0000092638

ORIGINAL

BEFORE THE
POWER PLANT AND TRANSMISSION LINE SITING COMMITTEE
SUPPLEMENTAL INFORMATION

2000 DEC -1 P 1:26

AZ CORP COMMISSION
DOCUMENT CONTROL

In the matter of the Application of Gila Bend Power Partners, L.L.C., or their assignee(s), in conformance with the requirements of Arizona Revised Statutes 40-360.01 *et seq.*, for a Certificate of Environmental Compatibility authorizing construction of a natural gas-fired, combined cycle generating plant, switchyard, and related facilities in the Town of Gila Bend, Maricopa County, Arizona located in the southwest quarter of Section 19, Township 5 South, Range 5 West, Gila and Salt River Base and Meridian.	Case No.: L-00000V-00-0106

Arizona Corporation Commission
DOCKETED
DEC 01 2000
DOCKETED BY JM

APPLICATION FOR
CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY

SUPPLEMENTAL INFORMATION II

DOCKET NO. L-00000V 00-0106

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ENVIRONMENTAL SERVICES DEPARTMENT
AIR QUALITY DIVISION
1001 N. Central Ave., Suite 200
Phoenix, Arizona 85004
(602) 506-6700
(602) 506-6986 (FAX)

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

November 29, 2000

Gila Bend Power Partners, L.L.C.
5949 Sherry Lane, Suite 1880
Dallas, TX 75225
Attn: Robert C Walther

Re: Title V Application for Gila Bend Power Generating Station Number V00-001

Dear Mr. Walther:

We have performed a completeness review on the subject Title V Application in accordance with Rule 210 Section 301.1 of the Maricopa County Air Pollution Control Rules and Regulations (MCAPCRR) and Appendix B of the MCAPCRR. As of November 28, 2000 your Title V permit application is complete.

If you have any questions on this matter, please contact me at (602) 506-4669.

Sincerely,

Elena Gorelik,
Air Quality Engineer

MALCOLM PIRNIE

GILA BEND POWER GENERATION STATION PROJECT CORRESPONDENCE

To: Pete Wright, GBPP **Date:** November 30, 2000

Copy: Bob Walther, GBPP
Thom Shelton, GBPP
Gary Rogers, MPI
Phyllis Diosey, MPI
Jae Chang, MPI

From: Gary Bacon, MPI

Re: Visibility Impact Analysis

BACKGROUND

The U.S. Forest Service's Federal Land Manager ("FLM") requested that the Gila Bend Power Partners ("GBPP") conduct a visibility analysis for the Gila Bend Power Generation Station Project ("Project") on Class II wilderness areas located within 50 kilometers of the facility. The Class II wilderness areas included 1) North Maricopa Mountains, 2) Signal Mountain, 3) South Maricopa Mountain, and 4) Woolsey Peak. In addition, the Phoenix metropolitan area was also evaluated for visibility effects related to the Project.

In an effort to further reduce potential visibility effects from the Project, the FLM suggested that nitrogen oxides (NO_x) emissions be decreased below the USEPA's current Best Available Control Technology ("BACT") level of 3.0 parts per million ("ppm") to 2.5 ppm. The GBPP volunteered to install additional air pollution controls to reduce the NO_x emissions to 2.5 ppm.

VISIBILITY MODEL

To evaluate the resulting visibility effects from NO_x emissions at 2.5 ppm, Malcolm Pirnie used the USEPA-approved VISCREEN model. The attached computer output summarizes the model input parameters and model's visibility results for each Class II wilderness area and the Phoenix metropolitan area.

The VISCREEN model calculates two measures of potential plume/visibility effects. The first is the total "color contrast" (delta E) which considers intensity, brightness, and plume color. The second measure is "plume contrast" which relates to the change in light extinction coefficient between views against a background feature (either sky or terrain) and views against the plume. Plume contrast is the parameter used more extensively in visibility analyses.

The "deciview" visibility index (logarithmic transformation of the light extinction coefficient) has been designed to be linear with humanly perceived changes under assumed commonly occurring conditions. The deciview value increases with increasing visibility impairment. As an example of the measure of a potentially significant change in visibility at Class I areas, a 0.5 deciview has been established as the criteria for Class I areas. A 0.5 deciview change is equivalent to a 5 percent change in extinction coefficient or a 0.05 contrast value.

MODEL RESULTS

Some of the contrast values presented in the attached model results are greater than Class I area contrast value of 0.05. Based on the very conservative meteorological and particle scattering assumptions used in the VISCREEN model, these results do not specifically suggest that the visibility effects of the Project are significant in the Class II wilderness areas and the Phoenix metropolitan area. The visibility effects thresholds have only been established for Class I areas and have not been developed for visibility in Class II wilderness areas or metropolitan areas. Therefore, it is also inappropriate to simply compare a Class I area effects threshold value to Class II area contrast values.

Visual Effects Screening Analysis for
Source: gbpgs
Class I Area: north maricopa mtn wild

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	100.10	LB /HR
NOx (as NO2)	64.90	LB /HR
Primary NO2	.00	LB /HR
Soot	.00	LB /HR
Primary SO4	.00	LB /HR

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.04 ppm
Background Visual Range:	225.00 km
Source-Observer Distance:	18.50 km
Min. Source-Class I Distance:	18.50 km
Max. Source-Class I Distance:	36.00 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	1.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	157.	36.0	11.	2.00	26.155*	.05	.625*
SKY	140.	157.	36.0	11.	2.00	6.178*	.05	-.198*
TERRAIN	10.	84.	18.5	84.	2.00	33.100*	.05	.230*
TERRAIN	140.	84.	18.5	84.	2.00	2.249*	.05	.019

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	1.	1.0	168.	2.00	59.885*	.05	1.796*
SKY	140.	1.	1.0	168.	2.00	18.943*	.05	-.512*
TERRAIN	10.	1.	1.0	168.	2.00	59.123*	.05	.691*
TERRAIN	140.	1.	1.0	168.	2.00	25.032*	.05	.503*

Visual Effects Screening Analysis for
Source: gbpgs
Class I Area: south maricopa mtn wild

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	100.10	LB /HR
NOx (as NO2)	64.90	LB /HR
Primary NO2	.00	LB /HR
Soot	.00	LB /HR
Primary SO4	.00	LB /HR

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.04 ppm
Background Visual Range:	225.00 km
Source-Observer Distance:	27.50 km
Min. Source-Class I Distance:	27.50 km
Max. Source-Class I Distance:	47.00 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	2.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	154.	47.0	15.	2.00	11.136*	.05	.241*
SKY	140.	154.	47.0	15.	2.00	2.272*	.05	-.076*
TERRAIN	10.	84.	27.5	84.	2.00	15.684*	.05	.106*
TERRAIN	140.	84.	27.5	84.	2.00	.812	.05	.009

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	0.	1.0	168.	2.00	42.738*	.05	1.107*
SKY	140.	0.	1.0	168.	2.00	11.123*	.05	-.321*
TERRAIN	10.	0.	1.0	168.	2.00	44.534*	.05	.513*
TERRAIN	140.	0.	1.0	168.	2.00	13.698*	.05	.275*

Visual Effects Screening Analysis for
Source: gbpgs
Class I Area: signal mtn wilderness

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	100.10	LB /HR
NOx (as NO2)	64.90	LB /HR
Primary NO2	.00	LB /HR
Soot	.00	LB /HR
Primary SO4	.00	LB /HR

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.04 ppm
Background Visual Range:	225.00 km
Source-Observer Distance:	25.00 km
Min. Source-Class I Distance:	25.00 km
Max. Source-Class I Distance:	31.00 km
Plume-Source-Observer Angle:	11.25 degrees
Stability: 6	
Wind Speed: 2.00 m/s	

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	132.	31.0	37.	2.00	6.932*	.05	.150*
SKY	140.	132.	31.0	37.	2.00	1.561	.05	-.047
TERRAIN	10.	84.	25.0	84.	2.00	16.963*	.05	.112*
TERRAIN	140.	84.	25.0	84.	2.00	.879	.05	.009

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	0.	1.0	168.	2.00	43.669*	.05	1.154*
SKY	140.	0.	1.0	168.	2.00	11.488*	.05	-.335*
TERRAIN	10.	0.	1.0	168.	2.00	46.859*	.05	.537*
TERRAIN	140.	0.	1.0	168.	2.00	14.180*	.05	.279*

Visual Effects Screening Analysis for
Source: gbpgs
Class I Area: woolsey peak wilderness

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	100.10	LB /HR
NOx (as NO2)	64.90	LB /HR
Primary NO2	.00	LB /HR
Soot	.00	LB /HR
Primary SO4	.00	LB /HR

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.04 ppm
Background Visual Range:	225.00 km
Source-Observer Distance:	11.50 km
Min. Source-Class I Distance:	11.50 km
Max. Source-Class I Distance:	25.50 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	2.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	160.	25.5	9.	2.00	21.101*	.05	.497*
SKY	140.	160.	25.5	9.	2.00	4.964*	.05	-.157*
TERRAIN	10.	160.	25.5	9.	2.00	40.560*	.05	.385*
TERRAIN	140.	160.	25.5	9.	2.00	5.649*	.05	.079*

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	1.	1.0	168.	2.00	49.719*	.05	1.417*
SKY	140.	1.	1.0	168.	2.00	14.027*	.05	-.411*
TERRAIN	10.	1.	1.0	168.	2.00	64.470*	.05	.689*
TERRAIN	140.	1.	1.0	168.	2.00	17.795*	.05	.266*

Visual Effects Screening Analysis for
Source: GBPGS
Class I Area: Phoenix Metro

*** Level-1 Screening ***

Input Emissions for

Particulates	100.10	LB /HR
NOx (as NO2)	64.90	LB /HR
Primary NO2	.00	LB /HR
Soot	.00	LB /HR
Primary SO4	.00	LB /HR

**** Default Particle Characteristics Assumed

Transport Scenario Specifications:

Background Ozone:	.04 ppm
Background Visual Range:	225.00 km
Source-Observer Distance:	51.60 km
Min. Source-Class I Distance:	51.60 km
Max. Source-Class I Distance:	100.00 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	1.00 m/s

R E S U L T S

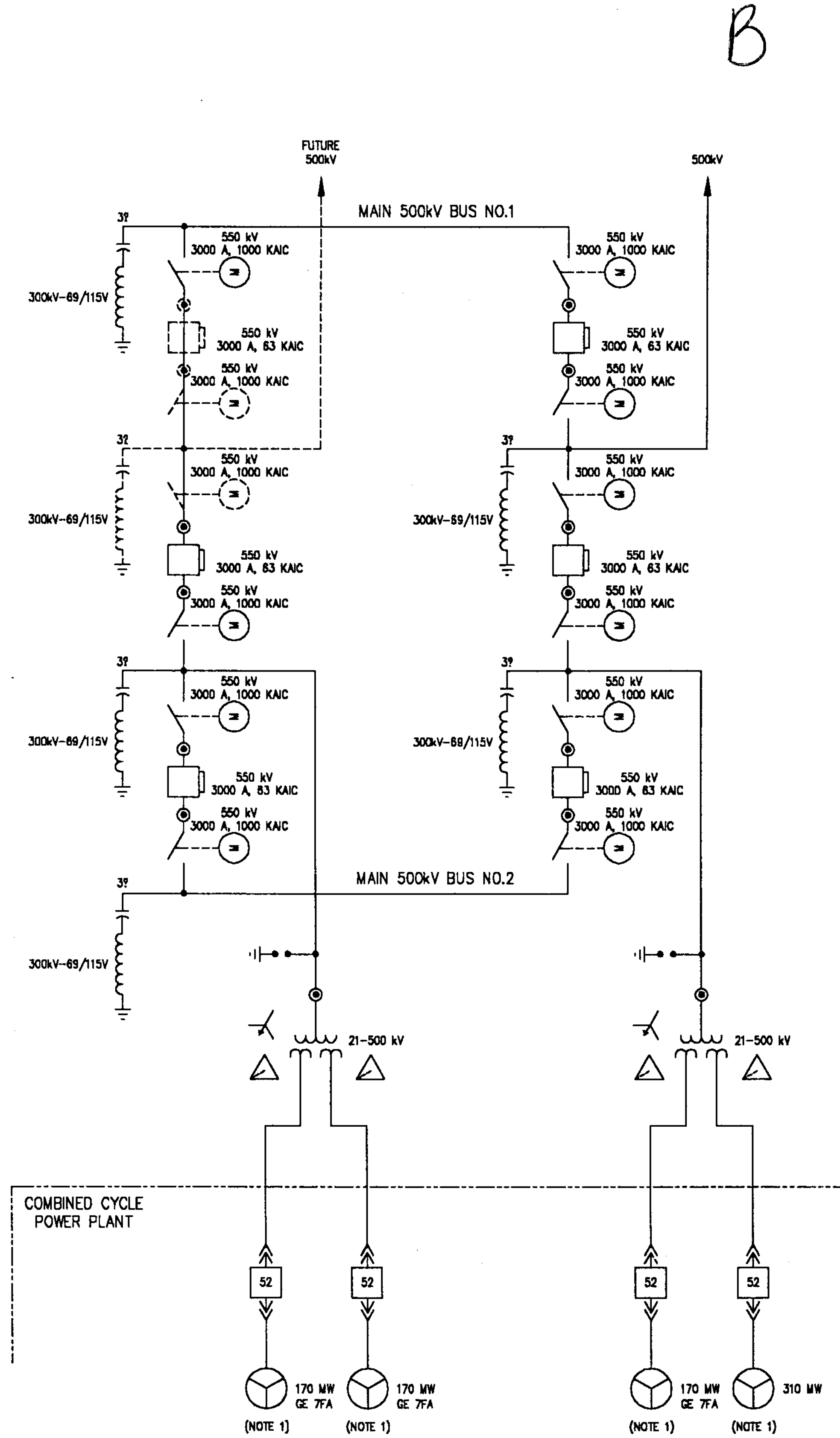
Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	155.	91.7	14.	2.00	8.020*	.05	.147*
SKY	140.	155.	91.7	14.	2.00	1.460	.05	-.047
TERRAIN	10.	84.	51.6	84.	2.00	13.442*	.05	.115*
TERRAIN	140.	84.	51.6	84.	2.00	.831	.05	.013

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	0.	1.0	169.	2.17	46.063*	.05	1.022*
SKY	140.	0.	1.0	169.	2.00	11.970*	.05	-.292*
TERRAIN	10.	0.	1.0	169.	2.00	32.661*	.05	.382*
TERRAIN	140.	0.	1.0	169.	2.00	15.127*	.05	.328*


B
FUTURE 500kV
500kV
MAIN 500kV BUS NO.1
3Ø
300kV-69/115V
550 kV
3000 A, 1000 KAIC
550 kV
3000 A, 63 KAIC
MAIN 500kV BUS NO.2
21-500 kV
COMBINED CYCLE POWER PLANT
52
170 MW GE 7FA
310 MW
(NOTE 1)

LEGEND

- HIGH VOLTAGE BUS
- POWER CIRCUIT BREAKER (OUTDOOR)
- POWER TRANSFORMER
- SOLIDLY GROUNDED
- PHASOR REPRESENTATION (DELTA)
- PHASOR REPRESENTATION (GROUNDED WYE)
- GENERATOR
- GROUP OPERATED AIR DISCONNECT SWITCH (MOTOR OPERATED)
- SURGE ARRESTER
- EQUIPMENT BUSHING
- CAPACITIVE VOLTAGE TRANSFORMER (DUAL SECONDARY)
- THREE WINDING TRANSFORMER
- 25kV CLASS CIRCUIT BREAKER

NOTES

1. DETAILS FOR THE GENERATORS HAVE NOT BEEN SHOWN SINCE IT IS OUT OF THE SCOPE OF THIS ONE LINE DIAGRAM.
2. EQUIPMENT RATINGS SHOWN ARE PRELIMINARY.

INDUSTRIAL POWER TECHNOLOGY
2227 CAPRICORN WAY SUITE 101
SANTA ROSA, CALIFORNIA 95407
TEL: 707-528-8900/FAX: 707-528-8901

ELECTRICAL CONSULTANTS, INC

No.	Revisions	Date

GILA BEND POWER PROJECT

SINGLE LINE DIAGRAM

BACH	LEP	RCW
DESIGN	DRAWN	ENG.

Job Number: 147100

Date: 7/26/00

Sheet Number: SL1

1 of 1 sheets

20001128.141244

c

November 14, 2000

Ms. Elena Gorelik
Maricopa County
Environmental Services Department
1001 N. Central Avenue, Suite 200
Phoenix, Arizona 85004

Re: Gila Bend Power Generation Station
Addendum No. 2 to Air Quality Permit Application (V00-001)

Dear Ms. Gorelik:

On behalf of the Gila Bend Power Partners, L.L.C., Malcolm Pirnie is providing additional information in order to supplement the original Air Quality Permit Application and the Application Addendum No.1 in response to the letter from Ms. Hatch dated October 27, 2000. The following sections, which provide the supplementary information, are in the same order as Ms. Hatch's letter.

Applicable New Source Performance Standards

Subpart Da of 40 CFR 60 outlines performance standards for each electric utility steam generating unit capable of combusting more than 250 million Btu/hour (either alone or in combination); and constructed after September 18, 1978. Subpart Da is applicable to the Gila Bend Power Generation Station (Facility), since it will be equipped with duct burners having capacities greater than the regulatory threshold.

The Facility will comply with the air emission limitations, emission monitoring, performance tests, and reporting requirements prescribed in the Subpart Da. Attachment 1 includes Table 8-1 Regulatory Applicability Analysis Summary and Table 16-1 Compliance Status Summary that have been revised to incorporate the additional Subpart Da requirements.

Equipment Information

As Ms. Hatch's letter stated, Gila Bend Power Partners will provide specific equipment information, such as make, model, serial number, as it becomes available.

Supporting Documentation

Attachment 2 includes the requested supporting documentation, which establishes the control efficiency of the proposed SCR units. Gila Bend Power Partners proposes to voluntarily equip the Facility with SCR systems capable of achieving 2.5 ppm NOx corrected to 15% oxygen. While the SCR systems will be designed to achieve 2.5 ppm NOx, it is difficult to measure the reduction in concentration at this low level with currently available continuous emission monitors (CEMs). Determining compliance based on the 2.5 ppm standard using CEMs is not appropriate. We propose to operate the SCR systems based on 2.5 ppm design criteria (such as ammonia injection rate) and determine the appropriate outlet NOx concentration from the first two years of operations.

The requested supporting documentation, which establishes control efficiency of the proposed Selective Catalytic Oxidation units, is enclosed in Attachment 2 for your review.

Compliance Certification

Attachment 3 includes the required Compliance Certification that contains all four of the elements missing in the original Compliance Certification. The four elements are a statement identifying the applicable requirements, the methods used to determine compliance, enhanced monitoring and/or compliance certification requirements, and a schedule of compliance certification submittal. This Compliance Certification replaces the current Compliance Certification in the Permit Application. Attachment 3 also includes a copy of the Certification of Truth, Accuracy, and Completeness.

Hazardous Air Pollutants

Malcolm Pirnie believes the current AP-42 emission factor for formaldehyde overestimates hazardous air pollutant (HAP) emissions for the Facility. In order to find a more appropriate emission factor, Malcolm Pirnie used the USEPA database called "AP-42 Chapter 3, Section 3.1 Emission Factor Query." According to the database, an 87.83 Mw GE combustion turbine Model MS7001E with no HAPs control emitted less than 1 percent of the AP-42 emission factor. Attachment 4 includes a copy of the database. It is appropriate to use this new emission factor, since it is based on closer types and sizes of the proposed 170 Mw GE combustion turbine Model MS7001FA. Table A-2.1 of Attachment 4 shows detailed calculations including the emission factors, equipment and operational parameters, and other assumptions.

Based on the revised estimates, the Facility will not be a major source of HAPs. Therefore, a case-by-case Maximum Available Control Technology (MACT) analysis as described in Section 112(g) of the Act and Maricopa County Rule 370 Section 401 is not applicable. In addition, there are no applicable sections from Maricopa County Rule 370 because there is currently no MACT applicable to natural gas-fired combined cycle turbines.

Therefore, Malcolm Pirnie proposes to cap the Facility's HAP emissions at 9.9 tons per year of any single HAP and 24.9 tons per year of total HAPs. The required performance test will provide source specific and actual emission factors that will be used to calculate HAPs emissions. If the results of the performance test indicate the Facility is a major source of HAPs, the Facility will equip its turbines with MACT (e.g., catalytic oxidation units) with a minimum removal efficiency of 90 percent.

As we discussed in our November 8, 2000 meeting, Malcolm Pirnie appreciates the Department's prompt review of this letter so our supplemental information can be used to deem the Facility's application complete. If you have any questions, please contact me at (602) 231-5537 or Mr. Gary Bacon at (602) 231-5591.

Very truly yours,

MALCOLM PIRNIE, INC.

Jae Chang
Engineer

Enclosures

c: Massie Hatch, URS
Dale Lieb, Maricopa County
Peter Lahm, US Forest Services
Bob Innamorati, GBPP
Pete Wright, GBPP
Bob Walther, IPT
Karen Peters, SSD
Gary Rogers, MPI
Gary Bacon, MPI

M:/3962001/reports/psdapp/addendum_2/mactlett2.doc

ATTACHMENT 1

TABLE 8-1

GILA BEND POWER GENERATION STATION
REGULATORY APPLICABILITY ANALYSIS
SUMMARY [1]

Regulatory Citation	Regulatory Title	Applicable	Non-Applicable
40 CFR[2] Part	***Federal***		
50	National Primary and Secondary Ambient Air Quality Standards		*
51	Requirements for Preparation, Adoption, Submittal of Implementation Plans		*
52	Approval and Promulgation of Implementation Plans		*
53	Ambient Air Monitoring Reference and Equivalent Methods		*
54	Prior notice of Citizen Suit		*
55	Outer Continental Shelf Air Regulations		*
56	Regional Consistency		*
57	Primary nonferrous Smelter Orders		*
58	Ambient Air Quality Surveillance		*
60	New Source Performance Standards (Subparts Da, Dc and GG)	*(3)	
61	National Emission Standards for Hazardous Air Pollutants (Subparts A and M)		*(4)
61	National Emission Standards for Hazardous Air Pollutants (Subparts B-FF, except M)		*(4)
62	Approval and Promulgation of State Plans for Designated Facilities and Pollutants		*
63	National Emission Standards for Hazardous Air Pollutants for Source Categories		*
63	Compliance Assurance Monitoring	*	
65	Delayed Compliance Orders		*
66	Assessment and Collection of noncompliance Penalties by EPA		*
67	EPA Approval of State noncompliance Penalty Program		*
68	Chemical Accident Prevention Provisions (Subparts A, B, E, F,	*	

TABLE 8-1 GILA BEND POWER GENERATION STATION REGULATORY APPLICABILITY ANALYSIS SUMMARY [1]			
Regulatory Citation	**Regulatory Title**	**Applicable**	**Non-Applicable**
	G, and H)		
69	Special Exemptions from Requirements of Clean Air Act		*
70	State Operating Permit Program		*(5)
71	Federal Operating Permit Programs		*
72	Acid Rain Program (Subparts A, B, C, D, E, H, and I)	*	
73	Sulfur Dioxide Allowance System	*	
74	Sulfur Dioxide Opt-ins		*
75	Continuous Emission Monitoring (Subparts A, B, C, D, F, G)	*	
76	Acid Rain Nitrogen Oxides Emission Reduction Program		*
77	Excess Emissions		*
78	Appeal Procedures for Acid Rain Program		*
79	Registration of Fuels and Fuel Additives		*
80	Regulation of Fuels and Fuel Additives		*
81	Designation of Areas for Air Quality Planning Purposes		*
82	Protection of Stratospheric Ozone (Subparts B, E, F, and G)		*
85	Control of Air Pollution from Motor Vehicles and Motor Vehicle Engines		*
86	Control of Air Pollution from New and In-use Motor Vehicles and New and In-use Motor Vehicle Engines		*
87	Control of Air Pollution from Aircraft and Aircraft Engines		*
88	Clean Fuel Vehicles		*
89	Control of Emissions from New and In-use Nonroad Engines		*
90	Control of Emissions from Nonroad Spark-Ignition Engines		*
93	Determining Conformity of Federal Actions to State or Federal Implementation Plans		*

TABLE 8-1

GILA BEND POWER GENERATION STATION
REGULATORY APPLICABILITY ANALYSIS
SUMMARY [1]

Regulatory Citation	Regulatory Title	Applicable	Non-Applicable
95	Mandatory Patent Licenses		*
Clean Air Act	***Federal***		
Title I	New Source Review		*[6]
Title II	Mobile Sources		*[6]
Title III	Hazardous Air Pollutants Program		*[6]
Title IV	Acid Deposition Control		*[6]
Title V	Operating Permit Program		*[6]
Title VI	Stratospheric Ozone Protection		*[6]
Article	***Arizona Administrative Code - Title 18, Chapter 2***		
1	General (R18-2-101 through R18-2-103)		*
2	Ambient Air Quality Standards, Area Designations, Classifications (R18-2-201 through R18-2-220)		*
3	Permits and Permit Revisions (R18-2-301 through R18-2-333)		*
4	Permit Requirements for New Major Sources and Major Modifications to Existing Sources (R18-2-401 through R18-2-411)		*
5	General Permits (R18-2-501 through R18-2-525)		*
6	Emissions from Existing and New Nonpoint Sources (R18-2-601 through R18-2-610)		*
7	Existing Stationary Source Performance Standards (R18-2-710)		*
8	Emissions from Mobile Sources (R18-2-801 through R18-2-805)		*
9	New Source Performance Standards (R18-2-901)		*
10	Motor Vehicles: Inspections and Maintenance (R18-2-1001 through R18-2-1031)		*
11	Federal Hazardous Air Pollutants (R18-2-1101 through R18-2-1102)		*
14	Conformity Determinations (R18-2-1401 through R18-2-1438)		*
Rule	***Arizona State Implementation Plan (SIP)*** [7]		

TABLE 8-1

GILA BEND POWER GENERATION STATION
REGULATORY APPLICABILITY ANALYSIS
SUMMARY [1]

Regulatory Citation	Regulatory Title	Applicable	Non-Applicable
1	Emission Required: Policy, Legal Authority		*(8)
2	Definitions		*(8)
3	Air Pollution Prohibited		*(8)
220	Permits to Operate		*(8)
20	Permits Required		*(8)
21	Permit Conditions		*(8)
23	Permit Classes		*(8)
24	Installation Permit Fees		*(8)
25	Emissions Test Methods/Annual Operating Permit Fees and Procedures		*(8)
26	Portable Equipment		*(8)
27	Performance Tests		*(8)
28	Permit Fees		*(8)
30	Visible Emissions		*(8)
31	Emissions of Particulate Matter		*(8)
32	Odors and Gaseous Emissions		*(8)
33	Storage and Handling of Petroleum Products		*(8)
34	Organic Solvents		*(8)
35	Incinerators		*(8)
Regulation IV	Production of Records: Monitoring, Testing, and Sampling Facilities		*(8)
Regulation V	Unlawful Open Burning		*(8)
Regulation VI	Violations		*(8)
Regulation VII	Ambient Air Quality Standards		*(8)
Regulation	Validity and Operation		*(8)

TABLE 8-1

GILA BEND POWER GENERATION STATION
REGULATORY APPLICABILITY ANALYSIS
SUMMARY [1]

Regulatory Citation	Regulatory Title	Applicable	Non-Applicable
VIII			
Rule	***Maricopa County***		
100	General Provisions and Definitions	*	
110	Violations		*(9)
120	Conditional Orders		*
200	Permit Requirements	*	
210	Title V Permit Provisions	*	
220	Non-Title V Permit Provisions		*
230	General Permits		*
240	Permits for New Major Sources and Major Modifications to Existing Major Sources	*	
241	Permits for New Sources and Modifications to Existing Sources	*	
245	Continuous Source Emission Monitoring		*
270	Performance Tests	*	
280	Fees	*	
300	Visible Emissions	*	
310	Open Fugitive Dust Sources	*	
311	Particulate Matter from Process Industries	*	
312	Abrasive Blasting	*	
313	Incinerators		*
314	Open Outdoor Fires		*
315	Spray Coating Operations	*	
316	Nonmetallic Mineral Mining and Processing		*
317	Medical Waste Incinerators		*
318	Approval of Residential Woodburning Devices		*

TABLE 8-1

GILA BEND POWER GENERATION STATION
REGULATORY APPLICABILITY ANALYSIS
SUMMARY [1]

Regulatory Citation	Regulatory Title	Applicable	Non-Applicable
320	Odors and Gaseous Air Contaminants	*	
321	Municipal Solid Waste Landfills		*
330	Volatile Organic Compounds	*	
331	Solvent Cleaning	*	
332	Perchloroethylene Dry Cleaning		*
333	Petroleum Solvent Dry Cleaning		*
334	Rubber Sports Ball Manufacturing		*
335	Architectural Coatings	*	
336	Surface Coating Operations		*
337	Graphic Arts		*
338	Semiconductor Manufacturing		*
339	Vegetable Oil Extraction Processes		*
340	Cutback and Emulsified Asphalt		*
341	Metal Casing		*
342	Coating Wood Furniture and Fixtures		*
343	Commercial Bread Bakeries		*
344	Automotive Windshield Washer Fluid		*
345	Vehicle Refinishing		*
346	Coating Wood Millwork		*
350	Storage of Organic Liquids at Bulk Plants and Terminals		*
351	Loading of Organic Liquids		*
352	Gasoline Delivery Vessels		*
353	Transfer of Gasoline into Stationary Storage Dispensing Tanks		*
360	New Source Performance Standards (Section 300 Subparts Da, Dc and GG)	*	

TABLE 8-1

GILA BEND POWER GENERATION STATION
REGULATORY APPLICABILITY ANALYSIS
SUMMARY [1]

Regulatory Citation	Regulatory Title	Applicable	Non-Applicable
370	Federal Hazardous Air Pollutant Program (Section 300 ɜɜ 301.1 and 301.8)		*
371	Acid Rain (Section 301)	*	
400	Procedure Before the Hearing Board		*[10]
500	Attainment Area Classification		*
510	Air Quality Standards		*
600	Emergency Episodes		*

Notes

1. Only the substantive regulations that impose specific requirements on the facility are identified as applicable.
2. CFR - Code of Federal Regulations, July 1996.
3. The New Source Performance Standards (NSPS) of 40 CFR Part 60 are incorporated by reference in Maricopa County Rule 360.
4. The National Emission Standards for Hazardous Air Pollutants (NESHAPs) in 40 CFR Part 61 are incorporated by reference in Maricopa County Rule 370.
5. This minimum requirements rule applies to states not to individual sources. Individual sources are subject to Maricopa County Rules 200 and 210.
6. These provisions are shown as non-applicable because they mainly provide the statutory authority for the state and county air quality programs and do not impose specific requirements on the facility. The facility's daily operation will be governed by the provisions in the Maricopa County air quality regulations.
7. Only the Maricopa County rules in the December 1996 SIP that are not codified in the current Maricopa County air quality rules are presented here.
8. This provision is shown as non-applicable because it is obsolete and has been superseded by the current Maricopa County air quality rules which are at least as stringent as this provision.
9. This provision is shown as non-applicable because it is administrative in nature and merely specifies the classification of violations of the County rules.
10. This provision is shown as non-applicable because it is administrative in nature and merely sets out the procedures before the hearing board.

Table 16-1 Compliance Status Summary

Regulatory Citation	Regulatory Title	Applicable Requirements	Compliance Demonstration
FEDERAL U.S. ENVIRONMENTAL PROTECTION AGENCY			
40 CFR Part 60 Subpart Da	New Source Performance Standards for Electric Utility Steam Generating Units	See Maricopa County Rule 360 which adopted 40 CFR Part 60 by reference.	The Facility will comply as set forth in the compliance demonstration for Maricopa County Rule 360.
40 CFR Part 60 Subpart Dc	New Source Performance Standards for Small Industrial-Commercial-Institutional Steam Generating Units	See Maricopa County Rule 360 which adopted 40 CFR Part 60 by reference.	The Facility will comply as set forth in the compliance demonstration for Maricopa County Rule 360.
40 CFR Part 60 Subpart GG	New Source Performance Standard for Stationary Gas Turbines	See Maricopa County Rule 360 which adopted 40 CFR Part 60 by reference.	The Facility will comply as set forth in the compliance demonstration for Maricopa County Rule 360.
40 CFR Part 64	Compliance Assurance Monitoring	• Design monitoring criteria to assure compliance. • Reporting and recordkeeping requirements for monitored data.	• Required CEM criteria will satisfy criteria. • CEM data will be recorded and reported as required.
40 CFR Part 68 Subpart A, B, E, F, G and H	Chemical Accident Prevention Provisions	• Prepare a worst case scenario Risk Management Plan. • Develop and implement an Emergency Response Program.	• The Facility will prepare and submit a RMP in accordance with 40 CFR Part 68, if necessary after examining the regulated substance thresholds.
40 CFR Part 72 Subpart A, B, C, D, E, H and I	Acid Rain Program	See Maricopa County Rule 371 which adopted 40 CFR Part 72 by reference.	The Facility will comply as set forth in the compliance demonstration for Maricopa

Table 16-1 Compliance Status Summary

Regulatory Citation	Regulatory Title	Applicable Requirements	Compliance Demonstration
			County Rule 371.
40 CFR Part 73	Sulfur Dioxide Allowance System	SO_2 allowance, tracking, and transfer standards.	The Facility will comply with allowance, tracking and transfer of SO_2 standards.
40 CFR Part 75 Subpart A, B C, D, F and G	Continuous Emission Monitoring	• Continuous Emission Monitor is required. • Monitor opacity, SO_2, NO_x, and CO_2.	• The Facility will install required CEM. • The Facility will certify CEM. • The Facility will comply with recordkeeping and reporting requirements.
MARICOPA COUNTY			
Rule 100	General Provisions and Definitions	• Prohibits the discharge of regulated air pollutants in excess of the quantities or concentrations specified in the applicable State or County rules. • Requires reports of excess emissions. • Requires recordkeeping of emissions testing, monitoring, and malfunctions. • Requires submittal of an annual emissions inventory questionnaire.	• The Facility will comply through monitoring of emissions as required by each applicable rule that contains an emission limit. • The Facility will comply by submitting any necessary excess emission reports. • The Facility will comply by maintaining all necessary records of emissions testing, monitoring, and malfunctions as required by each applicable rule. • The Facility will comply by submitting annual

Table 16-1 Compliance Status Summary

Regulatory Citation	Regulatory Title	Applicable Requirements	Compliance Demonstration
			emissions inventory reports to Maricopa County.
Rule 200	Permit Requirements	• Requires an air quality permit prior to commencement and operation of a new source. • Requires an earth moving permit prior to any earth moving operation that disturbs a total surface area of 0.10 acre or more.	• The Facility will comply by obtaining a Title V/PSD permit. • The Facility will comply with obtaining an earthmoving permit.
Rule 210	Title V Permit Provisions	• Lists criteria for a complete application. • Explains permit processing procedures and permit contents.	The Facility will submit an application in accordance with the complete application criteria.
Rule 240	Permits for New Major Sources and Major Modifications to Existing Major Sources	Required application content for attainment area including GEP stack height, air impact analysis, BACT evaluation, etc. for a major source.	The Facility will submit an application that has an acceptable air impact analysis, BACT analysis, and GEP stack height information.
Rule 241	Permit for New Sources and Modifications to Existing Sources	Requires application of RACT for ancillary activities such as abrasive blasting.	The Facility will comply with RACT requirement by operating within applicable County 300 series rules.

Table 16-1 Compliance Status Summary

Regulatory Citation	Regulatory Title	Applicable Requirements	Compliance Demonstration
Rule 270	Performance Tests	Establishes the requirements for performance tests, testing criteria, testing conditions, notice of testing and testing facilities that must be followed to determine compliance with applicable emissions limits.	The Facility will comply by conducting performance tests to ensure compliance with the emission limits for the electric generation and opacity through the following: • The Facility will conduct performance tests on the turbines, and boiler within 60 days after it has achieved the capability to operate at its maximum capacity on a sustained basis. • The Facility will notify Maricopa County of the performance test at least two weeks prior to conducting the tests. • The Facility will furnish Maricopa County with a written test protocol and a report of the results of the performance tests.
Rule 280	Fees	Establishes the fees for processing of Title V applications and permits and	The Facility will comply through the payment of all applicable fees.

Table 16-1 Compliance Status Summary

Regulatory Citation	Regulatory Title	Applicable Requirements	Compliance Demonstration
		for annual emissions of regulated air pollutants.	
Rule 300	Visible Emissions	Establishes an opacity limit of 20 percent with the exception of exceedences during startup, shutdown, and emergencies.	The Facility will retain copies of all opacity records for five years.
Rule 310	Open Fugitive Dust Sources	• Requires a dust control plan for any source commencing earth moving operations or dust generating operations. • Requires compliance with any applicable opacity standards. • Requires application of reasonable available control measures (RACM). • Requires an earth moving permit and operating permit in accordance with Maricopa County Rule 200.	• The Facility will comply by obtaining an approved Dust Control Plan and Earth Moving Permit from Maricopa County. • The Facility will comply through application of RACM as set forth in its approved Dust Control Plan and Earth Moving Permit issued by Maricopa County. The Facility will keep a daily written log recording the actual implementation of RACM and will make such information available for review on request by Maricopa County. Copies of all records will be retained for five years. • The Facility will comply by

Table 16-1 Compliance Status Summary

Regulatory Citation	Regulatory Title	Applicable Requirements	Compliance Demonstration
			having obtained its approved Earth Moving Permit and obtaining the Title V/PSD permit from Maricopa County.
Rule 311	Particulate Matter from Process Industries	Sets PM emission limit for fuel burning operation.	The Facility will comply with PM emission limit.
Rule 312	Abrasive Blasting	Lists approved controls for abrasive blasting such as wet blasting.	The Facility or its subcontractor will use one of the approved controls.
Rule 315	Spray Coating Operations	Lists approved controls for spray coating such as a three-sided enclosure.	The Facility or its subcontractor will use one of the approved controls.
Rule 320	Odors and Gaseous Air Contaminants	• Requires material containment to limit gaseous or odorous air contaminants from equipment, operations or premises thereby preventing air pollution. • Limits NOx emission to be less than 0.2 lb/MM BTU for gaseous fossil fuel for electric power plants after 1972.	• The Facility will control gaseous or odorous air contaminants by handling material in a manner to reduce unnecessary air pollution. • The Facility will comply with NOx emission limitation.
Rule 330	Volatile Organic Compounds	Lists VOC content limits for	• The Facility will use only

Table 16-1 Compliance Status Summary

Regulatory Citation	Regulatory Title	Applicable Requirements	Compliance Demonstration
		various solvents.	the approved solvents. • The Facility will keep a current list and usage for all solvents.
Rule 331	Solvent Cleaning	Lists acceptable material handling and equipment standards.	• The Facility will use only approved equipment and handling in safe manner to reduce unnecessary emissions. • The Facility will keep a current list and usage for all solvents.
Rule 335	Architectural Coatings	Lists VOC content limits for various architectural coatings.	The Facility will only use approved coatings.
Rule 360	New Source Performance Standards (Section 300 Subpart Da)	• Sets PM, SO2 and NOx emission standards for various fuel types combusted. • Lists testing, monitoring and recordkeeping & reporting requirements.	• The Facility will meet emission standards for natural gas combustion. • The Facility will comply with testing, monitoring and recordkeeping & reporting requirements.
Rule 360	New Source Performance Standards (Section 300 Subpart Dc)	• Sets opacity, SO2 and PM emission standards for various fuel types combusted. • Lists testing, monitoring, and recordkeeping & reporting requirements.	• The Facility combusts natural gas which has no applicable opacity, SO2 and PM standards. • The Facility will comply with testing, monitoring, and recordkeeping &

Table 16-1 Compliance Status Summary

Regulatory Citation	Regulatory Title	Applicable Requirements	Compliance Demonstration
			reporting requirements.
Rule 360	New Source Performance Standards (Section 300 Subpart GG)	• Sets NOx and SO2 emission standards. • Lists monitoring and testing requirements.	• The Facility will comply with the NOx and SO2 emission standards. • The Facility will comply with monitoring and testing requirements.
Rule 371	Acid Rain (Section 301)	• Required to submit an application and certificate of representation. • Required to operate in accordance with acid rain permit application.	• The Facility will submit an application and certificate of representation. • The Facility will operate in accordance with permit application.

ATTACHMENT 2

INDUSTRIAL POWER TECHNOLOGY

November 13, 2000

Ms. Elena Gorelik
Air Quality Division
Maricopa County Environmental Services Department
1001 North Central Avenue. Suite 200
Phoenix. AZ 85004-1942

RE: Gila Bend Power Partners, L.L.C. NOx reduction system

Dear Elena:

Gila Bend Power Partners. L.L.C. is committed to meeting a 2.5 ppm NO_x emissions level for the Gila Bend Power Project and will include this specification in our request for proposal for our EPC Contractor as well as any equipment specification we may affect NO_x emission levels.

In response to the AQD request for manufacturer's assurances that the Gila Bend Power Project can meet the 2.5 ppm NO_x limits, please accept the attached letter to Thom Shelton, of our office. from Ann English, P.E.. Foster Wheeler Energy International regarding their ability to provide an SCR Catalyst system which will meet or exceed the 2.5 ppm NO_x level.

Foster Wheeler is only one of several manufacturers who can provide the NOx reduction systems utilizing precious metals catalyst from suppliers such as Cormatech, Englehard, Hitachi-Zosen or IHI. some of whom also manufacture complete SCR systems.

If you have any questions regarding the control systems we've proposed or any subject related to the Gila Bend Power Partners L.L.C. project, please don't hesitate to call me at (707) 528-8900.

Sincerely,

R C Walther

Robert C. Walther, P.E.
President

Enclosure: FWC Fax letter

cc: Gary Bacon, MPI w/enclosures
Jae Chang, MPI

FAX TRANSMISSION

FOSTER WHEELER ENERGY INTERNATIONAL
Suite 208-11939 224th Street
Maple Ridge, B.C. V2X 5K4
604-463-8951
Fax: 604-463-8952 Email : ann_english@fwc.com

To:	Thom Shelton	**Date:**	November 9, 2000
Fax #:	707 528 8901	**Pages:**	1, including this cover sheet.
From:	Ann English		
Subject:	NOx Emissions		

COMMENTS:

Confirming our conversation of yesterday, regarding NOx emissions from HRSG's with 7FA natural gas fired turbines , Foster Wheeler advises the following:

A NOx level of 2.5 ppm @ 15% O2 is acheivable providing that the incoming NOx level from the gas turbine is reasonable and enough space considerations (as well as performance impact to the HRSG) are allowed for the SCR catalyst system.

We hope this information is useful to you and look forward to a successful outcome to your project that may include further involvement by Foster Wheeler.

Sincerely,

Ann English, P.Eng.,
Foster Wheeler District Manager, Pacific Northwest

cc.Rob Dueck - FWL

NEPCO

National Energy
Production Corporation
11831 North Creek Parkway Nort
Bothell, WA 98011
USA
Tel: (425) 415-3000
Fax: (425) 415-3095

VIA UPS (Next Day)

November 10, 2000

Mr. Robert C. Walther
Gila Bend Power Partners, L.L.C.
2227 Capricorn Way, suite 101
Santa Rosa, CA 95407

SUBJECT: SCR Information for Gila Bend Project

Dear Bob:

Per your request, attached is information on Engelhard NOx Reduction Catalysts SCR technology. I trust Foster Wheeler's Ann English was of help to you and Tom. Please let me know is there is anything else you need on this subject.

Very truly yours,

Donald D. Clasen
Director, Business Development

cc: S.L. Daniels
J.M. Kather
A.C. Slovic

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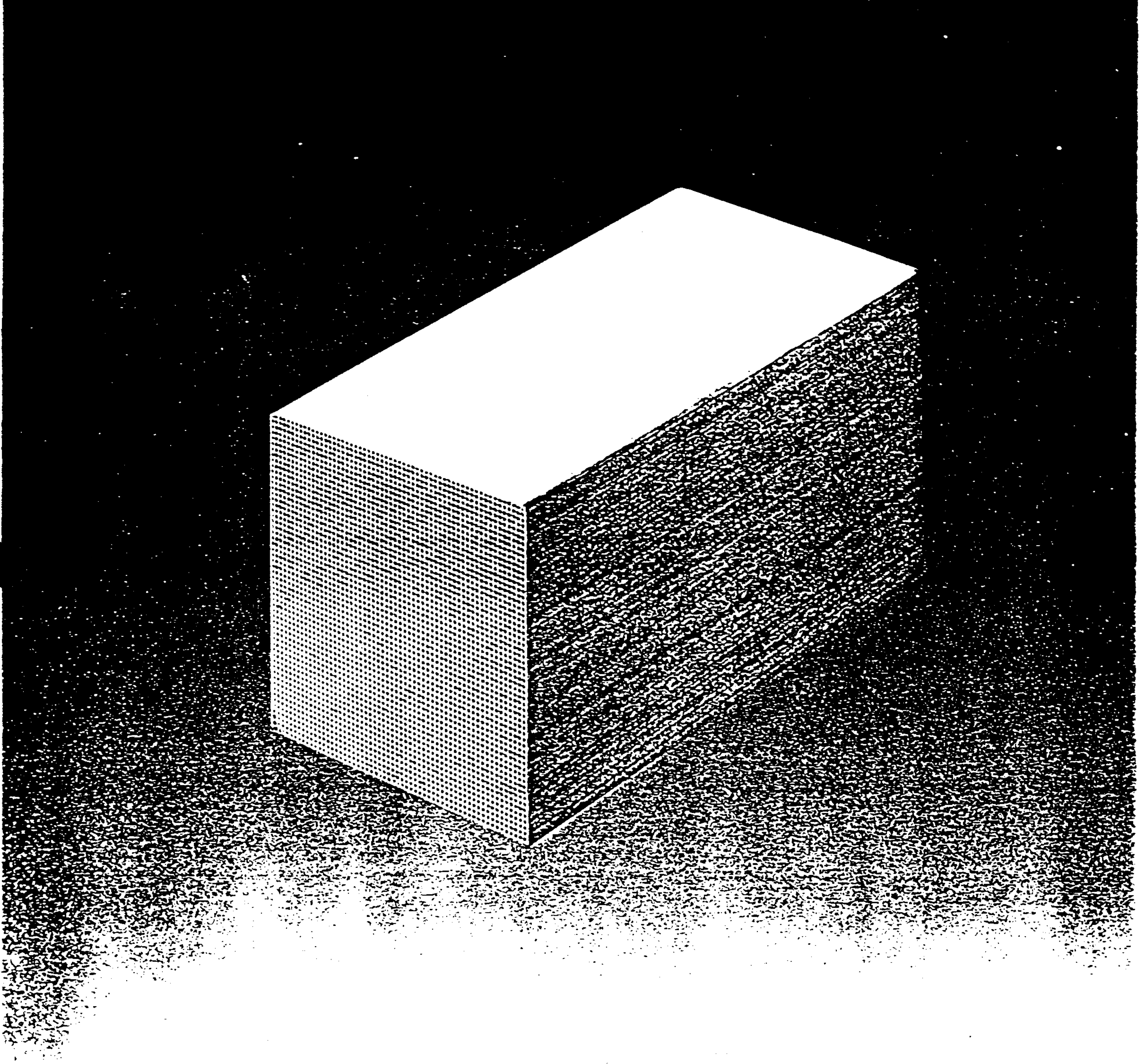
Engelhard NOx Reduction Catalysts
SCR technology for a cleaner environment



ENGELHARD
EXCEPTIONAL TECHNOLOGIES

Unsurpassed SCR catalyst technology

In today's era of environmental sensitivity, industry's search for effective and environmentally acceptable air pollution control technologies is never-ending. In the case of NOx, selective catalytic reduction (SCR) has been the most effective method of controlling emissions in many applications since the mid-1970s. SCR has been proven to reduce NOx by up to 90 percent or more, significantly better results than can be achieved by competing technologies.

Engelhard has been involved in developing SCR technology longer than anyone else in the industry. In fact, we invented SCR and obtained the first patents for this technology in 1957. Today, as a world leader in catalyst technology for emissions control, Engelhard continues to advance the state-of-the-art in SCR.

Our newest family of SCR catalysts demonstrates this leadership. ZNX™ catalysts allow operation at higher temperatures and reduce disposal concerns due to a unique composition which is free of heavy metals. Our VNX™ catalysts are based upon the broadly used, cost-effective vanadia/titania (V/Ti) formulation. Both catalyst families are developed, and manufactured in the United States with worldwide sales, engineering, technical and field support.

The fundamentals of the SCR system

Engelhard SCR catalysts promote the reduction of NOx emissions (oxides of nitrogen; principally nitrogen oxide...NO, and nitrogen dioxide...NO_2) with added ammonia (NH_3) in exhaust streams which have excess oxygen (O_2). The basic chemical reactions in this process are as follows:

$$4NO + 4NH_3 + O_2 - 4N_2 + 6H_2O$$

$$2NO_2 + 4NH_3 + O_2 - 3N_2 + 6H_2O$$

In SCR, ammonia (NH_3) is added to an exhaust stream and reacted with NOx in the SCR catalyst to produce nitrogen (N_2) and water (H_2O). This application is demonstrated schematically by the diagram below.

