



MEMORANDUM

Date: March 27, 2015

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

A handwritten signature in black ink, appearing to read "C.H. Huckelberry", is written over the typed name and title.

Re: **Clean Water Act Section 401 Certification of the Rosemont Copper Mine**

Background

On February 3, 2015, the Arizona Department of Environmental Quality (ADEQ) certified that certain activities at the Rosemont Copper Mine will comply with applicable Arizona water quality standards. The activities being certified include 40.4 acres of direct placement of dredge and fill material into streams and an additional 28.4 acres of streams, such as Barrel Canyon and Davidson Canyon, that would be indirectly impacted by reduced flows resulting from tailings and waste rock dumps.

This certification is important for those who might be concerned about water quality emanating from a future mine, as well as for the entire state because it represents a rare test of the state's "anti-degradation" program for streams. Normally, water quality impairments can and are routinely allowed through the permitting process, so long as water quality standards continue to be met. Streams designated Outstanding Waters (see Attachment 1) are intended to have the State's highest protection against degradation. The designation prohibits ADEQ from issuing permits to projects that would degrade existing water quality of Outstanding Waters. The Outstanding Waters in question, at Bar V Ranch and the Cienega Creek Natural Preserve, are wholly managed by Pima County and the Pima County Regional Flood Control District (RFCD) and lie downstream of the mine's proposed location.

Pima County Appeal

On March 5, the County Attorney's Office filed, on behalf of the County and the RFCD, an appeal of the Section 401 Certification as previously discussed with the Board (Attachment 2). Certified mail receipts from ADEQ, the hearing officer, and the Attorney General's Office indicate the appeal was received in a timely fashion.

The appeal explains why we are qualified to appeal this certification, including our ownership of land and water and our past involvement in the public process.

The Honorable Chair and Members, Pima County Board of Supervisors
Re: **Rosemont Copper Mine Section 401 Certification**
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Next, the appeal states that ADEQ based part of its decision on a document that was not subject to public review and comment. This is contrary to law; the public was unfairly denied an opportunity to comment on this document. The document in question is a surface water mitigation plan dated December 2014.

Furthermore, the surface water mitigation is flawed, and we believe the State's approval was arbitrary and capricious for reasons explained in greater detail in the appeal. These reasons include basing the mitigation, and therefore the certification, on a model that does not yet exist. ADEQ also relied on faulty technical data in its decision-making process; something our previous letters of comment documented.

Next Steps

The Office of Administrative Hearings may schedule a hearing to occur within 60 days after the Notice of Appeal was filed. A request for hearing and a request for an informal settlement conference have been submitted to ADEQ by the County Attorney's Office (Attachment 3). A representative with settlement authority would be required to attend the settlement conference.

CHH/mjk

Attachments

c: The Honorable Barbara LaWall, County Attorney
Thomas Weaver, Chief Civil Deputy County Attorney
Tobin Rosen, Deputy County Attorney

PROPOSED ROSEMONT MINE AND ENVIRONS

-  Mine to Vail Drainage Path
-  Other Stream or Wash
-  Outstanding Waters (per ADEQ)

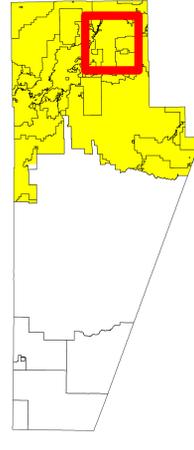
Proposed Rosemont Mine Land Position

-  Fee Land
-  Patented Claim
-  Unpatented Claim
-  Extent of Mine Operations

Other Land Management

-  State Trust Land
-  Bureau of Land Management
-  Incorporated Area
-  Pima County Preserve Land

