Wis. stats. 293.50 supplemental compliance demonstration report (Sacaton Mine, Pinal Co., AZ). 2003

Foley and Lardner
Crandon, Wisconsin: Nicolet Minerals Company, 2003

FOLEY & LARDNER
ATTORNEYS AT LAW

FOLEY & LARDNER
VEREX PLAZA
150 EAST GILMAN STREET
MADISON, WISCONSIN 53703-1481
POST OFFICE BOX 1497
MADISON, WISCONSIN 53701-1497
608.257.5035 TEL
608.258.4258 FAX
www.foleylardner.com

August 27, 2003

CLIENT/MATTER NUMBER
062745-0113

Ms. Melissa DeVetter
Crandon Project Manager
Wisconsin Department of Natural Resources
101 South Webster
PO Box 7921
Madison WI 53707-7921

Re: Crandon Project Wis. Stats. § 293.50 Compliance Demonstration -- Supplemental Report

Dear Ms. DeVetter:

Foley & Lardner, on behalf of its client Nicolet Minerals Company (NMC), is pleased to submit the enclosed Supplemental Compliance Demonstration Report regarding the Sacaton mine. This supplemental report, prepared by Foley & Lardner and its consultants, is intended to respond to Lawrence J. Lynch's May 31, 2002 letter to Gordon Reid, and must be read in conjunction with NMC's *Wis. Stats. § 293.50 Compliance Demonstration* filed in December 1998.

The purpose of this supplemental report is to further demonstrate that the Sacaton mine complies with the criteria set out in Wis. Stats. § 293.50, the so called "mining moratorium" statute. It was prepared in consultation with various local, state and federal regulators

As noted in the attached distribution list, NMC has forwarded copies of this document to all appropriate state and federal agencies, to local officials, and to various interested parties. It has also filed with the Wisconsin Department of Natural Resources six duplicate sets (three sets each in the WDNR's Madison and Rhinelander offices) of all materials corresponding to the numbered references noted in the supplemental report. (Those additional references are numbered serially with the references submitted with the December 1998 compliance demonstration document.) It is our understanding that the WDNR will assume responsibility for appropriately distributing this supplemental report to its staff members.

If you have any questions regarding this submission, please contact this office at (608) 257-5035, or NMC at (715) 478-3393.

Very truly yours,
Foley & Lardner

Mark L. Langenfeld

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1	Wisconsin Geological & Natural History Survey Mr. Tom Evans 3817 Mineral Point Road, Room 108 Madison, WI 53705

WIS. STATS. § 293.50
SUPPLEMENTAL COMPLIANCE DEMONSTRATION REPORT
(SACATON MINE, PINAL CO., AZ)

submitted by

NICOLET MINERALS COMPANY
P.O. Box 336
Crandon, WI 54520-0336

August 2003

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1.0 INTRODUCTION

In December 1998, Nicolet Minerals Company (NMC) submitted an addendum to its Mine Permit Application entitled "*Wis. Stats. § 293.50 Compliance Demonstration*" (the "1998 Report"), which identified three candidate mines in satisfaction of the requirements of Wisconsin's so-called mining "moratorium" statute. Those candidates included the Sacaton mine, located in Pinal County, Arizona.

On May 31, 2002, Lawrence J. Lynch, the WDNR's Mining Team Leader, notified NMC by letter ("the Lynch letter") that "the Sacaton Mine is not acceptable as an example of a mine that has been operated or has been closed for ten years without resulting in significant environmental pollution." Mr. Lynch went on to say that such conclusion was "not because we have reason to believe that there has been environmental pollution at the site, but rather there is simply not enough information from which to draw any conclusion regarding the mining site's performance in the period following closure."[1]

NMC continues to believe that the compliance case for the Sacaton mine -- as submitted in December 1998 -- meets each of the applicable statutory criteria. The Lynch letter gave little guidance as to why the WDNR disagreed, stating that the "only significant" monitoring data was that gathered in connection with the Hexcel chromium waste facility. Thus, the WDNR apparently disregarded (without explanation):

1. Montgomery & Associates groundwater data collected in 1987 in connection with evaluation of the mine pit as a potential landfill site;
2. The tailings facility leachate studies; and
3. The hydrogeological data and analysis demonstrating that the mine pit acts as a groundwater sump (precluding off-site migration of pit water contaminants).

There is no evidence whatsoever that the Sacaton mine has "caused significant environmental pollution . . . from acid drainage at the tailing site or at the mine site or from the release of heavy metals." In fact, the evidence submitted with the 1998 Report is quite to the contrary:

- ASARCO studied the local groundwater before it even began digging at the Sacaton mine, and it continued to monitor the quality of that resource during operations at the mine. After mine closure in the mid-1980's, groundwater quality was again tested in connection with a later-abandoned proposal to use the pit as a municipal landfill for the greater Phoenix area. And there was further groundwater testing at an adjacent industrial waste site unrelated to the mine in the early 1990's. All of those data were submitted with the 1998 report, and all demonstrated that the Sacaton mine has not polluted the groundwater.
- The Sacaton mine was among dozens of large Arizona mines routinely inspected by the EPA in the 1980s as part of the CERCLA program. EPA inspectors reported that they were "assured by the groundwater monitoring program of the ASARCO Sacaton Unit and the

[1] In fact, the Lynch letter states only that there is "not enough information for which to draw any conclusion regarding the mining site's performance *in the period following closure*" (emphasis added). NMC concludes, therefore, that its Sacaton mine case was deemed sufficient to satisfy the statute's ten-year operating criterion. Thus, the WDNR's complete dismissal of the Sacaton mine as an "unacceptable" compliance example seems both unfair and misleading.

Arizona Groundwater Compliance Program of the Arizona DHS [now the ADEQ] that the Sacaton Unit is in compliance with State environmental regulations." In September of 1986, the EPA removed the Sacaton mine from its CERCLA Information System list, noting that "there does not appear to be a hazardous waste contamination at this site," and that "[n]o further action under CERCLA is warranted." All of this information was disclosed in the 1998 report.

- There is no Arizona Aquifer Protection Permit (APP) program data available for the Sacaton mine because that program was not implemented until two years after the mine had closed. NMC fully disclosed that in its 1998 report. That fact, however, certainly does not mean that the groundwater at and near the mine has never been tested. To the contrary, the local hydrogeology has been studied and the groundwater quality monitored since before the mine opened, and such data was included with the 1998 report.
- The Sacaton mine site remains highly visible in an area that has been subject to continuous and aggressive development and development pressure since mine closure. Under the circumstances, evidence of "significant environmental pollution" would be extraordinarily difficult to miss or hide (environmental due diligence is now required in essentially every real estate transaction). There is no evidence of such pollution during the ten-year post-closure period or in the almost ten additional years since then.
- The Sacaton mine is located adjacent to an important agricultural area and within sight of the rapidly growing city of Casa Grande. Had it caused any significant pollution from acid drainage or the release of heavy metals to surface water or groundwater during operations or since closure, it is implausible there would not have been at least some mention of problem in the public record. NMC has scrutinized those records, and has been unable to find any such evidence.

Nonetheless, because the Lynch letter concluded by stating "[i]f additional site-specific monitoring information for the Sacaton Mine were available and subsequently submitted, the Department would reassess its position on the acceptability of the Sacaton Mine,"[2] NMC has since assembled additional relevant data which are submitted with and analyzed in the following sections of this Supplemental Compliance Demonstration Report (the "Supplemental Report"). In combination with the data submitted with and interpreted in the 1998 Report, NMC believes there is now absolutely no basis for excluding the Sacaton mine from continued review as an integral part of its "moratorium" compliance case.

1.1 Additional Demonstration of Compliance with Wis. Stats. § 293.50

NMC submits this Supplemental Report to augment the information on the Sacaton mine provided in the 1998 Report. This Supplemental Report presents the findings of an ongoing investigation which has identified newly available data and additional information to further demonstrate that the Sacaton mine satisfies all of the criteria set out in Wis. Stats. § 293.50.

The new information submitted and discussed herein consists of the following:

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[2] The WDNR ostensibly limits its invitation to submit additional data to "site-specific monitoring information . . . ." But nowhere does Sec. 293.50 limit "information provided by an applicant" to "site-specific" data. Rather, the statute requires the Department to make its determination based on "***relevant*** data" (emphasis added). NMC submits that non-site-specific monitoring data (off-site, but down gradient) can be - - and, in this case, is - - highly relevant to whether the Sacaton mine meets the statute's compliance criteria.

1. A 1999 Aquifer Protection Permit and associated permit application for an in situ copper mining project called the "Santa Cruz Joint Venture" located approximately three-and-one-half miles southwest and downgradient from the Sacaton mine. That permit application, on file at the Arizona Department of Environmental Quality (ADEQ), contains extensive groundwater quality monitoring data that was not available during NMC's 1998 investigation;

2. A 1999 Arizona Department of Water Resources (ADWR) publication regarding the Pinal Active Management Area, pertinent information from an ADWR water well database, and additional data from an ADWR groundwater quality database;

3. Photographs taken in August 2002 showing residential and commercial development in the immediate vicinity of the Sacaton mine, recently obtained historic aerial photographs, and an aerial photograph taken in 2002 of the Sacaton mine site and environs; and

4. A compilation of selected data from the references previously submitted with the 1998 Report into more readily accessible and useable formats, and a discussion of how that information continues to demonstrate that the Sacaton mine complies with all of the criteria set out in Wis. Stats., §293.50.

The new information presented in this Supplemental Report, in combination with the previously submitted information, demonstrates that the Sacaton mine not only should continue as a moratorium compliance candidate, but also that it satisfies all of the criteria in Wis. Stats. § 293.50.

1.2 Supplemental Report Organization

This Supplemental Report is comprised of the following chapters:

- Chapter 1 summarizes the newly available data, and includes a systematic discussion of how the Sacaton mine satisfies each of the criteria set out in Wis. Stats. § 293.50 (see ***Table 1-1***);

- Chapter 2 presents a detailed discussion of the new information obtained as a result of this ongoing investigation;

- Chapter 3 reviews previously submitted data and describes how those data further demonstrate the Sacaton mine meets all of the criteria set out in Wis. Stats. §293.50, and has not adversely affected groundwater quality.

- Chapter 4 discusses site-specific factors that determine which data are relevant in this inquiry;

- Chapter 5 lists the new references submitted with this Supplemental Report;

- Appendix A presents groundwater quality monitoring data collected from wells in the nearby Santa Cruz JV Project area from 1989 through 1996;

- Appendix B describes the regional hydrgeologic setting based upon information presented in a 1999 ADWR publication;

- Appendix C includes information from the ADWR Wells 55 Database on nearby water wells; and

- Appendix D presents groundwater quality data from the ADWR water quality database for water wells located immediately south and west of the Sacaton mine.

Table 1-1
Wisconsin Statute §293.50
Sacaton Mine Compliance Demonstration

Wis. Stats. §293.50 Criterion	Sacaton Mine Compliance Demonstration
Pollution Definition - §293.50(1)(a): "Pollution" means degradation that results in any violation of any environmental law as determined by an administrative proceeding, civil action, criminal action or other legal proceeding. For the purpose of this paragraph, issuance of an order or acceptance of an agreement requiring corrective action or a stipulated fine, forfeiture or other penalty is considered a determination of a violation, regardless of whether there is a finding or admission of liability.	• The Sacaton mine did not violate and has not violated any environmental law. • The Sacaton mine has never been the subject of an administrative proceeding, civil action, criminal action or other legal proceeding pertaining to pollution. • The Sacaton mine has never been the subject of an order or agreement requiring corrective action pertaining to pollution. • The Sacaton mine has never been charged with a stipulated fine, forfeiture or penalty pertaining to pollution.
Sulfide Ore Body Definition - §293.50(1)(b): "Sulfide ore body" means a mineral deposit in which metals are mixed with sulfide minerals."	• The Sacaton mine was developed in a porphyry copper deposit containing the following sulfide minerals: pyrite (an iron sulfide mineral); chalcopyrite, chalcocite and minor covellite (copper sulfide minerals); and molybdenite (a molybdenum sulfide mineral). • The small pool of acidic water (pH 3.8 – 4.1) in the bottom of the Sacaton open-pit mine confirms that the ore body together with the host rock has a net acid generating potential.
10-Year Operating Criterion - §293.50 (2)(a): "...that a mining operation has operated in a sulfide ore body, which together with the host rock, has a net acid generating potential in the United States or Canada for at least 10 years without the pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals."	• The Sacaton mine is in the U.S. (Arizona) • The Sacaton mine operated from 1972 to 1984. Records reveal that the mine operated during this period with an unblemished environmental track record, without the pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals, and without issuance of any notices of violation, fines, or forfeitures pertaining to pollution.

Wis. Stats. §293.50 Criterion	Sacaton Mine Compliance Demonstration
10-Year Closure Criterion - §293.50(2)(b): "...that a mining operation that operated in a sulfide ore body, which together with the host rock, has a net acid generating potential in the United States or Canada has been closed for at least 10 years without the pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals."	• The Sacaton mine has been closed since 1984. An extensive records review reveals that, since 1984, the mine has maintained an unblemished environmental track record. Those records disclose absolutely no pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals. Since closure, the mine has received no notices of violation, fines, or forfeitures pertaining to pollution.
National Priorities List (NPL) Criterion - §293.50(2m)(a): "The department may not base its determination on any mining operation that has been listed on the national priorities list..."	• The Sacaton mine is not, and has never been, listed on the National Priorities List.
Still in Business Criterion - §293.50(2m)(b): "The department may not base its determination on any mining operation for which the operator is no longer in business and has no successor that may be liable for any contamination for the mining operation and for which there are no other persons that may be liable for any contamination from the mining operation."	• Asarco, the company that operated the Sacaton mine, is still in business and is headquartered in Phoenix, AZ.
Relevant Data Criterion - §293.50(2m)(b) "The department may not base its determination under sub. (2)(a) or (b) on a mining operation unless the department determines, based on relevant data from groundwater or surface water monitoring, that the mining operation has not caused significant environmental pollution, as defined in s. 293.01 (4), from acid drainage at the tailings site or at the mine site or from the release of heavy metals."	• There is ample relevant information documenting that the Sacaton mine has not caused significant environmental pollution. Moreover, that information demonstrates why the Sacaton mine did not pollute either ground water or surface waters. Such information includes the following: 1. The local flow gradient immediately adjacent to and surrounding the pit flows into the pit and does not flow out. The extent and depth of the pit provides natural hydrogeologic containment. In addition, an upward hydraulic gradient beneath the pit isolates the pool in the pit from the surrounding environment. Acidic water seeping into the pit cannot flow out of the pit into the groundwater system. Therefore, the pit cannot and has not caused significant environmental pollution.

Wis. Stats. §293.50 Criterion	Sacaton Mine Compliance Demonstration
Relevant Data Criterion - §293.50(2m)(b) (continued) "The department may not base its determination under sub. (2)(a) or (b) on a mining operation unless the department determines, based on relevant data from groundwater or surface water monitoring, that the mining operation has not caused significant environmental pollution, as defined in s. 293.01 (4), from acid drainage at the tailings site or at the mine site or from the release of heavy metals."	2. The process water in the tailings was less saline than the receiving groundwater and contained no metals in concentrations that exceeded MCLs. The tailings impoundment was designed to allow seepage into the underlying soils and groundwater. Seepage of the process water caused no significant environmental pollution. 3. Monitoring data from the tailings monitoring well indicate seepage of the tailings process water actually improved the local groundwater quality during operation of the facility. 4. EP Toxicity leach extraction tests performed on the tailings solids confirmed they were not a potential source of leachable heavy metals. Thus, leachate from the tailings solids has caused no significant environmental pollution. 5. The deeper groundwater flow gradient that could be influenced by mine facilities away from the specific local influence of the pit, including waste rock dumps and the tailings impoundment, flows to the west and the west-southwest. Between 1972-1998, state and federal agencies collected water quality samples from numerous wells located in the down-gradient groundwater flow path of the Sacaton mine. Those wells are located within an area subject to water quality impacts from the tailings impoundment and waste rock dumps, based on a predicted groundwater movement rate of 10 ft./day. Analytical results from those samples show no evidence of having been affected by the mine, providing additional confirmation that the mine has not caused significant environmental pollution.

Wis. Stats. §293.50 Criterion	Sacaton Mine Compliance Demonstration
Relevant Data Criterion - §293.50(2m)(b) (continued) "The department may not base its determination under sub. (2)(a) or (b) on a mining operation unless the department determines, based on relevant data from groundwater or surface water monitoring, that the mining operation has not caused significant environmental pollution, as defined in s. 293.01 (4), from acid drainage at the tailings site or at the mine site or from the release of heavy metals."	6. The extensive groundwater monitoring data collected for the nearby Santa Cruz JV In-Situ Copper Mining Project from 1989 – 1996, show no evidence of environmental pollution. Water samples collected from those monitoring wells are not acidic, do not contain detectable copper or elevated levels of other metals. Those data are further evidence that the Sacaton mine has not caused significant environmental pollution. 7. Ongoing commercial and residential development near the Sacaton mine demonstrates that the mine impacts have not rendered the area unsuitable for commercial or residential uses. 8. The Arizona Department of Water Resources (ADWR) has authorized drilling of a domestic water well in T. 5 S., R. 5 E., Section 33, approximately one mile southwest of the tailings impoundment. The ADWR has expressed no concerns about potential impacts to that well from the mine, clearly indicating the mine has not polluted the groundwater with acid or heavy metals.

Wis. Stats. §293.50 Criterion	Sacaton Mine Compliance Demonstration
Definition of Environmental Pollution – §293.01 (4): "'Environmental pollution' means the contamination or rendering unclean or impure the air, land or waters of the state, or making the same injurious to public health, harmful for commercial or recreational use, or deleterious to fish, bird, animal or plant life." **Note: to be excluded from consideration, a mine must have caused "<u>significant</u>" environmental pollution. The Sacaton mine has caused neither environmental pollution nor "<u>significant</u>" environmental pollution**	• Both the Arizona Department of Environmental Quality (ADEQ) and ADWR actively monitor and regulate the environment of that state. There is absolutely no evidence in the ADEQ and ADWR records that the Sacaton mine has caused environmental pollution, as that is defined in s. 293.01 (4). • The continued expansion of residential and commercial land uses in the vicinity of the Sacaton mine provides evidence that the mine has not adversely affected the public's use of the region's air, land or water. • Water quality data from domestic and irrigation wells west and southwest (i.e., downgradient) of the mine collected between 1972 - 1998 show no evidence of environmental pollution from the Sacaton mine. Those water wells confirm that the mine has not been injurious to public health, harmful to commercial or recreational uses of adjacent lands, or has in any way limited the public's use of groundwater downgradient from the mine site.

2.0 NEW INFORMATION DOCUMENTING COMPLIANCE WITH WIS. STATS.§ 293.50

2.1 The Santa Cruz JV Project Aquifer Protection Permit

Asarco, the company that owned and operated the Sacaton mine, participated in an experimental project called the "Santa Cruz Joint Venture In Situ Copper Mining Project" (Santa Cruz JV) to demonstrate the feasibility of producing copper using in situ mining techniques. The Santa Cruz JV is located about three miles southwest of the Sacaton mine project area as shown in ***Figure 2-1***. ***Photograph 2-1*** is a 1996 color infrared aerial photograph that depicts both the Sacaton mine and the Santa Cruz JV project areas. (The scale for both ***Photograph 2-1*** and ***Figure 2-1*** is the same – one inch to one mile.) ***Photograph 2-2*** shows a gate into the Santa Cruz JV project area in the foreground, with the Sacaton tailings disposal facility and waste rock dump in the background.

The Santa Cruz JV began in 1988 as a $22-million cooperative research project conducted by the U.S. Bureau of Mines and the Santa Cruz JV, a joint venture between Asarco Santa Cruz, Inc. and Freeport-McMoRan Copper & Gold Inc. In 1996, federal sponsorship of the research project was transferred to the U.S. Bureau of Reclamation. The research project evaluated the technical and economic feasibility of extracting copper from the buried Santa Cruz copper deposit by injecting and recovering a dilute solution of sulfuric acid from specially designed wellfields.

In 1996, the Santa Cruz JV submitted an application to ADEQ for an Aquifer Protection Permit (APP) to conduct additional in situ mining research in an expanded area south of the Bureau of Reclamation – Santa Cruz JV cooperative research area. The expanded research project was designed to test deeper parts of the Santa Cruz copper ore body. The ADEQ issued an APP, Permit Number P-103147, for the proposed research project in May 1999. A copy of the 1996 Santa Cruz JV APP application (AS-44) and the 1999 Santa Cruz JV APP (AS-45) are included with this Supplemental Report.[3]

2.1.1 Santa Cruz JV Project Groundwater Monitoring Data

Errol L. Montgomery & Associates, Inc. (Montgomery & Associates) prepared the APP application for the expanded Santa Cruz JV project. That permit application contains additional groundwater monitoring data, including downgradient groundwater monitoring data which demonstrate that the Sacaton mine has not adversely affected groundwater quality or caused significant environmental pollution. Montgomery & Associates also prepared the application to turn the Sacaton open-pit mine into a sanitary landfill. (See AS-35.)

The APP application presents the results from thorough hydraulic testing and hydrogeologic characterization to establish ambient groundwater quality conditions. During the period 1989 through 1996, groundwater quality data were collected from wells drilled in the lower basin-fill deposits aquifer specifically as groundwater monitoring wells. During that same period, groundwater quality data were also collected from pre-existing irrigation, industrial, and domestic wells in the basin-fill aquifer. The locations for some of the Santa Cruz JV Project

[3] The new reference material being submitted with this Supplemental Report is numbered sequentially starting with AS-44 and should be added to the list of references (AS-1 through AS-43) shown in Table 4.7 (pages 4-12 through 4-14) of NMC's 1998 Report.

groundwater monitoring wells and pre-existing water wells sampled for water quality are shown in ***Figure 2-1***. (Not all of the wells can be shown on a map at this scale. The maps included with the 1999 APP application and submitted as AS-44 show the location of all of the Santa Cruz JV Project monitoring wells.)

The basin-fill aquifer that overlies the Santa Cruz copper deposit is the same hydrogeologic unit as the alluvial fill overlying the Sacaton ore deposit. The APP application includes numerous tables showing the water quality data collected over seven years in conjunction with the Santa Cruz JV Project. All of these data are being submitted to WDNR in reference number AS-44. To facilitate review, water quality data from the following sources are included as Appendix A to this Supplemental Report:

- Four groundwater monitoring wells in the basin-fill aquifer (SM-1, SM-2, SM-3, and SM-4, APP application, Tables 9 through 16); and

- Twelve wells in Sections 11, 12, 13, and 14 in T. 6 S., R. 4 E. (APP application, Tables 17 though 28).

According to Montgomery & Associates (personal correspondence, September 4, 2002, AS-46) data from several pumping tests in the basin-fill aquifer show that groundwater flows generally to the west in the Santa Cruz JV project area. Farther to the north, in the vicinity of the Sacaton mine, the direction of groundwater flow in the basin-fill aquifer is west-southwest. In both areas, the rate of groundwater movement in this aquifer is in the magnitude of 10 feet per day (3,650 feet per year).

As shown in ***Figure 2-1***, the Santa Cruz JV Project monitoring wells in Sections 12 and 13, T. 6 S., R. 4 E., are located about three and one-half to four miles southwest of the Sacaton tailings impoundment. Groundwater moving in a southwesterly direction (i.e., downgradient) from the vicinity of the tailings impoundment at a rate of 10 feet per day could reach the area in which the Santa Cruz JV Project monitoring wells were sited within roughly five to six years. Thus, 1984-vintage seepage from the tailings impoundment could be detected in the Santa Cruz JV Project monitoring wells starting in 1989. Therefore, the water quality samples were collected during the period in which post-closure seepage from the tailings facility could (and likely would) have reached wells in the Santa Cruz JV project area. Additionally, the groundwater data collected from the first one to two years of the Santa Cruz JV Project groundwater monitoring study also correspond to the time period in which seepage from the last few years of operation of the tailings impoundment would likely have reached the Santa Cruz JV project area.

There were 281 water quality sampling events during the seven-year water quality investigation at the Santa Cruz JV Project. A total of 174 water quality samples were tested for common constituents and routine parameters (e.g., major cations and anions, conductivity, pH, and temperature). Another 107 samples were analyzed for selected trace constituents, radiological parameters and organic constituents. The trace constituents include the following 19 metals: iron, manganese, arsenic, copper, zinc, barium, cadmium, total chromium, lead, mercury, selenium, silver, antimony, beryllium, nickel, thallium, molybdenum, cobalt, and aluminum. Those data are included in Appendix A of this Supplemental Report.

The Santa Cruz JV Project water quality data show absolutely no evidence of impacts from the Sacaton mine. Only one sample out of the 107 sample intervals tested contained detectable copper. (See Table 10 in Appendix A. The sample collected on June 21, 1994 contained 0.11

mg/l copper.) None of the other samples shown in Appendix A contained detectable copper or anomalous (i.e., above background) concentrations of the other targeted metals. Because the Sacaton mine was developed in a copper deposit, it is logical to assume that -- were there a metal-laden groundwater contaminant plume emanating from the mine -- it would contain copper. Similarly, there is absolutely no evidence of the Sacaton mine having been a source of acid pollution. Neither the sulfate concentrations nor pH levels (both indicators of acid generation) in the Santa Cruz JV Project monitoring wells are anomalous.

The water quality information from the Santa Cruz JV Project groundwater monitoring wells is, thus, additional relevant post-closure monitoring data providing substantial evidence that the Sacaton mine has not polluted the area groundwater with either dissolved metals or acid following closure.

2.2 New Groundwater Data Obtained from the ADWR

NMC's previous research into the Sacaton mine focused on files available at the ADEQ. During ongoing investigation, the company learned that ADEQ and ADWR share responsibility for monitoring groundwater quality and that ADWR publications and water well record databases provide useful information about the regional groundwater hydrology and water quality characteristics. The interrelationship between ADEQ's and ADWR's responsibilities to collect and store groundwater quality data is discussed in greater detail in Appendix B.

Two ADWR publications provide useful information about the hydrogeology of the area around the Sacaton mine. The first publication, "*Third Management Plan for Pinal Active Management Area 2000 – 2010*" (Pinal AMA Plan), accompanies the references submitted with this Supplemental Report as AS-47. (The Sacaton mine is located in the Pinal Active Management Area.) The second ADWR publication, "*Hydrologic Map Series Report Number 23,*" is included as AS-48. Appendix B reviews the information presented in both of these ADWR publications.

Additionally, as discussed in the following sections, ADWR's water well and water quality databases contain abundant information about water wells that have been drilled in the vicinity of the Sacaton mine. The following sections summarize such information.

2.2.1 Availability of Water Well Data

ADWR maintains records in its Wells 55 Database, accessible on-line as images stored in the Fortis PowerWeb system. Those records include files maintained for water wells and exploration drill holes that intersect groundwater. NMC examined that database to identify wells drilled within a several-mile radius of the Sacaton mine.

The ADWR database has information on all wells of record including domestic, irrigation, stock water, industrial, monitoring, and mineral exploration wells. The ADWR database typically contains scanned copies of Notices of Intent to drill wells, drillers' authorizations, drillers' reports with logs, completion reports, and various correspondence between ADWR staff and the applicants. This database does not typically present water quality data but, in rare instances, comments pertaining to water quality are also included.

2.2.2 Wells in the Vicinity of the Sacaton Mine

As shown in ***Figure 2-2***, there are many drill holes in the general vicinity of the Sacaton mine. Those drill holes include water wells used for domestic, irrigation, and industrial water supply; mineral exploration boreholes; monitoring wells; and wells drilled for other uses. For the purpose of this Supplemental Report, NMC has focused on the 49 wells closest to the mine. The distribution of well types in the Sacaton mine area is shown in ***Table 2-1***.

Table 2-1
Distribution of Well Types in the Sacaton Mine Area

Well Type	Total Wells	Wells Postdating 1984
Domestic and other uses	10	4
Irrigation and stock water	8	0
Mineral exploration files (with completion reports)	16	16
Monitor wells	4	3
Mining, shaft dewatering, mineral processing	2	0
Geotechnical (off mine site)	2	2
Cathodic well (gas pipeline)	1	1
Industrial (City of Casa Grande)	1	0
No water application or unknown purpose	5	4
Total wells (holes)	49	30

Appendix C of this Supplemental Report includes a complete list (***Table C-1***) of the wells categorized in ***Table 2-1***. ***Table C-1*** provides information on the total depth of each well, the depth to water, well completion information, and well owner.

Table 2-1 shows that 30 of the wells and exploration holes closest to the Sacaton mine were drilled after mine closure in 1984. The monitoring wells listed in ***Table 2-1*** and ***Table C-1*** are those installed from 1990 – 1992 to investigate potential impacts of the Hexel Corporation chromium disposal site. As discussed in NMC's 1998 Report, the groundwater quality information obtained from the Hexcel monitoring wells identified no water quality impacts attributable to the Sacaton mine.

2.2.3 Domestic Water Wells Near the Sacaton Mine

As shown in ***Table 2-1***, there are 10 domestic wells in the vicinity of the Sacaton mine, four of which were drilled after the mine closed in 1984. Among those is a domestic well drilled in 2000 approximately one mile southwest and downgradient of the Sacaton mine in SW ¼, NW ¼, SW ¼, Section 33, T. 5 S., R. 5 E. (shown on ***Figure 2-1*** as the blue dot in the southwestern corner of Section 33). The database indicates the well is 360-feet deep, and the depth to water is 300 feet.

Prior to approving the Notice of Intent to drill this well, the ADWR informed the property owners, Leslie and Joanna Roberts, that the proposed well "is in proximity to an area of groundwater contamination known as the Hexcel Waste Dump." In order to address concerns about potential cross-contamination of aquifers "and other problems that may be encountered when working in a contaminated area," the ADWR required the property owner's well driller to submit a well diagram. (See the May 2, 2000, letter from ADWR Hydrologist, Kay McNeely

to Leslie and Joanna Roberts included in Appendix C.) A WQARF/CERCLA Routing Sheet (see Appendix C) included in the ADWR records for this water well states the following:

> "Soil contamination consisted of chromium – no impact to groundwater. However, organics detected in groundwater in area. See attached information."

It is clear from the ADWR's response to the Notice of Intent for the Roberts' well that the agency takes an active management role in areas in which there are potential groundwater contamination issues. In the context of the Sacaton mine, it is significant that the record reveals absolutely no agency concerns about potential groundwater impacts due to the mine. The agency's comments about potential groundwater contamination were limited to possible problems associated with the Hexcel Corporation chromium disposal site.

As discussed in Section 2.1.1, groundwater flow in the basin-fill aquifer is west-southwest. Therefore, the very existence of the Roberts domestic well and other water wells west and southwest of the mine indicates that groundwater downgradient from the Sacaton mine is suitable for a variety of uses, including domestic water supply.

2.2.4 The ADWR Water Quality Database

The ADWR has maintained a database of water quality analyses from the Pinal AMA since 1941 to the present. NMC has examined a subset of that data relating to six townships comprising an area that extends south and west, down the hydrologic gradient from the Sacaton mine. Those townships are T.5 S., R.3, 4, and 5 E., and T.6 S., R.3, 4, and 5.E (***Figure 2-2***). A well-documented depression in groundwater elevation, representing the lowest level in the hydrologic gradient, underlies T.5 S., R.3E and T.6S., R.3E. (See ***Figure B.2-2*** in Appendix B.) Therefore, this subset of the data documents groundwater quality within the possible extent of seepage dispersal from the Sacaton mine.

The subset of the data from the Sacaton mine area consists of 598 sampling events from 278 wells. The database includes analyses for specific conductance, fluoride, temperature, pH, alkalinity, and dissolved oxygen. The records of specific conductance and temperature data are the most complete; the other parameters are inconsistently represented. Some wells have records of repeated analyses over time, but others have only one sampling event. Table D-1 in Appendix D presents that data.

As described at greater length in Appendix B.2.2, the ADWR uses specific conductance data as a proxy for the total dissolved solid content of water and to provide a general indicator of groundwater quality. Therefore, NMC has concentrated its data review on the patterns of specific conductance within the six townships listed above, and has categorized the analyses into the following time periods of significance to the history of mining at Sacaton:

- 1941 - 1971, the pre-mining period, (see ***Figure 2-2***);
- 1972 - 1984, the mining period (see ***Figure 2-3***); and
- 1985 - 2002, the post-mining period (see ***Figure 2-4***).

The three figures illustrate that groundwater within the area of the movement away from the Sacaton mine contained high levels (greater than 800 microsiemens per centimeter) of total dissolved solids (as proxied by conductivity) prior to mining. The general presence and levels of total dissolved solids in the area west and west-southwest of the mine are similar throughout the three time periods, indicating that groundwater quality within the area of the mine and its surrounding down-gradient environs is both similar and unchanged from the period prior to

mining. These data reveal nothing to indicate that the mine has caused either "significant" environmental pollution or any environmental pollution whatsoever relative to groundwater resources.

Figures 2-2, 2-3, and ***2-4*** show areas of elevated specific conductance, (i.e., wells with greater than 2,000 microsiemens per centimeter) in wells sampled since 1941 in areas south, southwest, northwest, and west of the Sacaton mine. It is clear from those figures that pockets of poor quality (i.e., saline) groundwater are not uncommon in the area. As discussed in Chapter 3, the Sacaton mine is located in a similar zone of highly saline groundwater.

2.3 Photographs Documenting Land Use Near the Sacaton Mine

2.3.1 Aerial Photographs of the Sacaton Mine and Vicinity

NMC has obtained historic and recent Color Infrared (CIR), Digital Orthophoto Quarter Quadrangle aerial photographs of the Sacaton mine and vicinity. In August 2002, NMC conducted a reconnaissance visit of the Sacaton project area and took additional land-based photographs showing residential and industrial buildings near the mine. The aerial and land-based photographs are reproduced at the end of this chapter.

The aerial photographs are particularly useful for showing the evolution of development of the mine and the residential, light industrial, and agricultural uses of land nearby. The 1971 photograph, ***Photograph 2-3***, shows the site prior to development of the mine. The 1983 photograph, ***Photograph 2-4,*** documents conditions in the area one year before mine closure in 1984. The 1996 and 2002 photographs, ***Photographs 2-1*** and **2-5**, show the site in the years following mine closure. As noted in Section 2.1, ***Photograph 2-1*** also shows the Santa Cruz JV project site.

The topographic quadrangle map ***(Figure 2-1)*** and all of the aerial photographs are shown at the same scale, roughly one inch to one mile. Using GIS software, the UTM coordinates and selected section numbers from the topographic map were added to the aerial photographs. ***Photographs 2-3, 2-4***, and ***2-5*** depict natural and cultural features in the vicinity of the Sacaton mine and Casa Grande, and extend from the western part of the city of Casa Grande, northwestward onto the southern slopes of the Sacaton Mountains. They include the agricultural and residential lands along the northern branch of the Santa Cruz Wash, the municipal airport, and the Sacaton mine pit, waste rock dump, and tailings disposal facility. ***Photograph 2-1*** extends far enough to the west to cover the Santa Cruz JV project area.

2.3.2 Industrial and Residential Features Near the Sacaton Mine

Photograph 2-5, the 2002 aerial photograph, shows two new facilities that were constructed since the 1996 photograph was taken. The new facilities include a lined area immediately south of the waste rock dump, and an industrial facility adjacent to the southeastern corner of the tailings impoundment.

The lined area south of the waste rock dump is a series of evaporative ponds built by Reliant Energy in conjunction with the company's electrical generating unit in Casa Grande. ***Photograph 2-6*** shows those ponds viewed from outside the gate of this facility. The Sacaton waste rock dump can be seen in the background.

The industrial facility adjacent to the southeastern corner of the tailings impoundment is the E-Crete building shown in ***Photograph 2-7.*** That facility produces "autoclaved, aerated concrete products." ***Photograph 2-8*** shows the Roberts' residence discussed in Section 2.2.3. The tailings impoundment can be seen in the background, behind the house. ***Photograph 2-9*** shows a land available sign adjacent to the Sacaton waste rock dump. ***Photographs 2-10*** and ***2-11*** show the Desert Camel subdivision, with the Sacaton waste rock dump in the background. That subdivision is also shown on ***Figure 2-1*** (see Section 16, T. 6 S., R. 5 E.). Judging from the size of the palm trees, the subdivision was developed some time ago, possibly while the Sacaton mine was still in operation.

It is evident from the new and diversified land uses in the vicinity of the Sacaton mine that the area is deemed suitable for both commercial and residential development. There is absolutely no indication that the Sacaton mine has adversely affected real estate use in the area. NMC believes that, in an era in which environmental due diligence is required in essentially all real estate transactions, it is highly unlikely that any such new development would have been undertaken if there were genuine concerns about "significant environmental pollution" from the mine.

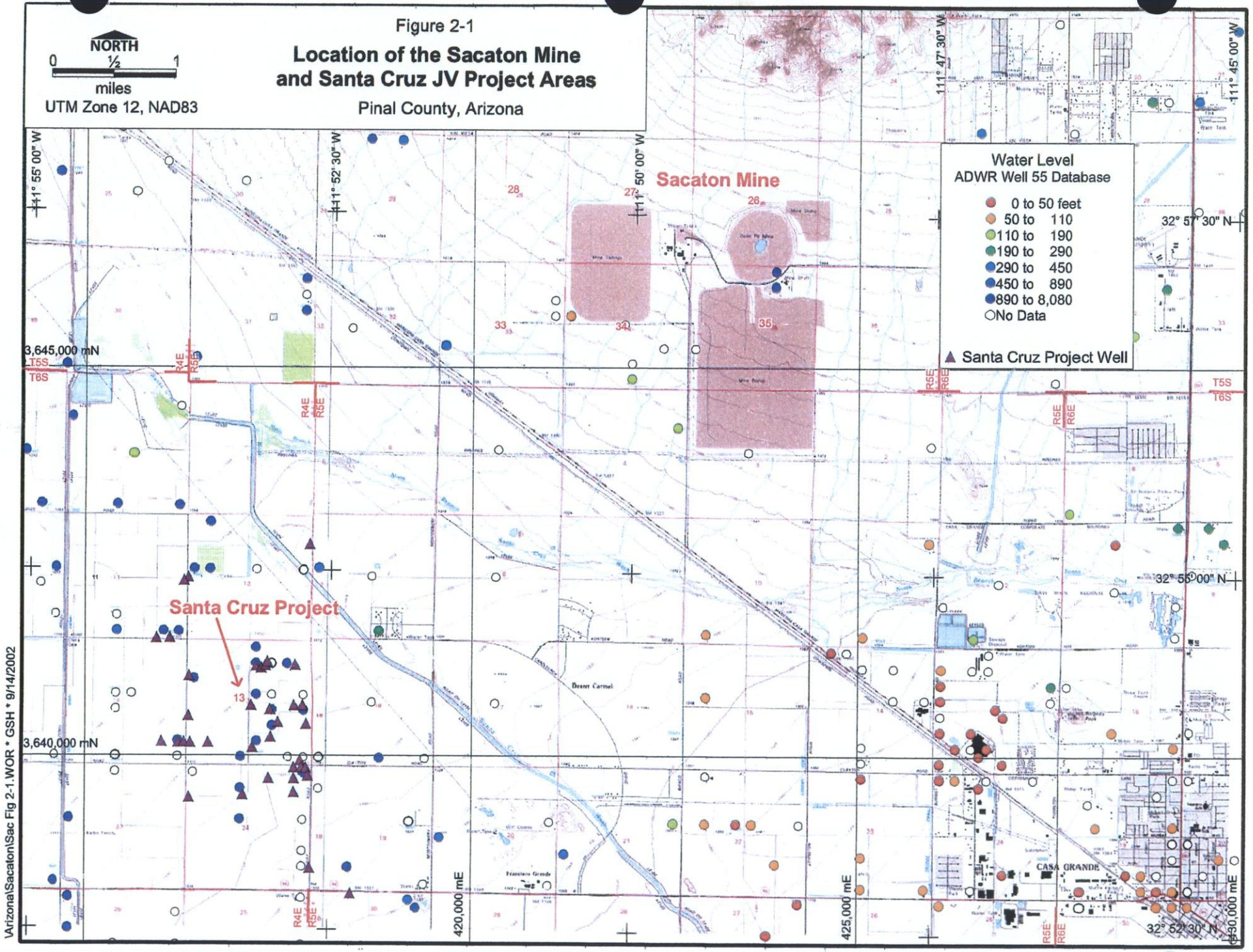
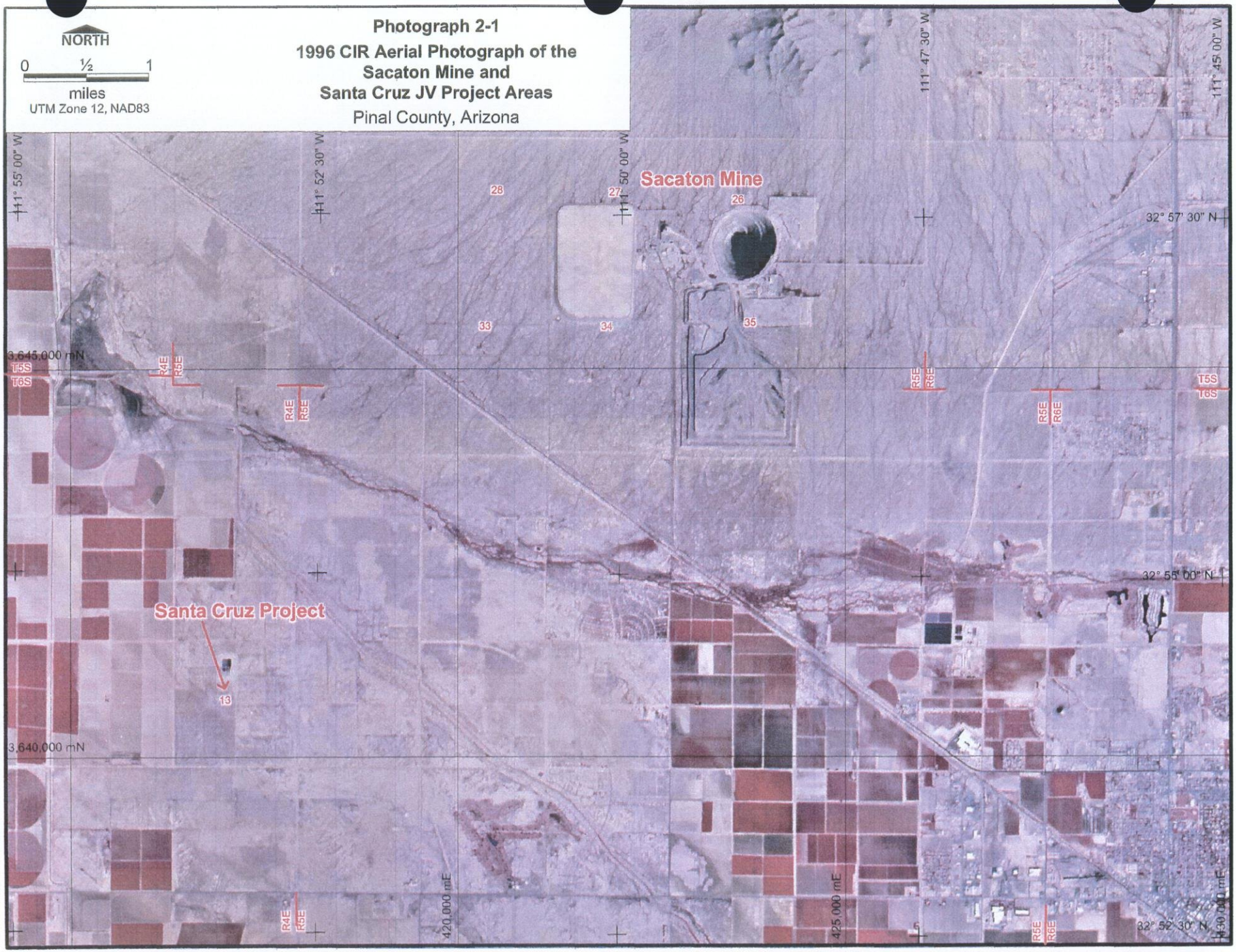
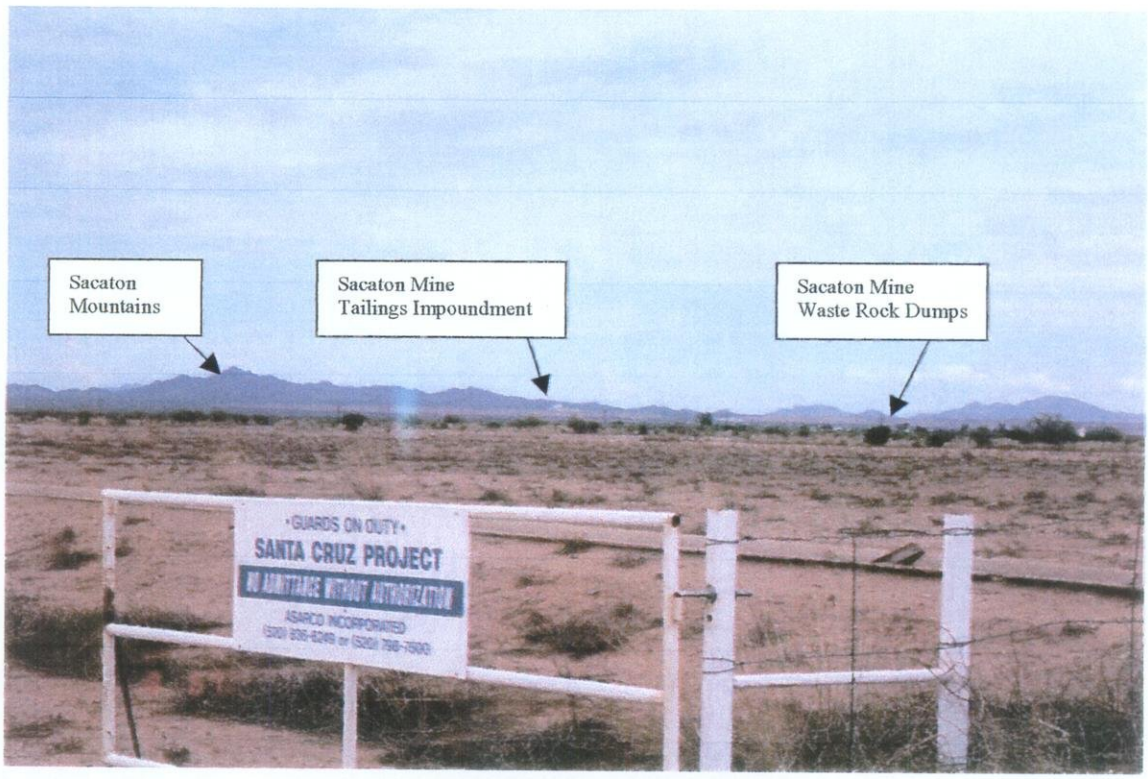


