the water utility industry. The arbitrator has no power to amend or modify this Agreement. Judgment on the award rendered by the arbitrator must be entered in any court with jurisdiction.

9.4 Other Remedies. The preceding subparagraphs of this Paragraph 8 are intended to set forth the primary procedure to resolve all disputes under this Agreement. It is expected that all disputes that would traditionally be resolvable by a law court would be resolvable under this procedure. However, the Parties recognize certain business relationships could give rise to the need for one or more of the Parties to seek equitable remedies from a court that were traditionally available from an equity court, such as emergency, provisional or summary relief and injunctive relief. Immediately following the issuance of any such equitable relief, the Parties will stay any further judicial proceeding pending arbitration of all underlying claims between the Parties. The Parties also recognize that the ACC has primary jurisdiction over certain issues that may arise among and between the Parties that relate to the provision of public utility service. Accordingly, this Article is not intended to prohibit any party from bringing any such issues to the ACC for resolution or from taking any position at the ACC that would be inconsistent with or barred by this Agreement or by collateral estoppel, *res judicata* or other issues or fact-preclusive doctrines.

9.5 Appeal. Within 30 days after the date of the arbitration award, a party may appeal to the U.S. District Court for the District of Arizona, if such court has jurisdiction, and otherwise to any state court of record in Arizona having jurisdiction, to vacate and remand, or modify or correct the arbitration award for any of the grounds specified in the Federal Arbitration Act.

9.6 Confidentiality. The arbitration proceedings will be conducted in secrecy. Except as otherwise agreed by the Parties in writing, (a) the fact of the pending arbitration will not be disclosed or confirmed by the Parties or the arbitrator to any person who is not a party to, or called to testify at, the proceedings until the arbitration award has been made, (b) the proceedings will not be recorded or transcribed in any manner, and (c) all documents, testimony and records (other than the contract documents out of which the dispute arises) will be received, heard and maintained by the arbitrator in secrecy, available for inspection only by the Parties, their attorneys and by experts who must agree, in advance and in writing, to receive all such information in secrecy. The secret information will not be described in the arbitration award in such manner as to be commercially useful.

10. Indemnification. Water Company is not responsible for the control, carriage, handling, use, disposal or distribution of any water beyond the Point of Delivery. Each party (indemnitor) to this Agreement agrees to indemnify and hold harmless the other party (indemnitee) and its governing bodies, agents, directors, officers and employees for, from and against any loss, damage or liability, including reasonable attorney's fees, caused by a negligent or intentionally willful action or inaction on the part of the indemnitor and its governing bodies, agents, directors, officers and employees, including without limitation, claims for bodily injury, illness, death or damage to property. Each party assumes liability for its own negligent or intentionally willful action or inaction arising out of the terms and conditions of this Agreement.

11. Uncontrollable Forces. Neither party will be considered to be in default in the performance of its obligations under this Agreement (other than obligations to make payments due hereunder) when a failure of performance is due to Uncontrollable Forces. The term "Uncontrollable Force" means any natural or artificial cause beyond the control of a party to this Agreement that renders the party unable to perform its obligations, including but not limited to, failure of or threat of failure of facilities, flood, earthquake, storm, fire, lightning and other natural catastrophes, epidemic, war, riot, civil disturbance or disobedience, strike, labor dispute, labor or material shortage, sabotage, government priorities and restraint by court order or public authority, and action or inaction by, or failure to obtain the necessary authorizations or approvals from, any governmental agency or authority, which by exercise of due diligence the party could not reasonably have been expected to avoid and which by exercise of due diligence it is unable to overcome. Nothing contained herein may be construed to require either party to settle any strike or labor dispute in which it is involved.

12. General Provisions

12.1 Effective Date. This Agreement is effective upon execution of the Agreement by all parties.

12.2 Recitals Incorporated. All of the recitals made herein are incorporated by reference.

12.3 Authorized Representatives. Within 30 days after execution of this Agreement, each party will designate in writing to the other party an authorized representative ("Representative") and an alternate ("Alternate") to administer the provisions of this Agreement on behalf of the designating parties. An Alternate may act only in the absence of the Representative. Written notice of a change of Representative or Alternate must be provided at least 30 days before such change becomes effective. Arrangements or understandings of the representatives pursuant to this Agreement must be in writing and signed by them, but notwithstanding the

foregoing, neither the Representatives nor the Alternates have authority to amend this Agreement.

12.4 Binding Effect. The provisions of this Agreement inure to the benefit of and be binding upon the respective heirs, personal representatives, successors and assigns of the Parties, but no assignment or transfer of this Agreement or any interest therein is valid until approved in writing by the other party. Such approval may not be unreasonably withheld.

12.5 Notices. Any notice given pursuant to this Agreement must be in writing and be personally delivered or deposited in the United States mail, postage prepaid, certified and return receipt requested to the Parties as follows:

To Water Company:	Sun City Water Company P.O. Box 1687 Sun City, Arizona 85372 Attn: General Manager
To Recreation Centers:	Recreation Centers of Sun City 10626 Thunderbird Boulevard Sun City, Arizona 85351

Notices are deemed given when personally delivered or, if mailed, five days after the deposit of the notice in the U.S. mail. If a notice initiates the running of a time period for the performance of, or compliance with, any obligation or duty set forth in this Agreement, the notice must be sent certified, return receipt requested. Any party hereto must give written notice of a change of address to the other party as provided above.

12.6 Good Standing; Authority. Each of the Parties represents and warrants to the other party: (a) that it is duly formed, validly existing and in good standing under all applicable laws; and (b) that the individual(s) executing this Agreement on behalf of the respective parties are authorized and empowered to bind the Parties on whose behalf each such individual is signing.

12.7 Attorney's Fees. If any action is brought by any party with respect to its rights under this Agreement, the prevailing party or parties are entitled to reasonable attorney's fees and court costs from the other party or parties as determined by the court.

12.8 Entire Agreement. The terms, covenants and condition of this Agreement constitute the entire agreement between the Parties and no understandings or obligations not expressly set forth herein are binding upon them. All prior and contemporaneous agreements, representations and

understandings of the Parties, oral or written, on the subject matter of this Agreement, are hereby superseded and merged herein.

12.9 Further Documentation. Each party agrees in good faith to execute, deliver, acknowledge or record further or additional documents, approvals or consents as are required or desirable in order to fully carry out the intent and purpose of this Agreement.

12.10 Governing Law. This Agreement is made under and is governed by the laws of the State of Arizona. Subject to the provisions of Paragraph 8, all proceedings related to this Agreement will be maintained in the courts of the State of Arizona (including the United States District Court for the District of Arizona), which courts have jurisdiction over those proceedings.

12.11 Counterparts. This Agreement may be executed in any number of counterparts, each of which is an original, but all of which constitute one and the same instrument. The signature pages from one or more counterparts may be removed from such counterparts and attached to a single instrument so that the signatures of all parties may be physically attached to a single document.

12.12 Amendments and Modifications. This Agreement may be modified, amended, rescinded, cancelled or waived, in whole or in part, only by a written instrument executed by all parties.

12.13 Severability. If any provision of this Agreement is held to be invalid, illegal or unenforceable under any applicable statute or rule of law, the provision is deemed null and void, but the remainder of this Agreement remains in full force and effect.