Either anhydrous (compressed gas) or aqueous (water solution) NH_3 may be used for this process.

SCR catalysts operate within certain temperature limits, depending upon the catalyst formulation. For a typical SCR catalyst, the temperature needs to be approximately 600 F in order to achieve high levels of NOx conversion and low NH_3 slip levels (after the catalyst) (Figure 1).

Figure 1 illustrates NOx conversion and NH_3 slip as a function of temperature for a generic SCR catalyst.

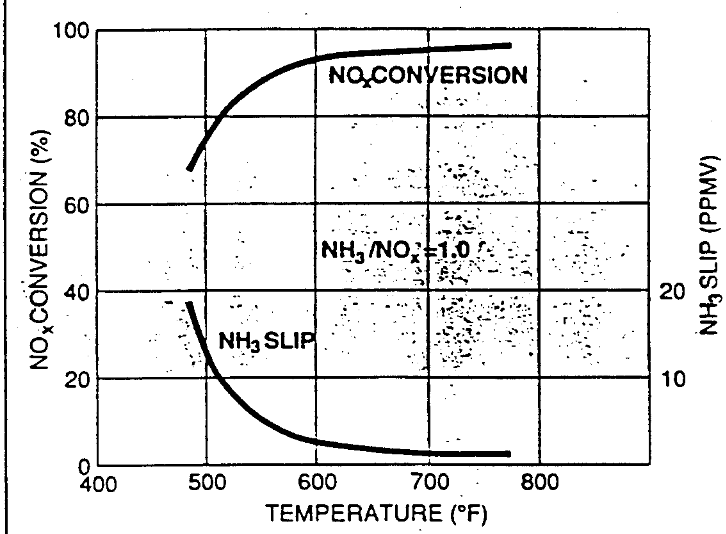
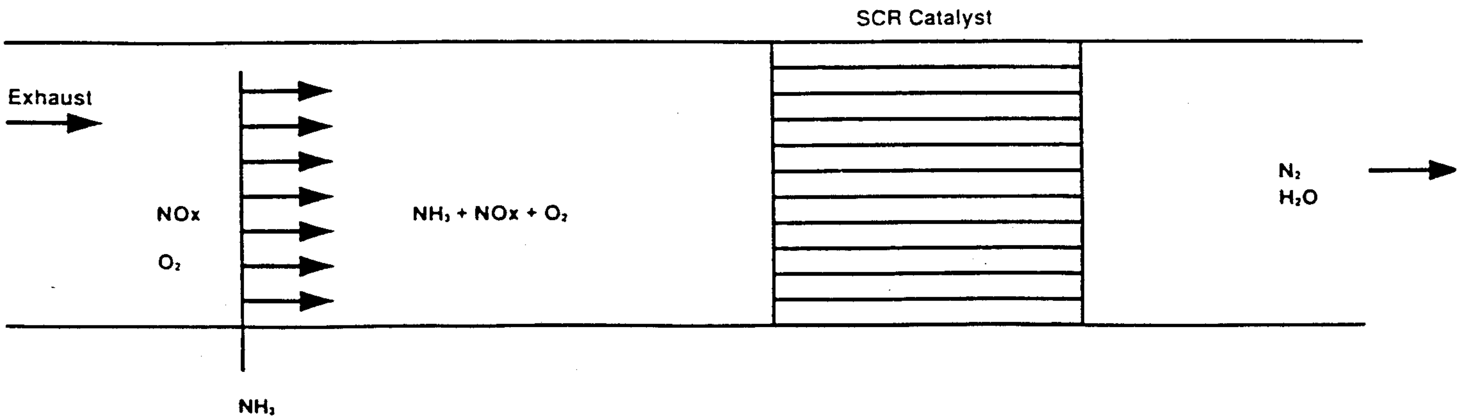


FIGURE 1



SCR Applications

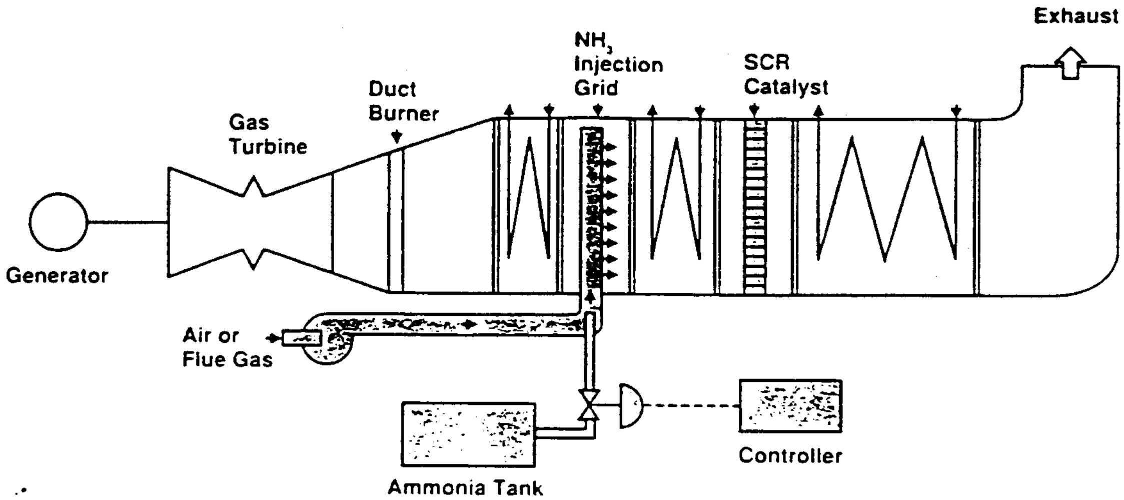


FIGURE 2

For gas turbine applications

Engelhard SCR catalysts are available for gas turbine cogeneration and combined cycle installations. Our newly developed ZNX catalyst is available for simple cycle gas turbine applications which require higher catalyst operating temperatures. A typical gas turbine SCR system schematic is outlined in Figure 2.

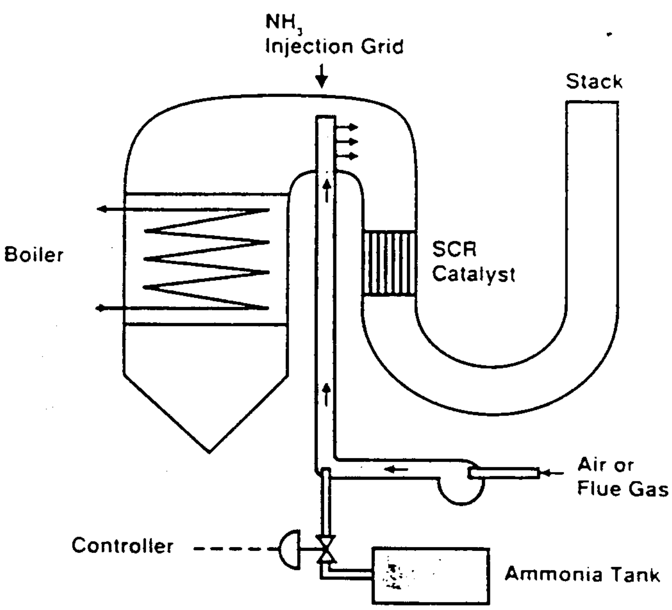


FIGURE 3

For boiler and heater applications

Our SCR catalysts are also available for a range of industrial and utility boilers and heaters which use natural gas, distillate oil, and coal fuels. A typical boiler SCR system schematic is presented in Figure 3.

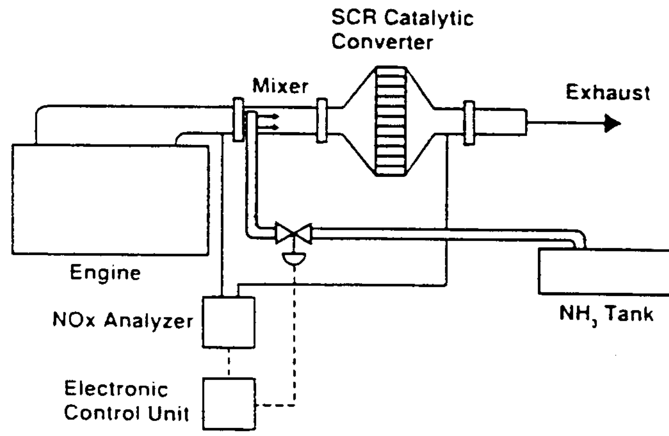


FIGURE 4

Recriprocating engine applications

Engelhard SCR technology is applicable to the emission control needs of stationary reciprocating engines – including both spark-ignited and diesel. Fuels for these engines can include natural gas, diesel oil, and heavier fuel oil. A typical engine SCR system schematic is shown in Figure 4.

Other industrial applications

SCR catalysts are available for a variety of other stationary source emission control applications. If you have a need to control NOx emissions from an industrial source, Engelhard application engineers can help you find the right solution.

VNX: a proven SCR performer

The VNX family of SCR catalysts is based upon vanadia/titania as the principle catalytic material. Vanadia/titania SCR catalysts are used in numerous NOx reduction applications, and have been successfully demonstrated in reciprocating engines, gas turbines, and utility/industrial boilers.

The VNX catalysts use a highly active vanadia/titania catalytic coating on ceramic honeycomb structures. The honeycomb catalysts are available in a range of cell sizes to facilitate optimum catalyst design to meet individual application requirements. Consult the enclosed data sheets for details.

ZNX: a new generation of SCR technology

The product of more than a decade of research and development, ZNX catalysts deliver reliable NOx reduction at temperatures in excess of 1,000°F, making them suitable for higher-temperature engines which otherwise could not use SCR catalysts.

The new honeycomb catalysts rely upon zeolitic materials rather than heavy metals for their catalytic activity. Engelhard zeolites are alumina silicates that are speciall processed to enhance their catalytic properties. Disposa concerns are reduced with ZNX catalysts because of the absence of heavy metals.

This new technology is based upon decades of Engelhar experience and expertise with zeolite catalysts, which have been used extensively in the petroleum industry for many years. Consult the enclosed data sheets for details

Composite construction provides improved performance

VNX and ZNX catalysts are able to deliver better overall performance, including NOx reduction and ammonia slip, than other SCR catalysts, principally due to their composite constructions. The composite catalyst is manufactured by bonding a layer of catalytic ingredients onto a strong, thin-walled ceramic honeycomb support. The composite construction provides maximum design flexibility, allowing Engelhard to tailor catalyst formulations to specific application requirements.

The ceramic honeycomb support has outstanding physical properties. This provides for the design of very thin walls in the honeycomb to reduce exhaust gas flow pressure loss. Additionally, higher cell densities (smaller cell pitch) than previously available for SCR helps to reduce catalyst volume.

The catalytic coating is formulated to provide optimum catalyst activity without sacrifice for mechanical strength. Maximum NOx reduction activity is achieved while reducing the undesired side reactions of NH_3 and SO_2 oxidation.

In addition, the catalyst can be recycled, reducing replacement costs.

Cell size versatility means design flexibility

VNX and ZNX catalysts are available in honeycomb configurations ranging from 25 cells per square inch (CPSI) of catalyst frontal area to 200 CPSI. The use of higher cell densities reduces catalyst volume, which results in smaller and lighter catalyst reactors, making them easier to apply when space is limited, especially in retrofit situations. When the exhaust contains particulate or when pressure drop requires it, lower cell density configurations are available.

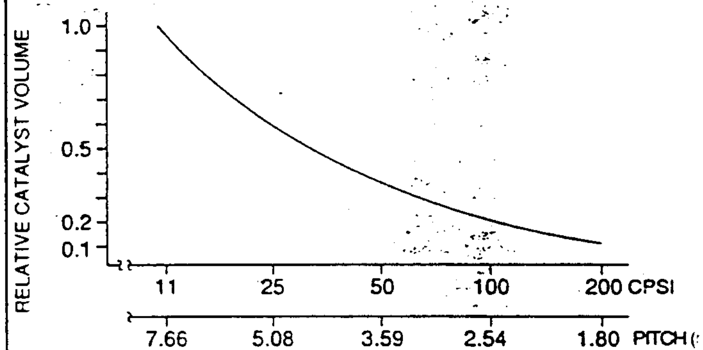


FIGURE 5

Features and Benefits

PRODUCT	FEATURES	BENEFITS
VNX and ZNX	• Composite catalyst; catalytic coating bonded to ceramic honeycomb — Catalytic coating optimized for SCR activity — Ceramic substrate optimized for strength with thin walls and outstanding thermal shock resistance	• Excellent NOx activity and low NH_3 slip • Minimizes undesirable side reactions of SO_2 oxidation and NH_3 oxidation • Less catalyst volume with higher cell densities • Low pressure loss with thin walls • No limitation on thermal cycle • Excellent resistance to mechanical/acoustical vibrations
	• Broad range of honeycomb cell densities (pitch)	• Reduced catalyst volume (catalytic reactor size, weight, and cost) with higher cell densities • Optimized catalyst design to meet performance and pressure loss performance requirements
	• Developed and manufactured in the U.S. with worldwide sales, engineering, technical and field support.	• Maximum responsiveness to customer/owner needs
	• Composite catalyst — Catalytic coating can be removed for recycle	• Reduces price of relacement catalyst with recycled ceramic substrate
	• Catalyst stores less NH_3 on V/Ti or zeolite	• Improves NH_3 control response for start-up/shudown and transient responses
VNX	• Most thoroughly proven SCR catalyst type	• Proven catalyst performance with 10-15 years of operation — Reciprocating engines — Gas turbines — Industrial boilers/heaters — Utility boilers
	• Composite catalyst — At least 80% less vanadia than typical vanadia based SCR catalyst	• Reduces disposal concerns via lower vanadia content of catalyst
ZNX	• High temperature stability	• Operation at temperatures several hundred degrees (F) higher than vanadia/titania catalyst • Catalyst not damaged by thermal upset conditions
	• No heavy metals	• Catalyst disposal concerns are minimized • Catalyst handling concerns are minimized
	• Low NH_3 slip characteristics	• Higher NOx conversion possible with specified NH_3 slip levels • Design of NH_3 mixing system less critical

Engineering and technical support responsive to your needs

Engelhard's engineering and technical support staff provides a full range of services – from project conception, design and installation of an entire SCR system to simply providing SCR catalysts. Our sales/application engineers provide quotations focused on meeting customers' technical and commercial requirements.

Project engineers work closely with customers to address all design issues and have at their disposal sophisticated CAD/CAM and proprietary catalyst design programs. Field service engineers manage all phases of erection and start-up and are always available for questions during operation of an Engelhard SCR system. And, our research and development staff works side-by-side with customer engineering groups to create improved catalyst designs as part of our continuing effort to improve the state-of-the-art in SCR catalyst technology.

The catalyst experts

Engelhard's high quality catalyst products are relied upon in a wide range of industries including chemical, petrochemical, petroleum refining, food, power generation, automotive and mining. Many of our innovative, proprietary technological developments are patent-protected. Engelhard is a leading supplier of:

- **Petroleum catalysts** for the petroleum refining and petrochemical markets, including those used in fluid catalytic cracking (FCC), high-octane reforming, crude upgrading and production of synthetics.
- **Chemical catalysts**, base- and precious-metal proprietary catalysts for the chemical, pharmaceutical, petroleum, edible oils and detergent industries.
- **Environmental catalysts** for the control of air-polluting exhaust emissions from on- and off-road vehicles, power generators, and industrial plants. Engelhard's broad line of environmental catalysts technologies are displayed below.

Put our knowledge and expertise to work controlling your gas turbine, boiler, stationary engine emissions or other industrial exhausts. For more information on what ZNX and VNX catalyst families can do for your operation, please contact us at the location listed on the back of this brochure.

Source		Emissions Controlled and Catalyst Technology			
		NOx	CO	UHC/VOC	Particulate
Automobiles	Gasoline	TWC	TWC,OX	TWC, OX	
	Diesel		OX	OX	DPF
Off Road Vehicles	LPG Gasoline	TWC	TWC, OX	TWC, OX	
	Diesel		OX	OX	DPF
Gas Turbines		SCR	OX	OX	
Boilers		SCR	OX	OX	
Stationary Engines	Spark	SCR,NSCR	NSCR, OX	OX	
	Diesel	SCR	OX	OX	DPF
Process Industries		SCR,NSCR	OX	OX	

Legend

TWC: Three-Way-Conversion Catalyst
OX: Oxidation Catalyst
SCR: Selective Catalytic Reduction Catalyst
NSCR: Non-Selective Catalytic Reduction Catalyst
DPF: Diesel Particulate Filter

ZNX™ SCR Catalysts

Over a decade of research and development has resulted in the formulation of the Engelhard ZNX catalyst. ZNX catalysts use zeolites as the principle catalytic material. The technology for these catalysts is based upon Engelhard's world-leading experience and expertise with zeolite catalysts.

ZNX catalysts feature composite honeycomb configurations which use highly active zeolite catalytic coatings on ceramic structures. ZNX catalysts do not contain heavy metals, eliminating disposal concerns.

Materials of Construction

- ☐ Zeolitic catalyst materials
- ☐ Does not contain heavy metals

Temperature Range

- ☐ 675 to 1,075°F optimum
- ☐ 600 to 1,125°F maximum
- ☐ Under 600°F, NO_x efficiency is reduced with increased NH_3 slip

Performance

- ☐ NH_3 reacts with NO_x to form nitrogen and water
- ☐ NO_x conversion increases with NH_3 injection
- ☐ With 0.9:1.0 NH_3:NO_x ratio 90% NO_x conversion and low NH_3 slip from 600 to 1125°F (Figure 1)
- ☐ At 800°F, NO_x conversion up to nearly 100% can be achieved with low NH_3 slip (Figure 3)

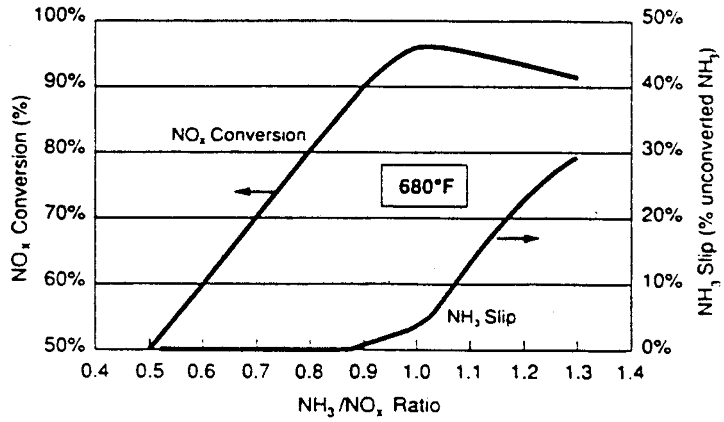


FIGURE 2

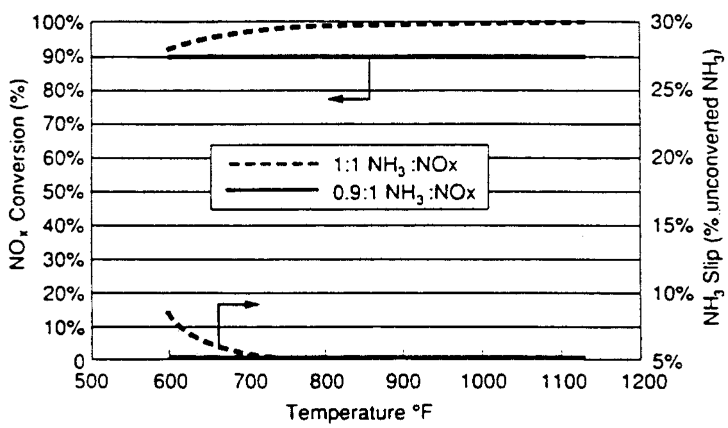


FIGURE 1

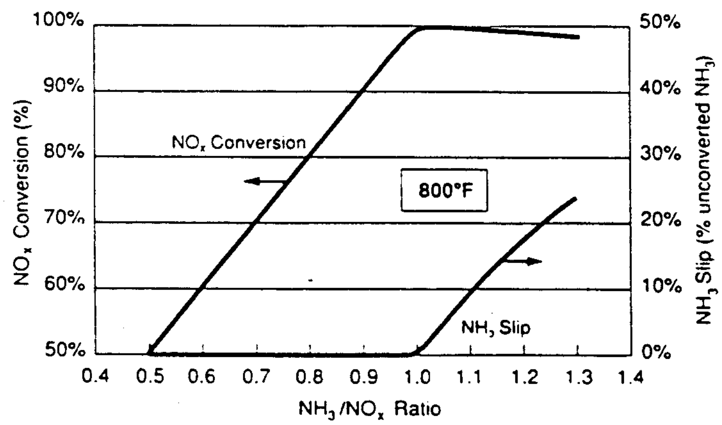


FIGURE 3

For additional information contact:
Engelhard Corporation, Environmental Catalysts Group, 101 Wood Avenue, Iselin, NJ 08830-0770
Telephone: (908) 205-6634 • Fax: (908) 205-6146 • Telex: 219984

ENGELHARD
EXCEPTIONAL TECHNOLOGIES

VNX™ SCR Catalysts

Engelhard's VNX family of SCR catalysts is based upon vanadia/titania as the principle catalytic material. Vanadia/titania SCR catalysts are used in numerous NO_x reduction applications, and have been successfully demonstrated in reciprocating engine, gas turbine and utility/industrial boiler applications.

Engelhard VNX catalysts feature composite honeycomb configurations which use highly active vanadia/titania catalytic coatings on ceramic structures. The honeycomb structures are available in a range of cell sizes to facilitate catalyst designs which meet individual application requirements.

Temperature Range

- ☐ 600 to 750°F optimum
- ☐ 575 to 800°F maximum
- ☐ Under 575°F, NO_x efficiency is reduced with increased NH_3 slip
- ☐ Above 800°F, catalytic efficiency decreases with time

Performance

- ☐ NH_3 reacts with NO_x to form nitrogen and wate
- ☐ NO_x conversion increases with NH_3 injection
- ☐ With 0.9:1.0 NH_3:NO_x ratio 90% NO_x conversio and low NH_3 slip from 575 to 700°F (Figure 1)
- ☐ Higher operating temperatures decrease NH_3 slip; but increase NH_3 consumption (Figures 2 and 3)

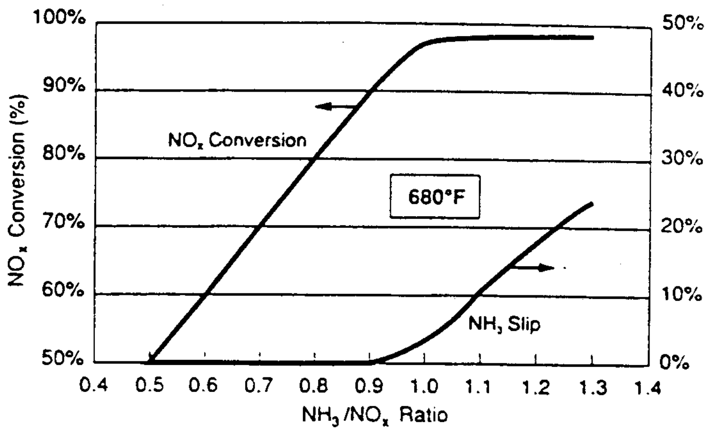


FIGURE 2

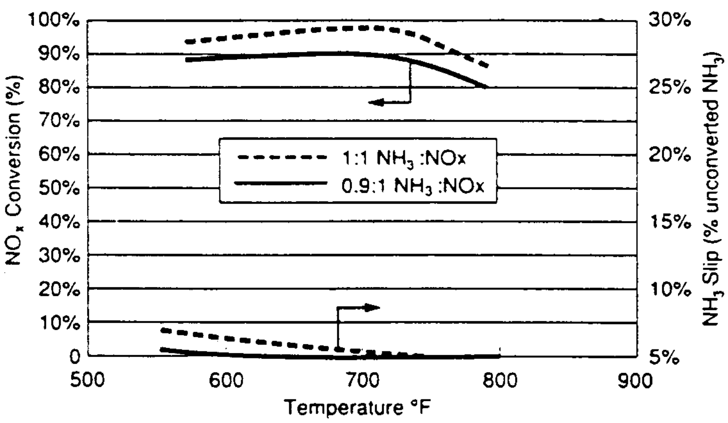


FIGURE 1

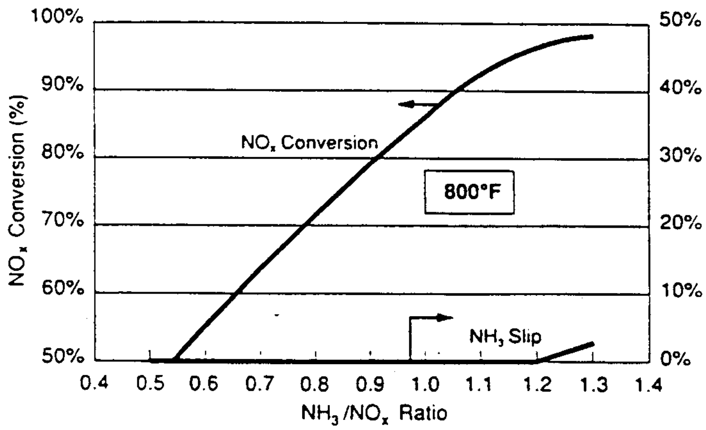


FIGURE 3

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ENGELHARD
EXCEPTIONAL TECHNOLOGIES

CATALYTIC CONTROL OF EMISSIONS FROM STATIONARY SOURCES

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Volatile organic compounds (VOC's), oxides of nitrogen (NO_x), and UV light combine in the atmosphere to form ozone (or photochemical smog) which is harmful to humans, vegetation, and industrial products like rubber. As a result, the U.S. EPA since 1970 through a series of mandates regulated and enforced by each state, have controlled the emissions of VOC's and NO_x from stationary sources. In addition, the states also control emissions of carbon monoxide (CO) in a similar manner. Since the sources of these air pollutants in South America is similar to those of the United States, the methods for controlling these emissions will likely be the same.

The technologies available for the control of these emissions are numerous, including various techniques of adsorption, condensation, incineration, combustion modifications, and catalytic processes. This paper will explain why the catalytic option may be the most cost effective and the most technically superior for certain applications. Catalytic performance and specific case studies will be discussed.

Introduction

The Clean Air Act of 1970 established the National Ambient Air Quality Standards (NAAQS), which clearly defined the requirements for the control of the following criteria air pollutants:

Ozone (atmospheric)
Nitrogen Oxides
Lead
Carbon Monoxide
Sulfur Oxides
PM-10 (particulate matter less than 10 microns)

To reduce the ambient levels of lead, nitrogen oxides, PM-10, and to some degree carbon monoxide, the EPA employed a national strategy of controlling mobile source emissions such as from automobiles. As a result, the control of these emissions have been very effective. What proved to be the most difficult of the criteria pollutants to control has been and continues to be ozone. Because atmospheric ozone is a product formed by the reaction of volatile organic compounds, NO_x, and UV light, the balance of these reactants and their transport in specific regions of the country is critical. For example, localized areas of higher levels of ozone versus areas of lower level have been found to exist in and around the major metropolitan areas.

The areas of high ozone levels have been designated as ozone nonattainment areas. And, the EPA has set specific compliance dates for each state in ozone nonattainment to achieve ozone reductions to meet the target ozone level of 0.12 ppm.

To achieve ozone reductions, the states have developed strategies for controlling emissions of VOC and NO_x from stationary sources. Since Carbon monoxide is also emitted by some of the same sources, simultaneous control of CO is also required in certain locations.. The strategies for reducing these emissions involve specific regulations of equipment that emit these air pollutants. Through a series of permitting procedures (permit to construct and permit to operate) the states have set limits for the emission of these air pollutants which the owner/operators of the equipment must comply or pay a penalty.

VOC Emission Sources

Volatile organic compounds are emitted by equipment used in a variety of manufacturing process industries, including:

- Chemical and Petrochemical
- Metal Coating and Decorating
- Can, Coil, and Film Coating
- Metal and Products Finishing
- Printing and Converting
- Paints and Paint Spray
- Pharmaceuticals

- Resins/Plastics/Rubber
- Wood/Paper/Fiber
- Soil Remediation
- Coffee Roasting
- Bakeries
- Hospital Sterilization
- Electronics

The types of organic emissions can be, for example, ketones, xylenes, toluene, and phenols from automotive paint spray operations. VOC's can include ethanol and acetaldehyde from bread baking, or formaldehyde, phenols, and pthalates from a resin plant. Hospital sterilizers will emit ethylene oxide. Petrochemical plants will emit a variety of aromatic and aliphatic hydrocarbons. Chlorinated hydrocarbons utilized in the manufacture of pharmaceuticals or as solvents in wood furniture manufacturing can be emitted. These are just a few of the examples of the processes where VOC's are emitted.

In order to reduce these VOC emissions, they must be captured in the manufacturing process and vented through a stack. Depending on the nature and value of the VOC, the VOC's are either captured for reuse or sale or they are destroyed. A variety of VOC capturing techniques, including carbon adsorption and condensation can be used. To destroy the VOC's, the most practical and time proven technique is incineration.

The method of incineration involves the oxidation of the VOC's at elevated temperatures, thus converting the VOC's to carbon dioxide (CO_2) and water (H_2O). When the VOC's are oxidized in a combustion chamber or across a burner, the process is referred to as thermal incineration. The typical temperatures required to achieve combustion of the VOC's are in the 1400°F to 1800°F range. The thermal incinerator combustion zone must be sufficiently large to cause the VOC's to be at the elevated temperatures for typically 0.5 to 2.0 seconds. [see Figure 1]

Thermal Recuperative Incineration

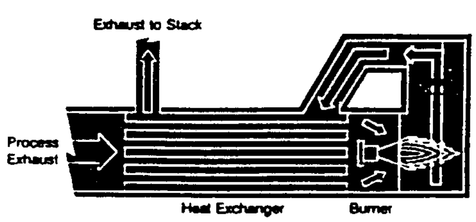


Figure 1

A technology that is similar to thermal incineration, but offering significant economical advantages is catalytic incineration (also referred to as catalytic oxidation). In catalytic oxidation, catalysts are inserted into the combustion chamber to accelerate the oxidation reaction thus speeding up the conversion of the VOC's to CO_2 and H_2O. The reactions will occur in less than 0.05 seconds and at typical temperatures of only 500°F to 700°F. The result is a dramatic savings in fuel usage and smaller, more compact equipment. [see Tables 1 and 2]

Catalytic vs. Thermal

Operating Temperatures for 95% DRE

	Catalytic	Thermal
Formaldehyde	375°F	1400°F
Benzene	425°F	1390°F
Acetone	630°F	1400°F
Methylene Chloride	830°F	1400°F

Table 1

Catalytic vs. Thermal

Residence Time for 95% DRE

	Catalytic	Thermal
Formaldehyde	.03 sec.	1 sec.
Benzene	.03 sec.	1 sec
Acetone	.03 sec.	1 sec.
Methylene Chloride	.06 sec.	1 sec.

Table 2

How Does Catalytic Oxidation of VOC's Work?

A catalytic incinerator comprises the following basic parts:

Blower
Burner
Combustion Chamber
VOC Catalyst
Temperature Controller

The blower brings the exhaust fumes into the catalytic incinerator, where the burner preheats the gas to the operating temperature. Thermocouples monitor the temperature, and a temperature controller maintains the temperature. The preheated gas is then passed across the VOC catalyst, where the VOC's are combusted. Since the oxidation of the VOC's will produce additional heat (exotherm), The controller also shuts down the unit if an over-temperature condition is observed. In most equipment, the extra heat, which is free, is passed through a heat exchanger which utilizes the excess heat to heat the incoming fumes. The result is additional fuel savings. [see Figure 2]

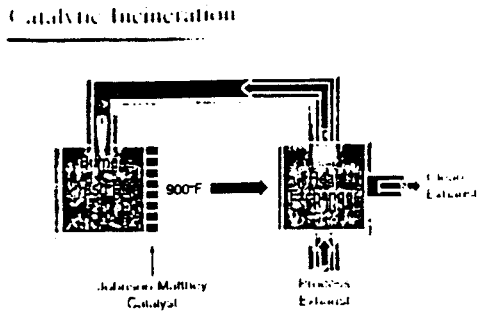


Figure 2

The key component in any catalytic incinerator is the catalyst. The catalyst is composed of PGM (platinum group metals) coated onto a high surface area alumina coating which is adhered to a substrate support structure. The substrate can be metal monolith (honeycomb), ceramic monolith (honeycomb), or ceramic pellets. The precious metals are applied in such a manner as to provide as many active reaction sites as possible in a stable configuration to insure high performance and long life. [see Figure 3]

Catalyst Composition Schematic

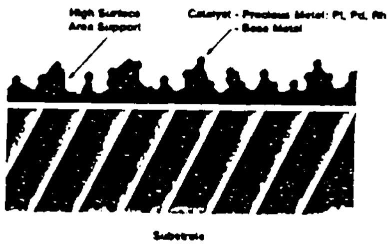


Figure 3

Catalyst Technology

To properly destroy or convert the air pollutants across the catalyst, the catalyst must be designed to meet the specific needs of the application. The temperature at which combustion of the VOC's take place across the catalyst is called the light off temperature. [Figure 4], is a generic light-off curve showing how a VOC is converted across a catalyst.

Catalyst Design

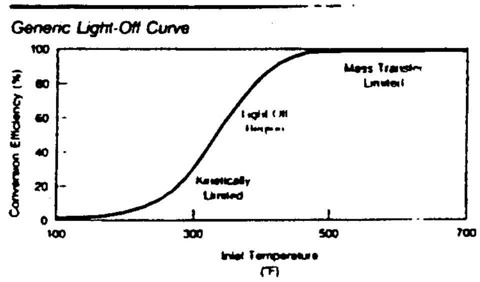


Figure 4

As the gas stream is heated up, the first point at which conversion of the VOC's take place is referred to as the kinetic limited region. As the temperature is further increased, the VOC begins to convert in the light off region. As the conversion is maximized at even higher temperatures, the conversion reaches the mass transfer limited region. This last region is where the catalyst is designed to operate.

[Figure 5] shows how formaldehyde, benzene, acetone, and methylene chloride lights off across VOC Oxidation catalyst.

Catalyst Design

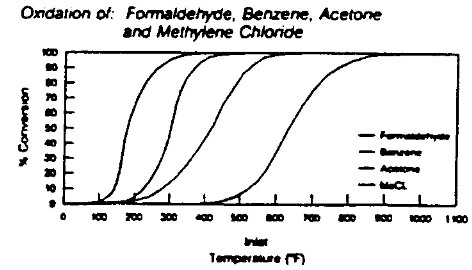


Figure 5

When designing the catalyst, several variables must be considered. These fairly simple but important factors are shown in [Table 3].

Catalyst Design Factors

- Application/Process
- Exhaust Gas = Composition (VOCs, O_2, H_2O)
  Flowrate
  Temperature
  Pressure
- Catalyst Contaminants
- Required Destruction Efficiency
- Pressure Drop Constraints
- Maintenance Interval
- Durability

Table 3

These factors coupled with a catalyst supplier's field experience will allow the catalyst supplier to accurately design the catalytic system to meet guaranteed performance.

Since by definition, a catalyst speeds up a reaction but remains unchanged itself, the catalyst should last forever. Theoretically this may be true, however in actual practice, harmful contaminants in the exhaust gas stream will deactivate the catalyst over time. Also, if the catalyst is subjected to an over-temperature condition, it's life will be shortened. Therefore, it is important to understand the type of catalyst contaminants, modes of catalyst failure, techniques to evaluate the catalyst, how to rejuvenate the catalyst, and how to prevent deactivation of the catalyst.

A. Catalyst contaminants - Heavy and base metals can deactivate the catalyst. These include: lead, nickel, iron, arsenic, phosphorous, silicon, chrome, sulfur, zinc, tin, antimony, copper, and mercury. High molecular weight organic material, dust and particulates can mask the catalyst, but these can usually be washed or physically removed from the catalyst.

B. Modes of catalyst deactivation - Catalyst can be irreversibly deactivated or poisoned when it reacts with a contaminant to form a new compound.

When the catalyst is overheated, it becomes irreversibly thermally deactivated. The result is loss in microscopic catalyst surface area or sintering of the precious metals.

Certain contaminants like silicone, for example, will react over the catalyst to form CO_2, H_2O, and SiO_2 (silicon dioxide). The CO_2 and H_2O are harmless, but the SiO_2 will mask the catalyst, covering the reaction sites. Masked catalyst can usually be washed to recover catalyst activity.

When debris or particulate matter accumulate on the catalyst, this is referred to as plugging. Plugging can be easily alleviated through air blow off, vacuuming, or other means of physical cleaning.

C Catalyst Evaluation - To determine the type and degree of catalyst deactivation, a complement of analytical techniques are used, which are summarized as follows:

VOC Solvent Rig - Determine VOC light-off characteristics

SCAT (Simulated Catalyst Activity Test) - Determines catalytic activity under controlled conditions

XRD (X-Ray Diffraction) - Measures crystalline phase of the catalyst support media

BET - Measures the surface area of the catalyst

XRF (X-Ray Fluorescence) - Provides quantitative elemental analysis of catalyst and contaminant composition

SEM (Scanning Electron Microscope) - Provides high magnification optical analysis

D. Catalyst Rejuvenation - Contaminated or deactivated catalyst can be reactivated through the following cleaning methods:

Thermal Cleaning - Elevated temperatures can oxidize residual organic materials adhered to the catalyst

Physical Cleaning - Air blow off or vacuuming to remove dust and debris

Chemical/Water Washing - Mild caustic or mild acid solutions or deionized water can remove masking agents and reduce poison concentrations on the catalyst [see Figure 6]

Chemical Washing

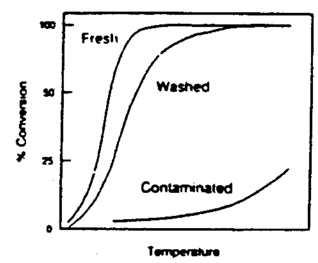


Figure 6

E. Monitoring Catalyst Performance - To ensure high performance of the catalytic system, temperatures before and after the catalyst must be monitored. This will determine the heat rise (exotherm) across the catalyst as an indicator of the amount of VOC entering the system.

To determine the level of physical plugging of the catalyst, pressure drop across the catalyst must be monitored. This will indicate when physical cleaning is needed.

If performance of the catalyst observed (as shown by a small exotherm relative to the VOC levels), then catalyst evaluation by the catalyst supplier must be performed. This evaluation will determine the amount and type of cleaning required. As a precautionary measure, catalyst cores or coupons can be placed on the catalyst bed and removed periodically for lab evaluation.

Proven VOC Catalyst Applications

Catalyst have been applied successfully to destroying VOC emissions from a variety of sources for over 25 years and continues to play a major role in reducing VOC and air toxic emissions today. VOC catalysts have been demonstrated to provide high destruction efficiencies and long life. To show this, actual case histories of applications such as: printing/converting, can coating, and chemical manufacturing are shown in [Tables 4, 5, and 6].

Case 1: Converting/Rotogravure

- Air Flow: 8170 SCFM
- VOC's: Butyl Acetate
  Xylene
  Propanol
  Propyl Acetate
- Inlet Temperature: 650° F
- Design Efficiency: 95% Conversion
- Start-Up Date: 5/87
- Status: Achieving greater than design conversion.

Table 4

Case 2: Can Coating

- Air Flow: 6000 SCFM
- VOC's: Cellosolve
  Butanol
  Xylene
- Inlet Temperature: 600° F
- Design Efficiency: 96% Conversion
- Start-Up Date: 4/87
- Status: Catalyst replaced after five years of successful service.

Table 5

Case 3: Chemical Manufacturing

- Air Flow: 37,000 SCFM
- VOC's: Phenol
  Acetone
  Cumene
- Inlet Temperature: 650° F
- Design Efficiency: 95% Conversion
- Start-Up Date: 7/87
- Status: Achieving greater than design efficiency.

Table 6

These applications are typical of similar applications around the world. The processes and emissions are similar.

NO_x and CO Emission Sources

NO_x comprising principally NO (nitric oxide) and NO_2 (nitrogen dioxide) is emitted by combustion sources such as IC engines, gas turbines, utility and industrial boilers, chemical and process heaters, nitric acid manufacturing plants, some chemical manufacturing plants, and incinerators. NO_x is formed by the oxidation of ambient nitrogen (N_2) or by the oxidation of nitrogen in the fuel supply or chemical process.

Carbon monoxide (CO) is often emitted by the same sources that emit NO_x. CO is also formed by the incomplete combustion of VOC's across a burner in thermal incinerators. CO is formed from the incomplete combustion of the fuel or hydrocarbon or from cold spots in the combustion zone of IC engines. When gas turbines are equipped with water or steam injection (to lower the NO_x emissions), the CO emissions are increased dramatically.

Both NO_x and CO are criteria pollutants which the U.S. EPA has mandated must be controlled. Both pollutants cause respiratory problems.

Catalytic Control of CO and NO_x Emissions

Figure 7 shows a family of catalyst products used to control these CO and NOx emision sources.

Families of Catalyst Products

NOx and CO Emissions

Applications	Catalyst Type	Active Component	Number of U.S. Installations
Nitric Acid Tail Gas	NOx Abatement	Pt, Rh, Pd, Al_2O_3	Over 200
Rich Burn IC Engines	3 Way NSCR	Pt, Rh, Pd, Al_2O_3, Ce	Over 2,000
Gas Turbine			
Boilers	SCR	W, V, Ti, Si	Over 200
Lean Burn Engines	CO Oxidation	Pt, Pd	Over 50

Figure 7

Although high temperature thermal processes can convert CO to CO_2, these are not as economical as catalytic processes. The most acceptable and proven solution for controlling CO emissions is oxidation catalyst. Oxidation catalysts are similar in composition and function as VOC catalyst. PGM (platinum group metals) are applied to an oxide support that is adhered to a substrate (either metallic or ceramic). Polluted exhaust gases from the sources indicated above will generally be in the 500°F to 1000°F range. The oxidation of CO to CO_2 on oxidation catalyst can be achieved very readily at these temperatures.

The approach to NO_x emissions is either not to emit them in the first place or to control them catalytically once they are emitted. Since it's virtually impossible for combustion sources to emit zero NO_x emissions, there are a variety of methods for minimizing NO_x emissions. These include: low NO_x burners, clean-burn engine modifications, water or steam injection for gas turbines. Although these combustion modification techniques can be effective, they are limited in their ability to reduce the emissions of NO_x to very low levels. Thus, the method of choice for providing the lowest NO_x emissions is catalytic.

The type of catalysts used to control the NO_x will depend on the type of equipment that is emitting the NO_x. NO_x that is emitted by nitric acid plants, for example, is controlled with NO_x Abatement catalyst. NO_x that is emitted by lean-burning (exhaust containing more than 1% O_2) sources such as gas turbines, thermal incinerators, chemical processes, boilers, and IC engines are controlled with SCR (selective catalytic reduction) catalyst. NO_x emissions from IC Engines which are rich-burning (exhaust containing less than 1% O_2) will be controlled with NSCR (non-selective catalytic reduction), also known as 3-Way catalyst.

NO_x Abatement Catalyst for Nitric Acid Plants

In the manufacture of nitric acid, excess amounts of NO_x is emitted by the process. To convert these NO_x emissions, NO_x Abatement catalyst is used. Nitric acid tail gas exhaust usually contains about 1 to 2 % O_2, which must be removed prior to removal of the NO_x. Using a PGM (platinum group metal) catalyst, a reductant such as purge gas (containing mostly hydrogen) or natural gas (methane) is introduced into the exhaust stream to first reduce the O_2 then the NO_x at normal exhaust temperatures (approximately 700°F to 900°F). The reductants are generally available on site as a by-product of another process or they may be purchased. Because of the extremely high exotherm caused by the O_2 reaction, NO_x Abatement catalyst is not recommended for gas streams containing much more than 2% O_2 content. For exhaust streams with high O_2 content, SCR catalyst is recommended.

This technology is proven in the field with several hundred installations in service.

NSCR or 3-Way Catalyst Technology

3-Way catalyst for stationary engines operate in the same manner as automotive catalyst. The active component are PGM's (platinum group metals). The catalyst can convert more than 98% of the NO_x and CO, and most of the HC (hydrocarbon) emissions simultaneously.

[Table 7 and Figure 8] show the simultaneous reactions that occur over the catalyst.

NSCR (3-Way)
CATALYTIC REACTIONS

$CO + 1/2\,O_2 \longrightarrow CO_2$

$H_2 + 1/2\,O_2 \longrightarrow H_2O$

$HC + O_2 \longrightarrow CO_2 + H_2O$

$NO_x + CO \longrightarrow CO_2 + N_2$

$HC + H_2O \longrightarrow H_2 + CO_2$

$NO_x + H_2 \longrightarrow H_2O + N_2$

Table 7

Typical 3-Way Catalyst Performance

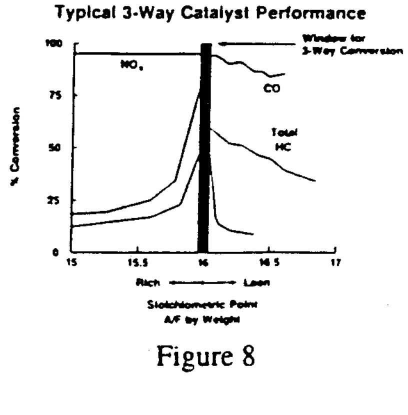


Figure 8

These reactions can only occur in this manner when the oxygen content of the exhaust is controlled to less than 1% (typically about 0.5%). This is easily accomplished by attaching an air/fuel ratio controller to the engine to regulate either the air or the fuel [see Figure 9].

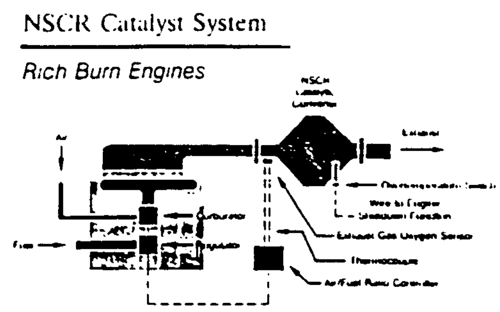


Figure 9

[Figure 10] shows an actual field installation of a gas engine equipped with 3-Way catalyst.

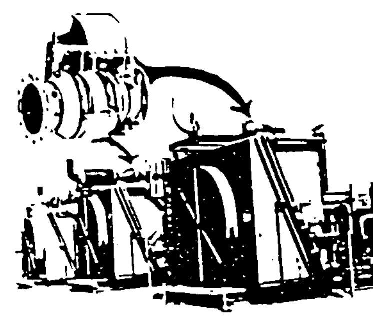


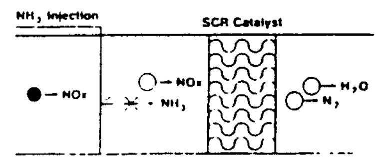
Figure 10

NSCR or 3-Way catalyst technology is proven in the field with over 2,000 installation in service today.

SCR Catalyst

SCR catalysts are used to reduce NO_x from exhaust streams containing a high amount of O_2 (gas streams containing more than 1% O_2). As the name implies, NO_x is selectively reduced by reacting it with a reductant, chiefly ammonia (NH_3) across a catalyst see [Figure 11]. The NH_3 reduces the NO and NO_2 to harmless nitrogen and water.

Selective Catalytic Reduction of NOx



Fundamental Reactions:

$4NO + 4NH_3 + O_2 \longrightarrow 4N_2 + 6H_2O$

$2NO_2 + 4NH_3 + O_2 \longrightarrow 3N_2 + 6H_2O$

Figure 11

The SCR catalyst is comprised of non-precious metals or base metals. These include vanadium, tungsten, titania, silica, and zeolites. These materials are coated onto a substrate support structure of metal honeycomb or ceramic honeycomb. The majority of the SCR catalysts in use today operate in the 600°F to 800°F range. Conversions of over 95% can be achieved. Ammonia is typically used at a 1:1 mole (or volume) ratio. Some ammonia will pass through the process as unreacted ammonia, or "ammonia slip". The slip ammonia is usually limited to less than 20 ppm and some cases to less than 5 ppm.

SCR catalyst technology is a proven technology with over 400 field installations in service today.

Conclusions:

- Ozone - A complex chemical reaction of VOC's and NOx (from industrial and mobile sources), in the presesnce of sunlight, continues to adversely affect public health and welfare.

- Controlling ozone must be a government and industry cooperative.

- National & local strategies must be employed to:
  - identify & measure criteria air pollutants
  - establish target ozone limits
  - identify effective control technologies

- Catalytic control technologies based on precious/ base metal chemistry have proven to be an available, reliable and cost-effective emissions control.

- Catalytic control technologies provide for:
  - excellent conversion efficiencies and longlife
  - lower reaction temperatures
  - dramatic fuel savings
  - lower material installation costs
  - reduced levels of pollutants.

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ENVIRONMENTAL PRODUCTS
CATALYTIC SYSTEMS DIVISION

ATTACHMENT 3

17.0 COMPLIANCE CERTIFICATION

The applicable requirements, which are the basis of this compliance certification, are identified in Section 8 and the methods used to determine compliance, including monitoring, recordkeeping and reporting requirements and test methods, are listed in Section 16 of this permit application. There are currently no enhanced monitoring or compliance certification requirements applicable to the Gila Bend Power Generation Station.

Annual compliance certification will be send postmarked no later than 90 days after the permit issuance date during the permit term.