Pima County Index Map



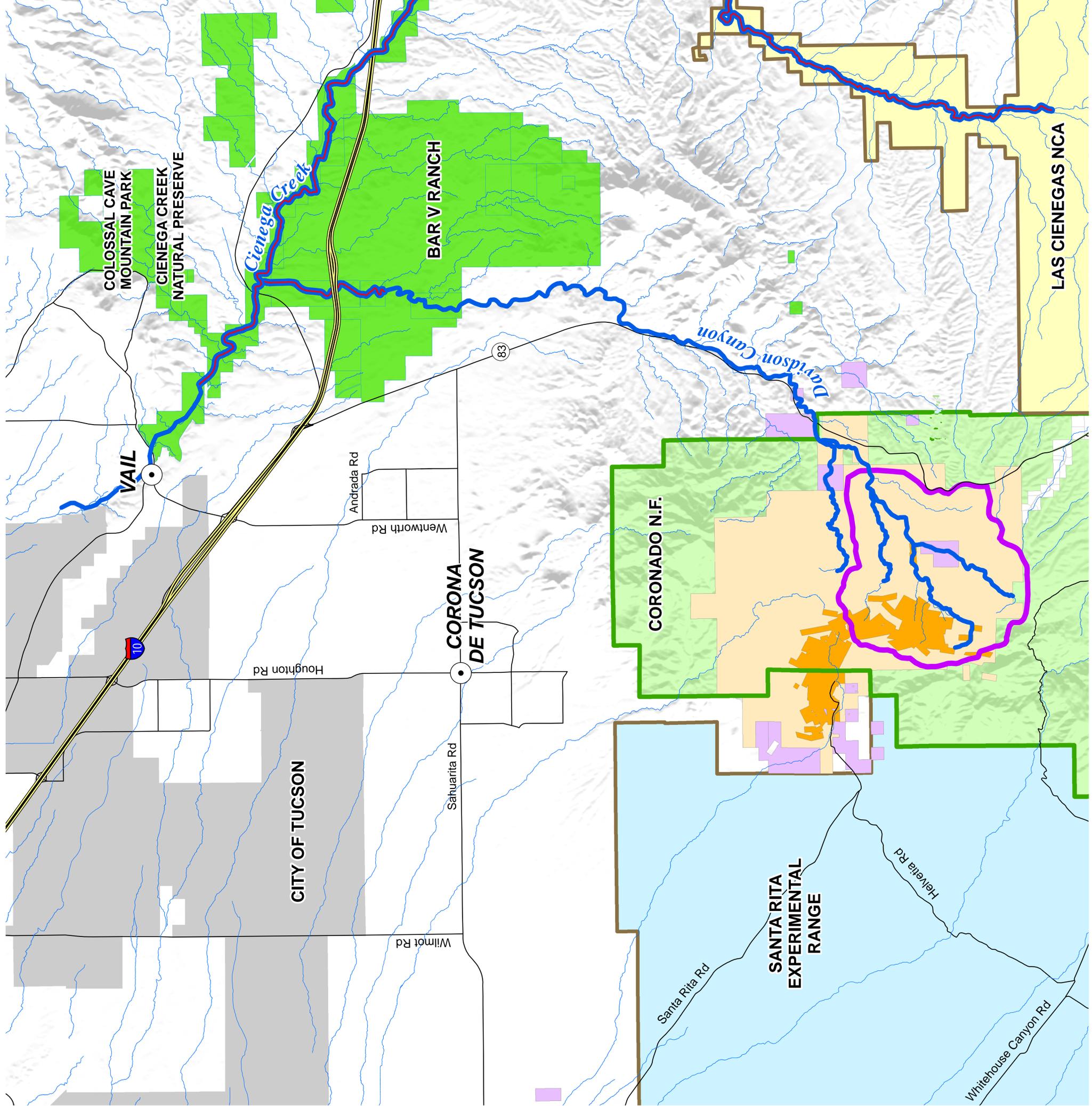
0 1 Mile

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3/25/2015



BARBARA LAWALL
PIMA COUNTY ATTORNEY
CIVIL DIVISION

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8 **ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY**

10 PIMA COUNTY, a body politic; and
11 PIMA COUNTY REGIONAL FLOOD
12 CONTROL DISTRICT,

12 Appellants,

13 vs.

14 THE STATE OF ARIZONA, and
15 THE ARIZONA DEPARTMENT OF
16 ENVIRONMENTAL QUALITY,

17 Respondents.

NOTICE OF APPEAL

18 I. INTRODUCTION

19 This is a challenge by Pima County and the Pima County Regional Flood Control District
20 (the "Appellants") to the Arizona Department of Environmental Quality's ("ADEQ")
21 issuance of a Clean Water Act Section 401 Water Quality Certification ("Certification")
22 to Rosemont Copper Company ("Rosemont") for its Rosemont Copper Project (the
23 "Mine"). A copy of the issued Certification is attached hereto as Exhibit A.