12.14 No Partnerships. The Parties to this Agreement may not be deemed to have formed a partnership or joint venture by their execution of this Agreement. The provisions of this Agreement are not intended to be for the benefit of any person, firm, organization or corporation not a party hereto and no such person or entity have any rights or cause of action under this Agreement.

12.15 Waiver. No delay in exercising any right or remedy will constitute a waiver thereof, and no waiver by any party of the breach of any covenant of this Agreement may be construed as a waiver of any preceding or succeeding breach of the same or any other covenant or condition of this Agreement.

12.16 Compliance with Laws. Recreation Centers agrees to comply with all applicable local, state and federal laws and permit requirements specifically including all requirements of the Arizona Groundwater Code.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement on the day and year first above written on behalf of Water Company and Recreation Centers by the respective company officials.

SUN CITY WATER COMPANY

Date: 7/27/2001

By: Ray L. Jones

Its: Vice President + General Manager

RECREATION CENTERS OF SUN CITY

Date: 07-19-2001

By: [illegible]

Its: President RCSC

Exhibit A

Recreation Centers of Sun City West
General Industrial Use Permits

59-511014.0000	347 acre feet
59-511012.0000	534 acre feet
59-511008.0000	198 acre feet
59-511016.0000	227 acre feet

Exhibit B

Recreation Centers of Sun City
Type 2 Grandfathered Water Rights

58-101683.0000	1,433 acre feet
58-101682.0000	848 acre feet
58-101680.0000	1,428 acre feet
58-101681.000	626 acre feet
58-101679.0001	822 acre feet
58-101678.0000	1,145 acre feet
58-0101677.000	307 acre feet

EXHIBIT
A-10
Admitted

OPERATING AGREEMENT

This Agreement for operation of facilities required for the exchange of Central Arizona Project ("CAP") water in Sun City West ("Agreement") is made this 26th day of April, 2001 by SUN CITY WEST UTILITIES COMPANY ("Water Company"), an Arizona corporation, and RECREATION CENTERS OF SUN CITY WEST ("Recreation Centers"), an Arizona non-profit corporation ("the parties").

RECITALS

A. Water Company and Recreation Centers entered into an Agreement for Exchange of CAP Water in Sun City West dated October 20, 2000 ("Exchange Agreement").

B. Water Company has entered into similar agreements for the Exchange of CAP water in Sun City West with Briarwood Country Club (the "Briarwood Exchange Agreement") and in Sun City with the Recreation Centers of Sun City (the "Sun City Exchange Agreement").

C. In order to implement the Exchange Agreement, the Briarwood Exchange Agreement and the Sun City Exchange Agreement must also be implemented and certain facilities must be constructed and certain operating policies and procedures must be established and coordinated.

D. Water Company or an affiliated entity intends to construct a new pipeline to deliver water from CAP canal to the Water Company's Water Campus ("CAP Trunk Pipeline"), in accordance with recommendations of the engineering report entitled "Sun City/Sun City West/Youngtown Groundwater Savings Project", dated August, 2000.

E. Water Company intends to use Recreation Centers' existing non-potable water distribution system, ("Existing Distribution System") for delivering CAP water from its Water Campus to the points of delivery at various golf courses ("Points of Delivery"), in accordance with recommendations of the engineering report entitled "Sun City/Sun City West/Youngtown Groundwater Savings Project", dated August, 2000.

F. Water Company shall construct a supervisory control and data acquisition system ("SCADA System") to control, regulate, and meter water deliveries to the various golf course Points of Delivery.

G. The CAP Trunk Pipeline, Existing Distribution System, SCADA System, and associated facilities and appurtenances ("Facilities") will together transport CAP water from CAP canal to the Points of Delivery on the golf courses.

H. Water Company and Recreation Center desire to enter into this Agreement to operate the Facilities and to effect the exchange of CAP water.

NOW, THEREFORE, in consideration of covenants and agreements contained herein, the sufficiency of which is hereby acknowledged, the Parties agree as follows:

1. Facilities Operation and Maintenance

1.1 Water Company shall operate and maintain the Facilities.

1.2 Notwithstanding Paragraph 1.1. above, Water Company maintenance of the Existing Distribution System shall be in accordance with Paragraph 9 of the Exchange Agreement.

1.3 Recreation Centers grants Water Company a right of access to Recreation Centers property for the purpose of constructing, operating, and maintaining the Facilities. All such access and maintenance shall be in cooperation with the Recreation Centers in a manner designed to cause minimal interruption to ongoing golf operations.

2. Operating Methodology

2.1 Recreation Centers shall meet golf course irrigation demands by utilizing available CAP water unless i) demand (including Briarwood County Club's demand) exceeds the Facilities' delivery capacity of 5.5 cubic feet per second or ii) collectively, 2,372 acre feet of CAP water has been delivered to Recreation Centers and Briarwood Country Club during the year.

2.2 Notwithstanding Paragraph 2.1 above, Recreation Centers may pump groundwater if Water Company is unable to deliver CAP Water due to Facilities outage or other reason and for periodic short-duration pumping for pump testing and maintenance activities.

3. Ordering of Water

3.1 Each year, not later than September 30, Water Company and Recreation Centers shall jointly prepare and approve a schedule of planned CAP water deliveries for the following year ("Water Schedule").

3.2 Based upon the Water Schedule, Water Company shall order, schedule and otherwise coordinate CAP water deliveries from the Central Arizona Project.

3.3 Recreation Centers shall notify Water Company, in a timely manner, of any changes to golf course operations, either planned or unforeseen, which could materially affect the Water Schedule.

4. Delivery of Water

4.1 CAP water shall be scheduled and delivered by Water Company to the Points of Delivery in accordance with the priority established by the Recreation Centers.

4.2 Water Company shall make CAP water deliveries, based on Recreation Centers requests, on a daily cycle with varying delivery times, flow rates and duration, so that Recreation Center lake levels are maintained within design parameters.

4.3 Water Company shall, through the SCADA System, monitor and record operational parameters for each Point of Delivery, including delivery times, flow rates, and lake level.

5. Limit of Operational Obligations: Water Company's operational obligations under this Agreement end with its delivery of CAP water at Points of Delivery. Subsequent transfer/handling of water for irrigation purpose shall be Recreation Centers' obligation.

6. Water Rights Pooling; Mutual Cooperation:

6.1 In the event that, after making its best efforts to do so, Recreation Centers is unable to renew any or all of its General Industrial Use Permits (said "GIUs" being more particularly described on Exhibit A hereto), annually, if and to the extent Water Company is able to lease, at no cost, from the Recreation Centers of Sun City, Type 2 Grandfathered Rights ("Sun City Type 2 Rights" being more particularly described on Exhibit B hereto), Water Company, on an annual basis, shall sublease Sun City Type 2 Rights to Recreation Centers, at no cost, for the sole purpose of providing exchangeable groundwater rights to Recreation Centers to allow their exchange of groundwater with Water Company in accordance with the Exchange Agreement. Water Company's obligation to sublease Sun City Type 2 Rights shall be limited to the quantity of Sun City Type 2 Rights actually leased to Water Company in a given calendar year.