I certify under penalty of law that, to the best of my knowledge and belief, my facility is in continuous compliance with all applicable federal, state, and Maricopa County requirements. I also certify that I will ensure that my facility continues to comply with all requirements that apply.

I further certify under penalty of law that the enclosed documents and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on information and belief formed after my reasonable inquiry, the statements and information in the documents submitted are true, accurate and complete.

Responsible Official: Mr. Robert A. Innamorati

Signature: [signature] Date: 11-7-00

Title: Gila Bend Power Partners, L.L.C.

By: PowerDevelopment Gila Bend, L.P., Member

By: PowerDevelopment Enterprises, L.P., G.P.

By: Robert A. Innamorati & Co., Inc., G.P.

By: [signature]

Its: President

Certification of Truth, Accuracy and Completeness

I certify under penalty of law that the enclosed documents and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on information and belief formed after my reasonable inquiry, the statements and information in the documents submitted are true, accurate and complete.

Responsible Official: Mr. Robert A. Innamorati

Signature: [signature]

Title: Gila Bend Power Partners, L.L.C.

By: PowerDevelopment Gila Bend, L.P., Member

By: PowerDevelopment Enterprises, L.P., G.P.

By: Robert A. Innamorati & Co., Inc., G.P.

By: [signature]

Its: President

Date: 11-9-00

ATTACHMENT 4

Natural Gas

Emission Factor Report for Formaldehyde with No Control

07-Nov-00

ID	Manufacturer	Model	Rating (MW)	Load (%)	EF (lb/MMBtu)	Count of Runs	ND Count	Control Device
313.1.1	General Electric	Frame 3	7.7	100	2.60E-04	3	0	None
313.1.2	General Electric	Frame 3	7.7	50	4.19E-04	3	0	None
318.1.1	General Electric	LM 2500	23	100	7.09E-04	3	0	None
28	General Electric	LM 2500	24	100	8.95E-05	3	0	None
315.2	General Electric	LM1500	10.6	25	2.54E-02	3	0	None
315.1	General Electric	LM1500	10.6	100	4.19E-03	3	0	None
16	General Electric	LM2500-P	67.4	33	2.00E-04	3	0	None

ID	Manufacturer	Model	Rating (MW)	Load (%)	EF (lb/MMBtu)	Count of Runs	ND Count	Control Device
2	General Electric	LM5000	23.33	100	< 6.19E-05	3	2	None
12.1	General Electric	MS6000	44	100	1.08E-04	3	0	None
26	General Electric	MS7001E	87.83	100	6.70E-06	3	0	None
6.2	General Electric	NS5000P	46.3	100	2.94E-04	3	0	None
316.1.2	Rolls Royce	Avon	10.7	25	1.49E-02	3	0	None
316.1.1	Rolls Royce	Avon	10.7	100	5.61E-03	3	0	None
316.2.1	Rolls Royce	Spey	12.2	100	1.84E-05	3	0	None
316.2.2	Rolls Royce	Spey	12.2	25	1.34E-02	3	0	None
317.1	Solar	Mars	10.9	100	2.21E-06	3	0	None

ID	Manufacturer	Model	Rating (MW)	Load (%)	EF (lb/MMBtu)	Count of Runs	ND Count	Control Device
317.2	Solar	Mars	10.9	25	2.48E-03	3	0	None
313.2.1	Solar	T12000	9.4	100	< 1.55E-05	3	1	None
313.2.2	Solar	T12000	9.4	25	9.43E-03	3	0	None

Avg EF =	**4.08E-03**
Count =	**19**
Std Dev =	**6.97E-03**
RSD(%) =	**170.7%**

APPENDIX TABLE A-2.1
MAXIMUM HAZARDOUS AIR POLLUTANT (HAP) CALCULATIONS

GILA BEND POWER GENERATION PROJECT
GILA BEND, ARIZONA

				CT Generators (Total)	Duct Burners (Total)	Auxiliary Boiler	Diesel Emergency Generator	Diesel Fire Pump	Facility Total HAPs Emissions
Annual Operation				8,760 hrs/yr	8,760 hrs/yr	8,760 hrs/yr	500 hrs/yr		
Fuel Type					Natural Gas				--
Heat Input (HHV)				1,671 MMBtu/hr	356 MMBtu/hr	26 MMBtu/hr	5.6 MMBtu/hr	3.0 MMBtu/hr	
Number of Units				3	3	1	1	1	
HAPs Emitted	Emission Factors from Natural Gas-Fired Turbines (lb/MMBtu)	Emission Factors from Natural Gas Combustion (lb/MMBtu)	Diesel Engines Uncontrolled Emission Factors (lb/MMBtu)	Annual Emissions (TPY)	Annual Emissions (TPY)	Annual Emissions (TPY)	Annual Emissions (TPY)	Annual Emissions (TPY)	Annual Emissions (TPY)
1,3-Butadiene	4.30E-07	--	3.91E-05	0.009	--	--	trace	trace	0.009
2-Methylnaphthalene	--	2.35E-08	--	--	Trace	Trace	--	--	0.000
Acetaldehyde	4.00E-05	--	7.67E-04	0.878	--	--	0.001	trace	0.879
Acrolein	6.40E-06	--	9.25E-05	0.141	--	--	trace	trace	0.141
Benzene	1.20E-05	2.06E-06	9.33E-04	0.263	0.010	Trace	0.001	trace	0.274
Dichlorobenzene	--	1.18E-06	--	--	0.006	Trace	--	--	0.006
Ethylbenzene	3.20E-05	--	--	0.703	--	--	--	--	0.703
Fluoranthene	--	2.94E-09	--	--	Trace	Trace	--	--	0.000
Fluorene	--	2.75E-09	--	--	Trace	Trace	--	--	0.000
Formaldehyde*	6.70E-06	7.35E-05	1.18E-03	0.147	0.344	0.008	0.002	trace	0.501
Hexane	--	1.76E-03	--	--	8.255	0.201	--	--	8.456
Naphthalene	1.30E-06	5.98E-07	8.48E-05	0.029	0.003	Trace	trace	trace	0.031
PAHs	2.20E-06	--	--	0.048	--	--	--	--	0.048
Phenanathrene	--	1.67E-08	--	--	Trace	Trace	--	--	0.000
Propylene	--	--	2.58E-03	--	--	--	0.004	0.002	0.006
Propylene Oxide	2.90E-05	--	--	0.637	--	--	--	--	0.637
Pyrene	--	4.90E-09	--	--	Trace	Trace	--	--	0.000
Toluene	1.30E-04	3.33E-06	4.09E-04	2.854	0.016	Trace	0.001	trace	2.871
TMA	--	--	--	--	--	--	--	--	0.000
Xylenes	6.40E-05	--	2.85E-04	1.405	--	--	trace	trace	1.405
Total				7.115	8.632	0.209	0.008	0.002	15.967

Note:
(1) Emissions factors obtained from the 7/98 AP-42 for Natural Gas Combustion (External Combustion Sources)
(2) Only the significant emission factors were taken from the list of Speciated Organic Compounds.
(3) Emission factor is based on AP-42 Table 3.1-3, Emission Factors for Hazardous Air Pollutants From Natural Gas-Fired Stationary Gas Turbines. 4/2000
* Emission factor obtained from the AP- 42 Emission Factor Database

Calculation Equation:

Annual Emissions (tpy):
(Heat Input)(Emission Factor)(Hours of Operation)(No. of Units)(ton/2,000 lb)

D

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

1400 East Southern Avenue, Suite 620
Tempe, AZ 85282-5679
Phone: 480.345.0888
Fax: 480.730.0508

December 1, 2000

VIA E-Mail

Mr. Thom Shelton
Development Manager
INDUSTRIAL POWER TECHNOLOGY
2227 Capricorn Way, Suite 101
Santa Rosa, CA 95407

Re: Re-analysis of Groundwater Impacts From Gila Bend Power Project

Dear Mr. Shelton:

As requested by the Arizona Corporation Commission (ACC) Power Line Siting Committee during our last meeting, Hargis + Associates, Inc. has re-analyzed the groundwater impacts for the Gila Bend Power Project. During the ACC meeting on November 15, 2000, the committee requested that Gila Bend Power Partners evaluate the impacts of groundwater use for the proposed facility and consider the groundwater use for the proposed Panda Gila River Project, the Town of Gila Bend and agricultural uses. Based on this request Hargis + Associates, Inc. in conjunction with the Gila Bend Power Partners has collected groundwater use information for the other users. Information on projected groundwater use for the Panda Gila River Project was provided from the documents submitted to the ACC. The groundwater use data for the Town of Gila Bend and the Paloma Ranch were provided by those entities. These data were used to evaluate the impact of these water uses on the aquifer in the Citrus Valley portion of the Gila Bend Basin. The results of that analysis are included in the attached document. This information will be supplied to the Arizona Department of Water Resources for review and comment, and will be modified per their comments for presentation at the next ACC hearing.

If you have any questions regarding this report, please call me at (480) 345-0888.

Sincerely,

HARGIS + ASSOCIATES, INC.

Michael R. Long, RG
Principal Hydrogeologist/Director of Arizona Operations

MRL:jla

Ltr to Thom.doc

Other Offices:
Tucson, AZ
San Diego, CA

DRAFT 12/1/00

GROUNDWATER ASSESSMENT

The maximum water demand for the Gila Bend Power Project is expected to be approximately 7,000 acre-feet per year (af/yr). This groundwater assessment was conducted to evaluate the impacts of withdrawing 7,000 af/yr of groundwater for 50 years from the Project Area to meet water demand. In addition, at the request of the ADWR, a scenario was evaluated that included groundwater withdrawals of 7,000 af/yr from the Gila Bend Power Project and 10,000 af/yr from the Panda Gila River Project Area. Finally, a worst case scenario was evaluated that included groundwater withdrawals of 7,000 af/yr from the Gila Bend Power Project, 10,000 af/yr from the Panda Gila River Project Area, 1,400 af/yr for the Town of Gila Bend municipal supply, and 18,200 af/yr for agricultural use on the Paloma Ranch.

WATER USE ESTIMATES

The estimated water use figures for the worst-case scenario were developed from data collected from the Town of Gila Bend using population and a per capita use rate, and from data provided by the Paloma Ranch regarding historical water use in the southern portion of the Gila Bend Basin. The information provided is as follows:

Town of Gila Bend

The Town of Gila Bend owns five wells. They are located as follows and are used for the following purposes:

Irrigation/backup municipal supply located in C(5-4) 31
Fire protection well located in C(5-4) 32
Municipal Supply three wells in C(6-4) 20

The current Town population is 1,700 people. Rounding this to 2,000 people and assuming a water demand of 150 gallons per day per capita equals a use of 300,000 gallons per day or approximately one acre-foot per day. This equals 365 acre-feet per year. To be conservative it is assumed that the Town will use 500 af/yr for municipal supply, 100 af/yr for urban agricultural uses and 100 af/yr for fire protection.. The 500 af/yr of municipal supply pumping is occurs in C(6-4) 20. This is equal to 310 gallons per minute continuously at this location. The 100 af/yr for fire protection occurs in C(5-4) 32 and 100 af/yr for urban irrigation occurs in C(5-4) 31. This is equal to 65 gallons per minute continuously from each of these sections.

Based on instructions from the Gila Bend Power Partners, the annual pumping for Gila Bend was assumed to increase in the future by 100 percent based on anticipated growth. The simulations included pumping for municipal use by withdrawing groundwater at a rate of 1,400 af/yr from the five Gila Bend wells for the 50-year simulation.

Paloma Ranch

The company that owns Paloma Ranch reported that it uses 130,000 af/yr of water per year for agriculture in the Basin. Thirty percent or 39,000 acre-feet, of the total use is surface water from the Gila River below Gillespie Dam. Approximately 91,000 af/yr is pumped from the groundwater reservoir. It is reported that 80 percent (72,800 acre-feet) of the groundwater is pumped in the Gila River basin between Gillespie Dam and the Gila Bend Area. Twenty percent (18,200 acre-feet) of the groundwater is pumped from the "Citrus Valley" area (Gila Bend west to Painted Rock Mountains). Paloma Ranch reports that this water is withdrawn from 20 active wells in the Citrus Valley area. The Paloma Ranch groundwater pumping in the Citrus Valley Area was simulated by withdrawing 910 af/yr at each of the twenty of the Paloma Ranch wells located in the Citrus Valley Area. This is equal to a continuous pumping rate at each well of 565 gallons per minute.

METHODOLOGY

Hydrogeologic data were collected to define regional and Project Area conditions (Sections 2.0 and 3.0). Examination of these data allowed the development of a conceptual hydrogeologic model for the region. The impact created by groundwater withdrawals at the Project Area was determined by simulating various pumping scenarios within the conceptual model using the groundwater model Winflow. Winflow utilizes the Theis non-equilibrium equation to determine drawdown created by pumping wells using selected aquifer hydraulic properties for selected periods of time. The Winflow analysis conducted for this evaluation did not include estimates of recharge from the Gila River or agricultural return flow.

Winflow input parameters include aquifer thickness, saturated thickness, hydraulic conductivity (K), specific yield (SY), and anticipated water demand. Review of the basic data indicates that alluvial materials are at least 1,100 feet thick in the Project Area. Wells located in the Project Area range from approximately 200 to 1,100 feet in total depth. Static depth to water in the Project Area is approximately 50 to 60 feet bls. Based on these data, a conservatively low saturated thickness of approximately 1,000 feet was assumed.

Aquifer test data were used to determine K for aquifer materials underlying the Project Area. However, due to the short duration of the aquifer tests available for the area, SY values were estimated using driller's logs and elements from the ADWR Drillers Log Program developed by ADWR (Long and Erb, 1980). One of the components of the ADWR Drillers Log Program is a standardized method of analyzing lithologic logs written by drillers so that specific yield, hydraulic conductivity could be estimated in wells where no aquifer test data exists.

The driller's reports received at ADWR contain lithologic logs prepared by drillers during the drilling of wells. Descriptions used by drillers in the preparation of these logs were standardized and values were assigned for the description of each type of aquifer material. Estimates for SY were calculated by multiplying the values assigned to each aquifer material type by the thickness of that material in the well. Then, the sum of the values for each type of aquifer material, from the water table to the total depth of the well, was divided by the total depth of the well to arrive at a weighted average for specific yield for each well.

Ranges of SY for the basin fill units were estimated based on well logs for the Project Area. The estimated SY based on the driller logs and using the method developed by the ADWR ranges from approximately .05 to 0.22 and averaged 0.14 (dimensionless). Based on these parameters; four pumping scenarios were simulated using conservative estimates of SY of 0.05 and 0.12. The four scenarios are:

1. Pumping 7,000 af/yr for the Gila Bend Power Project and 10,000 af/yr for the Panda Gila River Project for 50 years using K of 20 feet per day (ft/d) and SY of 0.12.

2. Pumping 7,000 af/yr for the Gila Bend Power Project and 10,000 af/yr for the Panda Gila River Project for 50 years using K of 20 ft/d and SY of 0.05.

3. Pumping 7,000 af/yr for the Gila Bend Power Project, 10,000 af/yr for the Panda Gila River Project, 1,400 af/yr for the Town of Gila Bend 18,200 af/yr for the Paloma Ranch for 50 years using a K of 20 ft/d and SY of 0.12.

4. Pumping 7,000 af/yr for the Gila Bend Power Project, 10,000 af/yr for the Panda Gila River Project, 1,400 af/yr for the Town of Gila Bend 18,200 af/yr for the Paloma Ranch for 50 years using a K of 20 ft/d and SY of 0.05.

RESULTS

The results of the simulations for the four scenarios indicate that the impacts created by groundwater withdrawals in the Project Area will not create excessive additional drawdown at or near Project Area boundaries. Figures depicting the amount of drawdown based on the four above-referenced scenarios have been prepared (Figures 1 through 4).

The projected drawdown after 50 years for Scenario 1 (GBPP and PGRP pumping with a K=20 ft/d and SY = 0.12) at the Gila Bend Power Project Area wells is approximately than 60 feet and approximately 80 feet at the Panda Gila River Project Site. The analysis indicates that the maximum projected drawdown caused by pumping at the GBPP and PGRP sites will be about 1.2 to 1.6 feet per year (Figure 1).

The projected drawdown after 50 years for Scenario 2 (GBPP and PGRP pumping with a K=20 ft/d and SY = 0.05) at the Gila Bend Power Project Area wells is approximately 70 feet and approximately 90 feet at the Panda Gila River Project Site. The analysis indicates that the maximum projected drawdown caused by pumping at the GBPP and PGRP sites will be about 1.4 to 1.8 feet per year (Figure 2)

The projected drawdown for Scenario 3 after 50 years (GBPP, PGRP, Gila Bend and Paloma Ranch pumping with a K=20 ft/d and SY = 0.12) at the Gila Bend Power Project Area wells is approximately 100 feet and approximately 110 feet at the Panda Gila River Project Site. The analysis indicates that the maximum projected drawdown caused by pumping at the GBPP and PGRP sites will be 2 to 2.2 feet per year (Figure 3).

As expected, the maximum amount of drawdown was projected for the 50-year pumping scenario and aquifer parameters according to Scenario 4 (GBPP, PGRP, Gila Bend and Paloma Ranch pumping with a K=20 ft/d and SY = 0.05). Even under this very conservative condition, drawdown at the Gila Bend Power Project Area wells after 50 years of pumping is approximately 110 feet and drawdown at the Panda Gila River Project is approximately 120 feet. The maximum projected drawdown in the area for Scenario 4 ranges from approximately 2.2 to 2.4 feet per year (Figure 4).

CONCLUSIONS

A review of the data collected for this investigation, and the results of the impact analysis, indicates that pumping groundwater to serve as a source of water supply to the Gila Bend Power Project will result in a projected 60 to 110 feet of drawdown at the Site over 50 years. Evaluation of a reasonable worst case scenario that included an increase in groundwater withdrawals due to the construction of the Panda Gila River Project and municipal growth in the Town of Gila Bend, indicates that drawdown at the site will likely range from approximately 1.2 to 2.4 feet per year.

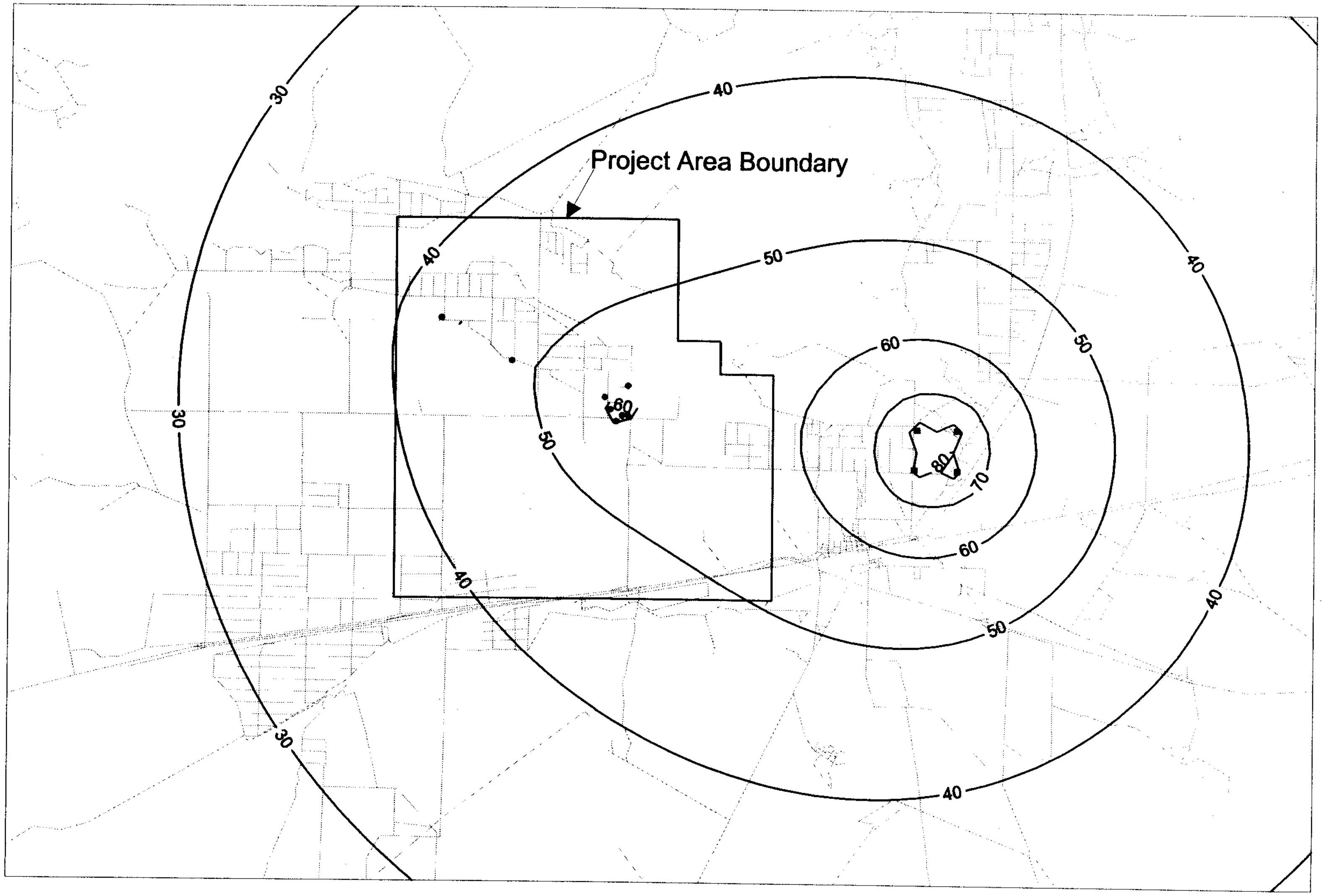


FIGURE 1 . PROJECTED DRAWDOWN FOR SCENARIO 1

GROUNDWATER PRODUCTION WELLS

- ● Gila Bend Power Project
- ■ Project Panda

80 — Contour line of equal drawdown in feet

N

0 — 1 MILE

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

GBN3

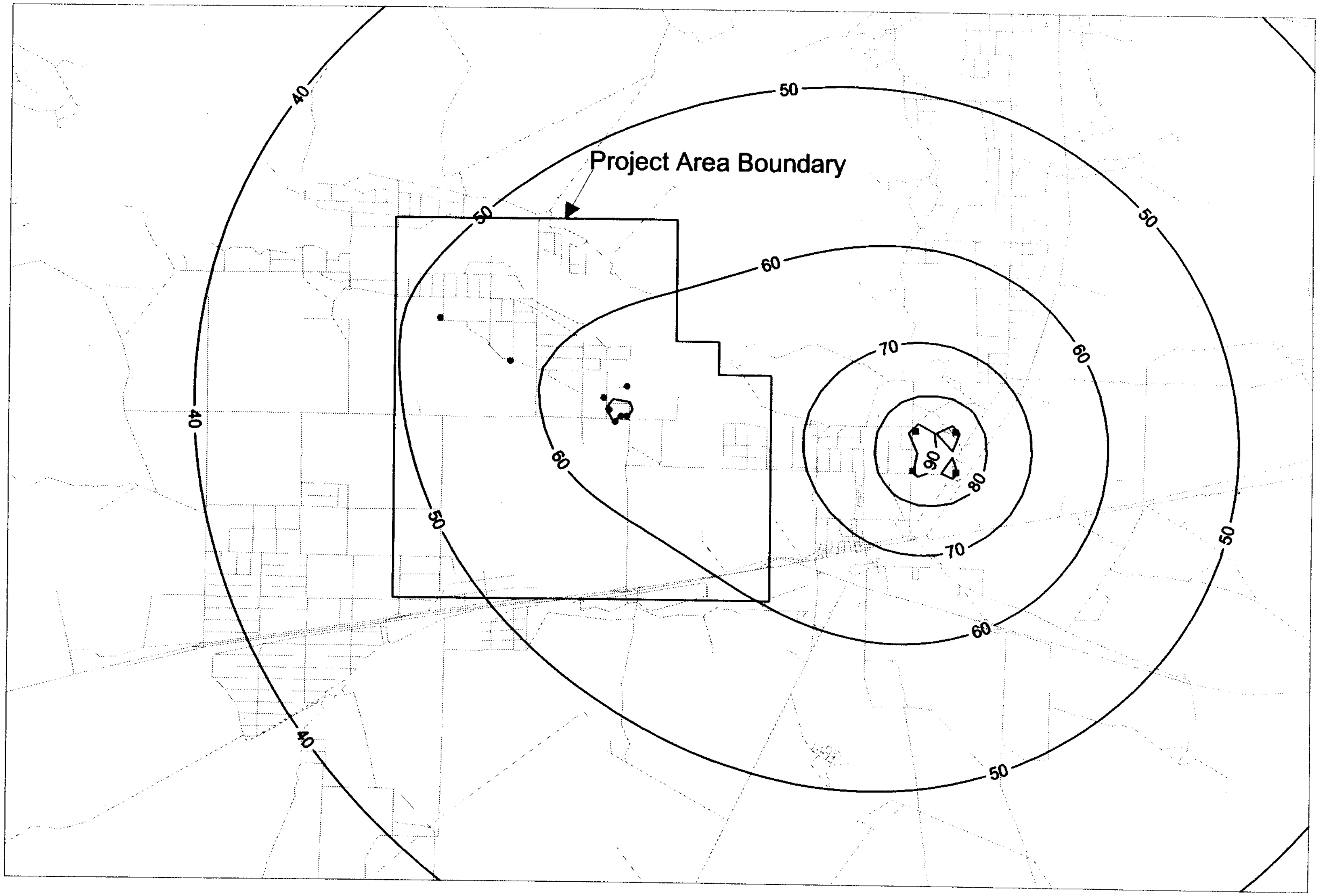


FIGURE 2. PROJECTED DRAWDOWN FOR SCENARIO 2

<u>GROUNDWATER PRODUCTION WELLS</u>

- ● Gila Bend Power Project
- ■ Project Panda

80 — Contour line of equal drawdown in feet

0 — 1 MILE

N

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

GBN4

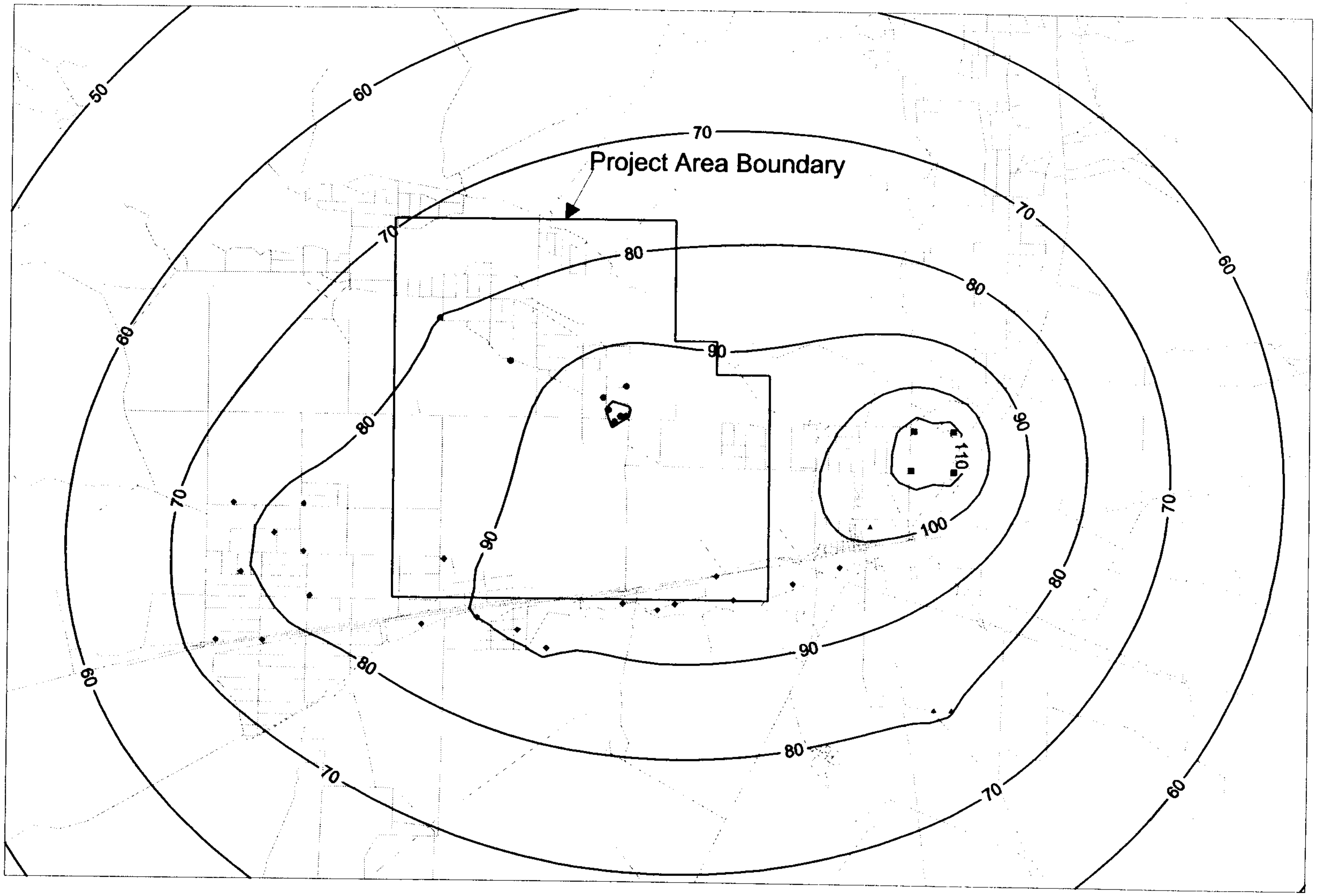


FIGURE 3 . PROJECTED DRAWDOWN FOR SCENARIO 3

<u>GROUNDWATER PRODUCTION WELLS</u>

- ● Gila Bend Power Project
- ◆ Paloma Ranch
- ■ Project Panda
- ▲ Town of Gila Bend

80 Contour line of equal drawdown in feet

N

0 1
MILE

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

GBN1

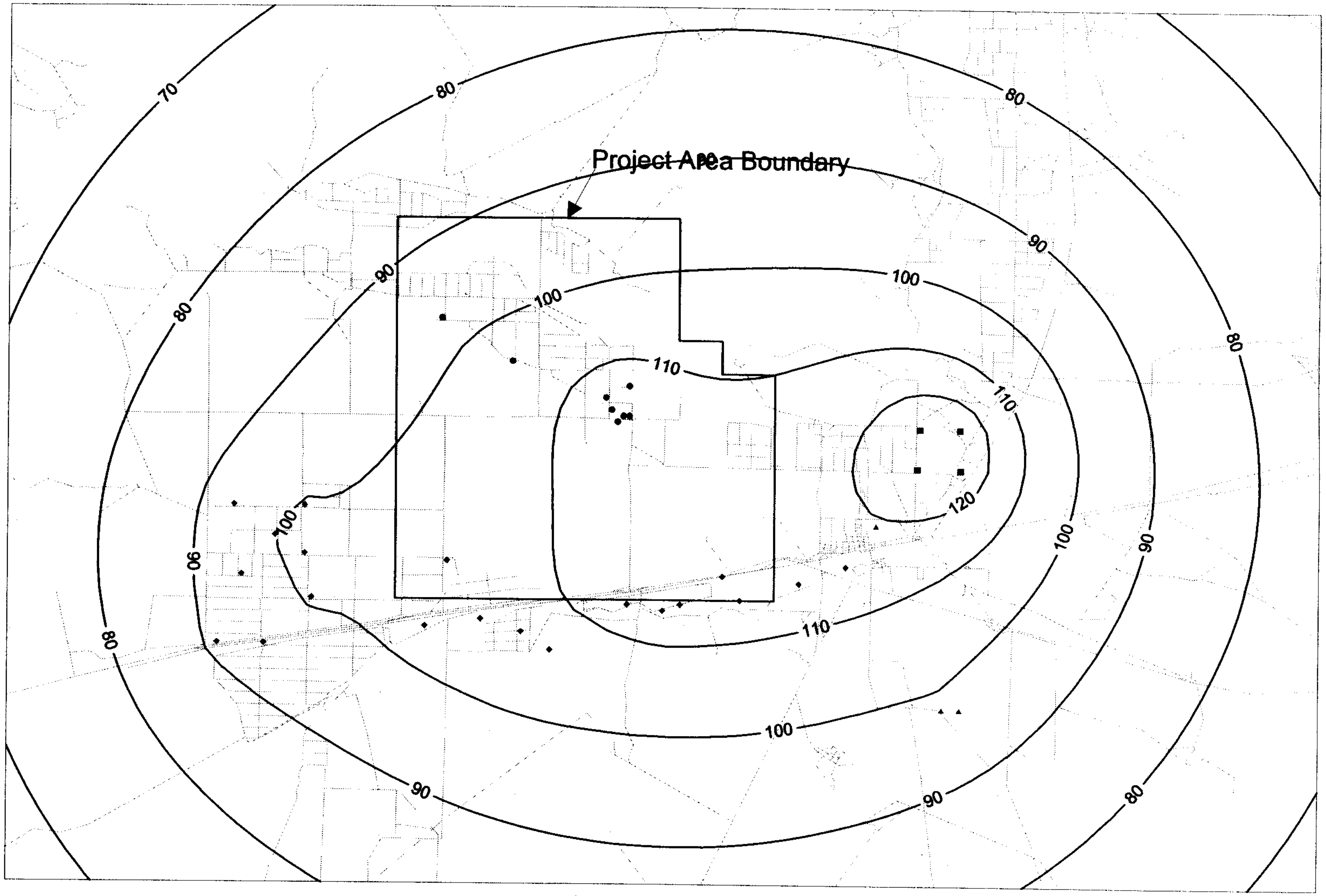


FIGURE 4 . PROJECTED DRAWDOWN FOR SCENARIO 4

N

0 1
MILE

GROUNDWATER PRODUCTION WELLS

● Gila Bend Power Project
◆ Paloma Ranch
■ Project Panda
▲ Town of Gila Bend

80 Contour line of equal drawdown in feet

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

GBN2

E

CHECK LIST

Please **CHECK** the following item(s) that apply to the type of information you are submitting and **RETURN** both pages of this form with your application to the Water Permits Section for review. We may have to return your submittal if this check list is not completed. If you are not sure which categories to check, or are uncertain whether you need to submit an application, please call the Water Permits Section at (602) 207-4675.

AQUIFER PROTECTION PERMIT APPLICATIONS / CLOSURE REPORTS

TYPE OF FACILITY (check box):

☒ **Industrial** ☐ **Mining** ☐ **Domestic Wastewater**

TYPE OF APPLICATION (check all boxes that apply)

☐ **Application to operate an existing (unpermitted) facility**

☒ **Application to operate a new facility**

☐ **Application for a major modification**

Aquifer Protection Permit (APP) No. ________________

☐ **Application for other modification (minor or other)**

APP No. ________________

☐ **Request for permit transfer**

APP No. ________________

☐ **Application for closure (NOT for Clean Closure Approval)**

☒ **Check for $ 4,500.00 enclosed (see attached Fee Schedule -- your application will not be processed without the required fee paid in full)**

CHECK LIST

TREATMENT PROCESS AND DISPOSAL METHOD

Please **CHECK** the following item(s) that apply to the type of treatment process and disposal method in use or proposed for use at your facility and **RETURN** it with your complete application submittal. Use this page **ONLY** if you are submitting an individual application for a new or existing facility.

TREATMENT PROCESS

	Type	✓
10	Septic Tank	
15	Aeration	
20	Non-Contact Cooling Water	x
50	Lagoon	
59	Nutrient Removal (NOS)	
63	Carbon Absorption	
67	Oil Water Separator	
70	Activated Sludge	
80	Copper Heap Leach	
81	Cyanide Heap Leach	
82	Mine Tailings	
83	Uranium Mining	
86	Slag or Dross Dump	
90	Mining (General)	
92	Industrial (General)	
94	Mineral Flotation	
99	Package Plant	

DISPOSAL METHOD

	Type	✓
01	Dry Stream	
05	Stream	
06	Lake	
07	River	
10	Leach Field	
20	Unlined Evaporation	
25	Reuse	
30	Dry Lake	
35	Injection Well	
40	Lined Evaporation	
45	No Discharge (other)	
50	Sub-Surface Irrigation	
60	Recharge	
65	Evaporation Basin (lining	X
70	Drywell	

TABLE OF CONTENTS

PART A. GENERAL INFORMATION

PART B. REQUIRED ATTACHMENTS

AQUIFER PROTECTION PERMIT APPLICATION

GILA BEND POWER PROJECT

GILA BEND, ARIZONA

Prepared for

GILA BEND POWER PARTNERS, L.L.C.

November 2000

Prepared by

Malcolm Pirnie, Inc.
One South Church Avenue, Suite 540
Tucson, Arizona 85701-1643

Project 3962001-500

Aquifer Protection Permit Application
Gila Bend Power Project
Gila Bend, Arizona

The material and data in this report were prepared under the supervision and direction of the undersigned.

Malcolm Pirnie, Inc.

Stacie R. Alter
Project Hydrogeologist

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

MALCOLM PIRNIE

A Part A

Part A A

PART A. GENERAL INFORMATION

APP General Information Form (A.A.C. R-18-9-108.A)

1. FACILITY DATA

a. NAME OF FACILITY (List previous names, if any)

Gila Bend Power Partners, L.L.C. – Gila Bend Power Project

b. DATE FACILITY BEGAN (or is expected to begin) OPERATIONS

Second Quarter, 2003

c. EXPECTED OPERATIONAL LIFE OF THE FACILITY

40+ years

d. MAILING ADDRESS OF FACILITY

Gila Bend Power Partners, L.L.C. – Gila Bend Power Project

5949 Sherry Lane, Suite 1880

Dallas, TX 75225

e. STREET ADDRESS OF FACILITY

Facility not yet constructed

f. COUNTY Maricopa

g. FACILITY LOCATION

1) Township	Range	Section(s)	Quarters	
5S	5W	19	SW ¼	Main Plant Site
5S	5W	18		Water Supply Wells

2) **Latitude** 32° 58' 18" N

Longitude 112° 48' 50" W

h. FACILITY CONTACT PERSON Bob Walther

i. TELEPHONE NUMBER 707-528-8900

j. NATURE OF BUSINESS (FACILITY)

Electric generation station

2. APPLICANT INFORMATION

IS THE APPLICANT (check box)

☐ **Owner** ☐ **Operator** ☑ **Both owner and operator**

a. NAME OF APPLICANT

Gila Bend Power Partners, L.L.C., – Gila Bend Power Project

b. APPLICANT MAILING ADDRESS

Gila Bend Power Partners, L.L.C., Gila Bend Power Project

5949 Sherry Lane, Suite 1880

Dallas, TX 75225

c. TELEPHONE NUMBER OF APPLICANT

214-210-5080 (Pete Wright)

d. CONSULTANT NAME, MAILING ADDRESS, AND PHONE (OPTIONAL)

Malcolm Pirnie, Inc.

One South Church Avenue, Suite 540

Tucson, Arizona 85701-1643

3. OWNER INFORMATION

a. NAME OF OWNER

Gila Bend Power Partners, L.L.C.

b. OWNER MAILING ADDRESS

Gila Bend Power Partners, L.L.C.

5949 Sherry Lane, Suite 1880

Dallas, TX 75225

c. TELEPHONE NUMBER OF OWNER

214-210-5080

d. LAND OWNER

Gila Bend Power Partners, L.L.C.

e. LAND OWNER ADDRESS

5949 Sherry Lane, Suite 1880

Dallas, TX 75225

4. OPERATOR INFORMATION

a. NAME OF OPERATOR (person who operates the discharging facility)

Gila Bend Power Partners, L.L.C

b. OPERATOR ADDRESS

5949 Sherry Lane, Suite 1880

Dallas, TX 75225

c. TELEPHONE NUMBER OF OPERATOR

707-528-8900 (Bob Walther)

5. EXISTING ENVIRONMENTAL PERMITS

a. NPDES PERMITS & NUMBERS **N/A**

b. REUSE PERMITS & NUMBERS **N/A**

c. RCRA PERMITS & NUMBERS **N/A**

d. AIR QUALITY PERMITS & NUMBERS **Submitted on March 20, 2000**

Application Number: V00-001; A separate air quality permit will be required for

non-routine dust generating operations for construction and excavation activities. That permit will be submitted at least ten days before construction activities commence.

e. SOLID WASTE PERMITS & NUMBERS N/A

f. EXISTING AQUIFER PROTECTION PERMIT N/A

g. NOTICE OF DISPOSAL N/A

h. GROUND WATER QUALITY N/A

i. CLEAN CLOSURE APPROVAL N/A

j. DRYWELL REGISTRATION(S) N/A

k. OTHER

Section 404 (U.S. Army Corps of Engineers) – Submitted 11/13/00

Section 401 (ADEQ) – Submitted 11/13/00

MALCOLM PIRNIE

Part B

B

PART B. REQUIRED ATTACHMENTS

MALCOLM PIRNIE

1.0 Section 1.0

Section 1.0 1.0

1 INTRODUCTION AND BACKGROUND

The purpose of this section of the permit application is to provide information pertaining to the design and operational details necessary for understanding the permitting approach, and an outline of the organization of the permit application for ease of reference and use.

1.1 Background

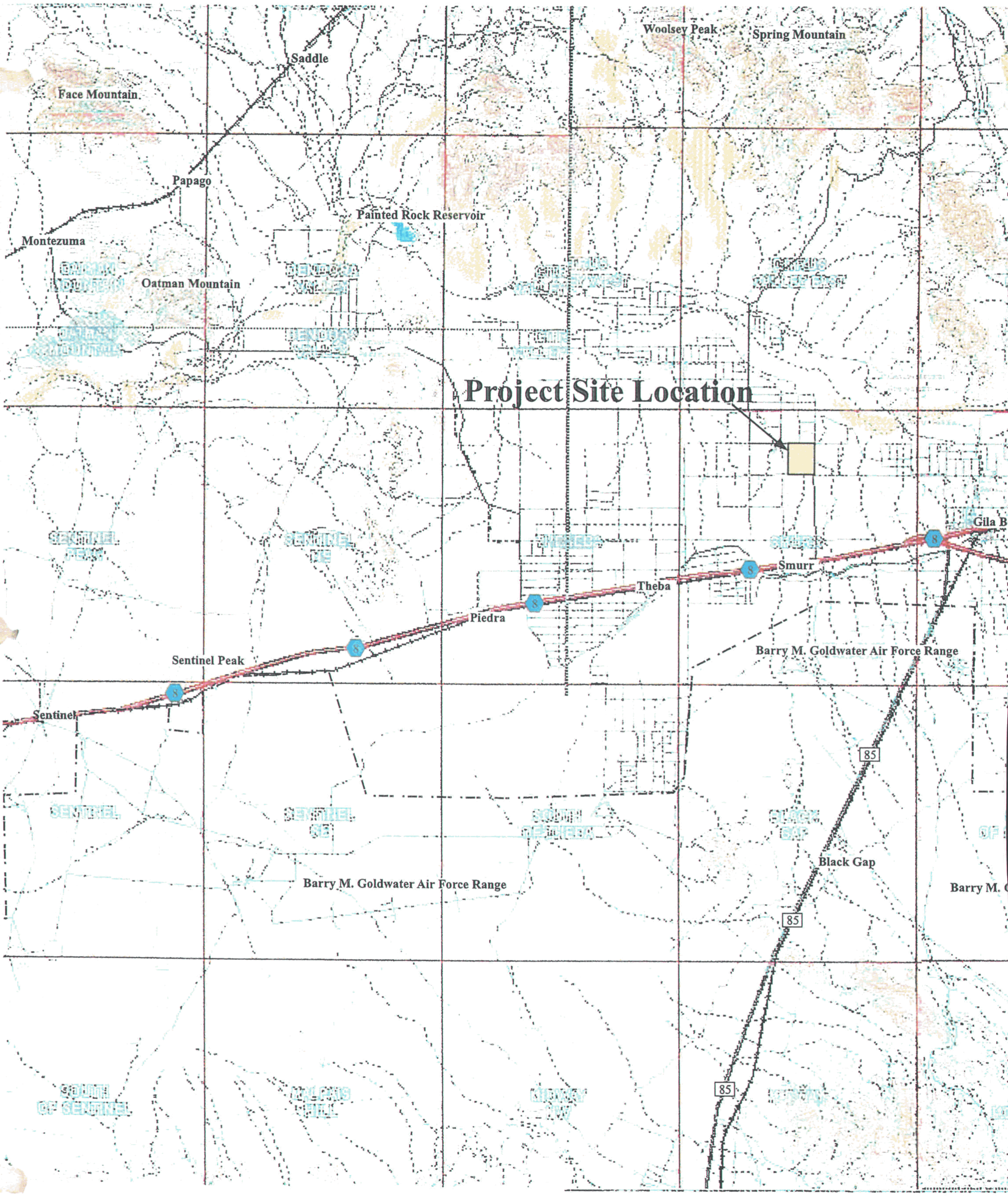
1.1.1 Plant Location

The proposed power plant will be located approximately six miles northwest of Gila Bend, Arizona. The location of the project area is depicted in Figure 1-1, the Location Map. The power plant area of the Gila Bend Power Generation Station (GBPGS) will be located in Section 19 of Township 5 South, Range 5 West of the Salt and Gila River Baseline and Meridian. According to the County Assessor's Office, the Book, Map, and Parcel number for the parcel on which the plant will be located is 403-15-049m. Refer to the Aquifer Protection Permit (APP) application form in Part A. for the latitude and longitude of the facility. The GBPGS site will consist of a total area of approximately 1,900 acres, which includes the power plant area and additional land (Figures 1-2 and 1-3). Land ownership of adjacent land is also shown in Figures 1-2 and 1-3.

1.1.2 Facility Information

The proposed GBPGS consists of a natural gas-powered, 845 gross megawatt electric generating facility. The proposed facility layout, including the proposed configuration of surface impoundments and chemical storage areas, is presented in Figures 1-4 and 1-5. Additional information, such as drainage diversion features, is presented in a Preliminary Design Report (Appendix A). As shown on those diagrams, the facility footprint consists of approximately 175 acres, and five evaporation ponds footprint consists of approximately 87 acres. The ponds will be double-lined with a leak detection/collection system, as described in Section 3.

Construction of the GBPGS is proposed to begin in the third quarter of 2001, and operations are expected to commence in the second quarter of 2003. The operational lifetime of the GBPGS is expected to be approximately 40 years.