25 II. JURISDICTION AND STANDING

26

1 a. This Petition is Proper in this Forum

2
3 Issuance of Clean Water Act Section 401 Certification in Arizona is authorized under
4 pertinent portions of A.R.S. § 49-202. Specifically, ADEQ is authorized to process § 401
5 certification requests in accordance with subsections C through H of A.R.S. § 49-202.
6 A.R.S. § 49-202(B). A.R.S. § 49-202(H) provides the pathway for appealing an ADEQ §
7 401 certification decision. Pursuant to that subsection, “[a]ny person who is or may be
8 adversely affected by the denial of or imposition of conditions on the certification of a
9 nationwide or general permit may appeal that decision pursuant to title 41, chapter 6,
10 article 10” entitled “Administrative Hearing Procedures.” Article 10 further provides: “A
11 party may obtain a hearing on an appealable agency action or contested case by filing a
12 notice of appeal or request for a hearing with the agency within thirty days after receiving
13 the notice prescribed in subsection A of this section.” The article 10 procedures allow
14 appeal by “a party who will be adversely affected by the appealable agency action or
15 contested case and who exercised any right provided by law to comment on the action
16 being appealed or contested, provided that the grounds for the notice of appeal or request
17 for a hearing are limited to issues raised in that party's comments.” A.R.S. § 41-
18 1092.03(B). While ARS § 49-202(B) does not require Appellants to have commented on
19 the appealed action, as noted below, Appellants did submit comments.
20

21 b. Appellants are Entitled to Bring this Action

22
23 i. Appellants are Adversely Affected by the Agency’s Action

24 Both Pima County (“County”) and the Pima County Regional Flood Control District
25 (“District”) will be adversely affected by the ADEQ action. Appellants own the land and
26

1 water rights in the Outstanding Waters reach of Davidson Canyon and the Outstanding
2 Waters reach downstream of Davidson Canyon. Both of these Outstanding Waters
3 reaches are downstream of surface water and ground water impacts resulting from the
4 construction and operation of the Mine. In addition, Appellants manage the Bar V ranch
5 and Cienega Creek Natural Preserve for wildlife and recreational purposes plus oversee
6 ranching at the Bar V Ranch. These facilities are also located downstream of the surface
7 water and ground water impacts resulting from the construction and operation of the
8 Mine. Allowing Rosemont to proceed with the proposed construction and operation of
9 the Mine will result in degradation of the quality of the surface water in Outstanding
10 Waters located on Appellant's properties and in adverse impacts to surface waters and
11 uses thereof on the Bar V Ranch.

12
13 ii. Appellants Commented on the Action being Appealed

14
15 Appellants submitted three sets of comments for ADEQ consideration in this matter:

- 16
17 1. The first County/District comment, attached hereto as Exhibit B, was
18 submitted to ADEQ on March 21, 2014;
19
20 2. The second County/District comment, attached hereto as Exhibit C, was
21 submitted to ADEQ on April 4, 2014; and
22
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25
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1 3. The third County/District comment, attached hereto as Exhibit D, was
2 submitted to ADEQ on July 16, 2014. This comment provided supplemental
3 information.¹

4
5 County/District comments contained in Exhibits B and C were timely submitted.² As
6 those Exhibits show, Appellants commented on the draft Certification. However, portions
7 of the final Certification and of documents used in the ADEQ decision-making process
8 were never available for public review and comment in the action below. Further, there is
9 no public record concerning ADEQ response to public comments or of what criteria
10 ADEQ used to modify the draft Certification. Those issues will be addressed below.

11
12 c. This Petition is Timely

13
14 The appeal procedure, A.R.S. title 41, chapter 6, article 10, sets forth a thirty day
15 limitation for filing a notice of appeal on an appealable agency action. A.R.S. § 41-
16 1092.03(B). To date, neither Appellant has received official notice of ADEQ's
17 Certification issuance. To ensure the timeliness of this appeal, Appellants are filing this
18 action within thirty days of the ADEQ signature date.