6.2 In the event that, after making its best efforts to do so, Briarwood County Club is unable to renew its General Industrial Use Permit ("GIU") number 59-511010.0000 in the amount of 333 acre feet, annually, Recreation Centers shall lease to Water Company, at no cost, that portion, but not more than 333 acre feet, of its Type 2 Grandfathered Water Right ("Type 2 Right") number 58-110773 not used by Recreation Centers for irrigation

of Recreation Center golf courses during the calendar year. Water Company shall then sublease the leased Type 2 Right to Briarwood Country Club for the sole purpose of providing exchangeable groundwater rights to Briarwood County Club to allow their exchange of groundwater with Water Company in accordance with the Briarwood Exchange Agreement. Water Company shall not use the Type 2 Rights for any other purpose than described in this section.

6.3 In the event that, during any given year, Recreation Centers shall not have used all of its Type 2 Right or its GIUs, and, in the same year, Recreation Centers of Sun City ("Sun City") shall, for reasons beyond its reasonable control, require additional groundwater pumping rights, then Recreation Centers agrees to work with Sun City and Water Company to effect a reciprocal lease and sublease consistent with the arrangement defined in Section 6.1 above to the extent it has unused water rights available.

7. Term of Agreement: The initial term of this Agreement runs from the day the Facilities become operational through December 31, 2043, which is the date of expiration of "Agreement for Exchange of CAP Water in Sun City West", signed October 20, 2000 by the Water Company and Recreation Centers. If the CAP Exchange Agreement is terminated/extended/renewed, the term of this Agreement will automatically change to equal the new term of the CAP Exchange Agreement.

8. Books and Records:

8.1 The parties shall establish and maintain books and records pertaining to purchase, transfer, reporting, and use of water under this Agreement. Specific records that must be maintained by each party shall include, but are not limited to, the following:

8.1.1 Water Company shall record: (i) CAP water ordered each year/month/day; (ii) CAP water delivered each year/month/day by Point of Delivery; and (iii) operational parameters required under Paragraph 4.3.

8.1.2 Recreation Centers shall record: (i) Usage of each well pump in its system, including duration of operation, monthly electricity charges and quantities of groundwater pumped.

8.2 Recreation Centers shall provide data collected and recorded by Recreation Centers to Water Company monthly. Water Company shall compile Recreation Center data and Water Company data into a monthly water usage report that shall be provided to Recreation Centers.

8.3 Water Company shall prepare an annual water usage report that shall include all data necessary to determine quantities of water exchanged and any other required data for purposes of annual reporting to the Department of Water Resources. Said report shall be provided to Recreation Centers. If requested by Recreation Centers, Water Company shall prepare annual exchange reports and annual groundwater withdrawal and use reports required by the Arizona Department of Water Resources for the approval and execution by Recreation Centers. Recreation Centers remains responsible for all fees and charges related to its annual water withdrawal and use reports.

8.4 Subject to applicable laws and regulations, each party to this Agreement has the right during office hours to examine and make copies of each other's books and records relating to this Agreement.

9. Dispute Resolution

9.1 Scope. This section governs the resolution of all disputes arising under this Agreement.

9.2 Good Faith Negotiations. The party that believes a dispute exists under this Agreement will first refer the dispute to the Representatives for resolution. The Representatives of each party will personally meet and attempt in good faith to resolve the dispute. If the Representatives cannot resolve the dispute within 14 days, the matter will be referred to senior management of Recreation Centers and Water Company for resolution. If these persons are unable to resolve the dispute within 30 days thereafter, a party that still believes the dispute requires resolution may avail itself of the provisions of section 9.3.

9.3 Arbitration. If a party still believes a dispute requires resolution, after following the procedures of Paragraph 9.2, that party will first give a detailed written notice of dispute to the other parties setting forth the nature of the dispute. The Parties will then, upon request of any party, be submitted for and settled by binding arbitration administered by AAA before a single arbitrator. The arbitrator must have substantial experience with the water utility industry. The arbitrator has no power to amend or modify this Agreement. Judgment on the award rendered by the arbitrator must be entered in any court with jurisdiction.

9.4 Other Remedies. The preceding subparagraphs of this Paragraph 8 are intended to set forth the primary procedure to resolve all disputes under this Agreement. It is expected that all disputes that would traditionally be resolvable by a law court would be resolvable under this procedure. However, the Parties recognize certain business relationships could give rise to the need for one or more of the Parties to seek equitable remedies

from a court that were traditionally available from an equity court, such as emergency, provisional or summary relief and injunctive relief. Immediately following the issuance of any such equitable relief, the Parties will stay any further judicial proceeding pending arbitration of all underlying claims between the Parties. The Parties also recognize that the ACC has primary jurisdiction over certain issues that may arise among and between the Parties that relate to the provision of public utility service. Accordingly, this Article is not intended to prohibit any party from bringing any such issues to the ACC for resolution or from taking any position at the ACC that would be inconsistent with or barred by this Agreement or by collateral estoppel, *res judicata* or other issues or fact-preclusive doctrines.

9.5 Appeal. Within 30 days after the date of the arbitration award, a party may appeal to the U.S. District Court for the District of Arizona, if such court has jurisdiction, and otherwise to any state court of record in Arizona having jurisdiction, to vacate and remand, or modify or correct the arbitration award for any of the grounds specified in the Federal Arbitration Act.

9.6 Confidentiality. The arbitration proceedings will be conducted in secrecy. Except as otherwise agreed by the Parties in writing, (a) the fact of the pending arbitration will not be disclosed or confirmed by the Parties or the arbitrator to any person who is not a party to, or called to testify at, the proceedings until the arbitration award has been made, (b) the proceedings will not be recorded or transcribed in any manner, and (c) all documents, testimony and records (other than the contract documents out of which the dispute arises) will be received, heard and maintained by the arbitrator in secrecy, available for inspection only by the Parties, their attorneys and by experts who must agree, in advance and in writing, to receive all such information in secrecy. The secret information will not be described in the arbitration award in such manner as to be commercially useful.

10. Indemnification. Water Company is not responsible for the control, carriage, handling, use, disposal or distribution of any water beyond the Point of Delivery. Each party (indemnitor) to this Agreement agrees to indemnify and hold harmless the other party (indemnitee) and its governing bodies, agents, directors, officers and employees for, from and against any loss, damage or liability, including reasonable attorney's fees, caused by a negligent or intentionally willful action or inaction on the part of the indemnitor and its governing bodies, agents, directors, officers and employees, including without limitation, claims for bodily injury, illness, death or damage to property. Each party assumes liability for its own negligent or intentionally willful action or inaction arising out of the terms and conditions of this Agreement.

11. Uncontrollable Forces. Neither party will be considered to be in default in the performance of its obligations under this Agreement (other than obligations to make payments due hereunder) when a failure of performance is due to Uncontrollable Forces. The term "Uncontrollable Force" means any natural or artificial cause beyond the control of a party to this Agreement that renders the party unable to perform its obligations, including but not limited to, failure of or threat of failure of facilities, flood, earthquake, storm, fire, lightning and other natural catastrophes, epidemic, war, riot, civil disturbance or disobedience, strike, labor dispute, labor or material shortage, sabotage, government priorities and restraint by court order or public authority, and action or inaction by, or failure to obtain the necessary authorizations or approvals from, any governmental agency or authority, which by exercise of due diligence the party could not reasonably have been expected to avoid and which by exercise of due diligence it is unable to overcome. Nothing contained herein may be construed to require either party to settle any strike or labor dispute in which it is involved.