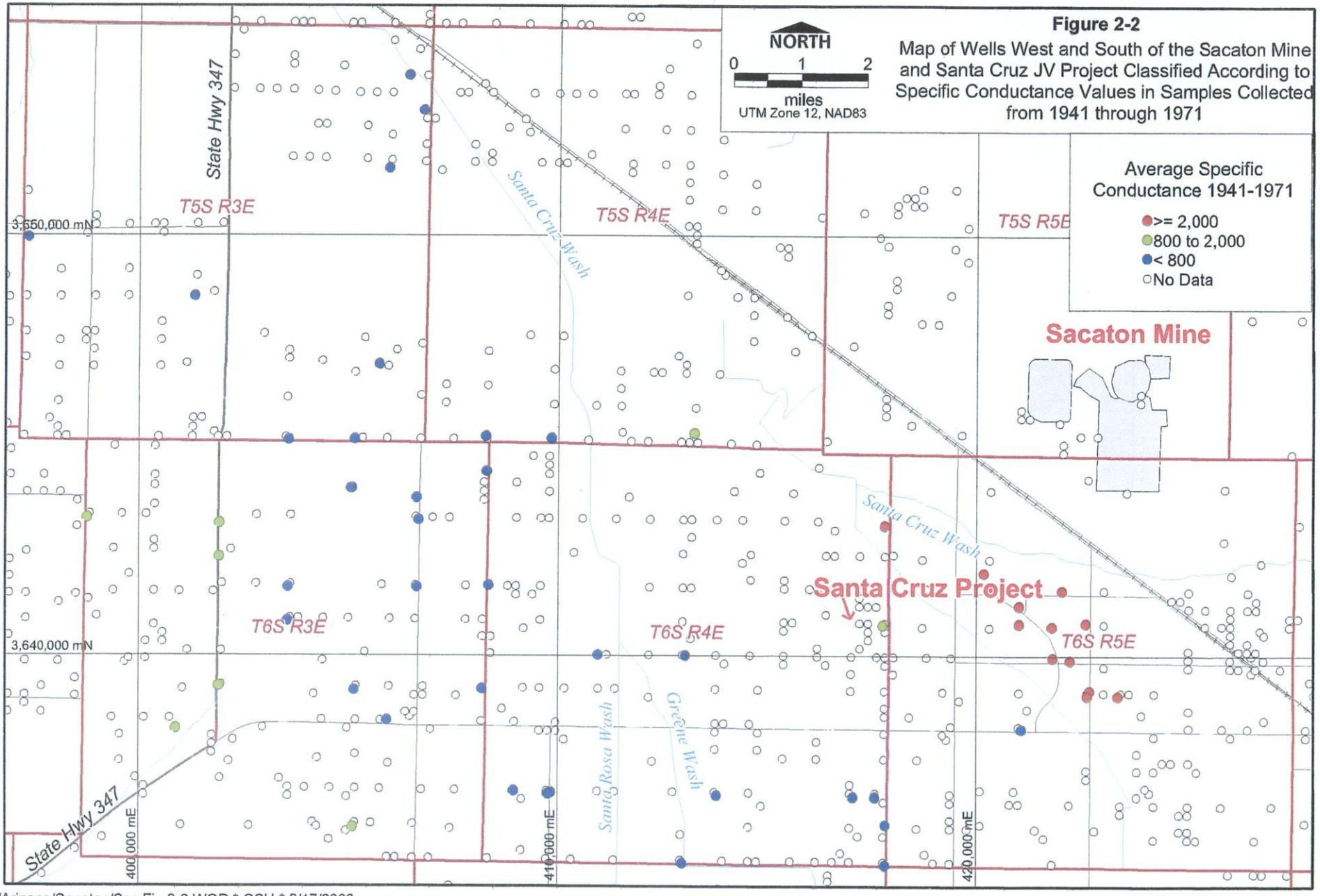
Figure 2-1
Location of the Sacaton Mine
and Santa Cruz JV Project Areas
Pinal County, Arizona
NORTH
0 ½ 1
miles
UTM Zone 12, NAD83
Water Level
ADWR Well 55 Database
0 to 50 feet
50 to 110
110 to 190
190 to 290
290 to 450
450 to 890
890 to 8,080
No Data
Santa Cruz Project Well
Sacaton Mine
Santa Cruz Project
111° 55' 00" W
111° 52' 30" W
111° 50' 00" W
111° 47' 30" W
111° 45' 00" W
32° 57' 30" N
32° 55' 00" N
32° 52' 30" N
3,645,000 mN
3,640,000 mN
420,000 mE
425,000 mE
430,000 mE
T5S
T6S
R4E
R5E
R6E
CASA GRANDE
Desert Carmel
\Arizona\Sacaton\Sac Fig 2-1.WOR * GSH * 9/14/2002



\Arizona\Sacaton\Sacaton Photo 2-1.WOR * GSH * 9/15/2002



Photograph 2-2. View to the northeast of the entrance to the Santa Cruz Joint Venture. The dumps and tailings impoundment of the Sacaton Mine are visible on the lower slopes of the Sacaton Mountains.



/Arizona/Sacaton/Sac Fig 2-2.WOR * GSH * 9/17/2002

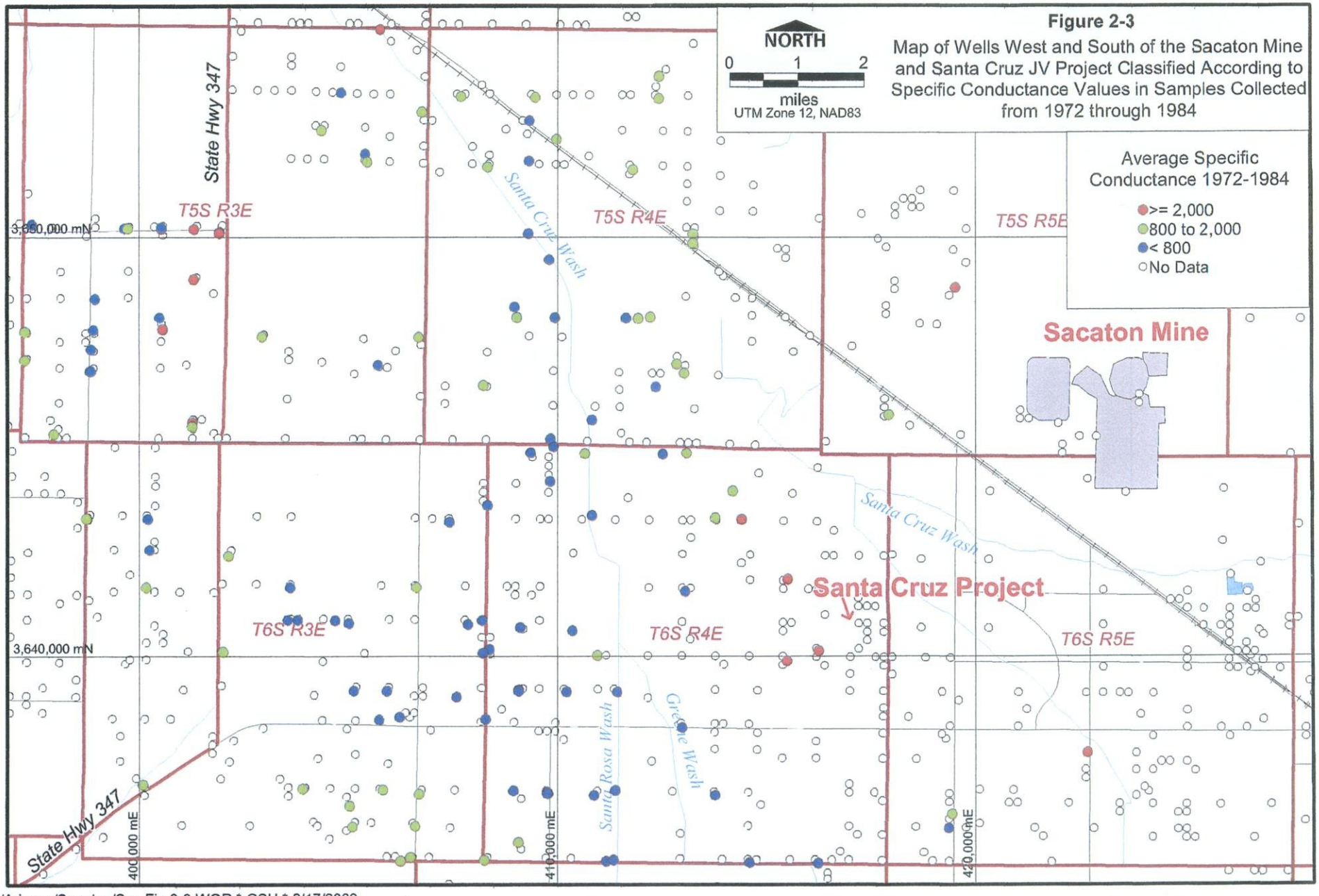
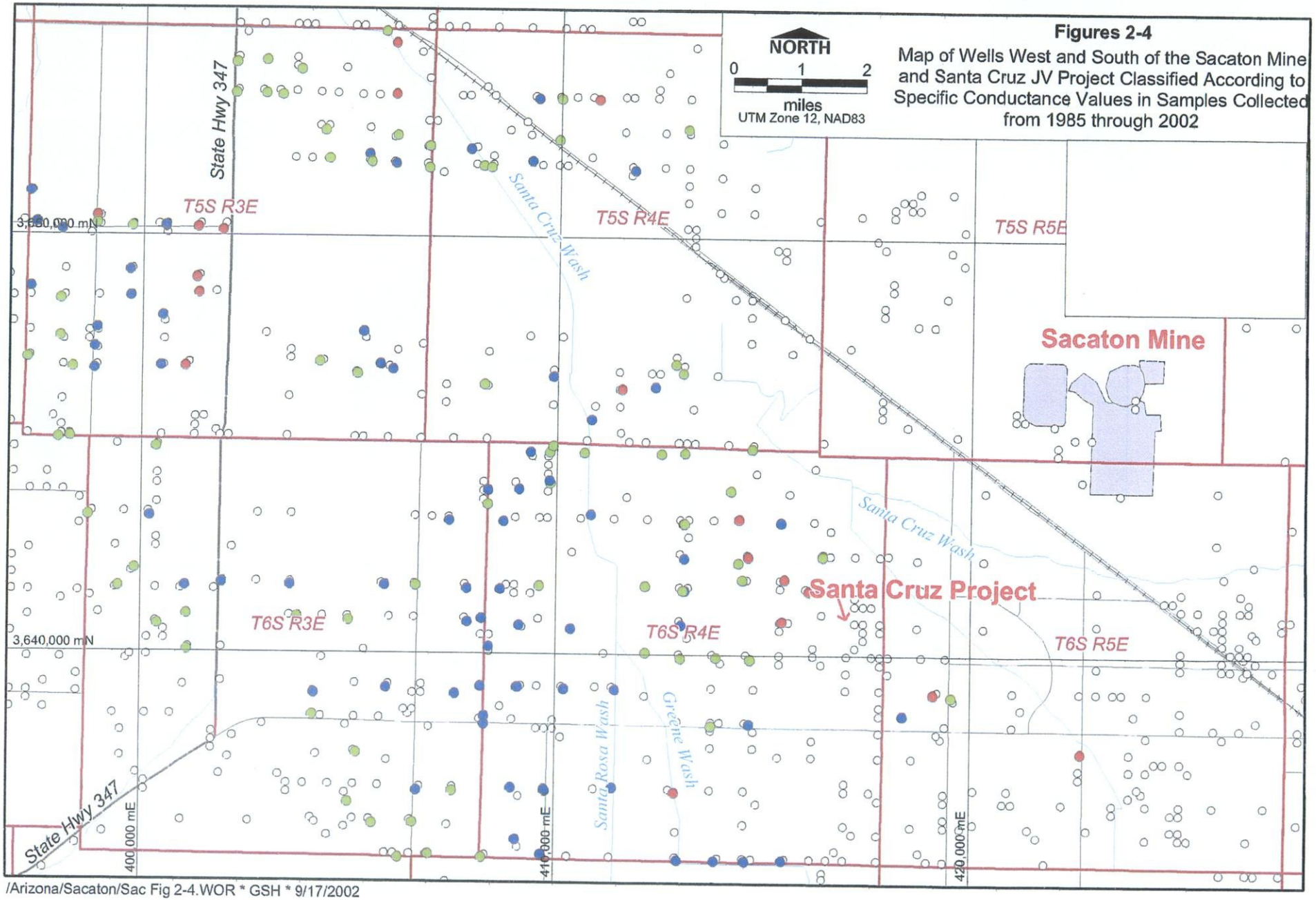
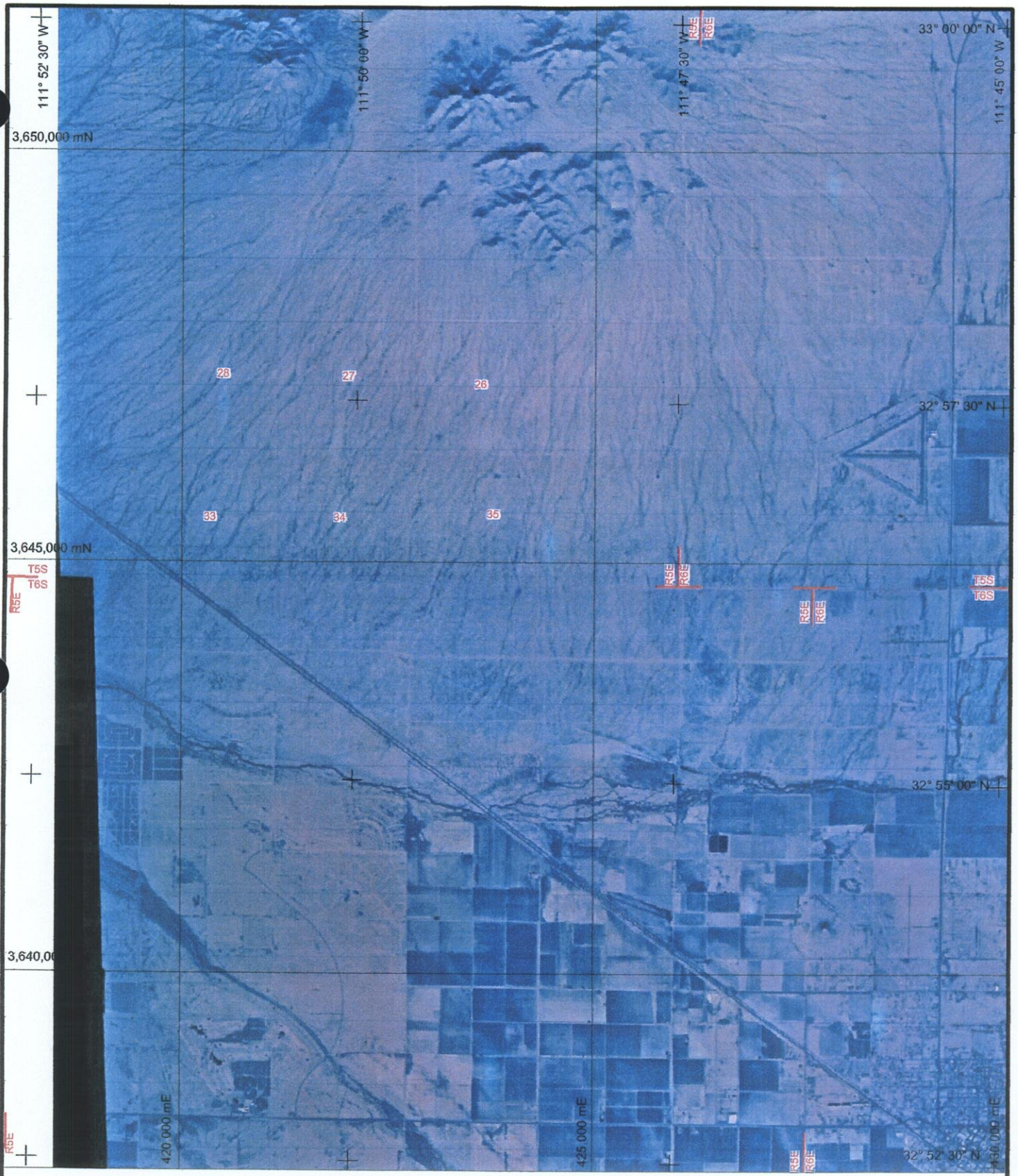


Figure 2-3
Map of Wells West and South of the Sacaton Mine and Santa Cruz JV Project Classified According to Specific Conductance Values in Samples Collected from 1972 through 1984

/Arizona/Sacaton/Sac Fig 2-3.WOR * GSH * 9/17/2002

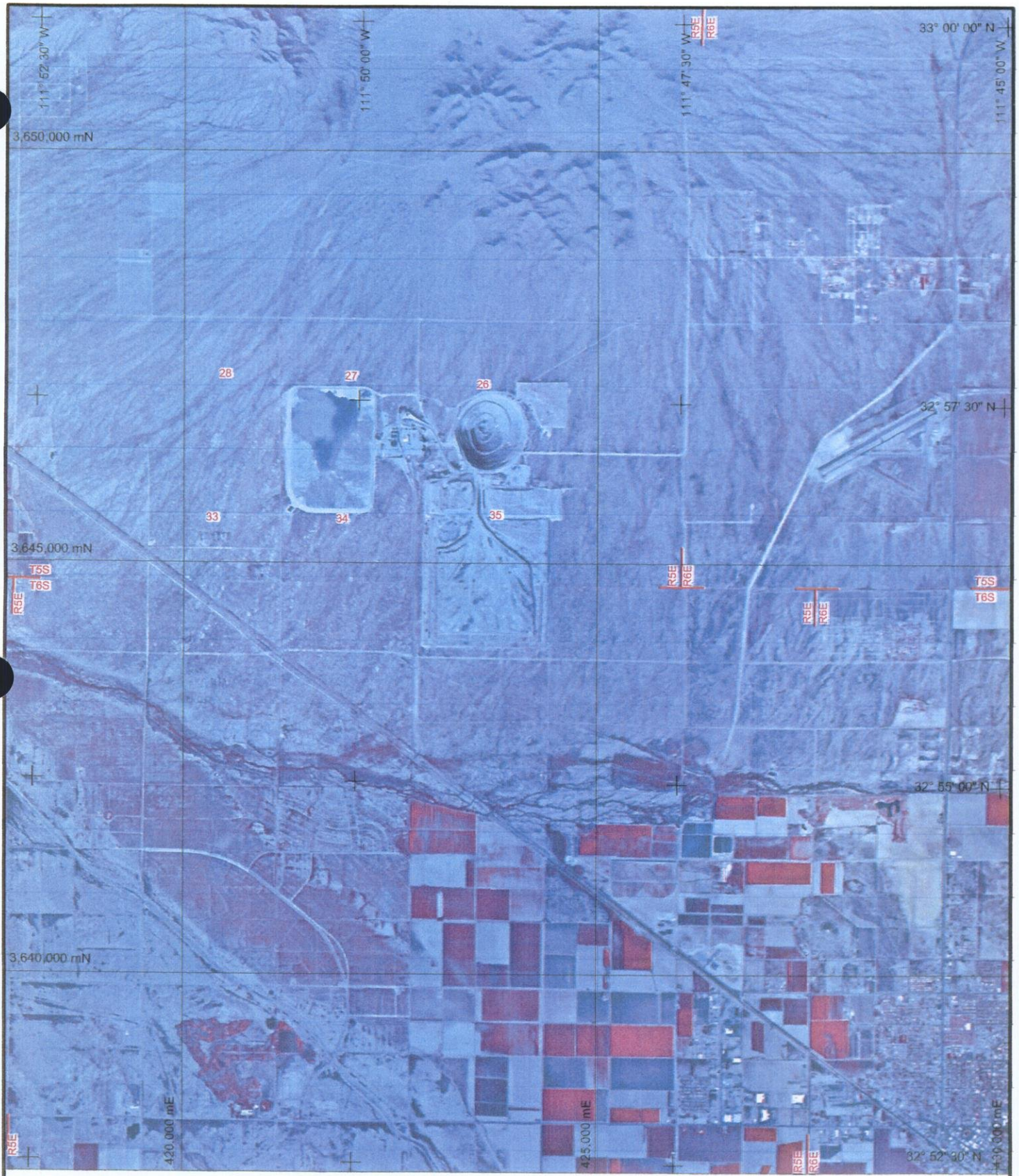


/Arizona/Sacaton/Sac Fig 2-4.WOR * GSH * 9/17/2002



\Arizo...aton\Sacaton photo 2-3.WOR * GSH * 9/15/2002

Photograph 2-3
1971 Aerial Photograph of the Sacaton Mine Project Area Before Mining
Pinal County, Arizona

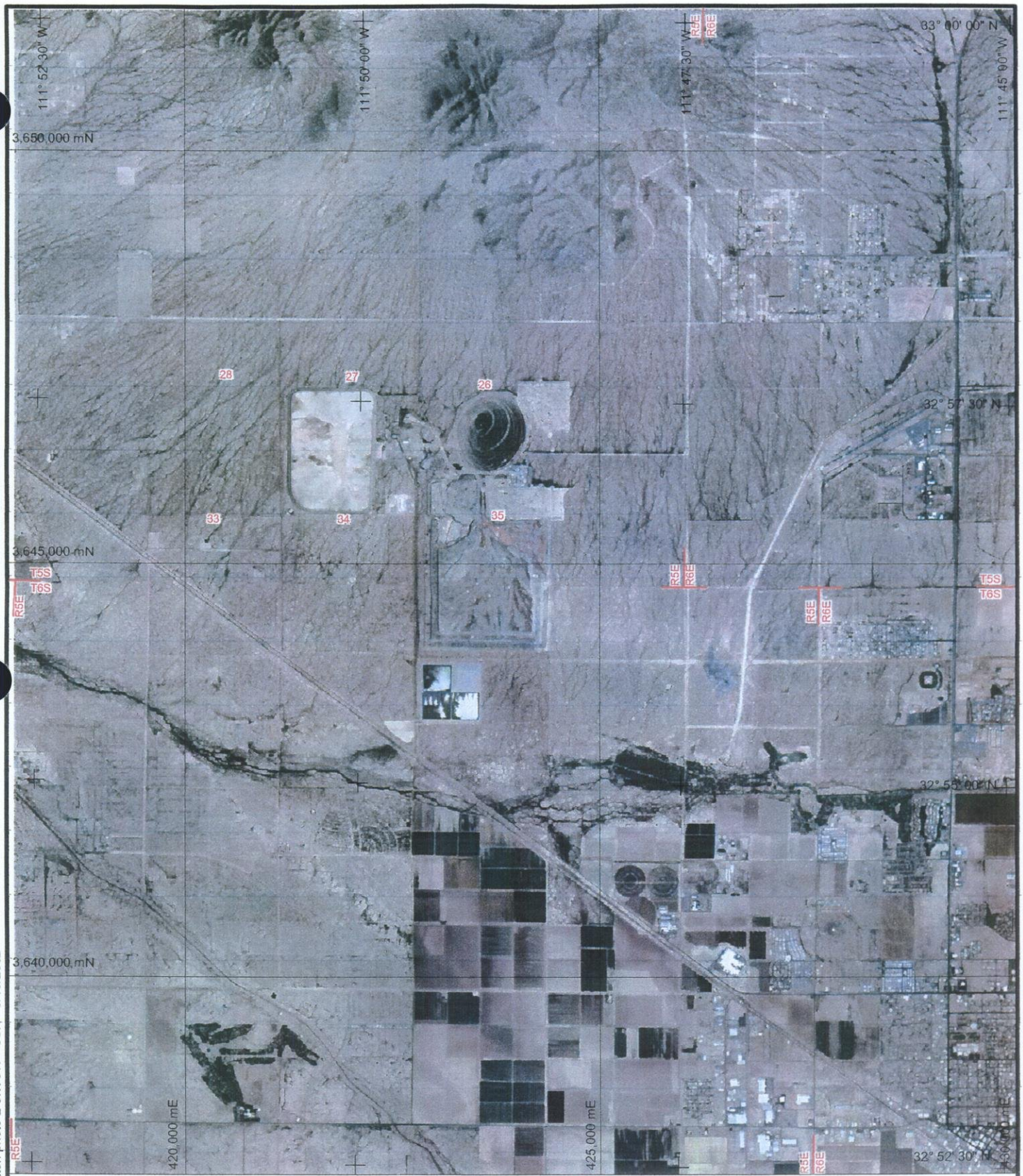


\Arizo...aton\Sacaton photo 2-4.WOR * GSH * 9/15/2002

Photograph 2-4

1983 CIR Aerial Photograph of the Sacaton Mine Project Area During Mining

Pinal County, Arizona



NORTH

0 ½ 1

miles

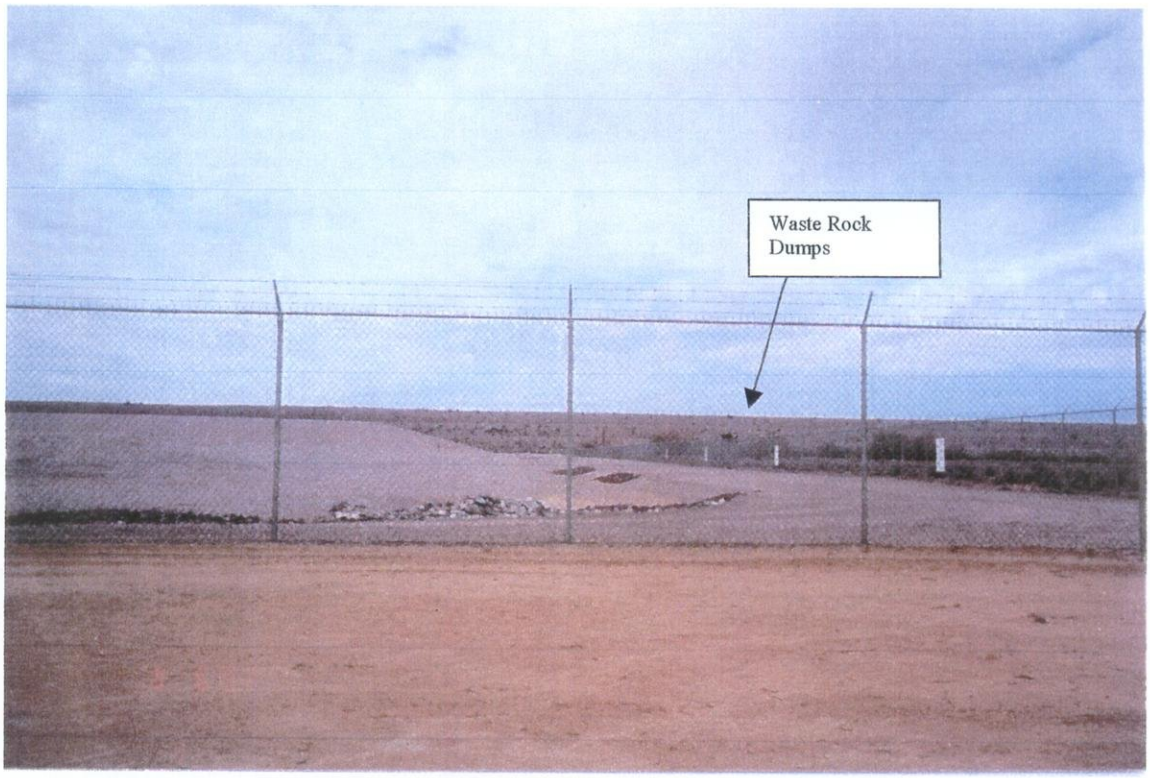
UTM Zone 12, NAD83

Photograph 2-5

2002 Aerial Photograph of the Sacaton Mine Project Post-Mining

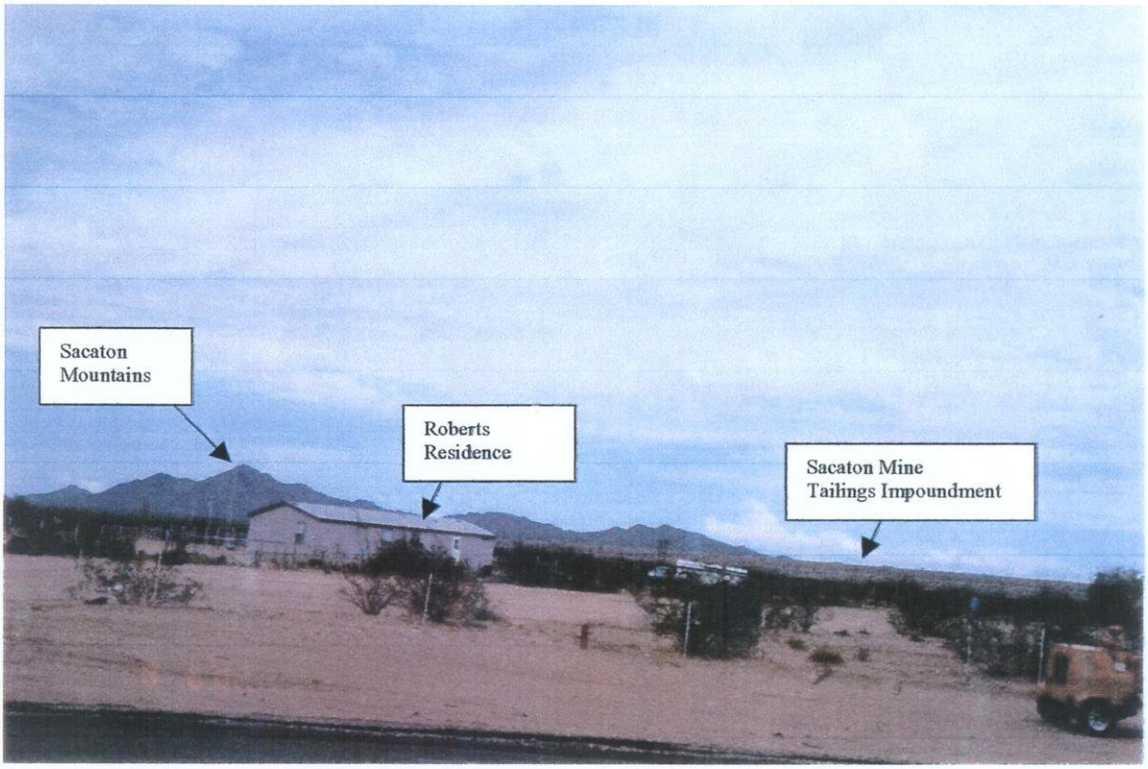
Pinal County, Arizona

\Arizo aton\Sacaton photo 2-5.WOR * GSH * 9/15/2002



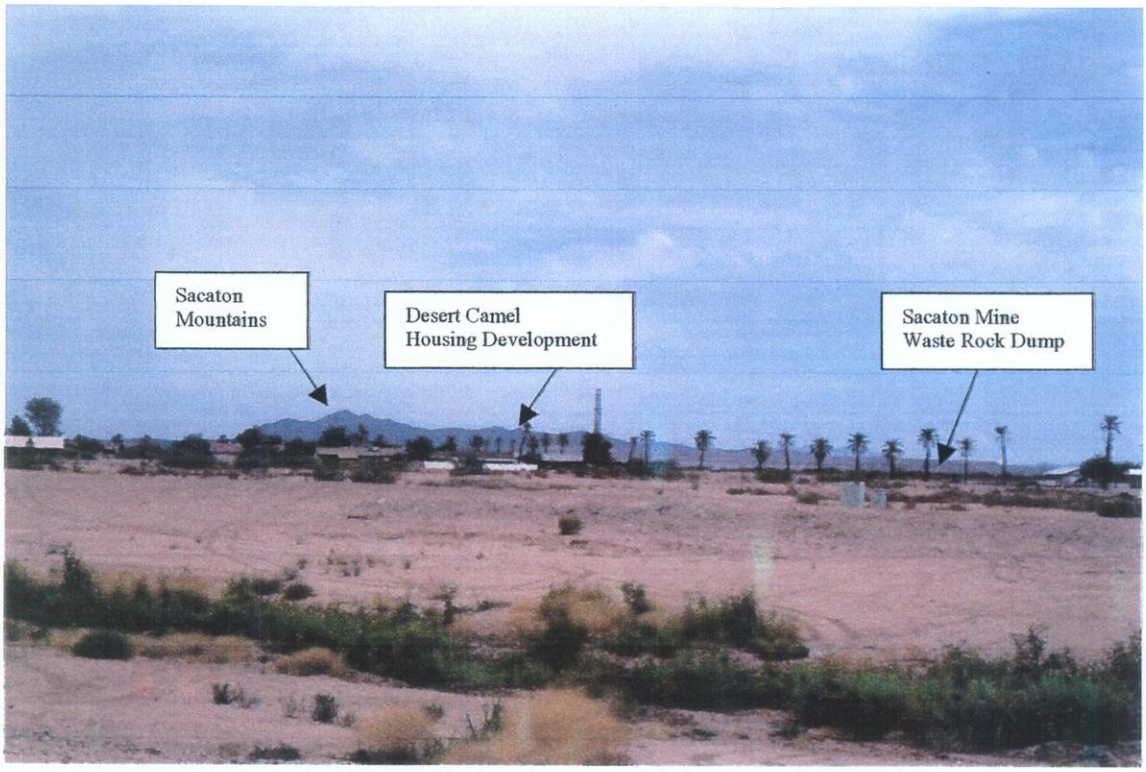
Photograph 2-6. Entrance to the evaporative ponds built by Reliant Electric south of the Sacaton Mine waste rock dump.

Photograph 2-7. E-Crete concrete product facility at the Sacaton Mine

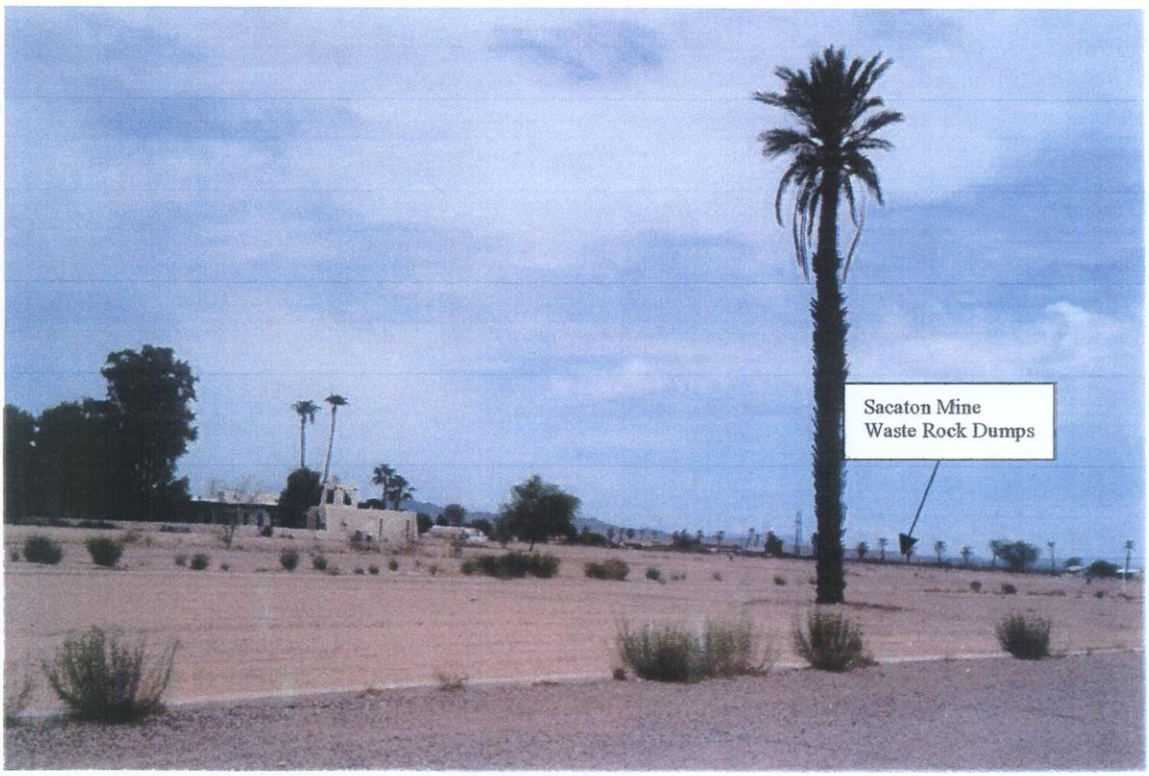


Photograph 2-8. Roberts residence located approximately 1 mile southwest of the Sacaton Mine tailings impoundment.

Photograph 2-9. Land for sale near the Sacaton Mine waste rock dumps.



Photograph 2-10. Desert Camel housing development located approximately 2 Miles south of the Sacaton Mine.



Photograph 2-11. Desert Camel housing development showing mature vegetation.

3.0 PREVIOUSLY SUBMITTED DATA THAT DOCUMENT COMPLIANCE WITH WIS. STATS. § 293.50

3.1 Review of Information Submitted with NMC's 1998 Report

Many of the references submitted with NMC's 1998 Report present useful information about the hydrogeologic setting of the Sacaton mine. That information should be considered in evaluating environmental conditions during mine operation and following mine closure. The 1998 Report also includes water quality information for the tailings process water, groundwater quality data collected from the tailings monitoring well, water quality data from other nearby wells, and waste characterization data for the tailings. All of those data provide information relevant to determining whether the Sacaton mine satisfies the criteria set out in Wis. Stats. § 293.50.

The following sections augment the 1998 Report with more-detailed discussions of the previously submitted data, and explain how that information demonstrates that the Sacaton mine complies with Wis. Stats. § 293.50. In order to facilitate WDNR's review of the discussion presented in this chapter, some of the previously submitted data has been compiled in formats which are more user-friendly than the raw data submitted with the 1998 Report.

3.2 Pre-Mine Groundwater Quality in the Sacaton Mine Area

A number of the references included with the 1998 Report discuss the presence of mineralized water in the vicinity of the Sacaton mine due to its location overlying the Casa Grande Ridge. The information presented in Section 2.2.4 and in Appendix B of this Supplemental Report corroborates the presence of zones of highly saline groundwater in the vicinity of the Sacaton mine. As shown in ***Figure 2.2,*** water quality samples collected as early as 1941 reveal zones of highly mineralized groundwater.

The 1980 report, entitled "*Geology and Hydrology of Asarco Sacaton mine Unit, Pinal County, Arizona,*" Water Development Corporation and stamped by Leonard C. Halpenny, Arizona Registered Professional Engineer and Registered Geologist (AS-40), describes the groundwater associated with the Casa Grande Ridge hydrologic bedrock feature as:

> "highly mineralized, with total dissolved solids content of the water in several of the wells overlying the ridge area exceeding 4,000 ppm, compared to total dissolved solids content ranging from 300 to 800 ppm for water from wells in the surrounding area." (Water Development Corporation Report, page 4-20, AS-40)

According to the Water Development Corporation Report, groundwater associated with the Casa Grande Ridge locally has total dissolved solids concentrations that exceed 10,000 ppm. Table 7 of the Water Development Corporation report compares a sample of Casa Grande Ridge water with water from a seep collected in the Sacaton Pit. This table is repeated herein as ***Table 3-1***. It should be noted that the Casa Grande Ridge water sample was collected in T. 6 S., R. 5 E. (i.e., in the next township to the south of the mine) in June 1972, the year development started at Sacaton.

Table 3-1 clearly illustrates the naturally poor quality, saline, and highly mineralized nature of the groundwater underlying the Sacaton mine both before and during mining. The data comparison also shows the acidic nature and significantly poorer quality of the resident water within the Sacaton pit as compared with the slightly alkaline, but still saline, Casa Grande Ridge

groundwater. As discussed previously, the Sacaton pit acts as an isolated hydrogeological sump from which this low pH water cannot escape into the environment.

Table 3-1
Analyses of Casa Grande Ridge Water and Bedrock Water
(Table 7 from the Water Development Corporation Report in AS-40)

Constituent	Well (D-6-5)12ccb Casa Grande Ridge Water	ASARCO Sacaton Pit Water 790' Level
Calcium (mg/l)	190	470
Magnesium (mg/l)	44	87
Sodium (mg/l)	1,050	1,750
Potassium (mg/l)	10	92
Carbonate (mg/l)	0	0
Bicarbonate (mg/l)	462	0
Sulfate (mg/l)	1,430	2,432
Chloride (mg/l)	719	2,100
Nitrate (mg/l)	95	159.5
Boron (mg/l)	0.11	2.9
Fluoride (mg/l)	4.5	4.4
TDS @ 180 ° F (mg/l)	4,514	7,827
Specific conductance (micromhos @ 25° C)	5,900	10,830
pH	7.9	3.8
Date Sampled	09/19/72	07/10/79

As further discussed in the Water Development Corporation Report (AS-40), the location of the Sacaton mine along the northern limit of the Casa Grande hydrologic bedrock feature precluded the development of a local water supply. The highly mineralized character of the groundwater at the mine site was not suitable for use in the milling process. (Water Development Corporation Report, page 4-24.) Asarco had to purchase land east of the mine, outside the area of the Casa Grande hydrologic ridge, in order obtain good quality water.

Table 3-2 presents groundwater quality data from other wells in the area with naturally poor water quality. The data shown in ***Table 3-2*** is a compilation of information included in Tables 2

and 3 in AS-22. The water quality samples shown in ***Table 3-2*** were collected while mining was underway at the Sacaton mine. One of the wells, (D-6-5)27aaa, has water quality data dating back to 1941. It should be noted that the natural concentration of arsenic in the water sampled from all of the wells shown in ***Table 3-2*** exceeds the new Maximum Contaminant Level (MCL) of 0.01 mg/l. The arsenic levels shown in ***Table 3-2*** are also consistent with the concentrations measured in the groundwater monitoring wells at the Santa Cruz JV Project (see the water quality data in the tables in Appendix A), and represent a broad region of groundwater with high levels of naturally occurring arsenic.

Table 3-2
Water Quality Data from Wells in the Vicinity of the Sacaton Mine Showing Naturally High Background Concentrations of Total Dissolved Solids and Arsenic
(Data compiled from Tables 2 and 3 in Reference No. AS-22)

	(D-5-6) 28aac		(D-5-6) 28daa		(D-6-5) 27aaa				(D-5-6) 33aaa		(D-6-4) 11ddc
	08/21/72	11/30/82	09/19/72	11/30/82	06/19/41	09/19/72	09/10/76	07/24/84	09/19/72	11/30/82	08/25/82
pH	8.3	8.1	8.3	8.5	--	8.0	7.7	7.5	8.3	8.4	--
TDS (mg/l)	525	833	520	603	4,100	2,159	1,500	1,500	733	720	1,300
Specific Conductance	1,200	1,300	710	950	5,920	2,900	2,530	2,600	980	1,125	--
Sulfate (mg/l)	270	293	185	225	1,400	510	390	440	248	250.0	420
Nitrate (mg/l)	2	5.8	<0.5	5.3	44	59	--	--	9.3	8.9	--
Fluoride (mg/l)	6.8	6.6	6.5	6.9	4.4	3.2	3.5	4.4	4.7	5.8	1.0
Arsenic (mg/l)	--	0.1	--	0.07	--	--	--	0.022	--	0.05	0.021
Copper (mg/l)	--	(-)0.01	--	(-)0.01	--	--	--	(-)0.01	--	(-)0.01	0.001
Zinc (mg/l)	--	0.01	--	0.01	--	--	--	0.008	--	(-)0.01	0.30

The previously submitted 1992 Hydro Geo Chem report on the Hexcel Chromium Disposal Site (ASH-5) also discusses the highly mineralized groundwater present in the mine area, including the area of the Sacaton tailings disposal facility. As noted in the Hydro-Geo Chem report, there are a number of wells in the region that exceed the arsenic MCL (which at the time was 0.05 mg/l). In addition to the wells shown in ***Table 3-2*** that exceed the current arsenic MCL of 0.01 mg/l , ***Table 3-3*** shows two other wells in the area with elevated background concentrations of arsenic.