19
20 d. Scope of Review and Basis for Reversal

21
22 Review of ADEQ's action is limited by statute:

23
24
25 _____
26 ¹ The information was also provided to the involved federal agencies for ESA consultation on the § 404 permit decision.

² The initial comment period closed on March 24, 2014 but was extended by ADEQ until April 7, 2014.

1 The court shall affirm the agency action unless after reviewing the administrative
2 record and supplementing evidence presented at the evidentiary hearing the court
3 concludes that the action is not supported by substantial evidence, is contrary to
4 law, is arbitrary and capricious or is an abuse of discretion.

5 A.R.S. § 12-910(E).

6

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9 III. BASIS OF APPEAL

10

11 In issuing the Certification, ADEQ acted arbitrarily and capriciously and abused its
12 discretion. ADEQ has produced no explanation of the basis for its decision to issue,
13 despite extensive comments by Appellants (and others), a final Certification that is nearly
14 identical to the draft version issued [date]. Further, ADEQ included documents in its
15 decision record that were not in the available for public review and comment.
16 Specifically, ADEQ considered Rosemont’s December 2014 “Surface Water Mitigation
17 Plan.” That plan is flawed and the flaws raise serious questions about Rosemont’s ability
18 to meet the Arizona surface water quality standards (“SWQS”) and maintain existing
19 uses, including recreation, wildlife and livestock.

20

21 a. Facts

22

- 23 i. Pima County and Pima County Regional Flood Control District have
24 Invested Millions of Taxpayer Dollars to Protect Lands in the
25 Cienega Creek Groundwater Basin.

26

1 Pima County has worked to protect and conserve natural resources in the Cienega basin
2 since 1986, with the creation of the Cienega Creek Natural Preserve. According to the
3 County Administrator's Office, total acquisition costs for lands in the Cienega Creek
4 basin total nearly \$64 million. Most notably, these include portions of lower Cienega
5 Creek and Davidson Canyon, downstream of the proposed mine. The Cienega Creek
6 Natural Preserve is a 4000-acre protected area owned by Pima County Regional Flood
7 Control District containing intermittent and perennial flow reaches, and springs supported
8 by a shallow water table. Acquisition costs total \$8.6 million for the Preserve.
9 Acquisition began in 1986 and was largely completed in the early 1990s.

10

11 The Bar V Ranch, located along Davidson Canyon south of Interstate Highway 10 was
12 acquired for \$8.1 million in 2005. The State Transportation Board unanimously approved
13 a contribution of \$500,000 to acquire 600 acres of the ranch along Davidson Canyon to
14 preserve viewsheds along state-designated scenic roads and highways. Bar V Ranch
15 includes a vital wildlife linkage recognized by Arizona Game Fish Department along
16 Davidson Canyon.

17

18 In addition, the county also acquired 58 acres near the Empire Mountains at a cost of
19 \$190,000 called the Amadon and Nunez properties. These lands are located five to six
20 miles east of the mine, and were purchased in conjunction consistent with the U. S.
21 Bureau of Land Management's plan for Las Cienegas National Conservation Area.

22

23 ii. Pima County and Pima County Regional Flood Control District have
24 Acted to Protect Water and Water Quality along Cienega Creek and
25 Davidson Canyon.

26

1 The presence of water combined with riparian vegetation creates wildlife habitat of very
2 high value supporting diverse populations of mammals, birds, fish, reptiles, and
3 amphibians. Several special status species are present within the Preserve including the
4 endangered Gila Topminnow, the threatened Gila Chub Mexican garter snake, and the
5 yellow-billed cuckoo. These same water conditions create an area with very high values
6 for recreation, educational opportunities and scenic quality, as well as wildlife.
7

8 The ecological and recreational significance of the Preserve is amplified because it is one
9 of a very few remaining examples of a desert riparian environment. Environments of this
10 type once paralleled many of the water courses and drainages in southern Arizona such as
11 the Santa Cruz River near Tucson. During the past century, the extent of these riparian
12 areas has been greatly reduced.
13

14 When the Preserve was established in 1986, the Pima County Board of Supervisors,
15 sitting as the Board of Directors of the Pima County Flood Control District, adopted a
16 Declaration of Restrictions, Covenants, and Conditions that applies to areas along
17 Cienega Creek and Davidson Canyon. This document states that the Preserve was
18 established ...for the purposes of the preservation and protection of the natural and scenic
19 resources of the property,...