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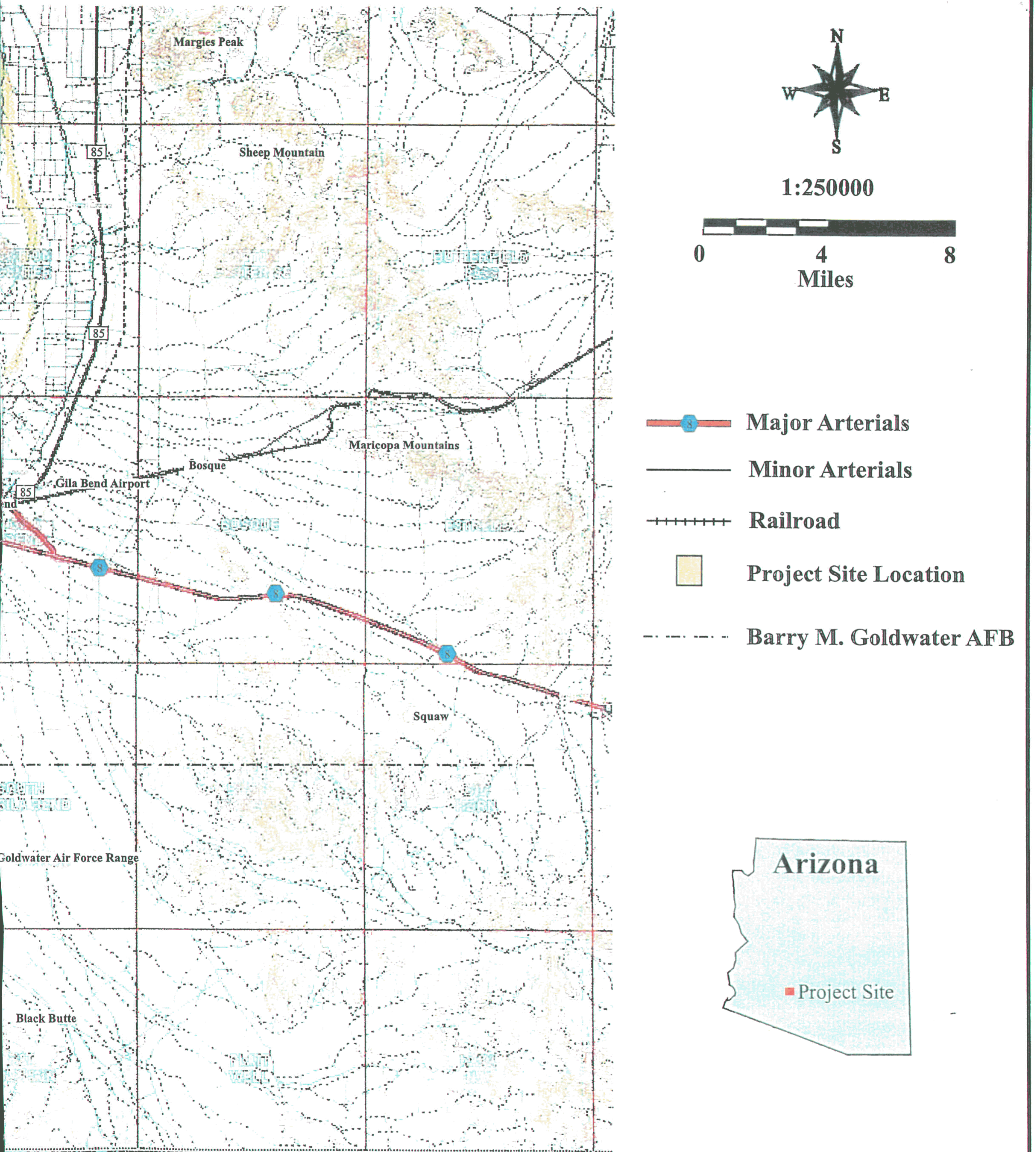

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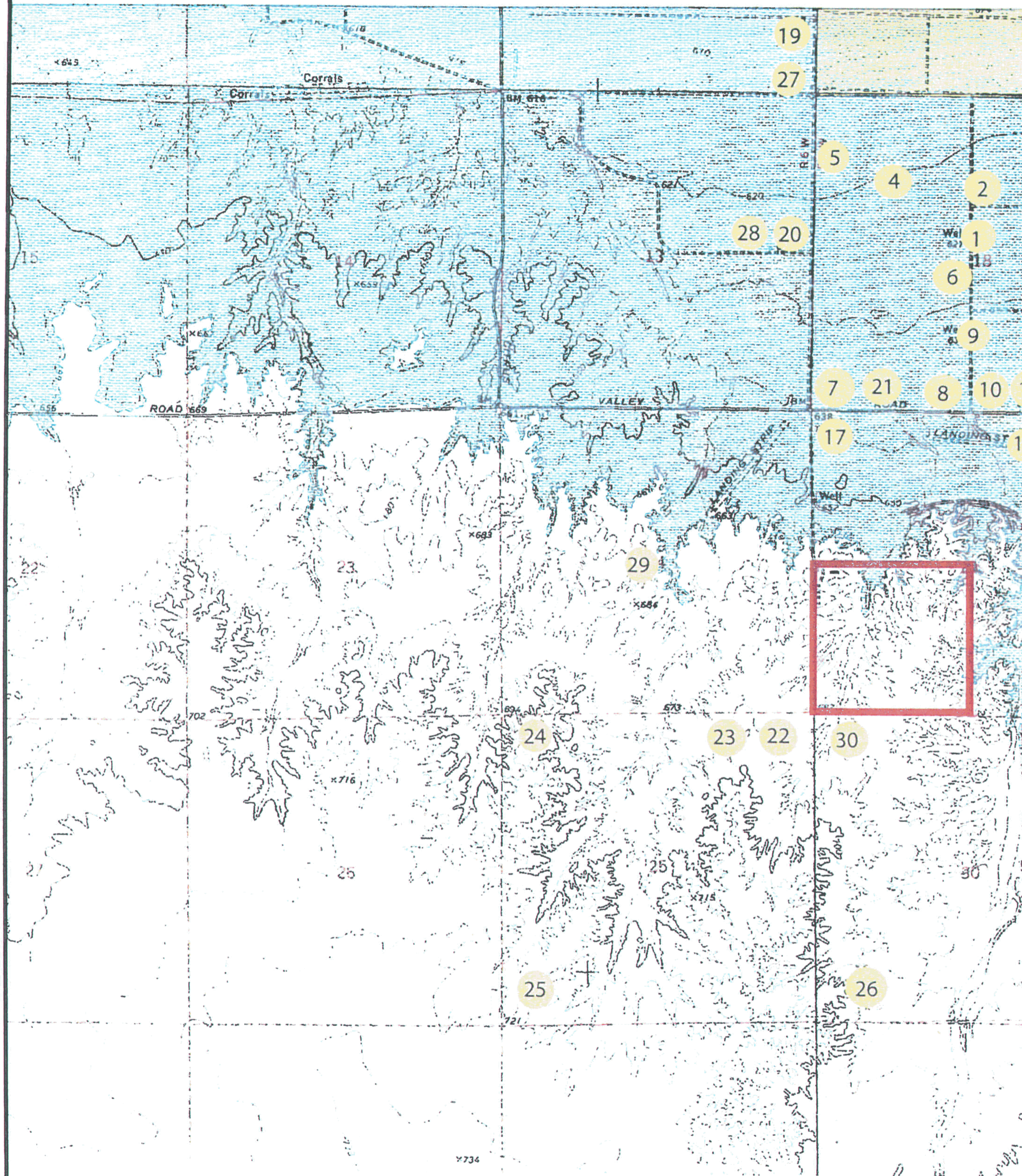
N MAP

MALCOLM PIRNIE, INC.

FIGURE 1-1



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WELL

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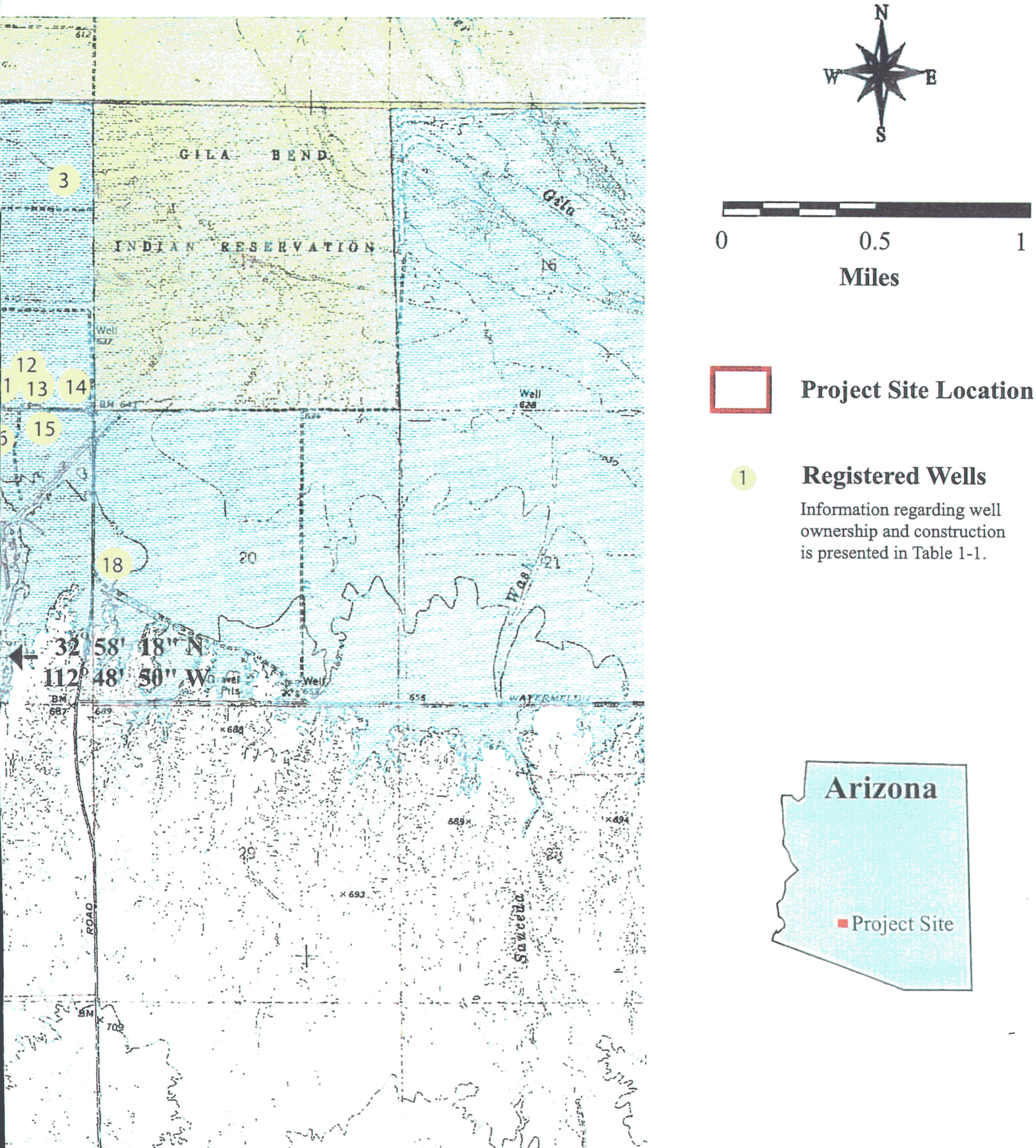
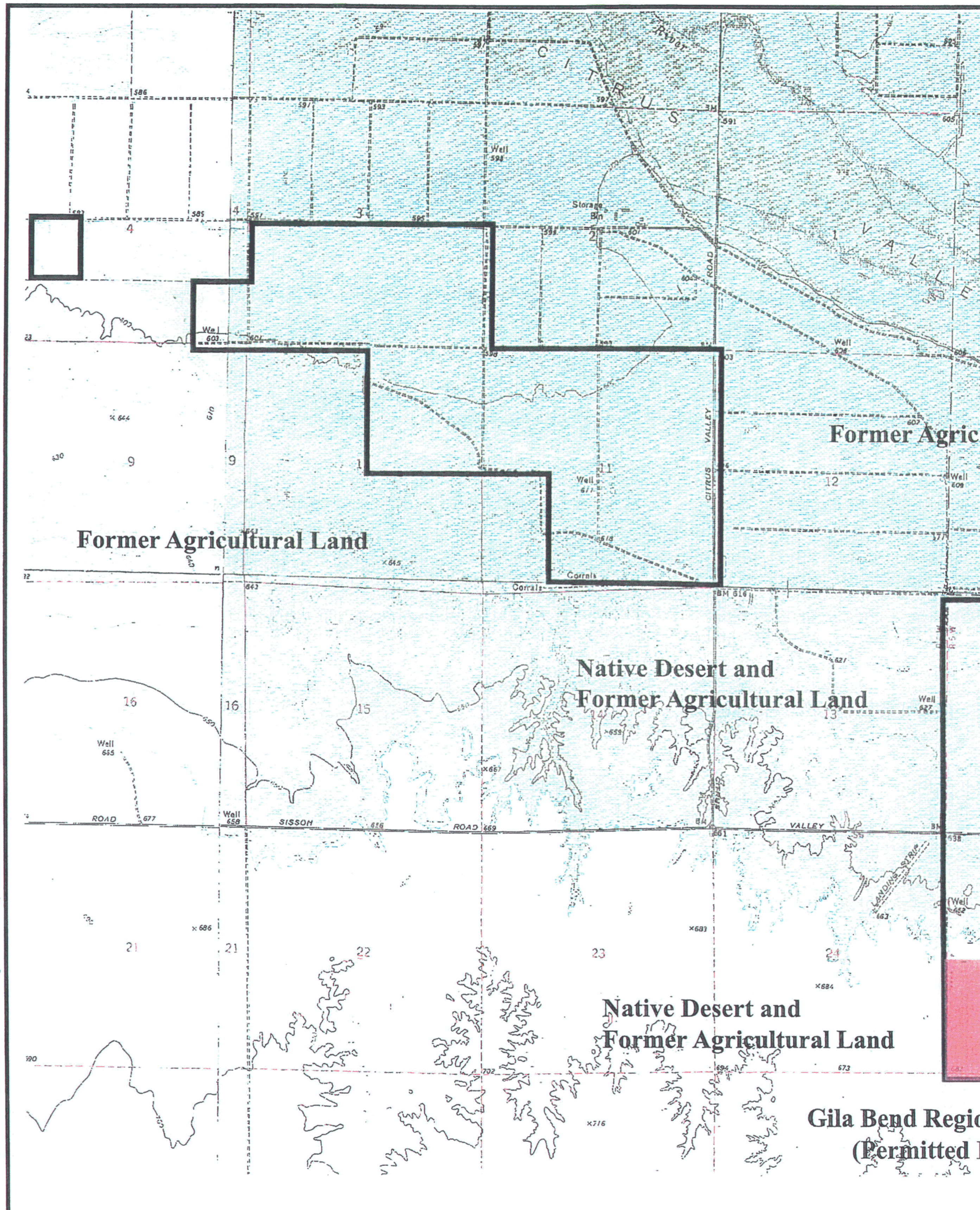


D POWER PROJECT
TION PERMIT APPLICATION
LOCATIONS

MALCOLM PIRNIE, INC.

FIGURE 1-2



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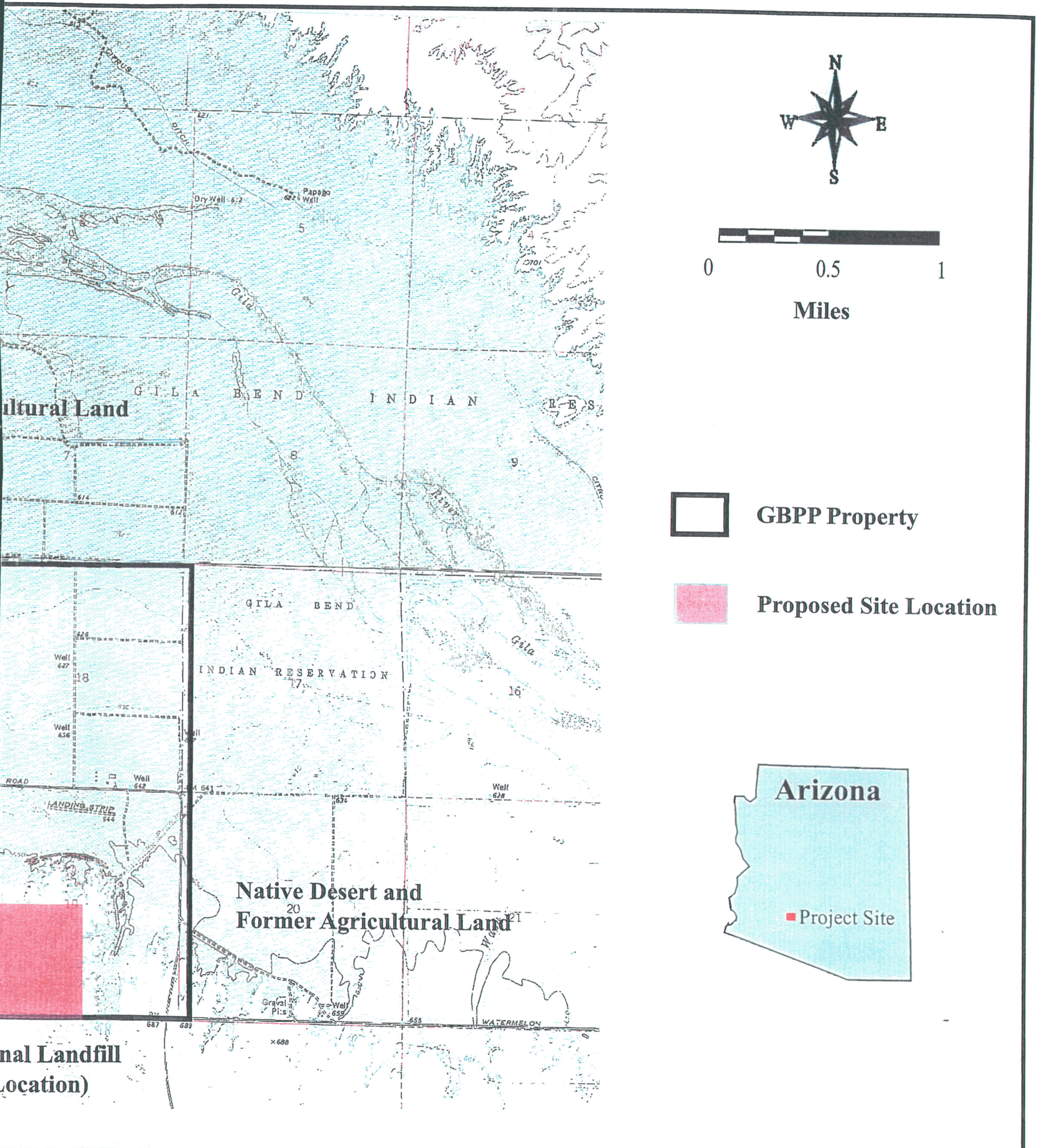

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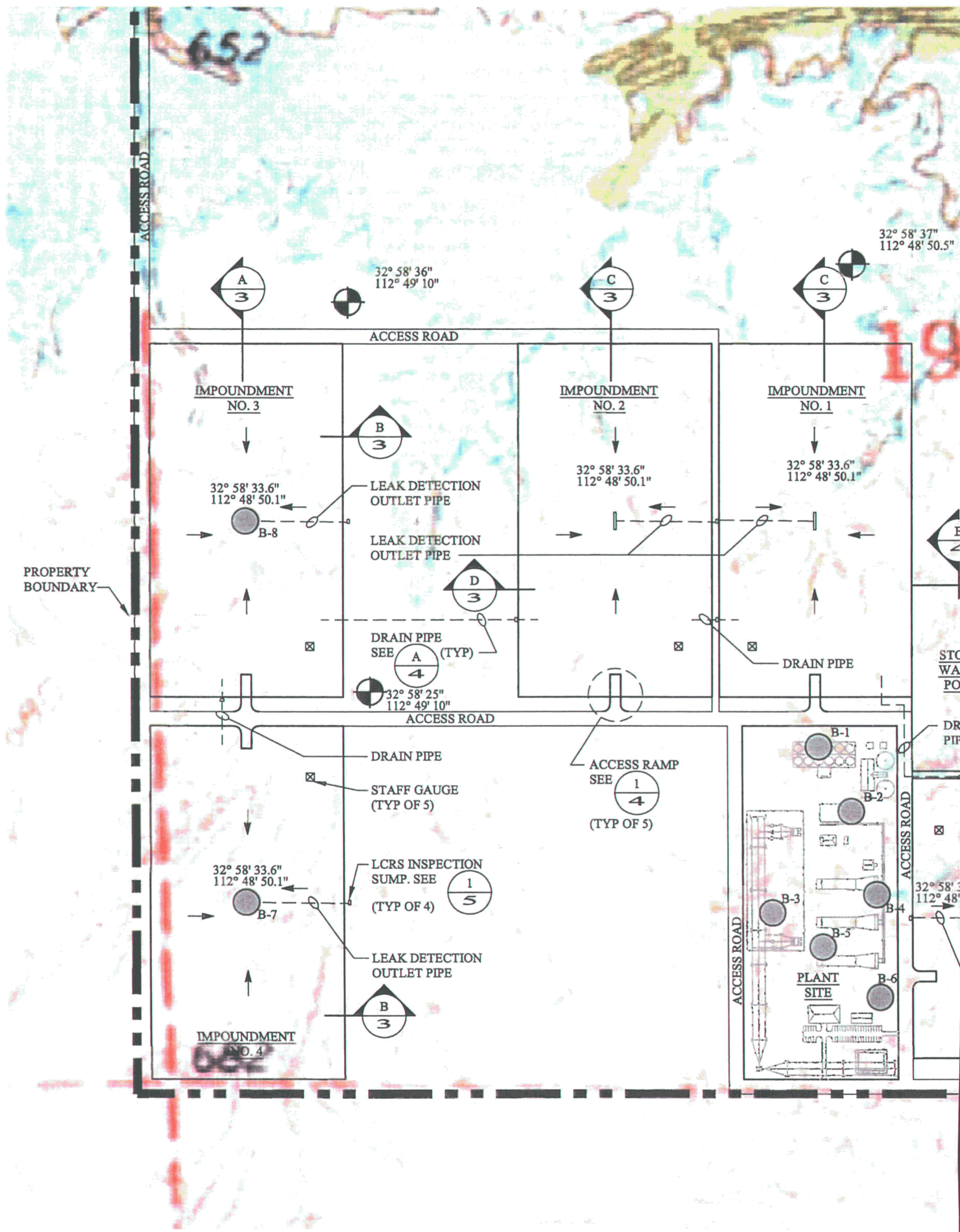
TE MAP

MALCOLM PIRNIE, INC.

FIGURE 1-3



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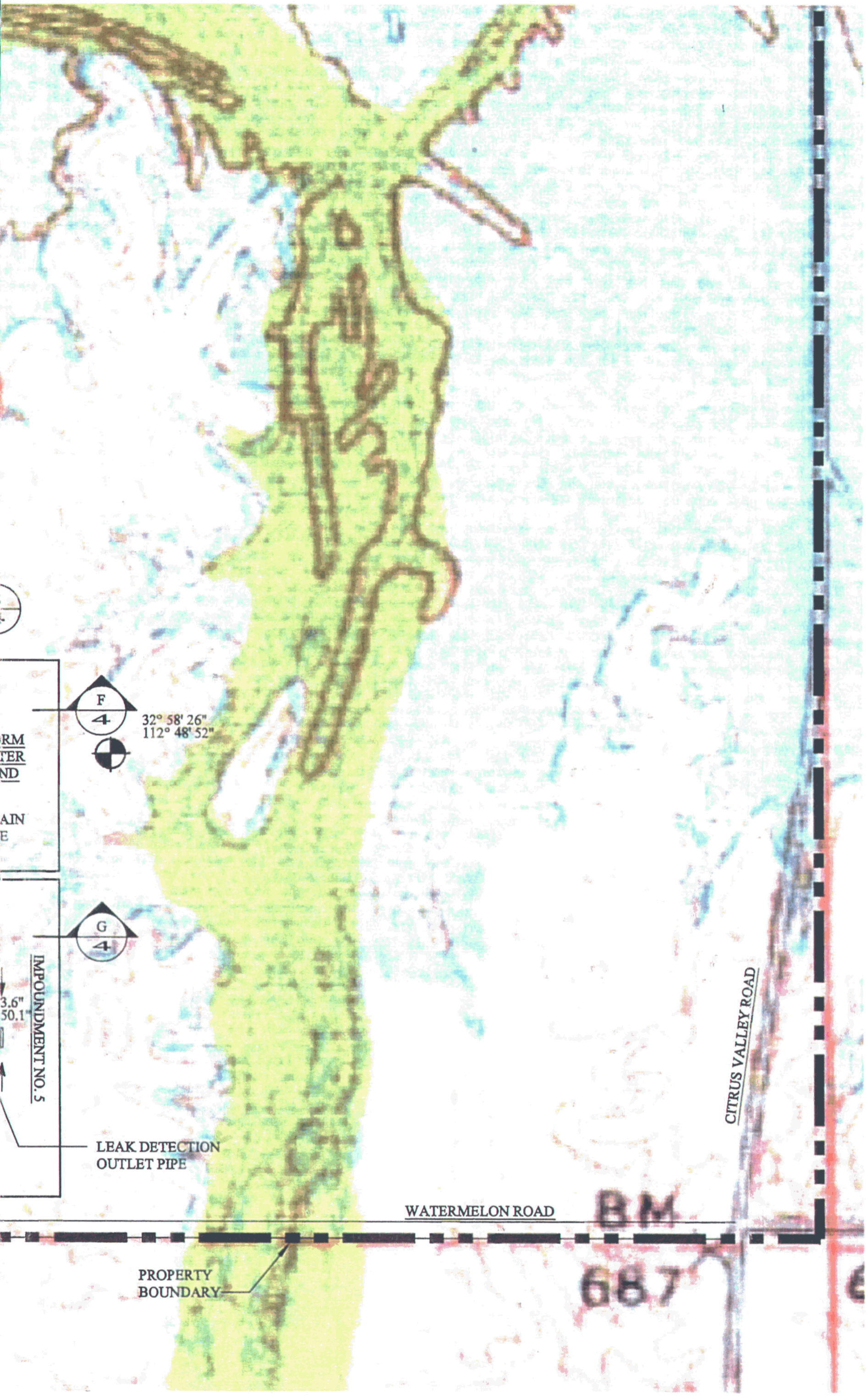

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POINT OF COMPLIANCE

APPROXIMATE LOCATION OF GEOTECHNICAL SOIL BORING

LOCATION IDENTIFICATION

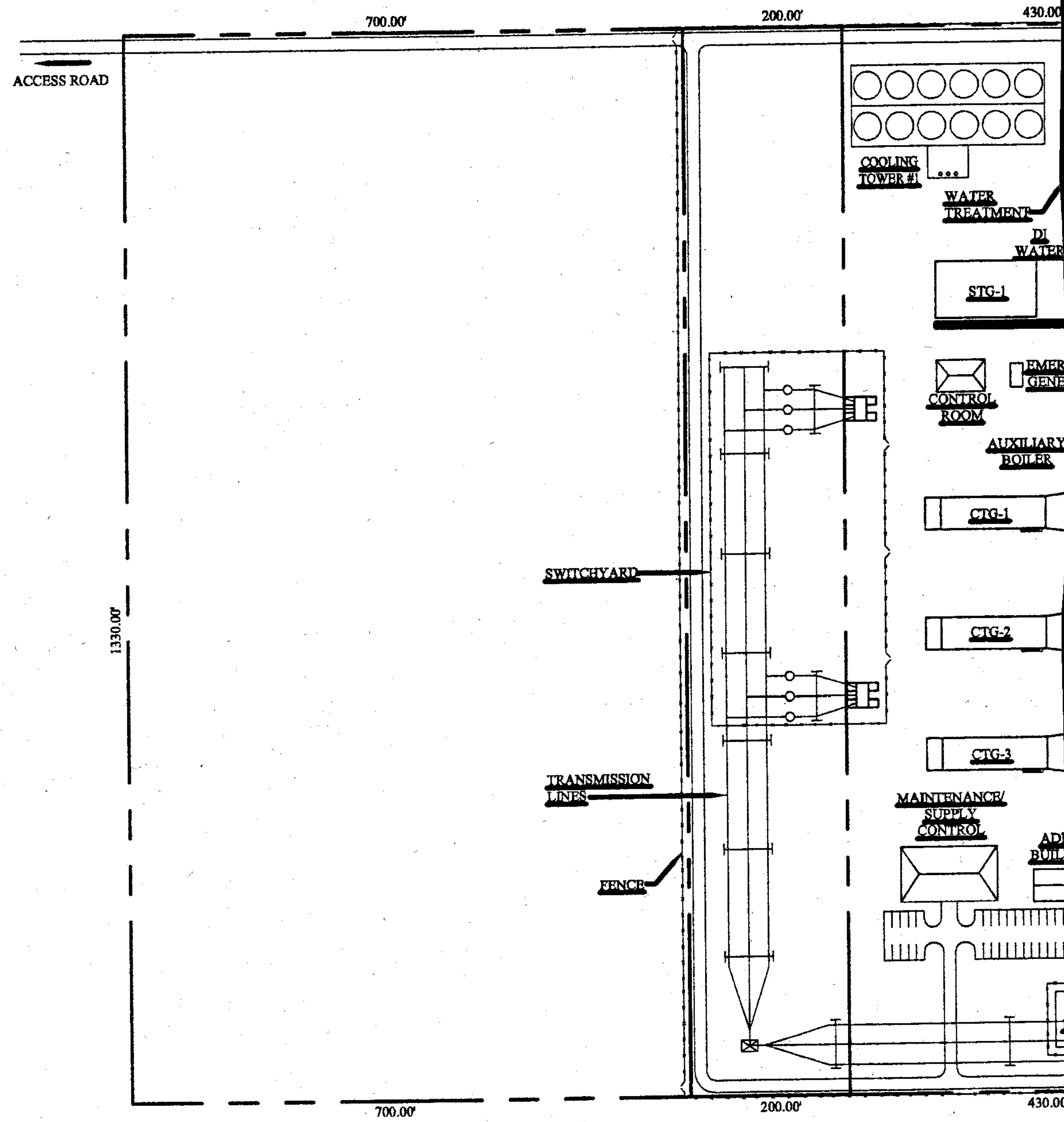
32° 58' 36.6" LATITUDE
112° 48' 50.1" LONGITUDE

BEND POWER PROJECT
TECTION PERMIT APPLICATION

SITE PLAN

MALCOLM PIRNIE, INC.

FIGURE 1-4



User:CADD Spec:ACAD File:M:\3962001\APP\Figures\FIG_2.DWG Scale:1:1 Date:10/30/2000 Time:13:27 Layout:Layout1

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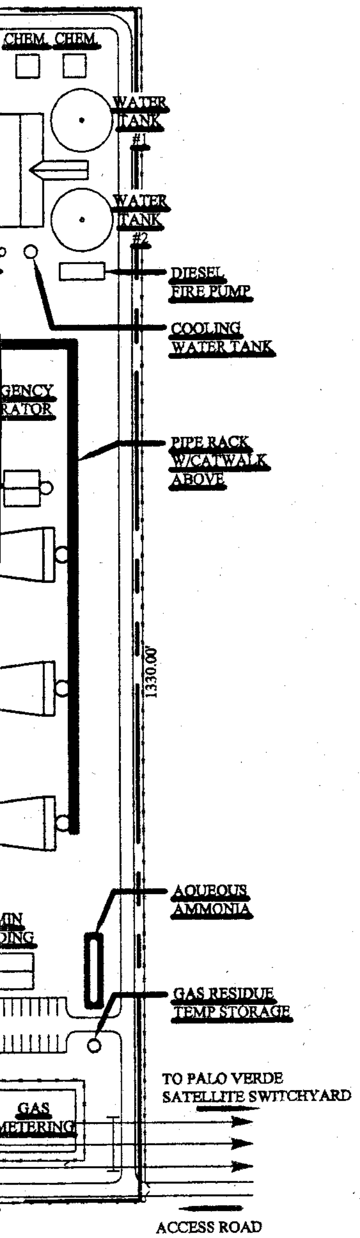
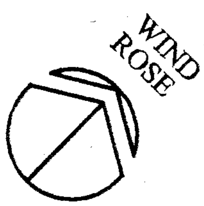
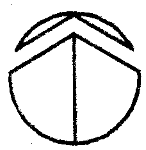
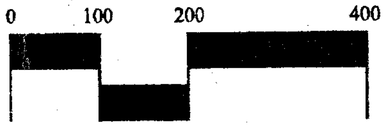


COOLING TOWER:	240'x100'x50'
CTG 1-3:	250'x60'x55'
CTG STACK:	18' DIA.x165'
AUX. BOILER BLDG.:	40'x40'x20'
AUX. BOILER STACK:	45'x31"
WATER TANK:	70' DIA.x40'
WATER TREATMENT BLDG.:	125'x50'x20'
CONTROLS ROOM:	40'x60'x20'
STG 1:	125'x70'x30'
MAINT./SUPPLY CONTROL:	120'x60'x30'
ADMIN. BLDG.:	80'x40'x25'
COOLING WATER TANK:	15' DIA.x15'
DI WATER TANK:	10' DIA.x10'
AQUEOUS AMMONIA TANK:	10' DIA.x75'
GAS RESIDUE TEMPORARY STORAGE:	15' DIA.x15'



NORTH





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MALCOLM PIRNIE, INC.

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LED SITE PLAN

FIGURE 1-5

1.1.3 Overview of Plant Water

It is anticipated that the GBPGS will require approximately 6,200 acre-ft of water per year, of which approximately 20% will end up in a wastewater stream. Approximately 78% of the water will be lost to evaporation from the plant's cooling processes. The remaining 2% will be used for plant service water and potable purposes. A simplified water flow diagram, which includes approximate process stream flows, is presented as Figure 1-6.

In general, water needed for plant processes will be pumped from the well field into raw water storage tanks. Water supply wells for the GBPGS will be located in Township 5 South, Range 5 East, Section 18. Water from the raw water storage tanks will be used for service water and fire suppression. In addition, water from the raw water storage tanks will be transferred into the water treatment and filtration system or directly into the cooling towers. From the water treatment and filtration system, water will either be delivered to the potable water tank or be circulated through plant cooling processes and will eventually be transported to the lined evaporation ponds (Figure 1-6). Incidental water from the equipment and maintenance sumps and from the water building sumps will be conveyed through an oil-water separator and into the evaporation ponds. Stormwater runoff (i.e., non-industrial contact) will be conveyed to a storm water retention pond.

1.1.4 Overview of Plant Waste Water Distribution

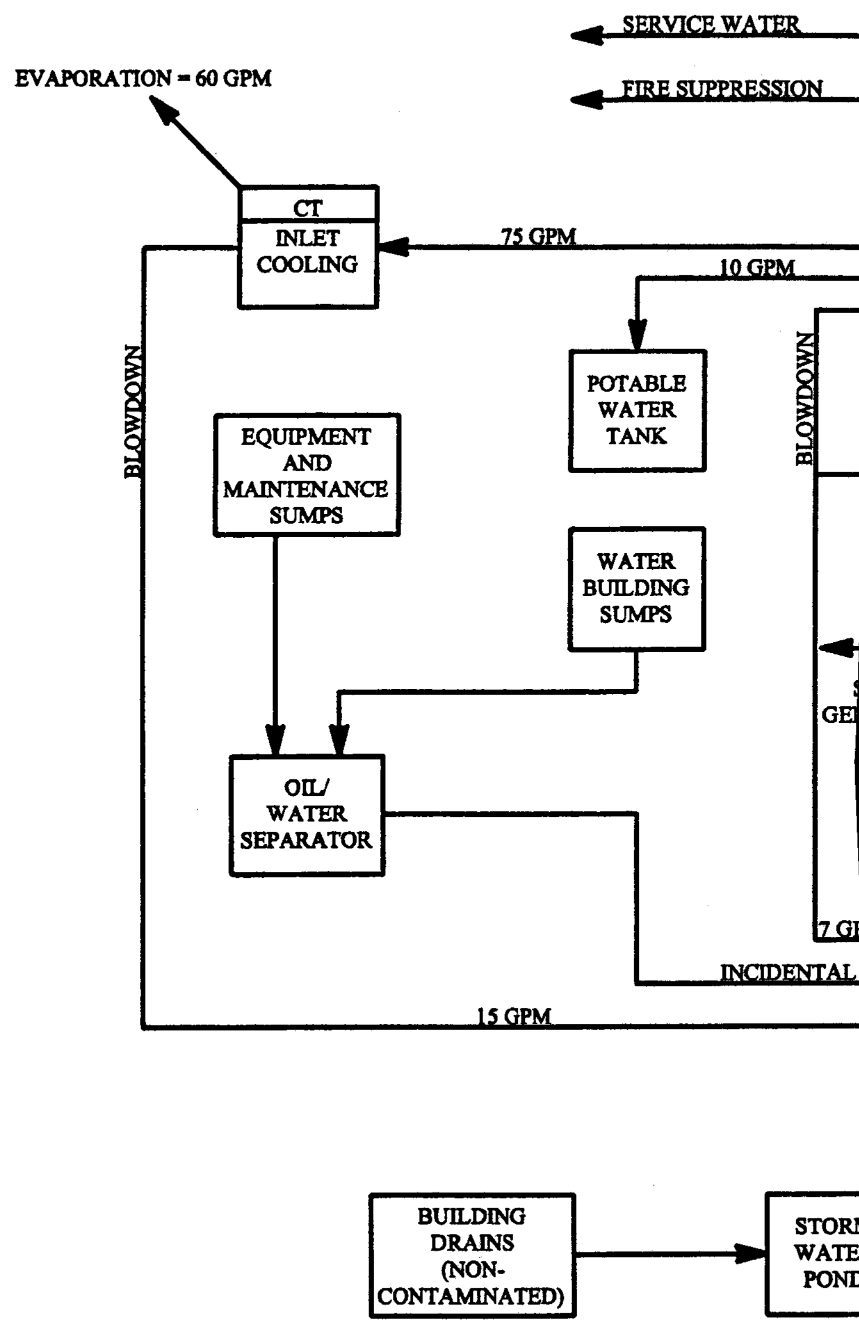
As discussed above, it is anticipated that approximately 20 percent of the incoming water will end up in a wastewater stream. The following wastewater streams will be generated by plant processes: R.O. reject, Cooling Tower Blowdown, Non-process Wastes (waters generated by drains, washes, etc. which will be diverted to an oil-water separator and then into evaporation ponds), Boiler Blowdown, and Blowdown from intake evaporator cooling. Cooling Tower Blowdown will comprise approximately 95% of the generated waste stream. It is anticipated that the wastewater will be high in total dissolved solids.

1.2 General Description of Discharging Activities

Malcolm Pirnie, Inc. (MPI) has identified the proposed evaporation ponds at the GBPGS as "discharging" areas, as defined under the APP program. The septic system for the GBPGS will consist of septic tanks accepting less than 2,000 gallons per day and are, therefore, exempt from the APP process. The storm water retention basin will receive only non-contact storm water, and is also exempt from the APP process. The evaporation ponds are described below and are shown in Figure 1-4 (i.e., Impoundments No. 1 through 5), and in the Preliminary Design Report prepared by IPT (Appendix A).

Table 1-1 Registered Wells Within One Mile of Property
Gila Bend Generating Station
Gila Bend, Arizona

Map Number	Cadastral Location	Well ID#	Well Type	Water Use	Installation Date	Drill Depth (ft)	Casing Type	Depth of Casing (ft)	Casing Width (in)	Owner
1	5S, 5W, 18ACC	Not Registered				657			20	S&P Farms
2	5S, 5W, 18ACC	Not Registered				396			20	Sisson
3	5S, 5W, 18ADA	55-603692	Non-exempt	Irrigation	01/01/1951	347	Steel - Perforated or Slotted Casing	0	20	S&P Farms
4	5S, 5W, 18B	Not Registered				865			20	Sisson
5	5S, 5W, 18BBC	Not Registered				945			20	Sisson
6	5S, 5W, 18CAA	55-603694	Non-exempt	Irrigation	01/01/1966	679	Steel - Perforated or Slotted Casing	679	18	S&P Farms
7	5S, 5W, 18CCC	55-559643	Exploration	None	11/30/1996	235	-	-	0	Southwest Gas Corporation
8	5S, 5W, 18CDD	55-603682	Exempt	Domestic	01/01/1950	500	Steel - Perforated or Slotted Casing	500	6	S&P Farms
9	5S, 5W, 18DCB	55-603693	Non-exempt	Irrigation	11/11/1976	890	Steel - Perforated or Slotted Casing	890	18	S&P Farms
10	5S, 5W, 18DCC	Not Registered				1031			20	Sisson
11	5S, 5W, 18DCD	55-603697	Exempt	Domestic	01/01/1947	400	Steel - Perforated or Slotted Casing	400	6	Gila Gin Co
12	5S, 5W, 18DDC	Not Registered				770			20	Sisson
13	5S, 5W, 18DDC	55-603690	Non-exempt	Irrigation	01/01/1950	400	Steel - Perforated or Slotted Casing	0	20	S&P Farms
14	5S, 5W, 18DDD	55-603691	Non-exempt	Irrigation	01/01/1951	669	Steel - Perforated or Slotted Casing	669	20	S&P Farms
15	5S, 5W 19AAB	Not Registered				1135			30	Pierce
16	5S, 5W 19ABA	55-603689	Non-exempt	Irrigation	06/05/1974	1130	Steel - Perforated or Slotted Casing	1130	18	S&P Farms
17	5S, 5W 19BBB	55-603683	Exempt	Domestic	01/01/1960	188	Steel - Perforated or Slotted Casing	188	8	S7
18	5S, 5W 20CBB	55-622334	Non-exempt	Irrigation	12/01/1974	1114	Steel - Perforated or Slotted Casing	1114	16	Paloma Ranch Investments, LLC
19	5S, 6W 12DAA	Not Registered				979			20	Narramore
20	5S, 6W 13ADD	Not Registered				1000			18	Narramore
21	5S, 5W 18CCD	Not Registered				936			18	S&P Farms
22	5S, 6W 25AAA	55-555387	Monitor or piezometer	Monitoring	03/11/1996	50	Plastic or PVC	50	4	Continental Waste
23	5S, 6W 25ABA	55-551348	Monitor or piezometer	Monitoring	02/21/1996	75	-	0	4	Continental Waste
24	5S, 6W 25BBB	55-551346	Monitor or piezometer	Monitoring	02/27/1996	65	Plastic or PVC	61	4	Continental Waste
25	5S, 6W 25CCC	Unknown	Monitor or piezometer	Monitoring	10/05/1995	74	Plastic or PVC	72	4	Continental Waste
26	5S, 6W 30CC	55-551347	Monitor or piezometer	Monitoring	10/05/1995	39	Plastic or PVC	38	4	Continental Waste
27	5S, 6W 12DDD	55-610343	Non-exempt	Irrigation	01/01/1946	500	Steel - Perforated or Slotted Casing	500	20	Narramore
28	5S, 6W 13ADC	55-627766	Non-exempt	Irrigation	-	0	-	0	0	Great Western Water
29	5S, 6W 24	55-555677	Exploration	None	03/22/1996	60	-	0	0	Continental Waste
30	5S, 5W 30BBA	55-551351	Monitor or piezometer	Monitoring	02/28/1996	50	Plastic or PVC	50	4	Continental Waste



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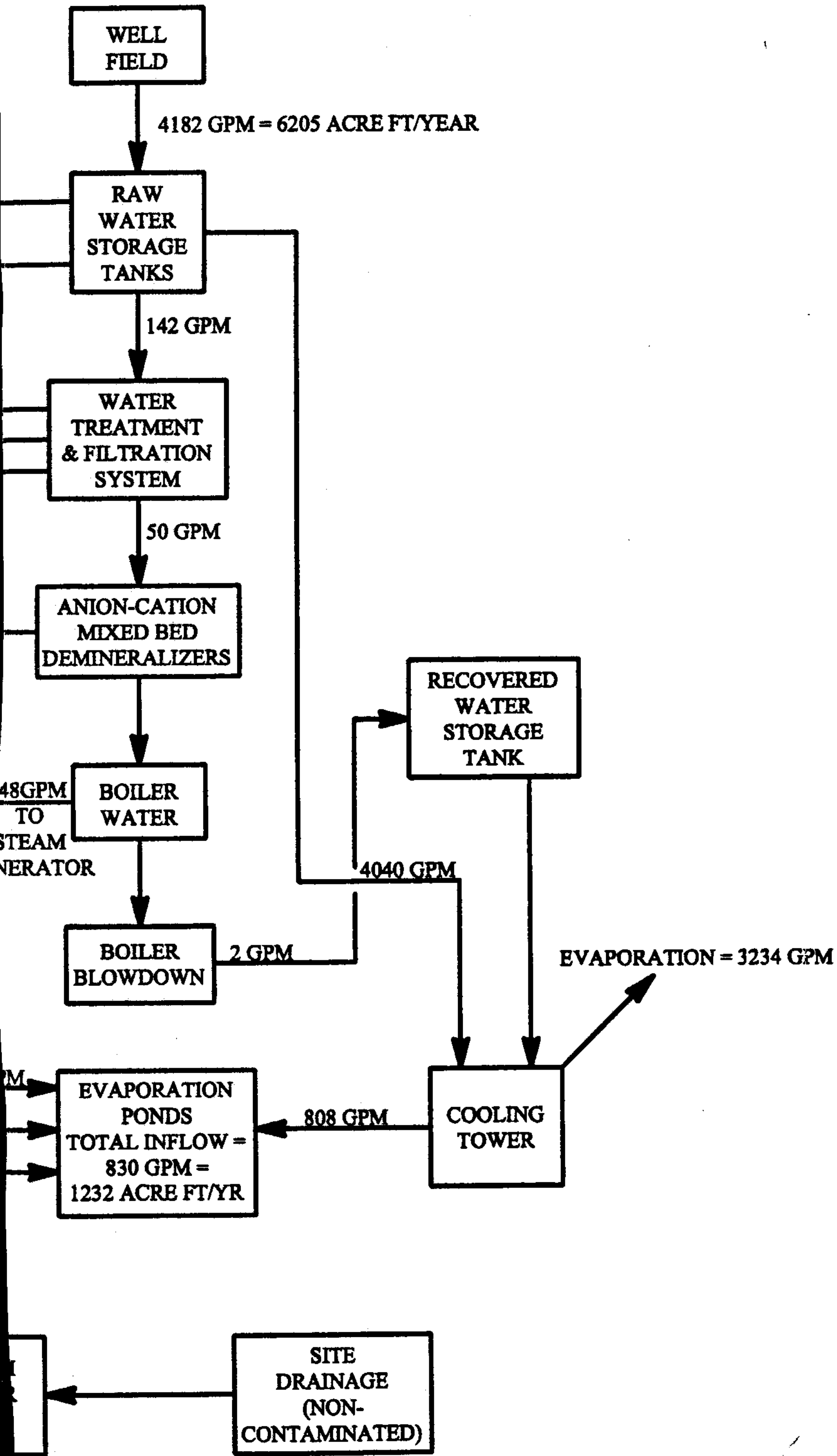

WATER VOLUMES ARE APPROXIMATE

ID POWER PROJECT TION PERMIT APPLICATION	MALCOLM PIRNIE, INC.
ATER FLOW DIAGRAM	FIGURE 1-6

1.2.1 Evaporation Ponds

Four 20-acre evaporation ponds and one 7-acre evaporation pond are proposed for the GBPGS. Pipes provide for outflows to cascade from one pond to the next. All evaporation ponds will be lined with a primary 80 mil HDPE liner and a secondary 60 mil HDPE liner with a total storage capacity of approximately 625 ac-ft not including 2 ft of freeboard (Appendix A).

1.3 Organization of Application

The application forms are presented in Part A of this application. The application report is organized in accordance with the APP application packet provided by ADEQ. Supporting figures and tables have been included within each section.

- **Section 2 – Discharge Characterization** – This section describes the location of each discharging facility, as defined by the APP program, provides a description of the anticipated physical, biological, and chemical characteristics of the discharge, and a description of the rates, volumes, duration, and frequency of discharges.

- **Section 3 – Best Available Demonstrated Control Technology** - This section presents a general discussion of the BADCT requirements and the approach used in the permit application to evaluate and select BADCT for the evaporation ponds.

- **Section 4 – Demonstration of Compliance with Standards** - This section describes the demonstration of compliance with standards. The point of compliance selection, evaluation of compliance, and assessment of the discharge impact area are included in this section. This section also combines data obtained during various investigative efforts at the GBPGS to characterize the geology, hydrogeology, and surface water hydrology of the site to address requirements of the APP permitting program.

- **Section 5 – Demonstration of Technical Capability** – This section provides information relating to the technical qualifications of the individuals responsible for the design, construction, and operation of the GBPGS.

- **Section 6 – Demonstration of Financial Capability** – This section provides documentation relating to the anticipated costs of constructing, operating, and closing the GBPGS and of the applicant's ability to provide financing for the aforementioned costs.

- **Section 7 – Administrative Demonstrations** – This section includes information pertaining to past enforcement actions taken against the applicant, zoning requirements for the GBPGS, and a summary of the initial fees owed for application review.

- **Section 8 – Certification –** This section provides a certification statement from the Gila Bend Power Partners, L.L.C. (GBPP)

MALCOLM PIRNIE

Section 2.0

2.0

2.0 Section 2.0

2 DISCHARGE CHARACTERIZATION

Discharge characterization is critical to the evaluation of BADCT and compliance with Aquifer Water Quality Standards (AWQS). The following sections summarize information relating to the rates, volumes, duration, and frequency of discharge, as well as information relating to the quality of discharge. The five evaporation ponds (Impoundments No. 1 through 5) at the GBPGS have been identified as discharging facilities. Those five evaporation ponds and associated latitudes/longitudes are:

1. **Impoundment #1** – 32° 58' 33.6"/112° 48' 50.1", Capacity: 47.5 million gallons
2. **Impoundment #2** – 32° 58' 33.6"/112° 48' 58.1", Capacity: 47.5 million gallons
3. **Impoundment #3** –32° 58' 33.6"/112° 49' 12.5", Capacity: 47.5 million gallons
4. **Impoundment #4** – 32° 58' 18.3"/112° 49' 12.5", Capacity: 47.5 million gallons
5. **Impoundment #5** – 32° 58' 18.2"/112° 48' 40.2", Capacity: 12 million gallons

The locations of the surface impoundments are shown on Figure 1-4. The GBPGS property does not have a history of discharge or waste disposal. Groundwater samples were collected from the regional aquifer and analyzed for parameters listed in the APP Application Guidance Manual (ADEQ, 1997), as well as parameters indicated by ADEQ personnel to determine ambient groundwater quality. These water quality results were used to calculate anticipated discharge characteristics. That information is presented below.

2.1 Chemical, Biological, and Physical Characteristics

Groundwater samples were collected from wells located in Section 20 of Township 5 South, Range 5 West, to determine ambient groundwater quality in the regional aquifer. The GBPGS will draw water from wells screened in the regional aquifer (T 5S R 5W Section 18) for plant operations. At the time of this permit application, water quality information for wells in Section 18 was not available. However, analytical results for groundwater samples collected from wells in Section 20 were used to generally represent the quality of water that will be used as source water for plant operations. Since water supply wells in Section 18 will draw water from the same aquifer as wells in Section 20, this assumption is valid. A summary of analytical results for water samples collected from the regional aquifer is presented as Table 2-1. MPI used these analytical results to estimate the quality of discharge from the GBPGS. A summary of the estimated discharge water quality is presented as Table 2-2. The estimated evaporation pond water quality was developed by considering the concentrating effects that will occur on the naturally occurring inorganics in the source groundwater, as a result of the plant recirculating cooling processes, and the concentration of inorganic compounds in the plant water treatment reject streams. Laboratory analytical results for the source groundwater are included in Appendix B.