Table 3-3
Additional Wells in the Vicinity of the Sacaton Mine with Elevated Background Arsenic
(Data compiled from Table 2 and 3, Reference No. AS-22)

	(D-6-6)7aaa2			(D-6-6)9dad
	08/30/62	09/19/72	07/13/84	08/26/82
PH	8.5	8.7	8.8	--
TDS (mg/l)	--	486	420	680
Specific Conductance	804	650	1,000	--
Sulfate (mg/l)	170	153	130	100
Nitrate (mg/l)	--	(-)0.5	--	--
Fluoride (mg/l)	4.8	5.9	6.5	1.1
Arsenic (mg/l)	--	0.05	0.057	0.016
Copper (mg/l)	--	--	(-)0.010	0.004
Zinc (mg/l)	--	--	0.032	0.003
Chromium (total) (mg/l)	--	--	--	0.010
Cadmium (mg/l)	--	--	(-)0.001	(-)0.001

(- - indicates no data shown in the original report)

3.3 Groundwater Quality During and After Mining at Sacaton

In 1986, Asarco submitted a report prepared by Montgomery & Associates to the Arizona Department of Health Services, Office of Waste and Water Quality Management, Division of Environmental Health Services, in conjunction with a proposal to develop the inactive Sacaton open-pit mine into a sanitary landfill. (This report was submitted as reference number AS-22 with the 1998 Report.) The Montgomery & Associates report contains much useful groundwater quality data for the Sacaton mine and surrounding area. ***Table 3-4*** presents a compilation of some of the groundwater quality data included in the 1986 Montgomery & Associates report. ***Table 3-4*** shows water quality sample results for samples collected from wells located adjacent to the pit, from the production shaft, and from the pool of water at the base of the pit.

The analytical data presented in Table 3-4 confirms that the Sacaton pit is a localized and specific sump from which acidic and highly mineralized water cannot escape. The perimeter Sacaton mine groundwater wells and water from the P Shaft near the pit contain alkaline water with conductivities similar to those in the domestic and irrigation wells within the groundwater flow gradient to the west and the west-southwest (discussed in Section 2.0). If acidic pit water was escaping into the general groundwater flow path, specific conductance, total dissolved solids, and sulfate concentrations would be elevated at those sampling sites, and pH values would be considerably lower.

Table 3-4
Sacaton Mine Water Quality Data
(compiled from Montgomery & Associates, 1986, AS-22)

	Well No. 5 - SE Pit Perimeter (D-5-5) 35aba1		Well No. 6 - SE Pit Perimeter (D-5-5) 35aba2		P. Shaft (D-5-5) 35aba3		Pit Water (D-5-5) 26dcb
	06/28/79	07/10/79	07/10/79	11/30/82	06/05/79	07/10/79	04/03/86
PH	--	8.4	8.4	8.8	--	10.0	4.1
TDS (mg/l)	--	567	587	550	--	777	8,400
Specific Conductance	--	890	910	940	--	1,120	10,300
Sulfate (mg/l)	--	170	200	197	--	204.0	3,200
Nitrate (mg/l)	--	4.4	7.1	2.2	--	5.3	48.7
Fluoride (mg/l)	--	11.2	12.0	12.2	--	15.8	6.2
Arsenic (mg/l)	--	--	--	0.10	--	--	--
Copper (mg/l)	0.01	--	--	(-)0.01	0.01	--	--
Zinc (mg/l)	---	--	--	(-)0.01	--	--	--
Cadmium (mg/l)	--	--	--	---	--	--	--
Chromium total (mg/l)	--	--	--	(-)0.01	--	--	--

(- - indicates no data shown in the original report)

3.3.1 Sacaton Tailings Disposal Facility Groundwater Monitoring Data

Several of the references submitted with the 1998 Report presented groundwater monitoring data for the Sacaton mine tailings disposal facility. As described in the 1998 Report, Asarco installed a downgradient groundwater monitoring well at the southwestern corner of the tailings disposal facility in order to evaluate the impact that the seepage of process water from the unlined tailings impoundment might have on local groundwater. It should be noted that Arizona did not (and currently does not) require tailings impoundments to be lined unless the milling circuit uses reagents that warrant containment.

Asarco collected samples from the tailings monitoring well on a regular basis. Part of this information is presented in AS-22, and the remainder in the Water Development Corporation report included with AS-40. ***Table 3-5*** is a compilation of the tailings monitoring well data from both of those references.

Table 3-5 Groundwater Monitoring Data for the Sacaton Mine Tailings Disposal Facility (compiled from data presented in AS-22 and the Water Development Corporation Report included in AS-40)

Date	8/22/73	8/12/75	1/8/76	8/5/76	1/6/77	7/15/77	1/18/78	8/9/78	1/23/79	7/10/79	1/31/80	8/5/80	1/5/83	3/15/85
Calcium	28.0	58	36	23	30.2	23.8	19.5	33.0	30.0	19.5	21	19.9	--	111
Magnesium	11.3	12.3	8.0	4.1	5.3	5.6	6.0	7.8	6.0	6.0	5.0	3.6	--	20
Sodium	1,140	1,430	1,140	780	870	780	810	950	880	750	850	710.0	--	1,470
Potassium	14.5	5.5	7.0	1.8	1.9	1.7	1.7	4.5	1.0	1.2	1.0	0.7	--	1.4
Carbonate	0	0	0	23.0	14.5	12.8	8.5	8.5	0	0	0	0	--	5.1
Bicarbonate	553.3	367.2	230.6	176.7	187.1	149.0	153.3	152.5	159.4	157.7	137.7	145.5	--	170.0
Chloride	633.7	672.6	555.8	371.7	375.2	404.3	439.7	352.2	481.9	385.5	435.4	303.4	--	630.0
Sulfate	1,213	1,945	1,560	1,101	1,204	1,007	1,017	1,199	1,250	970	1,140	1,025	--	2,350
Nitrate	1.86	43.6	13.9	27	36.3	21.7	19.5	22.2	17.3	23.9	31.9	31.0	--	68.2
Boron	3.0	7.02	4.1	3.62	1.6	1.3	1.7	2.1	4.6	1.0	.97	--	--	--
Fluoride	10.0	5.4	18.5	2.2	5.2	18.9	16.5	8.0	14.4	15.6	16.2	15.0	--	9.2
Specific Conductance	5,200	6,700	5,100	3,600	3,900	3,900	3,910	4,100	4,000	3,670	4,020	3,400	--	6,700
TDS	3,080	4,117	3,057	2,463	2,387	2,397	2,543	2,750	2,487	2,323	2,447	2,083	--	4,950
pH	7.7	8.1	8.2	8.2	8.3	8.4	8.2	8.2	8.0	8.1	7.8	8.1	--	8.2
Iron	0.07	--	--	--	--	1.1	--	--	--	--	--	--	(-)0.05	--
Manganese	0.08	-	--	--	--	0.04	--	--	--	--	--	--	(-)0.01	--
Arsenic	0.02	--	--	--	--	0.03	--	--	--	--	--	--	0.03	--
Copper	(-)0.01	--	--	--	--	(-)0.01	--	--	--	--	--	--	0.01	--
Zinc	0.11	--	--	--	--	0.31	--	--	--	--	--	--	0.54	--
Barium	--	--	--	--	--	(-)1.0	--	--	--	--	--	--	--	--
Cadmium	--	--	--	--	--	0.008	--	--	--	--	--	--	--	--
Chromium	0.08	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead	(-)0.05	--	-	--	--	0.004	--	--	--	--	--	--	(-)0.01	--
Mercury	--	--	--	--	--	(-)0.002	--	--	--	--	--	--	--	--
Selenium	(-)0.01	--	--	--	--	(-)0.01	--	--	--	--	--	--	(-)0.01	--
Silver	--	--	--	--	--	(-)0.01	--	--	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nickel	--	--	--	--	--	(-)0.05	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Boron	3.0	--	--	--	--	1.3	--	--	--	--	--	--	--	--
Silica	--	--	-	--	--	--	--	--	--	--	--	--	21	--
Moly (Mo)	0.01	--	--	--	--	--	--	--	--	--	--	--	--	--
Strontium	--	--	--	--	--	(-)0.1	--	--	--	--	--	--	--	--

Notes: Analytical data shown in mg/l except for specific conductance and pH. Specific conductance shown in micromhos @ 25° C, pH shown in standard pH units. Total Dissolved Solids (TDS) @ 180° F. (- - indicates no data shown in the original report)

As noted in the 1980 Water Development Corporation Report (included with the 1998 Report in AS-40), the August 1973 water sample shown in ***Table 3-5*** is representative of baseline water quality prior to use of the Sacaton tailings disposal facility and seepage of tailings water into the groundwater downgradient from the tailings impoundment:

> "The results of analyses of samples from the monitor well are presented in Table 11. The first column of values listed in this table are representative of the quality of the naturally occurring groundwater underlying the pond area. This sample was collected prior to the use of the tailings pond, and reflects conditions uninfluenced by potential pond seepage. Results of this analysis indicate the predominant ions are sodium (1,114 ppm), sulfate (1,213 ppm), chloride (634 ppm), and bicarbonate (553 ppm). The fluoride content was 10 ppm, and the total dissolved solids at 180° F was 3,080 ppm. Comparison with the values on the anlyses of Casa Grande Ridge water and bedrock water (see Table 7), and with samples from other wells completed in the Gasline conglomerate along the Casa Grande Ridge indicates the results of this sample are very representative of water along the ridge." (Water Development Corporation, 1980, page 4-32.) Note: Table 11 referenced above is included in ***Table 3-5*** herein; Table 7 referenced above is reproduced herein as ***Table 3-1***).

The chemistry of the August 1973 water sample is similar to the mineralized water samples collected from water wells in the Casa Grande Ridge. For example, compare this sample with the total dissolved solids, sulfate concentration, and other constituents in the Casa Grande Ridge water shown in ***Table 3-1***, and the high total dissolved solids levels in water samples from several of the wells shown in ***Table 3-2***.

As discussed in the 1998 Report, seepage of water from the Sacaton tailings disposal facility into the downgradient groundwater system locally diluted and, thereby, actually improved the groundwater quality. This temporary, local dilution and improvement effect due to seepage of the tailings water is readily seen by examining the trends for sodium, bicarbonate, chloride, specific conductance, and total dissolved solids shown in ***Table 3-5***. Judging from the chemistry of the sample collected in March 1985, approximately one year after closure of the Sacaton mine, this dilution effect had by then ended and the total dissolved solids and sulfate concentrations had recovered to levels consistent with background concentrations in the groundwater associated with the Casa Grande Ridge.

The references submitted with NMC's 1998 Report examined the location of the tailings monitoring well to verify that it was properly sited to evaluate groundwater conditions downgradient from the tailings disposal facility. The Water Development Corporation Report included with AS-40, states:

> "The existing monitor well is properly sited with respect to the position of the tailings pond. The data show that the monitor well is functioning satisfactorily as a means of evaluating the effect of pond seepage." (page 4-32.)

3.3.2 The Sacaton Tailings Disposal Facility and Groundwater Quality Impacts

A thorough evaluation of the information available for the Sacaton tailings disposal facility reveals that it did not adversely impact downgradient groundwater quality during operation, and that there is no potential (and never was any potential) for the tailings disposal facility to adversely impact groundwater quality after mining operations ceased. As discussed below, this conclusion is based on the following data:

1. The water quality monitoring data collected during operation of the facility and described above in Section 3.3.1;

2. The chemistry of the tailings decant water (i.e., process water), as discussed below and shown in ***Table 3-6***; and

3. The leach extraction tests performed on the tailings, as discussed below and shown in ***Table 3-7***.

The chemistry of the tailings pond decant water is shown in ***Table 3-6***. The tailings pond decant water contained less sodium, bicarbonate, chloride, sulfate, and boron, and total dissolved solids, and had a lower specific conductance than the receiving groundwater. (Compare ***Table 3-6*** with the August 1973, pre-tailings disposal, sample interval in ***Table 3-5***.) Additionally, the metals concentrations shown in ***Table 3-6*** for the August 1983 decant water sample are below the MCLs for each of the listed metals.

Because the tailings pond decant water was better quality (i.e., less saline) water than the naturally occurring groundwater, and did not contain metals in concentrations that exceeded an MCL, there was no potential for seepage of that water into the groundwater to adversely impact groundwater quality. Therefore, the tailings (i.e., process) water could not and did not contribute "significant environmental pollution," during operation of the mine. When milling and tailings deposition ceased, the remaining pool of tailings water evaporated, and the dilution effects that temporarily resulted from seepage of better quality tailings water into the groundwater also ceased. The pre-existing groundwater quality returned beneath and downgradient from the tailings facility once the less-saline tailings water had evaporated from the tailings impoundment surface and the water remaining in the pore spaces of the tailings had seeped out of the impoundment.

Table 3-6
Analysis of Tailings Pond Decant (Process) Water
(Water Development Corporation Report, page 4-27, AS-40)

Constituent or Parameter	Concentration or Analytical Result[a]: reference AS-40, sample date unknown	Concentration or Analytical Result[a]: reference AS-39, 8/16/83 sample date
Calcium	140	108
Magnesium	2.4	0.80
Sodium	435.0	345
Potassium	110.0	--
Carbonate	0	--
Bicarbonate	34.7	--
Chloride	306.2	258
Sulfate	920.0	710
Nitrate	<0.5	10.6 (as N)
Boron	0.6	(--)
Fluoride	15.6	17.0
Specific conductance	2,920	(--)
Total Dissolved Solids @ 180° F	2,040	1,593
pH	7.5	7.1
Copper	(--)	0.16
Zinc	(--)	0.02
Arsenic	(--)	<0.01
Barium	(--)	<0.5
Cadmium	(--)	<0.005
Chromium (total)	(--)	<0.01
Lead	(--)	<0.01
Mercury	(--)	<0.0002
Selenium	(--)	0.019
Silver	(--)	<0.01

Notes: [a] all units in mg/l except for specific conductance which is micromos @25° C and pH which is shown in standard pH units, (--) indicates no data in the report cited.

A similar conclusion is warranted for the tailings solids because leachate derived from the Sacaton tailings does not exceed an MCL for any of the tested parameters. As described in a document contained in AS-40, Asarco performed "Extraction Procedure (EP) tests on the Sacaton tailings using methods prescribed at the time by the State of Arizona Hazardous Waste Regulations and the Federal Environmental Protection Agency." (The EP tests were a precursor test to the current Toxicity Characteristic Leaching Procedure, or TCLP test, that the U.S. EPA and state regulators used to classify a waste as hazardous based on the characteristic of toxicity.)

Table 3-7 presents the results of the EP tests, and compares those results to the Arizona standards applicable in the early 1980s and to the current federal MCLs for arsenic, barium, cadmium, chromium, mercury, and selenium; the secondary MCL for silver; and the Action

Level/Treatment Technique for lead. As can be seen from ***Table 3-7***, the EP test showed results for the Sacaton tailings well below Arizona water quality standards applicable at the time. They are also below the current primary MCLs for arsenic, barium, cadmium, chromium, mercury, and selenium, and below the secondary MCL for silver. The value obtained for lead (.05 mg/l) is above the current lead Action Level/Treatment Technique of 0.015 mg/l, but the tailings groundwater monitoring data shown in Table 3-5 for sampling dates July 15, 1977 and January 5, 1983 (the two sampling intervals that include lead analyses) are both below the current Action Level/Treatment Technique for lead.

The EP test data provide two important facts about the Sacaton tailings: first, the tailings are not hazardous waste (regardless of the status of the Bevill amendment) and, second, leachate produced by the tailings solids met drinking water standards for the listed parameters. Therefore, during operation, seepage of leachate from the tailings solids had no potential whatsoever to degrade groundwater (especially the highly mineralized groundwater in the vicinity of the tailings disposal facility). Similarly, there is no post-closure potential for the tailings to produce a leachate that could contaminate groundwater. Moreover, the likelihood of producing a leachate from the tailings in this extremely arid setting is quite slim. Nonetheless, even if small volumes of leachate formed during the ten years following mine closure and seeped out of the impoundment, the metals content of that leachate would not have exceeded an MCL. The same conclusion is applicable to any tailings leachate that might be produced in the future.

Thus, it is clear that the Sacaton tailings disposal facility can be ruled out as a potential source of groundwater contaminants both during operations and following mine closure. Neither the leachate from the tailings solids nor the tailings process water contained metals in concentrations above an MCL. Moreover, the tailings process water was less saline than the receiving groundwater. Thus, the Sacaton tailings disposal facility could not have caused and did not cause any "significant environmental pollution" during the ten years in which it was operated. Similarly, the tailings facility has caused no "significant environmental pollution" since the mine closed in 1984.

Table 3-7
Extraction Procedure Toxicity Test Leachate Analysis for the Sacaton Tailings
(Analysis Included in AS-40)

Constituent (mg/l)	EP Toxicity Test Results (mg/l)	AZ Standards at Time of Test (mg/l)	Current MCLs (mg/l)
Arsenic	<.005	5.0	0.10
Barium	<1.0	100.0	2
Cadmium	<.002	1.0	0.005
Chromium	<.02	5.0	0.1
Lead	.05	5.0	0.015(Action Level[a])
Mercury	<.001	0.2	0.002
Selenium	<.004	1.0	0.05
Silver	<.002	5.0	0.1[b]

Notes: [a] Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L. (EPA website on Drinking Water Standards: http://www.epa.gov/safewater/mcl.html#1) See also actual groundwater lead levels reported in Table 3-5.

[b] The silver standard shown is a secondary MCL

3.3.3 Sacaton Open Pit Groundwater Quality Impacts

NMC's 1998 Report characterizes the Sacaton open-pit mine as a "local hydrologic sump," and substantiates that statement with several references. This situation is one of the key reasons Asarco was interested in converting the open pit mine into a sanitary landfill. As a hydrologic sump, the pit was an ideal setting – offering, as it did, hydrogeologic containment of leachates that would have developed from municipal solid waste. The Montgomery & Associates report describes the suitability of the Sacaton pit for use as a sanitary landfill as follows:

> "Site conditions that would minimize impact on groundwater at the proposed landfill (the Sacaton pit) include: dry climate; easily controlled ephemeral surface water runoff; dewatered conditions in unconsolidated rocks and low permeability conditions in the underlying consolidated rocks penetrated by the pit; small groundwater inflow from the pit walls; an upward hydraulic gradient in the groundwater system below the mine pit and naturally occurring poor chemical quality of the groundwater." (AS 35, see NMC 1998 Report, page 4-7.)

The hydrogeologic characteristics of the pit – groundwater locally flows into the pit and the upward hydraulic gradient beneath the pit – prevent contaminants from migrating from the pit and into the groundwater system. Put another way, the pit is a self-contained system; there is no receiving groundwater. Because contaminants cannot migrate downward or outwards from the pit, the Sacaton mine excavation has no potential to degrade groundwater or to cause "significant environmental pollution" either during operations or following mine closure. Thus, like the tailings facility, the Sacaton pit can be ruled out as a source or potential source of significant environmental pollution.

3.3.4 Sacaton Waste Rock Dump Groundwater Quality Impacts

The Sacaton waste rock dump contains basin-fill sediments that covered the Sacaton ore deposit and the igneous rocks that are part of the Sacaton porphyry copper system. The igneous rocks in the waste rock dump have the potential to generate acid. (The acidic pool in the bottom of the pit clearly demonstrates the acid-generating potential of the pit wall rocks. Those same rocks are present in the waste rock dump.)

Because the climate is hot and dry, runoff or drainage from the dump occurs only during occasional, short-lived major storm (monsoonal) events. The arid climate also minimizes seepage from the waste rock dump into the underlying vadose zone and groundwater system and, although the igneous rocks in the waste rock dump have a net-acid-generating potential, the only mechanism to transport the products of such a reaction into the groundwater or onto the surrounding land surface is weak and highly episodic. There is also no surface water in the vicinity of the waste rock dump that could be impacted in the unlikely event of acidic runoff from the dump.

4.0 DISCUSSION OF RELEVANT MONITORING DATA

4.1 A General Definition of Relevant Data

As discussed in the 1998 Report and Chapters 2 and 3 of this Supplemental Report, there are substantial and adequate data to demonstrate the Sacaton mine meets both the operating and closure criteria set out in Wis. Stats. §293.50. Those data are a combination of site-specific monitoring data collected at the Sacaton site, and data collected for other purposes in the vicinity of the mine. Much of the complementary data presented in this Supplemental Report consist of water quality information from water wells downgradient of the Sacaton mine. The aerial and land photographs discussed in Section 2.3 contribute additional useful information about actual environmental and land-use conditions around the mine site.

In evaluating this information and its relevance to the Sacaton mine, it should be recognized that "relevant monitoring data" can be defined on something broader than a site-specific basis. There is no "one-size-fits-all" blueprint for monitoring groundwater impacts from a mine and ancillary facilities.

The plain-language meaning of the word "relevant" demonstrates this point. Webster's New Seventh Collegiate Dictionary defines "relevant" as follows:

> "**relevant - 1a:** bearing upon the matter at hand: PERTINENT **b:** affording evidence tending to prove or disprove the matters at issue or under discussion"

Listed synonyms for "relevant" include: germane, material, pertinent, apposite, applicable, apropos. The definition further states:

> "RELEVANT implies a traceable, significant, logical connection."

4.2 Identifying Relevant Data Specifically for the Sacaton Mine

The regional hydrogeologic setting of the Sacaton mine area forms the framework upon which the impacts associated with the Sacaton mine must be evaluated. Additionally, the hydrogeologic setting defines the types of operational and post-closure groundwater monitoring measures that would yield useful data about mine-associated groundwater quality impacts. The site-specific climatic and hydrogeologic setting of the mine and the characteristics of the mine waste must therefore be considered as primary factors in determining what data are relevant in assessing environmental conditions at the Sacaton mine. Those site-specific factors are briefly discussed in each of the following sections.

4.2.1 Pit Hydrology

As discussed in Section 3.3.3, the Sacaton pit is a hydrogeological sump. Therefore, it is not possible to monitor water quality impacts emanating *from* the pit because there is no flow out of the pit, downward or laterally. As a hydrogeological sump, the pit provides hydrogeological containment. Any influence the pit might have on groundwater quality is confined to the isolated puddle of water in the bottom pit.

Because of those conditions, groundwater monitoring wells in the immediate vicinity of the pit will only provide information about the characteristics of the water flowing into the pit. They can also verify that the direction of the flow gradient has not changed and that the pit continues to be a groundwater sump. But the persistent presence of the small pool in the bottom of the pit is sufficient to confirm that. The pool would be an ephemeral feature if it formed solely in response to storm events, because it would shrink and disappear on a regular basis due to the locally high rate of evaporation.

If analytical results from the pit perimeter wells were to turn acidic with associated elevated sulfate concentrations, the obvious conclusion would be that pit waters were migrating outward and down-gradient as a plume. But that has not happened. And, at the accepted estimated movement rate within the aquifer of 10 ft./day over the 19-year period since the mine closed, such a plume should be detectable in some or all of the numerous down-gradient wells within an approximate 13-mile radius. That has not happened, either.

As discussed in Section 2.0, neither "significant" nor "any" pollution attributable to the Sacaton mine site has been detected outside of the contained pool on the floor of the pit, as evidenced by analytical data from both the pit perimeter wells and down-gradient irrigation and domestic wells, and from monitoring wells at the Santa Cruz Joint Venture project. Likewise, there has been no regulatory action at any level to suggest otherwise.

4.2.2 Tailings Waste Characterization

The tailings disposal facility has no demonstrable potential to degrade groundwater quality, as discussed in Section 3.3.2, for the following reasons:

- The process water (tailings decant water) was of higher quality (less saline) than the receiving groundwater, and displayed no metals concentrations exceeding MCLs; and

- Leach extraction tests (EP tests) on the Sacaton tailings confirm they are benign and produce no leachate exceeding MCLs for the parameters tested.

The groundwater quality data collected from the monitoring well at the southwest corner of the tailings disposal facility during the life of the mine show that seepage from the tailings disposal facility actually caused a temporary, local improvement in groundwater quality.

There are no technical reasons to require post-closure groundwater monitoring downgradient from the tailings disposal facility given the benign character of both the historic tailings process water and the leachate from the tailings solids themselves. Seepage of tailings process water and/or tailings leachate into the area groundwater actually caused a temporary, local improvement in water quality. Thus, post-closure monitoring would be expected to simply document a return to the naturally lower pre-mining groundwater quality immediately downgradient from the tailings disposal facility. The March 1985 water quality data from the tailings disposal facility suggest that is precisely what happened within about one year after mine closure.

4.2.3 Waste Rock Seepage Potential

As discussed in Section 3.3.4, the arid climate at Sacaton generates no drainage from the waste rock dump except in response to the occasional large storm event. Even then, it is apparent that no problematic leachate seeps from the dump into the vadose zone and, finally, to the water table. That is confirmed by seven years of groundwater quality data collected in conjunction with the Santa Cruz JV Project, which show absolutely no trace of copper or other dissolved metals that would be the inevitable indicators of such pollution from the Sacaton waste rock.

4.2.4 Empirical Indicators

Nearby groundwater use downgradient of the Sacaton mine provides additional evidence that the mine has not adversely impacted groundwater quality. As discussed in Section 2.2, the ADWR water well database shows numerous water wells in the vicinity of the Sacaton mine. Those wells document the extensive and ongoing use of local groundwater with absolutely no indication of mine-related groundwater contamination or impairment.

Both the ADWR and the ADEQ actively monitor and regulate groundwater quality in the Pinal Active Management Area (AMA) that includes the Sacaton mine site. Both regulatory agencies administer detailed and well documented programs to monitor groundwater use and groundwater quality in the Pinal AMA. Given the scope of their respective regulatory programs, it is simply not reasonable to expect either agency to be unaware of potential groundwater issues associated with the Sacaton mine. And NMC's thorough records check at both the ADWR and ADEQ confirm that neither agency has active concerns about groundwater quality impacts attributable to the Sacaton mine.

The Santa Cruz JV APP application and the Roberts' water well are particularly significant indicators that there are no agency concerns about the Sacaton mine. The ADEQ APP for the Santa Cruz JV reflects no concerns about the nearby, upgradient Sacaton mine. As discussed in Section 2.1, the extensive water quality data submitted in support of the permit application confirms that the mine has not affected groundwater quality in the adjacent project area.

Similarly, as discussed in Section 2.2.3, the ADWR actively monitored the drilling permit for the Roberts residence domestic water well, and voiced concerns only about potential effects of the Hexcel chromium waste disposal site. There is absolutely no indication that the ADWR was similarly concerned about potential impacts from the Sacaton mine. Given the agency's direct involvement with that water well permit, it is only reasonable to expect that it would also have raised the Sacaton mine as an issue had there been any concerns about it.

Finally, the aerial and ground photographs presented in Section 2.3 document ongoing residential and industrial growth and development in the vicinity of the mine since its closure in 1984. The photographs further demonstrate that the area is both suitable and desirable for development. Given the abundance of open space in this region of Arizona, developers would surely select other locations if there were genuine concerns that the mine was a potential source of pollution.

5.0 LIST OF NEW REFERENCE MATERIALS SUBMITTED WITH THIS SUPPLEMENTAL REPORT

AS-44: Aquifer Protection Permit Application for In Situ Mining Tests in Expanded Test Area, Santa Cruz In Situ Copper Mining Project, Pinal County, Arizona: Errol L. Montgomery & Associates, Inc., Final Report, September 9, 1996.

AS-45: Aquifer Protection Permit, Permit Number P-103147, Santa Cruz Joint Venture In Situ Copper Mining Project, Arizona Department of Environmental Quality, May 13, 1999.

AS-46: Letter from Errol L. Montgomery & Associates, Inc. to Debra W. Struhsacker, September 4, 2002.

AS-47: *Third Management Plan for Pinal Active Management Area 2000 –2010*, Arizona Department of Water Resources, 1999.

AS-48: *Maps Showing Groundwater Conditions in the Eloy and Maricopa-Stanfield Sumb-Basins of the Pinal active Management Area, Pinal, Pima, and Maricopa Counties, Arizona – 1989*, Hammett, B.A., Hydrologic Map Series Report Number 23" Arizona Department of Water Resources, 1992.

APPENDIX A
WATER QUALITY DATA TABLES PRESENTED
IN THE
SANTA CRUZ JV PROJECT AQUIFER PROTECTION PERMIT APPLICATION

TABLE 9. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	07-08-89	07-24-89	07-31-89	08-31-89	10-04-89	11-03-89	01-11-90	04-12-90	05-03-90
FIELD SAMPLE IDENTIFIER	4261	4262	4264	4265	4266	14648	4378	019933	002144
LAB SAMPLE IDENTIFIER	5370	5845	5974	6950	7916	8789	410-1	3453-4	6586-01
LABORATORY[a]	BC	BC	BC	BC	BC	BC	BC	BC	ATI
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	228.	231.	233.	215.	211.	191.	251.	215.	---
Magnesium	38.	41.	38.	39.	37.	34.	43.	40.	---
Sodium	242.	251.	250.	253.	256.	248.	304.	259.	---
Potassium	4.8	4.8	4.7	4.9	5.3	5.3	4.8	4.3	---
ANIONS (mg/L)									
Carbonate	ND	ND	ND	ND	ND	ND	ND	ND	---
Bicarbonate	162.	172.	166.	171.	170.	84.9	193.	170.	---
Chloride	353.	391.	380.	362.	384.	382.	435.	406.	353
Sulfate	432.	560.	540.	560.	504.	524.	610.	520.	---
Nitrate	---	37.2	38.1	36.3	33.7	38.5	46.1	29.2	---
Fluoride	0.66	0.57	0.48	0.66	0.57	0.71	0.41	0.32	---
Alkalinity (as $CaCO_3$)	133.	142.	137.	140.	139.	69.6	159.	139.	---
Boron	0.81	0.82	0.84	0.87	0.81	0.75	1.0	---	---
Bromide	---	---	---	---	---	1.1	1.4	1.1	<30
Total Dissolved Solids	1,650.	1,715.	1,690.	1,690.	1,630.	1,610.	1,900.	1,720.	1,610
PARAMETERS									
Conductivity, Field (μmho/cm)[c]	1,950	2,900	2,900	2,100	2,570	2,100	2,600	2,280	2,400
Conductivity, Lab (μmho/cm)	2,500.	2,600.	2,600.	2,500.	2,600.	2,500.	3,000.	2,500.	---
pH, Field	7.42	7.16	7.34	7.28	7.22	7.26	7.27	7.08	7.24
pH, Lab	7.5	7.5	6.5	7.5	7.0	6.5	7.6	7.4	---
Temperature (°C)[d]	30.0	29.0	28.3	28.6	28.0	26.0	26.2	28.1	28.1

TABLE 9. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	05-08-90	05-11-90	05-16-90	05-19-90	05-20-90	06-20-90	07-06-90	07-10-90	03-05-91
FIELD SAMPLE IDENTIFIER		002145	002146	002147	002148	002151	002154	019964	004438
LAB SAMPLE IDENTIFIER		6586-02	6586-03	6586-04	6586-05	7518-01	8526-03	6081-7	3800-3
LABORATORY[a]		ATI	ATI	ATI	ATI	ATI	ATI	BC	BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	---	---	---	---	---	---	215.	217.
Magnesium		---	---	---	---	---	---	40.	38.
Sodium		---	---	---	---	---	---	255.	262.
Potassium		---	---	---	---	---	---	4.4	4.3
ANIONS (mg/L)									
Carbonate		---	---	---	---	---	---	ND	ND
Bicarbonate		---	---	---	---	---	---	172.	184.
Chloride		344	344	354	353	390	411	391.	375.
Sulfate		---	---	---	---	---	---	540.	555.
Nitrate		---	---	---	---	---	---	33.2	39.9
Fluoride		---	---	---	---	---	---	0.51	0.69
Alkalinity (as $CaCO_3$)		---	---	---	---	---	---	142.	151.
Boron		---	---	---	---	---	---	0.91	0.89
Bromide		<30	<30	<30	<30	1.2	1.1	1.24	0.84
Total Dissolved Solids		1,580	1,600	1,570	1,600	1,640	---	1,680.	1,630.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]		2,240	2,280	2,470	2,380	2,710	2,430	2,500	2,460.
Conductivity, Lab (µmho/cm)		---	---	---	---	---	---	2,600.	2,500
pH, Field		7.50	7.45	7.30	7.38	7.31	7.33	7.19	7.34
pH, Lab		---	---	---	---	---	---	7.4	7.4
Temperature (°C)[d]		27.1	27.4	26.8	26.8	28.1	28.5	28.4	27.1

TABLE 9. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	03-05-91	03-14-91	03-20-91	04-02-91	04-02-91	05-01-91	06-04-91	07-02-91	08-06-91
FIELD SAMPLE IDENTIFIER	004438		019982	014744	014745	019989	014763	014769	004474
LAB SAMPLE IDENTIFIER	103577-03		103832-01	104529-03	4622-3	105555-03	106569-03	107548-02	108606-02
LABORATORY[a]	ATI		ATI	ATI	BC	ATI	ATI	ATI	ATI
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	---		---	---	---	---	---	---	---
Magnesium	---		---	---	---	---	---	---	---
Sodium	---		---	---	---	---	---	---	---
Potassium	---		---	---	---	---	---	---	---
ANIONS (mg/L)									
Carbonate	---		---	---	---	---	---	---	---
Bicarbonate	---		---	---	---	---	---	---	---
Chloride	390.		350.	350.	374.	390.	370.	340.	400.
Sulfate	---		---	---	---	---	---	---	---
Nitrate	---		---	---	---	---	---	---	---
Fluoride	---		---	---	---	---	---	---	---
Alkalinity (as $CaCO_3$)	---		---	---	---	---	---	---	---
Boron	---		---	---	---	---	---	---	---
Bromide	1.0		0.95	0.99	1.02	1.1	1.0	1.2	1.3
Total Dissolved Solids	1,600.		1,600.	1,630.	1,670.	1,600.	1,600.	1,700.	1,600.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,460.		2,370.	2,410.	2,410.	2,200.	2,620.	2,410.	2,490.
Conductivity, Lab (µmho/cm)	2,310.		2,270.	2,330.	---	2,290.	2,460.	2,327.	2,330.
pH, Field	7.34		7.27	7.18	7.18	7.25	7.14	6.93	7.24
pH, Lab	7.4		7.4	7.8	---	7.9	7.7	7.4	7.4
Temperature (°C)[d]	27.1		25.6	27.7	27.7	27.6	28.1	28.3	27.6

BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE

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TABLE 9. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	08-06-91	09-04-91	09-04-91	10-02-91	11-06-91	12-04-91	01-14-92	02-07-92	03-06-92
FIELD SAMPLE IDENTIFIER		004485	004485	004492	004526	004530	002468	004544	004569
LAB SAMPLE IDENTIFIER		109586-03	9966-3	110529-02	111587-02	112663-02	201695-02	202657-01	203633-02
LABORATORY[a]		ATI	BC	ATI	ATI	ATI	ATI	ATI	ATI
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium		---	208.	---	---	---	---	---	---
Magnesium		---	32.	---	---	---	---	---	---
Sodium		---	270.	---	---	---	---	---	250.
Potassium		---	4.4	---	---	---	---	---	---
ANIONS (mg/L)									
Carbonate		---	ND	---	---	---	---	---	---
Bicarbonate		---	170.	---	---	---	---	---	---
Chloride		370.	385.	380.	340.	380.	370.	380.	360.
Sulfate		---	530.	---	---	---	---	---	---
Nitrate		---	35.4	---	---	---	---	---	---
Fluoride		---	0.68	---	---	---	---	---	---
Alkalinity (as $CaCO_3$)		---	139.	---	---	---	---	---	---
Boron		---	0.74	---	---	---	---	---	---
Bromide	END TRACER TEST AT RESEARCH PROJECT TEST SITE	1.3	0.82	1.0	0.9	1.1	1.1	1.2	1.1
Total Dissolved Solids		1,600.	1,625.	1,600.	1,600.	1,600.	1,600.	1,600.	1,600.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]		2,400.	2,400.	2,300.	2,285.	2,320.	2,300.	2,350.	2,450.
Conductivity, Lab (µmho/cm)		2,330.	2,600.	2,290.	2,260.	2,240.	2,150.	2,190.	2,330.
pH, Field		7.08	7.08	7.10	7.18	7.15	7.20	7.23	7.24
pH, Lab		7.4	7.1	7.4	7.6	7.5	7.5	7.4	7.4
Temperature (°C)[d]		28.9	28.9	28.0	27.5	26.8	26.7	27.2	27.5

TABLE 9. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-23-92	10-02-92	01-11-94	06-21-94	06-14-95	12-12-95	02-12-96	03-18-96	06-11-96
FIELD SAMPLE IDENTIFIER	014881	002772	001175	001356	001541	003379		003753	001748
LAB SAMPLE IDENTIFIER	5646-2	8993-2	94-00413-3	94-06751-3	95-07304-2	95-14818-2		96-03314-5	96-06830-5
LABORATORY[a]	BC	BC	BC	BC	BC	BC		BC	BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	180.	205.	199.	195.	192.	190.		---	---
Magnesium	35.	37.	35.	37.	34.	34.		---	---
Sodium	266.	255.	251.	258.	258.	254.		---	---
Potassium	4.6	4.4	4.6	4.6	4.5	4.3		---	---
ANIONS (mg/L)									
Carbonate	ND	ND	ND	ND	ND	ND		---	---
Bicarbonate	169.	171.	174.	173.	183.	189.		---	---
Chloride	357.	361.	363.	365.	340.	332.		347.	358.
Sulfate	525.	500.	500.	500.	480.	460.		485.	502.
Nitrate	35.4	35.4	33.2	33.2	39.8	31.		---	---
Fluoride	0.7	0.62	0.68	0.68	0.71	0.64		---	---
Alkalinity (as $CaCO_3$)	138.	140.	143.	142.	150.	155.		---	---
Boron	0.81	0.85	0.82	0.84	0.98	0.96		---	---
Bromide	0.89	1.0	0.95	0.85	0.65	0.69		---	---
Total Dissolved Solids	1,590.	1,590.	1,600.	1,660.	1,580.	1,590.		1,540.	1,620.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,420.	2,300.	2,390.	2,425.	2,380.	2,250.		2,180.	2,380.
Conductivity, Lab (µmho/cm)	2,600.	2,600.	2,440.	2,390.	2,360.	2,320.		2,390.	2,320.
pH, Field	7.15	7.18	7.33	7.11	7.12	7.23		7.23	7.15
pH, Lab	7.2	7.4	7.4	7.5	7.7	7.4		7.5	7.6
Temperature (°C)[d]	28.0	27.8	27.2	27.7	28.0	27.4		27.7	28.5

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

[a] BC = BC Laboratories, Inc., Bakersfield, California
ATI = Analytical Technologies, Inc., Phoenix, Arizona

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

--- = Analysis not conducted

ERROL L. MONTGOMERY & ASSOCIATES, INC.