12. General Provisions

12.1 Effective Date. This Agreement is effective upon execution of the Agreement by all parties.

12.2 Recitals Incorporated. All of the recitals made herein are incorporated by reference.

12.3 Authorized Representatives. Within 30 days after execution of this Agreement, each party will designate in writing to the other party an authorized representative ("Representative") and an alternate ("Alternate") to administer the provisions of this Agreement on behalf of the designating parties. An Alternate may act only in the absence of the Representative. Written notice of a change of Representative or Alternate must be provided at least 30 days before such change becomes effective. Arrangements or understandings of the representatives pursuant to this Agreement must be in writing and signed by them, but notwithstanding the foregoing, neither the Representatives nor the Alternates have authority to amend this Agreement.

12.4 Binding Effect. The provisions of this Agreement inure to the benefit of and be binding upon the respective heirs, personal representatives, successors and assigns of the Parties, but no assignment or transfer of this Agreement or any interest therein is valid until approved in writing by the other party. Such approval may not be unreasonably withheld.

12.5 Notices. Any notice given pursuant to this Agreement must be in writing and be personally delivered or deposited in the United States mail, postage prepaid, certified and return receipt requested to the Parties as follows:

To Water Company: Sun City West Utilities Company
P.O. Box 1687
Sun City, Arizona 85372
Attn: General Manager

To Recreation Centers: Recreation Centers of Sun City West
19803 RH Johnson Boulevard
Sun City West, Arizona 85375

Notices are deemed given when personally delivered or, if mailed, five days after the deposit of the notice in the U.S. mail. If a notice initiates the running of a time period for the performance of, or compliance with, any obligation or duty set forth in this Agreement, the notice must be sent certified, return receipt requested. Any party hereto must give written notice of a change of address to the other party as provided above.

12.6 Good Standing; Authority. Each of the Parties represents and warrants to the other party: (a) that it is duly formed, validly existing and in good standing under all applicable laws; and (b) that the individual(s) executing this Agreement on behalf of the respective parties are authorized and empowered to bind the Parties on whose behalf each such individual is signing.

12.7 Attorney's Fees. If any action is brought by any party with respect to its rights under this Agreement, the prevailing party or parties are entitled to reasonable attorney's fees and court costs from the other party or parties as determined by the court.

12.8 Entire Agreement. The terms, covenants and condition of this Agreement constitute the entire agreement between the Parties and no understandings or obligations not expressly set forth herein are binding upon them. All prior and contemporaneous agreements, representations and understandings of the Parties, oral or written, on the subject matter of this Agreement, are hereby superseded and merged herein.

12.9 Further Documentation. Each party agrees in good faith to execute, deliver, acknowledge or record further or additional documents, approvals or consents as are required or desirable in order to fully carry out the intent and purpose of this Agreement.

12.10 Governing Law. This Agreement is made under and is governed by the laws of the State of Arizona. Subject to the provisions of Paragraph 8, all proceedings related to this Agreement will be maintained in the courts of the State of Arizona (including the United States District Court for the District of Arizona), which courts have jurisdiction over those proceedings.

12.11 Counterparts. This Agreement may be executed in any number of counterparts, each of which is an original, but all of which constitute one and the same instrument. The signature pages from one or more counterparts may be removed from such counterparts and attached to a single instrument so that the signatures of all parties may be physically attached to a single document.

12.12 Amendments and Modifications. This Agreement may be modified, amended, rescinded, cancelled or waived, in whole or in part, only by a written instrument executed by all parties.

12.13 Severability. If any provision of this Agreement is held to be invalid, illegal or unenforceable under any applicable statute or rule of law, the provision is deemed null and void, but the remainder of this Agreement remains in full force and effect.

12.14 No Partnerships. The Parties to this Agreement may not be deemed to have formed a partnership or joint venture by their execution of this Agreement. The provisions of this Agreement are not intended to be for the benefit of any person, firm, organization or corporation not a party hereto and no such person or entity have any rights or cause of action under this Agreement.

12.15 Waiver. No delay in exercising any right or remedy will constitute a waiver thereof, and no waiver by any party of the breach of any covenant of this Agreement may be construed as a waiver of any preceding or succeeding breach of the same or any other covenant or condition of this Agreement.

12.16 Compliance with Laws. Recreation Centers agrees to comply with all applicable local, state and federal laws and permit requirements specifically including all requirements of the Arizona Groundwater Code.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement on the day and year first above written on behalf of Water Company and Recreation Centers by the respective company officials.

SUN CITY WEST UTILITIES COMPANY

Date: 4/26/01

By: Ray L. [illegible]

Its: Vice President & General Manager

RECREATION CENTERS OF SUN CITY WEST

Date: 27 APRIL 2001

By: [illegible]

Its: PRESIDENT, SCW GOVERNING BOARD

Exhibit A

Recreation Centers of Sun City West
General Industrial Use Permits

59-511014.0000	347 acre feet
59-511012.0000	534 acre feet
59-511008.0000	198 acre feet
59-511016.0000	227 acre feet

Exhibit B

Recreation Centers of Sun City
Type 2 Grandfathered Water Rights

58-101683.0000	1,433 acre feet
58-101682.0000	848 acre feet
58-101680.0000	1,428 acre feet
58-101681.000	626 acre feet
58-101679.0001	822 acre feet
58-101678.0000	1,145 acre feet
58-0101677.000	307 acre feet

EXHIBIT
A-11
Admitted

OPERATING AGREEMENT

This Agreement for operation of facilities required for the exchange of Central Arizona Project ("CAP") water in Sun City West ("Agreement") is made this 30th day of March, 2001 by SUN CITY WEST UTILITIES COMPANY ("Water Company"), an Arizona corporation, and BRIARWOOD COUNTRY CLUB ("Briarwood"), an Arizona non-profit corporation, ("the parties").

RECITALS

A. Water Company and Briarwood entered into an Agreement for Exchange of CAP Water in Sun City West, dated December 14, 2000 ("Exchange Agreement").

B. Water Company has entered into similar agreements for the Exchange of CAP water in Sun City West with Recreation Centers of Sun City West (the "Sun City West Exchange Agreement") and in Sun City with the Recreation Centers of Sun City (the "Sun City Exchange Agreement").

C. In order to implement the Exchange Agreement, the Sun City West Exchange Agreement and the Sun City Exchange Agreement must also be implemented and certain facilities must be constructed and certain operating policies and procedures must be established and coordinated.

D. Water Company or an affiliated entity intends to construct a new pipeline to deliver water from CAP canal to the Water Company's Water Campus ("CAP Trunk Pipeline"), in accordance with recommendations of the engineering report entitled "Sun City/Sun City West/Youngtown Groundwater Savings Project", dated August, 2000.

E. Water Company intends to use an existing non-potable water distribution system owned by the Recreation Centers of Sun City West ("Existing Distribution System") for delivering CAP water from its Water Campus to the point of delivery at Briarwood's golf course ("Point of Delivery"), in accordance with recommendations of the engineering report entitled "Sun City/Sun City West/Youngtown Groundwater Savings Project", dated August, 2000.