The largest contributor to the evaporation ponds is cooling tower blowdown, which contains only a slightly higher concentration of natural salts than the groundwater used as feed water. Standard water conditioning chemicals will be added to the cooling tower water and the inlet evaporation cooler water. Such chemicals would include corrosion and anti-scaling inhibitors, such as orthophosphate or polyphosphate compounds. Biocides, such as chlorine or bromine, may also be added. Hydrochloric acid may also be added to the cooling water to control pH. Concentrations of all the water treatment chemicals in the wastewater would be low compared to other constituents. The Material Safety Data Sheets (MSDS) for water treatment chemicals will be provided under a compliance schedule.

The GBPGS will not be discharging wastes of an animal or human nature. Therefore, it is not necessary to characterize the discharge for biological components.

2.2 Discharge Rate and Volume

For detailed information regarding discharge rates, volumes, frequency, and duration, refer to the Preliminary Design Report prepared by IPT in Appendix A. In summary, the inflow rate to each impoundment varies from 650 gallons per minute (gpm) to 800 gpm, depending on the time of year. The highest discharge rate is anticipated to be approximately 800 gpm, occurring from January through March. The lowest estimated discharge rate, 650 gpm, is anticipated to occur from July through September. The average annual flow rate (weighted average) is 725 gpm. Generally, the discharge to the impoundments will be continuous, with flow rates varying with power demand. During drier than average climatic conditions, flow rates may be increased, and during wetter than average climatic conditions, flow rates can be decreased. In addition, aeration may be employed on a seasonal basis. The capacity of each of the five impoundments is listed above. The volume of water delivered to the impoundments on a daily basis is estimated to be approximately 3.4 acre-feet per day.

Table 2-1 Ambient Groundwater Quality-Regional Aquifer
Gila Bend Power Project
Gila Bend, Arizona

Parameters	Date Sampled	Sample ID C (5-5) 20 CBB		C (5-5) 20 DCC		Units
Chloride	06/21/2000	610		510		mg/l
Sulfate	06/21/2000	160		130		mg/l
Nitrate (as NO_3)	06/21/2000	2.1		2		mg/l
Alkalinity	06/21/2000	53		59		mg/l
Fluoride	06/21/2000	4.3		4.1		mg/l
pH	06/21/2000	8.0		8.02		pH units
Conductance	06/21/2000	2400		2100		umhos/cm
Temperature	06/21/2000	18		18		°C
Total Dissolved Solids	06/21/2000	1300		1100		mg/l
		Total	**Dissolved**	**Total**	**Dissolved**	
Calcium	06/21/2000	57	57	41	43	mg/l
Magnesium	06/21/2000	3.8	4	2.5	2.7	mg/l
Sodium	06/21/2000	410	410	360	370	mg/l
Potassium	06/21/2000	7.9	7.9	6.6	7.2	mg/l
Chromium	06/21/2000	<0.01	<0.01	<0.01	<0.01	mg/l
Copper	06/21/2000	<0.02	<0.02	<0.02	<0.02	mg/l
Lead	06/21/2000	<0.05	<0.05	<0.05	<0.05	mg/l
Silica	06/21/2000	32	34	31	32	mg/l
Antimony	06/21/2000	<0.05	<0.05	<0.05	<0.05	mg/l
Arsenic	06/21/2000	<0.05	<0.05	<0.05	<0.05	mg/l
Barium	06/21/2000	<0.01	<0.01	<0.01	<0.01	mg/l
Beryllium	06/21/2000	<0.004	<0.004	<0.004	<0.004	mg/l
Cadmium	06/21/2000	<0.005	<0.005	<0.005	<0.005	mg/l
Mercury	06/21/2000	<0.0002	<0.0002	<0.0002	<0.0002	mg/l
Nickel	06/21/2000	<0.05	<0.05	<0.05	<0.05	mg/l
Selenium	06/21/2000	<0.05	<0.05	<0.05	<0.05	mg/l
Silver	06/21/2000	<0.005	<0.005	<0.005	<0.005	mg/l
Thallium	06/21/2000	<0.05	<0.05	<0.05	<0.05	mg/l
Zinc	06/21/2000	<0.05	<0.05	<0.05	<0.05	mg/l

Notes:

<0.01 = Compound not detected above laboratory detection limit.

C (5-5) 20 CBB = Sample collected from a well located in Township 5 South, Range 5 West, Section 20.

Table 2-2. Predicted Discharge Quality
Gila Bend Power Project
Gila Bend, Arizona

Parameter	Predicted Concentration [1, 2]
pH	8.0 to 9.0
Temperature	90 degrees Fahrenheit
Total Dissolved Solids	19,500
Specific Conductance	30,500 [3]
Total Alkalinity	975
Calcium	2,800
Chloride	8,100
Fluoride	60
Magnesium	195
Potassium	105
Sodium	5,450
Sulfate	2,100
Antimony	ND [4]
Arsenic	ND
Barium	9
Beryllium	ND
Cadmium	ND
Chromium	ND
Copper	ND
Lead	ND
Mercury	ND
Nickel	ND
Nitrate	30
Selenium	ND
Silicate	450
Silver	ND
Thallium	ND
Zinc	ND

Notes

[1] Concentrations calculated from June, 2000 groundwater quality data from wells located in T 5 S, R 5 W, Section 20

[2] All values are expressed in milligrams per liter, unless otherwise noted

[3] micromhos per centimeter

[4] Constituent was not detected in original groundwater sample

Section 3.0 3.0

3 BEST AVAILABLE DEMONSTRATED CONTROL TECHNOLOGY

3.1 Introduction

Pursuant to A.R.S. § 49-243.B.1 and A.A.C. R18-9-108.B.5, a demonstration is required to justify that the GBPGS is designed in such a manner that any discharges will not have an adverse effect on the uppermost aquifer, and that the best control technology will be applied for protection of groundwater and reducing potential discharges.

The BADCT program allows consideration of the practicality of the application, where practicable is defined as "reasonably done from the standpoint of technical practicality and except for pollutants addressed in 49-243.I, and are economically achievable on an industry-wide basis".

The evaluation of BADCT for a facility includes identifying the "optimal" design of the facility; developing performance criteria; evaluating site characteristics in relation to their effectiveness in reducing discharge; and, evaluating whether other factors augment BADCT design for the facility. Based on the evaluation of these items, a final design is then selected for the facility.

3.2 Discharge Characteristics

Discharge characteristics, including anticipated discharge quality, rates, volumes, and frequency, are described in Section 2.0 and in the Preliminary Design Report prepared by IPT (Appendix A).

3.3 Site Characteristics

Surface Hydrology

The major natural surface water feature in the Gila Bend Basin is the Gila River, located approximately 3 miles north of the proposed GBPGS. Associated manmade features include Gillespie Dam, the Gila Bend Canal, Painted Rock Dam, and Painted Rock

Reservoir. An unnamed wash is located approximately 1,000 feet east of the proposed GBPGS. The GBPGS, including the proposed evaporation ponds, are not located within a 100-year floodplain (Section 4). The GBPGS has been designed to prevent wastewater from contacting surface water flows. Surface water will be diverted around surface impoundments as described in the Preliminary Design Report prepared by IPT (Appendix A).

Hydrogeology

The GBPGS is located within the Gila Bend Basin of the Basin and Range Physiographic Province. Basin-fill deposits include stream alluvium, an upper basin-fill, and a lower basin-fill deposit. Stream alluvium refers to unconsolidated deposits along the Gila River and its tributaries. Upper basin fill refers to those alluvial deposits that are unconsolidated to moderately consolidated. Lower basin fill consists primarily of weakly to highly consolidated gravel, sand, silt, and clay. The upper and lower basin-fill deposits comprise the principal aquifer of the Gila Bend Basin. Groundwater in the upper basin fill is generally unconfined to semi-confined. Perched, semiperched, or confined conditions can occur locally. Groundwater in the Gila Bend Basin is recharged primarily by infiltration of surface flows of the Gila River and its tributaries. Changes in water levels throughout the basin are governed by a complex interaction of groundwater and surface water. Depth to groundwater in the regional aquifer ranges from approximately 50 to over 75 feet below ground surface in the vicinity of the GBPGS. The direction of regional groundwater flow in the project vicinity is reported to be to the south (Rascona, 1993).

Site characterization activities at the site and in the vicinity of the site indicate that a perched aquifer exists at the site at a depth of approximately 25 feet below ground surface. Available information indicates that groundwater flow direction in this aquifer is generally to the northeast. Refer to Section 4.0 for a detailed description of regional and site geology/hydrogeology.

Geologic Hazards

The proposed location of the evaporation ponds meets prescriptive BADCT criteria. The evaporation ponds are not located within a 100-year floodplain. The site is located in the Basin and Range Physiographic Province in west-central Arizona and no geologic hazards are expected at the site. According to Menges and Pearthree (1989), this part of the state has witnessed little tectonic movement during the last 250,000 years. There also has not been an epicenter of earthquakes 6.0 or greater on the Richter scale recorded in Arizona in historic time (Péwé, 1989). Therefore, earthquakes are not expected to represent a significant geologic hazard at the site. In addition, the site is not located in an area of documented subsidence due to groundwater withdrawal or on landslide prone terrain.

3.4 Summary of BADCT Approach

The intent of the evaporation impoundment design is to meet the prescriptive design criteria established under the BADCT guidelines for qualifying double-lined impoundments. Five double-lined impoundments will be constructed at the GBPGS, each having an individual leak detection system. The surface impoundments will cover approximately 87 acres with a total capacity of approximately 625 acre-ft (not including a 2-ft freeboard). A BADCT matrix (Table 3-1) summarizing prescriptive BADCT and GBPGS control technology is included in this section.

Preferred BADCT for the evaporation ponds is outlined in the BADCT matrix (Table 3-1) and includes criteria for each of the following: site characterization; surface water control; geologic hazards; solution/effluent characterization; capacity and storage design; site preparation; liner specifications and; inspection criteria. As shown in the BADCT matrix, a high level of BADCT is demonstrated for the surface impoundments at the GBPGS.

Each of the surface impoundments will be constructed according to technical specifications outlined in Appendix A. The GBPGS will employ a Manager of Water Services who will inspect the impoundments weekly. A contingency plan for accidental discharges will be in place to mitigate any releases into the subsurface (Section 4).

Design

Five double-lined impoundments will be constructed at the GBPGS, each having an individual leak detection system. Four impoundments will be approximately 20 acres in size, and one impoundment will be approximately 7 acres. The total capacity of the surface impoundments is estimated at 625 acre-ft (not including a 2-ft freeboard). Water balance and storage capacity evaluations are included in the Preliminary Design Report prepared by IPT (Appendix A).

The composite liner system used for this facility consists of a primary 80 mil HDPE liner and a secondary 60 mil liner. A specific liner manufacturer has not yet been chosen. However, liner specifications for various manufacturers have been included in Appendix C. The liners at the GBPGS will either be one of these liners or a liner of equivalent or better quality. The attached information demonstrates that the anticipated wastewater quality for the GBPGS is compatible with the type of liner chosen for the facility. Specifically, documentation from Poly-Flex indicates that salts have no effect on HDPE

Table 3-1. BADCT MATRIX – Evaporation Ponds
Gila Bend Power Project
Gila Bend, Arizona

RESERVOIRS	HAZARD RANKING	PRESCRIPTIVE BADCT CRITERIA	Gila Bend Power Partners, L.L.C.
Evaporation Ponds	medium to high	**Site Characterization** • Identify site characteristics • Determine depth and flow direction of groundwater.	The proposed facility location consists of native desert. Land in the vicinity of the proposed facility consists of native desert and agricultural land. The site is not located within a 100-year floodplain. Depth to groundwater is approximately 25 feet bgs (uppermost, perched aquifer). Groundwater flow direction in the uppermost aquifer is generally to the northeast (Section 4)
		Surface Water Control • Impoundment cannot be located in 100-year floodplain. • Diversion and retention structures must be designed to convey a 100-year, 24-hour storm event or design event per other regulatory program, whichever is greater.	No impoundments are located in a 100-year floodplain (Figure 4-10). GBPP designed site drainage for 100-year, 24-hour storm event (Appendix A).
		Geologic Hazards Impoundment cannot be located in: • areas of documented subsidence due to groundwater withdrawal • seismically active areas with Holocene displacement • landslide prone terrain • areas of known geologic instability	Site is not located in area of geologic hazards (Section 3).
		Solution/Effluent Characterization Identify the following characteristics of contained constituents: • Chemical characteristics • Physical characteristics • Temperature • pH • Other parameters, as needed for liner design	Estimated water quality parameters included in Table 2-2. Effluent characterization samples will be collected and analyzed under a Compliance Schedule. Specifications for Poly-Flex, HDPE liners indicate that salts have no effect on HDPE (Appendix C).
		Capacity and Storage Design Impoundment must be designed to contain: • 100-year, 24-hour design storm event or design event	IPT designed site drainage for 100-year, 24-hour storm event (Appendix A).

Table 3-1. BADCT MATRIX – Evaporation Ponds
Gila Bend Power Project
Gila Bend, Arizona

RESERVOIRS	HAZARD RANKING	PRESCRIPTIVE BADCT CRITERIA	Gila Bend Power Partners, L.L.C.
		per other regulatory program, whichever is greater. • Estimated volume of inflow seepage. • Additional 2 ft. of freeboard.	IPT designed the surface impoundments to allow for two feet of freeboard (Appendix A).
		Site Preparation • Salvage and/or relocate native plants. • Grub and grade the area. • Subgrade to consist of, at a minimum, 6 inches of native or natural materials compacted to 95% maximum dry density. • Side slopes no steeper than 2:1.	The site will be properly prepared prior to construction. Refer to technical specifications for earthwork (Appendix A).
		Liner Specifications • Double liner system with a lower composite liner and upper flexible membrane liner. • Lower composite liner to be a single flexible membrane liner of at least 30 ml thickness (exception - 60 mil., if proposing HDPE) over a minimum 6 inches of 3/8" minus native or natural materials compacted to achieve a saturated hydraulic conductivity no greater than 10^{-6}cm/sec. • Upper flexible membrane liner to be of at least 30 mil. thickness (exception - 60 mil if proposing HDPE), and UV resistant for areas exposed to sunlight. • Liner secured by an engineered trench. • QA/QC for liner installation, operation, and maintenance.	Technical specifications for surface impoundments are included in Appendix A. A description of the surface impoundments is included in Section 3. HDPE liner specifications indicate resistance to UV radiation (Appendix C). Proposed QA/QC plan for liners is included as Appendix A.
		Leachate Collection and Removal System • System consists of a drainage layer of sand, gravel, geonet, or other permeable material located between the two synthetic liners. • Drainage layer media must achieve a hydraulic conductivity of 10^{-2} or greater and be chemically	Technical specifications for the LCRS are presented in Appendix A.

Table 3-1. BADCT MATRIX – Evaporation Ponds
Gila Bend Power Project
Gila Bend, Arizona

RESERVOIRS	HAZARD RANKING	PRESCRIPTIVE BADCT CRITERIA	Gila Bend Power Partners, L.L.C.
		compatible with the solutions discharged to the impoundment. • Geonet or a minimum 12-inch thick layer of granular material. A three percent slope is required to promote drainage to a collection sump. • The system must be connected to a sump for solution extraction and leachate monitoring. • A leak collection pipe system may be required between the liners. • The system will be designed to receive a pump capable of pumping the necessary volume in order to maintain less than one foot of head on the bottom liner.	The sump is 18 inches in diameter. The calculated Alert Levels range from approximately 2,000 gal/day to 20,000 gal/day. The sump is large enough to house a pump that can accommodate this amount of leakage.
		Inspection Criteria • Inspection to be instituted at the time of impoundment construction and on a quarterly basis thereafter or after a major storm or surface water event. • Inspection to include visual survey to evaluate liner integrity. Physical monitoring of impoundment design, including presence of minimum freeboard. • Develop and implement Contingency Plan approved by ADEQ that specifies permittee courses of action to be taken in event of an accidental discharge. • Inspection records are to remain onsite	Technical specifications for surface impoundments included in Appendix A. Surface impoundments will be inspected weekly by a Water Services Manager. Inspections will also occur following a major storm or surface water event (Appendix J). Contingency plan adheres to ADEQ requirements for facilities employing prescriptive BADCT (Section 4 and Appendix J). Inspection records will be maintained on site.
		Closure/Post-Closure • Permanent closure by evaporation or physical removal of contained solution and proper disposal of sludge to landfill. • Liners and areas under the liners are to be inspected for damage resulting from facility operation and remediation undertaken, if warranted. • After removal or backfilling, site is to be graded such that the site does not impound or collect liquids.	The GBGS will be closed per clean closure requirements. A closure strategy is presented in Section 4.

and that the physical properties are not significantly changed. In addition, the liners presented in Appendix C have an anticipated lifetime of "many decades" under normal operating conditions. The HDPE is formulated to resist ultraviolet rays for "many decades". Typically, carbon black has been added to the product to improve performance under long-term UV exposure. Physical characteristics of HDPE are described in the attached property tables. The tables show information on tensile strength, elongation, tear resistance, stress crack resistance, oxidative induction and oven aging as UV resistance. The tests of oxidative induction and UV resistance are used to characterize effects from long-term exposure to sun. Oven aging tests describe effects from temperature. Most HDPE products perform the same for these tests. Manufacturer's specifications indicate that the liner will last "many decades". The expected lifetime of the facility is approximately 40 years. The GBPGS will conduct frequent inspections of liners to ensure that, as the liners age, their integrity is not compromised.

The side slopes of the impoundments are sloped at 3:1 and the bottom of each impoundment slopes to a centrally located leak collection sump at a 0.5% slope. Solution collected in this leak collection sump is conveyed through 6-inch HDPE SDR17 collection pipes and directed into one of the five inspection sumps. Solution from these inspection sumps is then pumped back into the impoundments.

The evaporation impoundments are designed in such a manner to allow for regular removal of deposits. The soil overliner and free draining gravel layers protect the composite liner system from being damaged during removal of deposits. Loaders and trucks will be used to excavate the deposits and transport them for disposal.

Action Response Levels

Action Response Levels (ARLs) were calculated for the evaporation impoundments in accordance with Appendix I of the model expedited permit developed by ADEQ (1998). The ARLs are calculated to identify exceedances which activate contingency plans. Two action levels, ARL #1 and ARL #2, are required for each impoundment. ARL #1 assumes that seam defects may occur and result in a 3.1 mm^2 hole. An exceedance of this level activates a contingency plan that includes notifying ADEQ, assessing the condition of the liner, and submitting a corrective action plan to ADEQ for approval. ARL #2 assumes failure in the geomembrane with an 11.3 mm^2 hole. An exceedance of ARL #2 activates a contingency plan that includes notifying ADEQ, identifying leak locations within three days, ceasing disposal to the surface impoundment, and submitting a corrective action plan to ADEQ for approval. This contingency plan also includes collecting samples from the LCRS sump for laboratory analysis and preparing a report for the APP Compliance Unit that describes the remedial action plan taken to repair the system. Action Response Level calculations are presented in Appendix D.

ARL #1 is calculated as **5,369.48 gal/day**, per impoundment, for impoundments 1, 2, 3, and 4.

ARL #1 is calculated as **1,933.8 gal/day** for impoundment 5.

ARL #2 is calculated as **19,572.64 gal/day**, per impoundment, for impoundment 1, 2, 3, and 4.

ARL #2 is calculated as **7,049 gal/day** for impoundment 5.

These calculations were based on the following assumptions:

1. Impoundments #1, #2, #3, and #4 are the same size: approximately 20 acres.

2. Impoundment #5 is 7 acres in size.

3. The beginning depth of each basin is 7 feet, including 2 feet of freeboard.

4. The average depth of impoundment 1, 2, 3, and 4 is 6.7 ft (2.04m).

5. The average depth of impoundment 5 is 7 ft (2.16m).

The sump has been designed to handle the amount of water indicated by the ARLs. The system is designed to receive a pump capable of pumping the necessary volume in order to maintain less than one foot of head on the bottom liner. The sump diameter is 18 inches, large enough to receive a pump that can maintain necessary water levels. Leakage through the composite liner system will be collected in the sump. A solution-level sensor will be placed in the inspection sump to prompt the need for sump evacuation. The solution will then be pumped out and returned to an adjacent impoundment. A description of the leak collection and removal system (LCRS) is provided in Appendix A.

Estimate of Facility Discharge

An estimate of facility discharge to the vadose zone was calculated for all five evaporation impoundments in accordance with the BADCT guidance document developed by ADEQ (July 1996). The discharge was calculated using an equation developed for the rate of leakage through a composite liner with a 10 mm^2 hole in the liner. The facility discharge calculations are presented in Appendix E.

The discharge from the GBPGS was estimated to be **6.25 gal/day** for all five impoundments. This calculation was based on the following assumptions:

1. Good contact between the lower liner and the low permeability soil.

2. One hole occurs per acre (4000 m^2).

3. The hydraulic conductivity of the low permeability soil underlying the liner is 1 x 10^{-6} cm/sec.

4. The area of the hole is assumed to be 10 mm^2.

3.5 Construction Specifications and Quality Assurance

Construction specifications and quality assurance documentation is provided in the Preliminary Design Report prepared by IPT (Appendix A). As discussed previously, a specific liner manufacturer has not yet been chosen for the GBPGS. However, technical specifications have been provided for ADEQ's review. In addition, the liner chosen will be of equal or higher quality than the liners for which information has been provided (Appendix C). Furthermore, during installation the seams will be routinely inspected for quality control during installation and, following installation of the liner system, the LCRS will be tested for effectiveness as described in the Preliminary Design Report (Appendix A).

3.6 Operation and Maintenance

The operation and maintenance of the surface impoundments is described in the Preliminary Design Report (Appendix A). In general, operation and maintenance at the GBPGS consists of three components. These include the inflow of excess cooling tower water, the evaporation of water contained in the impoundments, and the removal of salt deposits.

3.7 Closure Strategy

Within 90 days of final closure, the GBPP will submit a closure plan to ADEQ. Following ADEQ's approval, the closure plan will be implemented. For permitting purposes, the following clean closure strategy is presented.

At final closure, residual liquid in the surface impoundments will be allowed to evaporate. Any residual solids remaining in the surface impoundments following evaporation will be sampled and analyzed for metals. The residual solids will be disposed of off-site. Impoundment liners will be removed and disposed of in accordance with applicable regulations. If, during removal activities, the liner is observed to be defective and contamination is suspected to be present in the subsurface, the GBPP will develop a site characterization plan to characterize the impact on the subsurface. The plan may include collecting surface samples or advancing soil borings to collect samples to be analyzed for metals. Once liners are removed and following any necessary site characterization activities, the area will be regraded and revegetated to promote positive drainage. Since the surface impoundments will be closed using clean closure procedures, post-closure care will not be required. Cost estimates for closure are presented in Section 6.

Impacts on Future Use

Since the surface impoundments will be closed per clean closure requirements, no significant impacts on future land use are anticipated. In addition, the evaporation ponds have been designed to meet prescriptive BADCT and significant discharges to the subsurface are not anticipated. Therefore, the facility is not expected to impact the existing groundwater quality. Furthermore, a groundwater supply study conducted by Hargis (2000), indicates that the facility will cause approximately 0.3 to 0.5 feet of drawdown per year in the regional aquifer. This amounts to a total drawdown of approximately 12 to 20 feet over the 40 year estimated lifetime of the facility. It is unlikely that this amount of drawdown will cause significant impacts to future site usage.

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Section 4.0

4.0

4 DEMONSTRATION OF COMPLIANCE WITH STANDARDS

The APP program requires that the permit applicant provide a demonstration that the facility will not cause or contribute to a violation of AWQS at the applicable point(s) of compliance. Where AWQS are already exceeded in a particular aquifer, the permit applicant will provide a demonstration that no additional degradation will occur. Demonstration of compliance with standards for the GBPGS includes:

- Describing surface and subsurface geology and hydrology
- Presenting ambient groundwater quality data
- Mapping the potential discharge impact area for the site
- Describing any anticipated impacts the facility will have on groundwater flow direction or groundwater quality
- Establishing a point of compliance in the uppermost aquifer
- Demonstrating that the facility will not cause or contribute to a violation of AWQS at the applicable POC

4.1 Site Characteristics

Subsurface investigations have been conducted at and in the vicinity of the GBPGS in connection with a groundwater supply study, a geotechnical investigation, and with a proposed landfill site located south of the GBPGS. As a result, considerable information regarding site-specific geologic and hydrogeologic conditions has been collected. Geologic and hydrogeologic information compiled in this APP is based on the following sources:

- logs of 60 soil borings advanced to the south and west of the proposed GBPGS (Malcolm Pirnie, Inc., 1996)
- geotechnical investigation at the site (Ninyo & Moore, 2000)

- geotechnical laboratory results of 20 soil samples collected to the south and west of the GBPGS which were analyzed for permeability, plasticity index, dry density, unconfined compression, consolidation and/or moisture content (Malcolm Pirnie, 1996)

- logs of 14 test pits excavated in the vicinity of the GBPGS during a geotechnical investigation (Malcolm Pirnie, 1996)

- logs and data collected during the construction of 6 monitoring wells to the south of the GBPGS and subsequent monitoring (Malcolm Pirnie, 1996)

- data collected from groundwater wells investigated during water supply investigations (Hargis, 2000)

4.2 Geology

Hargis (2000) completed a review of regional and site geology and hydrology. Much of the information presented below is paraphrased from Hargis' report entitled, *Gila Bend Power Project Groundwater Assessment* (2000).

4.2.1 Regional Geology

The GBPGS is located in the Basin and Range Lowlands Physiographic Province of Arizona. The Basin and Range Physiographic Province is characterized by isolated mountain ranges separated by alluvial valleys and basins. Most of the mountain ranges follow a northwest-trending alignment (Montgomery and Harshbarger, 1989).

The regional geology of the Gila Bend Basin area has been described by several researchers including studies by the U.S. Bureau of Reclamation (BOR), U.S. Geological Survey (USGS), and various state agencies (Oxford and Bender, 1973; Johnson and Cahill, 1955; Wilson et al., 1957). For the purposes of this report, rocks present within the region are broadly divided into bedrock and basin-fill deposits. Bedrock outcrops in the mountain areas along the margins of the Gila Bend Basin.

Bedrock

The Gila Bend Basin is enclosed by bedrock outcrops except for an area on the southwest between the Painted Rock and Sauceda Mountains (BOR, 1976a). Volcanic outcrops between the Sauceda and Painted Rock Mountains are probably remnants of the Sentinel lava flow. The Sentinel lava flow consists of Quaternary basalt and occupies about 225 square miles of southwestern Maricopa County to the west of the Gila Bend Basin (Oxford and Bender, 1973). Basalt, probably from this flow, also occurs along the western edge of the basin at shallow depths between 80 and 150 feet below land surface (bls).

Other igneous rocks are found in the mountains surrounding the basin. These include Precambrian granites of varying ages found in all the mountains except the Sauceda and Painted Rock Mountains. Younger granites formed during the Laramide Orogeny outcrop out in the Buckeye Hills and the Painted Rock Mountains. Quaternary basalt and Cretaceous andesite occur in the Gila Bend, Sand Tank, Sauceda, and Painted Rock Mountains. Metamorphic rocks include older Precambrian granite gneiss found in the southeastern tip of the Gila Bend Mountains and older Precambrian schist in the Sand Tank Mountains, Maricopa Mountains, and the White Hills. Sedimentary rocks composed of Tertiary sand, gravel and conglomerates are found mainly in the Sand Tank Mountains. A 200-foot cliff of steeply tilted sandstone beds occurs in the extreme southwestern part of the Gila Bend Mountains (Johnson and Cahill, 1955).

Alluvial Deposits

The BOR divided the alluvium of the Gila Bend Basin into three units identified as the upper alluvial unit, the middle fine-grained unit, and the lower conglomerate unit.

- The composition of the upper alluvial unit is not defined by the BOR, but is reported to range in thickness from 0 to 1,000 feet (BOR, 1976a). Approximately 300 to 500 feet of coarse- to fine-grained deposits overlie the locally named Sil Murk Formation (of the middle fine-grained unit) in the upper alluvial unit south of the Gila Bend Mountains (Heindl and Armstrong, 1963). These deposits were laid down from the late Tertiary to the early Quaternary Period when the main surface-water drainage from the basin was probably around the south end of the Painted Rock Mountains (Heindl and Armstrong, 1963).

- The middle fine-grained unit includes the Sil Murk Formation. The middle fine-grained unit ranges in thickness from 0 to 700 feet and is found primarily in that part of basin west of Gila Bend but may extend further east (BOR, 1976a). The Sil Murk Formation is comprised mainly of pebble- to boulder-sized conglomerates with thin interbedded volcanics near the top (BOR, 1976a), and is probably late middle Tertiary in age (Heindl and Armstrong, 1963). The top of the Sil Murk Formation marks an old erosional surface upon which the upper alluvial unit is deposited. This surface dips gently to the west and south and more steeply to the east away from the Gila Bend Mountains (Heindl and Armstrong, 1963).

- The surface of the lower conglomerate unit ranges from about 600 feet above msl in the northern part of the basin to over 600 feet below sea level near Paloma

Ranch. The age of the lower conglomerate is unknown. Locally, it may exceed 1,000 feet in thickness (BOR, 1976a).

4.2.2 Site Geology

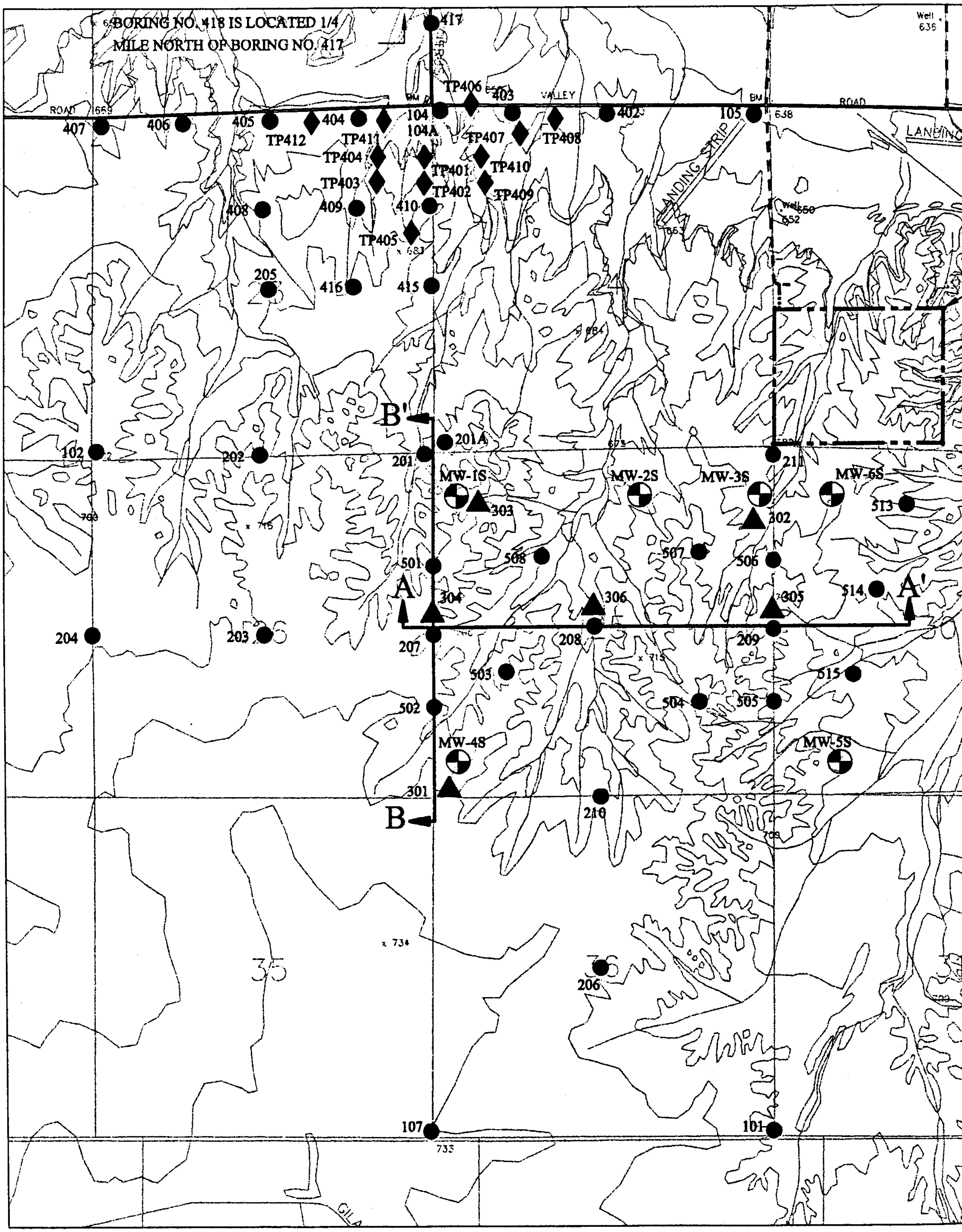
Surficial geology in the site vicinity consists of deposits of the Upper Basin fill, consisting predominantly of sands with varying amounts of silt. Much of the area is covered with desert pavement, a surface veneer of pebbles and cobbles. The topography slopes gently toward the Gila River to the north and northeast. Surface elevations range from approximately 650 to 680 feet above mean sea level (amsl).

A number of investigations were conducted to the south and west of the site between October 1995 and June 1996. These investigations were conducted as part of a landfill siting project and included drilling and soil sampling, test pit excavations, monitoring well installation, groundwater sampling, and groundwater level measurements.

As part of these site characterization activities, 60 soil borings were advanced, ranging in depth from 15 to 260 feet below ground surface (bgs). Fourteen test pits were excavated and six groundwater monitoring wells were installed (Figure 4-1). A generalized geologic cross section for those sample locations is provided as Figure 4-2. Logs and construction diagrams are included in Appendix F.

The materials encountered in the soil borings generally consisted of sand and silty sand overlying clay with interbedded sand and clay. The lithology encountered during drilling activities has been interpreted as braided stream deposits (Malcolm Pirnie, Inc., 1996). The boring logs in Appendix F provide detailed descriptions of variations in lithology encountered during drilling activities. It is apparent from the geologic cross sections that, in the areas investigated, coarse-grained units are present from the ground surface to approximately 80 to 100 feet bgs. Finer-grained units are present beneath the coarser grained units. Subsurface investigation determined that these finer-grained sediments act as a perching unit (Malcolm Pirnie, Inc., 1996).

Ninyo & Moore (2000) conducted a geotechnical investigation at the site. Six soil borings were advanced in the vicinity of the plant site and two soil borings were advanced in the vicinity of Impoundments #3 and #4. The soil borings were advanced to depths ranging from approximately 18 feet to 26 feet bgs. The materials encountered in the soil borings generally consisted of silty sand and poorly graded sand. Clayey gravel and clayey sand were also encountered in some soil borings. Groundwater was encountered in one soil boring, B2, at an approximate depth of 24 feet bgs. Groundwater was not encountered in any of the other borings, however none of the other borings were advanced deeper than 20 feet bgs. Field maps of soil boring locations and corresponding lithologic logs are included in Figure 1-4 and Appendix F. A copy of Ninyo & Moore's



GILA BEN

AQUIFER PROTEC

SOIL BORINGS, TEST PITS

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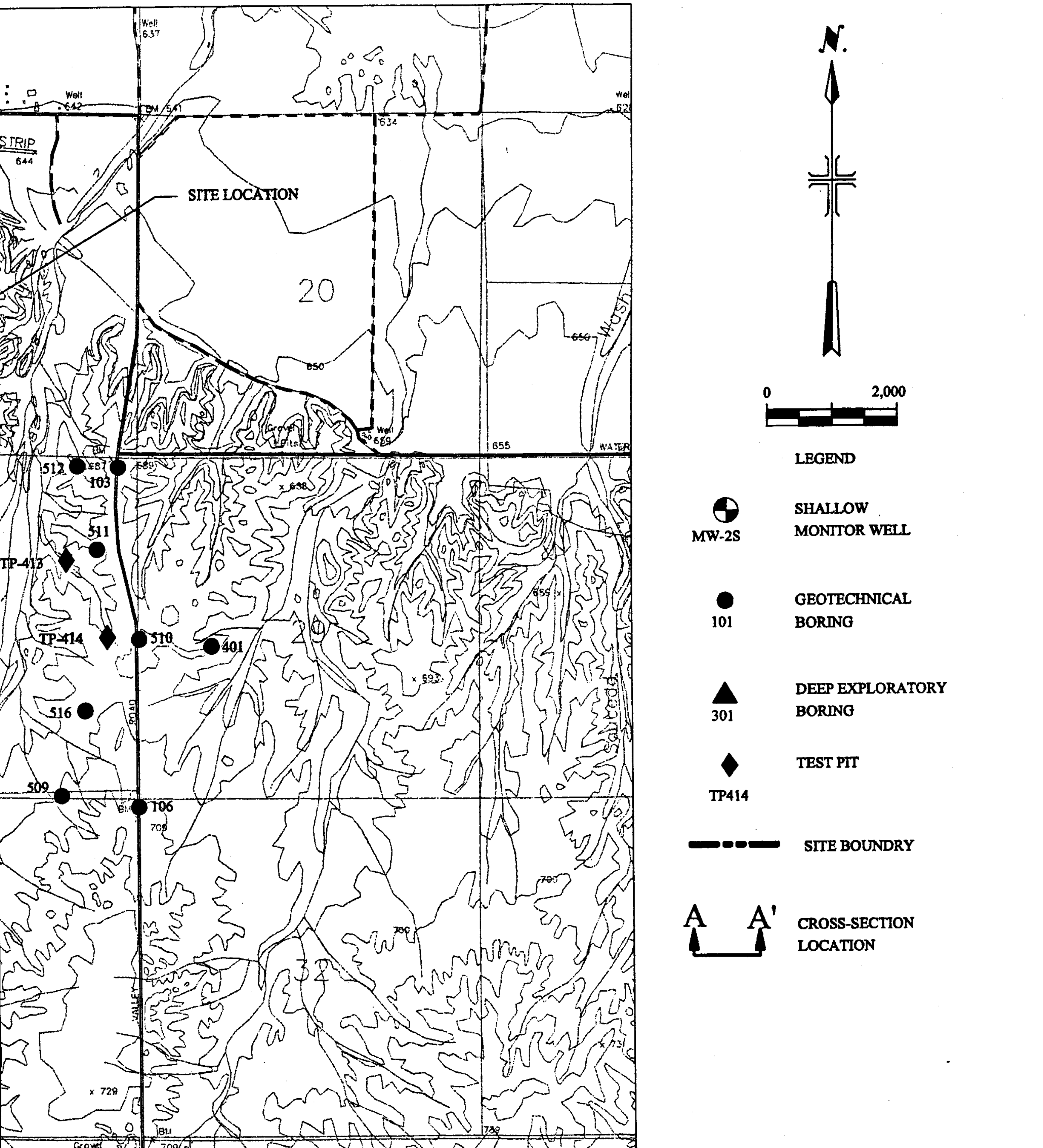
User:CADD Spec:ACAD File:M:\3962001\APP\Figures\FIG4-1.DWG Scale:1:2000 Date:10/30/2000 Time:13:19 Layout:Layout1



BASE MAP SOURCE: USGS SMURR
ARIZONA, 1973

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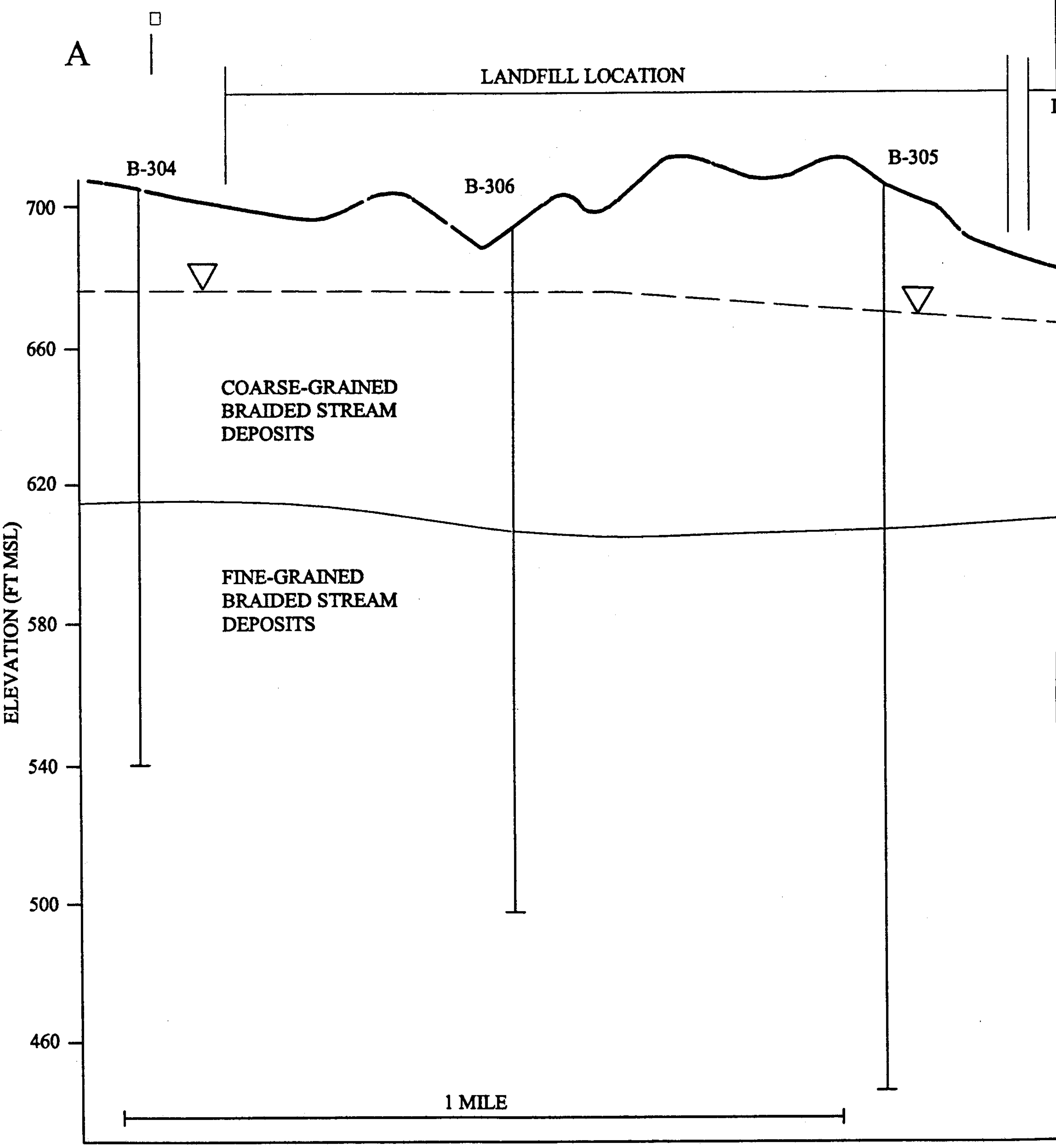
AND MONITOR WELL LOCATIONS

FIGURE 4-1



CROSS-SECTION A-A'

VERT SCALE: 0 40 80 SCALE IN FEET

HORIZ SCALE: 0 1000 2000 SCALE IN FEET

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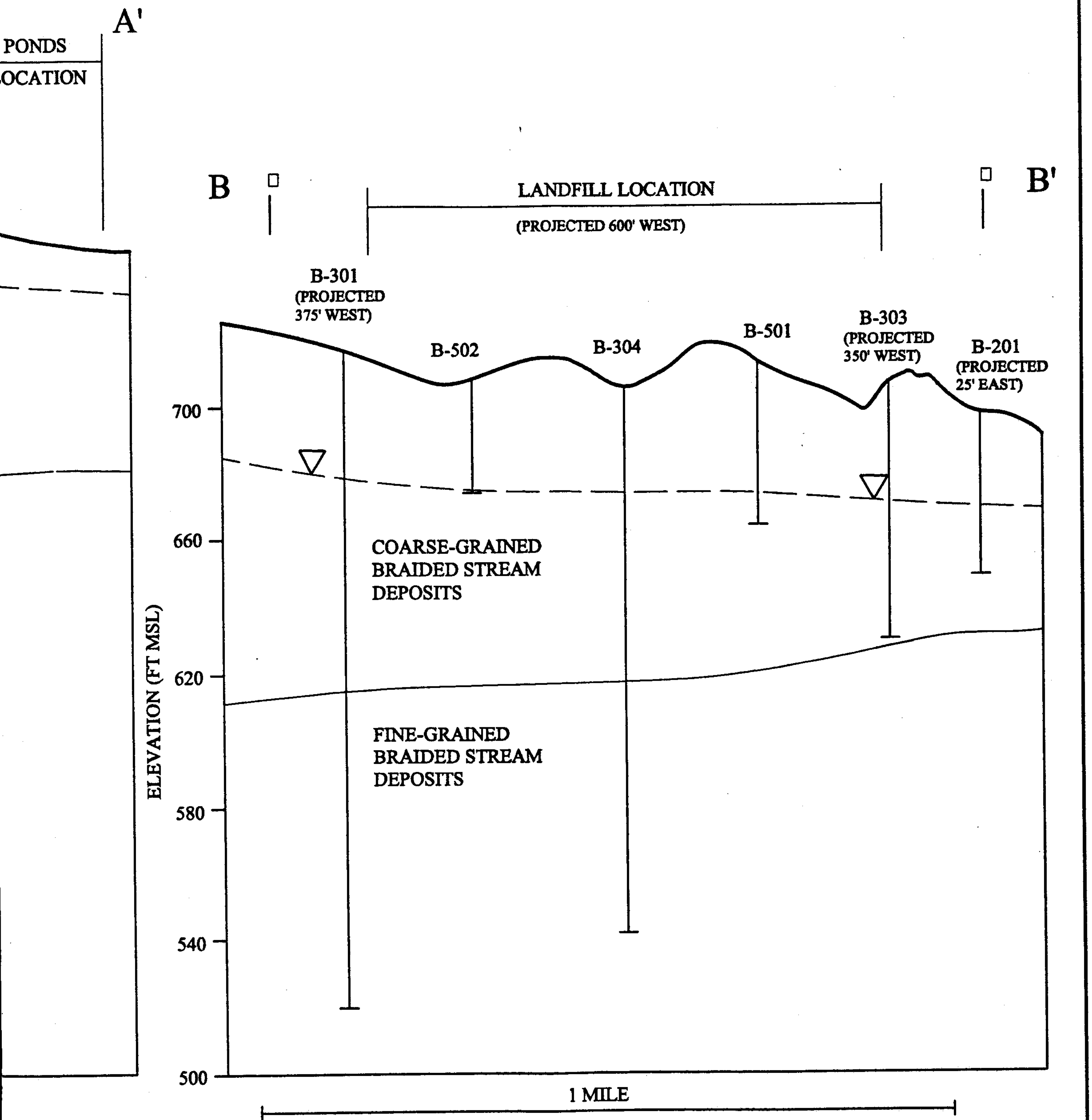
AQUIFER PROTECT

HYDROGEOLO

User:CADD Spec:ACAD File:M:\3962001\APP\Figures\FIG4-2.DWG Scale:1:1 Date:10/30/2000 Time:13:22 Layout:Layout1



CROSS-SECTION B-B'

VET EX = 25X

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GIC CROSS-SECTIONS

FIGURE 4-2

report is included in Appendix A. The lithology encountered during the geotechnical investigation was similar to that encountered during previous investigations conducted in the site vicinity.

4.3 Hydrogeology

4.3.1 Regional Hydrogeology

The regional hydrogeology of the GBB has also been described by several researchers including studies by the US Bureau of Reclamation, US Geological Survey, and various state agencies (Oxford and Bender, 1973;Johnson and Cahill, 1955; Sebenik, 1981, Rascona,1993) Additional hydrologic data were obtained from the Arizona Department of Water Resources (ADWR) and the USGS (ADWR, 2000a, 2000b, and 2000c). The following description of regional hydrogeology is paraphrased from Hargis (2000).

Hydrogeologic Units

A review of the literature and available data indicate that basin-fill deposits are the main waterbearing units within the region. The basin-fill deposits can be further subdivided into three distinct units based on lithology: 1) stream alluvium; 2) the upper basin-fill unit; and 3) the lower basin-fill unit (BOR, 1976; Rascona, 1993). This nomenclature will be adopted for this permit application.

For the purposes of this permit application, terms proposed by Anderson, Freethey and Tucci (1990) to describe the basin fill of alluvial basins in south central Arizona are used for convenience in defining the hydrogeology of Gila Bend Basin area. Stream alluvium refers to the unconsolidated deposits along the Gila River and its tributaries. It ranges in age from late Pliocene to Holocene. Upper basin fill refers to those alluvial deposits that are unconsolidated to moderately consolidated and include most of the upper alluvial unit identified by the BOR. Lower basin fill refers primarily to weakly to highly consolidated gravel, sand, silt, and clay, which includes most of the middle fine-grained unit, the Sil Murk Formation, and lower conglomerate unit identified by the BOR. In general, lower basin fill represents deposition in topographically closed basins with interior drainage and upper basin fill represents deposition during a transition period from a closed- to integrated-drainage basin.

The basin-fill north of Gila Bend is relatively thin due to the presence of pediments, and locally contains interbedded volcanics (Wolcott, 1953). Driller's logs show extensive pediments on the eastern part of the basin north of Gila Bend, but virtually none on the west where the basin fill is up to 1,480 feet thick. East of the Gila River, the basin fill is generally not much thicker than 1,000 feet and decreases in thickness to the east as the pediments are encountered. Driller's logs show the upper basin fill near Gila Bend is at least 1,622 feet thick. The lower basin fill is at least 160 feet thick near Gila Bend. East of Gila Bend the upper basin fill is at least 2,158 feet thick. The thickness of the lower basin fill in this area is unknown.