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TABLE 10. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	07-08-89	07-24-89	07-31-89	08-31-89	10-04-89	11-03-89	01-11-90
FIELD SAMPLE IDENTIFIER	4261	4262	4264	4265	4266	14648	4378
LAB SAMPLE IDENTIFIER[a]	5370	5845	5974	6950	7916	8789	410-1
	907092	907316	908017	909028	910116	911074	1163014
TRACE CONSTITUENTS (mg/L)[b]							
Iron	ND	ND	0.065	0.050	ND	ND	ND
Manganese	0.020	0.011	0.010	0.010	ND	ND	0.012
Arsenic	ND	0.024	0.013	0.013	0.012	0.012	0.010
Copper	ND	ND	ND	ND	ND	ND	ND
Zinc	1.83	0.949	0.884	0.937	0.820	0.684	0.277
Barium	ND	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND
Total Chromium	ND	ND	ND	ND	ND	ND	0.010
Lead	ND	ND	ND	ND	ND	ND	ND
Mercury	0.00068	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND
Antimony	ND	ND	ND	ND	ND	ND	ND
Beryllium	ND	ND	ND	ND	ND	ND	ND
Nickel	ND	ND	ND	ND	ND	ND	ND
Thallium	ND	ND	ND	ND	ND	ND	ND
Molybdenum	ND	ND	ND	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND	ND	ND	ND
Aluminum	ND	ND	ND	ND	ND	ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	11.8 ± 8.8	1.0 ± 4.1	4.5 ± 2.9	10 ± 1.89	1.1 ± 6.8	2.8 ± 2.5	16.4 ± 2.3
Gross Beta	15.5 ± 4.0	12.5 ± 1.5	5.6 ± 1.0	15 ± 0.62	2.4 ± 9.7	17.0 ± 0.8	10.6 ± 0.8
ORGANIC CONSTITUENTS (mg/L)[d]							
Kerosene	ND	ND	ND	ND	ND	ND	ND
Volatile Organic Compounds[e]	---	---	---	---	---	---	---

TABLE 10. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	04-12-90	05-08-90	07-10-90	03-05-91	03-14-91	08-06-91	09-04-91
FIELD SAMPLE IDENTIFIER	019933		019964	004438			004485
LAB SAMPLE IDENTIFIER[a]	3453-4		6081-7	3800-3			9966-3
	42000						
TRACE CONSTITUENTS (mg/L)[b]							
Iron	0.306	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	0.082	ND	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	END TRACER TEST AT RESEARCH PROJECT TEST SITE	0.055
Manganese	0.012		0.013	0.011			ND
Arsenic	0.011		0.010	0.012			0.013
Copper	ND		ND	ND			ND
Zinc	0.971		0.620	0.740			0.252
Barium	ND		ND	ND			ND
Cadmium	ND		ND	ND			ND
Total Chromium	ND		0.018	ND			0.010
Lead	ND		ND	ND			ND
Mercury	ND		ND	ND			ND
Selenium	ND		0.002	0.003			ND
Silver	ND		ND	ND			ND
Antimony	ND		ND	ND			ND
Beryllium	ND		ND	ND			ND
Nickel	ND		ND	ND			ND
Thallium	ND		ND	ND			ND
Molybdenum	ND		0.013	ND			ND
Cobalt	ND		ND	ND			ND
Aluminum	ND		ND	ND			ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	10.3 ± 1.7		10.3 ± 2.7	7.5 ± 1.6			9.2 ± 4.9
Gross Beta	3.5 ± 0.7		5.4 ± 0.9	7.6 ± 0.6			7.5 ± 1.7
ORGANIC CONSTITUENTS (mg/L)[d]							
Kerosene	ND		ND	ND			ND
Volatile Organic Compounds[e]	---		ND	---			---

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TABLE 10. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-23-92	10-02-92	01-25-93	06-15-93	01-11-94	06-21-94	06-14-95
FIELD SAMPLE IDENTIFIER	014881	002772	002848	007669	001175	001356	001541
LAB SAMPLE IDENTIFIER[a]	5646-2	8993-2	93-00782-3 936168E-2	93-06047-11 937506E-11	94-00413-3 941102-2	94-06751-3 942308-3	95-07304-2 952393-2
TRACE CONSTITUENTS (mg/L)[b]							
Iron	ND	ND	ND	ND	ND	ND	ND
Manganese	ND	ND	ND	0.015	ND	ND	ND
Arsenic	0.013	0.015	0.0114	0.011	0.013	0.013	0.011
Copper	ND	ND	ND	ND	ND	0.011	ND
Zinc	0.339	0.289	0.345	0.331	0.322	0.540	0.630
Barium	ND	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND
Total Chromium	ND	ND	0.012	ND	0.013	0.018	0.012
Lead	ND	ND	ND	ND	ND	ND	ND
Mercury	ND	ND	ND	ND	ND	ND	ND
Selenium	0.0035	0.0047	0.0029	0.0042	0.0047	0.0042	0.004
Silver	ND	ND	ND	ND	ND	ND	ND
Antimony	NA	ND	ND	ND	ND	ND	ND
Beryllium	NA	ND	ND	ND	ND	ND	ND
Nickel	ND	ND	ND	ND	ND	ND	ND
Thallium	NA	ND	ND	ND	ND	ND	ND
Molybdenum	ND	ND	ND	0.010	ND	0.014	ND
Cobalt	ND	ND	ND	ND	ND	ND	ND
Aluminum	ND	ND	ND	ND	ND	ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	15 ± 5	5 ± 4	24 ± 18	10 ± 11	12 ± 8	21 ± 12	20 ± 13
Gross Beta	15 ± 3	7 ± 3	17 ± 10	19 ± 12	8.8 ± 8.3	19 ± 8	13 ± 9
ORGANIC CONSTITUENTS (mg/L)[d]							
Kerosene	---	---	---	---	---	---	---
Volatile Organic Compounds[e]	---	---	---	---	---	---	---

TABLE 10. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	12-12-95	02-12-96
FIELD SAMPLE IDENTIFIER	003379	
LAB SAMPLE IDENTIFIER[a]	95-14818-2	
	954080-2	
TRACE CONSTITUENTS (mg/L)[b]		
Iron	ND	
Manganese	ND	
Arsenic	0.013	
Copper	ND	
Zinc	0.234	
Barium	ND	
Cadmium	ND	
Total Chromium	0.010	
Lead	ND	
Mercury	ND	
Selenium	0.004	
Silver	ND	
Antimony	ND	
Beryllium	ND	
Nickel	ND	
Thallium	ND	
Molybdenum	ND	
Cobalt	ND	
Aluminum	ND	
RADIOLOGICAL PARAMETERS (pCi/L)[c]		
Gross Alpha	10 ± 10	
Gross Beta	5 ± 13	
ORGANIC CONSTITUENTS (mg/L)[d]		
Kerosene	---	
Volatile Organic Compounds[e]	---	

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

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TABLE 10. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc1[SM-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed prior to 1991, second lab sample identifier refers to analyses conducted by Analytical Technologies, Inc. For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado

[d] Analyses by Analytical Technologies, Inc., San Diego, California, and Tempe, Arizona

[e] U.S. Environmental Protection Agency method 624; compounds considered to be laboratory contaminants are not reported

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

TABLE 11. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	10-15-89	01-15-90	04-11-90	05-08-90	07-06-90	07-10-90	03-05-91	03-05-91	03-05-91
FIELD SAMPLE IDENTIFIER	4268	4380	019931		002149	002152	019961	004436	004436
LAB SAMPLE IDENTIFIER	8172-2	551-1	3453-2		6586-06	8526-01	6081-4	3800-1	103577-01
LABORATORY[a]	BC	BC	BC		ATI	ATI	BC	BC	ATI
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	242.	250.	246.		---	---	245.	248.	---
Magnesium	44.	38.	43.		---	---	45.	44.	---
Sodium	292.	295.	289.		---	---	285.	286.	---
Potassium	4.3	4.3	4.0		---	---	4.1	5.6	---
ANIONS (mg/L)									
Carbonate	ND	ND	ND		---	---	ND	ND	---
Bicarbonate	202.	188.	192.		---	---	193.	213.	---
Chloride	422.	423.	440.		414	411	425.	416.	450.
Sulfate	620.	600.	585.		---	---	625.	630.	---
Nitrate	40.3	41.6	41.2		---	---	42.1	46.5	---
Fluoride	0.33	0.34	0.25		---	---	0.35	0.58	---
Alkalinity (as $CaCO_3$)	166.	154.	158.		---	---	159.	175.	---
Boron	1.0	0.91	---		---	---	1.0	1.1	---
Bromide	1.5	1.3	1.3		<30	1.0	1.31	1.03	1.2
Total Dissolved Solids	1,930.	1,835.	1,850.		1,900.	---	1,835.	1,800.	1,800.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,950	2,400	2,490		2,820	2,560	2,750	2,700.	2,700.
Conductivity, Lab (µmho/cm)	3,000.	2,900.	2,900.		---	---	2,800.	3,000.	2,550.
pH, Field	7.01	7.24	7.23		7.04	7.21	7.09	7.21	7.21
pH, Lab	6.9	7.4	7.5		---	---	7.3	7.5	7.5
Temperature (°C)[d]	29.0	26.3	27.1		27.5	27.1	27.3	26.5	26.5

BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE

TABLE 11. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	03-14-91	03-20-91	04-02-91	04-02-91	05-01-91	06-04-91	07-02-91	08-06-91	08-06-91
FIELD SAMPLE IDENTIFIER		019983	014740	014741	019987	014761	014768	004473	
LAB SAMPLE IDENTIFIER		103832-02	104529-01	4622-1	105555-01	106569-01	107548-01	108606-01	
LABORATORY[a]		ATI	ATI	BC	ATI	ATI	ATI	ATI	
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	---	---	---	---	---	---	---	
Magnesium		---	---	---	---	---	---	---	
Sodium		---	---	---	---	---	---	---	
Potassium		---	---	---	---	---	---	---	
ANIONS (mg/L)									
Carbonate		---	---	---	---	---	---	---	
Bicarbonate		---	---	---	---	---	---	---	
Chloride		380.	400.	410.	420.	420.	420.	400.	
Sulfate		---	---	---	---	---	---	---	
Nitrate		---	---	---	---	---	---	---	
Fluoride		---	---	---	---	---	---	---	
Alkalinity (as $CaCO_3$)		---	---	---	---	---	---	---	
Boron		---	---	---	---	---	---	---	
Bromide		1.0	1.1	1.09	1.3	1.2	1.4	1.1	
Total Dissolved Solids		1,800.	1,780.	1,845.	1,800.	1,800.	1,800.	1,800.	
PARAMETERS									
Conductivity, Field (µmho/cm)[c]		2,520.	2,600.	2,600.	2,350.	2,900.	2,640.	2,675.	
Conductivity, Lab (µmho/cm)		2,450.	2,550.	---	2,510.	2,460.	2,616.	2,560.	
pH, Field		7.20	7.16	7.16	7.19	7.07	7.02	7.06	
pH, Lab		7.4	7.9	---	8.0	7.6	7.4	7.3	
Temperature (°C)[d]		26.2	26.6	26.6	27.0	27.0	27.5	27.1	

TABLE 11. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	08-06-91	08-06-91	09-04-91	09-04-91	10-02-91	11-06-91	12-04-91	01-14-92	02-07-92
FIELD SAMPLE IDENTIFIER	004473		004483	004483	004491	004525	004529	002467	004545
LAB SAMPLE IDENTIFIER	108606-01		109586-01	9966-1	110529-01	111587-01	112663-01	201695-01	202657-02
LABORATORY[a]	ATI		ATI	BC	ATI	ATI	ATI	ATI	ATI
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	---		---	233.	---	---	---	---	---
Magnesium	---		---	42.	---	---	---	---	---
Sodium	---		---	290.	---	---	---	---	---
Potassium	---		---	4.1	---	---	---	---	---
ANIONS (mg/L)									
Carbonate	---		---	ND	---	---	---	---	---
Bicarbonate	---		---	187.	---	---	---	---	---
Chloride	400.		410.	422.	420.	370.	430.	400.	390.
Sulfate	---		---	620.	---	---	---	---	---
Nitrate	---		---	44.3	---	---	---	---	---
Fluoride	---		---	0.56	---	---	---	---	---
Alkalinity (as $CaCO_3$)	---		---	153.	---	---	---	---	---
Boron	---		---	1.0	---	---	---	---	---
Bromide	1.1		1.5	0.99	1.2	1.0	1.4	1.2	1.2
Total Dissolved Solids	1,800.		1,800.	1,860.	1,700.	1,800.	1,800.	1,700.	1,800.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,675.		2,680.	2,680.	2,550.	2,530.	2,525.	2,475	2,500.
Conductivity, Lab (µmho/cm)	2,560.		2,560.	2,900.	2,540.	2,450.	2,420.	2,520	2,420.
pH, Field	7.06		6.95	6.95	7.12	7.02	7.18	7.14	7.13
pH, Lab	7.3		7.3	7.1	7.3	7.6	7.5	7.5	7.4
Temperature (°C)[d]	27.1		27.9	27.9	27.2	26.8	26.5	26.0	24.5

END TRACER TEST AT RESEARCH PROJECT TEST SITE

TABLE 11. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	03-06-92	06-23-92	10-02-92	01-25-93	06-15-93	01-11-94	06-21-94	06-14-95	12-12-95
FIELD SAMPLE IDENTIFIER	004568	014880	002773	002846	007668	001173	001354	001543	003378
LAB SAMPLE IDENTIFIER	203633-01	5646-1	8993-3	93-00782-1	93-06047-10	94-00413-1	94-06751-1	95-07304-4	95-14818-3
LABORATORY[a]	ATI	BC	BC	BC	BC	BC	BC	BC	BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	---	235.	221.	220.	216.	222.	216.	218.	210.
Magnesium	---	39.	40.	38.	38.	38.	41.	37.	37.
Sodium	281.	305.	275.	279.	278.	273.	286.	280.	270.
Potassium	---	4.3	4.0	4.1	4.5	3.9	4.2	4.2	4.0
ANIONS (mg/L)									
Carbonate	---	ND	ND	ND	ND	ND	ND	ND	ND
Bicarbonate	---	190.	195.	197.	201.	198.	203.	210.	212.
Chloride	410.	392.	392.	394.	396.	392.	398.	361.	354.
Sulfate	---	605.	550.	560.	566.	545.	555.	525.	498.
Nitrate	---	42.1	42.1	38.1	39.8	39.8	42.1	48.7	35.4
Fluoride	---	0.52	0.5	0.54	0.52	0.54	0.56	0.54	0.49
Alkalinity (as $CaCO_3$)	---	156.	160.	161.	165.	162.	166.	172.	174.
Boron	---	0.99	1.0	1.1	1.1	1.1	1.0	1.2	1.1
Bromide	1.2	0.97	1.2	1.1	1.0	1.16	1.05	0.73	0.76
Total Dissolved Solids	1,800.	1,820.	1,740.	1,780.	1,810.	1,720.	1,800.	1,720.	1,680.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,550.	2,600.	2,425.	2,500.	2,550.	2,550.	2,600.	2,450.	2,350.
Conductivity, Lab (µmho/cm)	2,520.	2,800.	2,800.	2,800.	2,800.	2,640.	2,630.	2,550.	2,470.
pH, Field	7.17	7.06	7.10	7.25	7.04	7.22	7.08	7.14	7.13
pH, Lab	7.4	7.2	7.4	7.4	7.4	7.6	7.3	7.8	7.3
Temperature (°C)[d]	26.6	27.0	27.1	26.5	27.4	26.5	27.2	27.5	26.5

TABLE 11. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	02-12-96	03-18-96	06-11-96
FIELD SAMPLE IDENTIFIER		003751	001749
LAB SAMPLE IDENTIFIER		96-03314-3	96-06830-6
LABORATORY[a]		BC	BC
CONSTITUENTS			
CATIONS (mg/L)[b]			
Calcium		---	---
Magnesium		---	---
Sodium		---	---
Potassium		---	---
ANIONS (mg/L)			
Carbonate		---	---
Bicarbonate		---	---
Chloride		370.	396.
Sulfate		555.	554.
Nitrate		---	---
Fluoride		---	---
Alkalinity (as $CaCO_3$)		---	---
Boron		---	---
Bromide		---	---
Total Dissolved Solids		1,700.	1,770.
PARAMETERS			
Conductivity, Field (µmho/cm)[c]		2,315.	2,580.
Conductivity, Lab (µmho/cm)		2,460.	2,540.
pH, Field		7.24	7.06
pH, Lab		7.5	7.6
Temperature (°C)[d]		26.9	27.9

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

[a] BC = BC Laboratories, Inc., Bakersfield, California
ATI = Analytical Technologies, Inc., Phoenix, Arizona

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

--- = Analysis not conducted

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741\APP\TABLE.11\08-05-96

TABLE 12. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-2] SANTA CRUZ IN SITU COPPER MINING PROJECT PINAL COUNTY, ARIZONA

DATE SAMPLED	10-15-89	01-15-90	04-11-90	05-08-90	07-10-90	03-05-91	03-14-91
FIELD SAMPLE IDENTIFIER	4268	4380	019931		019961	004436	
LAB SAMPLE IDENTIFIER[a]	8172-2 91024802	551-1 121201	3453-2 420002		69081-4	3800-1	
TRACE CONSTITUENTS (mg/L)[b]							
Iron	0.156	0.122	0.215	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	0.085	ND	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE
Manganese	0.048	0.013	0.010		ND	ND	
Arsenic	ND	ND	0.010		0.009	0.009	
Copper	ND	ND	ND		ND	ND	
Zinc	0.172	0.245	0.125		1.33	0.194	
Barium	ND	ND	ND		ND	ND	
Cadmium	ND	ND	ND		ND	ND	
Total Chromium	ND	ND	ND		ND	ND	
Lead	ND	ND	ND		ND	ND	
Mercury	ND	ND	ND		ND	ND	
Selenium	ND	ND	ND		0.003	0.003	
Silver	ND	ND	ND		ND	ND	
Antimony	ND	ND	ND		ND	ND	
Beryllium	ND	ND	ND		ND	ND	
Nickel	ND	ND	ND		ND	ND	
Thallium	ND	ND	ND		ND	ND	
Molybdenum	ND	ND	ND		ND	ND	
Cobalt	ND	ND	ND		ND	ND	
Aluminum	ND	ND	ND		ND	ND	
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	4.29 ± 4.2	28.0 ± 2.9	20.7 ± 2.4		12.6 ± 3.1	10.8 ± 1.4	
Gross Beta	8.5 ± 3.0	26.9 ± 1.0	10.7 ± 0.8		6.0 ± 1.0	10.4 ± 0.5	
ORGANIC CONSTITUENTS (mg/L)[d]							
Kerosene	ND	ND	ND		ND	ND	
Volatile Organic Compounds[e]	---	---	---		ND	---	

TABLE 12. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED		08-06-91	09-04-91	06-23-92	10-02-92	01-25-93	06-15-93	01-11-94
FIELD SAMPLE IDENTIFIER			004483	014880	002773	002846	007668	001173
LAB SAMPLE IDENTIFIER[a]			9966-1	5646-1	8993-3	93-00782-1 936168E-1	93-06047-10 937506E-10	94-00413-1 941102-1
TRACE CONSTITUENTS (mg/L)[b]								
Iron	END TRACER TEST AT RESEARCH PROJECT TEST SITE		0.065	ND	ND	0.052	ND	ND
Manganese			ND	ND	ND	ND	ND	ND
Arsenic			0.009	0.0089	0.0098	0.008	0.0072	0.0079
Copper			ND	ND	ND	ND	ND	ND
Zinc			0.111	0.172	0.220	0.397	0.372	0.399
Barium			ND	ND	ND	ND	ND	ND
Cadmium			ND	ND	ND	ND	ND	ND
Total Chromium			0.013	ND	ND	ND	ND	ND
Lead			ND	ND	ND	ND	ND	ND
Mercury			ND	ND	0.0002	ND	ND	ND
Selenium			ND	0.0041	0.0046	0.0039	0.0048	0.0056
Silver			ND	ND	ND	ND	ND	ND
Antimony			ND	NA	ND	ND	ND	ND
Beryllium			ND	NA	ND	ND	ND	ND
Nickel			ND	ND	ND	ND	ND	ND
Thallium			ND	NA	ND	ND	ND	ND
Molybdenum			ND	ND	ND	ND	ND	ND
Cobalt			ND	ND	ND	ND	ND	ND
Aluminum			ND	ND	ND	ND	ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]								
Gross Alpha			11.1 ± 5.8	7 ± 4	6 ± 5	18 ± 18	17 ± 15	20 ± 11
Gross Beta			5.5 ± 2.0	11 ± 3	5 ± 3	22 ± 10	11 ± 14	11 ± 9
ORGANIC CONSTITUENTS (mg/L)[d]								
Kerosene			ND	---	---	---	---	---
Volatile Organic Compounds[e]			---	---	---	---	---	---

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TABLE 12. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-21-94	06-14-95	12-12-95	02-12-96
FIELD SAMPLE IDENTIFIER	001354	001543	003378	
LAB SAMPLE IDENTIFIER[a]	94-06751-1	95-07304-4	95-14818-3	
	942308-1	952393-1	954080-3	
TRACE CONSTITUENTS (mg/L)[b]				
Iron	ND	ND	ND	
Manganese	ND	ND	ND	
Arsenic	0.0086	0.0082	0.010	
Copper	ND	ND	ND	
Zinc	0.360	0.550	0.453	
Barium	ND	ND	ND	
Cadmium	ND	ND	ND	
Total Chromium	ND	ND	ND	
Lead	ND	ND	ND	
Mercury	ND	ND	ND	
Selenium	0.004	0.0038	0.0044	
Silver	ND	ND	ND	
Antimony	ND	ND	ND	
Beryllium	ND	ND	ND	
Nickel	ND	ND	ND	
Thallium	ND	ND	ND	
Molybdenum	ND	ND	ND	
Cobalt	ND	ND	ND	
Aluminum	0.052	ND	ND	
RADIOLOGICAL PARAMETERS (pCi/L)[c]				
Gross Alpha	52 ± 17	21 ± 14	21 ± 11	
Gross Beta	20 ± 10	4.2 ± 9.4	5 ± 12	
ORGANIC CONSTITUENTS (mg/L)[d]				
Kerosene	---	---	---	
Volatile Organic Compounds[e]	---	---	---	

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

TABLE 12. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-2].
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed prior to 1991, second lab sample identifier refers to analyses conducted by Analytical Technologies, Inc. For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado.

[d] Analyses by Analytical Technologies, Inc., San Diego, California, and Tempe, Arizona

[e] U.S. Environmental Protection Agency method 624; compounds considered to be laboratory contaminants are not reported

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

TABLE 13. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-3] SANTA CRUZ IN SITU COPPER MINING PROJECT PINAL COUNTY, ARIZONA

DATE SAMPLED	10-15-89	01-15-90	04-11-90	05-08-90	06-05-90	07-06-90	07-10-90	03-05-91	03-05-91
FIELD SAMPLE IDENTIFIER	4267	4381	019932		002150	002153	019962	004437	004437
LAB SAMPLE IDENTIFIER	8172-1	551-2	3453-3		6586-07	8526-02	6081-5	3800-2	103577-02
LABORATORY[a]	BC	BC	BC		ATI	ATI	BC	BC	ATI
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	240.	245.	260.		---	---	240.	250.	---
Magnesium	42.	40.	40.		---	---	44.	43.	---
Sodium	262.	280.	279.		---	---	275.	296.	---
Potassium	4.5	4.9	4.4		---	---	4.4	4.4	---
ANIONS (mg/L)									
Carbonate	ND	ND	ND		---	---	ND	ND	---
Bicarbonate	188.	176.	186.		---	---	188.	198.	---
Chloride	405.	415.	428.		421	367	414.	409.	410.
Sulfate	580.	600.	610.		---	---	600.	615.	---
Nitrate	38.1	41.2	39.0		---	---	39.9	44.3	---
Fluoride	0.38	0.40	0.25		---	---	0.33	0.58	---
Alkalinity (as $CaCO_3$)	572.	144.	153.		---	---	154.	162.	---
Boron	0.89	0.91	---		---	---	1.0	0.99	---
Bromide	1.3	1.2	1.5		<30	0.9	1.37	0.94	1.1
Total Dissolved Solids	1,850.	1,790.	1,900.		1,790	---	1,870.	1,790.	1,800.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,790.	2,300.	2,460.		2,780.	2,670.	2,680.	2,690.	2,690.
Conductivity, Lab (µmho/cm)	2,900.	2,900.	2,800.		---	---	2,700.	2,800.	2,450.
pH, Field	7.02	7.29	7.28		7.12	7.19	7.08	7.31	7.31
pH, Lab	6.8	7.6	7.4		---	---	7.4	7.4	7.4
Temperature (°C)[d]	28.0	26.8	26.4		28.4	28.0	28.1	27.2	27.2

BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE

ERROL L. MONTGOMERY & ASSOCIATES, INC.

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TABLE 13. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-3]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	03-14-91	03-20-91	04-02-91	04-02-91	05-01-91	06-04-91	07-02-91	08-06-91	08-06-91
FIELD SAMPLE IDENTIFIER		019984	014742	014743	019988	014762	014770	004475	
LAB SAMPLE IDENTIFIER		103832-03	104529-02	4622-2	105555-02	106569-02	107548-03	108606-03	
LABORATORY[a]		ATI	ATI	BC	ATI	ATI	ATI	ATI	
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	---	---	---	---	---	---	---	END TRACER TEST AT RESEARCH PROJECT TEST SITE
Magnesium		---	---	---	---	---	---	---	
Sodium		---	---	---	---	---	---	---	
Potassium		---	---	---	---	---	---	---	
ANIONS (mg/L)									
Carbonate		---	---	---	---	---	---	---	
Bicarbonate		---	---	---	---	---	---	---	
Chloride		390.	400.	415.	420.	410.	390.	400.	
Sulfate		---	---	---	---	---	---	---	
Nitrate		---	---	---	---	---	---	---	
Fluoride		---	---	---	---	---	---	---	
Alkalinity (as $CaCO_3$)		---	---	---	---	---	---	---	
Boron		---	---	---	---	---	---	---	
Bromide		1.1	1.2	1.03	1.3	1.2	1.3	1.3	
Total Dissolved Solids		1,800.	1,810.	1,850.	1,800.	1,800.	1,800.	1,800.	
PARAMETERS									
Conductivity, Field (µmho/cm)[c]		2,575.	2,650.	2,650.	2,350.	2,750.	2,560.	2,600.	
Conductivity, Lab (µmho/cm)		2,540.	2,560.	---	2,560.	2,510.	2,535.	2,560.	
pH, Field		7.20	7.17	7.17	7.22	7.16	6.83	7.09	
pH, Lab		7.4	7.8	---	7.9	7.6	7.4	7.3	
Temperature (°C)[d]		26.5	26.9	26.9	27.1	27.6	28.3	27.3	

ERROL L. MONTGOMERY & ASSOCIATES, INC.

TABLE 13. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-3]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	09-04-91	09-04-91	10-02-91	11-06-91	12-04-91	01-14-92	02-07-92	03-06-92	06-23-92
FIELD SAMPLE IDENTIFIER	004484	004484	004493	004527	004531	002471	004546	004570	014882
LAB SAMPLE IDENTIFIER	109586-02	9966-2	110529-03	111587-03	112663-03	201695-04	202657-03	203633-03	5646-3
LABORATORY[a]	ATI	BC	ATI	ATI	ATI	ATI	ATI	ATI	BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	---	250.	---	---	---	---	---	---	230.
Magnesium	---	43.	---	---	---	---	---	---	40.
Sodium	---	290.	---	---	---	---	---	266.	290.
Potassium	---	4.6	---	---	---	---	---	---	4.8
ANIONS (mg/L)									
Carbonate	---	ND	---	---	---	---	---	---	ND
Bicarbonate	---	185.	---	---	---	---	---	---	186.
Chloride	410.	420.	410.	380.	420.	420.	380.	410.	395.
Sulfate	---	625.	---	---	---	---	---	---	580.
Nitrate	---	42.1	---	---	---	---	---	---	42.1
Fluoride	---	0.58	---	---	---	---	---	---	0.58
Alkalinity (as $CaCO_3$)	---	152.	---	---	---	---	---	---	152.
Boron	---	0.94	---	---	---	---	---	---	1.1
Bromide	1.4	0.95	1.2	1.0	1.2	1.2	1.2	1.2	0.97
Total Dissolved Solids	1,800.	1,830.	1,800.	1,800.	1,700.	1,700.	1,800.	1,800.	1,800.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,660.	2,660.	2,450.	2,485.	2,510.	2,500.	2,550.	2,620.	2,620.
Conductivity, Lab (µmho/cm)	2,510.	2,900.	2,520.	2,420.	2,390.	2,380.	2,410.	2,510.	2,900.
pH, Field	6.98	6.98	7.15	7.13	7.14	7.25	7.2	7.14	7.07
pH, Lab	7.3	7.1	7.5	7.6	7.4	7.4	7.4	7.3	7.2
Temperature (°C)[d]	28.0	28.0	27.2	27.3	26.8	25.0	26.0	27.2	27.8

TABLE 13. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-3]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	10-02-92	01-25-93	06-15-93	01-11-94	06-21-94	06-14-95	12-12-95	02-12--96	03-18-96
FIELD SAMPLE IDENTIFIER	002774	002847	007670	001174	001355	001542	003377		003752
LAB SAMPLE IDENTIFIER	8993-4	93-00782-2	93-06047-12	94-00413-2	94-06751-2	95-07304-3	95-14818-4		96-03314-4
LABORATORY[a]	BC	BC	BC	BC	BC	BC	BC		BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	232.	223.	224.	227.	224.	216.	218.		---
Magnesium	41.	38.	38.	38.	41.	37.	37.		---
Sodium	270.	275.	265.	269.	276.	274.	269.		---
Potassium	4.4	4.7	5.1	4.7	4.7	4.6	4.4		---
ANIONS (mg/L)									
Carbonate	ND	ND	ND	ND	ND	ND	ND		---
Bicarbonate	186.	187.	188.	191.	194.	202.	203.		---
Chloride	394.	396.	394.	392.	401.	362.	352.		370.
Sulfate	560.	560.	566.	550.	560.	525.	510.		535.
Nitrate	42.1	38.1	39.8	39.8	40.7	48.7	35.4		---
Fluoride	0.52	0.58	0.56	0.58	0.56	0.58	0.52		---
Alkalinity (as $CaCO_3$)	152.	153.	154.	157.	159.	166.	166.		---
Boron	1.0	1.1	1.1	1.0	0.97	1.1	1.1		---
Bromide	1.1	1.05	1.1	1.13	0.85	0.7	0.91		---
Total Dissolved Solids	1,730.	1,780.	1,770.	1,740.	1,800.	1,720.	1,720.		1,690.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,500.	2,500.	2,570.	2,550.	2,650.	2,500.	2,410.		2,315.
Conductivity, Lab (µmho/cm)	2,800.	2,800.	2,800.	2,630.	2,600.	2,540.	2,480.		2,480.
pH, Field	7.14	7.28	7.10	7.28	7.14	7.21	7.19		7.21
pH, Lab	7.4	7.4	7.5	7.3	7.3	7.8	7.4		7.6
Temperature (°C)[d]	27.4	26.5	27.7	26.6	27.4	27.7	27.1		27.4

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

TABLE 13. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-3]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-13-96
FIELD SAMPLE IDENTIFIER	001747
LAB SAMPLE IDENTIFIER	96-06830-4
LABORATORY[a]	BC
CONSTITUENTS	
CATIONS (mg/L)[b]	
Calcium	---
Magnesium	---
Sodium	---
Potassium	---
ANIONS (mg/L)	
Carbonate	---
Bicarbonate	---
Chloride	382.
Sulfate	550.
Nitrate	---
Fluoride	---
Alkalinity (as $CaCO_3$)	---
Boron	---
Bromide	---
Total Dissolved Solids	1,820.
PARAMETERS	
Conductivity, Field (µmho/cm)[c]	2,540.
Conductivity, Lab (µmho/cm)	2,500.
pH, Field	7.10
pH, Lab	7.6
Temperature (°C)[d]	28.1

[a] BC = BC Laboratories, Inc., Bakersfield, California
ATI = Analytical Technologies, Inc., Phoenix, Arizona

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

--- = Analysis not conducted

741\APP\TABLE.13\08-08-96

TABLE 14. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-3]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	10-15-89	01-15-90	04-11-90	05-08-90	07-10-90	03-05-91	03-14-91
FIELD SAMPLE IDENTIFIER	4267	4381	019932		019962	004437	
LAB SAMPLE IDENTIFIER[a]	8172-1 91024801	551-2 121201	3453-3 420003		6081-5	3800-2	
TRACE CONSTITUENTS (mg/L)[b]							
Iron	0.284	0.065	0.166		0.084	ND	
Manganese	0.012	0.010	ND		0.015	ND	
Arsenic	0.011	ND	0.012		0.009	0.010	
Copper	ND	ND	ND		ND	ND	
Zinc	0.220	0.484	0.414		0.322	0.795	
Barium	ND	ND	ND		ND	ND	
Cadmium	ND	ND	ND		ND	ND	
Total Chromium	ND	ND	ND		0.016	ND	
Lead	ND	ND	ND		ND	ND	
Mercury	ND	ND	ND		ND	ND	
Selenium	ND	ND	ND		0.003	ND	
Silver	ND	ND	ND		ND	ND	
Antimony	ND	ND	ND		ND	ND	
Beryllium	ND	ND	ND		ND	ND	
Nickel	ND	ND	ND		ND	ND	
Thallium	ND	ND	ND		ND	ND	
Molybdenum	ND	ND	ND		ND	ND	
Cobalt	ND	ND	ND		ND	ND	
Aluminum	ND	ND	ND		ND	ND	
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	9.65 ± 6.7	12.7 ± 2.2	17.7 ± 2.1		14.6 ± 3.2	11.5 ± 1.9	
Gross Beta	8.5 ± 3.0	14.5 ± 0.7	11.6 ± 0.7		7.8 ± 1.1	10.8 ± 0.7	
ORGANIC CONSTITUENTS (mg/L)[d]							
Kerosene	ND	ND	ND		ND	ND	
Volatile Organic Compounds[e]	---	---	---		ND	---	

BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE

BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE

741\APP\TABLE.14\08-05-96

ERROL L. MONTGOMERY & ASSOCIATES, INC.

TABLE 14. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-3]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

END TRACER TEST AT RESEARCH PROJECT TEST SITE

DATE SAMPLED	08-06-91	09-04-91	06-23-92	10-02-92	01-25-93	06-15-93	01-11-94
FIELD SAMPLE IDENTIFIER		004484	014882	002774	002847	007670	001174
LAB SAMPLE IDENTIFIER[a]		9966-2	5646-3	8993-4	93-00782-2 936168E-4	93-06047-12 937506E-12	94-00413-2 941102-4
TRACE CONSTITUENTS (mg/L)[b]							
Iron		ND	ND	ND	ND	ND	ND
Manganese		ND	ND	ND	ND	ND	ND
Arsenic		0.011	0.010	0.011	0.0081	0.004	0.0081
Copper		ND	ND	ND	ND	ND	ND
Zinc		0.320	0.642	0.790	0.987	0.956	1.210
Barium		ND	ND	ND	ND	ND	ND
Cadmium		ND	ND	ND	ND	ND	ND
Total Chromium		0.013	ND	ND	ND	ND	ND
Lead		ND	ND	ND	ND	ND	ND
Mercury		ND	ND	0.0002	ND	ND	ND
Selenium		ND	0.004	0.0047	0.0037	0.0052	
Silver		ND	ND	ND	ND	ND	0.0052
Antimony		ND	---	ND	ND	ND	ND
Beryllium		ND	---	ND	ND	ND	ND
Nickel		ND	ND	ND	ND	ND	ND
Thallium		ND	---	ND	ND	ND	ND
Molybdenum		0.010	ND	ND	ND	ND	ND
Cobalt		ND	ND	ND	ND	ND	ND
Aluminum		ND	ND	ND	ND	ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha		9.4 ± 5.3	9 ± 5	ND	16 ± 15	11 ± 13	13 ± 10
Gross Beta		5.7 ± 1.9	8 ± 3	ND	17 ± 8	9 ± 14	11 ± 10
Ra-226				---	0.1 ± 0.5	---	0.9 ± 0.6
Ra-228				---	1.5 ± 1.1	---	1.2 ± 1.1
Rn-222				---	690 ± 160	---	160 ± 410
Uranium (mg/L)				---	0.0189	---	0.0183
ORGANIC CONSTITUENTS (mg/L)[d]							
Kerosene		ND	---	---	---	---	---
Volatile Organic Compounds[e]		---	---	---	---	---	---

TABLE 14. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-3]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-21-94	06-14-95	12-12-95	02-12-96
FIELD SAMPLE IDENTIFIER	001355	001542	003377	
LAB SAMPLE IDENTIFIER[a]	94-06751-2 942283-1 942308-2	95-07304-3 952393-4	95-14818-4 954080-4	
TRACE CONSTITUENTS (mg/L)[b]				
Iron	ND	ND	ND	
Manganese	0.010	ND	ND	
Arsenic	0.0096	0.0076	0.0082	
Copper	ND	ND	ND	
Zinc	1.020	1.810	1.640	
Barium	ND	ND	ND	
Cadmium	ND	ND	ND	
Total Chromium	ND	ND	ND	
Lead	ND	ND	ND	
Mercury	ND	ND	ND	
Selenium	0.0046	0.0032	0.0046	
Silver	ND	ND	ND	
Antimony	ND	ND	ND	
Beryllium	ND	ND	ND	
Nickel	ND	ND	ND	
Thallium	ND	ND	ND	
Molybdenum	ND	ND	ND	
Cobalt	ND	ND	ND	
Aluminum	ND	ND	ND	
RADIOLOGICAL PARAMETERS (pCi/L)[c]				
Gross Alpha	20 ± 12	7 ± 11	13 ± 11	
Gross Beta	12 ± 9	12 ± 10	10 ± 13	
Ra-226	0.3 ± 0.3	0.1 ± 0.4	0.4 ± 0.3	
Ra-228	1.5 ± 1.9	---	---	
Rn-222	390 ± 200	351 ± 433	---	
Uranium (mg/L)	0.0181	0.0181	0.0146	
ORGANIC CONSTITUENTS (mg/L)[d]				
Kerosene	---	---	---	
Volatile Organic Compounds[e]	---	---	---	

BEGIN IN SITU MINING TEST
AT RESEARCH PROJECT TEST SITE

741\APP\TABLE.14\08-05-96

ERROL L. MONTGOMERY & ASSOCIATES, INC.

TABLE 14. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13abc2[SM-3]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed prior to 1991, second lab sample identifier refers to analyses conducted by Analytical Technologies, Inc. For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado.

[d] Analyses by Analytical Technologies, Inc., San Diego, California, and Tempe, Arizona

[e] U.S. Environmental Protection Agency method 624; compounds considered to be laboratory contaminants are not reported

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

TABLE 15. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13aac2[SM-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	10-15-89	01-15-90	04-11-90	05-08-90	07-10-90	03-05-91	03-05-91	03-14-91	06-04-91
FIELD SAMPLE IDENTIFIER	4269	4382	019930		019963	004439	004439		014764
LAB SAMPLE IDENTIFIER	8172-3	551-3	3453-1		6081-6	3800-4	103577-04		106569-04
LABORATORY[a]	BC	BC	BC		BC	BC	ATI		ATI
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	234.	245.	256.		240.	251.	---		---
Magnesium	43.	39.	42.		49.	44.	---		---
Sodium	270.	275.	264.		263.	270.	---		---
Potassium	4.9	5.0	4.5		4.5	4.5	---		---
ANIONS (mg/L)									
Carbonate	ND	ND	ND		ND	ND	---		---
Bicarbonate	188.	183.	188.		184.	200.	---		---
Chloride	401.	398.	428.		402.	407.	410.		400.
Sulfate	600.	600.	600.		605.	620.	---		---
Nitrate	38.1	43.4	19.5		39.9	44.3	---		---
Fluoride	0.37	0.37	0.25		0.32	0.56	---		---
Alkalinity (as $CaCO_3$)	154.	150.	154.		151.	164.	---		---
Boron	0.84	0.78	---		0.90	0.94	---		---
Bromide	1.3	1.2	1.5		1.17	0.91	1.1		1.2
Total Dissolved Solids	1,875.	1,770.	1,890.		1,845.	1,790.	1,700.		1,700.
PARAMETERS									
Conductivity, Field (μmho/cm)[c]	2,750.	2,500.	2,400.		2,640.	2,560.	2,590.		2,625.
Conductivity, Lab (μmho/cm)	2,900.	2,900.	2,800.		2,700.	2,700.	2,310.		2,470.
pH, Field	6.99	7.30	7.07		7.08	7.26	7.26		7.17
pH, Lab	7.0	7.4	7.4		7.3	7.4	7.5		7.5
Temperature (°C)[d]	29.0	26.3	27.5		27.4	25.9	25.9		26.8

BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE

BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE

ERROL L. MONTGOMERY & ASSOCIATES, INC.

741\APP\TABLE.15\08-05-96

TABLE 15. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13aac2[SM-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	08-06-91	09-04-91	09-04-91	01-14-92	07-01-92	01-25-93	06-15-93	01-11-94	06-21-94
FIELD SAMPLE IDENTIFIER		004486	004486	002470	014886	002849	007672	001176	001358
LAB SAMPLE IDENTIFIER		109568-04	9966-4	201695-03	5977-1	93-00782-4	93-06047-14	94-00413-4	94-06751-5
LABORATORY[a]		ATI	BC	ATI	BC	BC	BC	BC	BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium		---	230.	---	245.	228.	222.	222.	216.
Magnesium		---	41.	---	41.	39.	39.	40.	41.
Sodium		---	270.	---	272.	264.	266.	256.	266.
Potassium		---	5.4	---	4.7	4.8	5.3	4.9	4.8
ANIONS (mg/L)									
Carbonate		---	ND	---	ND	ND	ND	ND	ND
Bicarbonate		---	187.	---	192.	187.	191.	188.	192.
Chloride		390.	415.	360	391.	391.	390.	387.	384.
Sulfate		---	595.	---	605.	560.	564.	545.	540.
Nitrate		---	42.1	---	35.4	39.8	39.8	39.8	39.8
Fluoride		---	0.56	---	0.56	0.56	0.54	0.56	0.56
Alkalinity (as $CaCO_3$)		---	153.	---	---	153.	157.	154.	157.
Boron		---	0.80	---	0.94	1.0	0.98	0.94	1.1
Bromide		1.4	0.94	1.2	1.1	1.0	0.96	1.11	1.0
Total Dissolved Solids		1,800.	1,810.	1,700.	1,720.	1,820.	1,790.	1,710.	1,750.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	END TRACER TEST AT RESEARCH PROJECT TEST SITE	2,620.	2,620.	2,500.	2,550.	2,500.	2,500.	2,550.	2,600.
Conductivity, Lab (µmho/cm)		2,470.	2,800.	2,280.	2,800.	2,700.	2,700.	2,600.	2,510.
pH, Field		6.94	6.94	7.16	7.18	7.15	7.13	7.18	7.12
pH, Lab		7.3	7.1	7.4	7.5	7.5	7.4	7.4	7.3
Temperature (°C)[d]		27.8	27.8	25.6	27.1	26.5	27.5	26.4	27.2

TABLE 15. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13aac2[SM-4] SANTA CRUZ IN SITU COPPER MINING PROJECT PINAL COUNTY, ARIZONA

DATE SAMPLED	06-14-95	12-12-95	02-12-96	03-18-96	06-11-96
FIELD SAMPLE IDENTIFIER	001540	003380		003754	001744
LAB SAMPLE IDENTIFIER	95-07304-1	95-14818-1		96-00314-6	96-06830-1
LABORATORY[a]	BC	BC		BC	BC
CONSTITUENTS					
CATIONS (mg/L)[b]					
Calcium	218.	218		---	---
Magnesium	38.	38		---	---
Sodium	272.	266		---	---
Potassium	4.9	4.6		---	---
ANIONS (mg/L)					
Carbonate	ND	ND		---	---
Bicarbonate	204.	209		---	---
Chloride	362.	370		372.	390.
Sulfate	515.	512		520.	546.
Nitrate	48.7	39.9		---	---
Fluoride	0.58	0.52		---	---
Alkalinity (as $CaCO_3$)	167.	171		---	---
Boron	1.1	1.1		---	---
Bromide	0.79	0.9		---	---
Total Dissolved Solids	1,590.	1,720.		1,700.	1,740.
PARAMETERS					
Conductivity, Field (µmho/cm)[c]	2,480.	2,350.		2,310.	2,510.
Conductivity, Lab (µmho/cm)	2,100.	2,480.		2,460.	2,490.
pH, Field	7.10	7.15		7.08	6.98
pH, Lab	7.7	7.3		7.5	7.4
Temperature (°C)[d]	27.5	26.5		27.0	28.0

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

[a] BC = BC Laboratories, Inc., Bakersfield, California
ATI = Analytical Technologies, Inc., Phoenix, Arizona

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

--- = Analysis not conducted

741\APP\TABLE.15\08-05-96

TABLE 16. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13aac2[SM-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	10-15-89	01-15-90	04-11-90	05-08-90	07-10-90	03-05-91	03-14-91
FIELD SAMPLE IDENTIFIER	4269	4382	019930		019963	004439	
LAB SAMPLE IDENTIFIER[a]	8172-3 91024803	551-3 121203	3453-1 420001		6081-6	3800-4	
TRACE CONSTITUENTS (mg/L)[b]							
Iron	0.260	0.054	0.106		0.057	ND	
Manganese	ND	0.010	ND		0.015	ND	
Arsenic	0.013	ND	0.012		0.010	0.011	
Copper	ND	ND	ND		ND	ND	
Zinc	0.207	0.336	0.389		0.342	0.391	
Barium	ND	ND	ND		ND	ND	
Cadmium	ND	ND	ND		ND	ND	
Total Chromium	ND	ND	0.012		0.012	ND	
Lead	ND	ND	ND		ND	ND	
Mercury	ND	ND	ND		ND	ND	
Selenium	ND	ND	ND		0.003	0.003	
Silver	ND	ND	ND		ND	ND	
Antimony	ND	ND	ND		ND	ND	
Beryllium	ND	ND	ND		ND	ND	
Nickel	ND	ND	ND		ND	ND	
Thallium	ND	ND	ND		ND	ND	
Molybdenum	ND	ND	ND		ND	ND	
Cobalt	ND	ND	ND		ND	ND	
Aluminum	ND	ND	ND		ND	ND	
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	19.5 ± 8.5	15.0 ± 2.3	10.3 ± 1.7		16.0 ± 3.3	12.9 ± 2.0	
Gross Beta	10.4 ± 3.1	10.4 ± 0.8	3.5 ± 0.7		<0.5 ± 1.1	11.3 ± 0.7	
ORGANIC CONSTITUENTS (mg/L)[d]							
Kerosene	ND	ND	ND		ND	ND	
Volatile Organic Compounds[e]	---	---	---		ND	---	

BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE

BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE

741\APP\TABLE.16\08-05-96

ERROL L. MONTGOMERY & ASSOCIATES, INC.

TABLE 16. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13aac2[SM-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	08-06-91	9-04-91	07-01-92	01-25-93	06-15-93	01-11-94	06-21-94
FIELD SAMPLE IDENTIFIER		004486	014886	002849	007672	001176	001358
LAB SAMPLE IDENTIFIER[a]		9966-4	5977-1	93-00782-4 936168E-3	93-06047-14 937506E-14	94-00413-4 941102-3	94-06751-5 942308-5
TRACE CONSTITUENTS (mg/L)[b]							
Iron	END TRACER TEST AT RESEARCH PROJECT TEST SITE	ND	ND	ND	ND	ND	ND
Manganese		ND	ND	ND	ND	ND	ND
Arsenic		0.011	0.012	0.0096	0.0094	0.0094	0.013
Copper		ND	ND	ND	ND	ND	ND
Zinc		0.335	0.375	0.527	0.414	0.270	0.400
Barium		ND	ND	ND	ND	ND	ND
Cadmium		ND	ND	ND	ND	ND	ND
Total Chromium		ND	ND	ND	0.011	ND	ND
Lead		ND	ND	ND	ND	ND	ND
Mercury		ND	ND	ND	ND	ND	ND
Selenium		ND	0.003	0.0034	0.0044	0.005	0.005
Silver		ND	ND	ND	ND	ND	ND
Antimony		ND	ND	ND	ND	ND	ND
Beryllium		ND	---	ND	ND	ND	ND
Nickel		ND	ND	ND	ND	ND	ND
Thallium		ND	---	ND	ND	ND	ND
Molybdenum		ND	ND	ND	ND	ND	ND
Cobalt		ND	ND	ND	ND	ND	ND
Aluminum		ND	ND	ND	ND	ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha		12.3 ± 5.8	13 ± 5	25 ± 19	37 ± 21	19 ± 9	35 ± 15
Gross Beta		8.1 ± 2.0	5 ± 3	18 ± 10	21 ± 19	12 ± 7	24 ± 10
ORGANIC CONSTITUENTS (mg/L)[d]							
Kerosene		ND	---	---	---	---	---
Volatile Organic Compounds[e]		---	---	---	---	---	---

TABLE

SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13aac2[SM-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-14-95	12-12-95	02-12-96
FIELD SAMPLE IDENTIFIER	001540	003380	
LAB SAMPLE IDENTIFIER[a]	95-07304-1 952393-3	95-14818-1 954080-1	
TRACE CONSTITUENTS (mg/L)[b]			
Iron	ND	ND	
Manganese	ND	ND	
Arsenic	0.0074	0.011	
Copper	ND	ND	
Zinc	0.570	0.358	
Barium	ND	ND	
Cadmium	ND	ND	
Total Chromium	ND	ND	
Lead	ND	ND	
Mercury	ND	ND	
Selenium	0.0036	0.0044	
Silver	ND	ND	
Antimony	ND	ND	
Beryllium	ND	ND	
Nickel	ND	ND	
Thallium	ND	ND	
Molybdenum	ND	ND	
Cobalt	ND	ND	
Aluminum	ND	ND	
RADIOLOGICAL PARAMETERS (pCi/L)[c]			
Gross Alpha	25 ± 13	22 ± 10	
Gross Beta	12 ± 9	11 ± 11	
ORGANIC CONSTITUENTS (mg/L)[d]			
Kerosene	---	---	
Volatile Organic Compounds[e]	---	---	

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

741\APP\TABLE.16\08-05-96

TABLE 16. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM GROUNDWATER MONITOR WELL (D-6-4)13aac2[SM-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed prior to 1991, second lab sample identifier refers to analyses conducted by Analytical Technologies, Inc. For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado.