F. Water Company shall construct a supervisory control and data acquisition system ("SCADA System") to control, regulate, and meter water deliveries to the golf course Point of Delivery.

G. The CAP Trunk Pipeline, Existing Distribution System, SCADA System, and associated facilities and appurtenances ("Facilities") will together transport CAP water from CAP canal to the Point of Delivery on the golf course.

H. Water Company and Briarwood desire to enter into this Agreement to operate the Facilities and to effect the exchange of CAP water.

NOW, THEREFORE, in consideration of covenants and agreements contained herein, the sufficiency of which is hereby acknowledged, the Parties agree as follows:

1. Facilities Operation and Maintenance:

1.1 Water Company shall operate and maintain the Facilities.

1.2 Briarwood grants Water Company a right of access to Briarwood's property for the purpose of constructing, operating, and maintaining the Facilities. All such access and maintenance shall be scheduled in cooperation with Briarwood in a manner designed to cause minimal interruption to ongoing golf operations.

2. Operating Methodology

2.1 Briarwood shall meet golf course irrigation demands by utilizing available CAP water unless i) demand (including Recreation Centers of Sun City West demand) exceeds the Facilities' delivery capacity of 5.5 cubic feet per second or ii) collectively, 2,372 acre feet of CAP water has been delivered to Briarwood and Recreation Centers of Sun City West during the year.

2.2 Notwithstanding Paragraph 2.1 above, Briarwood may pump groundwater if Water Company is unable to deliver CAP Water due to Facilities outage or other reason and for periodic short-duration pumping for pump testing and maintenance activities.

3. Ordering of Water

3.1 Each year, not later than September 30, Water Company and Briarwood shall jointly prepare and approve a schedule of planned CAP water deliveries for the following year ("Water Schedule").

3.2 Based upon the Water Schedule, Water Company shall order, schedule and otherwise coordinate CAP water deliveries from the Central Arizona Project.

3.3 Briarwood shall notify Water Company, in a timely manner, of any changes to golf course operations, either planned or unforeseen, which could materially affect the Water Schedule.

4. Delivery of Water

4.1 Water Company shall make CAP water deliveries, based on Briarwood's requests, on a daily cycle with varying delivery times, flow rates and duration, so that Briarwood lake levels are maintained within design parameters.

4.2 Water Company shall, through the SCADA System, monitor and record operational parameters including delivery times, flow rates, and lake level.

5. Limit of Operational Obligations: Water Company's operational obligations under this Agreement end with its delivery of CAP water at Point of Delivery. Subsequent transfer/handling of water for irrigation purpose shall be Briarwood's obligation.

6. Water Rights Pooling; Mutual Cooperation: In the event that, after making its best efforts to do so, Briarwood is unable to renew its General Industrial Use Permit number 59-511010.000 ("GIU") in the amount of 333 acre feet and if Briarwood has, after the exercise of all due diligence, been unable to purchase or lease exchangeable groundwater rights to replace its GIU, annually, if and to the extent Water Company is able to lease, at no cost, from the Recreation Centers of Sun City West, a portion of Type 2 Grandfathered Right number 58-110773, Water Company, on an annual basis, shall sublease said portion of Sun City West Type 2 Right to Briarwood, at no cost, for the sole purpose of providing exchangeable groundwater rights to Briarwood to allow their exchange of groundwater with Water Company in accordance with the Exchange Agreement. Water Company's obligation to sublease said Sun City West Type 2 Right shall be limited to the quantity of said Sun City Type 2 Right actually leased to Water Company in a given calendar year and shall not exceed 333 acre feet annually.

7. Term of Agreement: The initial term of this Agreement runs from the day the Facilities become operational through December 31, 2043, which is the date of expiration of "Agreement for Exchange of CAP Water in Sun City West", signed December 14, 2000 by the Water Company and Briarwood. If the CAP Exchange Agreement is terminated/extended/renewed, the term of this Agreement will automatically change to equal the new term of the CAP Exchange Agreement.

8. Books and Records:

8.1 The parties shall establish and maintain books and records pertaining to purchase, transfer, reporting, and use of water under this Agreement. Specific records that must be maintained by each party shall include, but are not limited to, the following:

7.1.1 Water Company shall record: (i) CAP water ordered each year/month/day; (ii) CAP water delivered each year/month/day; and (iii) operational parameters required under Paragraph 4.3.

7.1.2 Briarwood shall record: (i) Usage of each well pump in its system, including duration of operation, monthly electricity charges and quantities of groundwater pumped.

8.2 Briarwood shall provide data collected and recorded by Briarwood to Water Company monthly. Water Company shall compile Briarwood data and Water Company data into a monthly water usage report that shall be provided to Briarwood.

8.3 Water Company shall prepare an annual water usage report that shall include all data necessary to determine quantities of water exchanged and any other required data for purposes of annual reporting to the Department of Water Resources. Said report shall be provided to Briarwood. If requested by Briarwood, Water Company shall prepare annual exchange reports and annual groundwater withdrawal and use reports required by the Arizona Department of Water Resources for the approval and execution by Briarwood. Briarwood remains responsible for all fees and charges related to its annual water withdrawal and use reports.

8.4 Subject to applicable laws and regulations, each party to this Agreement has the right during office hours to examine and make copies of each other's books and records relating to this Agreement.

9. Dispute Resolution

9.1 Scope. This section governs the resolution of all disputes arising under this Agreement.

9.2 Good Faith Negotiations. The party that believes a dispute exists under this Agreement will first refer the dispute to the Representatives for resolution. The Representatives of each party will personally meet and attempt in good faith to resolve the dispute. If the Representatives cannot resolve the dispute within 14 days, the matter will be referred to senior management of Briarwood and Water Company for resolution. If these persons are unable to resolve the dispute within 30 days thereafter, a party that still believes the dispute requires resolution may avail itself of the provisions of section 8.3.

9.3 Arbitration. If a party still believes a dispute requires resolution, after following the procedures of Paragraph 8.2, that party will first give a detailed written notice of dispute to the other parties setting forth the

nature of the dispute. The Parties will then, upon request of any party, be submitted for and settled by binding arbitration administered by AAA before a single arbitrator. The arbitrator must have substantial experience with the water utility industry. The arbitrator has no power to amend or modify this Agreement. Judgment on the award rendered by the arbitrator must be entered in any court with jurisdiction.

9.4 Other Remedies. The preceding subparagraphs of this Paragraph 8 are intended to set forth the primary procedure to resolve all disputes under this Agreement. It is expected that all disputes that would traditionally be resolvable by a law court would be resolvable under this procedure. However, the Parties recognize certain business relationships could give rise to the need for one or more of the Parties to seek equitable remedies from a court that were traditionally available from an equity court, such as emergency, provisional or summary relief and injunctive relief. Immediately following the issuance of any such equitable relief, the Parties will stay any further judicial proceeding pending arbitration of all underlying claims between the Parties. The Parties also recognize that the ACC has primary jurisdiction over certain issues that may arise among and between the Parties that relate to the provision of public utility service. Accordingly, this Article is not intended to prohibit any party from bringing any such issues to the ACC for resolution or from taking any position at the ACC that would be inconsistent with or barred by this Agreement or by collateral estoppel, *res judicata* or other issues or fact-preclusive doctrines.