The upper and lower basin-fill units comprise the principal aquifer of the GBB. Groundwater in the upper basin fill is generally unconfined to semi-confined. Perched, semiperched, or confined conditions occur locally (BOR, 1976a). Well yields in the GBB range from 1,000 to 5,000 gpm, with well yields north of Gila Bend having yields less than wells west of Gila Bend.

Groundwater in the GBB is primarily recharged by infiltration of surface flows of the Gila River and its tributaries. Other sources of recharge include infiltration of surface water applied to agricultural land and underflow from the Hassayampa sub-basin of the Phoenix Active Management Area north of Gillespie Dam. Changes in water levels throughout the GBB are governed by complex interactions of groundwater and surface water. Water-level declines occur primarily in response to the pumping of wells during periods of low flow in the Gila River. During periods of high flows, water levels may rise despite large withdrawals of groundwater from wells.

West of Gila Bend, on Paloma Ranch, groundwater in the lower basin fill is primarily unconfined except possibly where fine-grained deposits are present causing the groundwater to be locally semi-confined to confined (BOR, 1976a). Water level elevations in four wells measured in 1993 on Paloma Ranch are 40 to more than 100 feet higher than those of surrounding wells. The depth to water in these four wells range from 65 to 109 feet bgs. The vertical head differences observed in these wells are probably the result of the heterogeneous nature of the regional aquifer in this area combined with specific well depth and perforated interval of the individual wells rather than the existence of an areally extensive separate aquifer. All four driller's logs of these wells show significant clay layers ranging from 150 to 500 feet thick at various depths. West of Gila Bend, under unconfined conditions, depth to water increases southward and ranges from 125 to 323 feet bgs.

North of Gila Bend, unconfined groundwater occurs primarily in the sands and gravels of the basin fill and may occur in the interbedded volcanics (White, 1963). Groundwater levels north of Gila Bend are shallowest west of the Gila River and generally increase in depth toward the east side of the basin. Depths to groundwater increases from 12 feet bgs west of the river to 351 feet bgs about 5 miles east of the river. Depth to water ranges from 31 to over 400 feet bgs near Gila Bend. Depth to water generally increases with increasing distance from the river due primarily to rising land-surface altitude.

According to Heindl and Armstrong (1963), the Sil Murk Formation is one of the principal waterbearing formations of the area north of Gila Bend. This formation is part of the lower basin fill and is interconnected with the upper basin fill. It does not constitute a separate aquifer. Heindl and Armstrong (1963) believed the Sil Murk Formation extends under the upper basin fill from the northwest toward Gila Bend and possibly beyond. Driller's logs from wells in Section 33, Township 5 South, Range 5 West, and Section 2, Township 6 South, Range 3 West show the volcanic member of the Sil Murk Formation occurring at depths bgs of 1,622 to 1,782 feet and 2,158 to 2,209 feet, respectively.

Recharge and Movement

Infiltration of surface flow from the Gila River is the primary source of recharge to the GBB. However, streamflow in the Gila River and its tributaries varies greatly from year to year. Johnson and Cahill (1955) estimated that at least half of the total flow of the Gila River through the GBB is recharged to the groundwater reservoir. Turner (1956) suggested that approximately 28,000 acre-feet of surface water is recharged annually to the groundwater reservoir of the basin during average or dry years. The potential recharge during years with greater than normal flow could greatly exceed this amount. Since 1976, net surface-water flow into the basin (inflow minus outflow) has been greater than total groundwater pumpage. Net surface water into the GBB from 1976 to 1993 was 4,603,000 acre-feet. Groundwater pumpage from the basin was 3,917,000 acre-feet over this time period. Therefore, there was a maximum gain to the aquifer of approximately 700,000 acre-feet from recharge (Rascona, 1993). Other sources of recharge include infiltration of irrigation water and underflow from the Hassayampa sub-basin of the Phoenix AMA.

The direction of groundwater flow in the GBB area is controlled by the location of sources of recharge and the location of major areas of agricultural pumping. Groundwater recharged in the northern part of the basin by surface flows of the Gila River generally moves in an easterly direction as a result of heavy pumping east of the river. Contributing to this flow pattern, bedrock to the west of the river acts as a barrier to groundwater flow. As the river bends to the west around the southern tip of the Gila Bend Mountains, groundwater flow continues in an east-southeasterly direction before turning sharply to the southwest. The overall flow direction of groundwater south of Gila Bend is to the southwest.

Cahill and Wolcott (1955) were the first to suggest groundwater principally flowed out of the GBB south of the Painted Rock Mountains. There is also evidence that the Gila River once flowed out of the basin through this area after a lava flow dammed its path through the Painted Rock Narrows (Turner, 1956). Contours of groundwater-elevations suggest that most of the groundwater in the western part of the GBB presently moves south away from the Painted Rock Reservoir area and exits the basin south of the Painted Rock Mountains. Lava flows associated with the Sentinel Plain lava flow in this area overlie alluvium, are too thin and occur at depths too shallow to act as barriers to groundwater flow.

4.3.2 Regional Surface Water Hydrology

The major natural surface water feature in the Gila Bend Basin is the Gila River, located approximately 3 miles north of the proposed GBPGS. Associated manmade features include Gillespie Dam, the Gila Bend Canal, the Enterprise Canal, Painted Rock Dam, and Painted Rock Reservoir. The Gila River enters the Gila Bend Basin from the north at Gillespie Dam, flows south toward Gila Bend, and then bends around the Gila Bend Mountains and exits at Painted Rock Dam. The flow of the Gila River at Gillespie Dam is perennial, predominately due to a combination of effluent discharge upstream, return flow of agricultural irrigation water, and groundwater pumped into the river for drainage purposes by the Buckeye Irrigation District. Gillespie Dam was constructed in 1921 to divert all non-flood flows of the Gila River entering the basin to the Gila Bend and Enterprise Canals. The canals supply water to most of the farmland in the Gila Bend Basin (U.S. Army Corps of Engineers, 1994).

Painted Rock Dam was completed in 1960 to control all upstream floods up to approximately 300,000 cubic feet per second (ft^3/sec) peak flow, and has a maximum controllable discharge of 22,500 ft^3/sec (U.S. Army Corps of Engineers, 1962). Painted Rock Reservoir, created by the dam, inundates approximately 53,200 acres and has a capacity of approximately 2,476,300 acre-feet at the dam spillway crest, which is 661 feet above mean sea level (msl) (U.S. Army Corps of Engineers, 1994). The operational maximum flood release was exceeded for the first time in February 1993 at a peak outflow of 25,600 ft^3/sec (U.S Army Corps of Engineers, 1994).

4.3.3 Site Hydrogeology

Malcolm Pirnie, Inc. reviewed well construction information and water level data for wells located in the vicinity of the GBPGS. MPI reviewed information for wells located in Township 5 South, Range 5 West, Sections 18, 19, and 30 and in Township 5 South, Range 6 West, Sections 13, 24, and 25. Data obtained from ADWR and Hargis (2000) indicates that water levels range from 24 to 73 feet bgs. Well depths range from 39 feet to 1,135 feet bgs. A review of historical data and hydrographs in the area of the GBPGS indicates that water levels in the regional aquifer have gradually risen since the late 1970s (Rascona, 1993). This rise in groundwater may be due to the cessation of pumping near the project area.

Malcolm Pirnie, Inc., conducted site characterization activities for the proposed Gila Bend Regional Landfill in 1996. Site characterization activities were conducted in Sections 29, 30, and 31 of Township 5 South, Range 5 West, and in Sections 23, 24, 25, 26, and 36 of Township 5 South, Range 6 West. Groundwater monitoring wells were installed to the south of the GBPGS in Section 30 of Township 5 South, Range 5 West, and in Section 25 of Township 5 South, Range 6 West (MW-1S through MW-6S, Figure 4-1). Site characterization activities at the proposed Gila Bend Regional Landfill site indicated that perched groundwater occurs in alluvium. The mean grain size of the aquifer, based on sieve analyses, is approximately 0.05 cm (geotechnical results are presented in Appendix G). The hydraulic conductivity of the aquifer based on slug tests in monitor wells MW-1S and MW-2S is approximately $1x10^{-2}$ cm/s. Slug test data is included in Appendix H. The perching unit is a fine-grained unit, consisting primarily of clay with some interbedded sand. The vertical permeability of the clay, as determined in a laboratory permeator using an undisturbed sample, is approximately $3x10^{-8}$ cm/s (Appendix G).

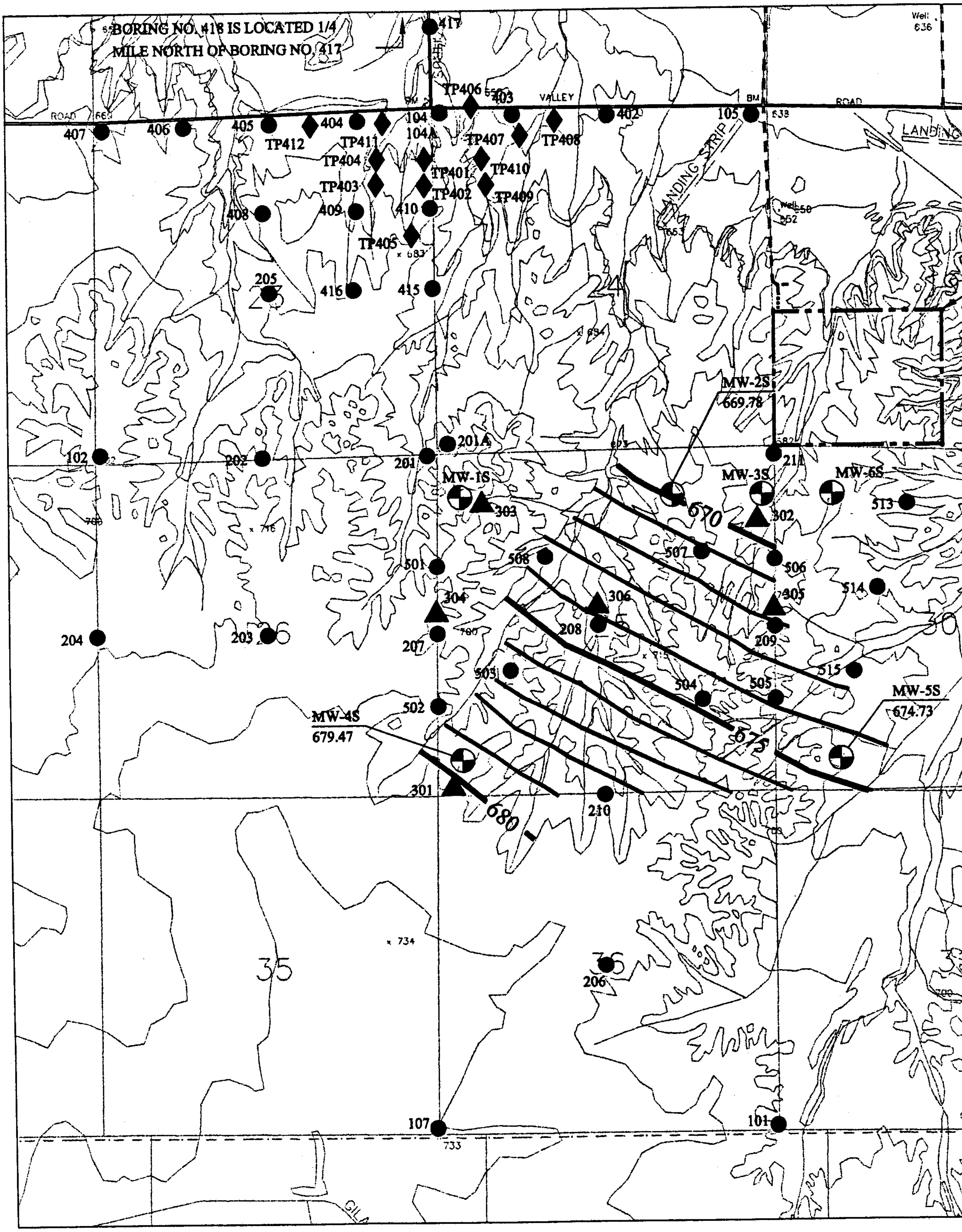
Water levels measured in monitoring wells MW-1S through MW-6S, during the period lasting from October 1995 to June 1996, ranged from 665 to 680 feet amsl (Table 4-1). Contour maps for four sampling events (February, March, April, and June 1996) were constructed (Figures 4-3 through 4-6). Groundwater flow in the perched aquifer was generally northeastward. Groundwater gradients were in the range of 0.0017 to 0.0019 feet/feet. Linear groundwater velocity was estimated to be 0.13 feet/day, based on a hydraulic conductivity of $1x10^{-2}$ cm/sec and a porosity of 0.4.

The aerial extent of the perched aquifer has not been defined. Groundwater was encountered in numerous soil borings advanced as part of landfill site characterization activities to the south and west of the GBPGS site (Figure 4-9). Table 4-2 provides a summary of the soil borings advanced as part of landfill characterization activities and the depth at which groundwater occurred in each of those borings. Figure 4-9 shows the groundwater flow direction contoured from soil boring data. Groundwater was also encountered in one soil boring advanced at the GBPGS site during a geotechnical investigation (Ninyo & Moore, 2000). Groundwater was encountered at an approximate depth of 24 feet bgs. While a total of eight soil borings were advanced during the geotechnical investigation at the site, only one was drilled to a depth at which groundwater was encountered. The remaining seven borings were advanced to more shallow depths to avoid encountering groundwater. This was done because, had soil borings been advanced to groundwater in the remaining soil borings, Ninyo & Moore would have been in violation of ADWR permit requirements.

Table 4-1. Summary of Measured Groundwater Levels
Gila Bend Power Project
Gila Bend, Arizona

Date	Groundwater Elevation (feet amsl)					
	MW-1S	**MW-2S**	**MW-3S**	**MW-4S**	**MW-5S**	**MW-6S**
10/05/1995	--[1]	669.47	--	680.16	675.42	--
10/25/1995	--	669.49	--	680.31	674.95	--
11/01/1995	--	669.56	--	680.28	675.07	--
12/01/1995	--	669.59	--	679.96	675.40	--
02/19/1996	--	669.78	--	679.47	674.73	--
03/11/1996	671.95	669.77	668.44	679.16	674.36	665.43
04/26/1996	672.22	669.87	668.37	679.51	674.22	665.28
06/05/1996	672.16	669.77	668.16	679.66	674.19	665.08

1. "--" denotes not yet constructed.

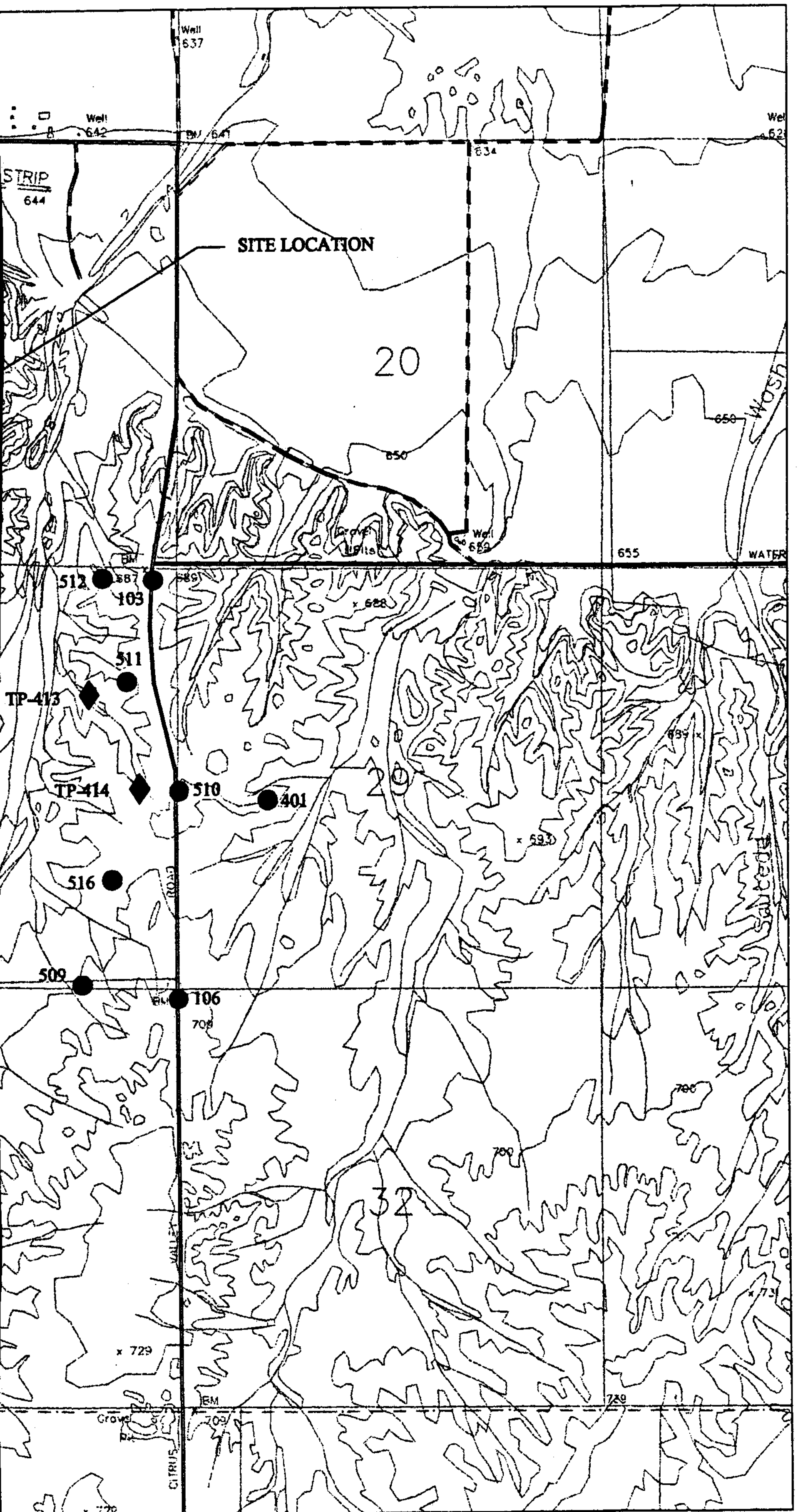


User:CADD Spec:ACAD File:M:\3962001\APP\Figures\FIG4-3.DWG Scale:1:2000 Date:10/30/2000 Time:11:42 Layout:Layout1

MALCOLM PIRNIE

GILA BE
AQUIFER PROTEC

POTENTIOMETRIC



LEGEND

MW-2S — SHALLOW MONITOR WELL

101 — GEOTECHNICAL BORING

301 — DEEP EXPLORATORY BORING

TP414 — TEST PIT

SITE BOUNDRY

MW-5S 674.73 — MONITOR WELL ELEVATION (MSL)

670 — EQUIPOTENTIAL LINE (ELEVATION MSL) (CONTOUR INTERVAL=1 ft) DATA FOR FEBRUARY 19, 1996

BASE MAP SOURCE: USGS SMURR ARIZONA, 1973

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D POWER PROJECT
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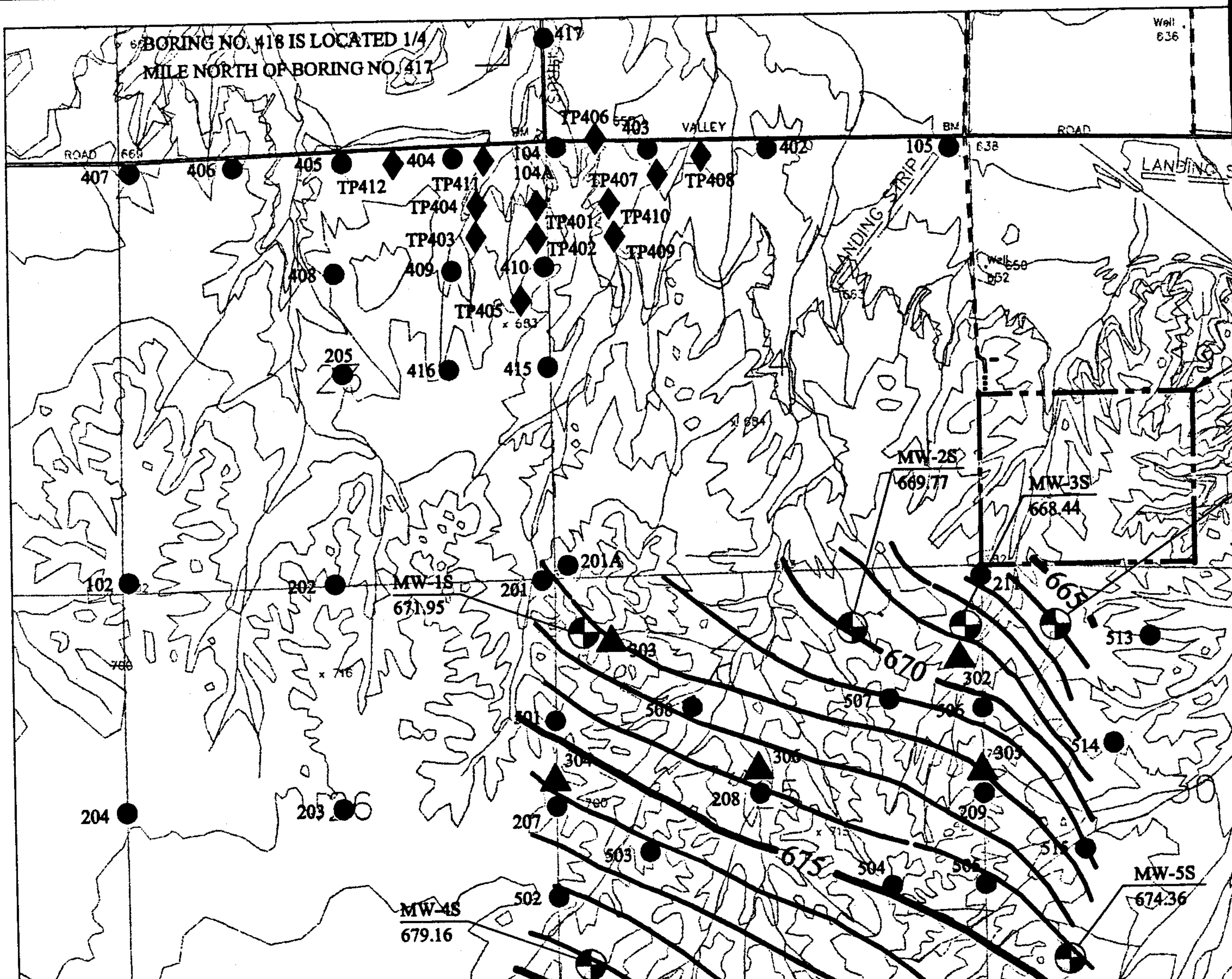
SURFACE - FEBRUARY 1996

FIGURE 4-3



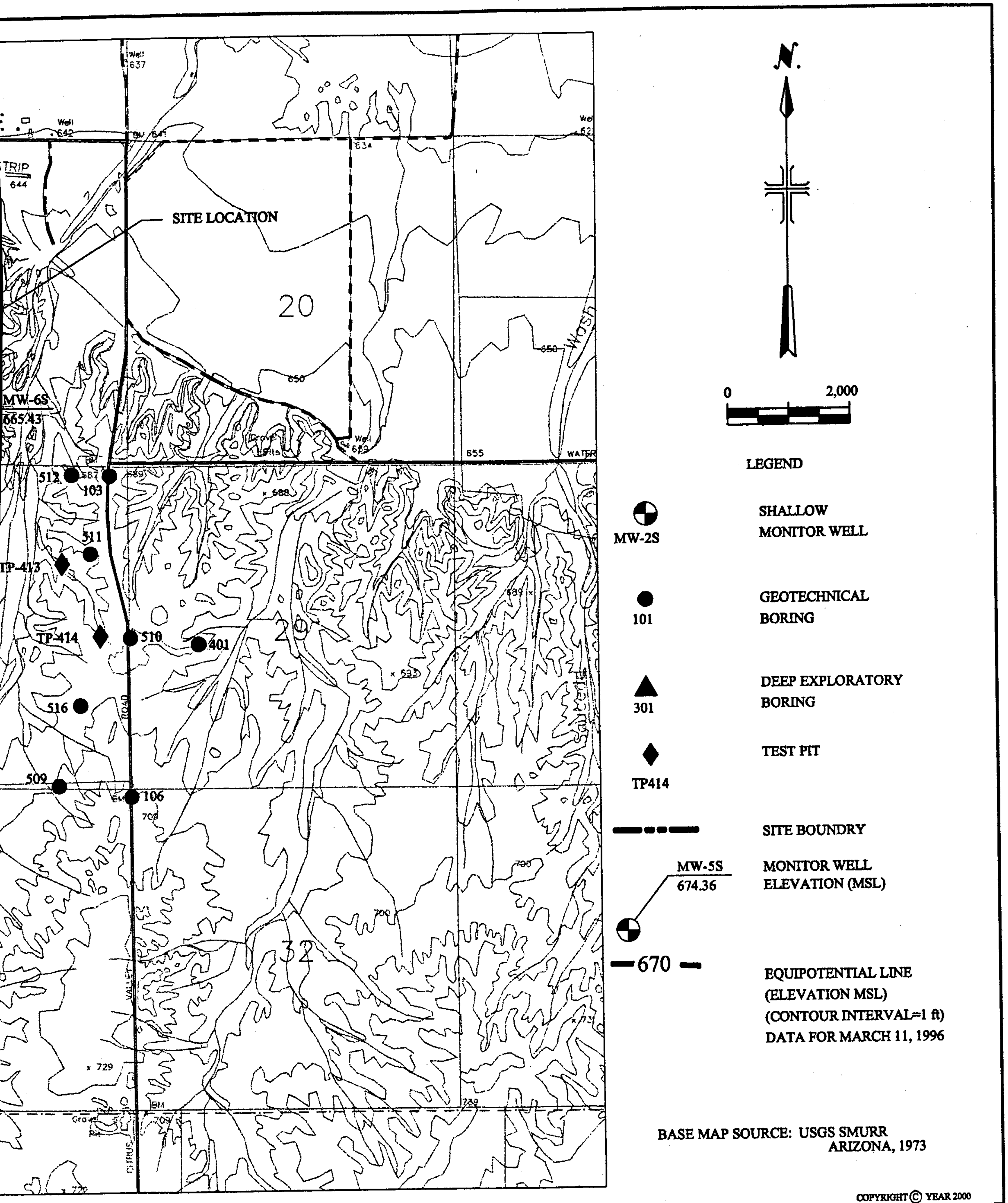
GILA BE

AQUIFER PROTEC

POTENTIOMETRI

MALCOLM PIRNIE

User:CADD Spec:ACAD File:M:\3962001\APP\Figures\FIG4-4.DWG Scale:1:2000 Date:10/30/2000 Time:13:31 Layout:Layout1

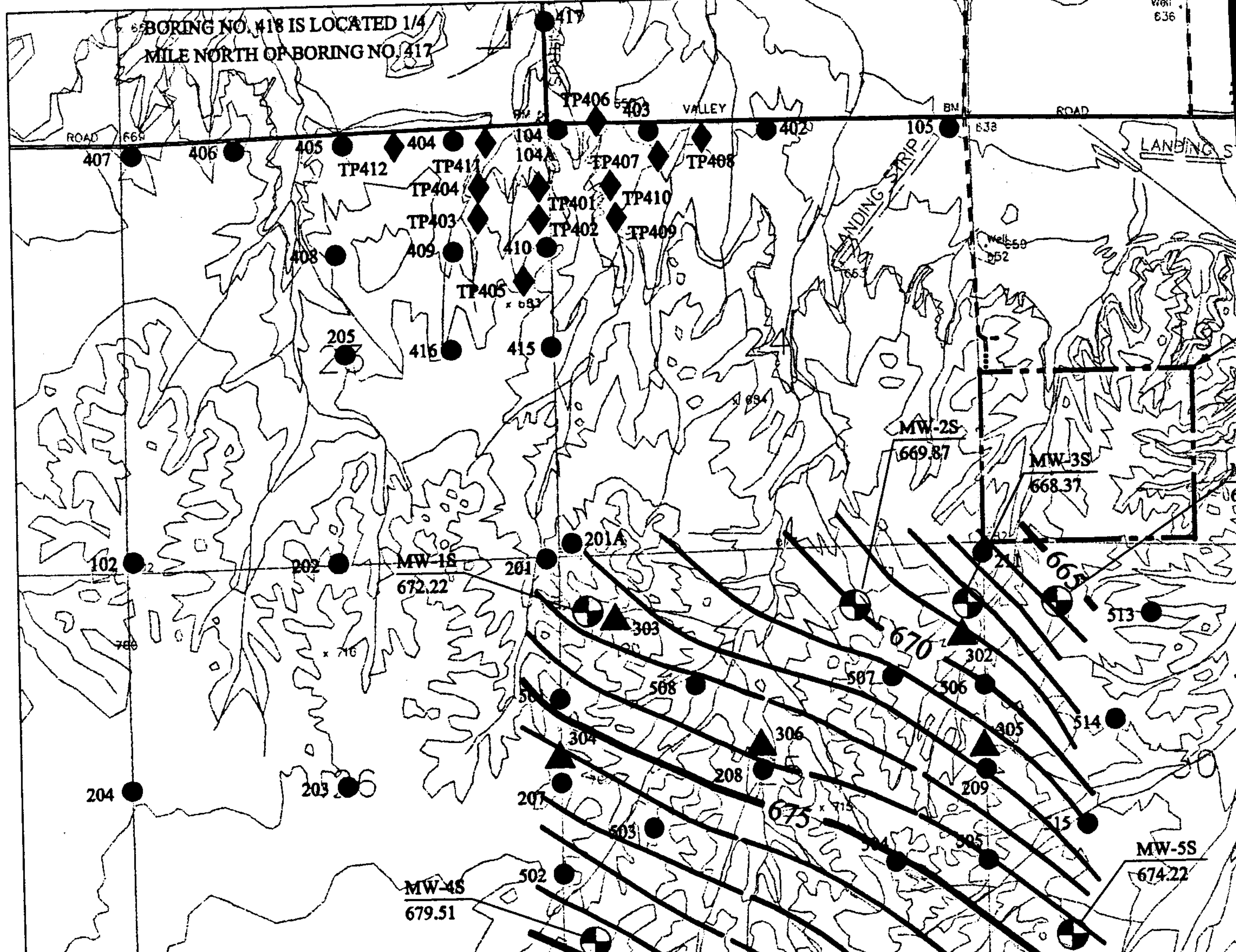


D POWER PROJECT
TION PERMIT APPLICATION

C SURFACE - MARCH 1996

MALCOLM PIRNIE, INC.

FIGURE 4-4



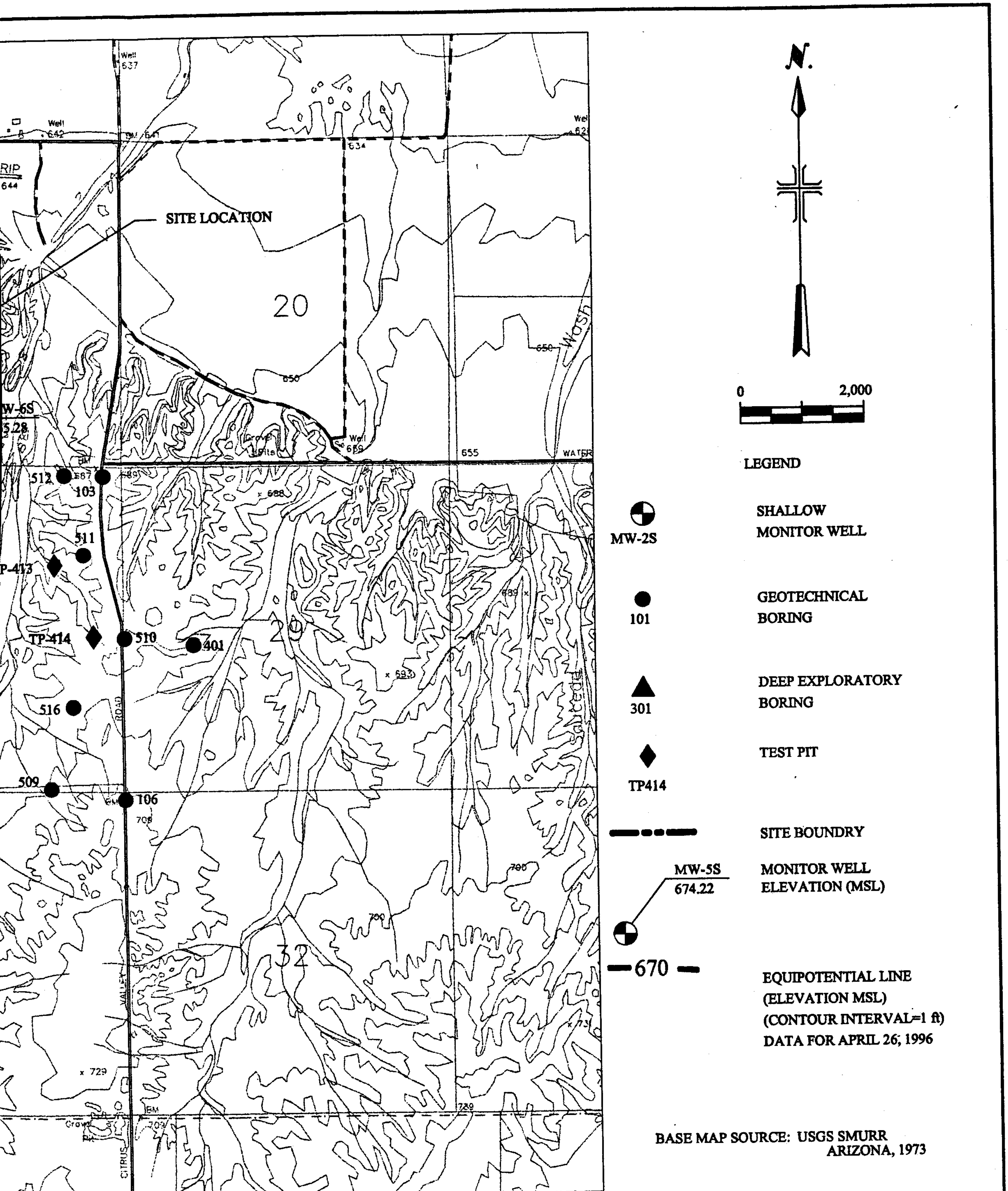
GILA BEN

AQUIFER PROTEC

POTENTIOMETRI

MALCOLM PIRNIE

User:CADD Spec:ACAD File:M:\3962001\APP\Figures\FIG4-5.DWG Scale:1:2000 Date:10/30/2000 Time:09:53 Layout:Layout1



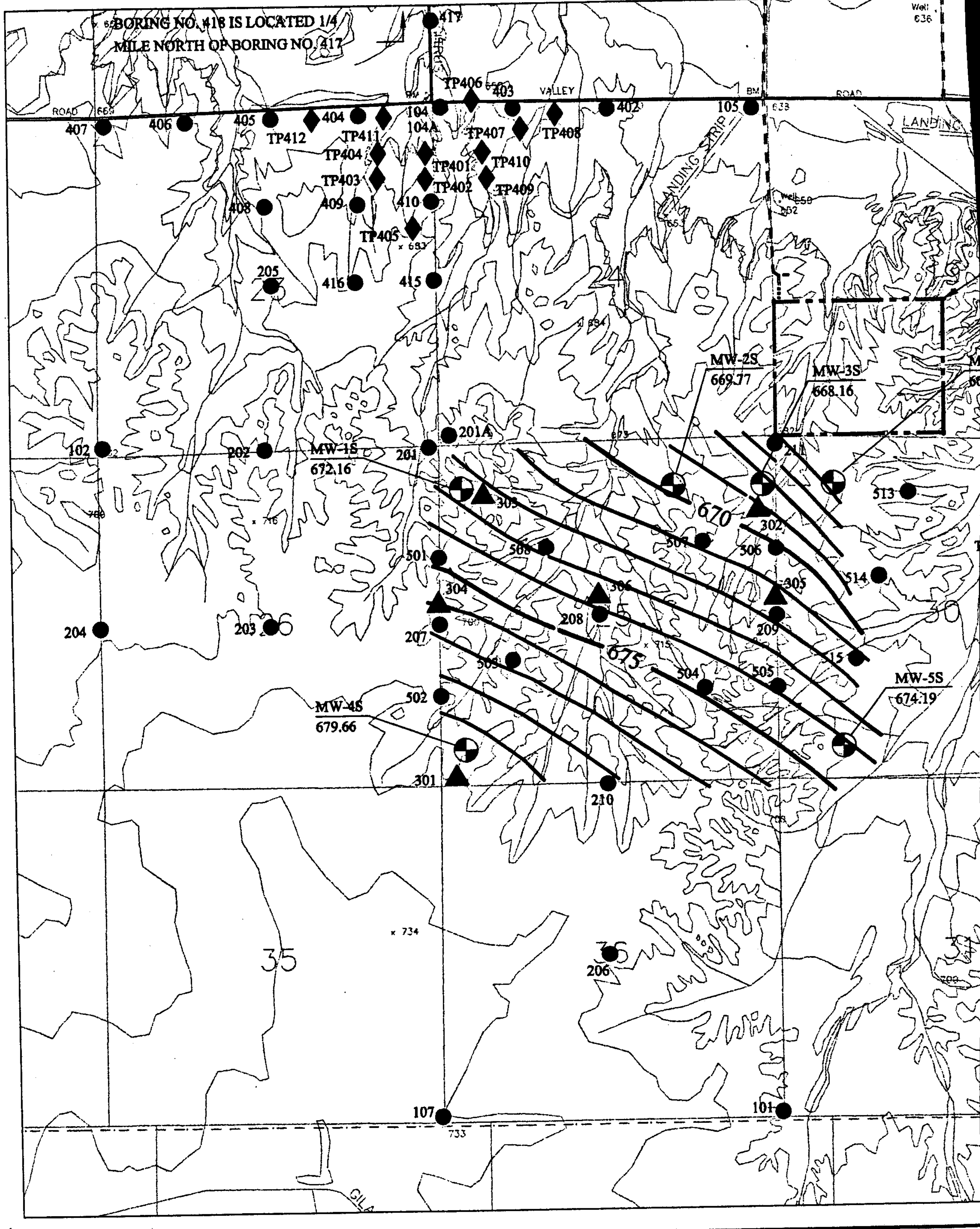
MALCOLM PIRNIE, INC.

D POWER PROJECT

TION PERMIT APPLICATION

C SURFACE - APRIL 1996

FIGURE 4-5



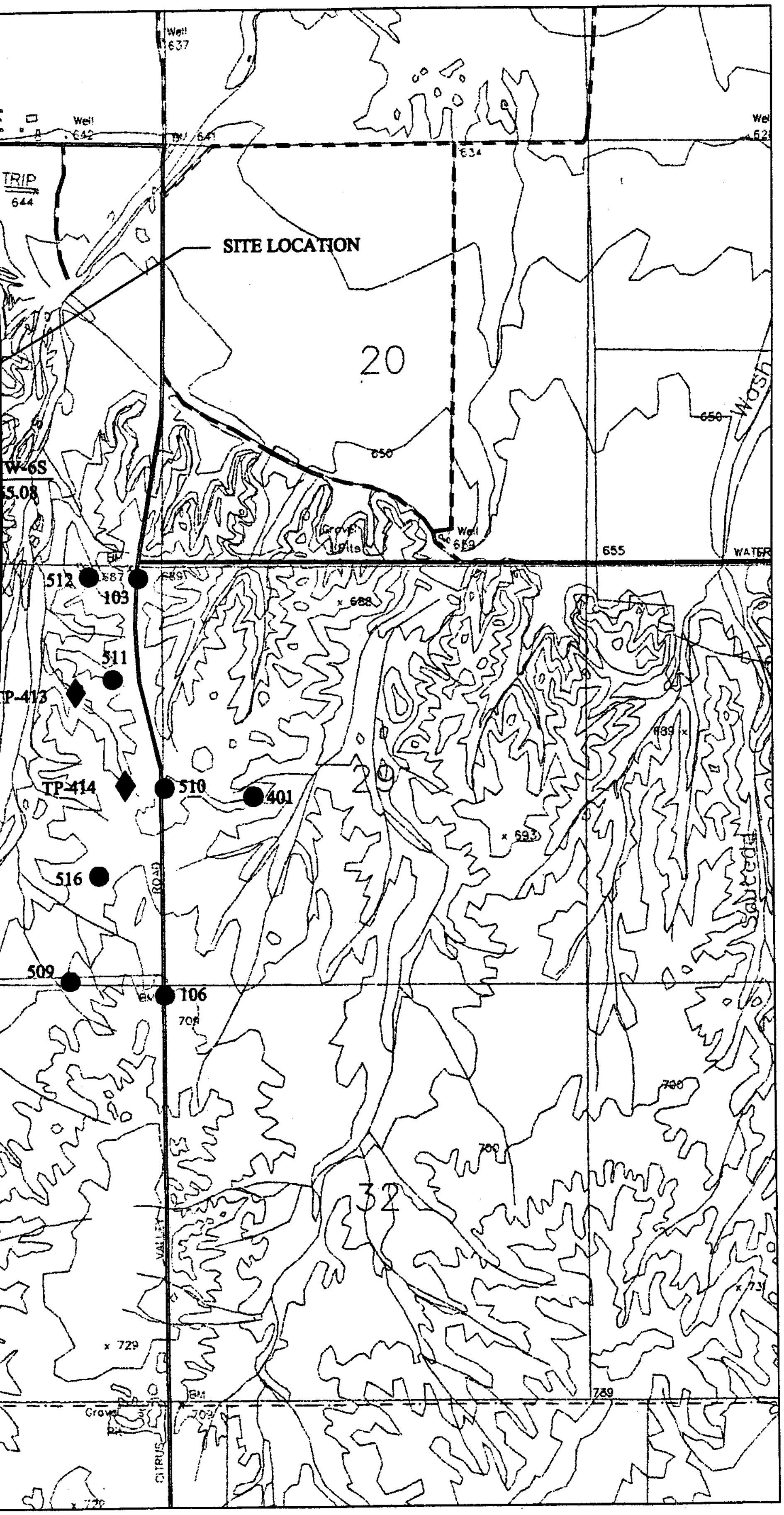
User:CADD Spec:ACAD File:M:\3962001\APP\Figures\FIG4-6.DWG Scale:1:2000 Date:10/30/2000 Time:11:55 Layout:Layout1

MALCOLM PIRNIE

GILA BEN

AQUIFER PROTECT

POTENTIOMETR



N.

0 2,000

LEGEND

MW-2S SHALLOW MONITOR WELL

101 GEOTECHNICAL BORING

301 DEEP EXPLORATORY BORING

TP414 TEST PIT

SITE BOUNDRY

MW-5S 674.19 MONITOR WELL ELEVATION (MSL)

670 EQUIPOTENTIAL LINE (ELEVATION MSL) (CONTOUR INTERVAL=1 ft) DATA FOR JUNE 5, 1996

BASE MAP SOURCE: USGS SMURR ARIZONA, 1973

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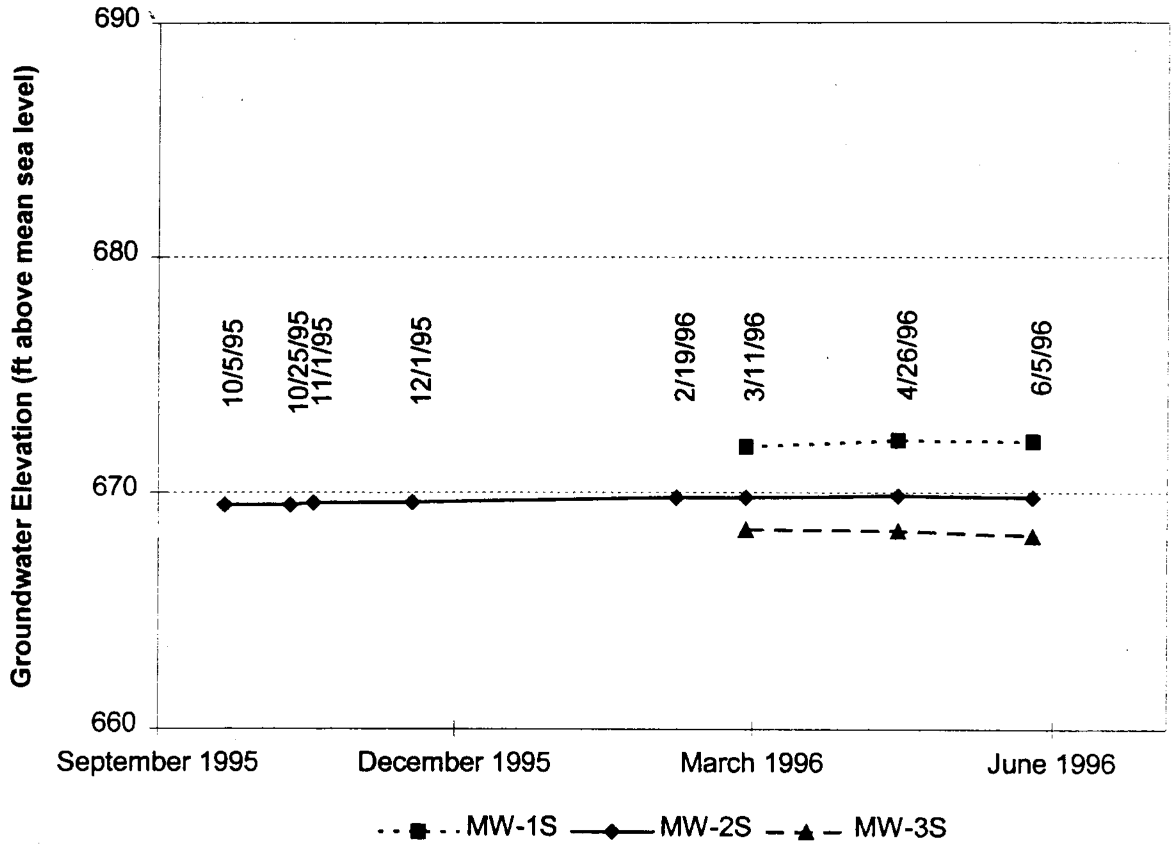
C SURFACE - MAY -1996

FIGURE 4-6



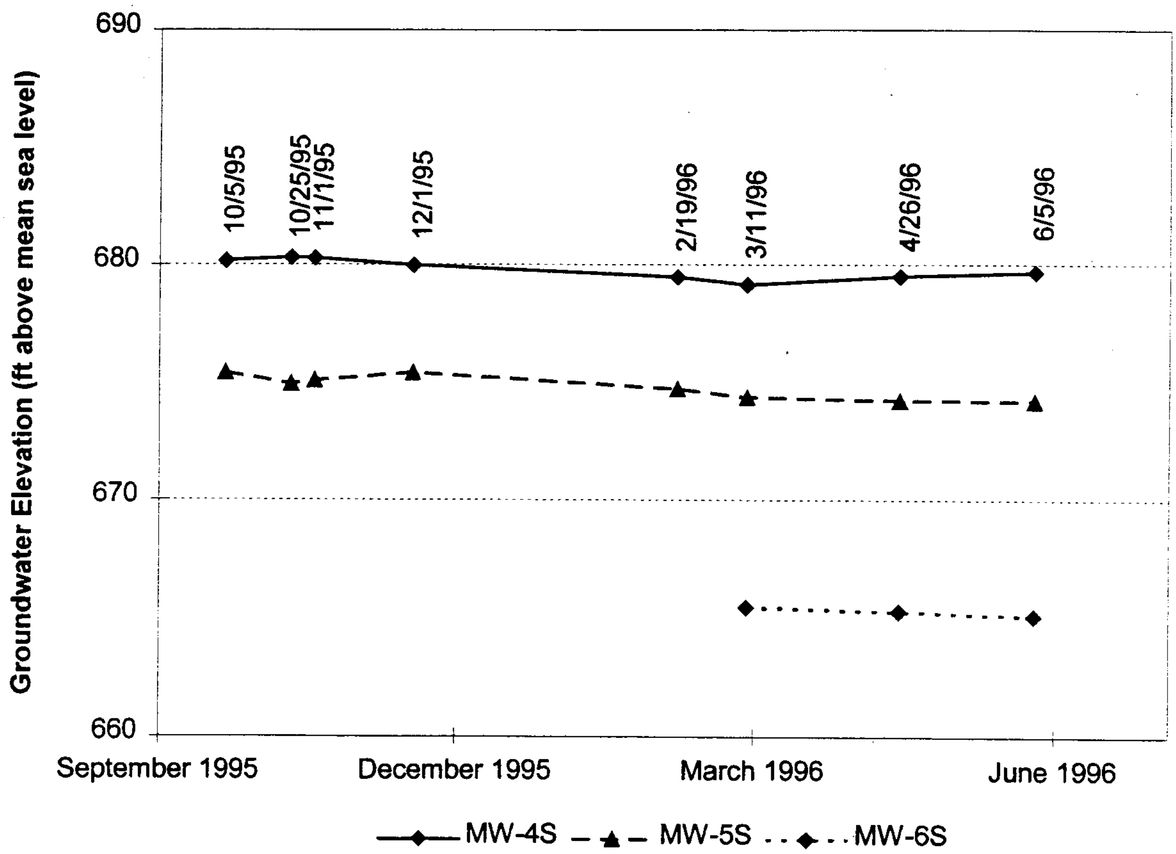
Spec: PIRNIE STANDARD M:\3962001\APP\Figures\Hydrogrph.ppt

MALCOLM PIRNIE

GILA BEND POWER PROJECT
AQUIFER PROTECTION PERMIT APPLICTION

HYDROGRAPHS: MW-1S, MW-2S, MW-3S

FIGURE 4-7



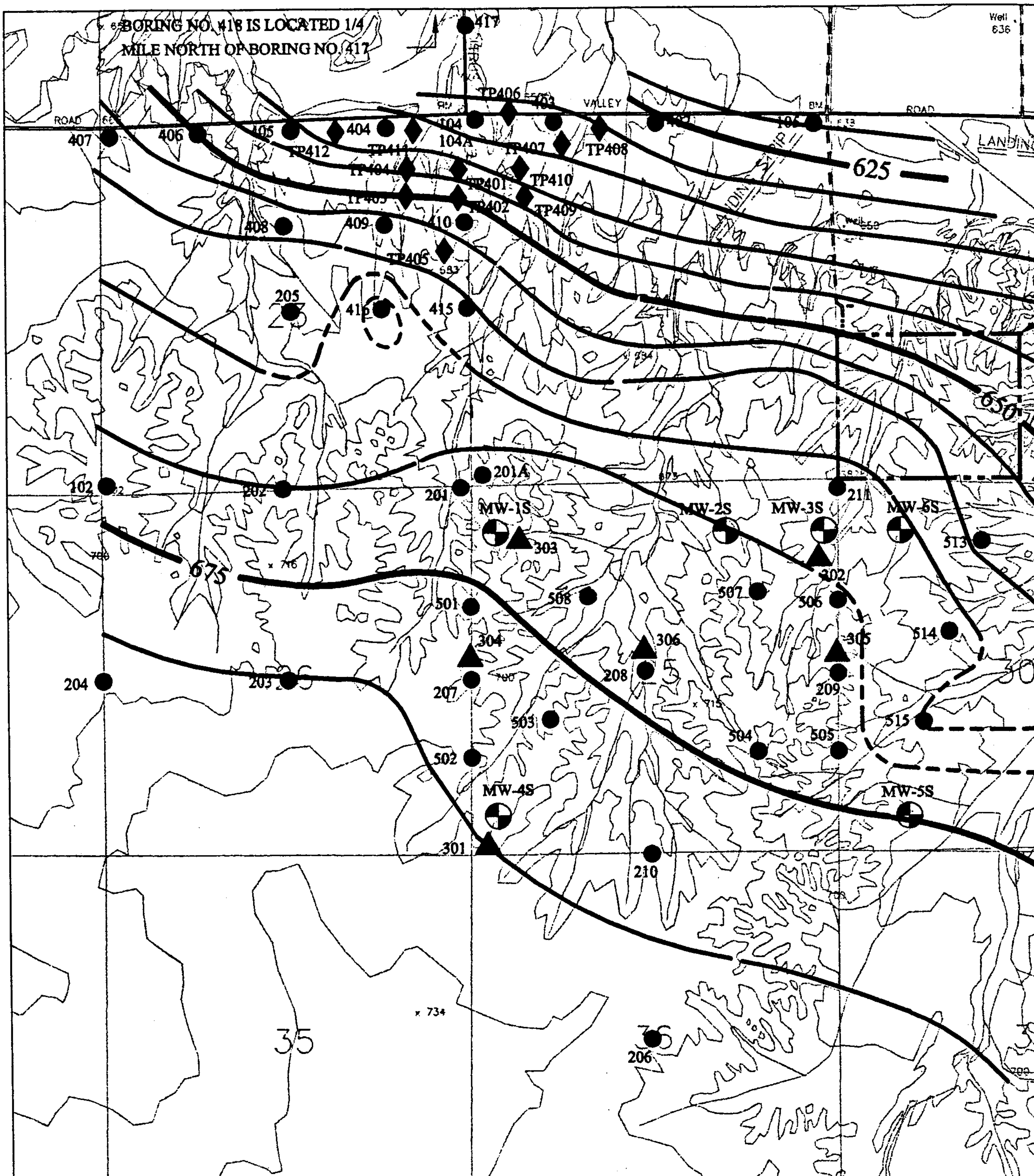
MALCOLM PIRNIE

GILA BEND POWER PROJECT
AQUIFER PROTECTION PERMIT APPLICATION

HYDROGRAPHS: MW-4S, MW-5S, MW-6S

MALCOLM PIRNIE, INC.