[d] Analyses by Analytical Technologies, Inc., San Diego, California, and Tempe, Arizona

[e] U.S. Environmental Protection Agency method 624; compounds considered to be laboratory contaminants are not reported

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

TABLE 17. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)11ddc1
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-20-89	05-08-90	07-10-90	03-14-91	08-06-91	04-28-92	07-01-92	06-14-93	06-22-94
FIELD SAMPLE IDENTIFIER	004258		019959			014842	014888	007663	001366
LAB SAMPLE IDENTIFIER	4923-2		6081-2			3878-3	5977-3	93-06047-5	94-06751-13
LABORATORY[a]	BC		BC			BC	BC	BC	BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	242.		245.			247.	255.	233.	229.
Magnesium	45.		50.			46.	45.	43.	45.
Sodium	245.		260.			282.	284.	264.	270.
Potassium	3.7		3.4			3.5	3.6	3.9	3.5
ANIONS (mg/L)									
Carbonate	ND		ND			ND	ND	ND	ND
Bicarbonate	152.		152.			165.	158.	149.	152.
Chloride	442.		469.			456.	448.	442.	441.
Sulfate	500.		550.			575.	576.	566.	560.
Nitrate	48.7		53.2			39.8	39.0	39.8	42.1
Fluoride	0.78		0.63			0.9	0.92	0.9	0.88
Alkalinity (as $CaCO_3$)	125.		125.			135.	129.	122.	125.
Boron	0.72		0.76			0.83	0.82	0.88	0.72
Bromide	---		1.72			1.5	1.3	1.4	1.35
Total Dissolved Solids	1,785.		1,960.			1,860.	1,890.	1,840.	1,790.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,100.		2,770.			2,750.	2,780.	2,700.	2,750.
Conductivity, Lab (µmho/cm)	2,700.		2,800.			2,900.	3,000.	2,900.	2,660.
pH, Field	7.25		7.25			7.14	7.18	7.26	7.24
pH, Lab	7.6		7.4			7.6	7.5	7.5	7.4
Temperature (°C)[d]	28.4		28.3			28.2	28.2	28.2	28.1

BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE

BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE

END TRACER TEST AT RESEARCH PROJECT TEST SITE

741\APP\TABLE.17\08-05-96

TABLE 17. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)11ddc1 SANTA CRUZ IN SITU COPPER MINING PROJECT PINAL COUNTY, ARIZONA

DATE SAMPLED	06-28-95	02-12-96	06-18-96
FIELD SAMPLE IDENTIFIER	003413		002747
LAB SAMPLE IDENTIFIER	95-08021-8		96-07218-5
LABORATORY[a]	BC		BC
CONSTITUENTS			
CATIONS (mg/L)[b]			
Calcium	230.		228.
Magnesium	43.		41.
Sodium	270.		268.
Potassium	3.6		3.5
ANIONS (mg/L)			
Carbonate	ND		6.8
Bicarbonate	159.		159.
Chloride	398.		436.
Sulfate	520.		574.
Nitrate	44.3		48.7
Fluoride	0.9		0.86
Alkalinity (as $CaCO_3$)	130.		142.
Boron	0.9		0.92
Bromide	1.1		1.1
Total Dissolved Solids	1,820.		1,760.
PARAMETERS			
Conductivity, Field (µmho/cm)[c]	2,510.		2,610.
Conductivity, Lab (µmho/cm)	2,640.		2,650.
pH, Field	7.12		7.14
pH, Lab	7.8		8.4
Temperature (°C)[d]	28.4		28.0

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

[a] BC = BC Laboratories, Inc., Bakersfield, California

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

--- = Analyses not conducted

741\APP\TABLE.17\08-05-96

TABLE 18. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)11ddc1
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-20-89	05-08-90	07-10-90	03-14-91	08-06-91	04-28-92	07-01-92
FIELD SAMPLE IDENTIFIER	004258		109959			014842	014888
LAB SAMPLE IDENTIFIER[a]	4923-2		6081-2			3878-3	5977-3
TRACE CONSTITUENTS (mg/L)[b]							
Iron	ND	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	ND	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	END TRACER TEST AT RESEARCH PROJECT TEST SITE	ND	ND
Manganese	ND		ND			ND	ND
Arsenic	0.016		0.015			0.0174	0.016
Copper	ND		ND			ND	ND
Zinc	ND		ND			ND	ND
Barium	ND		ND			ND	ND
Cadmium	ND		ND			ND	ND
Total Chromium	ND		ND			ND	ND
Lead	ND		ND			ND	ND
Mercury	ND		ND			ND	ND
Selenium	ND		0.003			0.0028	0.003
Silver	ND		ND			ND	ND
Antimony	ND		ND			---	ND
Beryllium	ND		ND			---	---
Nickel	ND		ND			ND	ND
Thallium	ND		ND			---	---
Molybdenum	ND		ND			ND	ND
Cobalt	ND		ND			ND	ND
Aluminum	0.078		ND			ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	1.2 ± 5.4		5.4 ± 2.3			11 ± 6	5 ± 4
Gross Beta	3.4 ± 2.2		7.8 ± 0.9			7 ± 3	5 ± 3

TABLE 18. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)11ddc1
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-14-93	06-22-94	06-28-95	02-12-96	06-18-96
FIELD SAMPLE IDENTIFIER	007663	001366	003413		002747
LAB SAMPLE IDENTIFIER[a]	93-06047-5 937506E-5	94-06751-13 942308-13	95-08021-8 952560-8		96-07128-5 962351-5
TRACE CONSTITUENTS (mg/L)[b]					
Iron	ND	ND	ND		ND
Manganese	ND	ND	ND		ND
Arsenic	0.015	0.018	0.017		0.015
Copper	ND	ND	ND		ND
Zinc	ND	ND	ND		ND
Barium	ND	ND	ND		ND
Cadmium	ND	ND	ND		ND
Total Chromium	0.013	0.014	0.014		0.010
Lead	ND	ND	ND		ND
Mercury	ND	ND	ND		ND
Selenium	0.005	0.0052	0.0046		0.0044
Silver	ND	ND	ND		ND
Antimony	ND	ND	ND		ND
Beryllium	ND	ND	ND		ND
Nickel	ND	ND	ND		ND
Thallium	ND	ND	ND		ND
Molybdenum	0.016	ND	ND		ND
Cobalt	ND	ND	ND		ND
Aluminum	ND	ND	ND		ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]					
Gross Alpha	18 ± 15	34 ± 15	21 ± 14		16 ± 11
Gross Beta	17 ± 15	21 ± 11	3 ± 12		7 ± 13

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

TABLE 18. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)11ddc1
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado.

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

TABLE 19. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM DOMESTIC WELL (D-6-4)12bcc1
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	05-12-92	07-14-92	06-14-93	06-22-94	06-28-95	02-12-96
FIELD SAMPLE IDENTIFIER	002697	002733	007665	001364	003412	
LAB SAMPLE IDENTIFIER	4295-1	6296-1	93-06047-7	94-06751-11	95-08021-9	
LABORATORY[a]	BC	BC	BC	BC	BC	
CONSTITUENTS						
CATIONS (mg/L)[b]						
Calcium	105.	120.	120.	126.	146.	
Magnesium	19.4	20.	22.	25.	26.	
Sodium	185.	177.	174.	179.	182.	
Potassium	3.0	3.1	3.5	3.2	3.3	
ANIONS (mg/L)						
Carbonate	ND	ND	ND	ND	ND	
Bicarbonate	139.	133.	131.	127.	129.	
Chloride	238.	252.	270.	284.	293.	
Sulfate	255.	265.	274.	280.	294.	
Nitrate	22.1	22.1	24.3	24.3	31.	
Fluoride	1.2	1.1	1.2	1.2	1.2	
Alkalinity (as $CaCO_3$)	114.	109.	107.	104.	106.	
Boron	0.35	0.31	0.33	0.34	0.36	
Bromide	0.67	1.1	0.89	0.95	0.90	
Total Dissolved Solids	930.	1,010.	1,070.	1,060.	1,190.	
PARAMETERS						
Conductivity, Field (µmho/cm)[c]	1,610.	1,700.	1,700.	1,790.	1,700.	
Conductivity, Lab (µmho/cm)	1,490.	1,550.	1,620.	1,690.	1,800.	
pH, Field	7.50	7.54	7.44	7.47	7.28	
pH, Lab	7.7	7.8	7.7	7.6	8.0	
Temperature (°C)[d]	29.0	29.4	29.2	29.2	29.3	

BEGIN IN SITU MINING TEST
AT RESEARCH PROJECT TEST SITE

[a] BC = BC Laboratories, Inc., Bakersfield, California

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

741\APP\TABLE.19\08-08-96

TABLE 20. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM DOMESTIC WELL (D-6-4)12bcc1
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	05-12-92	07-14-92	06-14-93	06-22-94	06-28-95	02-12-96
FIELD SAMPLE IDENTIFIER	002697	002733	007665	001364	003412	
LAB SAMPLE IDENTIFIER[a]	4295-1	6296-1	93-06047-7 937506E-7	94-06751-11 942308-11	95-08021-9 952560-9	
TRACE CONSTITUENTS (mg/L)[b]						
Iron	ND	ND	ND	ND	ND	
Manganese	ND	ND	ND	ND	ND	
Arsenic	0.017	0.015	0.015	0.017	0.015	
Copper	ND	ND	ND	ND	ND	
Zinc	ND	ND	ND	ND	ND	
Barium	ND	ND	ND	ND	ND	
Cadmium	ND	ND	ND	ND	ND	
Total Chromium	ND	ND	0.020	0.014	0.015	
Lead	ND	ND	ND	ND	ND	
Mercury	ND	ND	ND	ND	ND	
Selenium	ND	ND	0.0026	0.0024	0.002	
Silver	ND	ND	ND	ND	ND	
Antimony	---	ND	ND	ND	ND	
Beryllium	---	---	ND	ND	ND	
Nickel	ND	ND	ND	ND	ND	
Thallium	---	---	ND	ND	ND	
Molybdenum	0.012	ND	0.019	0.013	ND	
Cobalt	ND	ND	ND	ND	ND	
Aluminum	ND	ND	ND	ND	ND	
RADIOLOGICAL PARAMETERS (pCi/L)[c]						
Gross Alpha	0 ± 2	2 ± 2	2.9 ± 7.3	4.4 ± 6.1	4.3 ± 7.5	
Gross Beta	0 ± 3	3 ± 3	5 ± 10	5.5 ± 5.6	6.1 ± 7.8	

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

TABLE 20. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM DOMESTIC WELL (D-6-4)12bcc1
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado.

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

TABLE 21. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)12bcc2
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-27-89	05-08-90	09-13-90	03-14-91	08-06-91	05-12-92	07-14-92	06-14-93	06-22-94
FIELD SAMPLE IDENTIFIER	004260		019976			002698	002734	007666	001365
LAB SAMPLE IDENTIFIER	5158-1		8193-1			4295-2	6296-2	93-06047-8	94-06751-12
LABORATORY[a]	BC		BC			BC	BC	BC	BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	144.		134.			103.	110.	100.	116.
Magnesium	26.		25.			18.1	18.8	18.5	23.
Sodium	178.		200.			173.	175.	172.	183.
Potassium	3.9		4.6			4.2	4.6	5.	4.2
ANIONS (mg/L)									
Carbonate	ND		ND			ND	ND	ND	ND
Bicarbonate	145.		152.			133.	137.	137.	128.
Chloride	268.		293.			234.	230.	233.	264.
Sulfate	304.		300.			260.	258.	255.	265.
Nitrate	32.3		35.4			20.4	18.6	17.7	23.
Fluoride	0.99		1.0			1.4	1.4	1.5	1.3
Alkalinity (as $CaCO_3$)	118.		125.			109.	112.	112.	105.
Boron	0.44		0.36			0.4	0.38	0.37	0.31
Bromide	---		1.81			0.68	0.73	0.7	0.8
Total Dissolved Solids	1,110.		1,110.			950.	950.	980.	1,040.
PARAMETERS									
Conductivity, Field (μmho/cm)[c]	2,000.		1,790.			1,610.	1,600.	1,610.	1,725.
Conductivity, Lab (μmho/cm)	1,700.		1,750.			1,490.	1,480.	1,480.	1,630.
pH, Field	7.85		7.39			7.38	7.48	7.35	7.44
pH, Lab	7.6		8.0			7.7	7.8	7.7	7.6
Temperature (°C)[d]	29.3		29.6			29.6	29.7	30.1	29.5

BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE

BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE

END TRACER TEST AT RESEARCH PROJECT TEST SITE

ERROL L. MONTGOMERY & ASSOCIATES, INC.

741\APP\TABLE.21\08-05-96

TABLE 21. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)12bcc2
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-28-95	02-12-96	06-18-96
FIELD SAMPLE IDENTIFIER	003411		002748
LAB SAMPLE IDENTIFIER	95-08021-10		96-07218-4
LABORATORY[a]	BC		BC
CONSTITUENTS			
CATIONS (mg/L)[b]			
Calcium	141.		119.
Magnesium	26.		22.
Sodium	184.		178.
Potassium	3.9		4.3
ANIONS (mg/L)			
Carbonate	ND		6.8
Bicarbonate	131.		120.
Chloride	292.		277.
Sulfate	288.		287.
Nitrate	31.		23.
Fluoride	1.2		1.3
Alkalinity (as $CaCO_3$)	107.		110.
Boron	0.37		0.38
Bromide	0.92		0.75
Total Dissolved Solids	1,170.		1,020.
PARAMETERS			
Conductivity, Field (µmho/cm)[c]	1,700.		1,562.
Conductivity, Lab (µmho/cm)	1,800.		1,650.
pH, Field	7.27		7.56
pH, Lab	7.9		8.3
Temperature (°C)[d]	29.5		30.0

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

[a] BC = BC Laboratories, Inc., Bakersfield, California

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

--- = Analysis not conducted

TABLE 22. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)12bcc2
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-27-89	05-08-90	09-13-90	03-14-91	08-06-91	05-12-92	07-14-92
FIELD SAMPLE IDENTIFIER	004260		019976			002698	002734
LAB SAMPLE IDENTIFIER[a]	5158-1		8193-1			4295-2	6296-2
TRACE CONSTITUENTS (mg/L)[b]							
Iron	0.059	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	ND	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	END TRACER TEST AT RESEARCH PROJECT TEST SITE	ND	ND
Manganese	ND		ND			ND	ND
Arsenic	0.016		0.010			0.013	0.012
Copper	ND		ND			ND	ND
Zinc	ND		ND			ND	ND
Barium	---		ND			ND	ND
Cadmium	ND		ND			ND	ND
Total Chromium	0.011		0.010			ND	ND
Lead	ND		ND			ND	ND
Mercury	0.0006		ND			ND	ND
Selenium	ND		ND			ND	ND
Silver	ND		ND			ND	ND
Antimony	ND		ND			---	ND
Beryllium	ND		ND			---	---
Nickel	ND		ND			ND	ND
Thallium	ND		ND			---	---
Molybdenum	ND		0.019			0.021	0.021
Cobalt	ND		ND			ND	ND
Aluminum	ND		ND			ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	6.2 ± 4.8		1.2 ± 0.5			0 ± 2	3 ± 2
Gross Beta	17.3 ± 2.1		0.8 ± 0.1			6 ± 3	20 ± 4

TABLE 22. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)12bcc2
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-14-93	06-22-94	06-28-95	02-12-96	06-18-96
FIELD SAMPLE IDENTIFIER	007666	001365	003411		002748
LAB SAMPLE IDENTIFIER[a]	93-06047-8 937506E-8	94-06751-12 942308-12	95-08021-10 952560-10		96-07218-4 962351-4
TRACE CONSTITUENTS (mg/L)[b]					
Iron	ND	ND	ND	BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE	ND
Manganese	ND	ND	ND		ND
Arsenic	0.011	0.013	0.013		0.014
Copper	ND	ND	ND		ND
Zinc	ND	ND	ND		ND
Barium	ND	ND	ND		ND
Cadmium	ND	ND	ND		ND
Total Chromium	0.012	0.013	0.011		ND
Lead	ND	ND	ND		ND
Mercury	ND	ND	ND		ND
Selenium	0.002	0.0022	0.002		ND
Silver	ND	ND	ND		ND
Antimony	ND	ND	ND		ND
Beryllium	ND	ND	ND		ND
Nickel	ND	ND	ND		ND
Thallium	ND	ND	ND		ND
Molybdenum	0.027	0.016	0.011		ND
Cobalt	ND	ND	ND		ND
Aluminum	ND	ND	ND		ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]					
Gross Alpha	34 ± 16	11 ± 9	15 ± 9		1.0 ± 5.0
Gross Beta	10 ± 13	6.1 ± 9.4	6.7 ± 7.9		21 ± 8

TABLE 22. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)12bcc2
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado.

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

TABLE 23. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM PROCESS WATER WELL (D-6-4)13bcb[PW-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	05-08-90	08-09-90	03-05-91	03-14-91	08-06-91	01-14-92	03-06-92	04-29-92	06-23-92
FIELD SAMPLE IDENTIFIER		019973	004440			002469	004571	014846	014883
LAB SAMPLE IDENTIFIER		7113-1	3800-5			464-1	2242-1	3878-1	5646-4
LABORATORY[a]		BC	BC			BC	BC	BC	BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	312.	276.	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	END TRACER TEST AT RESEARCH PROJECT TEST SITE	260.	264.	255.	245.
Magnesium		46.	50.			44.	47.	49.	43.
Sodium		290.	312.			310.	292.	320.	316.
Potassium		3.9	3.8			3.9	3.7	3.8	4.0
ANIONS (mg/L)									
Carbonate		ND	ND			ND	ND	ND	ND
Bicarbonate		197.	202.			200.	188.	209.	193.
Chloride		457.	466.			432.	450.	464.	440.
Sulfate		720.	705.			630.	640.	624.	640.
Nitrate		51.4	53.2			48.7	47.8	53.1	48.7
Fluoride		0.26	0.48			0.57	0.50	0.44	0.50
Alkalinity (as $CaCO_3$)		161.	166.			---	---	171.	158.
Boron		---	1.2			---	---	1.0	0.95
Bromide		1.5	1.15			1.2	1.1	1.2	1.1
Total Dissolved Solids		1,920.	1,990.			1,930.	1,950.	2,020.	1,940.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]		2,950	2,910.			2,800.	2,800.	2,875.	2,800.
Conductivity, Lab (µmho/cm)		3,100.	3,000.			3,000.	3,000.	3,000.	3,000.
pH, Field		7.17	7.34			7.21	7.15	7.04	7.19
pH, Lab		7.5	7.4			7.1	7.5	7.6	7.2
Temperature (°C)[d]		27.5	26.			25.7	26.9	27.6	27.5

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741\APP\TABLE.23\08-05-96

TABLE 23. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM PROCESS WATER WELL (D-6-4)13bcb[PW-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	10-02-92	06-15-93	06-21-94	06-28-95	02-12-96	06-19-96
FIELD SAMPLE IDENTIFIER	002771	007671	001357	003420		002739
LAB SAMPLE IDENTIFIER	8993-1	93-06047-13	94-06751-4	95-08021-1		96-07218-13
LABORATORY[a]	BC	BC	BC	BC		BC
CONSTITUENTS						
CATIONS (mg/L)[b]						
Calcium	230.	241.	233.	236.		226.
Magnesium	49.	43.	45.	43.		41.
Sodium	305.	299.	311.	290.		302.
Potassium	3.9	4.2	3.8	3.9		3.7
ANIONS (mg/L)						
Carbonate	ND	ND	ND	ND		15.4
Bicarbonate	192.	189.	191.	203.		187.
Chloride	444.	446.	452.	412.		440.
Sulfate	615.	612.	600.	620.		610.
Nitrate	48.7	44.3	53.1	53.2		44.3
Fluoride	0.47	0.48	0.50	0.49		0.46
Alkalinity (as $CaCO_3$)	157.	155.	157.	166.		179.
Boron	1.1	1.1	1.3	1.1		1.3
Bromide	1.4	1.2	1.2	1.0		1.1
Total Dissolved Solids	1,940.	1,960.	1,960.	1,940.		1,880.
PARAMETERS						
Conductivity, Field (µmho/cm)[c]	2,675.	2,800.	2,950.	2,590.		2,860.
Conductivity, Lab (µmho/cm)	3,000.	3,000.	2,830.	2,710.		2,780.
pH, Field	7.16	7.21	7.09	6.94		7.19
pH, Lab	7.4	7.5	7.4	7.7		8.4
Temperature (°C)[d]	27.1	27.5	27.1	27.2		27.0

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

[a] BC = BC Laboratories, Inc., Bakersfield, California

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

--- = Analysis not conducted

TABLE 24. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM PROCESS WATER WELL (D-6-4)13bcb[PW-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	05-08-90	08-09-90	03-05-91	03-14-91	08-06-91	04-29-92	06-23-92
FIELD SAMPLE IDENTIFIER		019973	004440			014846	014833
LAB SAMPLE IDENTIFIER[a]		7113-1	3800-5			014847	5646-4
						3878-7	
						204978-01	
TRACE CONSTITUENTS (mg/L)[b]							
Iron	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	ND	ND	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	END TRACER TEST AT RESEARCH PROJECT TEST SITE	ND	ND
Manganese		0.016	ND			ND	ND
Arsenic		0.009	0.012			0.0098	0.0096
Copper		ND	ND			ND	ND
Zinc		0.718	0.366			0.449	0.412
Barium		ND	ND			ND	ND
Cadmium		ND	ND			ND	ND
Total Chromium		ND	ND			ND	ND
Lead		ND	ND			ND	ND
Mercury		ND	ND			ND	ND
Selenium		0.003	0.003			0.0026	0.005
Silver		---	ND			ND	ND
Antimony		ND	ND			---	---
Beryllium		ND	ND			---	---
Nickel		ND	ND			ND	ND
Thallium		ND	ND			---	---
Molybdenum		ND	ND			ND	ND
Cobalt		ND	ND			ND	ND
Aluminum		0.093	ND			ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha		6.6 ± 3.2	15.1 ± 3.0			6 ± 5	5 ± 4
Gross Beta		18.1 ± 1.1	12.7 ± 1.1			9 ± 3	5 ± 4
ORGANIC CONSTITUENTS (mg/L)[d]							
Kerosene		ND	ND			---	---
Volatile Organic Compounds[e]		---	---			ND	---

TABLE 24. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM PROCESS WATER WELL (D-6-4)13bcb[PW-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	10-02-92	06-15-93	06-21-94	06-28-95	02-12-96	06-19-96
FIELD SAMPLE IDENTIFIER	002771	007671	001357	003420		002739
LAB SAMPLE IDENTIFIER[a]	8993-1	93-06047-13 937506E-13	94-06751-4 942308-4	95-08021-1 952560-1		96-07218-13 962351-13
TRACE CONSTITUENTS (mg/L)[b]						
Iron	ND	ND	ND	ND		ND
Manganese	ND	ND	ND	ND		ND
Arsenic	0.013	0.0088	0.0098	0.0051		0.011
Copper	ND	ND	ND	ND		ND
Zinc	0.342	0.306	0.300	0.102		0.138
Barium	ND	ND	ND	ND		ND
Cadmium	ND	ND	ND	ND		ND
Total Chromium	ND	ND	0.011	ND		ND
Lead	ND	ND	ND	ND		ND
Mercury	ND	ND	ND	ND		ND
Selenium	0.0056	0.0056	0.005	0.0048		0.0044
Silver	ND	ND	ND	ND		ND
Antimony	ND	ND	ND	ND		ND
Beryllium	ND	ND	ND	ND		ND
Nickel	ND	ND	ND	ND		ND
Thallium	ND	ND	ND	ND		ND
Molybdenum	ND	ND	ND	ND		ND
Cobalt	ND	ND	ND	ND		ND
Aluminum	ND	ND	ND	ND		ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]						
Gross Alpha	31 ± 28	18 ± 17	31 ± 15	18 ± 14		18 ± 12
Gross Beta	100 ± 58	8 ± 18	22 ± 10	22 ± 13		6 ± 13
ORGANIC CONSTITUENTS (mg/L)[d]						
Kerosene	---	---	---	---		---
Volatile Organic Compounds[e]	---	---	---	---		---

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

TABLE 24. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS, RADIOLOGICAL PARAMETERS, AND ORGANIC CONSTITUENTS FOR GROUNDWATER SAMPLES OBTAINED FROM PROCESS WATER WELL (D-6-4)13bcb[PW-1]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado.

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

TABLE 25. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)13daa1[TW-4] SANTA CRUZ IN SITU COPPER MINING PROJECT PINAL COUNTY, ARIZONA

DATE SAMPLED	06-21-89	05-08-90	07-10-90	03-14-91	08-06-91	05-27-92	07-01-92
FIELD SAMPLE IDENTIFIER	004259		019958			007033	014887
LAB SAMPLE IDENTIFIER	4923-3		6081-1			4755-1	5977-2
LABORATORY[a]	BC		BC			BC	BC
CONSTITUENTS							
CATIONS (mg/L)[b]							
Calcium	200.		175.			169.	170.
Magnesium	39.		36.			33.	31.
Sodium	307.		300.			310.	302.
Potassium	4.0		3.4			3.5	3.4
ANIONS (mg/L)							
Carbonate	ND		ND			ND	ND
Bicarbonate	217.		204.			206.	210.
Chloride	406.		389.			385.	358.
Sulfate	500.		500.			460.	450.
Nitrate	47.8		37.7			39.8	34.1
Fluoride	0.54		0.82			0.78	0.92
Alkalinity (as $CaCO_3$)	178.		168.			169.	172.
Boron	1.1		1.0			1.1	0.98
Bromide	---		1.12			1.0	0.68
Total Dissolved Solids	1,730.		1,600.			1,550.	1,730.
PARAMETERS							
Conductivity, Field (μmho/cm)[c]	2,800.		2,450.			2,350.	2,400.
Conductivity, Lab (μmho/cm)	2,700.		2,600.			2,600.	2,600.
pH, Field	7.10		7.23			7.18	7.18
pH, Lab	7.5		7.4			7.5	7.5
Temperature (°C)[d]	26.9		27.2			27.3	27.5

BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE

BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE

END TRACER TEST AT RESEARCH PROJECT TEST SITE

ERROL L. MONTGOMERY & ASSOCIATES, INC.

741\APP\TABLE.25\08-05-96

TABLE 25. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)13daa1[TW-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-14-93	06-22-94	06-28-95	02-12-96	06-19-96
FIELD SAMPLE IDENTIFIER	007667	001362	003419		002740
LAB SAMPLE IDENTIFIER	93-06047-9	94-06751-9	95-08021-2		96-07218-12
LABORATORY[a]	BC	BC	BC		BC
CONSTITUENTS					
CATIONS (mg/L)[b]					
Calcium	164.	157.	161.		156.
Magnesium	31.	32.	30.		28.
Sodium	291.	288.	287.		280.
Potassium	3.9	3.4	3.5		3.3
ANIONS (mg/L)					
Carbonate	ND	ND	ND		11.1
Bicarbonate	212.	203.	214.		181.
Chloride	372.	366.	348.		360.
Sulfate	454.	430.	405.		428.
Nitrate	39.8	37.6	39.9		36.8
Fluoride	0.71	0.80	0.85		0.76
Alkalinity (as $CaCO_3$)	174.	166.	175.		167.
Boron	1.0	1.0	1.1		1.1
Bromide	0.79	0.70	0.67		0.74
Total Dissolved Solids	1,560.	1,560.	1,550.		1,480.
PARAMETERS					
Conductivity, Field (µmho/cm)[c]	2,400.	2,400.	2,140.		2,370.
Conductivity, Lab (µmho/cm)	2,600.	2,350.	2,300.		2,300.
pH, Field	7.13	7.31	7.05		7.17
pH, Lab	7.4	7.4	7.7		8.5
Temperature (°C)[d]	27.2	27.2	27.3		27.5

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

[a] BC = BC Laboratories, Inc., Bakersfield, California

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

--- = Analysis not conducted

TABLE 26. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)13daa1[TW-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-21-89	05-08-90	07-10-90	03-14-91	08-06-91	05-27-92	07-01-92
FIELD SAMPLE IDENTIFIER	004259		019958			007033	014887
LAB SAMPLE IDENTIFIER[a]	4923-3		6081-1			4755-1	5977-2
TRACE CONSTITUENTS (mg/L)[b]							
Iron	ND	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	0.100	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	END TRACER TEST AT RESEARCH PROJECT TEST SITE	0.076	0.081
Manganese	ND		ND			ND	ND
Arsenic	ND		0.009			0.0091	0.011
Copper	ND		ND			ND	ND
Zinc	0.038		ND			0.017	ND
Barium	ND		ND			ND	ND
Cadmium	ND		ND			ND	ND
Total Chromium	0.013		0.001			0.014	0.014
Lead	ND		ND			ND	ND
Mercury	ND		ND			ND	ND
Selenium	ND		0.002			0.0026	0.002
Silver	ND		ND			ND	ND
Antimony	ND		ND			---	ND
Beryllium	ND		ND			---	---
Nickel	ND		ND			ND	ND
Thallium	ND		ND			---	---
Molybdenum	ND		ND			ND	ND
Cobalt	ND		ND			ND	ND
Aluminum	ND		ND			ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	11.4 ± 6.8		18.9 ± 3.2			9 ± 6	6 ± 4
Gross Beta	5.7 ± 2.7		7.0 ± 1.0			0 ± 3	10 ± 3

TABLE 26. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)13daa1[TW-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-14-93	06-22-94	06-28-95	02-12-96	06-19-96
FIELD SAMPLE IDENTIFIER	007667	001362	003419		002740
LAB SAMPLE IDENTIFIER[a]	93-06047-9	94-06751-9	95-08021-2		96-07218-12
	937506E-9	942308-9	952560-2		962351-12
TRACE CONSTITUENTS (mg/L)[b]					
Iron	0.059	ND	0.288	BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE	ND
Manganese	ND	ND	0.013		0.010
Arsenic	0.0086	0.011	0.011		0.011
Copper	ND	ND	ND		ND
Zinc	ND	ND	ND		0.331
Barium	ND	ND	ND		ND
Cadmium	ND	ND	ND		ND
Total Chromium	0.015	0.016	0.027		0.015
Lead	ND	ND	ND		ND
Mercury	ND	ND	ND		ND
Selenium	0.004	0.0032	0.0032		0.003
Silver	ND	ND	ND		ND
Antimony	ND	ND	ND		ND
Beryllium	ND	ND	ND		ND
Nickel	ND	ND	ND		ND
Thallium	ND	ND	ND		ND
Molybdenum	ND	ND	ND		ND
Cobalt	ND	ND	ND		ND
Aluminum	ND	ND	ND		ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]					
Gross Alpha	7.7 ± 7.7	44 ± 15	18 ± 12		17 ± 10
Gross Beta	12 ± 9	20 ± 8	25 ± 11		10 ± 12

TABLE 26. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)13daa1[TW-4]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado.

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

TABLE 27. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)14dda1[TW-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-20-89	05-08-90	07-10-90	03-14-91	08-06-91	04-28-92	07-01-92	06-14-93	06-22-94
FIELD SAMPLE IDENTIFIER	004257		019960			014841	014889	007662	001363
LAB SAMPLE IDENTIFIER	4923-1		6081-3			3878-2	5977-4	93-06047-4	94-06751-10
LABORATORY[a]	BC		BC			BC	BC	BC	BC
CONSTITUENTS									
CATIONS (mg/L)[b]									
Calcium	185.	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	185.	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	END TRACER TEST AT RESEARCH PROJECT TEST SITE	185.	175.	164.	156.
Magnesium	41.		42.			37.	35.	34.	35.
Sodium	250.		260.			268.	264.	254.	254.
Potassium	3.5		3.2			3.3	3.3	3.6	3.2
ANIONS (mg/L)									
Carbonate	ND		ND			ND	ND	ND	ND
Bicarbonate	165.		176.			183.	181.	180.	175.
Chloride	361.		374.			370.	346.	355.	343.
Sulfate	455.		485.			451.	446.	432	415.
Nitrate	41.2		37.7			39.8	33.6	35.4	37.6
Fluoride	3.3		3.4			2.9	3.1	2.9	3.0
Alkalinity (as $CaCO_3$)	136.		144.			150.	148.	147.	143.
Boron	1.0		1.1			1.1	1.0	1.0	1.0
Bromide	---		1.00			0.95	0.75	0.84	0.75
Total Dissolved Solids	1,520.		1,560.			1,480.	1,500.	1,460.	1,460.
PARAMETERS									
Conductivity, Field (µmho/cm)[c]	2,600.		2,480.			2,320.	2,310.	2,340.	2,125.
Conductivity, Lab (µmho/cm)	2,500.		2,500.			2,500.	2,500.	2,500.	2,210.
pH, Field	7.33		7.16			7.22	7.11	7.23	7.23
pH, Lab	7.7		7.4			7.6	7.5	7.5	7.5
Temperature (°C)[d]	30.4		28.9			28.5	28.4	28.6	28.6

TABLE 27. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)14ddal[TW-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-28-95	02-12-96	06-18-96
FIELD SAMPLE IDENTIFIER	003414		002744
LAB SAMPLE IDENTIFIER	95-08021-7		96-07218-8
LABORATORY[a]	BC		BC
CONSTITUENTS			
CATIONS (mg/L)[b]			
Calcium	162.		164.
Magnesium	34.		33.
Sodium	258.		250.
Potassium	3.3		3.2
ANIONS (mg/L)			
Carbonate	ND		10.3
Bicarbonate	185.		163.
Chloride	320.		350.
Sulfate	390.		428.
Nitrate	39.9		48.7
Fluoride	2.6		2.7
Alkalinity (as $CaCO_3$)	152.		151.
Boron	1.2		1.1
Bromide	0.68		0.72
Total Dissolved Solids	1,490.		1,420.
PARAMETERS			
Conductivity, Field (µmho/cm)[c]	2,080.		2,260.
Conductivity, Lab (µmho/cm)	2,210.		2,220.
pH, Field	7.06		7.11
pH, Lab	7.7		8.5
Temperature (°C)[d]	28.7		28.0

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

[a] BC = BC Laboratories, Inc., Bakersfield, California

[b] mg/L = milligrams per liter

[c] µmho/cm = micromhos per centimeter

[d] °C = degrees Celsius

ND = Not detected

--- = Analysis not conducted

TABLE 28. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)14dda1[TW-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-20-89	05-08-90	07-10-90	03-14-91	08-06-91	04-28-92	07-01-92
FIELD SAMPLE IDENTIFIER	004257		019960			014841	014889
LAB SAMPLE IDENTIFIER[a]	4923-1		6081-3			3878-2	5977-4
TRACE CONSTITUENTS (mg/L)[b]							
Iron	ND	BEGIN ACID DEVELOPMENT OF TEST WELLS AT RESEARCH PROJECT TEST SITE	ND	BEGIN TRACER TEST AT RESEARCH PROJECT TEST SITE	END TRACER TEST AT RESEARCH PROJECT TEST SITE	ND	ND
Manganese	ND		ND			ND	ND
Arsenic	0.117		0.021			0.0975	0.092
Copper	ND		ND			ND	ND
Zinc	ND		ND			ND	ND
Barium	ND		0.002			ND	ND
Cadmium	ND		ND			ND	ND
Total Chromium	0.013		0.021			0.015	0.012
Lead	ND		ND			ND	ND
Mercury	ND		ND			ND	ND
Selenium	ND		0.002			0.0022	0.002
Silver	ND		ND			ND	ND
Antimony	ND		ND			---	ND
Beryllium	ND		ND			---	---
Nickel	ND		ND			ND	ND
Thallium	ND		ND			---	---
Molybdenum	ND		ND			ND	ND
Cobalt	ND		ND			ND	ND
Aluminum	ND		ND			ND	ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]							
Gross Alpha	5.5 ± 5.5		15.5 ± 2.6			15 ± 6	5 ± 3
Gross Beta	4.8 ± 2.4		10.8 ± 1.0			12 ± 4	7 ± 3

TABLE 28. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)14dda1[TW-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

DATE SAMPLED	06-14-93	06-22-94	06-28-95	02-12-96	06-18-96
FIELD SAMPLE IDENTIFIER	007662	001363	003414		002744
LAB SAMPLE IDENTIFIER[a]	93-06047-4	94-06751-10	95-08021-7		96-07218-8
	937506E	942308-10	952560-7		962351-8
TRACE CONSTITUENTS (mg/L)[b]					
Iron	0.078	ND	ND		ND
Manganese	0.010	ND	ND		ND
Arsenic	0.097	0.113	0.085		0.086
Copper	ND	ND	ND		ND
Zinc	ND	ND	ND		ND
Barium	ND	ND	ND		ND
Cadmium	ND	ND	ND		ND
Total Chromium	ND	0.018	0.023		ND
Lead	ND	ND	ND		ND
Mercury	ND	ND	ND		ND
Selenium	0.0034	0.004	0.003		0.0032
Silver	ND	ND	ND		ND
Antimony	ND	ND	ND		ND
Beryllium	ND	ND	ND		ND
Nickel	ND	ND	ND		ND
Thallium	ND	ND	ND		ND
Molybdenum	ND	ND	ND		ND
Cobalt	ND	ND	ND		ND
Aluminum	ND	ND	ND		ND
RADIOLOGICAL PARAMETERS (pCi/L)[c]					
Gross Alpha	27 ± 13	38 ± 13	25 ± 13		20 ± 9
Gross Beta	9.7 ± 9.5	17 ± 8	19 ± 10		14 ± 12

BEGIN IN SITU MINING TEST AT RESEARCH PROJECT TEST SITE

TABLE 28. SUMMARY OF RESULTS OF LABORATORY CHEMICAL ANALYSES FOR SELECTED TRACE CONSTITUENTS AND RADIOLOGICAL PARAMETERS FOR GROUNDWATER SAMPLES OBTAINED FROM IRRIGATION WELL (D-6-4)14dda1[TW-2]
SANTA CRUZ IN SITU COPPER MINING PROJECT
PINAL COUNTY, ARIZONA

[a] For samples analyzed after 1992, second lab sample identifier refers to analyses conducted by Barringer Laboratories, Inc.

[b] mg/L = milligrams per liter; samples for trace constituents filtered through 0.45 micron filter

[c] pCi/L = picocuries per liter; samples for radiological parameters filtered through 0.45 micron filter; analyses after 1992 by Barringer Laboratories, Inc., Golden, Colorado.

ND = Not detected

--- = Analysis not conducted

(Analyses by BC Laboratories, Inc., Bakersfield, California, unless otherwise noted)

APPENDIX B
REGIONAL HYDROGEOLOGIC INFORMATION
PRESENTED IN THE 1999 ADWR PUBLICATION ENTITLED
"THIRD MANAGEMENT PLAN FOR PINAL ACTIVE MANAGEMENT AREA 2000 – 2010"

APPENDIX B
REGIONAL HYDROGEOLOGIC INFORMATION PRESENTED IN THE 1999 ADWR PUBLICATION ENTITLED *"THIRD MANAGEMENT PLAN FOR PINAL ACTIVE MANAGEMENT AREA 2000 – 2010"*

B.1.0 Introduction

The 1998 Report and the associated references include some regional hydrogeologic information. However, NMC thereafter learned that the Arizona Department of Water Resources (ADWR) has issued several publications containing hydrologic and groundwater quality data that are useful in understanding regional groundwater hydrologic characteristics. This Appendix presents a synthesis of the ADWR data to provide additional information about groundwater characteristics in the region and, more specifically, in the vicinity of the Sacaton mine.

The regional hydrogeologic setting of the Sacaton mine area forms the framework upon which potential impacts associated with the Sacaton mine must be evaluated. Additionally, the hydrogeologic setting defines the types of operational and post-closure groundwater monitoring measures that would yield relevant data about the groundwater quality impacts associated with the Sacaton mine.

The ADWR has divided the state into "Active Management Areas" on the basis of hydrogeologic boundaries. The Sacaton mine is located in the Pinal Active Management Area (Pinal AMA), along the boundary of the Eloy sub-basin to the east and the Maricopa-Stanfield sub-basin to the west.

B.1.1 Availability of ADWR Information

The ADEQ and ADWR share responsibility for monitoring groundwater quality as described in the 1999 ADWR document entitled "*Third Management Plan for Pinal Active Management Area 2000 – 2010*" (the "Pinal AMA Plan", included herein as AS-47):

> "Because groundwater quantity and quality issues are so interrelated, ADEQ and ADWR work together to prevent and mitigate groundwater quality and quantity problems. ADEQ has the lead role in protecting the state's groundwater and surface water quality, while ADWR secondarily manages groundwater quality concerns." (ADWR, Pinal AMA Plan, page 7-5.)

As further discussed in the Pinal AMA Plan, the Hydrology Division of the ADWR is charged with monitoring water well physical characteristics and the production of groundwater from wells permitted in the Pinal AMA. Each year, the ADWR monitors 182 water level index wells located on irrigated lands to evaluate changes in water level. The agency also samples 40 wells for the following water quality parameters: specific conductance; temperature; pH; fluoride; total dissolved solids; dissolved oxygen; and alkalinity.

Additionally, once every four to five years, the ADWR conducts a broader monitoring study to investigate approximately 1,200 wells, including the index wells. In 1992, ADWR published "*Hydrologic Map Series Report Number 23,*" which is a series of maps depicting groundwater conditions based on the comprehensive data collected in 1989. (Map Series Report Number 23 is included with the new references submitted with this Supplemental Report as AS-48.) Using that information, the ADWR developed a regional groundwater flow model for the Pinal AMA in

1990. According to the Pinal AMA Plan, the data collected annually from the water level index wells, coupled with the Pinal AML Groundwater Model, provide a cumulative source of hydrologic and geologic data for the AMA.

B.2.1 Regional Hydrology

B.2.1.1 Description of the Pinal Active Management Area

The Pinal Active Management Area (AMA) was created by the Arizona Groundwater Management Act of 1980 as an area for active management of diminishing groundwater resources. The Pinal AMA covers approximately 4,000 square miles in central Arizona, and is divided into five sub-basins with unique groundwater underflow, storage, and surface water characteristics. Virtually all of the water use in the Pinal AMA occurs in the Maricopa-Stanfield and Eloy sub-basins. (ADWR, 1992.) As shown on ***Figure B.2-1*** (Figure 1-2 from the Pinal AMA Plan), the Sacaton mine is situated on the boundary between these two sub-basins. (The referenced figures are located at the end of this appendix.)

The ADWR has been collecting detailed hydrologic information from the Maricopa-Stanfield and Eloy sub-basins for many years. During the winter of 1984-1985, the agency measured water levels in most of the wells susceptible to measurement in the two sub-basins, and compared that data with data collected in 1976-77 to provide information on groundwater occurrence, movement, and changes in level. The 1984-1985 study also included a water quality sampling effort in which samples were collected and analyzed in detail to determine their chemical characteristics. The ADWR conducted another round of water level measurements in 1988-1989 to provide additional data for use in groundwater modeling efforts. (ADWR, 1992.)

B.2.1.2 Surface Water

Surface water in the Pinal AMA includes intermittent flow in the Gila and Santa Cruz Rivers and some imported water from the Colorado River through the Central Arizona Project (CAP). Treated effluent is available for reuse from several industrial and municipal sources. There are no perennial streams in the Pinal AMA except for a slough that emanates from the Casa Grande Wastewater Treatment Plant. That slough follows the course of the relict north branch of the Santa Cruz River, and has become a riparian habitat zone. As noted in the 1998 Report, there is no surface water in the immediate vicinity of the Sacaton mine.

B.2.1.3 Groundwater

Large-scale groundwater withdrawal in the Pinal AMA started in the early 1930s. Since then, withdrawals have greatly exceeded recharge. As a result, water levels have declined in the area, and localized land subsidence and earth fissuring have occurred. (ADWR, 1992.)

Groundwater has been the exclusive source of potable water to supply municipal drinking water demands. Thus, there is extensive pumping of groundwater throughout the Pinal AMA. In recent years, however, groundwater use has diminished somewhat as imported CAP water became available. The rate of groundwater withdrawal in the Pinal AMA has declined significantly from approximately 685,000 acre-feet per year in 1985, to 410,000 acre-feet per year in 1995.