9.5 Appeal. Within 30 days after the date of the arbitration award, a party may appeal to the U.S. District Court for the District of Arizona, if such court has jurisdiction, and otherwise to any state court of record in Arizona having jurisdiction, to vacate and remand, or modify or correct the arbitration award for any of the grounds specified in the Federal Arbitration Act.

9.6 Confidentiality. The arbitration proceedings will be conducted in secrecy. Except as otherwise agreed by the Parties in writing, (a) the fact of the pending arbitration will not be disclosed or confirmed by the Parties or the arbitrator to any person who is not a party to, or called to testify at, the proceedings until the arbitration award has been made, (b) the proceedings will not be recorded or transcribed in any manner, and (c) all documents, testimony and records (other than the contract documents out of which the dispute arises) will be received, heard and maintained by the arbitrator in secrecy, available for inspection only by the Parties, their attorneys and by experts who must agree, in advance and in writing, to receive all such information in secrecy. The secret information will not be described in the arbitration award in such manner as to be commercially useful.

MAY-03-2001 09:49 FROM: APR-03-2001 08:35 FROM: TO:6025460588 P.005/010

10. Indemnification. Water Company is not responsible for the control, carriage, handling, use, disposal or distribution of any water beyond the Point of Delivery. Each party (indemnitor) to this Agreement agrees to indemnify and hold harmless the other party (indemnitee) and its governing bodies, agents, directors, officers and employees for, from and against any loss, damage or liability, including reasonable attorney's fees, caused by a negligent or intentionally willful action or inaction on the part of the indemnitor and its governing bodies, agents, directors, officers and employees, including without limitation, claims for bodily injury, illness, death or damage to property. Each party assumes liability for its own negligent or intentionally willful action or inaction arising out of the terms and conditions of this Agreement.

11. Uncontrollable Forces. Neither party will be considered to be in default in the performance of its obligations under this Agreement (other than obligations to make payments due hereunder) when a failure of performance is due to Uncontrollable Forces. The term "Uncontrollable Force" means any natural or artificial cause beyond the control of a party to this Agreement that renders the party unable to perform its obligations, including but not limited to, failure of or threat of failure of facilities, flood, earthquake, storm, fire, lightning and other natural catastrophes, epidemic, war, riot, civil disturbance or disobedience, strike, labor dispute, labor or material shortage, sabotage, government priorities and restraint by court order or public authority, and action or inaction by, or failure to obtain the necessary authorizations or approvals from, any governmental agency or authority, which by exercise of due diligence the party could not reasonably have been expected to avoid and which by exercise of due diligence it is unable to overcome. Nothing contained herein may be construed to require either party to settle any strike or labor dispute in which it is involved.

12. General Provisions

12.1 Effective Date. This Agreement is effective upon execution of the Agreement by all parties.

12.2 Recitals Incorporated. All of the recitals made herein are incorporated by reference.

12.3 Authorized Representatives. Within 30 days after execution of this Agreement, each party will designate in writing to the other party an authorized representative ("Representative") and an alternate ("Alternate") to administer the provisions of this Agreement on behalf of the designating parties. An Alternate may act only in the absence of the Representative. Written notice of a change of Representative or Alternate must be provided at least 30 days before such change becomes effective. Arrangements or understandings of the representatives pursuant to this Agreement must be in writing and signed by them, but notwithstanding the

MAY-03-2001 09:49 FROM: HAY-03-2001 08:40 FROM: TO:6025460588 P.006/010

foregoing, neither the Representatives nor the Alternates have authority to amend this Agreement.

12.4 Binding Effect. The provisions of this Agreement inure to the benefit of and be binding upon the respective heirs, personal representatives, successors and assigns of the Parties, but no assignment or transfer of this Agreement or any interest therein is valid until approved in writing by the other party. Such approval may not be unreasonably withheld.

12.5 Notices. Any notice given pursuant to this Agreement must be in writing and be personally delivered or deposited in the United States mail, postage prepaid, certified and return receipt requested to the Parties as follows:

To Water Company: Sun City West Utilities Company
P.O. Box 1687
Sun City, Arizona 85372
Attn: General Manager

To Briarwood: Briarwood Country Club
20800 N. 135th Avenue
Sun City West, Arizona 85375
Attn: John Kauffmann,
General Manager

Notices are deemed given when personally delivered or, if mailed, five days after the deposit of the notice in the U.S. mail. If a notice initiates the running of a time period for the performance of, or compliance with, any obligation or duty set forth in this Agreement, the notice must be sent certified, return receipt requested. Any party hereto must give written notice of a change of address to the other party as provided above.

12.6 Good Standing; Authority. Each of the Parties represents and warrants to the other party: (a) that it is duly formed, validly existing and in good standing under all applicable laws; and (b) that the individual(s) executing this Agreement on behalf of the respective parties are authorized and empowered to bind the Parties on whose behalf each such individual is signing.

12.7 Attorney's Fees. If any action is brought by any party with respect to its rights under this Agreement, the prevailing party or parties are entitled to reasonable attorney's fees and court costs from the other party or parties as determined by the court.

MAY-03-2001 09:50 FROM: TO:6025466588 P.007/010

12.8 Entire Agreement. The terms, covenants and condition of this Agreement constitute the entire agreement between the Parties and no understandings or obligations not expressly set forth herein are binding upon them. All prior and contemporaneous agreements, representations and understandings of the Parties, oral or written, on the subject matter of this Agreement, are hereby superseded and merged herein.

12.9 Further Documentation. Each party agrees in good faith to execute, deliver, acknowledge or record further or additional documents, approvals or consents as are required or desirable in order to fully carry out the intent and purpose of this Agreement.

12.10 Governing Law. This Agreement is made under and is governed by the laws of the State of Arizona. Subject to the provisions of Paragraph 8, all proceedings related to this Agreement will be maintained in the courts of the State of Arizona (including the United States District Court for the District of Arizona), which courts have jurisdiction over those proceedings.

12.11 Counterparts. This Agreement may be executed in any number of counterparts, each of which is an original, but all of which constitute one and the same instrument. The signature pages from one or more counterparts may be removed from such counterparts and attached to a single instrument so that the signatures of all parties may be physically attached to a single document.

12.12 Amendments and Modifications. This Agreement may be modified, amended, rescinded, cancelled or waived, in whole or in part, only by a written instrument executed by all parties.

12.13 Severability. If any provision of this Agreement is held to be invalid, illegal or unenforceable under any applicable statute or rule of law, the provision is deemed null and void, but the remainder of this Agreement remains in full force and effect.

12.14 No Partnerships. The Parties to this Agreement may not be deemed to have formed a partnership or joint venture by their execution of this Agreement. The provisions of this Agreement are not intended to be for the benefit of any person, firm, organization or corporation not a party hereto and no such person or entity have any rights or cause of action under this Agreement.

12.15 Waiver. No delay in exercising any right or remedy will constitute a waiver thereof, and no waiver by any party of the breach of any covenant of this Agreement may be construed as a waiver of any preceding or

MAY-03-2001 09:50 FROM: TO:6025466588 P.008/010

succeeding breach of the same or any other covenant or condition of this Agreement.

12.16 Compliance with Laws. Briarwood agrees to comply with all applicable local, state and federal laws and permit requirements specifically including all requirements of the Arizona Groundwater Code.