FIGURE 4-8



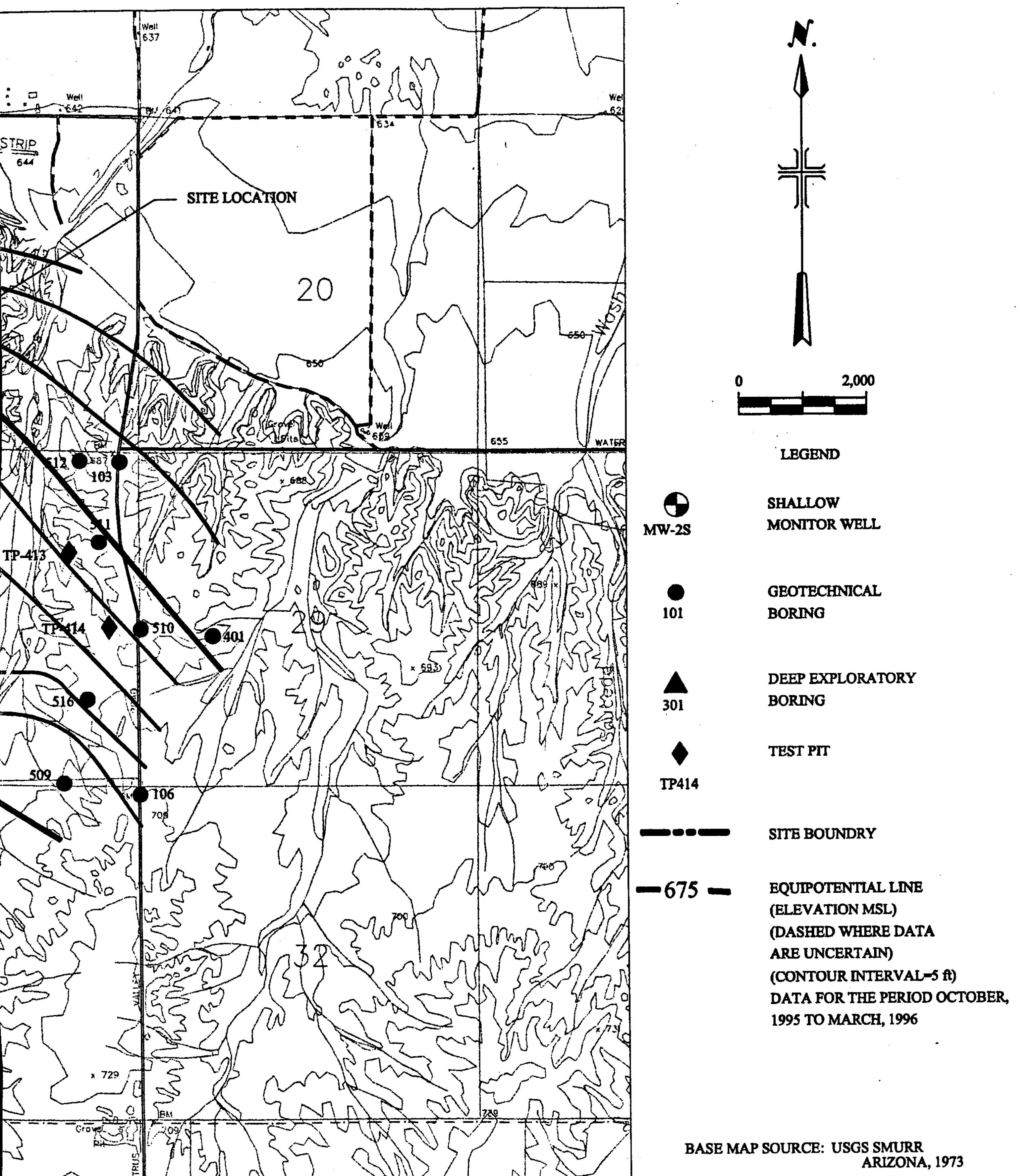
MALCOLM PIRNIE

GILA BE

AQUIFER PROTEC

POTENTIOMETRIC SURFAC

User:CADD Spec:ACAD File:M:\3962001\APP\Figures\FIG4-9.DWG Scale:1:2000 Date:10/30/2000 Time:11:58 Layout:Layout1



D POWER PROJECT
TION PERMIT APPLICATION

- COMPOSITE FROM BORING DATA

MALCOLM PIRNIE, INC.

FIGURE 4-9

Table 4-2. Water Levels In Soil Borings
Gila Bend Power Project
Gila Bend, Arizona

Boring No.	Groundwater Elevation (feet, msl)	Boring No.	Groundwater Elevation (feet, msl)
101	687	408	659
102	671	409	658
103	–[1]	410	653
104	631	411	–
105	620	412	–
106	668	413	–
107	683	414	–
201	–	415	660
201A	671	416	671
202	670	417	–
203	680	418	615
204	682	501	676
205	663	502	676
206	–	503	676
207	–	504	674
208	–	505	674
209	–	506	670
210	–	507	671
211	–	508	673
301	680	509	672
302	–	510	–
303	672	511	–
304	676	512	649
305	–	513	659
306	–	514	667
401	647	515	665
402	628	MW-1S	–
403	631	MW-2S	670
404	639	MW-3S	668
405	640	MW-4S	679
406	650	MW-5S	675
407	658	MW-6S	665

1. "–" indicates no water level data

Impact on Flow Conditions

Hargis (2000) conducted a groundwater supply assessment for the GBPGS. The impact to the regional aquifer created by groundwater withdrawals in the site area was determined by simulating various pumping scenarios using the groundwater model Winflow. Winflow utilizes the Theis non-equilibrium equation to determine drawdowns created by pumping wells with selected aquifer properties for various time periods. Hargis (2000) concluded that operations at the GBPGS would cause approximately 0.3 to 0.5 feet per year of drawdown in the regional aquifer. Over the projected lifetime of the facility (approximately 40 years), the total amount of drawdown could range from 12 to 20 feet. The water supply wells for the GBPGS will be located in Section 18 of Township 5 South, Range 5 West and could impact flow directions in the regional aquifer.

4.3.4 Existing Groundwater Quality

Regional

Groundwater sampling conducted in the Gila Bend by the USGS in 1946 showed the quality of groundwater throughout the basin was poor and would be classified as unsatisfactory for most agricultural uses. Groundwater throughout the basin was found to have a high dissolved-solids concentration consisting mostly of large amounts of sodium and chloride. Groundwater to the north of Gila Bend had even higher concentrations of dissolved solids. There were higher amounts of calcium and magnesium and lower amounts of fluoride than in groundwater to the south and west (Hem, in Babcock and Kendall, 1948). Rascona (1993) presents the results of a water quality investigation conducted in the GBB from 1991 through 1993. Results of that investigation indicated that water quality conditions did not significantly change between 1946 and 1993. The following description of water quality is paraphrased from Rascona (1993).

Fluoride concentrations in groundwater from wells sampled ranged from 0.2 to 5.9 milligrams per liter (mg/L). Fluoride from wells to the north of Gila Bend averaged 2.1 mg/L. Samples from wells to the south and west average 4.9 mg/L of fluoride. The dividing line between the north, south, and west parts of the basin is arbitrarily drawn diagonally from the northwest corner of Township 5 North, Range 4 West to the center of Township 6 South, Range 3 West. Although Gila Bend is located south of this line, Gila Bend is used synonymously with the line. The maximum contaminant level (MCL) for fluoride is either 4.0 or 6.0 mg/L. The MCL is an enforceable standard set by the U.S. Environmental Protection Agency (EPA) for drinking water. The fluoride level allowed is dependent on the number of year-round residents a water system serves (Arizona Department of Environmental Quality, 1991). Private domestic wells and wells used for agriculture are exempt from state and federal regulations of water quality. Analyses of samples collected between 1991 and 1993 show sulfate, alkalinity, and specific conductance values were higher north of Gila Bend than elsewhere in the basin.

Groundwater samples from four wells sampled for this study exceed the MCL for nitrates ($N0_2 + N0_3$, dissolved) of 10 mg/L as N. Samples from two of these wells also exceed the MCL of 10 micrograms per liter (µg/L) for selenium. The concentration of nitrates in the surface flows of the Gila River above diversions at Gillespie Dam averaged 8.8 mg/L from October 1990 to September 1991 and the concentration of selenium averaged 3.4 µg/L (Boner and others, 1992).

Boron in groundwater throughout the GBB was previously reported to be higher than limits suggested by the U.S. Department of Agriculture for boron-sensitive crops such as citrus (Johnson and Cahill, 1955). Boron is also present in high concentrations in surface flows of the Gila River. Boron ranged from 1,300 to 2,500 µg/L from October 1990 to September 1991 in samples collected from the Gila River above diversions at Gillespie Dam (Boner and others. 1992). Maximum boron concentration from groundwater samples was 6,600 µg/L. *Al*though water containing 2,000 µg/L may be used without injury, an upper limit of 750 µg/L is thought to protect most sensitive crops from boron toxicity (EPA, 1986). Of 32 wells sampled for boron, 20 exceed 750 µg/L. Wells sampled north of Gila Bend average 1,120 µg/L of boron. Wells sampled in the south and west average 1,430 µg/*l*.

Surface flows of the Gila River throughout the basin are usually highly mineralized with calcium and sodium (Hem, in Babcock and Kendall, 1948). As groundwater was withdrawn by the pumping of wells it was expected that groundwater would be replaced with the more highly mineralized water of the Gila River resulting in a continual increase of the dissolved-solids content of the groundwater (Hem, in Babcock and Kendall, 1948). However, Johnson and Cahill (1955) reported that high flows during floods were considerably less mineralized and recharge from this water tended to reduce the concentration of dissolved solids in the groundwater reservoir. Dissolved-solids content decreased in 19 of 23 wells sampled in 1953-55 and 1964-66. From 1953 to 1966 water levels declined throughout the basin and flows of the Gila River were low. The low flows of the Gila River were highly mineralized from 1953 to 1966, but they were apparently insufficient in volume to replenish the groundwater reservoir.

From 1966 to 1976 specific conductance of the Gila River remained relatively unchanged while pumpage throughout the basin increased substantially. Recharge from minor floods in 1966 and 1973 caused water levels to rise in the northern part of the basin despite the increased pumpage. The average specific conductance of groundwater in the northern part of the basin increased over this time. Specific conductance also increased in groundwater in the western part of the basin even though most static water levels declined from 1966 to 1976. A possible explanation for this situation is that although recharge occurred throughout the basin, it was not enough to replenish groundwater withdrawn in the central and western parts of the basin. However, the volume and dissolved-solids concentration of the recharge water were insufficient to cause the increase in specific conductance.

The average specific conductance of groundwater throughout the basin has not changed significantly since the late 1970's . The average annual specific conductance of the Gila River measured at Gillespie Dam above diversions declined sharply in the late 1970's but has since remained relatively unchanged. Specific conductance is an indirect measure of the dissolved-solids content of a groundwater or surface water sample. Concentrations of dissolved solids detected in groundwater samples may be approximated by multiplying the specific conductance value measured in the groundwater sample by a factor of 0.6. Of 16 wells sampled in 1976-79 and again in 1991-93 by the USGS and ADWR, six show slight-to-moderate increases in concentrations of dissolved solids, nine remain relatively unchanged, and one exhibited a significant decrease in concentrations of dissolved solids. Of the six wells that exhibited increases in concentrations of dissolved solids, all but one are north of Gila Bend. The single well that exhibited a decrease in concentration of total dissolved solids is also north of Gila Bend.

The average specific conductance of groundwater south and west of Gila Bend has consistently been lower than that of groundwater to the north. Specific conductance values in groundwater samples collected from wells sampled throughout the GBB range from 1,250 to over 10,000 micromhos/cm at 25°C. Specific conductance values in groundwater samples collected from wells north of Gila Bend average 3.500 microsiemens per centimeter (uS/cm) while those to the south and west average 2,300 uS/cm. Wells throughout the basin that are perforated exclusively below 1,000 feet bls consistently exhibit lower specific conductance values than those with perforations above 1,000 feet. Most wells west of Gila Bend are over 1,000 feet deep, while few to the north exceed 1,000 feet in depth.

The dissolved-solids content of the groundwater is not expected to rise unless significant recharge of highly mineralized flows occurs. This situation is not likely since most recharge occurs during periods of high flow in which the dissolved-solids content is low. A decrease in concentrations of dissolved-solids in groundwater has been observed during periods of high pumpage and low flows in the Gila River. A possible explanation of this observation could be that the groundwater is stratified so that highly mineralized water occurs only in the upper part of the groundwater reservoir.

As the upper zone is dewatered and water levels drop, less water of poor quality is yielded to wells. As long as water levels remain high or continue to rise, water quality is not expected to improve. Only when water levels were at the lowest level did a marked improvement in water quality occur (Rascona, 1993).

Site

Groundwater quality conditions in the vicinity of the site have been based on historic groundwater quality samples collected by ADWR, S-P Farms, and from site characterization activities at the proposed Gila Bend Regional Landfill. Groundwater samples collected by ADWR and S-P Farms are representative of the regional aquifer, and samples collected from monitoring wells at the proposed Gila Bend Regional Landfill are representative of the perched aquifer discussed earlier in this section.

Groundwater samples were collected by ADWR from selected wells located in the general vicinity of the project area. The groundwater samples collected by ADWR were analyzed for selected common ions and trace metals. In addition, S-P Farms (former property owner of the site location) collected groundwater samples in 1979, prior to decommissioning the wells before the Painted Rock Reservoir flooded in the early 1980s. The groundwater samples collected by S-P Farms were analyzed for TDS, pH, standard inorganic cations and anions. In general, groundwater samples collected from the regional aquifer (in the vicinity of the site) indicate that the groundwater is of poor quality for domestic and most agricultural uses. The TDS concentrations ranged from 807 to 5,887 parts per million (ppm). In general, TDS concentrations were highest in shallow wells and lowest in deeper wells. The dominant constituents in the water are sodium and chloride. Fluoride was detected at concentrations exceeding the AWQS of 4.0 mg/L. Refer to Appendix I for those analytical results.

Additional samples were collected from the regional aquifer in June 2000, from two wells located in Township 5 South, Range 5 West, Section 20. The Paloma Ranch Water Company owns the two wells. Water samples were collected from well number C(5-5) 20DCC and C(5-5)20CBB. These two wells are deep irrigation wells. Well C(5-5)20DCC is approximately 1,800 feet deep and is reportedly screened below 400 feet. Well C(5-5)20CBB is reportedly approximately 1,100 feet deep. Samples from these wells were analyzed for total and dissolved metals, common cations and anions, and other inorganic parameters. The analytical results for those samples, which were used to calculate discharge quality, are summarized on Table 2-1. Those results, the most recent results available for the site area, indicate that fluoride was detected at concentrations of 4.1 and 4.3 mg/L. In addition, TDS ranged from 1,100 to 1,300 mg/L. These samples were collected from a depth of approximately 700 feet bgs. Refer to Appendix B for analytical results.

As discussed previously, monitoring wells were constructed in the perched aquifer to the south of the site, during site characterization activities for a proposed landfill. Four

Table 4-3. Summary of Analytical Results for Monitoring Wells Located South of the GBGS

Gila Bend Power Project

Gila Bend, Arizona

Parameter	Units	MW-1S Round[2]			MW-2S Round				MW-3S Round[2]			MW-4S Round				MW-5S Round				MW-6S Round[2]		
		2	3	4	1	2	3	4	2	3	4	1	2	3	4	1	2	3	4	2	3	4
Alkalinity	mg/l	240	240	240	260	260	260	280	230	220	240	240	250	240	260	230	250	240	240	230	220	240
Calcium	mg/l	99	63	37	66	55	51	71	220	48	56	37	30	37	38	69	83	56	54	510	150	120
Chloride	mg/l	1,400	1,500	1,500	1,500	1,500	1,600	1,700	1,600	1,600	1,600	840	690	1,400	1,300	1,400	1,400	1,500	1,500	1,700	1,600	1,700
Fluoride	mg/l	5.6	6.2	5.7	6.8	6.6	6.8	6.8	5.6	5.8	5.8	9.2	8.4	8.2	7.6	7.4	7.4	8.0	7.4	4.8	4.8	4.8
Magnesium	mg/l	15	12	9.5	19	18	17	20	22	11	11	14	14	16	17	16	17	15	15	62	44	41
NO_3 - NO_2	mg/l	29	27	30	28	27	26	29	28	28	29	15	16	23	22	26	28	26	26	30	28	29
pH	s.u.	8.0	7.9	7.9	7.7	7.7	7.8	7.8	7.9	7.8	7.8	8.2	8.0	7.9	7.9	7.8	7.7	7.8	7.7	7.6	7.5	7.5
Phenol	mg/l	--[3]	--	--	--	--	--	--	0.026	--	--	--	--	--	--	--	--	--	--	--	--	0.006
Potassium	mg/l	19	17	16	8.2	6.1	6.3	7.8	14	10	10	8.2	7.5	6.4	7.2	7.2	6.5	5.9	5.6	16	9.2	8.5
Sodium	mg/l	1,000	1,400	1,100	1,500	1,100	1,800	1,300	1,100	1,600	1,300	910	740	1,200	1,100	1,400	1,000	1,400	1,300	1,100	1,700	1,300
Specific Conductance	umhos/cm	6,150	6,010	5,800	6,630	6,690	6,350	6,250	6,530	6,310	6,270	3,810	4,210	5,380	5,160	6,060	6,150	6,090	5,790	6,920	6,600	6,640
Sulfate	mg/l	940	990	1,000	1,200	1,100	1,100	1,100	1,100	1,100	1,200	550	540	740	770	1,200	860	1,100	1,000	1,400	1,400	1,400
TDS	mg/l	4,000	4,000	3,900	4,300	4,400	4,300	4,300	4,300	4,400	4,300	2,400	2,700	3,500	3,400	4,100	4,100	4,100	4,100	4,600	4,700	4,800
TOC	mg/l	--	2	1.5	--	1.8	1.5	1.3	64	1.5	1.0	--	3.8	1.8	1.2	--	--	1.1	2.4	--	1.4	1.2
Ethylbenzene	ug/l	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.3	--
Toluene	ug/l	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.2	--
Xylene	ug/l	--	--	--	--	--	9.7	--	--	8.5	--	--	--	8.5	--	--	3	5.8	--	--	17	--
Copper	mg/l	--	0.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.08	--	--	--	--
Iron	mg/l	18	6.8	0.55	5	2.2	0.25	8.6	35	0.22	2.4	9.5	7.2	0.13	1.4	3.6	8.1	--	--	52	2.6	1.5
Manganese	mg/l	0.75	0.24	--	0.1	--	--	0.15	1.1	--	0.06	0.29	0.19	--	--	0.1	0.2	--	--	3.1	0.17	0.10
Barium	mg/l	0.26	--	--	0.18	0.07	--	0.16	0.77	--	0.07	0.26	0.11	--	--	0.15	0.15	--	--	0.68	--	--
Chromium	mg/l	0.05	--	--	--	--	--	--	0.07	--	--	--	--	--	--	--	--	--	--	0.08	--	--
Vanadium	mg/l	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.21	--	--	--	--	--

1. Summary presents only constituents (totals) that were detected in at least one sample. See Attachment 7E for full list of individual parameters.
2. Samples were not taken in Round 1 of sampling in these wells (wells were not yet constructed).
3. "--" denotes not detected.

rounds of samples were collected from the six monitoring wells during 1996. The samples were analyzed for metals, common cations and anions, and volatile organic compounds. Results are summarized on Table 4-3. Analytical results indicate that TDS ranged from 2,400 mg/L to 4,800 mg/L. Fluoride was detected at concentrations ranging from 4.8 mg/L to 8.0 mg/L. In addition, ethylbenzene, toluene, and xylene were detected in samples collected from wells during the April 1996, sampling event. Xylene was also detected in monitoring well MW-5S during the March 1996 sampling event.

4.3.5 Floodplains

The GBPGS and the evaporation ponds are not located within the 100-year floodplain, as shown in Figure 4-10.

4.3.6 Off-Site and On-Site Drainage

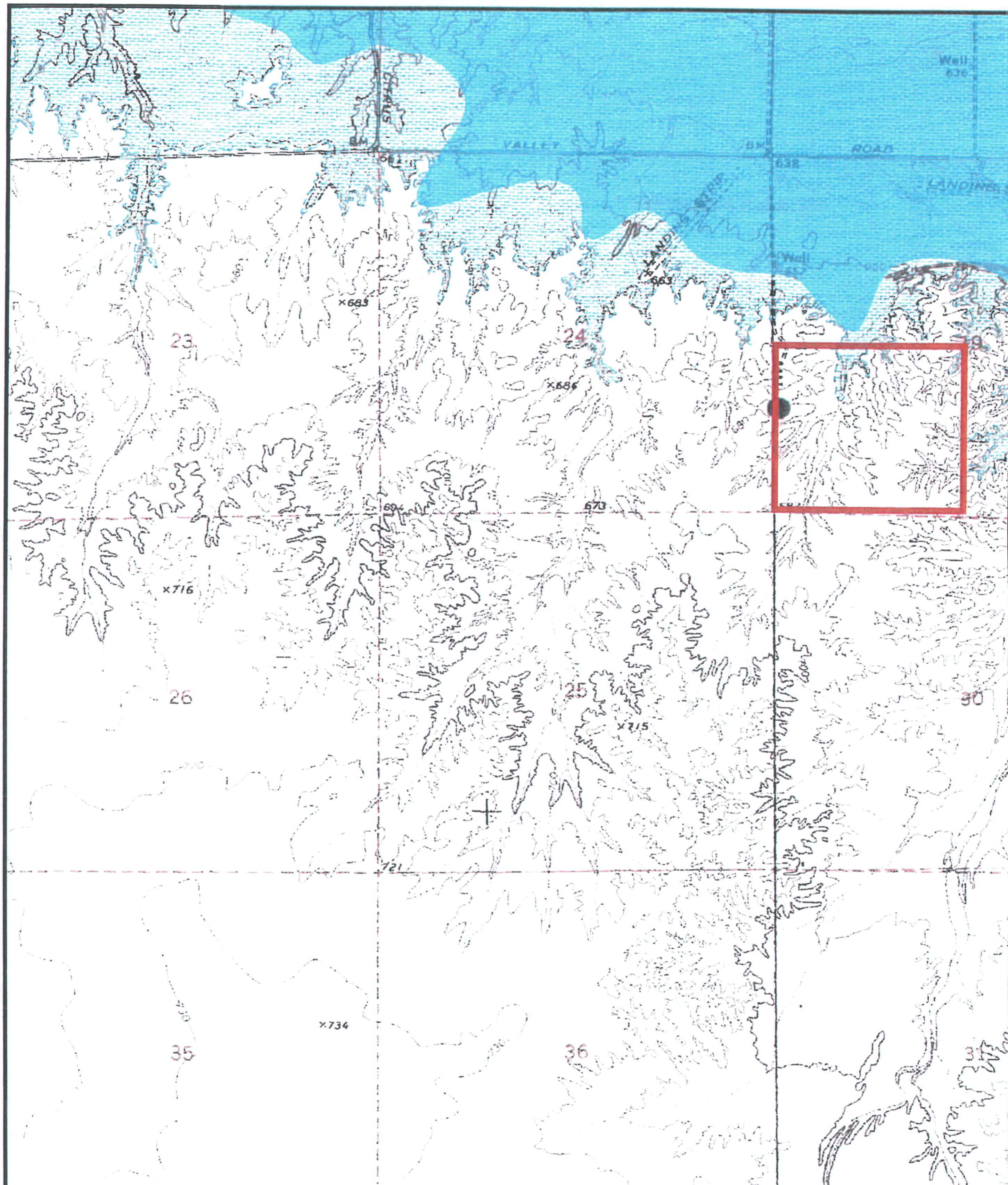
In general, surface water is diverted away from the power plant area, to the storm water pond, primarily by topographic measures. Refer to the Preliminary Design Report in Appendix A for details.

4.4 Point of Compliance (POC) Selection

The Point of Compliance (POC) is defined as a vertical plane through the uppermost aquifer in the downgradient direction at which compliance with standards shall be determined (A.R.S. §49-244).

The direction of groundwater flow and the groundwater gradient at the GBPGS was estimated during site characterization conducted in the vicinity of the GBPGS. This information was used to select the POC locations.

Available information relating to the uppermost aquifer indicates that groundwater flow direction is generally to the northeast. POC locations were selected for hazardous and non-hazardous constituents. Four POC locations were identified, as shown on Figure 4-11. Since the evaporation ponds at the GBPGS will be constructed to meet prescriptive BADCT, well(s) will not be installed at the POC location(s) unless a significant release to the subsurface occurs, as stipulated in the draft APP in Appendix J. If it is necessary to install a POC well, the groundwater flow conditions will be reassessed at that time to determine if the designated POC(s) are still appropriate.



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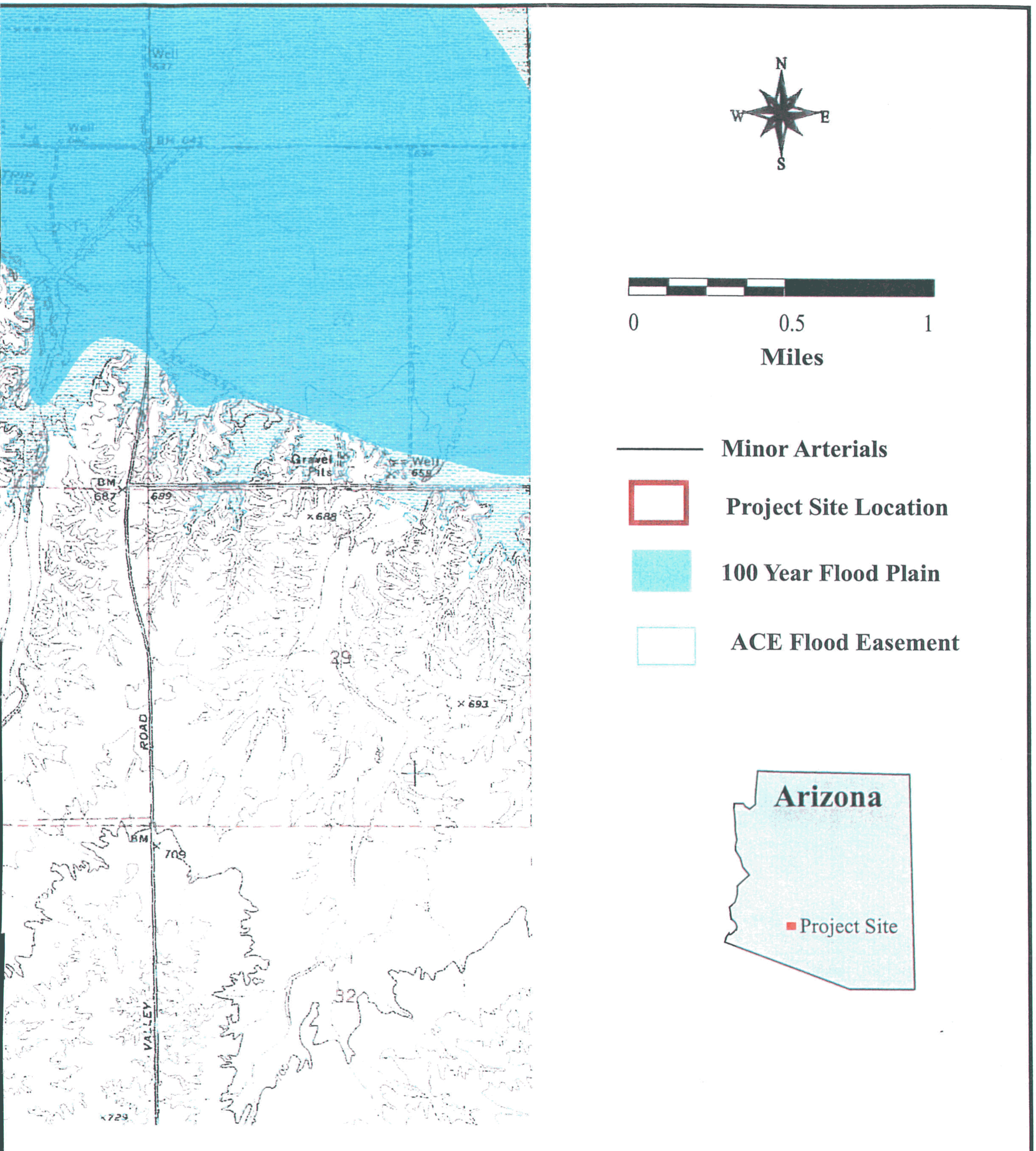

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FLOOD PLAIN

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FIGURE 4-10

4.5 Evaluation of Compliance at the POC

In the event one or more POC wells are installed, a monitoring program will be developed to ensure compliance with AWQS at those locations. Alert Levels will be calculated per ADEQ protocol and analytical results from POC locations will be compared to the Alert Levels to assess compliance.

Data validation will be conducted on all field and laboratory data. Field data will be examined for completeness, accuracy, and adherence to standard operating procedures. Comparisons of field instrument results to laboratory results will also be made.

Laboratory guidelines will be validated following U.S. Environmental Protection Agency guidelines. Results will be evaluated to determine compliance with data quality objectives.

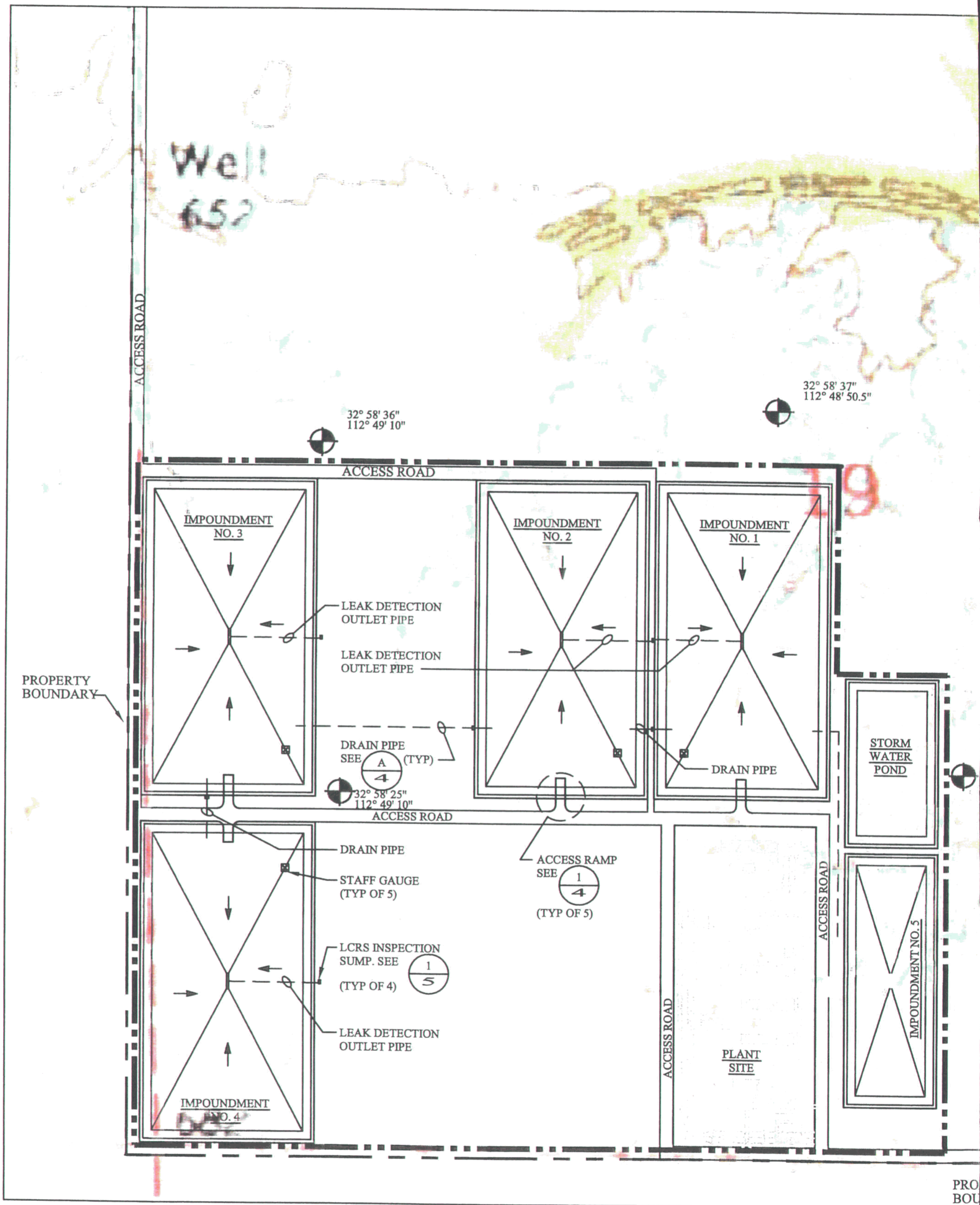
4.6 Assessment of the Discharge Impact Area (DIA)

The DIA in the APP application guidance manual is defined as the maximum aerial extent of pollutant migration, as projected on the land surface, resulting from discharge. This aerial extent is predicted by tracking the concentration of a particular pollutant released in the aquifer due to the result of a discharge to a point where this concentration dilutes to an ambient level. The impact of a release to groundwater is dependent on contaminant type and amount, transport mechanisms, and recharge rates. However, because this facility meets prescriptive BADCT, no discharge is anticipated. For purposes of satisfying requirements of the APP program, the DIA has been conservatively defined and is shown on Figure 4-11.

4.6 Monitoring Records

Pursuant to A.A.C. R18-9-112, the GBPGS will retain a monitoring record consisting of all of the following:

- The date, time, and exact place of a sampling or measurement and the name of each individual who performed the sampling or measuring
- The procedures used to collect the sample or make the measurement
- The name of each individual or laboratory who performed the analysis
- The analytical techniques or methods used to perform the sampling and analysis
- The chain of custody records



User:CADD Spec:ACAD File:M:\3962001\APP\Figures\FIG4-11.DWG Scale:1:1 Date:10/30/2000 Time:14:19 Layout:Blank

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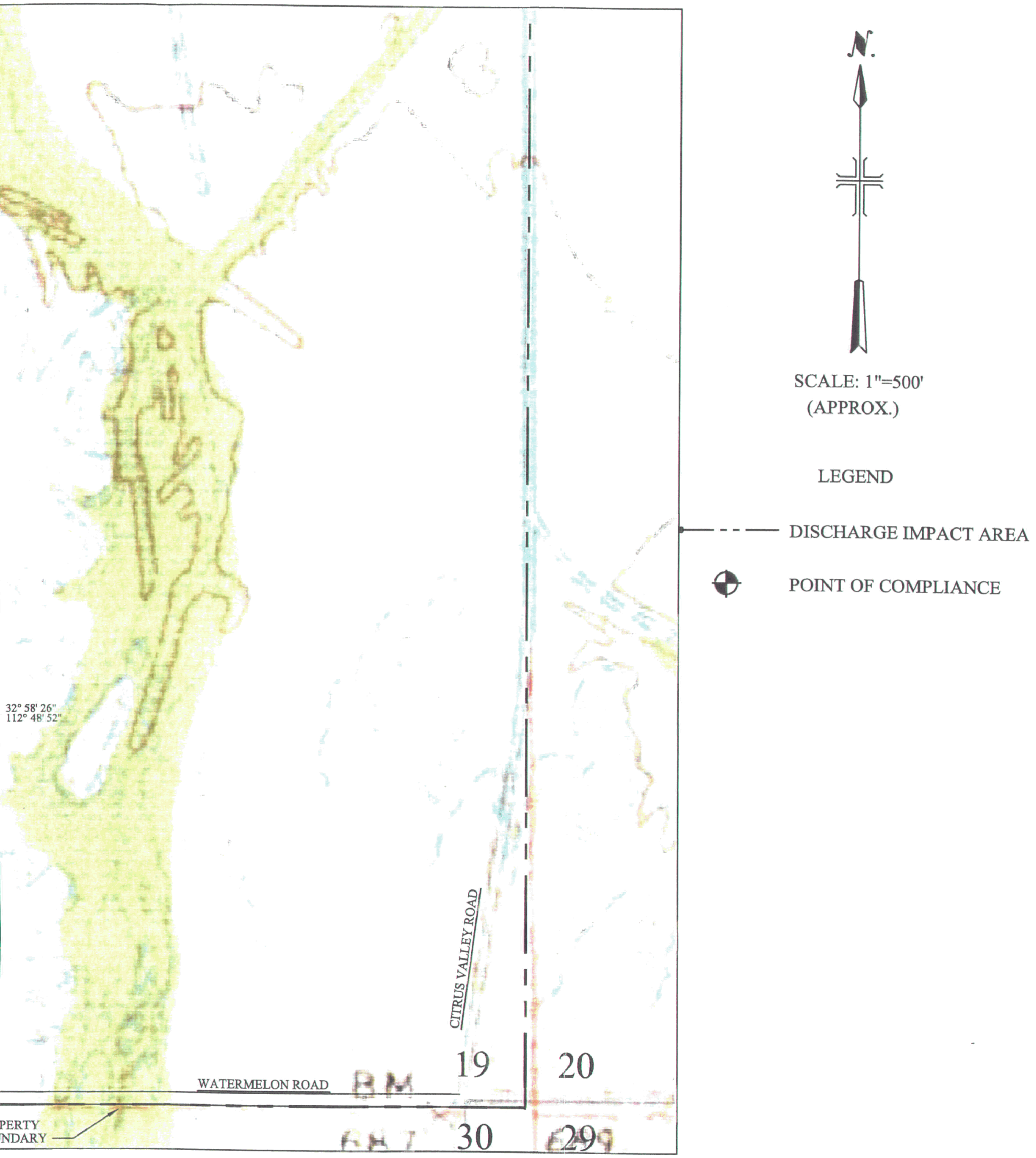
DISCHARGE IMPACT A



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TION PERMIT APPLICATION

REA AND POC LOCATIONS

MALCOLM PIRNIE, INC.

FIGURE 4-11

- Any field notes relating to the information above

In addition, the GBPGS will either retain or have access to monitoring records for a period of 10 years after the date of the sample or measurement.

4.7 Reporting Requirements

Pursuant to A.A.C. R18-9-113, the GBPGS will abide by the following reporting requirements:

- Written notice will be given to the Director 180 calendar days before any major modification to the facility

- The Director will be notified of a violation of a permit condition or that an alert level has been exceeded at a POC within five days after becoming aware of the violation

- A written report describing the violation (pursuant to A.A.C. R18-9-113) will be submitted to ADEQ within 30 days after the GBPGS become aware of a permit condition

- The Director will be notified within five days after the occurrence of one of the following: bankruptcy filing by the permitee, or any order or judgment against the permitee for the enforcement of any environmental protection statute and in which monetary damages or civil penalties are imposed

4.8 Discharge Monitoring and Limitations

As stipulated in the Draft Aquifer Protection Permit Application (Appendix J), the GBPGS will be required to monitor the discharges on a weekly basis. Impoundment volumes will be restricted to the original design capacity. However, should a discharge limit violation or an accidental release from one of the surface impoundments occur, the following contingency plan will be implemented pursuant to A.A.C. R18-9-111. The contingency plan will be made available to all employees responsible for the operation of the GBPGS.

4.9 Contingency Plan

In the event that a discharge results in any of the following, a contingency plan (consistent with the requirements of A.A.C. R18-9-114) will be implemented:

- violation of a permit condition

- violation of an AWQS
- exceedance of an alert level
- overtopping of the impoundment or a breach of its berm
- imminent and substantial endangerment to the public health or the environment.

Exceedance of ARL #1

In the event that there is an exceedance of Action Response Level #1, the appropriate reporting requirements will be followed, the dual liner system will be evaluated, and if necessary, a corrective action plan will be submitted to ADEQ for approval and then implemented.

Exceedance of ARL #2

In the event that there is an exceedance of Action Response Level #2, the appropriate reporting requirements will be followed. Within three days of detecting the leak, actions will be initiated to identify the leak location, and if practical, disposal to the impoundment(s) will cease. A corrective action plan to replace the liner system will be submitted to ADEQ for approval and then implemented. Samples will be collected from the leak detection sump within five days of detection, and analyzed for the constituents listed in Table 2 of the Draft APP (Appendix J). Analytical results as well as a final report summarizing the remedial actions will be submitted to ADEQ.

Discharge To Vadose Zone

In the event that there is a leak through the dual liner system and into the vadose zone, flow to the impoundments will be stopped immediately. ADEQ will be contacted within 24 hours of detection of the leak. Within 5 days of detecting the leak, the remaining liquid in the impoundment will be contained and sampled for the constituents in Table 2 of the Draft APP (Appendix J). Analytical results as well as a corrective action plan will be submitted to ADEQ. A contamination assessment, as well as an evaluation of the dual liner system will be performed. If required by ADEQ, the groundwater will be monitored at the applicable POC.

Overtopping of the Impoundment

In the event that the impoundments are overtopped, flow to the impoundment will cease immediately. ADEQ will be contacted within 24 hours of the overflow. Liquid in the impoundments will be removed and properly disposed of until the water level is at or below the freeboard limit. The amount of water removed, a description of the removal method, and the disposal arrangements will be noted in a facility log. Within 5 days of detecting the leak, the remaining liquid in the impoundment will be sampled for the constituents in Table 2 of the Draft APP (Appendix J). Analytical results will be submitted to ADEQ as soon as possible. The circumstances that resulted in the overtopping of the impoundment will be assessed and a corrective action plan will be implemented to address the problems identified. A contamination assessment will be performed to identify impacted soil or groundwater. If required by ADEQ, the groundwater will be monitored at the applicable POC. Remedial activities for treating, storing, or disposing contaminated soil or groundwater will be implemented.

Emergency Response

An emergency response coordinator will be designated for the facility immediately prior to the commencement of plant operations. This coordinator will be responsible for activation of emergency response measures. The emergency response coordinator will adhere to the emergency response measures outlined in the Draft APP (Appendix J).

Emergency Fire Suppression

It may be necessary to use water from the surface impoundments during emergency fire suppression activities. Water from the storm water retention pond will be utilized before water from the evaporation impoundments. If water from the evaporation impoundments is used during emergency fire suppression activities, the GBPGS will notify the ADEQ's Compliance Unit. The GBPGS will provide ADEQ with information relating to the amount and quality of water discharged to the subsurface. Depending on the amount of water discharged to the subsurface and the quality of that water, the GBPGS may be required to collect soil samples and prepare a report describing the impact of the release to the subsurface for ADEQ submittal.

4.10 Closure and Post-Closure Plans

Under the provisions of Arizona Senate Bill 1401, a facility is no longer required to submit a closure plan. This bill authorizes the director of ADEQ to require a closure strategy only as part of the application. The closure strategy for the evaporation ponds is presented in Section 3.6.

In accordance with R18-9-116, the GBPGS will notify ADEQ of the intent to cease operations for any activity for which the facility was designed or operated, prior to ceasing those activities. Within 90 days following that notification, the GBPGS will submit a closure plan to ADEQ. The closure plan will include:

- approximate quantities and the chemical, biological, and physical characteristics of the materials to be removed from the facility

- the destination of the materials to be removed from the facility and an indication that placement of the materials at that destination is approved
- approximate quantities and the chemical, biological, and physical characteristics of the materials that will remain at the facility
- methods to be used to treat any materials remaining at the facility
- methods to be used to control the discharge of pollutants from the facility
- any limitations on future land or water uses created as a result of the facility's operations or closure activities
- methods to be used to secure the facility
- an estimate of the cost of closure

The GBPGS will close the surface impoundments in accordance with clean closure requirements (Section 3.6). Therefore, post-closure maintenance will not be required.

4.11 Compliance Schedule

Pursuant to A.A.C. R18-9-115, the GBPGS will adhere to the compliance schedule established in the Aquifer Protection Permit as expeditiously as is practicable. If a compliance schedule provides that actions be taken during a period that exceeds one year from the date of permit issuance, the schedule shall set forth interim requirements and the dates for their achievement. If the time necessary for completion of any interim requirements is more than one year and is not readily divisible into stages for completion, the permit shall contain interim dates for submission of reports on progress toward completion of the interim requirements and shall indicate a projected completion date.

The following information will be submitted to ADEQ within 90 days of the commencement of plant operations:

- The GBPGS will submit MSDS for any treatment chemicals added to process water
- CQA for surface impoundments
- Analytical results for wastewater samples. The samples will be analyzed for the constituents listed in Table 1 of the Draft APP (Appendix J).

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5.0 Section 5.0

Section 5.0 5.0

5 DEMONSTRATION OF TECHNICAL CAPABILITY

Any person applying for an APP must demonstrate the technical competence to carry out the conditions of the permit. The Gila Bend Power Partners are responsible for the design, construction, and operation of the GBPGS. MPI is responsible for the preparation of the APP.