Historic groundwater depletion in the Maricopa-Stanfield and Eloy sub-basins has created two large drawdown areas. During the early 1990s, an accelerated rate of recovery of water levels in many wells in these basins occurred due to natural recharge from flooding of the Gila and Santa Cruz Rivers in 1983 and 1993. The substitution of imported CAP water for groundwater previously used for irrigation is another reason for that recovery. (Pinal AMA Plan.)

Extensive withdrawals have had major impacts on the natural groundwater flow paths in the Pinal AMA. Prior to 1900, groundwater movement was essentially horizontal to the northwest across both sub-basins. Due to the influence of extensive pumping, however, groundwater in the Pinal AMA presently moves in a variety of directions, and has significant vertical and horizontal flow components.

The geologic and hydrologic characteristics of the Maricopa-Stanfield and the Eloy sub-basins are similar. The sub-basins generally coincide with structural depressions containing vertically and horizontally heterogeneous sediments that are saturated at depth. Both sub-basins are bounded and underlain by relatively impermeable rocks of the mountains and pre-Basin and Range sedimentary rocks. Very little groundwater is exchanged between the two sub-basins. (ADWR, 1992.)

Geohydrologic studies of the Maricopa-Stanfield and Eloy sub-basins have identified four distinct geohydrologic units that have the potential to yield groundwater. From oldest to youngest these include:

1. Hydrologic bedrock comprised of well-cemented sedimentary rocks;

2. Pre-Basin and Range Tertiary sedimentary rocks;

3. Lower basin fill, upper basin fill; and

4. Stream alluvium.

The lower and upper basin fill deposits are primarily composed of unconsolidated sands, gravels, silts, and clays that were deposited by the ancestral Gila and Santa Cruz Rivers.

The hydrologic bedrock forms buried ridges that define the geohydrologic system. One of those bedrock ridges, known as the Casa Grande Ridge, lies between the Sacaton Mountains to the north and the Sawtooth Mountains to the south. The Casa Grande Ridge is an important hydrogeologic feature in the vicinity of the Sacaton mine, because it influences groundwater quality as discussed in Section B.2.2.

This buried bedrock high comes within 200 feet of the land surface and forms most of the hydrologic boundary between the Maricopa-Stanfield and the Eloy sub-basins. The hydrologic bedrock is faulted and tilted by Basin and Range faults. Except locally, this unit is not an important source of groundwater because it is not very permeable and it is typically overlain by a thick section of more permeable sediments.

A large area of perched groundwater in the vicinity of Casa Grande lies on top of the Casa Grande Ridge. The northern boundary of this perched groundwater is located roughly two miles south of the Sacaton mine (see ***Figure B.2-2,*** Figure 2-3 in the Pinal AMA Plan). As shown on the maps in the ADWR Map Series Report Number 23, the Casa Grande perched aquifer straddles the boundary between the Maricopa-Stanfield and Eloy sub-basins. The depth to water in areas underlain by the Casa Grande perched water table varies from less than 10 feet to about 100 feet below ground.

The ADWR Hydrologic Map Series Report No. 23 identifies two principal aquifers in the Maricopa-Stanfield and Eloy sub-basins: a Lower Main Water Zone and an Upper Main Water Zone. The maps included with this report show depth to water and water chemistry characteristics of these two zones.

The Lower Main Water Zone is the most extensive zone, and is primarily contained in the lower basin fill geohydrologic unit. Unconfined, confined, and semi-confined conditions occur within the Lower Main Water Zone. Several groundwater depressions occur in this zone, formed in response to large-scale, long-term groundwater withdrawal in the vicinity of the depressions. The perched Casa Grande water zone appears to be a major source of flux into the Lower Main Water Zone. In the Eloy sub-basin, the depth to water in the Lower Main Water Zone ranges from 200 feet below surface in the area southeast of Coolidge, to nearly 550 feet below surface in the area southeast of Friendly Corners. In the Maricopa-Stanfield sub-basin, the depth to water ranges from more than 100 feet below surface in the northern part near the Santa Cruz River, to more than 725 feet below surface in the area southwest of Stanfield.

The Upper Main Water Zone is contained mostly within the upper basin fill. This zone is the primary source of groundwater for extraction by wells, and it is an especially important water source in the Eloy sub-basin. Groundwater depressions in the Upper Main Water Zone correspond with depressions in the Lower Main Zone. Depth to water in the Upper Main Water Zone in the Eloy sub-basin is from about 20 feet below surface near the Gila River, to nearly 450 feet below surface in the vicinity of Friendly Corners. In the Maricopa-Stanfield sub-basin, the depth to water ranges from over 50 feet below surface near the Gila River in the north, to more than 400 feet below surface in Section 18, T. 6 S., R. 3 E.

Following over 40 years of intensive agricultural pumping that caused water levels to decline, the water levels in both the Maricopa-Stanfield and the Eloy sub-basins have begun to stabilize. In fact, in some areas of the Maricopa-Stanfield sub-basin, water levels have risen by as much as 100 feet. In 1996, the depth to groundwater in this sub-basin ranged from about 150 feel to more than 600 feet below surface.

Similarly, water levels have risen in the Eloy sub-basin due to diminished agricultural pumping and recharge from isolated flood events. In 1989, rises of as much as 50 to 60 feet were measured in some wells. In 1993, the depth to groundwater in the Eloy sub-basin ranged from less than 100 feet below surface in the northern portion of the sub-basin, to about 300 to 400 feet in the south-central part. However, in 1996, water levels in the extreme northern and south-central portions of the Eloy sub-basin exhibited signs of decline. The observed decline in the northern part of the sub-basin is thought to be due to the dissipation of the groundwater mound

that formed after the 1993 Gila River flood. In the southern part of the sub-basin, the decline is probably due to deep well pumping in that area.

B.2.2 Regional Groundwater Quality

As noted above, the ADWR collected a large number of grab samples in conjunction with the 1984 – 1986 hydrologic investigation, and analyzed those samples for specific conductance and fluoride. Sheet 3 of the Hydrologic Map Series Report No. 23 (AS-48) presents that analytical data and also includes Stiff pattern diagrams to illustrate the ionic content of the samples and provide a means to compare, contrast, and correlate similar and dissimilar water chemistry types. The parameters shown on the Stiff diagrams are chloride, total alkalinity, sulfate, sodium, calcium, and magnesium. The agency used the specific conductance data as a proxy for the total dissolved solids content of the sampled wells. Specific conductance, measured in microsiemens per centimeter at 25 ° Centigrade (μS/cm), can be used to approximate the concentration of dissolved solids by multiplying the specific conductance value in μS/cm by a factor of 0.6 to obtain the approximate dissolved solids value in the milligrams per liter (mg/l). The diagrams show a wide range of chemical composition of the groundwater in the Maricopa-Stanfield and Eloy sub-basins.

As described in the notes on Sheet 3 of the Hydrologic Map Series Report No. 23 (AS-48), the specific conductance data for the Casa Grande perched water zone show elevated levels ranging from about 2,000 μS/cm (corresponding to roughly 720 mg/l total dissolved solids) to more than 3,000 μS/cm (greater than 1,800 mg/l total dissolved solids). The higher concentration of dissolved solids in this water zone probably reflects the geochemical signature from the Casa Grande hydrologic bedrock high and the underlying crystalline rocks. (Water Development Corporation, pages 4-20 and 4-21 in AS-40 submitted with the 1998 Report). As discussed in Chapter 3 of this Supplemental Report, the background chemistry of groundwater in the Sacaton mine vicinity is consistent with the data obtained from other wells located in the Casa Grande perched water zone overlying the Casa Grande hydrologic bedrock high.

The Pinal AMA Report also contains a great deal of useful groundwater quality information. According to that report, the quality of most Pinal AMA groundwater and surface water supplies tends to be within the acceptable range of both state and federal standards. In several locations within the Pinal AMA, however, high levels of nitrates limit the use of groundwater as a supply of potable water. Radiochemicals also restrict the use of groundwater in one remote area. Currently, groundwater quality is not a limiting factor for irrigated agriculture in the Pinal AMA. Crop rotation and leaching are used in areas where the salinity of groundwater exceeds 1,000 parts per million (ppm) of total dissolved solids (TDS) to mitigate the effects of high salinity. Surface water in the Pinal AMA is used exclusively for irrigation and turf watering; it is not used as a source of drinking water.

The Pinal AMA Report states: "based on the most current and available data, there are no major issues which affect or are affected by water quality in the AMA." (Pinal AMA Report, page 7-1.) The report does, however, enumerate the following concerns:

1. Agricultural activities may be adversely affecting domestic and municipal water supplies;

2. Continued groundwater pumping could cause contaminant migration; and

3. Abandoned wells and subsidence fissuring in the AMA may pose a risk of groundwater contamination by providing unrestricted access to aquifers.

It is significant to note that this discussion lists no concerns about groundwater problems associated with the closed Sacaton mine.

The Pinal AMA Plan describes water quality data that were collected by an interagency team comprised of ADWR and ADEQ personnel since 1990. That Plan presents groundwater quality maps for the following constituents: nitrate nitrogen and nitrite plus nitrate; sulfate; total dissolved solids; and metals. The following subsections summarize the water quality information presented in the Pinal AMA Plan. The groundwater quality maps, ***Figure B.2-3*** through ***Figure B.2-8*** (Figures 7-1 through 7-5 from the Pinal AMA Plan) are included at the end of this Appendix.

B.2.2.1 Nitrate

Groundwater with nitrate concentrations that exceed the Maximum Contaminant Level (MCL) of 10 mg/l is found throughout the northern parts of the Maricopa-Stanfield and Eloy sub-basins. Since 1990, 11 exceedences of the nitrate MCL have been reported for water systems in the two sub-basins. ***Figure B.2-3*** (Figure 7-1 from the Pinal AMA Plan) illustrates the location of 149 water quality samples tested for nitrate levels. As shown in this figure, nitrate levels exceeded the MCL in 36 of the samples. There were no wells sampled for nitrate in the vicinity of the Sacaton mine.

B.2.2.2 Sulfate

Figure B.2-4 (Figure 7-2 from the Pinal AMA Plan) shows the location of the 35 wells sampled for sulfate. The sulfate concentration at four of the sample locations exceeded the secondary MCL for sulfate of 250 mg/l. Sulfate concentrations up to 800 mg/l have been detected near Casa Grande. The elevated sulfate concentrations may reflect the saline character of the water associated with the Casa Grande hydrologic bedrock high and the Casa Grande perched water table.

B.2.2.3 Total Dissolved Solids

As shown in ***Figures B.2.5*** and ***B.2-6*** (Figures 7-3 and 7-3a of the Pinal AMA Plan), the interagency team collected and analyzed 531 samples for Total Dissolved Solids (TDS). Figure 7-3 clearly illustrates that TDS concentrations above the secondary MCL of 500 mg/l are common throughout the Pinal AMA. Only 155 out of the 531 wells sampled had TDS concentrations below 500 mg/l (***Figure B.2-6***). Areas of highest TDS levels correlate well with the Casa Grande perched water zones and other areas of perched groundwater associated with hydrologic bedrock highs. This correlation can be easily seen by comparing ***Figure B.2-5*** with ***Figure B.2-2***. Sheet 3 from the ADWR Hydrologic Map Series No. 3 (AS-48) also illustrates the

extent of groundwater displaying elevated specific conductance, which was used as a proxy indicator of TDS. The highest TDS concentrations occur in the northern part of the Eloy and Maricopa-Stanfield subbasins, where concentrations of up to 10,000 mg/l have been found near the cities of Casa Grande, Coolidge, and Maricopa. (Pinal AMA Plan, page 7-25.)

B.2.2.4 Metals

Thirty-two samples, including one sample collected in the immediate vicinity of the Sacaton mine, were analyzed for the nine metals for which EPA has established a primary MCL (e.g., antimony, arsenic, barium, beryllium, cadmium, chromium, mercury, selenium, and thallium). None of the samples collected exceeded the MCL for any of those metals. As explained in the Pinal AMA Plan, metals contamination is not a problem in the area, but elevated concentrations of some metals have been identified:

> "While problems with metals are uncommon in the Pinal AMA, selenium has been detected at concentrations above the MCL of 50 µg/l near Eloy and Randolph. Arsenic concentrations in excess of 50 µg/l have been detected at Anegam, in the southwestern part of the AMA. Since 1990, three exceedences for the MCLs for arsenic, barium and cadmium have been detected in water systems in the AMA." (Pinal AMA Plan, page 7-25.)

Figure B.2-7 (Figure 7-4 in the Pinal AMA Plan) shows the sample locations for which there is metals data.

B.2.2.5 Fluoride

Isolated occurrences of groundwater with fluoride concentrations that exceed the 4 mg/l primary MCL are shown in ***Figure B.2-8*** (Figure 7-5 in the Pinal AMA). Sheet 3 of the ADWR Hydrologic Map Series Report No. 23 (AS-48) also shows a few scattered wells with fluoride concentrations that exceed 4.0 mg/l.

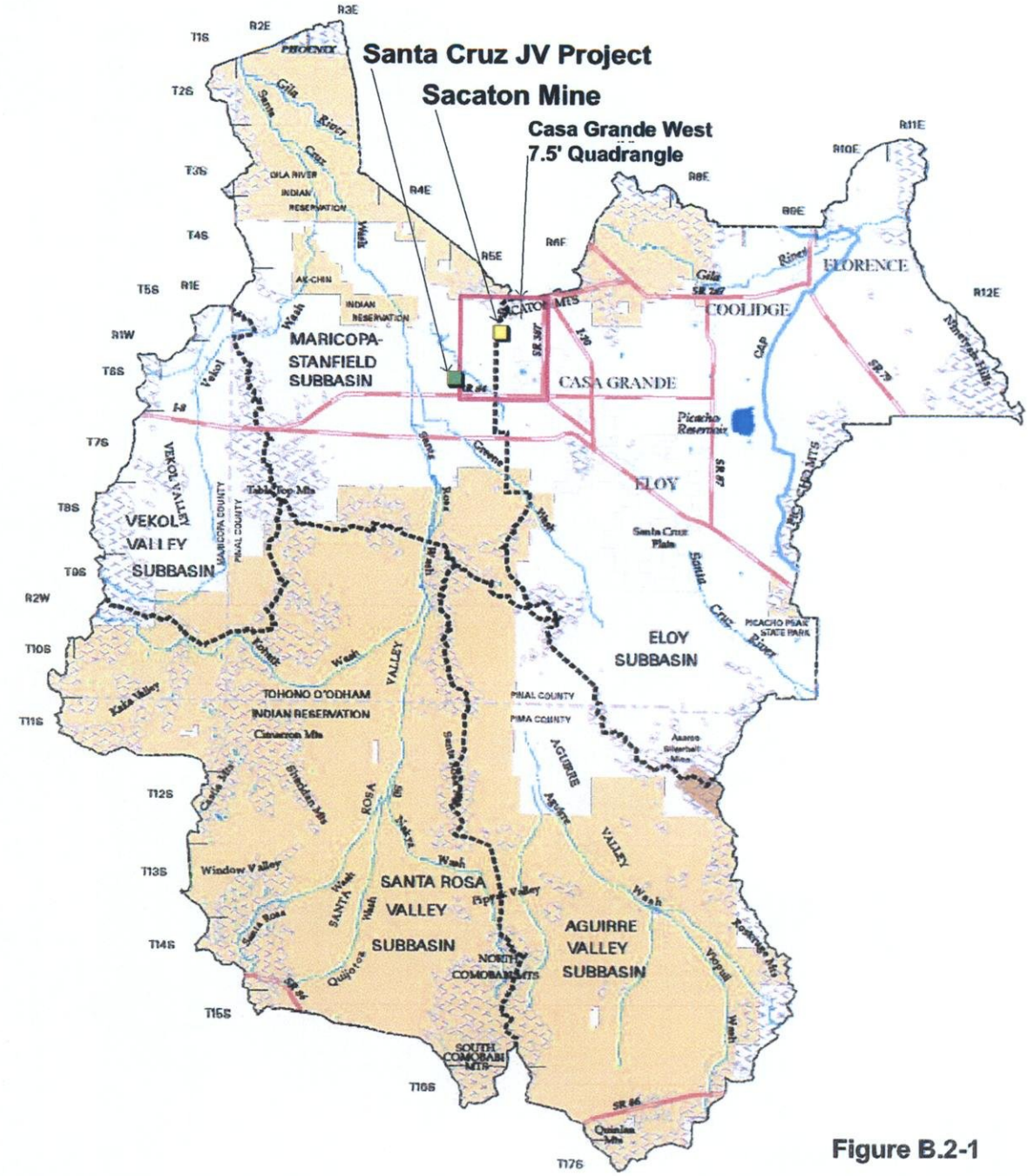


Figure B.2-1

Location of Sacaton Mine within the Pinal Active Management Area

Pinal County, Arizona

ORIGINAL SOURCE

Arizona Department of Water Resources
Geographic Information System

Figure 1 - 2

Pinal Active Management Area

SacatonISac fig b2-1.WOR * GSH * 9/15/2002

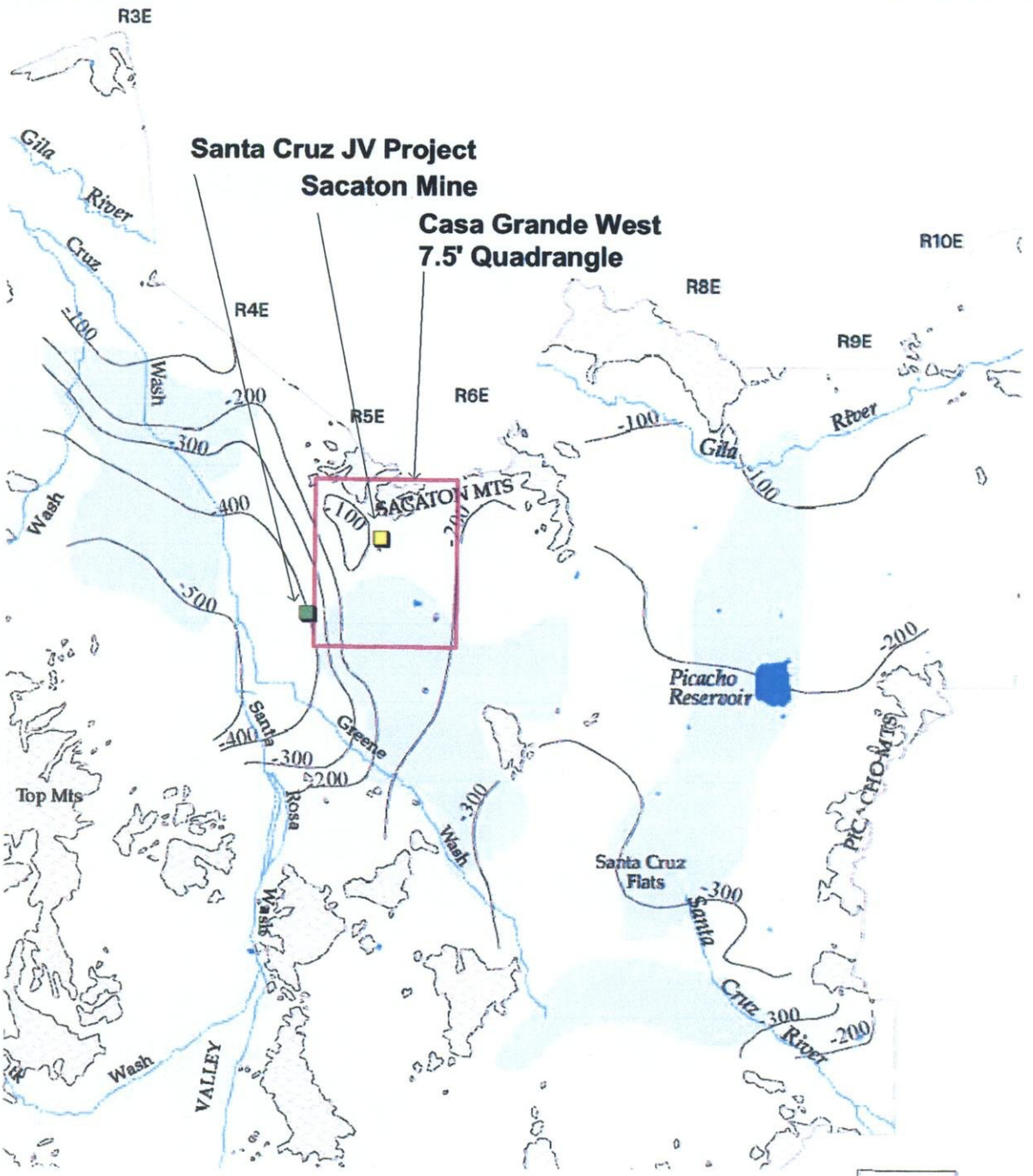
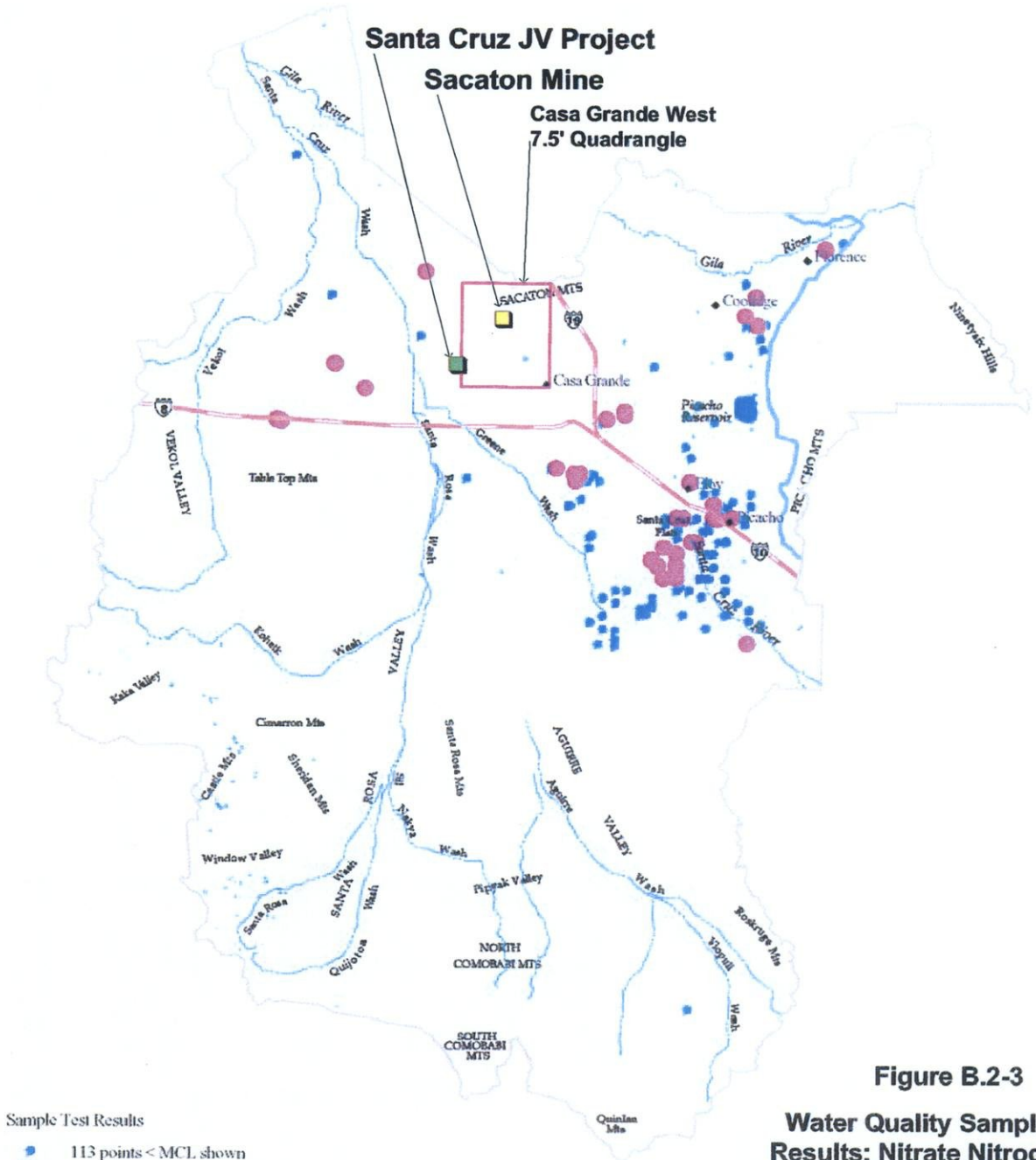


Figure B.2-2
Map of Water Elevation Change and the Casa Grande Perched Aquifer Near the Sacaton Mine
Pinal County, Arizona



Sample Test Results

- 113 points < MCL shown
- 36 points >= MCL shown

- Pinal AMA
- Highways and Roads
- Rivers and Streams
- CAP Canal
- Cities

Figure B.2-3

Water Quality Sample Test Results: Nitrate Nitrogen and Nitrate plus Nitrite

Pinal County, Arizona

Figure 7- 1

Water Quality Sample Test Results

Nitrate Nitrogen and Nitrite Plus Nitrate

0 3 6 9 12

Miles

North

ORIGINAL SOURCE

Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990

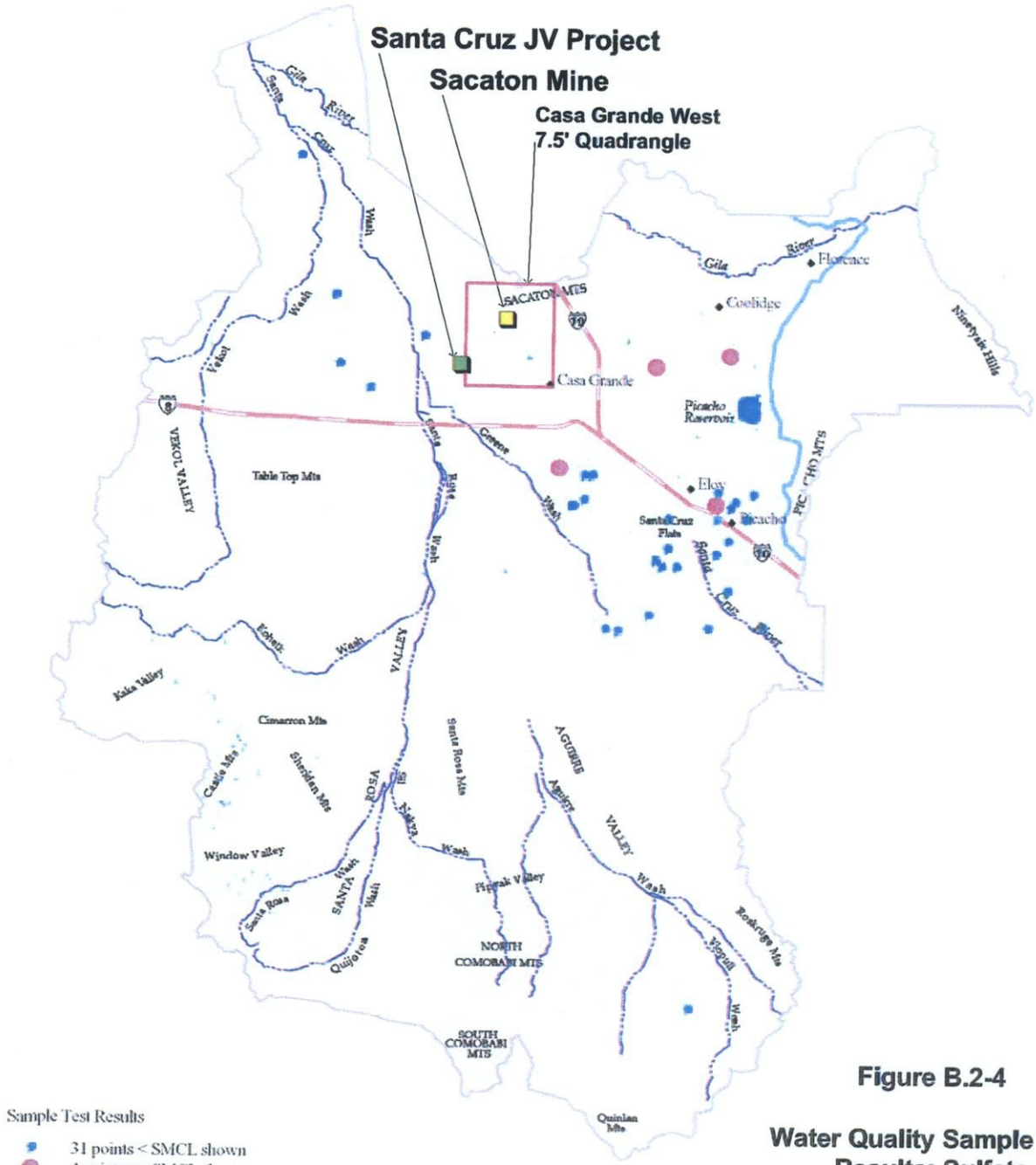


Figure 7-2

Water Quality Sample Test Results

Sulfate

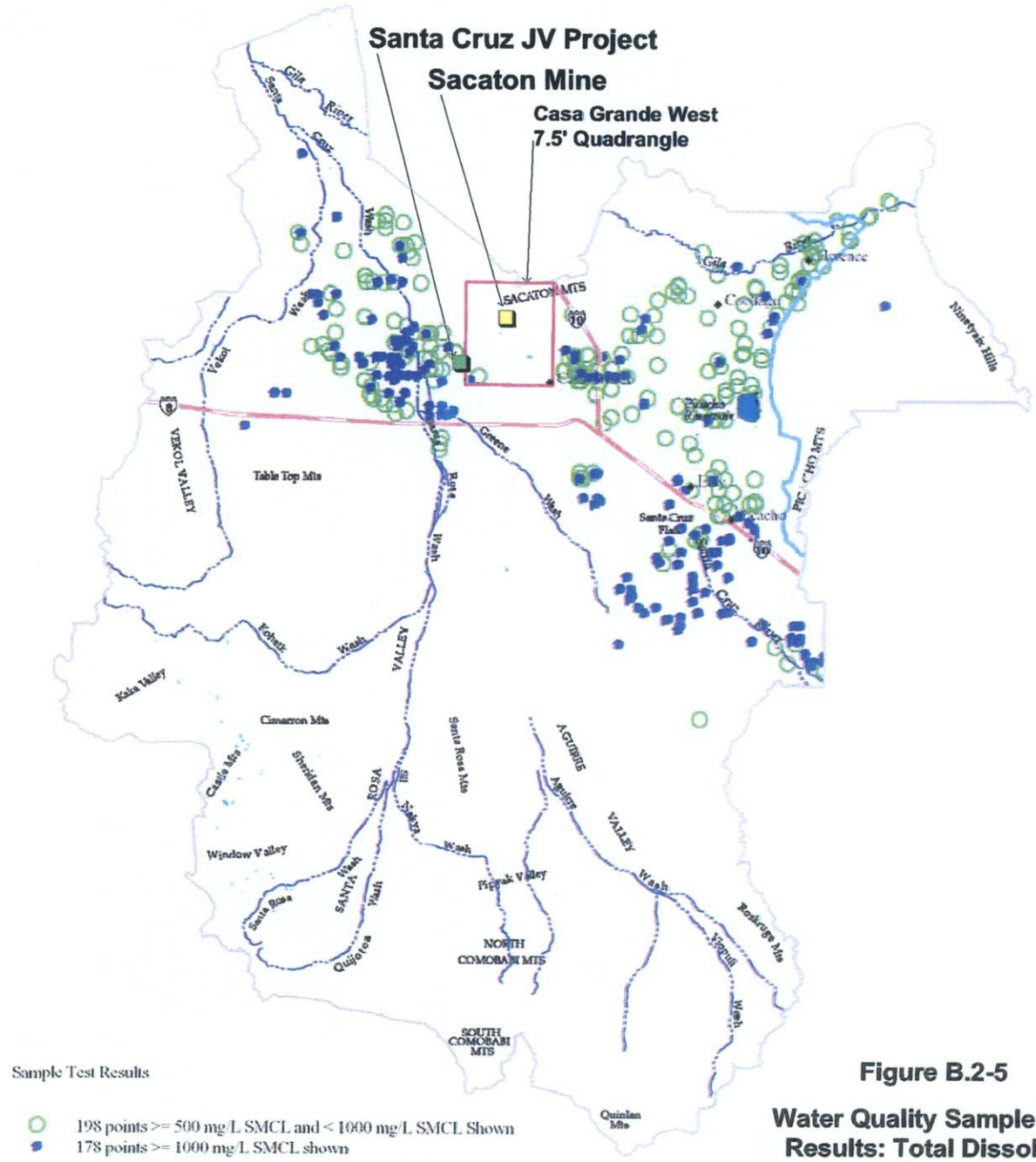
Figure B.2-4

Water Quality Sample Test Results: Sulfate

Pinal County, Arizona

ORIGINAL SOURCE

Arizona Dept of Environmental Quality: Well Locations and Water Quality Samples since 1990



Sample Test Results

- 198 points >= 500 mg/L SMCL and < 1000 mg/L SMCL Shown
- 178 points >= 1000 mg/L SMCL shown

- Pinal AMA
- Highways and Roads
- CAP Aqueduct
- Streams
- Cities

Figure 7-3

Water Quality Sample Test Results

Total Dissolved Solids

0 3 6 9 12 Miles

North

Figure B.2-5

Water Quality Sample Test Results: Total Dissolved Solids that Exceed MCL

Pinal County, Arizona

ORIGINAL SOURCE

Arizona Department of Water Resources:
GWSI Well Locations
Water Quality Samples since 1990
Calculated from Specific Conductivity

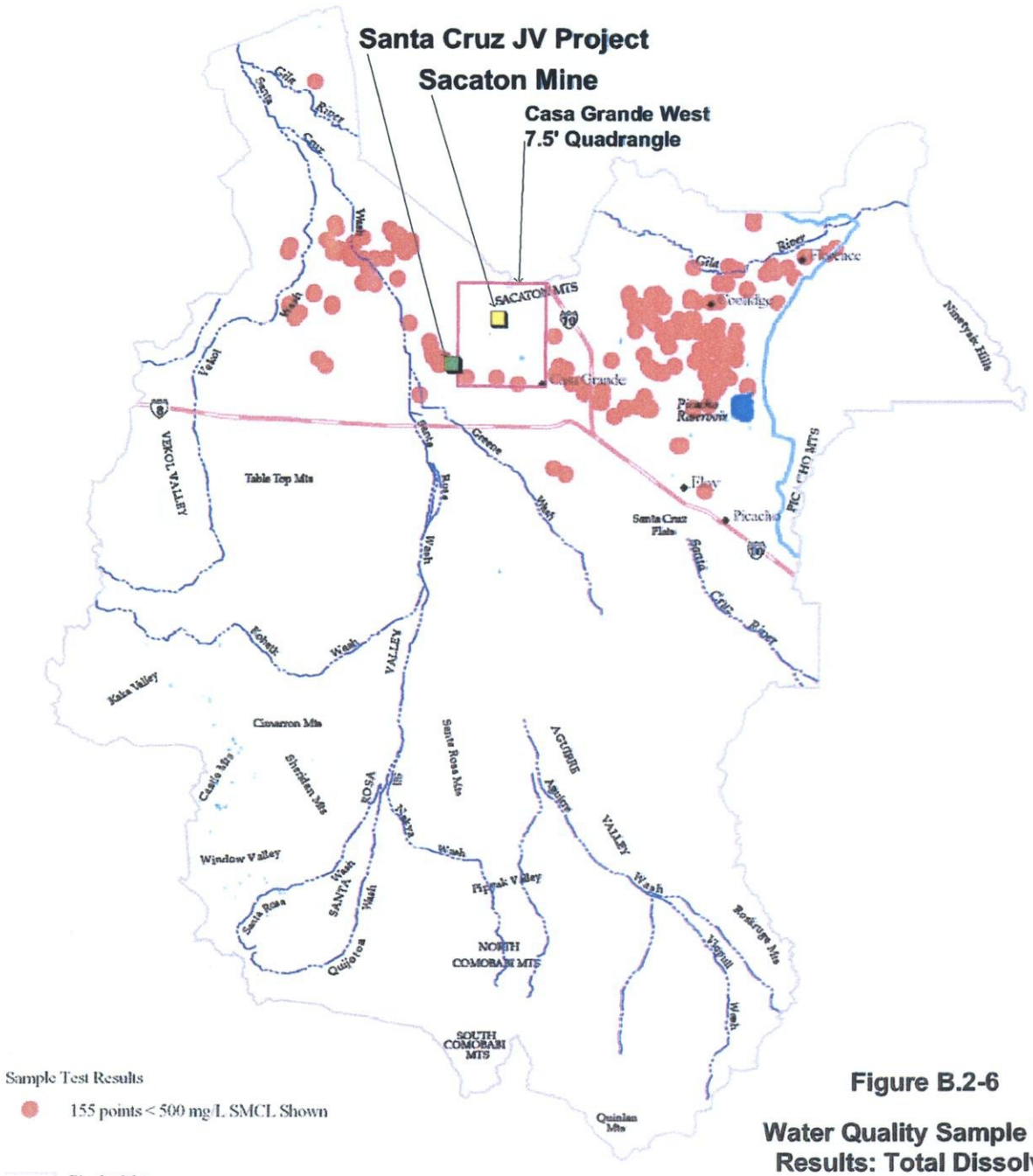


Figure B.2-6

Water Quality Sample Test Results: Total Dissolved Solids <500 mg/l

Pinal County, Arizona

Figure 7-3a

Water Quality Sample Test Results

Total Dissolved Solids

ORIGINAL SOURCE

Arizona Department of Water Resources:
GWSI Well Locations
Water Quality Samples since 1990
Calculated from Specific Conductivity

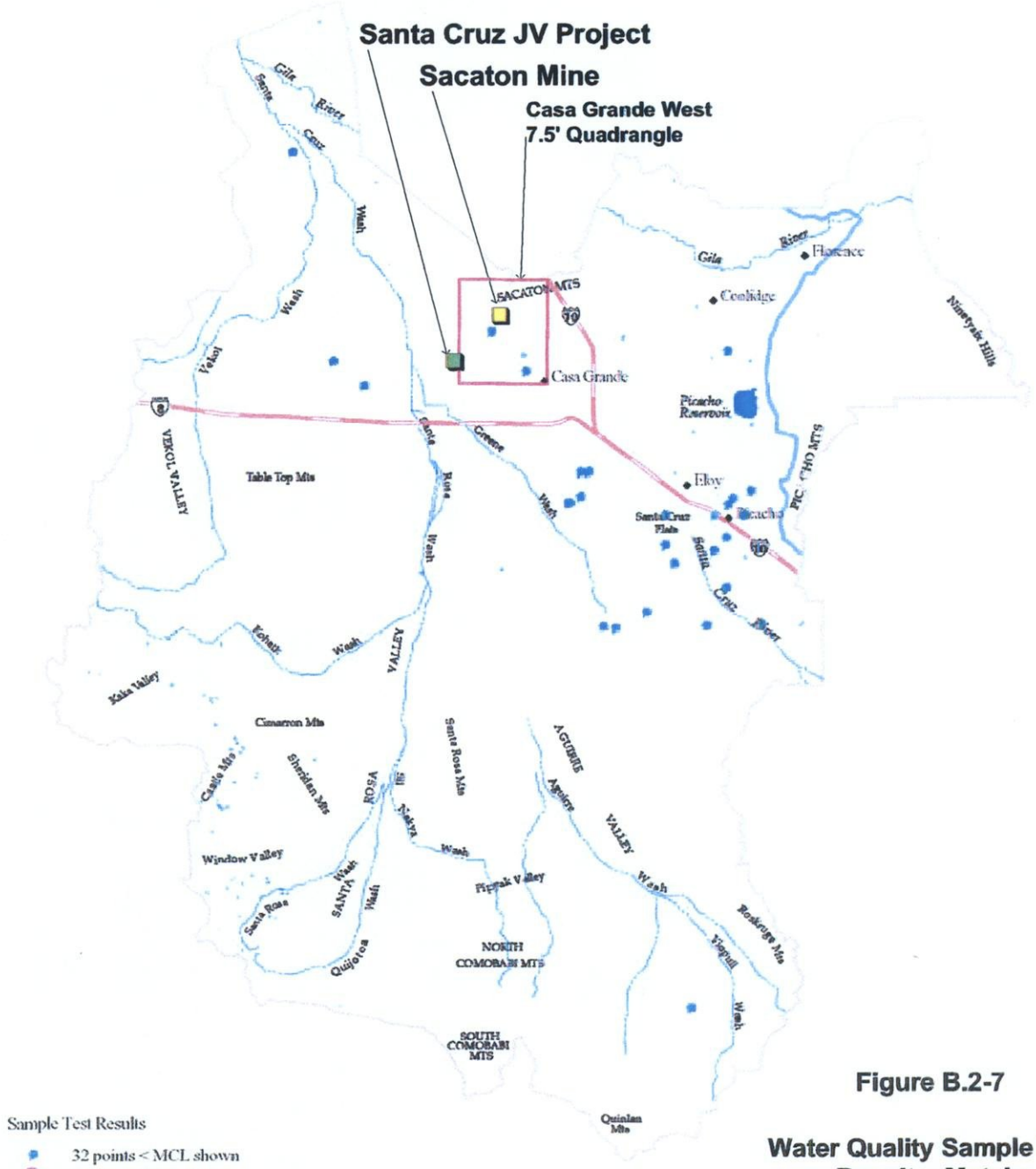


Figure B.2-7

Water Quality Sample Test Results: Metals

Pinal County, Arizona

ORIGINAL SOURCE

Arizona Dept of Environmental Quality: Well Locations and Water Quality Samples since 1990

Figure 7-4

Water Quality Sample Test Results
Metals

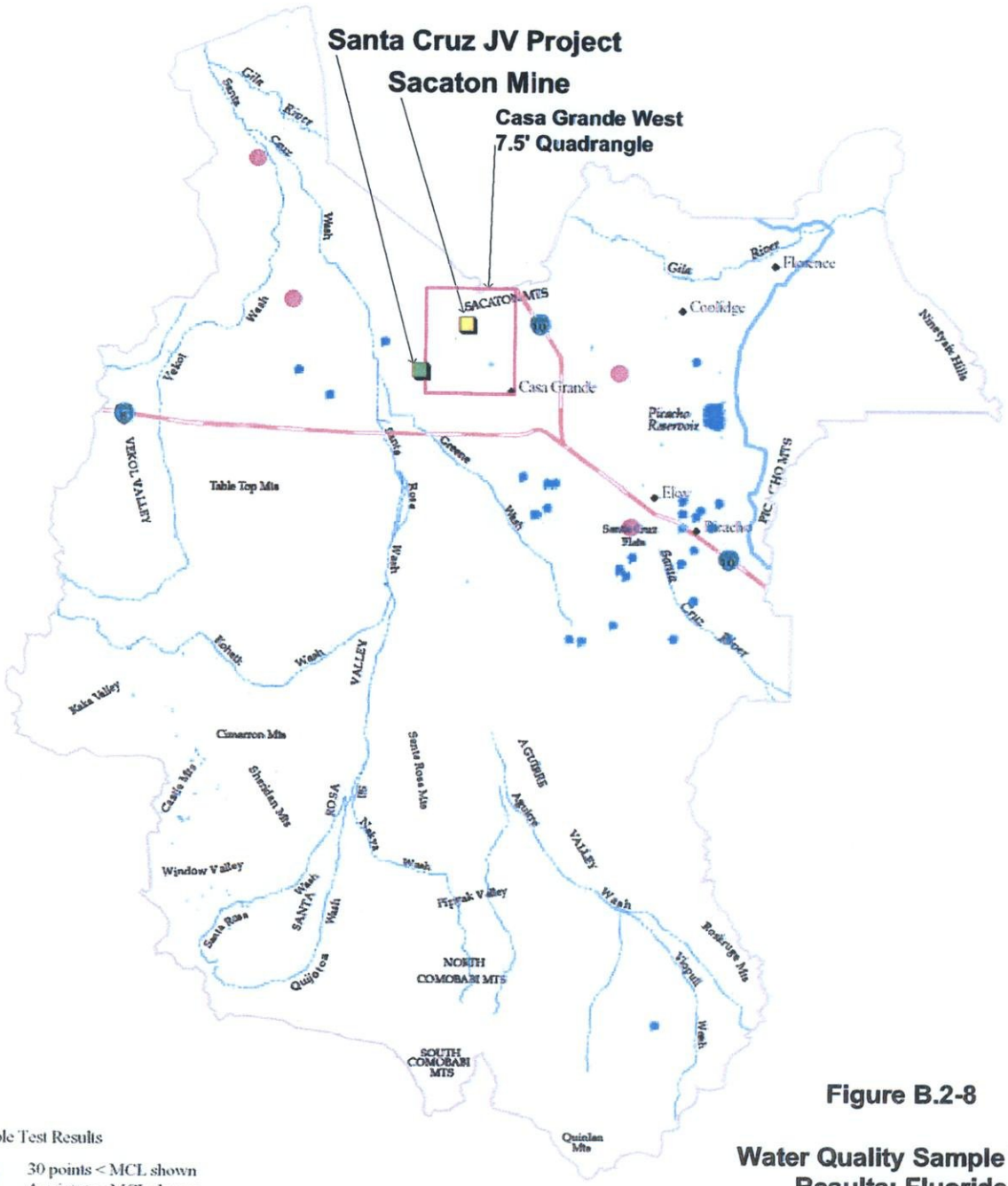


Figure 7- 5

Water Quality Sample Test Results
Fluoride

Figure B.2-8

Water Quality Sample Test Results: Fluoride

Pinal County, Arizona

ORIGINAL SOURCE
Arizona Dept of Environmental Quality:
Well Locations and Water Quality
Samples since 1990