MAY-03-2001 09:50 FROM:
MAY-03-2001 08:41 FROM:
TO:6025460588
P.009/010

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement on the day and year first above written on behalf of Water Company and Briarwood by the respective company officials.

SUN CITY WEST UTILITIES COMPANY

Date: 3/30/01

By: [signature]

Its: Vice President + General Manager

BRIARWOOD COUNTRY CLUB

Date: April 3, 2001

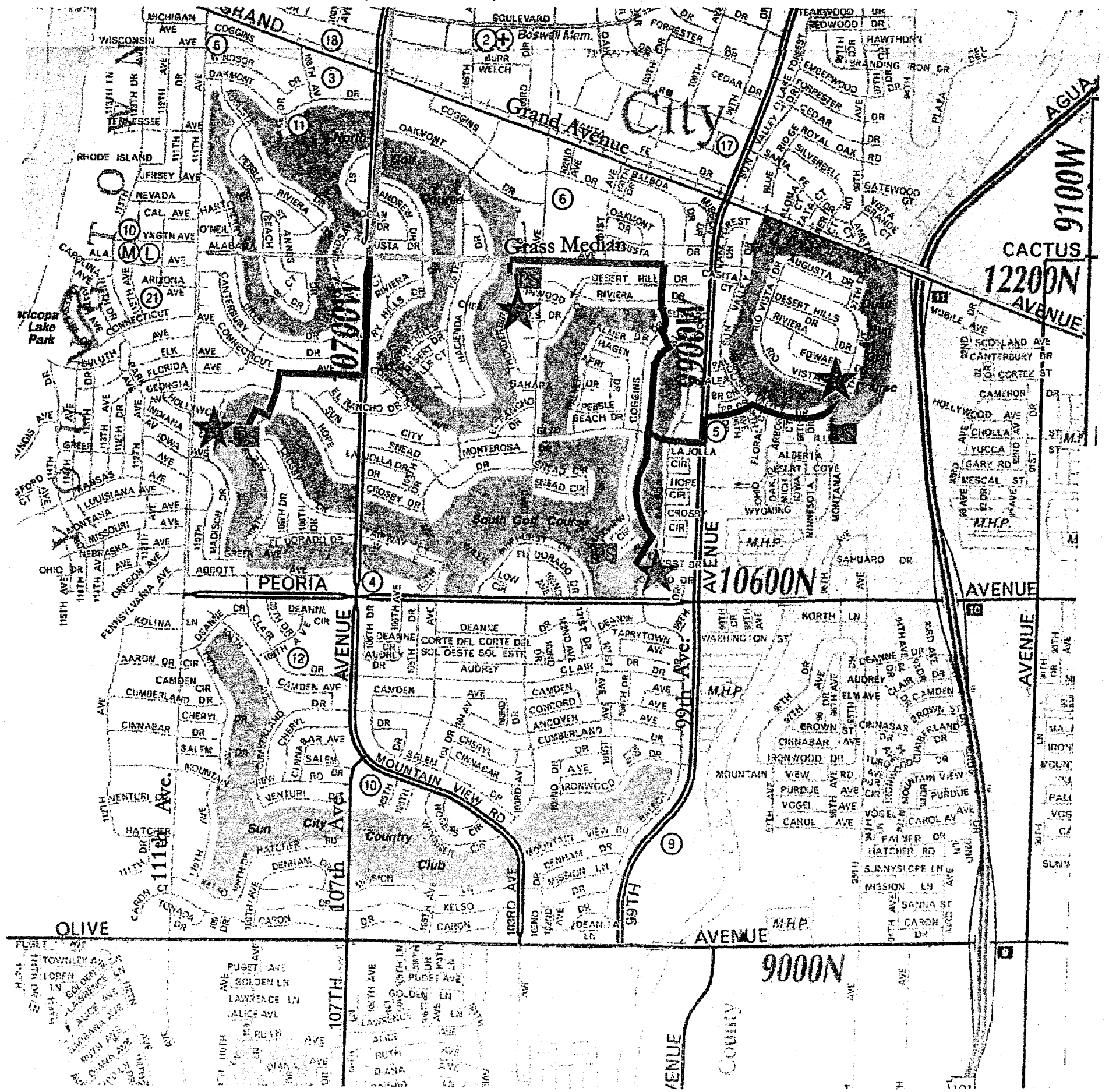
By: [signature]

Its: President

APR-03-2001 08:42 FROM: TO:6025460588 P.010/010

EXHIBIT
A-12
Admitted

(SEE FIGURE D.7)



CITIZENS water resources

SUN CITY / SUN CITY WEST / YOUNGTOWN
GROUND WATER SAVINGS PROJECT

N

LEGEND

- PROPOSED 12" PIPELINES
- PROPOSED 16" PIPELINES
- PUMP STATION
- RESERVOIR LAKE
- POINTS OF DELIVERY

EXHIBIT A
LOCATIONS OF USE AND POINTS OF DELIVERY

Sun City
PROPOSED DISTRIBUTION NETWORK

A-12

(SEE FIGURE D.6)

(SEE FIGURE D.8)