5.1 Gila Bend Power Partners, L.L.C.

The Applicant, Gila Bend Power Partners, L.L.C. (GBPP), is a Delaware special purpose limited liability corporation formed to develop an approximate 845-megawatt electric power generation facility (GBPGS) near the town of Gila Bend, Arizona. The owners of the GBPP are Dallas, Texas-based Sammons Power Development Inc. (SPDI), and Dallas Texas-based PowerDevelopment Gila Bend, L.P. Funding and financial support for the GBPP has been supplied primarily by Sammons Enterprises, Inc. the ultimate parent corporation of SPDI.

GBPP will employ a Manager of Water Services. This individual will be responsible for ensuring that permit requirements are met. Since this individual will not be hired before the submittal of this application, Mr. Bob Walther's resume is included in Appendix K. Mr. Walther, a registrant of the California State Board of Technical Registration, oversaw the design and construction of the Gila Bend Power Generation Station.

5.2 Malcolm Pirnie, Inc.

Malcolm Pirnie, Inc. is a century-old firm of independent engineers, scientists, and consultants. Malcolm Pirnie, Inc., one of the largest consulting firms in the United States devoted solely to environmental concerns, employs a staff of over 1,300 technical and support personnel with experience in all of areas of environmental problem-solving. Malcolm Pirnie, Inc., offers over 3,000 clients a comprehensive array of environmental services in such areas as site investigations, design, solid and hazardous wastes, air quality, and water quality. The resumes of the individuals responsible for the preparation and review of this APP application are included in Appendix K.

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Section 6.0

6.0

6.0 Section 6.0

6 DEMONSTRATION OF FINANCIAL CAPABILITY

Any person applying for an APP must demonstrate the financial competence to construct, operate, close, and assure proper post-closure care of the facility. GBPP is solely responsible for the financial aspects of this APP. To show financial capability, GBPP has provided total cost estimates for construction, operation, and closure of the GBPGS (Tables 6-1 and 6-2). Assumptions that were made during the preparation of the cost estimates are included in the Preliminary Design Report prepared by IPT (Appendix A). The GBPP have prepared a financial report containing the information stipulated in the APP Guidance Manual. That information has been provided under separate cover. A statement from the chief financial officer stating that GBPP is financially capable of meeting the above mentioned costs, and the proposed financial arrangements has also been provided (Refer to Financial Documentation submittal).

Table 6-1. Estimated Construction Costs
Gila Bend Power Project
Gila Bend, Arizona

Gila Bend Power Project
Impoundment Construction Cost Opinion — **26-Oct-00**

Item Description	Unit	Quantity	Unit Cost	Total Cost
Clear Grub and Disposal	SqYd	408,278	$0.10	$40,828
Excavation of Impoundment & Rough Berm Construction	CuYd	544,370	$1.25	$680,463
Smooth Grading & Contouring	SqYd	408,278	$0.25	$102,070
Collection Sumps (Excavation, trenching, piping & backfill)	EA	3	$10,000.00	$30,000
Drain Piping (Trenching, HDPE piping, valves& manholes)	EA	4	$8,000.00	$32,000
Excavate & backfill Anchor Trenches	LF	17,800	$1.75	$31,150
Install Low permeability Soil Liner (6 in)	SqFt	3,674,500	$0.29	$1,065,605
Install Secondary Liner (60-mil HDPE)	SqFt	3,674,500	$0.36	$1,322,820
Install Drainage Geonet	SqFt	3,674,500	$0.16	$587,920
Install Primary Liner (80-mil HDPE)	SqFt	3,674,500	$0.48	$1,763,760
Electrical & Instrumentation	EA	1	$78,000.00	$78,000
Soil Overliner	CuYd	89,821	$9.00	$808,389
Gravel Overliner (above Soil Overliner)	CuYd	44,911	$12.00	$538,932
Staff Gage Stations	EA	5	$500.00	$2,500
Pond Access Roads (Preparation)	SqFt	57,600	$5.00	$288,000
Pond Access Roads (Gravel Surface)	CuYd	28,800	$9.00	$259,200
Sub-total				$7,631,636
General Conditions	3.00%			$228,949
Permitting	3.00%			$228,949
Insurance	0.75%			$57,237
Performance Bond	0.50%			$38,158
Survey	0.75%			$57,237
Engineering	3.00%			$228,949
QA/QC Testing	1.00%			$76,316
Sub-total				$915,796
Total Construction Costs				**$8,547,432**

ASSUMPTIONS:

1. Construction of the surface impoundments will be concurrent with and part of the power plant construction.

Table 6-2. Estimated Operation and Closure Costs
Gila Bend Power Project
Gila Bend, Arizona

Gila Bend Power Project **Impoundment** **Operation & Closure Cost Opinion**	**26-Oct-00**
Item Description	**Cost**
Operation & Maintenance	
Total Pond Area (ac.)	82
Acres cleaned annually	20.5
Salt Accumulation (tons/hr)	5
Total Salt Accumulation (tons)	40,296
Salt Disposal Cost ($/ton)	$10
Disposal Cost	$402,960
Equipment Cost	$56,000
Annual Impoundment Cleaning Cost	$458,960
Operation & Maintenance	$6,820
Total Annual Operating Costs	**$465,780**
Closure	
Construction Mobilization & Demobilization	$25,000
Remove & Replace Soil Liners	$170,000
Removal & Disposal of HDPE & Geonet Liners	$625,000
Removal & Disposal of Sumps & Piping	$65,250
Soil Sampling & Metals Analysis	$5,000
Earthwork & Final Grading	$750,000
Re-vegetation	$85,000
Total Closure Costs	**$1,725,250**

ASSUMPTIONS:

1. Ponds will be cleaned at the rate of 1 pond each year.
2. Each cleanout will require approximately 160 hours to complete.
3. 1 Front End Loader & 3 Transports will be required.

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Section 7.0 7.0

7 ADMINISTRATIVE DEMONSTRATIONS

7.1 Enforcement Actions

The APP application must include a description of any enforcement action of any federal or state law, rule or regulation, city or local government ordinance relating to the protection of the environment. The Gila Bend Power Partners, L.L.C. is comprised of Power Development Enterprises, Inc. and Industrial Power Technology. Neither of those companies have had any enforcement action related to the protection of the environment taken against them during the five years prior to the submittal of this application.

7.2 Zoning

The zoning for the property on which the GBPGS is proposed will be amended, such that the facility will comply with zoning ordinances. The Gila Bend Power Partners submitted an application for an amendment to the general plan and an application for a change in zoning. A copy of that submittal is included in Appendix L. The Gila Bend Power Partners understand that an APP can not be issued until evidence of zoning compliance is submitted. Documentation of zoning compliance will be submitted to ADEQ upon its approval.

7.3 Initial Fee

The fee rules require that initial fees be paid in full before the ADEQ reviews the application. The GBPGS is applying for an APP for a new, industrial facility with lined surface impoundments. According to ADEQ's fee schedule, the initial review fee for this type of facility is $4,500. A check for that amount has been included with this application.

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8.0 Section 8.0

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8 CERTIFICATION

The ADEQ requires that a statement certifying that the applicant has examined and is familiar with the information submitted in the APP application and all attachments, and that the applicant certifies that the information presented in the APP application is true and accurate. A certification statement has been included as Appendix M.

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F

FINANCIAL DOCUMENTATION

GILA BEND POWER PROJECT

GILA BEND, ARIZONA

November 2000

Prepared by

Gila Bend Power Partners, L.L.C.
5949 Sherry Lane, Suite 1880
Dallas, Texas 75225

Project 3962001-500

8. DEMONSTRATION OF FINANCIAL CAPABILITY (p. 22-23)
Any person applying for an Aquifer Protection Permit must be financially capable of constructing, operating, closing, and assuring proper post-closure care of the facility. **A person applying for an individual Aquifer Protection Permit must submit all of the following** in support of the demonstration of financial capability. ADEQ strongly advises that the required financial information be assembled in a document separate from the rest of the application, so that this information can be kept confidential, pursuant to ARS § 49 - 243.N.

a. Provide estimates for the total costs of each of the following aspects of the facility. Each of these components must be included in the financial capability demonstration in order for your application to be administratively complete:

- Construction - *Estimated at $8.5 million*
- Operation - *Estimated at $466 thousand per year.*
- Closure - *Estimated at $1.7 million.*
- Post-closure care - *Not applicable.*

b. Provide a statement by the chief financial officer of the applicant that the applicant is financially capable of meeting the costs of constructing, operating, closing, and assuring proper post-closure care. The statement must specify in detail the financial arrangements for meeting the closure and post-closure conditions described in the application.

See Attachment - Statement of Financial Capability

c. If the applicant is not a governmental entity, your submittal must also include **one** of the following three items:

- The most recent 10K form of the applicant

- A report that contains all of the following:

  > Applicant's organizational structure (status as a corporation, partnership, or other legal entity)

  > Description of applicant's business

  > Applicant's net worth, describing major assets and liabilities or latest financial statement

- Description of judgments exceeding $100,000.00 against applicant during five years prior to making this application
- Description of bankruptcy or insolvency proceedings by applicant during five years prior to making this application
- Names and dates of birth of executive officers (if applicant is a corporation)

- Evidence of a bond, insurance, or trust fund

See Attachment – Report on Applicant

Attachment – Report on Applicant

- Applicant's Organizational Structure:

  The Applicant, Gila Bend Power Partners. L.L.C. ("GBPP"), is a Delaware special purpose limited liability corporation formed to develop an approximate 845-megawatt electric power generation facility (the "Project") near the town of Gila Bend, Arizona. The owners of the Applicant are Dallas, Texas-based Sammons Power Development, Inc. ("SPDI") and Dallas, Texas-based PowerDevelopment Gila Bend, L.P. Funding and financial support for the Applicant has been supplied primarily by Sammons Enterprises, Inc. the ultimate parent corporation of SPDI (see Description of "Applicant's Net Worth, Describing Major Assets and Liabilities or Latest Financial Statement" below).

- Description of Applicant's Business:

  Applicant's business is the development, construction, ownership and operation of an approximate 845-megawatt electric power generation facility near Gila Bend, Arizona. Applicant's financial backer for funding development through construction and operations is Sammons Enterprises, Inc. ("Sammons"). Sammons is a diversified, privately held company with headquarters in Dallas, Texas. Sammons owns companies operating in a variety of industries that include, in addition to electric power, life insurance, industrial and oil field supply distribution, industrial equipment sales and leasing, mortgage banking, travel and tourism, and bottled water.

- Applicant's net worth, describing major assets and liabilities or latest financial statement:

  Applicant's financial strength is evidenced by Sammons' investment to date of over $11 million in development funding of the GBPP Project and its continued commitment to fund the Project up to and through its commercial operations. Sammons' portfolio companies have total assets of approximately $7.1 billion, aggregate sales of approximately $1.5 billion, and a combined net worth of approximately $1.5 billion. Sammons operates throughout the United States and has approximately 3,000 employees.

- Description of judgments exceeding $100,000.00 against Applicant during five years prior to making this application:

  None.

- Description of bankruptcy or insolvency proceedings by Applicant during five years prior to making this application:

  None.

- Names and dates of birth of Applicant's executive officers (if Applicant is a corporation):

  Executive Officers and Dates of Birth of Sammons Enterprises, Inc.

  President - Robert W. Korba (10/15/43)
  VP - John H. Washburn (10/06/49)
  VP & Treasurer - Joe A. Ethridge (07/17/41)

Estimated Construction, Operation and Closure Costs
Gila Bend Generating Station
Gila Bend, Arizona

Gila Bend Power Project
Impoundment Construction Cost Opinion **26-Oct-00**

Item Description	Unit	Quantity	Unit Cost	Total Cost
Clear Grub and Disposal	SqYd	408,278	$0.10	$40,828
Excavation of Impoundment & Rough Berm Construction	CuYd	544,370	$1.25	$680,463
Smooth Grading & Contouring	SqYd	408,278	$0.25	$102,070
Collection Sumps (Excavation, trenching, piping & backfill)	EA	3	$10,000.00	$30,000
Drain Piping (Trenching, HDPE piping, valves& manholes)	EA	4	$8,000.00	$32,000
Excavate & backfill Anchor Trenches	LF	17,800	$1.75	$31,150
Install Low permeability Soil Liner (6 in)	SqFt	3,674,500	$0.29	$1,065,605
Install Secondary Liner (60-mil HDPE)	SqFt	3,674,500	$0.36	$1,322,820
Install Drainage Geonet	SqFt	3,674,500	$0.16	$587,920
Install Primary Liner (80-mil HDPE)	SqFt	3,674,500	$0.48	$1,763,760
Electrical & Instrumentation	EA	1	$78,000.00	$78,000
Soil Overliner	CuYd	89,821	$9.00	$808,389
Gravel Overliner (above Soil Overliner)	CuYd	44,911	$12.00	$538,932
Staff Gage Stations	EA	5	$500.00	$2,500
Pond Access Roads (Preparation)	SqFt	57,600	$5.00	$288,000
Pond Access Roads (Gravel Surface)	CuYd	28,800	$9.00	$259,200
Sub-total				$7,631,636
General Conditions	3.00%			$228,949
Permitting	3.00%			$228,949
Insurance	0.75%			$57,237
Performance Bond	0.50%			$38,158
Survey	0.75%			$57,237
Engineering	3.00%			$228,949
QA/QC Testing	1.00%			$76,316
Sub-total				$915,796
TOTAL CONSTRUCTION COSTS				**$8,547,432**

ASSUMPTIONS:

1. Construction of the surface impoundments will be concurrent with and part of the power plant construction.

Estimated Construction, Operation and Closure Costs
Gila Bend Generating Station
Gila Bend, Arizona

Gila Bend Power Project Impoundment Construction, Operation & Closure Cost Opinion	**26-Oct-00**
Item Description	**Cost**
Operation & Maintenance	
Total Pond Area (ac.)	82
Acres cleaned annually	20.5
Salt Accumulation (tons/hr)	5
Total Salt Accumulation (tons)	40,296
Salt Disposal Cost ($/ton)	$10
Disposal Cost	$402,960
Equipment Cost	$56,000
Annual Impoundment Cleaning Cost	$458,960
Operation & Maintenance	$6,820
Total Annual Operating Costs	**$465,780**
CLOSURE	
Construction Mobilization & Demobilization	$25,000
Remove & Replace Soil Liners	$170,000
Removal & Disposal of HDPE & Geonet Liners	$625,000
Removal & Disposal of Sumps & Piping	$65,250
Soil Sampling & Metals Analysis	$5,000
Earthwork & Final Grading	$750,000
Re-vegetation	$85,000
Total Closure Costs	**$1,725,250**

ASSUMPTIONS:

1. Ponds will be cleaned at the rate of 1 pond each year.
2. Each cleanout will require approximately 160 hours to complete.
3. 1 Front End Loader & 3 Transports will be required.

Attachment - Statement of Financial Capability

To Whom It May Concern:

I hereby certify that the applicant, Gila Bend Power Partners, L.L.C., ("Applicant") is financially capable of meeting the costs of constructing, operating, closing, and assuring proper post-closure care of the contemplated evaporative pond facilities.

Construction and operating costs for the evaporative pond facilities will be part of a project financing arrangement for the Gila Bend Power Generation Project (the "Project") that will have its debt requirements provided by bank or long term bond financing. It is anticipated that the equity for the Applicant to support the debt requirements of the project financing will come from Sammons Enterprises, Inc. ("Sammons") and affiliates or subsidiaries of Sammons. Financial arrangements for meeting the closure and post-closure conditions described herein will be met by cash flow from the Project operations.

I hereby certify this 27th day of October, 2000.

By: Joseph A. Ethridge

Joseph Ethridge
Senior Vice President – Finance
& Treasurer
Sammons Enterprises, Inc.

PRICEWATERHOUSECOOPERS

SAMMONS ENTERPRISES, INC. AND SUBSIDIARIES

CONSOLIDATED FINANCIAL STATEMENTS WITH REPORT OF INDEPENDENT ACCOUNTANTS

FOR THE YEARS ENDED DECEMBER 31, 1999 AND 1998

SAMMONS ENTERPRISES, INC. AND SUBSIDIARIES

TABLE OF CONTENTS
DECEMBER 31, 1999 AND 1998

PRICEWATERHOUSECOOPERS

PricewaterhouseCoopers LLP
2001 Ross Avenue, Suite 1800
Dallas TX 75201-2997
Telephone (214) 754 7900

Report of Independent Accountants

To the Board of Directors of
Sammons Enterprises, Inc. and Subsidiaries:

In our opinion, the accompanying consolidated balance sheets and the related consolidated statements of income, stockholders' equity and of cash flows present fairly, in all material respects, the financial position of Sammons Enterprises, Inc. and Subsidiaries at December 31, 1999 and 1998, and the results of their operations and their cash flows for the years then ended in conformity with accounting principles generally accepted in the United States. These financial statements are the responsibility of the Company's management; our responsibility is to express an opinion on these financial statements based on our audits. We conducted our audits of these statements in accordance with auditing standards generally accepted in the United States which require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for the opinion expressed above.

PricewaterhouseCoopers LLP

March 17, 2000

SAMMONS ENTERPRISES, INC. AND SUBSIDIARIES

CONSOLIDATED BALANCE SHEETS
DECEMBER 31, 1999 AND 1998
(Amounts in Thousands)

ASSETS	1999	1998
Cash and cash equivalents	$ 21,557	$ 17,164
Marketable securities and investments	5,112,664	5,403,240
Mortgage receivables, net	59,506	-
Accounts and notes receivable, trade, net of allowance of $2,424 and $1,822, respectively	144,331	133,950
Inventories	99,882	79,291
Property, plant and equipment, net	194,714	188,620
Deferred policy acquisition costs	636,892	519,726
Present value of future profits of acquired business	181,263	171,009
Net assets of discontinued operations	7,056	8,553
Other assets	626,917	440,316
Total assets	$ 7,084,782	$ 6,961,869
LIABILITIES		
Accounts payable and accrued expenses	$ 321,678	$ 361,705
Notes and loans payable	133,906	85,869
Policy claims and other reserves	67,320	54,963
Liability for future policy benefits	5,090,298	4,838,758
Deferred income taxes (benefit) payable	(50,809)	50,718
Total liabilities	5,562,393	5,392,013
STOCKHOLDERS' EQUITY		
Common stock, $1 par value, 9,200 and 9,300 shares authorized, 9,165 and 9,299 shares issued, respectively	9,165	9,299
Paid-in capital	143,832	140,486
Unearned ESOP shares	(10,573)	(14,757)
Retained earnings	1,474,514	1,430,202
Accumulated other comprehensive (loss) income	(47,403)	58,914
Treasury stock, 637 and 734 shares, respectively, at cost	(47,146)	(54,288)
Total stockholders' equity	1,522,389	1,569,856
Total liabilities and stockholders' equity	$ 7,084,782	$ 6,961,869

The accompanying notes are an integral part of the consolidated financial statements.

SAMMONS ENTERPRISES, INC. AND SUBSIDIARIES

CONSOLIDATED STATEMENTS OF INCOME
FOR THE YEARS ENDED DECEMBER 31, 1999 AND 1998
(Amounts in Thousands, except per share amounts)

	1999	1998
SALES AND REVENUES		
Product	$ 515,881	$ 637,848
Service	80,235	47,982
Life insurance	886,507	862,833
Net realized investment losses	(13,984)	(873)
Net unrealized (losses) gains on trading securities	(20,436)	2,925
Other, net	27,505	29,519
Total sales and revenues	1,475,708	1,580,234
COSTS AND EXPENSES		
Cost of sales	389,006	492,105
Cost of services	25,048	24,009
Insurance benefits	470,360	482,933
Selling	65,101	59,280
General and administrative	199,673	164,972
Amortization of deferred policy acquisition costs	149,432	147,242
Depreciation and other amortization	34,297	24,663
Goodwill impairment charge	50,431	-
Interest	10,819	7,501
Total costs and expenses	1,394,167	1,402,705
Income before income taxes and discontinued operations	81,541	177,529
Provision for income taxes	23,382	56,089
Income before discontinued operations	58,159	121,440
Discontinued travel operations:		
Income from operations, net of income taxes of $593 and $365, respectively	627	199
Net income	$ 58,786	$ 121,639
INCOME PER COMMON SHARE		
Continuing operations	$ 6.97	$ 14.43
Discontinued operations	.08	.02
Total	$ 7.05	$ 14.45

The accompanying notes are an integral part of the consolidated financial statements.

SAMMONS ENTERPRISES, INC. AND SUBSIDIARIES

CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY FOR THE YEARS ENDED DECEMBER 31, 1999 AND 1998
(Amounts in Thousands)

	Common Stock		Paid-in
	Shares	Amount	Capital
Balance, January 1, 1998	9,429	$ 9,429	$ 131,526
Comprehensive income			
Net income			
Other comprehensive income, net of tax:			
Change in net unrealized investment loss on available for sale securities			
Comprehensive income			
Purchase and retirement of stock	(130)	(130)	5,263
Dividend paid:			
$.20 per share			
Net decrease in unearned ESOP shares			3,697
Balance, December 31, 1998	9,299	9,299	140,486
Comprehensive income			
Net income			
Other comprehensive income, net of tax:			
Foreign currency translation			
Change in net unrealized investment loss on available for sale securities			
Comprehensive income			
Purchase and retirement of stock	(134)	(134)	(2,111)
Dividend paid:			
$.46 per share			
Net decrease in unearned ESOP shares			5,457
Balance, December 31, 1999	9,165	$ 9,165	$ 143,832

The accompanying notes are an integral part of the consolidated financial statements.

Unearned ESOP Shares	Treasury Stock	Comprehensive Income	Accumulated Other Comprehensive Income	Retained Earnings	Total
$ (19,327)	$ (61,222)	$ -	$ 59,545	$1,328,850	$1,448,801
		121,639		121,639	121,639
		(631)	(631)		(631)
		$ 121,008			
	6,934			(18,567)	(6,500)
				(1,720)	(1,720)
4,570					8,267
(14,757)	(54,288)		58,914	1,430,202	1,569,856
		58,786		58,786	58,786
		675	(1,283)	1,958	675
		(105,034)	(105,034)		(105,034)
		$ (45,573)			
	7,142			(12,504)	(7,607)
				(3,928)	(3,928)
4,184					9,641
$ (10,573)	$ (47,146)		$ (47,403)	$1,474,514	$1,522,389

The accompanying notes are an integral part of the consolidated financial statements.

SAMMONS ENTERPRISES, INC. AND SUBSIDIARIES

CONSOLIDATED STATEMENTS OF CASH FLOWS
FOR THE YEARS ENDED DECEMBER 31, 1999 AND 1998
(Amounts in Thousands)

	1999	1998
OPERATING ACTIVITIES		
Net income	$ 58,786	$ 121,639
Adjustments to reconcile net income to net cash provided by operating activities:		
Depreciation and amortization	183,729	171,905
Benefit for deferred income taxes	(43,715)	(1,790)
Gains on disposal of property and equipment	(31)	(2,471)
Net proceeds from (cost of) trading securities	17,435	(48,728)
Unrealized investment losses (gains), net	20,436	(2,925)
Realized investment losses, net	13,984	873
Gain on sale of mortgage receivables	(17,337)	-
Loans originated, net	(653,721)	-
Loans sold	700,899	-
Goodwill impairment charge	50,431	-
Net changes in assets and liabilities, net of acquisition of other companies:		
Accounts and notes receivable, trade	(10,381)	54,248
Inventories	(20,591)	7,357
Deferral of policy acquisition costs	(141,713)	(120,792)
Accounts payable and accrued expenses	(13,332)	(109,907)
Policy claims and benefits	(37,229)	34,376
Discontinued operations - non-cash charges and working capital changes	1,963	2,663
Other, net	(26,584)	(365)
	24,243	(15,556)
Net cash provided by operating activities	83,029	106,083
INVESTING ACTIVITIES		
Purchases of investments	(1,923,359)	(2,853,538)
Sales of investments	1,826,514	2,897,135
Change in short-term investments, net	209,037	371,121
Additions to property, plant and equipment, net	(33,894)	(56,441)
Acquisition of company and business, net of cash acquired	(66,231)	(5,255)
Change in security lending	(50,500)	(257,625)
Net investing activities of discontinued operations	(466)	459
Net cash (used in) provided by investing activities	(38,899)	95,856

The accompanying notes are an integral part of the consolidated financial statements.

	1999	1998
FINANCING ACTIVITIES		
Payments of notes and loans payable	$ (37,543)	$ (22,287)
Receipts from interest sensitive life insurance and annuity contracts	532,116	500,815
Benefits of interest sensitive life insurance and annuity contracts	(523,450)	(676,455)
Purchase of Company's common stock	(7,607)	(6,500)
Dividends	(3,928)	(1,720)
Net financing activities of discontinued operations	-	(574)
Other	675	(1,897)
Net cash used in financing activities	(39,737)	(208,618)
Increase (decrease) in cash and cash equivalents	4,393	(6,679)
Cash and cash equivalents, beginning of year	17,164	23,843
Cash and cash equivalents, end of year	$ 21,557	$ 17,164
SUPPLEMENTAL INFORMATION		
Interest paid	$ 14,073	$ 10,046
Income taxes paid	$ 74,148	$ 71,050
Net assets acquired in the acquisition of Parkway	$ 11,487	$ -

The accompanying notes are an integral part of the consolidated financial statements.

1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Organization

Sammons Enterprises, Inc. ("SEI" or "the Parent") is a diversified holding company with principal subsidiaries operating in a variety of industries that include the life insurance and annuity business, industrial and oil field supply distribution, industrial equipment sales and leasing, travel and tourism, mortgage banking, and bottled water. At December 31, 1999, all operations were predominantly in the United States with limited international business.

The consolidated financial statements include the accounts of SEI and its wholly owned subsidiaries ("the Company"). Significant intercompany transactions have been eliminated in consolidation.

Basis of presentation

The preparation of financial statements in conformity with generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amount of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements, and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates.

The most significant areas which require the use of management's estimates relate to the determination of the fair values of financial instruments, deferred policy acquisition costs, and future policy benefits for traditional life insurance policies.

The Company is subject to the risk that interest rates will change and cause a decrease in the value of its investments. To the extent that fluctuations in interest rates cause the duration of assets and liabilities to differ, the Company may have to sell assets prior to their maturity and realize a loss.

Cash equivalents

The Company considers all demand deposits and interest bearing accounts not related to the investment function to be cash equivalents.

Investments and investment income

The Company classifies its fixed maturity investments (bonds and redeemable preferred stocks) and equity securities (common and non-redeemable preferred stocks) as trading, available for sale or held to maturity. The Company has no securities classified as held to maturity.

Trading securities are held for resale in anticipation of short-term market movements. The Company's trading securities are stated at market value. Gains and losses on these securities, both realized and unrealized, are included in the determination of net income. Net cost of or proceeds from trading securities are included in operating activities in the consolidated statement of cash flows.

Available for sale securities are classified as such if not considered trading securities or if there is not the positive intent and ability to hold the securities to maturity. Such securities are carried at market value with the unrealized holding gains and losses included directly in stockholders' equity, net of related adjustments to deferred policy acquisition costs and deferred income taxes. Cash flows from available for sale security transactions are included in investing activities in the consolidated statement of cash flows.

Short-term investments are stated at amortized cost which approximates market. Policy loans and other invested assets are carried at unpaid principal balances.

Investment income is recorded when earned. Realized gains and losses are determined on the basis of specific identification of the investments.

When a decline in value of an investment is determined to be other than temporary, the specific investment is carried at estimated realizable value and its original book value is reduced to reflect this impairment. Such reductions in book value are recognized as realized investment losses in the period in which they are written down.

Mortgage receivables, net

Mortgage receivables include loans held for sale to investors and certain loans held by the Company which may not be immediately sold, net of allowance for loan losses. Loans held for sale are stated at the lower of cost or market, determined on a net aggregate basis using current market prices and historical experience.

Gains or losses on mortgage receivables sold are recognized based on the difference between the selling price and the carrying value of the related mortgage loan. Direct loan origination costs, net of nonrefundable loan fees received, are deferred and included in the carrying value of the mortgage receivables.

Inventories

Inventories are stated at the lower of cost or market. Cost is determined principally using the last-in, first-out ("LIFO") method. The excess of current cost over LIFO value was approximately $32,590 and $40,151 at December 31, 1999 and 1998, respectively.

Property, plant and equipment

Property, plant and equipment are recorded at cost. Depreciation is provided over the estimated service lives of depreciable assets using both straight-line and accelerated methods. Gains or losses from retirements and dispositions are recorded in the period incurred.

Goodwill

Goodwill (the excess of purchase price over the fair value of net assets acquired) is carried at fair value at the date of acquisition less accumulated amortization. Goodwill is amortized using the straight-line method over the estimated useful lives of the respective assets. The carrying values of all long-term assets, including goodwill, are reviewed for impairment whenever events or changes in circumstances (such as significant declines in sales, earnings, or cash flows or material adverse changes in the business climate) indicate they may not be recoverable.

Insurance operations

Life insurance premiums, other than premiums on universal life and other interest sensitive life insurance and investment contracts, are recognized as revenue over the premium paying period. Revenues for universal life and other interest sensitive life insurance and investment contracts consist of policy fund charges for cost of insurance, policy administration, and surrender charges assessed against policyholder account balances.

Policy acquisition costs which vary with, and are primarily related to the production of new business, are deferred to the extent that such costs are deemed recoverable from future profits. Such costs include commissions, policy issuance, underwriting and variable agency expenses. For traditional insurance products, such costs are amortized over the estimated premium paying period of the related policies in proportion to the ratio of the annual premium revenues to the total anticipated premium revenues. Deferred costs related to interest sensitive policies are amortized over the lives of the policies (up to 25 years) in relation to the present value of actual and estimated gross profits, subject to regular evaluation and retroactive revision to reflect actual emerging experience.

The present value of future profits of acquired business ("PVFP") represents the portion of the purchase price of a block of business which is allocated to the future profits attributable to the insurance in force at the dates of acquisition. The PVFP is amortized in relationship to the actual and expected emergence of such future profits.

Policy reserves for universal life and other interest sensitive life insurance and investment contracts of $4,241,053 and $4,178,019 at December 31, 1999 and 1998, respectively, are determined using the retrospective deposit method. Policy reserves consist of the policyholder deposits and credited interest less withdrawals and charges for mortality, administrative and policy expenses. Interest credited rates ranged from 2.75% to 6.25% in 1999 and 3.00% to 6.50% during 1998.

The liabilities for future policy benefits for traditional life insurance policies and policy owner funds of $849,245 and $660,739 at December 31, 1999 and 1998, respectively, generally are computed by the net level premium method, based upon estimated future investment yield, mortality, morbidity and withdrawals which were appropriate at the time the policies were issued or acquired. Interest assumptions ranged from 6.25% to 11.25% in 1999 and 6.50% to 11.00% during 1998.

Liabilities for policy claims and benefits payable include provisions for reported claims and estimates for claims incurred but not reported, based on the terms of the related policies and contracts and on prior experience. Claim liabilities are necessarily based on estimates and are subject to future changes in claim severity and frequency. Estimates are periodically reviewed and adjustments are reflected in current operations.

Payment of dividends or other distributions of the insurance subsidiaries are limited by statute.

Fair value of financial instruments

The fair value of investment securities is generally based on quoted market prices or fair value prices obtained from independent pricing services using industry formulas applicable to the yield, credit quality, and maturity of the investments. Fair values for the liabilities under investment-type insurance contracts are estimated based on cash surrender values of the underlying contracts.

Federal income taxes

Deferred tax liabilities and assets are recognized based upon the difference between the financial statement and tax bases of assets and liabilities using enacted tax rates in effect for the year in which the differences are expected to reverse.

Income per common share

Income per common share is based on the weighted average number of common shares outstanding during each year.

Reclassifications

Certain reclassifications have been made to prior year's balances to conform to current year presentation.

2. ACQUISITION

In January 1999, the Company purchased substantially all of the assets of a mortgage company, Parkway Mortgage, Inc. ("Parkway"). In addition the Company assumed the responsibility for the liability of the warehouse line of credit used to fund loan originations. The acquisition was accounted for as a purchase. The total purchase costs of $65,520 were allocated to the assets and liabilities based on their relative fair values.

The Company has evaluated goodwill and recorded an impairment charge of $50,431 which was the unamortized balance of goodwill. This impairment charge was determined by measuring the carrying amount of goodwill against the estimated discounted cash flows associated with the operation of the mortgage operation. The evaluation at that time indicated that the future discounted cash flows were not sufficient to recover the carrying value of goodwill.

3. FAIR VALUE OF FINANCIAL INSTRUMENTS

The carrying value and estimated fair value of the Company's financial instruments are as follows:

	December 31, 1999		December 31, 1998	
	Carrying Value	Estimated Fair Value	Carrying Value	Estimated Fair Value
Financial assets:				
Fixed maturities -				
Available for sale	$ 3,726,466	$ 3,726,466	$ 3,916,313	$ 3,916,313
Trading				
Equity securities -				
Available for sale	398,610	398,610	319,006	319,006
Trading	80,696	80,696	117,021	117,021
Policy loans	313,555	313,555	311,845	311,845
Short-term investments	438,433	438,433	647,470	647,470
Other investments	154,904	154,904	91,585	91,585
Mortgage receivables, net	59,506	60,113	-	-
Financial liabilities:				
Investment-type insurance contracts	1,297,122	1,281,289	1,272,358	1,254,082
Warehouse line of credit	55,373	55,373	-	-
Other notes and loans payable	78,533	78,533	85,869	85,869

4. INVESTMENTS AND INVESTMENT INCOME

The amortized cost and estimated fair value of fixed maturities and equity securities classified as available for sale at December 31, 1999 and 1998 are as follows:

	December 31, 1999			
	Amortized Cost	Gross Unrealized Holding Gains	Gross Unrealized Holding Losses	Estimated Fair Value
Fixed maturities:				
U.S. Treasury and other U.S. government corporations and agencies	$ 217,329	$ 1,739	$ 3,839	$ 215,229
Corporate securities	1,939,937	8,551	135,225	1,813,263
Mortgage-backed securities	1,450,537	4,336	61,072	1,393,801
Other debt securities	307,012	5,139	7,978	304,173
Total fixed maturities	3,914,815	19,765	208,114	3,726,466
Equity securities	385,230	58,424	45,044	398,610
Total available for sale	$ 4,300,045	$ 78,189	$ 253,158	$ 4,125,076

	December 31, 1998			
	Amortized Cost	Gross Unrealized Holding Gains	Gross Unrealized Holding Losses	Estimated Fair Value
Fixed maturities:				
U.S. Treasury and other U.S. government corporations and agencies	$ 327,331	$ 16,208	$ 644	$ 342,895
Corporate securities	1,591,184	52,282	34,991	1,608,475
Mortgage-backed securities	1,659,748	45,160	14,887	1,690,021
Other debt securities	274,685	450	213	274,922
Total fixed maturities	3,852,948	114,100	50,735	3,916,313
Equity securities	260,258	63,598	4,850	319,006
Total available for sale	$ 4,113,206	$ 177,698	$ 55,585	$ 4,235,319

The cost of equity securities classified as trading securities is $98,868 and $103,798 as of December 31, 1999 and 1998, respectively.

The unrealized appreciation on the available for sale securities is reduced by deferred policy acquisition costs and deferred income taxes as of December 31, 1999 and 1998, and is reflected as accumulated other comprehensive income in the consolidated statement of stockholders' equity as shown below:

	1999	1998
Gross unrealized appreciation	$ (171,022)	$ 122,113
Foreign currency translation	(1,283)	-
Deferred policy acquisition costs	100,080	(30,188)
Deferred income taxes	24,822	(33,011)
Accumulated other comprehensive income	$ (47,403)	$ 58,914

The other comprehensive income in 1999 and 1998 is comprised of the change in unrealized gains (losses) on available for sale fixed maturity and equity security investments arising during the period less the realized losses included in income, deferred policy acquisition cost and deferred income taxes as follows:

	1999	1998
Fixed maturities	$ (264,877)	$ (48,434)
Equity securities	(41,822)	19,403
Foreign currency translation	(1,283)	-
Less the accumulated losses released into income	13,586	1,245
Less deferred policy acquisition cost impact	130,268	26,823
Less deferred income tax effect	57,811	332
	$ (106,317)	$ (631)

The amortized cost and estimated fair value of available for sale fixed maturities at December 31, 1999, by contractual maturity, are shown below. Expected maturities will differ from contractual maturities because borrowers may have the right to call or prepay obligations with or without call or prepayment penalties.

	Amortized Cost	Estimated Fair Value
Due in one year or less	$ 17,369	$ 17,385
Due after one year through five years	302,600	299,524
Due in five years through ten years	580,195	562,758
Due after ten years	1,568,201	1,457,082
Securities not due at a single maturity date	1,446,450	1,389,717
Total fixed maturities	$ 3,914,815	$ 3,726,466

Major categories of investment income are summarized as follows:

	1999	1998
Gross investment income:		
Fixed maturities	$ 287,746	$ 298,616
Equity securities	37,132	29,830
Policy loans	22,707	22,439
Short-term investments	23,856	40,904
Other invested assets	12,056	9,347
Gross investment income	383,497	401,136
Less investment expenses	(6,477)	(16,521)
Net investment income	$ 377,020	$ 384,615

The major categories of investment gains and losses reflected in the income statement are summarized as follows:

	1999		1998	
	Realized	Unrealized Trading Securities	Realized	Unrealized Trading Securities
Fixed maturities	$ (9,457)	$	$ 9,525	$ -
Equity securities	(4,390)	(20,436)	(9,331)	2,925
Other	(137)		(1,067)	-
Net investment gains (losses)	$ (13,984)	$ (20,436)	$ (873)	$ 2,925

Proceeds from the sale of available for sale securities and the gross realized gains and losses on these sales during 1999 and 1998, were as follows:

	1999		1998	
	Fixed Maturities	Equity	Fixed Maturities	Equity
Proceeds from sales	$ 1,055,588	$ 183,052	$ 1,257,085	$ 409,735
Gross realized gains	6,631	3,149	16,426	453
Gross realized losses	16,944	31,678	6,304	8,474

5. MORTGAGE RECEIVABLES, NET

Mortgage receivables consist primarily of loans made by the Company for resale in the secondary mortgage market. As of December 31, 1999, the Company's mortgage receivables consisted of the following:

	1999
Loans held for investment	$ 1,879
Loans held for sale	58,910
	60,789
Add: Deferred loan origination costs, net	558
Less: Allowance for possible loan losses	(1,084)
Less: Net unrealized loss on loans held for sale	(757)
Net mortgage receivables	$ 59,506

6. PROPERTY, PLANT AND EQUIPMENT

The major classifications of property, plant and equipment are as follows:

	1999	1998
Land and land improvements	$ 26,701	$ 27,079
Buildings and improvements	124,441	135,341
Rental equipment	93,236	70,328
Other	102,569	87,853
	346,947	320,601
Accumulated depreciation	(152,233)	(131,981)
	$ 194,714	$ 188,620

Depreciation expense was $30,521 and $24,291 for the years ended December 31, 1999 and 1998, respectively.

7. NOTES AND LOANS PAYABLE

Notes and loans payable are as follows:

	1999	1998
Stock acquisition note	$ 54,995	$ 61,437
Mortgage warehouse line of credit	55,373	-
Mortgage note payable	22,263	22,732
Other notes and loans payable	1,275	1,700
	$ 133,906	$ 85,869

In November 1993, the Company purchased 1,250,000 of its shares from a related party financed with a non-interest bearing note in the amount of $133,400. The acquisition was recorded at its discounted fair market value in the amount of $92,494. At December 31, 1999, the note requires 6 remaining annual payments ranging from $10,600 to $12,000 with the final payment due on December !, 2005.

As of December 31, 1999 and 1998, the Company had a mortgage note payable to a related party. The mortgage note bears interest at 10.5%, matures July 1, 2001, and requires principal and interest payments due in quarterly installments of $709. The mortgage note contains restrictive debt covenants including, but not limited to certain cash flow requirements, whereby at each quarter end, cash must exceed 130% of principal and interest payments due in the four subsequent quarters. The note is collateralized by certain real property, buildings and improvements, and equipment. Accrued interest payable to a related party of approximately $584 and $597 was included in accrued expenses as of December 31, 1999 and 1998, respectively.

As part of the acquisition of the mortgage operations, the Company assumed the liability for the warehouse line of credit used to fund loan originations. This $115,000 warehouse line of credit with First Union National Bank, as agent for itself and other participant lenders, expires January 28, 2000. Under the terms of the agreement, the Company has pledged certain mortgage receivables held for sale. Advances are generally made under the line of credit equal to 98% of the pledged mortgage receivables. Interest on the principal balance of loans outstanding is accrued at the federal funds lending rate plus 1% and is payable monthly. As of December 31, 1999, the interest rate on the line of credit was 5.88%. This line of credit agreement requires Parkway to meet certain financial ratios, which includes maintaining a minimum tangible net worth of $14,000 and be guaranteed by the Company until the expiration of the agreement. As of December 31, 1999, Parkway was in compliance with all loan covenants.

Subsequent to December 31, 1999, Parkway negotiated a new warehouse line of credit amounting to $100,000 with First Union National Bank, as agent for itself and other participant lenders. Under the terms of the new agreement, interest accrues at the federal funds lending rate plus 1.25% payable monthly. This line of credit agreement requires that Parkway meet certain financial ratios, which includes maintaining a minimum tangible net worth of $17,000, a leverage ratio of 8:1, and a minimum liquidity of 35% of adjusted tangible net worth as measured on the last day of each month. The Company does not guarantee this new line of credit.

Scheduled maturities of notes and loans payable are as follows:

Year ending December 31:	
2000	$ 63,406
2001	30,104
2002	9,133
2003	9,537
2004	10,436
Thereafter	11,290
	$ 133,906

8. INCOME TAXES

The Company files a consolidated federal income tax return for the Parent and eligible domestic subsidiaries. The provisions (benefits) for income taxes consist of the following:

	1999	1998
Current:		
Federal	$ 65,469	$ 65,438
State, local and foreign	1,628	(7,559)
	67,097	57,879
Deferred:		
Federal	(43,421)	(13,228)
State, local and foreign	(294)	11,438
	(43,715)	(1,790)
Provision for income taxes	$ 23,382	$ 56,089

The components of the net deferred tax (asset) liability are as follows:

	1999	1998
Deferred tax liabilities	$ 280,955	$ 301,332
Deferred tax assets	(344,331)	(258,726)
Valuation allowance	12,446	8,100
Net deferred tax (asset) liability	$ (50,930)	$ 50,706

The net deferred tax asset included in net assets of discontinued operations is $121 and $12 at December 31, 1999 and 1998, respectively.

Significant temporary differences include intangibles, deferred acquisition costs and future policy benefits and policy claims.

The difference between the provision for income taxes attributable to income before income taxes and the amounts that would be expected using the U.S. Federal statutory income tax rate of 35% in 1999 and 1998 is as follows:

	1999	1998
Federal income taxes at the statutory rate	$ 28,542	$ 62,200
State and local income taxes, net of federal benefit	(4,401)	839
Amortization of intangibles	772	772
Dividends received deduction	(698)	(2,022)
Meals and entertainment	324	282
Tax exempt interest	(2,678)	(1,636)
Foreign	1,392	795
Valuation allowance	4,346	-
Other	(4,217)	(5,141)
Provision for income taxes	$ 23,382	$ 56,089

Income taxes payable in the amount of $531 and $1,286 for the years ended December 31, 1999 and 1998, respectively, have been included as a component of accounts payable and accrued expenses. Prepaid income taxes of $17,008 and $11,227 for the years ended December 31, 1999 and 1998, respectively, have been included as a component of other assets.

As part of the revaluation of assets and liabilities with the acquisition of North American, a valuation allowance was established in 1996. To the extent that tax benefits are subsequently recognized relating to amounts for which this valuation allowance was provided, the effect will be applied to reduce goodwill by the same amount. Such a reduction, in the amount of $8,225, was taken in 1998 reducing the valuation allowance to $8,100.

In assessing the reliability of deferred tax assets, management considers whether it is more likely than not that some portion or all of the deferred tax assets will not be realized. Based on management's analysis of the realization of deferred assets at December 31, 1999, a valuation allowance was provided in the amount of $4,346. To the extent that tax benefits are subsequently recognized relating to amounts for which this valuation allowance was provided, the effect will be a reduction of tax expense in the period so recognized.

Prior to 1984, certain special deductions in arriving at taxable income were allowed life insurance companies. These special deductions, totaling $66,000 as of December 31, 1999 and 1998, respectively, are accumulated in a special "policyholders' surplus" memorandum tax account of an insurance subsidiary. Should stockholder dividends be paid from this account, the Company would be subject to additional federal income taxes.

9. OPERATING LEASES

The Company pays vehicle, office space, land, and plant facility rentals under various operating lease agreements. Rental expense of approximately $10,460 and $12,043 was incurred in 1999 and 1998, respectively. Approximate future minimum lease payments under noncancellable leases are as follow:

Year ending December 31,	
2000	$ 8,358
2001	7,255
2002	3,962
2003	1,460
2004	920
Thereafter	781
	$ 22,736

10. EMPLOYEE BENEFIT PLANS

The Company has noncontributory defined benefit pension plans covering certain full-time employees. In addition, the Company provides certain post-retirement health care and life insurance benefits for eligible active and retired employees through a defined benefit plan. The information for both plans at December 31, is as follows:

	Pension Benefits		Other Benefits	
	1999	1998	1999	1998
Benefit obligation	$ 55,350	$ 56,582	$ 8,994	$ 9,347
Fair value on plan assets	75,771	72,640		-
Funded status	$ 20,421	$ 16,058	$ (8,994)	$ (9,347)
Prepaid (accrued) benefit cost	$ 5,057	$ 6,343	$ (9,869)	$ (9,553)

	Pension Benefits		Other Benefits	
	1999	1998	1999	1998
Weighted-average assumptions as of December 31:				
Discount rate	7.75%	7.00%	7.75%	7.00%
Expected return on plan assets	8.75%	8.75%	-	-
Rate of compensation increase	4.25%	4.25%	-	-

For measurement purposes, a 6.25% and a 6.50% annual rate of increase in the per capita cost of covered health care benefits was assumed for 1999 and 1998, respectively. The rate was assumed to decrease gradually to 4.50% in 2006 and remain at that level thereafter.

	Pension Benefits		Other Benefits	
	1999	1998	1999	1998
Benefit cost	$ 1,286	$ 1,568	$ 886	$ 965
Employer contributions	-	4,393	570	941
Plan participants' contributions	-	-	309	262
Benefits paid	3,917	3,527	879	1,203

During 1998, the Company had a combined curtailment and settlement gain in the pension and other post-retirement benefit plans of approximately $487 and $422, respectively, included in operations. The curtailment was the result of a reduction in the covered workforce at one of the subsidiary companies.

The Company sponsors an Employee Stock Ownership Plan ("ESOP") covering certain full-time employees. As of December 31, 1999 and 1998, the ESOP trust was indebted to the Company in the aggregate amount of $10,573 and $14,757, respectively, in conjunction with stock purchases prior to 1994. These ESOP shares were initially pledged as collateral for its debt. The loan requires the ESOP to make annual principal payments of $3,000 to the Company. Dividends on shares held by the ESOP are paid to the ESOP trust and, together with Company contributions, are used by the ESOP to make principal and interest payments. As the debt is repaid, shares are released from collateral and allocated to active employees, based on the proportion of debt service paid in the year.

The shares pledged as collateral are reported as unearned ESOP shares, shown as a reduction of stockholders' equity. As shares are released from collateral, the Company reports compensation expense equal to the current market price of the shares, and the shares become outstanding for earnings-per-share computations.

The ESOP shares as of December 31, 1999 and 1998 were as follows:

	1999	1998
Allocated shares	313,380	305,072
Shares released for allocation	41,839	46,289
Unallocated shares	105,731	147,570
Total ESOP shares	460,950	498,931
Fair value of unallocated shares	$ 21,146	$ 26,120

11. COMMITMENTS AND CONTINGENCIES

The Company has, in the normal course of business, claims and lawsuits filed against it. The Company believes these claims and lawsuits, either individually or in aggregate, will not materially affect the Company's financial position or results of operations.

The Company presently reinsures the excess of each individual risk over $500 on ordinary life insurance in order to spread its risk of loss. Certain other individual health contracts are reinsured on a policy-by-policy basis.

To the extent that reinsurers may not be able to meet the obligations assumed under the reinsurance contracts, the Company is contingently liable to pay policy benefits.

12. DISCONTINUED OPERATIONS

During 1999, the Company entered into negotiations to sell its wholly-owned subsidiary, Adventure Tours USA, Inc. and Subsidiaries ("Adventure Tours"), a wholesale tour operator in the travel industry. Adventure Tours had operating revenue of $154,792 and $149,624 for the years ended December 31, 1999 and 1998, respectively. The transaction is expected to be completed during 2000.

Net assets of discontinued operations at December 31, 1999 and 1998 were $7,056 and $8,553. These net assets consist of net working capital, property and equipment, and intangibles less related liabilities.

13. SUBSEQUENT EVENT

During 1999, the Company entered into an agreement to acquire Royal Life Insurance Company of New York, a New York domiciled life insurance company for $85,000. Royal Life of New York has invested assets of $720,000 and policyholder obligations of $655,000. This transaction was completed in January 2000.