APPENDIX C

TABLE C-1
PARTIAL LIST OF WELLS IN THE SACATON MINE VICINITY FOR WHICH RECORDS WERE RECOVERED FROM THE ADWR DATABASE

and

COPIES OF DOCUMENTS IN THE ADWR DATABASE FOR THE ROBERTS RESIDENCE WATER WELL

Table C-1: Partial List of wells in Sacaton Mine Vicinity For Which Records Were Recovered From ADWR Database

REGISTRYID	SUBBASIN	T	N/S	R	E/W	S	160A	40A	10A	WATERUSE1	INSTALLED	WELL DEPTH	WATER LEVEL	CASING DEPTH	CASING WIDTH	DRILL LOG	LASTNAME	COMPANY
510405	MARICOPA-STANFIELD	5	S	5	E	29	NE	NW	NE	DOMESTIC	01-Oct-85	450	400	60	6	X	HERDEGEN, RICHARD,W	
507074	MARICOPA-STANFIELD	5	S	5	E	29	NW	NE	NE	DOMESTIC	05-Mar-84	640	585	640	7	X	KARKULA,E	
606194	MARICOPA-STANFIELD	5	S	5	E	30	NW	SE	SE	IRRIGATION	PRE 27-Apr-82	0	0	0	20		TRP LTD PRTSHIP.ET AL,	
606193	MARICOPA-STANFIELD	5	S	5	E	31	NE	NE	SE	IRRIGATION & STOCK	PRE 27-Apr-82	900	750	900	20		DOUBLE EE,	
606191	MARICOPA-STANFIELD	5	S	5	E	31	NE	SE	NE	IRRIGATION	PRE 27-Apr-82	0	0	0	20		DOUBLE EE,	
606192	MARICOPA-STANFIELD	5	S	5	E	31	NE	SE	SE	IRRIGATION & DOMESTIC	PRE 27-Apr-82	1000	700	1000	20		DOUBLE EE,	
606190	MARICOPA-STANFIELD	5	S	5	E	31	SW	SW	NW	IRRIGATION	01-Jan-65	1100	640	1100	20		DOUBLE EE,	
591975	MARICOPA-STANFIELD	5	S	5	E	31	SW	SW	SW	DOMESTIC	May-02?	?	?	?	?	?	Mystic Mountain Inc.	Notice only on file
806657	MARICOPA-STANFIELD	5	S	5	E	32	SW	NE	NW	UNKNOWN TO OWNER	31-Dec-50	0	0	0	20		MARSHALL ENTERPRISES,	
528942	MARICOPA-STANFIELD	5	S	5	E	33	NE	SE	NE	NONE	07-Sep-90	170	0	0	4	X	Not in Image database	ASARCO INC,
534252	MARICOPA-STANFIELD	5	S	5	E	33	NE	SE	SE	NONE	21-Feb-92	0	0	0	0	X	Not in Image database	ASARCO INC,
580835	MARICOPA-STANFIELD	5	S	5	E	33	SW	NW	SW	DOMESTIC	03-Nov-00	360	300	360	4	X	ROBERTS	
561130	MARICOPA-STANFIELD	5	S	5	E	34	<13 holes			MINERAL EXPLORATION	01-Mar-97	0	0	0	0			ASARCO SANTA CRUZ,
557382	MARICOPA-STANFIELD	5	S	5	E	34	4 holes			MINERAL EXPLORATION	30-Sep-96	0	0	0	0	X		ASARCO INC,
608108	MARICOPA-STANFIELD	5	S	5	E	34	NW	SW	SW	WATER TEST	01-Jan-73	400	104	400	10			AR SACATON LLC
534253	MARICOPA-STANFIELD	5	S	5	E	34	SE	NE	SW	NONE	18-Feb-92	0	0	0	0	X	Not in Image database	ASARCO INC,
542245	MARICOPA-STANFIELD	5	S	5	E	34	SE	SW	NW	MINERAL EXPLORATION	02-Feb-94	0	0	0	0	X		ASARCO INCORPORATED

Table C-1: Partial List of Wells in Sacaton Mine Vicinity For Which Records Were Recovered From ADWR Database

REGISTRYID	SUBBASIN	T	N/S	R	E/W	S	160A	40A	10A	WATERUSE1	INSTALLED	WELL DEPTH	WATER LEVEL	CASING DEPTH	CASING WIDTH	DRILL LOG	LASTNAME	COMPANY
526685	MARICOPA-STANFIELD	5	S	5	E	34	SE	SW	SW	MONITORING	26-Jan-90	220	117	99	12	X		HEXCEL CORP,
534974	MARICOPA-STANFIELD	5	S	5	E	34	SE	SW	SW	MONITORING	29-May-92	165	118	160	8	X		HEXCEL CORP,
534975	MARICOPA-STANFIELD	5	S	5	E	34	SE	SW	SW	MONITORING	27-May-92	168	116	164	8	X		HEXCEL CORP,
060000	ELOY	5	S	5	E	35	NE	NW	NE	MINING	PRE 1984?	1790	0	0	20		Not in Image database	AR SACATON LLC
608101	ELOY	5	S	5	E	35	NE	NW	NE	INDUSTRIAL MINING SHAFT DEWATER	25-May-79	2117	1077	2090	10			AR SACATON LLC
608107	ELOY	5	S	5	E	35	NE	NW	SE	INDUSTRIAL MINING SHAFT DEWATER	01-Feb-75	1798	666	1798	20			AR SACATON LLC
529416	ELOY	5	S	5	E	35	SW	NW	SW	NONE	12-Sep-90	0	0	160	4	X	Not in Image database	ASARCO INC,
590301	ELOY	6	S	5	E	2	NE	SE	SE	CATHODIC WELL	2002?	0	0	0	0			EL PASO PIPELINE GROUP/EP
580230	ELOY	6	S	5	E	3				GEOTECH TEST	2001?	0	0	0	0			RELIANT ENERGY DESERT BAS
638705	MARICOPA-STANFIELD	6	S	5	E	4	NE	SE	NE	DOMESTIC	15-Jul-52	600	150	560	8		WHITTEN,G R	
561125	MARICOPA-STANFIELD	6	S	5	E	5	<13 holes			MINERAL EXPLORATION	Apr-Jun-97	0	0	0	0	X		ASARCO SANTA CRUZ,
557385	MARICOPA-STANFIELD	6	S	5	E	7	6 of 12 holes			MINERAL EXPLORATION	30-Sep-96	0	0	0	0	X		ASARCO SNTA CRUZ INC,
561126	MARICOPA-STANFIELD	6	S	5	E	7	<13 holes			MINERAL EXPLORATION	Apr-Jun-97	0	0	0	0	X		ASARCO SANTA CRUZ,
612882	MARICOPA-STANFIELD	6	S	5	E	7	NW	SW	SW	DOMESTIC	PRE 03-June-82	0	447	0	0			SANTA CRUZ JOINT VNT,
612883	MARICOPA-STANFIELD	6	S	5	E	7	SE	SW	SW	DOMESTIC	PRE 03-June-82	0	192	673	8			SANTA CRUZ JOINT VNT,
557383	MARICOPA-STANFIELD	6	S	5	E	8	4 of 12 holes			MINERAL EXPLORATION	30-Sep-96	0	0	0	0	X		ASARCO SNTA CRUZ INC,
561127	MARICOPA-STANFIELD	6	S	5	E	8	<13 holes			MINERAL EXPLORATION	Apr-Jun-97	0	0	0	0	X		ASARCO SANTA CRUZ,

Table C-1: Partial List of Wells in Sacaton Mine Vicinity
For Which
Records Were Recovered From ADWR Database

REGISTRYID	SUBBASIN	T	N/S	R	E/W	S	160A	40A	10A	WATERUSE1	INSTALLED	WELL DEPTH	WATER LEVEL	CASING DEPTH	CASING WIDTH	DRILL LOG	LASTNAME	COMPANY
622030	ELOY	6	S	5	E	10	SW	SW	SE	IRRIGATION	01-Jan-45	600	50	600	20		AUZA, JOE,	
608900	ELOY	6	S	5	E	11	NE	NE	SE	IRRIGATION STOCK DOMESTIC	01-Jan-20	150	50	150	6		SCOTT & SCOTT TRAILR,	
608901	ELOY	6	S	5	E	11	NE	NE	SE	IRRIGATION STOCK DOMESTIC	01-Jan-50	500	50	250	20		SCOTT& SCOTT TRAILER,	
800542	ELOY	6	S	5	E	11	SW	SE	SE	IRRIGATION	PRE 31-May-83	200	60	200	12		HORNE & ASSOCIATE S,H	
576477	ELOY	6	S	5	E	12				GEOTECH TEST	16-Sep-99	0	0	0	0			RELIANT ENERGY DESERT BAS
612780	ELOY	6	S	5	E	12	SW	NW	SW	IRRIGATION	01-Jan-40	100	0	100	16			CASA GRANDE, CITY OF,
611157	ELOY	6	S	5	E	12	SW	SE	SW	INDUSTRIAL	PRE 08-June-82	230	160	230	12			CASA GRANDE, CITY OF,

ARIZONA DEPARTMENT OF WATER RESOURCES
GROUNDWATER MANAGEMENT SUPPORT SECTION
MAIL TO: P. O. BOX 458, PHOENIX, ARIZONA 85001-0458
FOR MORE INFORMATION CALL: MONICA ORTIZ 602-417-2470
NOTICE OF INTENTION TO DRILL, DEEPEN, REPLACE OR MODIFY A WELL

RECEIVED
APR 21 2000
GROUNDWATER MGT

PLEASE COMPLETE ALL ITEMS IN THE BOX BELOW DOWN TO COUNTY OR LOCAL AUTHORITY ENDORSEMENT. IF WATER FROM THE PROPOSED WELL (LISTED BELOW) WILL BE USED FOR DOMESTIC PURPOSES ON A PARCEL OF LAND 20 OR FEWER ACRES, THE APPLICABLE COUNTY OR LOCAL HEALTH AUTHORITY MUST ENDORSE ALL ITEMS IN THE BOX BEFORE SUBMISSION TO THE DEPARTMENT OF WATER RESOURCES. ITEMS C, D, E, AND F MAY BE AVAILABLE FROM YOUR COUNTY ASSESSOR'S OFFICE.

A. Leslie and Joanna Robeets (LANDOWNER'S NAME) 23138 E Munoz (CURRENT MAILING ADDRESS) Queen Creek (CITY) AZ (STATE) 85242 (ZIP)

B. TELEPHONE NO. 480 - 987 - 0461 COUNTY ASSESSOR'S PARCEL ID INFORMATION:

C. WELL LOCATED IN PINAL COUNTY D. 502 (BOOK) 41 (MAP) 017 (PARCEL) E. 16 (# OF ACRES)

OFFICIAL SEAL OR STAMP

WELL/LAND LOCATION (MUST BE COMPLETED AS REQUESTED):

F. SW (10AC) ¼ NW (40AC) ¼ SW (160AC) ¼ OF SECTION 33 TOWNSHIP 5 (S) N/S RANGE 5 (E) E/W
COUNTY OR LOCAL AUTHORITY ENDORSEMENT

CHECK ONE:
G. RECOMMEND APPROVAL ____; INSUFFICIENT INFORMATION TO MAKE A DETERMINATION ✓; VARIANCE REQUIRED ____ (EXPLANATION ATTACHED)

H. DATE 4/18/00 AUTHORIZED SIGNATURE R. Bustamante TITLE Sanitarian

1. OWNER OF WELL:
Leslie and Joanna Roberts
NAME
23138 E Munoz Street
CURRENT MAILING ADDRESS
Queen Creek AZ 85242
CITY STATE ZIP

TELEPHONE NUMBER 480-987-0461

2. ACTION REQUESTED:
DRILL NEW WELL X DEEPEN ____
MODIFY ____ REPLACE ____

WELL REGISTRATION NO 55-____

FOR A REPLACEMENT WELL PROVIDE:
MAX. CAPACITY OF THE ORIGINAL WELL ____ GALLONS PER MINUTE;

DISTANCE FROM THE ORIGINAL WELL: ____ FEET

3. CONSTRUCTION WILL START ABOUT:
MONTH 4 YEAR 2000

4. TYPE OF CASING FOR PROPOSED WELL:
SURFACE CASING: Steel
DIAMETER: 6 5/8" DEPTH: 20'

DOWNHOLE CASING: P.V.C
DIAMETER: 4" DEPTH: 500'

5. DESIGN PUMP CAPACITY:
35 GALLONS PER MINUTE

6. LESSEE OF LAND OF WELLSITE:
NAME
CURRENT MAILING ADDRESS
CITY STATE ZIP
TELEPHONE: - -

7. PRINCIPAL USE OF WATER: (BE SPECIFIC)
domestic use

8. OTHER USES OF WATER: (BE SPECIFIC).
None

FOR DEPARTMENT USE ONLY
REGISTRATION NO. 55-580835
DATE FILED 6/27/00
FILE NO. 05-5,33 CBC
AMA/INA Pinal
W/S 09 S/B 10
PROCESSED BY VB
DATE MAILED 6/23/00
W-XX

9. PLACE OF USE (LEGAL DESCRIPTION OF LAND):
SW ¼ (10AC) NW ¼ (40AC) SW ¼ (160AC) SECTION 33
TWNSHP 5 N/S RNG 5 E/W

10. TYPE OF WELL (CHECK ONE):
EXEMPT X NON-EXEMPT ____

11. CHECK ONE:
RESIDENTIAL X STOCKWATER ____
OTHER ____

12. IS THE PROPOSED WELLSITE WITHIN 100 FEET OF A SEPTIC TANK SYSTEM, SEWER DISPOSAL AREA, LANDFILL, HAZARDOUS MATERIALS OR PETROLEUM STORAGE AREAS AND TANKS?
YES ____ NO X

13. DRILLING FIRM:
Scallion Mountain Drilling
NAME
P.O Box 1449
MAILING ADDRESS
Queen Creek AZ 85242
CITY STATE ZIP
480-987-9355
TELEPHONE NO.
223
DWR LICENSE NUMBER
A-4 C-53
ROC LICENSE CATEGORY

I STATE THAT THIS NOTICE IS FILED IN COMPLIANCE WITH A.R.S. § 45-596, IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF AND THAT I UNDERSTAND THE LIMITATIONS AND CONDITIONS SET FORTH ON THE REVERSE SIDE OF THIS FORM.

Leslie Robert — Leslie Roberts — 4-17-00
14. TYPE OR PRINT NAME AND TITLE — 15. SIGNATURE OF LANDOWNER/LESSEE OF WELLSITE — 16. DATE

DWR 55-40 (REV 9/99)

APPLICATION GUIDELINES

In accordance with Arizona Revised Statutes ("A.R.S.") §§ 41-1008 and 1079, the Department of Water Resources (Department) provides the following information regarding the application review process for authority to drill.

NECESSARY STEPS & INSTRUCTIONS TO OBTAIN DRILLING AUTHORITY

1. Pursuant to A.R.S. § 45-596, a person may not drill, cause to be drilled, deepen or modify any well for which a permit is not required without first filing a Notice of Intent to Drill with the Department. Only a well drilling contractor licensed in the State of Arizona or a single well licensee (a person licensed to drill or modify one exempt well on his or her own property) is authorized to drill, deepen or modify a well. Drilling may not begin until the well drilling contractor or licensee has possession of a drilling card at the well site, issued by the Director in the name of the well drilling contractor or licensee, and which authorizes the drilling of the specific well in a specific location. To assist you in understanding the requirements for this application, copies of A.R.S. § 45-596 and Arizona Administrative Code ("A.A.C.") R12-15-810 are available at the Department bookstore (602-417-2450 x7127).
2. If replacing, deepening, or modifying an existing well, provide the registration number of the existing well in item 2. A replacement well is one located no more than 660 feet from the original well and that is not expected to annually withdraw more groundwater than historically withdrawn from the original well.
3. Information to complete items 3, 4, 5 and 13 may be available from your driller.
4. Information to complete items 9 and 12 may be available from your County Assessor's Office.
5. For item 10, in an Active Management Area, A.R.S § 45-454 only allows non-irrigation uses for "exempt" wells. If the proposed use includes the growing of 2 or more acres of plants for sale or human/animal consumption (irrigation use), the well does not qualify as an exempt well.
6. An exempt well, referred to in Item 10, means a well with a pump with a maximum capacity of not more than thirty-five gallons per minute and used for non-irrigation purposes.
7. For item 11, in an Active Management Area, A.R.S §45-454 allow up to 56 acre feet per year of pumping from a domestic (residential) or stock watering exempt well, and up to 10 acre ft per year from an exempt well used for other (usually commercial non-irrigation) purposes.
8. If any water from a proposed well on a parcel of twenty or fewer acres will be used for domestic purposes, as defined in § 45-454, the applicant must submit a well site plan of the property. The plan must be on an 8½" x 11" piece of plain paper with representation of the locations of all structures and proximity of adjacent lot lines, to scale. It must include the county assessor's parcel identification number. The plan must show the proposed well location and the location of any septic tank or sewer system that is either located on the property or within one hundred feet of the proposed well site, as well as indicating the measured shortest distance between the proposed well and existing septic tank system. **The plan must demonstrate that the well will not be drilled within one hundred feet of any septic or sewer system.**
9. The site plan must be approved by the county health authority, or by a local health authority in areas where the county health authority has delegated authority to approve septic or sewer systems. Endorsement by the county/local authority is based solely on the best available judgement that the proposed well, as shown on the site plan submitted, is 100 feet or more from all known and visually identifiable sewage treatment systems. It is not a representation that a well placed at this site will be guaranteed as to quantity or quality. In areas where there is no local or county authority that controls installation of septic tanks or sewer systems, or if the health authority is unable to determine whether the proposed well location complies with state and local requirements, the applicant must apply for approval directly to the Department of Water Resources.
10. If an individual other than the land owner or lessee signs this notice, an original letter of authorization from the land owner/lessee, stating that the individual has permission to sign this specific notice on his or her behalf, must accompany the notice.
11. Please mail **two original Notices with original signatures and two site plans and, in accordance with A.R.S. § 45-113, a check or money order (no cash) in the amount of $10.00** to P. O. Box 458, Phoenix Arizona, 85001-0458, or hand deliver to 500 North Third Street, Phoenix, Arizona.
12. Arizona Revised Statute § 45-596(D) provides that the Director of the Department is to determine whether or not all information required on this form has been submitted. If not, the person filing the Notice will be notified, and the drilling or modification of the well may **not** proceed.
13. This form is not applicable for non-exempt wells (those yielding more than thirty-five gallons per minute) within an Active Management Area. Contact Groundwater Management for further information regarding the appropriate notice to file with the Department.

TIME FRAME FOR REVIEW OF YOUR APPLICATION

Within 15 days after receipt of your Notice of Intention the Arizona Department of Water Resources ("Department") will determine whether your application should be granted or denied, unless this time is extended for lack of a complete application. If your application is incomplete, the Department will notify you in writing and will specify what information is necessary to make the application complete. Until the missing information is received, the time frame for review of your application will be suspended. Your application will not be complete until all of the requested information is received. If you do not supply the missing information within sixty (60) days, the Department may deem your application withdrawn and close the file.

At the end of its review, the Department will send you a written notice either granting or denying your application for drilling authority. If your application is approved, the Drill Card will be mailed directly to the drilling contractor. If denied, the Department's notice will state justification for the denial and an explanation of your right to appeal.

CONSTRUCTION AND FOLLOW UP REQUIREMENTS

1. Construction and abandonment standards for wells, must be in accordance with Department Regulations. A.R.S. § 45-594 and Arizona Administrative Code R12-15-811 require the well to be constructed with a twenty foot steel surface seal casing, including a one foot steel stickup and one and one-half inches of grout seal around the casing from the surface to a depth of twenty feet, unless a variance is granted (see **A.R.S. § 45-596 (G) for procedure to follow in requesting a variance**).
2. Pursuant to § 45-596(E), the drilling, deepening or modification of the well must be completed within one year of the date of the Notice of Intent. If the well is not completed within one year, a new Notice of Intent must be filed before proceeding with further construction.
3. If a well which was originally drilled as an exploration well, a monitor well, a piezometer well or for any use other than domestic use is later proposed to be converted to use for domestic purposes as defined in § 45-454, the well owner must file a Notice of Intention to Drill and comply with the requirements of § 45-596 before the well is converted and any water from that well is used for domestic purposes.
4. Within thirty days after installation of pumping equipment, the registered well owner must file a Completion Report with the Department. The person to whom a well is registered also must notify the Department of a change in ownership or a change in data relating to this well.

ARIZONA DEPARTMENT OF WATER RESOURCES
500 North 3rd Street
Phoenix, Arizona 85004

RECEIVED
NOV 20 2000
RECORDS MGT

WELL DRILLER REPORT

This report should be prepared by the driller in all detail and filed with the Department within 30 days following completion of the well.

1. ENVIRONMENTAL DRILLING & PUMP SERVICE, INC.
64 WEST RED FERN ROAD
QUEEN CREEK, AZ 85242-8234

2. Owner Name: Leslie & Joanna Roberts
Address: Queen Creek (City) AZ (State) 85242 (Zip)

3. Location: 5 (N/S) 5 (E/W) 33 (Township / Range / Section) ¼ SW (10-acre) ¼ NW (40-acre) ¼ SW (160-acre)

4. Well Registration No. 55-580835 (Required)

5. Permit No. _____ (If Issued)

DESCRIPTION OF WELL

6. Total depth of hole 360 ft.
7. Type of casing Steel & PVC
8. Diameter and length of casing 6 in. from 0 to 20, 4" PVC in from 0 to 360
9. Method of sealing at reduction points Neat Cement
10. Perforated from 300 to 360, from _____ to _____ from _____ to _____
11. Size of cuts .032 Number of cuts per foot 10
12. If screen was installed: Length _____ ft. Diam _____ in. Type _____
13. Method of construction ~~driven~~ Air
(drilled, dug, driven, bored, jetted, etc)
14. Date started 11 (Month) 1 (Day) 00 (Year)
15. Date completed 11 (Month) 3 (Day) 00 (Year)
16. Depth to water 300ft ft. (If flowing well, so state)
17. Describe point from which depth measurements were made, and give sea_level elevation if availabl
Top of Casing
18. If flowing well, state method of flow regulation: _____
19. Remarks: _____

COMPLETED NOV 30 2000

DWR-55-55-7/95 (Rev.)

DO NOT WRITE IN THIS SPACE
OFFICE RECORD
Registration No. 55- 580835
File No. D(5-5) 33 CBC
Received _____ By _____
Entered _____ By _____

LOG OF WELL

Indicate depth at which water was first encountered, and the depth and thickness of water bearing beds. If water is artesian, indicate depth at which encountered, and depth to which it rose in well.

From (feet)	To (feet)	Description of formation material
0	40	Sand & Gravel
40	80	Clay
80	200	Gravel
200	300	Decomposed Granite
300	360	Granite & Rock

I hereby certify that this well was drilled by me (or under by supervision), and that each and all statements herein contained are true to the best of my knowledge and belief.

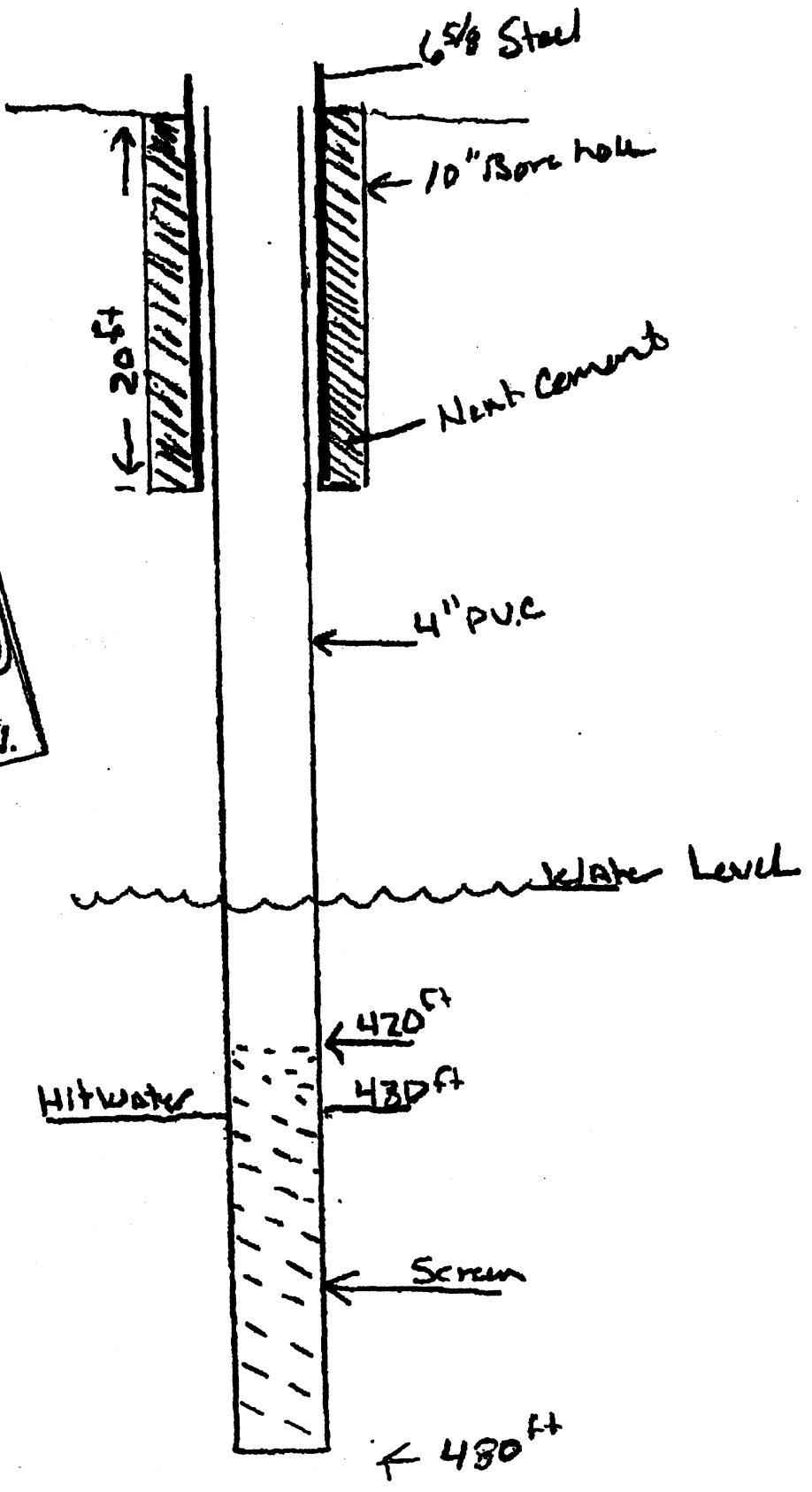
Driller Name: ENVIRONMENTAL DRILLING & PUMP SERVICE, INC

64 WEST RED FERN ROAD
Street

QUEEN CREEK, AZ 85242-8234
City State Zip Phone No.

Signature of Driller

11/5/00
Date



55-580835
Roberts

ARIZONA DEPARTMENT OF WATER RESOURCES
Hydrology Division
500 North Third Street, Phoenix, Arizona 85004
Telephone (602) 417-2448
Fax (602) 417-2425

JANE DEE HULL
Governor

RITA P. PEARSON
Director

May 2, 2000

LESLIE & JOANNA ROBERTS
23138 E. MUNOZ STREET
QUEEN CREEK, AZ 85242

Re: Notice of Intention to Drill a Domestic Well
Well Registry No. 55-580835
T5S, R5E, Section 33CBC

Dear Mr. and Ms. Roberts:

The Arizona Department of Water Resources received on April 18, 2000, your Notice of Intention to Drill a domestic well in Pinal County. The proposed location of your well is in proximity to an area of groundwater contamination known as the Hexcel Waste Dump.

Special considerations and/or well construction requirements may be applicable when working in this area to avoid possible vertical cross-contamination between aquifers and /or other problems that may be encountered when working in a contaminated area.

Your driller, Jerry White of Environmental Drilling, has been asked to submit a well diagram for our review.

The Department's administrative completeness time frame review is suspended until all requested information is provided.

Please call if you have any questions: 602-417-2400, extension 7258.

Sincerely,

Kay McNeely,
Hydrologist

cc: Driller
File

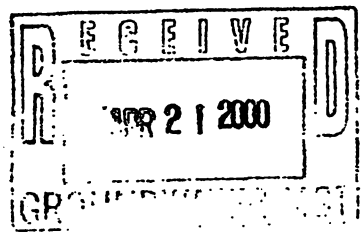
DATE: 4/17/2000 Mon PINAL COUNTY
TIME: 12:51:23 PM Planning & Development GENERAL INQUIRY SCREEN03
INQUIRY

Parcel.: 502-41-0170-0 0001/none T/R/S: 05S/05E/33 Acres: 0.000
Owner..: ROBERTS TIMOTHY & JOANNA & LES Deed: 42356-000
Address: 23138 E MUNOZ ST
City/ST: QUEEN CREEK AZ 85242
Use....: 0013 VACANT RESIDENTIAL RURAL SUBDIVIDED Non-municipality

Situs..: an assessor's clone Atlas Map: 058
City/ST:
Residnt: line-2 _____
line-3 _____
LEGAL DESCRIPTIONS: line-4 _____

1. GIBSON COLLARD DEVELOPMENT IN S2 SEC 33 5S 5E TRCT 16
2.
3.
4.
5.
6.
7.

F4=additional_DOR_info version_3/30/1999_
F3=Exit F5=Return to Selection Screen F10=Return to Prior Screen
F13=SITUS DISPLAY



ROBERTS

WQARF/CERCLA ROUTING SHEET

REGISTRATION N° 55- 580835
Date Received 4-21-00
Date Returned to GMSS 6-20-00

CADASTRAL LOCATION D(5-5)33CBC
Date to Water Quality 4-27-00
Date to Hydrology 5-01-00 @ 1200 HRS

Variance Letter Received Yes ____ No ✓
Well Diagram received Yes ____ No ✓

TYPE OF WELL:

Monitor/Piezometer ____
Domestic 1
Geotechnical ____
Other ____
NOI to Abandon ____

WATER QUALITY – WOARF ANALYST COMMENTS:

Drilling one domestic well located in the vicinity of an old waste dump ("Hexcel Waste Dump") - Not a WQARF site. Soil contamination consisted of chromium - no impact to groundwater. However, organics detected in groundwater in the area. See attached information.

Site Map attached – Referred to Hydrologist ✓
Subbasin map attached – returned to GMSS ____

RECEIVED
APR 27 2000
@ 1515 HRS
WATER QUALITY SECTION

WATER QUALITY APPROVAL:

Granted ✓
Not granted ____
Letter issued ____ no letter issued

Signature: Shannon L. Reif Date: 5/01/00

HYDROLOGY DIVISION – WOARF HYDROLOGIST COMMENTS:

CLOCK STOPPED 5-2-00 Requested a well diagram
CLOCK RESTARTED 6-20-00 well diagram received

HYDROLOGY DVISION APPROVAL:

Granted ✓
Not Granted ____
Letter Issued ____

Variance
Not Required ✓
Granted ____
Not Granted ____
Letter issued ____

Signature: Ray McNeely Date: 6-20-00

Revision Date: 12/2/99 CERCLARTNG

KB

APPENDIX D
ADWR WATER QUALITY DATABASE FOR WELLS IN THE VICINITY OF THE SACATON MINE

Appendix D
ADWR Water Quality Database for Wells in the Vicinity of the Sacaton Mine

Maricopa-Stanfield Subbasin

Cadastral	Site Id	Reg No.	Date	V	Spec. Cond.	Fluoride	Temp	pH	Alkalinity	Dis. Oxygen
D-05-03 01BAB	330143112003001	612720	4/23/1984		2,010	1	25			
D-05-03 01BAB	330143112003001	612720	7/1/1986		1,720	1.2	26			
D-05-03 01BAB	330143112003001	612720	7/13/1988		2,040	1	26	7.3		
D-05-03 01BAD	330134112002001	612705	7/1/1986		2,050	0.9	25.5			
D-05-03 01BAD	330134112002001	612705	7/13/1988		2,250	0.8	26	7.2		
D-05-03 01CDD	330054112001901	623827	5/1/1986		1,810	0.7	25			
D-05-03 01CDD	330054112001901	623827	9/13/1988		1,820	0.7	25.5	7.3		
D-05-03 01CDD	330054112001901	623827	7/14/1998		2,175		25	7		
D-05-03 01DAD1	330107112000501		2/1/1958	D	nd		25			
D-05-03 02DCC	330054112010601	612537	8/25/1976		606	0.7	26			
D-05-03 03BCC	330117112024801	612714	7/3/1986		1,525	1	26			
D-05-03 03BCC	330117112024801	612714	7/17/1988		1,850	0.9	26.5	7.5		
D-05-03 03BDD	330119112022001	612717	7/2/1986		1,350	1	26			
D-05-03 03BDD	330119112022001	612717	7/18/1988		2,260	0.9	26	7.3		
D-05-03 03CCC	330053112024801	612713	7/15/1988		1,770	1	26	7.6		
D-05-03 03CDD2	330053112022001	612716	7/18/1988		1,950	0.9	26	7.5		
D-05-03 03DAA	330112112014801	612719	7/2/1986		1,380	0.7	25			
D-05-03 03DAA	330112112014801	612719	7/15/1988		1,480	0.7	25.5	7.3		
D-05-03 03DCD	330052112020501	612715	7/1/1986		1,430	0.9	26			
D-05-03 03DCD	330052112020501	612715	7/18/1988		1,440	0.8	26.5	7.4		
D-05-03 11BDD2	330025112012401	612541	4/23/1984		1,020	0.8	25			
D-05-03 11BDD2	330025112012401	612541	7/14/1998		1,120		26	7.5		
D-05-03 11CDC	330007112004301	612533	4/23/1984		665	1.2	25			
D-05-03 11CDC	330007112004301	612533	7/9/1986		720	0.8	25.5			
D-05-03 11CDD	330003112012001	612532	6/10/1993		965	0.6	24	7.5		
D-05-03 11CDD	330003112012001	612532	7/13/1998		1,130		25	7.2		
D-05-03 12AAD	330040111595101		9/13/1949		638		25.5			
D-05-03 12AAD	330040111595101		8/11/1976		843	4.5	36			
D-05-03 12CAA	330022112001701	612539	2/23/1988		1,925	0.8	25			
D-05-03 12CAA	330022112001701	612539	6/3/1993		1,725	0.8	24	7.4		
D-05-03 12CAA	330022112001701	612539	7/14/1998		1,975		24.5	7.2		
D-05-03 12CCC2	330001112004101	612531	8/11/1976		1,100	0.6	26			
D-05-03 12CCC2	330001112004101	612531	7/9/1986		1,390	0.8	25.5			
D-05-03 12CCC2	330001112004101	612531	6/10/1993		1,675	0.9	24.5	7.3		
D-05-03 12CCC2	330001112004101	612531	7/13/1998		1,470		26	7.2		
D-05-03 12CDD2	330000112001801	86247	5/10/1993		470	0.7	40.5	9.1		
D-05-03 12DAD	330014111594701	623825	5/1/1986		1,340	0.9	27			
D-05-03 12DDD	325957111594701	623824	5/1/1986		1,300	0.8	26			
D-05-03 12DDD	325957111594701	623824	6/12/1986		1,370	0.8	27			
D-05-03 12DDD	325957111594701	623824	9/13/1988		1,500	0.7	26	7.4		
D-05-03 12DDD	325957111594701	623824	5/7/1993		1,615	0.6	25.5	7.1		
D-05-03 12DDD	325957111594701	623824	7/9/1998		1,960		25	7.3		
D-05-03 13BAA	325955112002201		9/17/1941		602		24.5			
D-05-03 16CCC1	325908112035001	615359	4/2/1984		4,200	0.8	25			
D-05-03 16CCC1	325908112035001	615359	7/17/1984		4,750	0.7	25	7.2	304	
D-05-03 16CCC1	325908112035001	615359	8/7/1985		3,990	0.9	25	7.2	293	
D-05-03 16CCC1	325908112035001	615359	6/5/1986		4,000	1.2	25			
D-05-03 16CCC1	325908112035001	615359	7/9/1986		3,900	1.2	25.5	7.5	244	
D-05-03 16CCC2	325909112035001	615361	8/12/1976		459	2.5	29			
D-05-03 16CCC2	325909112035001	615361	4/2/1984		488	3	28.5			
D-05-03 16CCC2	325909112035001	615361	7/17/1984		480	4.5	28.5	8.3	111	
D-05-03 16CCC2	325909112035001	615361	8/7/1985		500	3.9	29	8	124	
D-05-03 16CCC2	325909112035001	615361	6/5/1986		500	4.5	28			
D-05-03 16CCC2	325909112035001	615361	7/9/1986		505	4.4	29	8.3	114	
D-05-03 16CCC2	325909112035001	615361	7/28/1987		535	4.8	28.5	8.2	114	
D-05-03 16CCC2	325909112035001	615361	3/17/1988		565	3.2	29	8.4	113	
D-05-03 16CCC2	325909112035001	615361	3/8/1989		830	3	28.5	8.2	116	
D-05-03 16CCC2	325909112035001	615361	7/8/1991		650	5.1	29.5	8.4	76	
D-05-03 16CCC2	325909112035001	615361	5/23/1994		580	5.1	29	8.4	78	
D-05-03 16CCC2	325909112035001	615361	4/4/1995		585	4.8	28	8.6	91	
D-05-03 16CCC2	325909112035001	615361	6/11/2001		660	4.4	28.5	8.4	91	2
D-05-03 16DCC	325908112032001	615360	4/2/1984		2,700	1.1	24			
D-05-03 16DCC	325908112032001	615360	6/5/1986		3,500	1.1	25.5			
D-05-03 16DDD1	325906112025701	615362	4/5/1984		3,200	0.8	24			
D-05-03 16DDD1	325906112025701	615362	6/4/1986		3,300	0.8	24.5			
D-05-03 16DDD2	325905112025701	615358	4/2/1984		4,150	1	24			
D-05-03 17CCB	325916112045401	612414	6/11/1986		435	0.6	29.5			
D-05-03 17CCB	325916112045401	612414	7/6/1998		3,380		28	7.1		
D-05-03 17CCC2	325910112045401	612246	6/11/1986		400	0.8	30			
D-05-03 17CCC2	325910112045401	612246	6/13/1989		460	0.8	33	8.7		
D-05-03 17CCC2	325910112045401	612246	7/6/1998		1,800		29	7.8		
D-05-03 17DCC2	325908112042401	612416	1/5/1977		461	3.2	29			
D-05-03 17DCC3	325908112042101	612247	8/12/1976		970	0.5	29			
D-05-03 17DCC3	325908112042101	612247	6/13/1989		1,000	1	28.5	7.9		
D-05-03 17DCC3	325908112042101	612247	6/9/1993		1,460	0.3	27.5	7.5		
D-05-03 18BCC	325934112055601	502819	6/13/1989		710	10	33	8.3		
D-05-03 18BCC	325934112055601	502819	8/10/1989		669	7	32.5	8.3		
D-05-03 18CCC2	325910112055001	625626	8/12/1976		732	2.5	31			
D-05-03 18CCC2	325910112055001	625626	6/13/1989		764	4.5	31.5	8.3		

Appendix D
ADWR Water Quality Database for Wells in the Vicinity of the Sacaton Mine

Maricopa-Stanfield Subbasin

Cadastral	Site Id	Reg No.	Date	V	Spec. Cond.	Fluoride	Temp	pH	Alkalinity	Dis. Oxygen
D-05-03 18CCC2	325910112055001	625626	5/13/1993		790	4	32	8.3		
D-05-03 18CDD	325905112052601	625628	7/6/1989		609	5.5	33	8.6		
D-05-03 18CDD	325905112052601	625628	5/13/1993		555	5	33.5	8.3		
D-05-03 19BBB	325859112055301		8/29/1962		650	1.8	30.5	7.9		
D-05-03 19DBC	325820112055401	612407	6/6/1987		685	0.7	31			
D-05-03 19DBC	325820112055401	612407	6/16/1989		680	0.9	31.5	8.3		
D-05-03 19DBC	325820112055401	612407	6/7/1993		620	1	31.5	8.4		
D-05-03 19DBC	325820112055401	612407	7/21/1998		625		34	8		
D-05-03 19DCC	325811112052601	612406	6/6/1986		850	1.2	30			
D-05-03 20CCC	325813112045101	625624	4/3/1984		455	1.4	30			
D-05-03 20DBB	325834112042201	612249	6/13/1986		545	1	28.5			
D-05-03 20DCC2	325814112042101	612248	6/13/1986		540	0.8	28.5			
D-05-03 20DCC2	325814112042101	612248	6/16/1989		630	0.8	28.5	8.4		
D-05-03 21DBC	325829112032001	624093	4/3/1984		2,440	1				
D-05-03 21DBC	325829112032001	624093	11/2/1993		2,580	0.9	25	7.6		
D-05-03 21DBC	325829112032001	624093	7/28/1998		2,800		26	7.5		
D-05-03 21DCC1	325815112031901		9/1/1962	D			25			
D-05-03 21DCC2	325817112031801	86952	11/2/1993		4,180		24	7.3		
D-05-03 21DCC2	325817112031801	86952	7/28/1998		4,430	1.2	25	7.4		
D-05-03 22ADD	33584411201520 1		7/25/1984		1,265	6.5	25			
D-05-03 25ADD	325746111595201		1/3/1977		883	0.5	24			
D-05-03 25CBB	325749112004501	605592	7/8/1986		770	0.9	25.5			
D-05-03 26CDC	325725112012501	605589	7/8/1986		820	1.5	25.5			
D-05-03 26CDC	325725112012501	605589	6/15/1993		840	1	24.5	7.7		
D-05-03 27BCD	335750112023901		7/25/1984		2,210	0.8	25			
D-05-03 27BDD	325745112021701	625558	7/25/1984		1,800	0.8	24.5			
D-05-03 28BCB	325759112035101	612250	4/5/1984		710	1.8	27			
D-05-03 28BCB	325759112035101	612250	7/11/1989		550	1.3	27.5	8.2		
D-05-03 28BCB	325759112035101	612250	6/3/1993		910	1.4	26.5	8.1		
D-05-03 28CBB	325750112034801	612402	8/12/1976		5,460	0.6	25			
D-05-03 29BCC2	325749112045201	625623	4/4/1984		450	0.7	29.5			
D-05-03 29BCC2	325749112045201	625623	6/4/1986		520	0.6	29			
D-05-03 29CBC	325734112045401	625627	4/4/1984		430	0.8	29			
D-05-03 29CBC	325734112045401	625627	6/4/1986		450	0.7	29			
D-05-03 29CBC	325734112045401	625627	7/28/1998		595		30	8		
D-05-03 29CCC1	325717112045501	625629	8/12/1976		491	0.8	31			
D-05-03 29CCC2	325717112045401	625622	4/4/1984		505	1.1	29			
D-05-03 29CCC2	325717112045401	625622	6/3/1986		520	1.2	28.5			
D-05-03 30BCC	325747112055601	615366	4/3/1984		1,050	4.5				
D-05-03 30CCB	325725112055601	615365	8/12/1976		1,110	2	31.5			
D-05-03 30CCB	325725112055601	615365	6/21/1989		1,580	3.5	30.5	7.9		
D-05-03 30DBB	325742112052601	612405	6/21/1989		820	3.5	29	8.2		
D-05-03 30DCC3	325718112051401	612404	6/21/1989		980	3.5	29.5	8.1		
D-05-03 31CCC	325628112052801	612415	8/12/1976		1,310	2.5	32			
D-05-03 31DCC	325623112052601	801351	6/6/1986		1,220	4.5	30.5			
D-05-03 31DCD	325624112051501	801350	6/6/1986		840	3.9	28			
D-05-03 33DCB1	325638112032001	610736	4/5/1984		4,300	1.1	25			
D-05-03 33DCB1	325638112032001	610736	8/31/1984		4,600	0.6	25.5	7.5	113	
D-05-03 33DCB2	325635112032001	610738	4/5/1984		695	2.5	28			
D-05-03 33DCB2	325635112032001	610738	8/31/1984		1,090	1.2	28	8.2	89	
D-05-03 35AAA	325716112005001	625554	5/24/1993		825	0.6	25	7.5		
D-05-03S25BAA	325720112001701	605591	7/8/1986		765	1	25			
D-05-03S25BAB	325724112002901	605590	9/1/1941	D	nd		25.5			
D-05-03S25BAB	325724112002901	605590	8/13/1976		759	0.7	27			
D-05-03S25BAB	325724112002901	605590	7/3/1986		780	0.8	25.5			
D-05-03S28BAB	325720112032901	612403	6/13/1986		2,800	1.6	25			
D-05-03S28BBB2	325720112035201	612401	6/13/1986		505	1	28			
D-05-03S34AAA1	325625112015201		9/20/1941		502		25.5			
D-05-03S35AAA	325626112005101		9/16/1941		600		25.5			
D-05-04 03CAD	330109111561301		8/26/1976		865	2.5	32			
D-05-04 03CAD	330109111561301		5/21/1984		980	1.5	31			
D-05-04 03CDD	330052111561301		9/2/1982		1,610	2.1	29.4	8.2	88	
D-05-04 04DCC2	330052111571101	624040	7/10/1986		2,250	1.1	26			
D-05-04 05DCC	330052111580701	609901	5/21/1984		825	2	29			
D-05-04 05DCC	330052111580701	609901	6/18/1986		640	1.6	30.5			
D-05-04 05DDD1	330052111574601	609899	11/3/1988		1,950	1	25.5	7.4		
D-05-04 05DDD1	330052111574601	609899	11/3/1988		1,950	1	25.5	7.4		
D-05-04 06CDD2	330052111591501	618176	8/25/1976		1,460	0.7	27			
D-05-04 07DBC	330012111590901	623830	6/12/1986		640	3.5	33			
D-05-04 07DBC	330012111590901	623830	9/13/1988		660	3.2	36	8.9		
D-05-04 07DBC	330012111590901	623830	5/10/1993		830	0.8	33	8.5		
D-05-04 07DCD	325959111585701	623831	6/12/1986		1,290	1	27			
D-05-04 07DCD	325959111585701	623831	9/13/1988		580	5.5	36	8.7		
D-05-04 07DCD	325959111585701	623831	5/10/1993		1,470	1	26.5	7.4		
D-05-04 07DCD	325959111585701	623831	7/9/1998		1,550		29	7.4		
D-05-04 07DDD	325958111585001	623828	4/24/1984		850	2.8	30			
D-05-04 07DDD	325958111585001	623828	6/12/1986		823	2.2	31			
D-05-04 08ACB	330034111581201		5/22/1984		480	1.6	33			
D-05-04 08DAA	330020111574701		1/18/1983		1,880	1	26			