CITIZENS
water resources

SUN CITY / SUN CITY WEST / YOUNGTOWN
GROUND WATER SAVINGS PROJECT

N

LEGEND

- PROPOSED 12" PIPELINES
- PROPOSED 16" PIPELINES
- PS PUMP STATION
- RESERVOIR LAKE
- POINTS OF DELIVERY

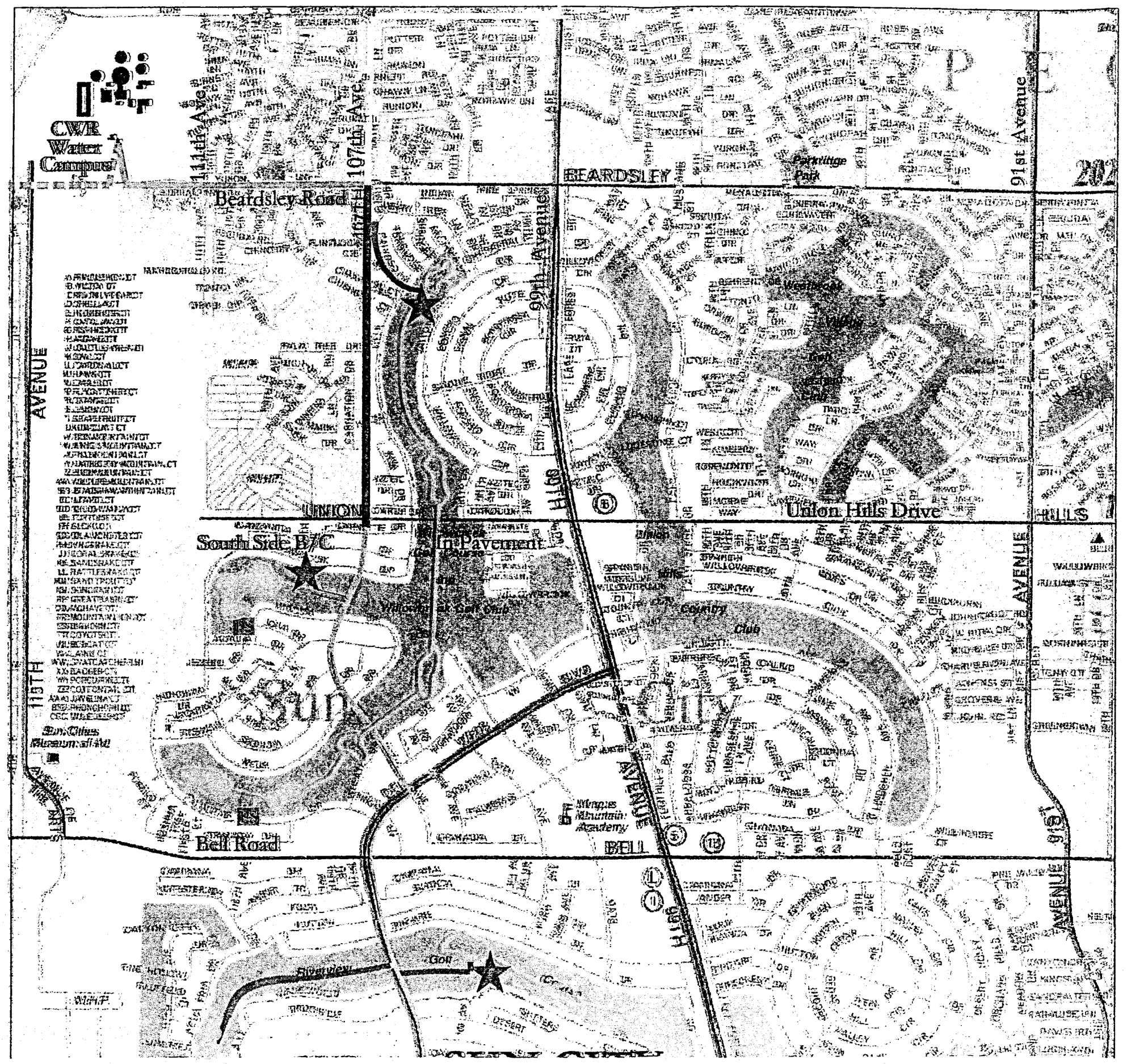
EXHIBIT A
LOCATIONS OF USE AND POINTS OF DELIVERY

Sun City
PROPOSED DISTRIBUTION NETWORK

EXHIBIT
TSCR 1-1 (A)

CITIZENS water resources

SUN CITY / SUN CITY WEST / YOUNGTOWN
GROUND WATER SAVINGS PROJECT



(SEE FIGURE D.7)

N

LEGEND

- PROPOSED 12" PIPELINES
- PROPOSED 16" PIPELINES
- PROPOSED 20" PIPELINES
- PROPOSED 24" PIPELINES
- PROPOSED 24" MAINLINE
- PUMP STATION
- RESERVOIR LAKE
- POINTS OF DELIVERY

EXHIBIT A
LOCATIONS OF USE AND POINTS OF DELIVERY

Sun City
PROPOSED DISTRIBUTION NETWORK

CITIZENS water resources

SUN CITY / SUN CITY WEST/YOUNGTOWN
GROUND WATER SAVINGS PROJECT

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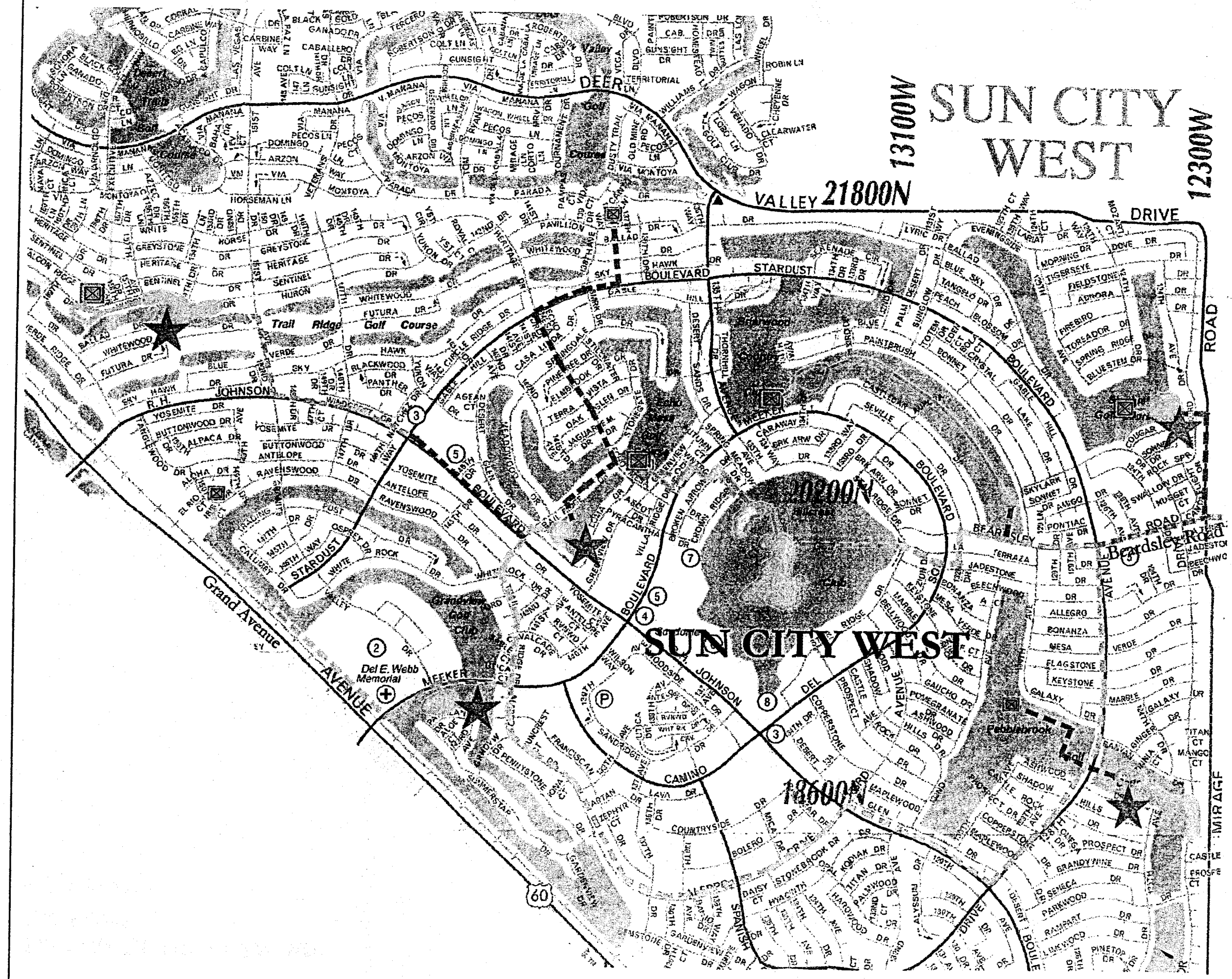

LEGEND

- EXISTING 12" PIPELINES
- EXISTING 14" PIPELINES
- EXISTING 16" PIPELINES
- EXISTING 20" PIPELINES
- WELL
- RESERVOIR LAKE
- POINTS OF DELIVERY

EXHIBIT A
LOCATIONS OF USE AND POINTS OF DELIVERY

Sun City West
EXISTING DISTRIBUTION NETWORK