Appendix D
ADWR Water Quality Database for Wells in the Vicinity of the Sacaton Mine

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Cadastral	Site Id	Reg No.	Date	V	Spec. Cond.	Fluoride	Temp	pH	Alkalinity	Dis. Oxygen
D-05-04 08DAA	330020111574701		5/22/1984		1,800	1	26			
D-05-04 08DAA	330020111574701		7/17/1984		1,640	0.7	26.5	7.3	107	
D-05-04 08DAA	330020111574701		7/29/1998		1,950		26	7.2		
D-05-04 08DCC	330003111581201	605058	8/25/1976		479	0.9	33			
D-05-04 08DCC	330003111581201	605058	5/10/1993		620	1.6	33	8.3		
D-05-04 09ADD	320028111565801	622119	8/14/1989		610	1	32	8		
D-05-04 10ADD	330030111554701	622123	11/3/1988		1,300	1.5	29	7.1		
D-05-04 10CCD	325957111563601	622120	4/27/1984		1,090	1	30			
D-05-04 10CCD	325957111563601	622120	8/14/1989		795	0.9	30	7.7		
D-05-04 10CCD	325957111563601	622120	7/29/1998		1,460		31	7.3		
D-05-04 14CCC	325908111554001	620625	4/16/1984		945	6				
D-05-04 17CDA UNSURV	325907111581201		4/24/1984		408	0.8				
D-05-04 20AB UNSURV	325847111575301		4/24/1984		460	4.5				
D-05-04 20CD1 UNSURV	325810111582401		7/10/1984		430	2.2	35.5	8.5	85	
D-05-04 20CD2 UNSURV	325802111582201		4/24/1984		1,850	1.1	25.5			
D-05-04 20CD2 UNSURV	325802111582201		7/10/1984		1,850	0.8	26	7.2	103	
D-05-04 20DD UNSURV	325802111574701		4/24/1984		398	1	32			
D-05-04 23BBB	325901111554001	620626	4/16/1984		955	3.2	31			
D-05-04 28DDA	323729111565001	623839	8/9/1976		1,740	0.6	29			
D-05-04 29DDD	325716111574801	622158	11/9/1988		430	2.5	30.5			
D-05-04 29DDD	325716111574801	622158	7/10/1989		405	0.8	32	8.6		
D-05-04 30DDD2UNSURV	325709111585201	606256	8/9/1976		930	0.4	27			
D-05-04 30DDD2UNSURV	325709111585201	606256	8/16/1989		1,280	0.8	25	7.6		
D-05-04 30DDD2UNSURV	325709111585201	606256	10/24/1990		1,220	0.7	26	7		
D-05-04 31DDD	325629111585001	806277	9/16/1941		534		25			
D-05-04 32ADD	325154111575001	622159	9/16/1941		526		25			
D-05-04 32ADD	325154111575001	622159	8/9/1976		621	0.7	30			
D-05-04 32ADD	325154111575001	622159	11/9/1988		1,140	2	25.5			
D-05-04 32ADD	325154111575001	622159	8/16/1989		1,200	1	25.5	7.7		
D-05-04 32ADD	325154111575001	622159	10/24/1990		1,280	1	26	6.9		
D-05-04 32DDD	325628111575001		9/16/1941		502		25		145	
D-05-04 32DDD	325628111575001		7/27/1976		734	0.5	30			
D-05-04 33AAD	325707111564401	623836	7/27/1998		2,370	0.8	28	7.4		
D-05-04 33DBB	325643111571201	623837	4/26/1984		478	0.5	31			
D-05-04 33DBB	325643111571201	623837	7/17/1998		480		32.5	8.3		
D-05-04 35CCB	325633111553801	606187	9/23/1941		604	0.8	25		120	
D-05-04 35CCB	325633111553801	606187	9/14/1949		1,200	0.5			132	
D-05-04 35CCB	325633111553801	606187	8/23/1950		1,360	0.5			125	
D-05-04 35DDD	325622111544201	606188	7/8/1986		1,020	1.5	28			
D-05-04 35DDD	325622111544201	606188	5/4/1993		1,230	1.4	28	7.4		
D-05-04S27BAA	325803111561901		4/26/1984		862	0.5	29			
D-05-04S27BBA	325802111563001		4/26/1984		824	0.4	29			
D-05-04S27BBB	325802111564101		4/26/1984		568	0.5	29			
D-05-04S27CDD	325709111561301	623427	9/13/1984		760	0.5	30			
D-05-04S27CDD	325709111561301	623427	6/20/1985		716	0.2	29			
D-05-04S27DAC	325727111555401	612722	9/13/1984		1,640	0.7	30			
D-05-04S27DAC	325727111555401	612722	7/5/1989		1,500	0.5	28	7.5		
D-05-04S27DDD	325720111554701	612721	4/17/1984		1,360	0.9	28			
D-05-04S27DDD	325720111554701	612721	9/12/1984		1,440	1.1	29			
D-05-04S27DDD	325720111554701	612721	6/20/1985		1,500	1	28.5			
D-05-04S27DDD	325720111554701	612721	6/12/1989		1,750	1	29.5	7.4		
D-05-05 16CBA	335917111512401	635823	5/4/1984		470	4.5				
D-05-05 20DAA	325828111513801		5/4/1984		9,500	3.5				
D-05-05 21BBC	335844111513401	635824	5/4/1984		5,050	4.5				
D-05-05 31ADD	325649111523801	606192	8/20/1984		1,990	3.1	30.5	7.6	127	
D-06-03 02DAD	325541111595301		9/1/1941	D	479		25.5			
D-06-03 03DAA	325548112005301		9/16/1941		nd		25.5			
D-06-03 03DDD	325548112005401		9/16/1941		488	1.4	24			
D-06-03 06CCC1	325523112045601		9/15/1949		974	2.9	26.5			
D-06-03 06CCC1	325523112045601		8/12/1976		1,100	2.5	32			
D-06-03 06CCC1	325523112045601		7/17/1984		1,120	3.8	30	7.9	198	
D-06-03 06CCC2	325523112045701	625621	4/11/1984		1,340	0.9	29			
D-06-03 06CCC2	325523112045701	625621	6/22/1989		1,310	4.5	29	8.1		
D-06-03 06CCC2	325523112045701	625621	5/3/1993		1,260	3	29	7.9		
D-06-03 06CCC2	325523112045701	625621	7/21/1998		1,330		30	7.9		
D-06-03 06DDD	325523112040001	610460	8/13/1976		554	1.2	27			
D-06-03 06DDD	325523112040001	610460	5/18/1993		575	1.5	28	8		
D-06-03 07BDD	335457112042801	625620	6/4/1986		1,140	4	30			
D-06-03 07BDD	335457112042801	625620	5/18/1993		1,160	3	30.5	8		
D-06-03 07BDD	335457112042801	625620	6/8/1993		1,140	4	29.5	8		
D-06-03 07DCA	325442112041301	622034	5/21/1993		1,225	2	28.5	8.3		
D-06-03 07DCA	325442112041301	622034	7/21/1998		1,240		29	7.9		
D-06-03 08BCC2	325459112035801		8/13/1976		785	1.3	30			
D-06-03 09BBB	325520112025401		9/16/1941		844		25			
D-06-03 09BCC2	325454112025401		3/29/1961		1,340		22	7.2		
D-06-03 09CBA	325455112024601		4/6/1984		855	1.2	26			
D-06-03 09CCC2	325432112025201	801231	6/10/1986		540	1.3	27.5			
D-06-03 09CCC2	325432112025201	801231	7/28/1987		540	1.2	28	8	143	
D-06-03 10CCC1	325431112015101		9/16/1941		641	1.2	25.5			

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Cadastral	Site Id	Reg No.	Date	V	Spec. Cond.	Fluoride	Temp	pH	Alkalinity	Dis. Oxygen
D-06-03 10CCC1	325431112015101		9/14/1949		541	1.6	25.5			
D-06-03 10CCC2	325431112014901	625531	8/25/1976		479	0.7	25.5			
D-06-03 10CCC2	325431112014901	625531	4/6/1984		475	3	27.5			
D-06-03 10CCC2	325431112014901	625531	6/14/1989		655	1	27.5	8.2		
D-06-03 10CCC2	325431112014901	625531	6/1/1993		500	1	27.5	8		
D-06-03 11CDD2	325432112002101	605532	6/3/1986		400	1	27			
D-06-03 11CDD2	325432112002101	605532	6/1/1993		480	1.1	26.5	8.5		
D-06-03 11DDD	325432111595201	605531	9/16/1941		465	1.4	25.5			
D-06-03 11DDD	325432111595201	605531	8/25/1976		1,300	0.3	27			
D-06-03 11DDD	325432111595201	605531	5/8/1984		920	0.5	24			
D-06-03 11DDD	325432111595201	605531	6/3/1986		840	0.6	24.5			
D-06-03 11DDD	325432111595201	605531	6/1/1993		805	0.2	24.5	7.7		
D-06-03 12DCD	325430111590501	623916	6/22/1989		510	0.1	28.5	8.3		
D-06-03 12DCD	325430111590501	623916	7/8/1998		445		28.5	7.8		
D-06-03 13ACD	325404111590401	623914	4/18/1984		nd		27			
D-06-03 13ACD	325404111590401	623914	7/6/1989		445	0.6	28	8.2		
D-06-03 13ACD	325404111590401	623914	5/17/1993		415	0.6	28	8.2		
D-06-03 13ACD	325404111590401	623914	7/8/1998		425		28.5	8		
D-06-03 13ADD	325407111585101	623917	8/9/1976		422	0.4	29			
D-06-03 13ADD	325407111585101	623917	4/18/1984		410	0.6	26.5			
D-06-03 13ADD	325407111585101	623917	5/17/1993		415	0.6	28	8.2		
D-06-03 13ADD	325407111585101	623917	7/8/1998		410		28	7.9		
D-06-03 15ACC	325406112010701	625530	4/10/1984		630	0.9	26.5			
D-06-03 15ADD	325404112005401	625552	4/10/1984		420	2.5	26.5			
D-06-03 15ADD	325404112005401	625552	6/14/1989		500	0.6	27.5	8.4		
D-06-03 15ADD	325404112005401	625552	6/1/1993		1,320	0.6	24.5	7.3		
D-06-03 15BCC1	325405112015101		9/16/1941		582		25.5		180	
D-06-03 15BCC3	325406112015101	625532	8/25/1976		566	0.7	29			
D-06-03 15BCC3	325406112015101	625532	4/10/1984		540	1.1	28.5			
D-06-03 15BDC	325406112014201	625533	4/10/1984		600	1.1	28			
D-06-03 15BDC	325406112014201	625533	5/3/1993		810	1.1	27.5	7.5		
D-06-03 16CCC2	325341112025001	615403	8/31/1982		1,090	2.4	28	7.8	204	
D-06-03 17ACC	325407112032401		3/6/1989		1,040	1.8	28	8	190	
D-06-03 17ACC	325407112032401		3/4/1991		1,240	2	27.5	8	163	
D-06-03 17ACC	325407112032401		3/5/1992		1,000	1.6	25.5	8	199	
D-06-03 17ACC	325407112032401		3/2/1993		1,050	1.6	28	8.2	206	
D-06-03 17ACC	325407112032401		7/15/1994		1,010	1.8	27.5	7.9	196	
D-06-03 17ACC	325407112032401		4/4/1995		1,250	1.9	28	8.1	156	
D-06-03 17ACC	325407112032401		4/17/1996		950	1.8	27.8	8.2	189	
D-06-03 17ACC	325407112032401		4/22/1997		1,050	1.7	26	8.1	196	4
D-06-03 17ACC	325407112032401		4/28/1998		995	2.1	27.5	8	194	7
D-06-03 17ACC	325407112032401		4/27/1999		1,040	1.7	28	8	190	8
D-06-03 17ACC	325407112032401		5/1/2000		1,020	1.8	28	8.1	202	8
D-06-03 17BAA	325429112032601	622036	7/27/1998		663	1	29	8.1		
D-06-03 17CBB	325359112035101	622035	5/18/1993		1,725	2	28	7.8		
D-06-03 17DCC	325339112032301	612410	5/21/1993		1,260	3.5	30	7.2		
D-06-03 18BAA	325428112042801	622033	6/14/1989		1,675	3.2	31	8		
D-06-03 18BAA	325428112042801	622033	5/18/1993		1,725	3.5	31.5	8		
D-06-03 19AAA	325430112040101	612412	8/25/1976		1,550	2.5	32			
D-06-03 21BCC1	325314112025301		1/18/1958		961	2.4	26.5	7.9		
D-06-03 22CAA	325307112012501	625537	6/26/1989		730	1.6	28.5	8.5		
D-06-03 22DCC	325250112012601	625536	3/22/1987		1,078	1.6	28	7.7	222	
D-06-03 22DCC	325250112012601	625536	7/28/1987		1,060	1.9	28	7.7	194	
D-06-03 22DCC	325250112012601	625536	8/18/1994		1,200		28	8		
D-06-03 23ACC	325312112001801	625550	9/14/1984		559	1.1	30			
D-06-03 23ACC	325312112001801	625550	8/10/1989		550	1.2	30	8.5		
D-06-03 23ACC	325312112001801	625550	5/27/1993		550	1.1	29.5	8.3		
D-06-03 23BCC	325312112004901	625538	9/16/1941		535		26			
D-06-03 23BCC	325312112004901	625538	8/24/1976		644	0.7	31			
D-06-03 23CDD	325250112002501	625534	8/24/1976		577	0.9	28.5			
D-06-03 23DCA	325252112000601		9/18/1984		660	1	29			
D-06-03 23DCC	325249112001801		9/16/1941		507	1.6	25.5			
D-06-03 23DCC	325249112001801		9/14/1949		555		26.5			
D-06-03 23DCC	325249112001801		8/23/1950		545		26.5			
D-06-03 24ADD	325314111585101	604529	9/16/1941		703	0.9	24			
D-06-03 24ADD	325314111585101	604529	3/1/1942	D	nd		23.8			
D-06-03 24ADD	325314111585101	604529	8/12/1987		925	0.8	25	7.5		
D-06-03 24ADD	325314111585101	604529	7/21/1998		765		25.5	7.4		
D-06-03 24DBB	325308111591401	604531	8/26/1976		424	0.2	27			
D-06-03 24DBB	325308111591401	604531	4/18/1984		420	0.6	26			
D-06-03 24DBB	325308111591401	604531	8/12/1987		442	0.6	27	8.2		
D-06-03 24DBB	325308111591401	604531	7/21/1998		447		27	7.9		
D-06-03 24DDD1	325245111584701	604530	8/13/1987		605	1	29.5	8		
D-06-03 24DDD2	325251111584701	604532	4/18/1984		445	0.8	26			
D-06-03 24DDD2	325251111584701	604532	8/13/1987		4,850	0.6	27.5	8.2		
D-06-03 24DDD2	325251111584701	604532	5/5/1993		460	0.5	27.5	8.1		
D-06-03 24DDD2	325251111584701	604532	7/7/1998		475		28	7.5		
D-06-03 25CCC	325153111594801	621965	1/20/1983		810	2	29			
D-06-03 25CCC	325153111594801	621965	7/13/1984		790	2	28.5			

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Cadastral	Site Id	Reg No.	Date	V	Spec. Cond.	Fluoride	Temp	pH	Alkalinity	Dis. Oxygen
D-06-03 25CCC	325153111594801	621965	7/11/1986		775	1.6	28			
D-06-03 25DCC	325153111591501	621967	7/17/1986		715	0.4	28			
D-06-03 25DCC	325153111591501	621967	8/4/1989		760	1.3	28	8.3		
D-06-03 25DCC	325153111591501	621967	7/7/1998		825		29	7.9		
D-06-03 26BCC	325221112004501	625547	3/6/1989		990	2.6	28.5	8	226	
D-06-03 26BCC	325221112004501	625547	3/4/1991		1,020	2.6	28.5	8	224	
D-06-03 26BCC	325221112004501	625547	4/23/1992		925	3.3	28.5	8.1	201	
D-06-03 26BCC	325221112004501	625547	5/27/1993		979	2.8	28.5	8.1	225	
D-06-03 26BCC	325221112004501	625547	5/23/1994		1,000	2.7	29	8	213	
D-06-03 26BCC	325221112004501	625547	4/6/1995		980	2.8	29	8	220	
D-06-03 26BCC	325221112004501	625547	4/15/1996		930	2.8	28.8	8.1	228	
D-06-03 26BCC	325221112004501	625547	4/3/1997		810	2.4	28.5	7.9	191	4
D-06-03 26CDD2	325156112002101		5/8/1984		990	0.6	28			
D-06-03 27CDC	325156112013601	615406	8/24/1976		1,240	1.7	31			
D-06-03 29BAA	325241112033201		4/25/1946		1,130	2.7	26			
D-06-03 30DDD	325158112040201		8/24/1976		1,300	3	30			
D-06-03 34AAD	325143112005201	85665	5/8/1984		1,260	3.5	28			
D-06-03 34AAD	325143112005201	85665	5/24/1993		1,280	3.5	30	8		
D-06-03 35ADD	325128111595101	625540	9/5/1984		1,330	2.5	29.5			
D-06-03 35ADD	325128111595101	625540	6/15/1993		1,300	1.8	27.5	7.9		
D-06-03 35BCC	325127112004901	625542	2/17/1958		1,090	3	29.5			
D-06-03 35BCC	325127112004901	625542	8/24/1976		1,300	3	30			
D-06-03 35BDC	325127112002901	625546	5/28/1993		1,480	3	29	7.9		
D-06-03 35DDC	325101112000401	625545	9/6/1984		1,055	4.8	30			
D-06-03 35DDC	325101112000401	625545	7/31/1985		1,090	3.3	29	8.2	210	
D-06-03 35DDC	325101112000401	625545	7/9/1986		1,090	4.6	30.5	8.1	221	
D-06-03 35DDD2	325104111595501	625541	8/24/1976		1,160	3	31			
D-06-03 35DDD2	325104111595501	625541	7/17/1984		1,140	4.1	29.5	7.8	220	
D-06-03 35DDD2	325104111595501	625541	9/18/1984		1,180	3.8	29.5			
D-06-03 36CDC	325104111593601	615408	6/26/1989		1,420	4	29.5	8		
D-06-03 36CDC	325104111593601	615408	6/2/1993		1,460	3.5	29	7.5		
D-06-03N05CCC	325617112035501	610463	6/13/1989		580	0.9	25	8.2		
D-06-03N05CCC	325617112035501	610463	6/1/1993		1,250	1.4	27	7.6		
D-06-03S01AAD	325602111584901	606255	9/16/1941		493		25			
D-06-03S01CDD	325523111592201		8/9/1976		748	0.4	25			
D-06-03S01CDD	325523111592201		4/18/1984		730	0.7	25			
D-06-03S01CDD	325523111592201		8/16/1989		755	0.5	24	7.6		
D-06-03S01DAA	325547111584701	623842	7/10/1989		438	0.8	29.5	8.7		
D-06-03S01DAA	325547111584701	623842	10/24/1990		370	0.8	29.5	8.1		
D-06-03S01DAD	325536111584701	623841	4/18/1984		482	0.8				
D-06-03S01DAD	325536111584701	623841	7/10/1989		965	0.8	26	7.8		
D-06-03S01DAD	325536111584701	623841	10/24/1990		895	1	26	7.2		
D-06-03S02DDD1	325524111595101		9/16/1941		451		25.5			
D-06-04 01DDD	325523111524201		6/19/1941		5,860	0.5			89	
D-06-04 07CCC	325434111584601		9/1/1941	D	498		24.5		150	
D-06-04 07CCD	325430111583401	605960	7/8/1998		595	0.4	28.5	7.8		
D-06-04 07DDC	325433111575801	605961	7/8/1998		995	0.6	24	7.4		
D-06-04 08BDC	325400111572801	619755	1/20/1983		720	0.5	26.5			
D-06-04 08BDC	325400111572801	619755	4/17/1985		590	0.2	29			
D-06-04 08BDC	325400111572801	619755	7/27/1987		600	0.5	29	7.5		
D-06-04 08BDC	325400111572801	619755	5/4/1993		850	0.5	26	7.4		
D-06-04 08BDC	325400111572801	619755	7/6/1998		605		29	7.3		
D-06-04 09ADD	325456111554301	619751	4/17/1985		750	0.5	27			
D-06-04 09CDD	325434111561901	619750	5/3/1993		890	0.5	25	7.4		
D-06-04 09DDD1	325431111554201	619767	7/27/1987		775	0.6	28.5	8		
D-06-04 09DDD2	325431111554401	619749	8/26/1976		641	0.3	29			
D-06-04 09DDD2	325431111554401	619749	5/3/1993		890	0.4	28.5	7.5		
D-06-04 09DDD2	325431111554401	619749	7/7/1998		875		29	7.3		
D-06-04 10ADD	325458111544401	605504	5/7/1991		2,000	0.9	26.5	7.3		
D-06-04 10DAB	325453111545301	605505	5/7/1991		1,500	0.7	27.5	7.5		
D-06-04 10DDA	325440111544901	605506	5/7/1991		1,900	0.9	27	7.4		
D-06-04 11CDA	325441111541001	605503	4/25/1984		2,310	1.6	28			
D-06-04 11CDA	325441111541001	605503	6/2/1986		2,240	1.2	27.5			
D-06-04 11CDA	325441111541001	605503	5/7/1991		2,100	1.2	27.5	7.3		
D-06-04 11DDC	325432111534801	605515	5/8/1991		2,550	1.1	27.5			
D-06-04 11DDD	325433111534001	605502	8/27/1976		2,930	1	27.5			
D-06-04 11DDD	325433111534001	605502	5/9/1991		2,600	1.1	27.5			
D-06-04 12BCC2	325500111533501	609693	4/8/1991		1,460	1.4	29	7.6		
D-06-04 12BCC3	325459111533501	609663	4/8/1991		1,500	1.4	29.5	7.5		
D-06-04 13ADD	325406111524301		9/15/1941		868	0.7	25			
D-06-04 13ADD	325406111524301		9/14/1949		1,610	0.9	25			
D-06-04 13ADD	325406111524301		8/23/1950		1,550		25.5			
D-06-04 13ADD	325406111524301		5/3/1951		1,580		26			
D-06-04 13ADD	325406111524301		7/16/1951		1,630		26			
D-06-04 14BDD	325408111541201	605510	5/7/1991		2,750	1.2	27.5	7.1		
D-06-04 14CDD1	325338111541001	605518	4/25/1984		2,340	1.1				
D-06-04 14DDA	325346111534101	605497	7/13/1984		2,330	0.5	29			
D-06-04 15CDD2	325339111551201	605507	5/8/1991		970	0.3	26			
D-06-04 15DDD2	325338111544101	605508	6/2/1986		1,095	0.7	27.5			

Appendix D
ADWR Water Quality Database for Wells in the Vicinity of the Sacaton Mine

Maricopa-Stanfield Subbasin

Cadastral	Site Id	Reg No.	Date	V	Spec. Cond.	Fluoride	Temp	pH	Alkalinity	Dis. Oxygen
D-06-04 15DDD2	325338111544101	605508	5/8/1991		1,320	0.7	27.5			
D-06-04 16ADD2	325404111554501	619748	7/12/1989		725	0.5	28	7.4		
D-06-04 16ADD2	325404111554501	619748	6/10/1993		755	0.6	27.5	7.6		
D-06-04 16CDD	325342111561801	619747	8/11/1987		925	0.6	28.5	7.9		
D-06-04 16CDD	325342111561801	619747	6/10/1993		700	0.7	24.5	7.4		
D-06-04 16DDD1	325341111554401		9/23/1941		493	1	25.5			
D-06-04 16DDD1	325341111554401		3/20/1951		524		26.5			
D-06-04 16DDD1	325341111554401		5/3/1951		515		27			
D-06-04 16DDD1	325341111554401		7/16/1951		510		26.5			
D-06-04 16DDD2	325338111554501	619756	4/17/1985		811	0.2	26			
D-06-04 16DDD2	325338111554501	619756	6/10/1993		880	0.7	26.5	7.7		
D-06-04 17DDC	325341111570501	615410	8/14/1952		501		26			
D-06-04 17DDC	325341111570501	615410	8/4/1953		498		23			
D-06-04 17DDC	325341111570501	615410	5/21/1956		574		24.5			
D-06-04 17DDC	325341111570501	615410	8/27/1976		1,180	0.4	27			
D-06-04 18CCB	325345111584401	605841	4/18/1984		415	0.8	26			
D-06-04 18CCB	325345111584401	605841	5/17/1993		425	0.6	28	8.3		
D-06-04 18CCB	325345111584401	605841	7/7/1998		420		28	7.7		
D-06-04 18CCC	325342111585001	605841	4/18/1984		690	0.6	25			
D-06-04 18DBB	325402111581601	87270	4/19/1984		432	0.7	27.5			
D-06-04 18DBB	325402111581601	87270	7/6/1989		520	0.7	28.5	8.1		
D-06-04 18DBB	325402111581601	87270	6/15/1993		525	0.7	27.5	8.1		
D-06-04 18DBB	325402111581601	87270	7/16/1998		507		29	7.9		
D-06-04 19ACC	325314111581701	604192	4/19/1984		580	0.7	25			
D-06-04 19ACC	325314111581701	604192	8/4/1989		455	0.4	27	7.9		
D-06-04 19ACC	325314111581701	604192	5/5/1993		450	0.5	27	8.1		
D-06-04 19CDD1	325313111581701		8/27/1976		429	0.3	27			
D-06-04 19CDD2	325314111581601	604193	6/28/1989		480	0.5	27	8.1		
D-06-04 19CDD2	325314111581601	604193	5/5/1993		450	0.5	27	8.1		
D-06-04 19CDD2	325314111581601	604193	7/17/1998		435		27	7.8		
D-06-04 20ADD	325313111564601	605652	4/19/1984		490	1.1	28			
D-06-04 20ADD	325313111564601	605652	11/10/1988		970	0.6	25			
D-06-04 20ADD	325313111564601	605652	7/5/1989		560	0.8	29.5	7.9		
D-06-04 20ADD	325313111564601	605652	5/13/1993		570	0.7	28.5	8		
D-06-04 20BCD	325313111573301	605651	4/19/1984		445	0.6				
D-06-04 20BCD	325313111573301	605651	7/5/1989		525	0.7	29	7.9		
D-06-04 20BCD	325313111573301	605651	5/17/1993		560	0.7	28.5	8.1		
D-06-04 21DDD2	325246111554601	615413	8/27/1976		612	0.4	27			
D-06-04 22CDD	325248111551601	605057	5/13/1993		1,040	0.7	26	7.8		
D-06-04 22DDD	325248111544101	623471	5/6/1993		770	0.5	28.5	7.8		
D-06-04 25CDD	325154111530901	612767	9/15/1941		494		24.5			
D-06-04 25DDC	325154111524901	605619	1/1/1955	M	nd		27			
D-06-04 27CDD	325154111551401		9/14/1949		523	0.6	25		148	
D-06-04 27CDD	325154111551401		9/23/1949		472	0.7	24.5		138	
D-06-04 27CDD	325154111551401		3/20/1951		546		24.5		141	
D-06-04 27DCC	325154111551501	615417	9/9/1976		545	0.3	28			
D-06-04 28DDD	325154111554901	615367	6/16/1993		5,100	0.8	28	7.9		
D-06-04 29DCD	325153111570701	617592	4/24/1984		532	0.6	27.5			
D-06-04 29DDD1	325155111574701	617591	9/15/1941		458		23.9			
D-06-04 29DDD2	325157111564701	617590	8/25/1982		567	0.4		8.2	115	
D-06-04 29DDD2	325157111564701	617590	4/23/1984		565	0.6	27			
D-06-04 29DDD2	325157111564701	617590	9/11/1984		620	0.6	28			
D-06-04 29DDD2	325157111564701	617590	7/17/1986		605	0.5	27			
D-06-04 30CDD	325156111582101	621966	9/16/1941		458		25.5			
D-06-04 30CDD	325156111582101	621966	4/25/1984		580	1.1	28			
D-06-04 30CDD	325156111582101	621966	7/15/1986		640	1	27			
D-06-04 30DDD1	325154111574901	621969	9/16/1941		504		25.5			
D-06-04 30DDD1	325154111574901	621969	8/27/1976		558	1	28	7.9	135	
D-06-04 30DDD1	325154111574901	621969	4/24/1984		512	1.3	28			
D-06-04 30DDD1	325154111574901	621969	7/17/1986		575	0.9	28.5			
D-06-04 30DDD1	325154111574901	621969	6/30/1989		nd	1	29	8.1		
D-06-04 30DDD1	325154111574901	621969	6/15/1993		550	0.9	28.5	7.9		
D-06-04 30DDD2	325155111575001		4/24/1984		560	1	28			
D-06-04 30DDD2	325155111575001		7/17/1986		510	1	28.5			
D-06-04 30DDD2	325155111575001		6/30/1989		600	1	29	8.2		
D-06-04 30DDD2	325155111575001		6/15/1993		575	0.9	28	8		
D-06-04 30DDD2	325155111575001		7/16/1998		607		29	7.8		
D-06-04 31CCC2	325102111584701	617593	9/14/1984		1,350	3	30			
D-06-04 31CCC2	325102111584701	617593	5/5/1993		1,300	2.5	30	7.7		
D-06-04 31DBC	325116111581601	617242	4/23/1984		780	1.1	27.5			
D-06-04 31DBC	325116111581601	617242	9/11/1984		885	1.1	29			
D-06-04 31DBC	325116111581601	617242	6/30/1989		900	0.9	28.5	8.2		
D-06-04 31DBC	325116111581601	617242	7/7/1998		775		29	7.9		
D-06-04 31DDD	325105111575201	617241	6/30/1989		730	0.9	28	8.2		
D-06-04 32DDC	325102111565501	617239	4/23/1984		540	0.8	27.5			
D-06-04 32DDD	325103111564801		8/27/1976		522	0.4	28			
D-06-04 32DDD	325103111564801		9/11/1984		558	0.7	28			
D-06-04 33DDD	325102111554501	625526	9/19/1941		456		24.3			
D-06-04 33DDD	325102111554501	625526	6/9/1993		550	0.9	26.5	7.7		

Appendix D
ADWR Water Quality Database for Wells in the Vicinity of the Sacaton Mine

Maricopa-Stanfield Subbasin

Cadastral	Site Id	Reg No.	Date	V	Spec. Cond.	Fluoride	Temp	pH	Alkalinity	Dis. Oxygen
D-06-04 34DCC	325102111551101	615423	7/11/1986		615	0.6	27			
D-06-04 34DDD	325102111544301	615422	9/9/1976		487	0.4	29			
D-06-04 34DDD	325102111544301	615422	11/8/1984		495	0.7	29.5			
D-06-04 34DDD	325102111544301	615422	6/29/1989		550	0.8	29	8.1		
D-06-04 34DDD	325102111544301	615422	7/8/1998		536		30	7.6		
D-06-04 35DCC	325103111540901	615424	7/22/1986		535	0.6	28	7.7	105	
D-06-04 35DDD	325102111534002	615425	9/20/1984		520	0.8	29			
D-06-04 36ADD	325133111523901		9/15/1941		496		24.3			
D-06-04 36DDD	325102111523901	629477	9/15/1941		490		25			
D-06-04N04AAA	325618111554401	606186	1/19/1983		1,925	0.8	25.5			
D-06-04N04AAA	325618111554401	606186	6/9/1993		1,610	0.7	27	7		
D-06-04N04ABB	325617111560601		4/17/1984		650	0.3	27.5			
D-06-04N04ABB	325617111560601		7/8/1986		610	0.4	28			
D-06-04N04ABB	325617111560601		7/9/1986		630	0.4	28.5	7.8	122	
D-06-04N04ABB	325617111560601		7/28/1987		670	0.3	28	7.6	123	
D-06-04N04ABB	325617111560601		3/7/1988		690	0.3	28.5	7.8	124	
D-06-04N04ABB	325617111560601		3/6/1989		650	0.3	28	7.8	122	
D-06-04N04ABB	325617111560601		8/10/1989		685	0.5	28	7.8		
D-06-04N04ABB	325617111560601		5/3/1990		760	0.2	28.5	7.6	123	
D-06-04N04ABB	325617111560601		3/17/1992		810	0.2	28	7.8	121	
D-06-04N04ABB	325617111560601		5/19/1993		850	0.3	28	7.8	120	
D-06-04N04ABB	325617111560601		5/24/1994		835	0.2	28.5	7.8	119	
D-06-04N04ABB	325617111560601		4/6/1995		860	0.2	28.5	7.7	116	
D-06-04N04ABB	325617111560601		4/16/1996		845	0.3	28	7.9	119	
D-06-04N04ABB	325617111560601		4/21/1997		920	0.3	28	7.7	114	6
D-06-04N04ABB	325617111560601		4/15/1998		985	0.2	28.5	7.7	113	7
D-06-04N04ABB	325617111560601		4/27/1999		1,020	0.2	28.5	8.5	111	7
D-06-04N04ABB	325617111560601		5/1/2000		1,020	0.2	28	7.6	114	7
D-06-04N04ABB	325617111560601		6/6/2001		1,150	0.2	29	7.6	105	6
D-06-04N05BAA	325617111571801	623838	4/24/1984		1,120	0.7	25			
D-06-04N05BAA	325617111571801	623838	5/26/1993		1,150	0.7	25	7.3		
D-06-04N06AAA1	325617111575001		7/11/1989		1,280	0.9	25	7.6		
D-06-04N06AAA3	325622111574701	622160	4/24/1984		770	0.7	30			
D-06-04N06AAA3	325622111574701	622160	7/10/1989		885	0.5	30	8		
D-06-04N06AAA3	325622111574701	622160	10/24/1990		810	0.5	31	7.4		
D-06-04N06ABA	325617111580801	622162	4/24/1984		585	1.1				
D-06-04N06ABA	325617111580801	622162	7/11/1989		780	1	30	8		
D-06-04S02CDD	325525111541401	609664	4/8/1991		310	1.1	27.5	7.2		
D-06-04S03ACD	325549111550101		4/23/1984		1,600	1.2	28			
D-06-04S03ACD	325549111550101		4/19/1985		1,650	1.5	29			
D-06-04S03ACD	325549111550101		5/7/1991		1,900	1.2	27.5	7.4		
D-06-04S03CDD	325528111551701	605514	4/23/1984		1,650	0.7	25			
D-06-04S03DDC	325527111545301	605501	8/27/1976		2,100	0.8	28			
D-06-04S03DDC	325527111545301	605501	4/23/1984		2,050	0.8	24.5			
D-06-04S03DDC	325527111545301	605501	7/13/1984		2,130	0.4	25	7.3	118	
D-06-04S03DDC	325527111545301	605501	4/19/1985		2,220	0.5	25			
D-06-04S03DDC	325527111545301	605501	5/7/1991		2,500	1.1	27	7.3		
D-06-04S04DDD2	325523111554401	619752	7/31/1985		829	0.4	28	7.8	120	
D-06-04S04DDD3	325523111554301	87174	4/17/1985		742	0.2	28			
D-06-04S04DDD3	325523111554301	87174	8/5/1985		1,310	0.3	24	7.6	124	
D-06-04S04DDD3	325523111554301	87174	7/9/1986		1,310	0.4	25	7.6	118	
D-06-04S04DDD3	325523111554301	87174	7/28/1987		1,300	0.4	25	7.4	118	
D-06-04S04DDD3	325523111554301	87174	3/17/1988		1,310	0.4	25	7.8	118	
D-06-04S04DDD3	325523111554301	87174	3/7/1989		1,220	0.4	24.5	7.7	115	
D-06-04S04DDD3	325523111554301	87174	5/2/1990		1,190	0.2	25	7.6	120	
D-06-04S04DDD3	325523111554301	87174	3/5/1991		1,240	0.3	25	7.7	123	
D-06-04S04DDD3	325523111554301	87174	3/4/1992		1,260	0.4	24.5	7.5	127	
D-06-04S04DDD3	325523111554301	87174	3/23/1993		1,180	0.3	25	7.3	122	
D-06-04S04DDD3	325523111554301	87174	7/15/1994		1,220	0.4	25	7.5	115	
D-06-04S04DDD3	325523111554301	87174	4/6/1995		1,270	0.4	25.5	7.6	114	
D-06-04S04DDD3	325523111554301	87174	5/16/1997		1,350	0.4	25	7.6	123	7
D-06-04S04DDD3	325523111554301	87174	4/28/1998		1,350	0.4	25	7.5	117	7
D-06-04S04DDD3	325523111554301	87174	5/3/1999		1,420	0.3	24.5	7.6	116	8
D-06-04S04DDD3	325523111554301	87174	6/6/2001		1,340	0.3	29	7.7	99	6
D-06-04S05DCC	325529111571101	619754	8/27/1976		503	1.1	31			
D-06-04S05DCC	325529111571101	619754	6/22/1993		565	1.7	32	8.3		
D-06-04S06ADA	325553111574901	606251	8/16/1989		1,020	0.5	24	7.4		
D-06-04S06ADD	325555111575001	606251	8/27/1976		445	0.3	31.5			
D-06-04S06ADD	325555111575001	606251	8/16/1989		475	0.6	31	8.2		
D-06-04S06ADD	325555111575001	606251	10/24/1990		450	0.7	32	7.7		
D-06-04S06BDD	325548111581801	606254	8/16/1989		450	1.3	29	8.2		
D-06-04S06BDD	325548111581801	606254	10/24/1990		510	4.5	26.5	7.5		
D-06-04S06CDC	325523111583201	604675	6/12/1989		470	0.8	28.5	8.2		
D-06-04S06CDC	325523111583201	604675	7/7/1998		400		29	8.1		
D-06-05 08CAD	325447111511101		6/19/1941		6,560	2.2	25.5			
D-06-05 08CDD	325433111510701		6/19/1941		6,560	2.6	24.5		144	
D-06-05 08CDD	325433111510701		9/23/1941		6,440				183	
D-06-05 08DCC	325434111510201		6/19/1941		6,500	1.7	25		161	
D-06-05 08DCC	325434111510201		9/23/1941		6,660				151	

Appendix D
ADWR Water Quality Database for Wells in the Vicinity of the Sacaton Mine

Maricopa-Stanfield Subbasin

Cadastral	Site Id	Reg No.	Date	V	Spec. Cond.	Fluoride	Temp	pH	Alkalinity	Dis. Oxygen
D-06-05 09DCC	325434111495901		6/19/1941		5,080	0.4			47	
D-06-05 16ADD	325409111493701		6/20/1941		6,060	1.5			209	
D-06-05 16BDD	325406111500801		6/20/1941		5,520	1.1	24			
D-06-05 16BDD	325406111500801		9/23/1941		6,230					
D-06-05 16CDD	325342111500701		6/20/1941		6,190	1.8	24.5		239	
D-06-05 16DCD	325340111495101		6/20/1940		5,440	0.5	24		161	
D-06-05 16DDD	325313111490701		6/20/1941		4,060	0.4	24.5			
D-06-05 16DDD	325313111490701		9/19/1941		nd		24.3			
D-06-05 16DDD	325313111490701		9/23/1941		4,870					
D-06-05 17AAD	325422111503801		6/20/1941		7,060	1.1	25		189	
D-06-05 17AAD	325422111503801		9/23/1941		7,370				185	
D-06-05 17ADD	325408111503801		6/2/1941		6,190	0.9	24.5			
D-06-05 17ADD	325408111503801		6/21/1949		6,040	0.6	24			
D-06-05 17ADD	325408111503801		8/23/1950		5,860		23.5			
D-06-05 17ADD	325408111503801		4/9/1951		5,000	1.2	24			
D-06-05 19ADC	325313111515101	603940	5/24/1994		2,210	0.8	27.5	8.1		
D-06-05 19CDB	325256111521901	603936	5/24/1994		740	1.6	33.5	8.6		
D-06-05 20CBB	325311111513401	603937	5/24/1994		1,640	1.5	29	9.1		
D-06-05 20DDD	325247111503501	603939	1/18/1958		377	0.4	25.5	7.7	126	
D-06-05 21ADD1	325317111493301		6/20/1941		5,150	1.8	24.5			
D-06-05 21ADD1	325317111493301		9/19/1941		nd		24.3			
D-06-05 21ADD1	325317111493301		9/23/1941		4,650					
D-06-05 21ADD1	325317111493301		6/21/1949		5,310	0.8	24			
D-06-05 21ADD1	325317111493301		8/23/1950		5,320		23.5			
D-06-05 21ADD1	325317111493301		3/20/1951		5,020		23.5			
D-06-05 21ADD1	325317111493301		5/3/1951		5,020		24			
D-06-05 21ADD1	325317111493301		6/8/1951		5,030					
D-06-05 21ADD2	325313111493501	612881	8/14/1952		4,800		24.5			
D-06-05 21ADD2	325313111493501	612881	7/20/1953		nd		24			
D-06-05 21ADD2	325313111493501	612881	8/10/1954		4,710	1.4	28			
D-06-05 21ADD2	325313111493501	612881	8/9/1955		4,400	1	23			
D-06-05 21ADD2	325313111493501	612881	5/21/1956		4,430		23.5			
D-06-05 21ADD2	325313111493501	612881	5/9/1957		4,120		24			
D-06-05 21ADD2	325313111493501	612881	5/26/1958		4,040		23.5			
D-06-05 21ADD2	325313111493501	612881	8/25/1959		3,900		24			
D-06-05 21ADD2	325313111493501	612881	6/21/1960		3,740		23.5			
D-06-05 21ADD2	325313111493501	612881	10/15/1961		3,780					
D-06-05 21ADD2	325313111493501	612881	9/6/1962		3,470	1.6	23.5			
D-06-05 21ADD2	325313111493501	612881	9/11/1963		3,370	2.1	23.5			
D-06-05 27AAD2	325229111493401	801144	9/10/1976		2,750	1.6	24			
D-06-05 27AAD2	325229111493401	801144	6/24/1988		2,290	2.5	23.5	7.5		
D-06-05 31ADA	325141111513701	622445	5/1/1984		970	0.8	28.5			
D-06-05 31ADA	325141111513701	622445	7/17/1984		975	0.5	29	7.6	92	
D-06-05 31ADD2	325130111514001	622444	9/9/1976		728	0.5	28.5			
D-06-05 31ADD2	325130111514001	622444	5/1/1984		810	0.5	28			