20
21 At the same time, the Board stated that Pima County's management goals, simply stated,
22 are to maintain the present natural characteristics of the Cienega Creek Natural Preserve,
23 and if possible, to allow natural restoration of the climax vegetation...The following
24 management policies support Pima County's desire to maintain our last remaining low-
25 elevation perennial stream in as natural a condition as possible"
26

1 The restrictions that run with the land also state that ... Pima County shall not conduct,
2 nor permit any other person to conduct mining, quarrying, sand hauling, fill hauling, or
3 timbering of any kind on the Preserve. Hunting or trapping of birds or animals, grazing of
4 cattle, or the destruction or removal of plants, shrubs, trees, except with written
5 permission of Pima County, is expressly prohibited. In the interest of resources
6 protection, no discharge of waste or by-products or materials on land or into water
7 channels that might result in harm to wildlife or human water supplies will be permitted.
8

9 As acquisitions proceeded over the next decade, the District obtained historic water rights
10 and transferred their uses to recreation and wildlife purposes to protect streamflow
11 occurring within the Natural Preserve. As authorized by the Board of Supervisors in
12 1986, the District also filed for in-stream flow rights, receiving an instream flow
13 certificate in 1993. The County holds water rights for stock-watering purposes along
14 Davidson Canyon.
15

16 At the request of Pima County Regional Flood Control District, Pima Association of
17 Governments began monitoring groundwater levels at three sites within the Preserve in
18 1989. This program was expanded to include groundwater monitoring along Davidson
19 Canyon and base flow discharges along Cienega Creek in the early 1990s. PAG continues
20 to monitor groundwater levels and surface water discharges today.
21

22 Pima County Regional Flood Control District and Pima County have also taken steps to
23 protect water quality of Cienega Creek and Davidson Canyon, beginning in 1987 with
24 water quality sampling. An interagency proposal was submitted in 1990 to protect
25 Cienega Creek within the Natural Preserve under the State of Arizona's Unique Waters
26 program, which imposes anti-degradation standards under state water quality rules. This

1 designation was received in 1992 for the lower Cienega Creek. The designation was
2 amend in 2002 in include portions of upper Cienega Creek located on U.S. Bureau of
3 Land Management land.

4
5 In recognition of Davidson Canyon's outstanding ecological and recreational values,
6 Pima County purchased the Bar V Ranch, consisting of 1763 acres of private lands and
7 12,674 acres of State Trust Land grazing leases. Bar V Ranch includes four channel miles
8 of Davidson Canyon and a working ranch. A riparian enclosure fence has been
9 constructed along part of the wash. The Cienega Creek Natural Preserve downstream has
10 an additional two miles of Davidson Canyon's flow and has also been excluded from
11 livestock grazing.

12
13 In 2005, Pima County Administrator C. H. Huckelberry requested to classify Davidson
14 Canyon as an Outstanding Water, pursuant to R18-11-112 of the Arizona Administrative
15 Code. The purpose was to protect the high quality water that Davidson provides to
16 Cienega Creek via springs and groundwater underflows.

17
18 Davidson Canyon is a rare, spring-fed, low-elevation desert stream that supports leopard
19 frogs, and at times, the native fish known as the long-fin dace. The Arizona Game and
20 Fish Department has recognized this as one of the most important wildlife migration
21 corridors in this part of Arizona, linking the Rincon, Empire and Santa Rita Mountains
22 (see Arizona Wildlife Linkage Assessment, 2006). Sky Island Alliance has monitored
23 wildlife use of Davidson Canyon below the Rosemont Mine in several places periodically
24 since 2001. Their data show that Davidson Canyon is used by black bear, mountain lion,
25 bobcat, coatimundi, white-tailed deer and at least three species of skunks.

26

1 Water chemistry data indicated that the water in the bottom of Davidson Canyon is
2 excellent, lower in total dissolved solids than the base flows in the main channel of
3 Cienega Creek where the Unique Waters designation had already been received from the
4 State. In addition, an isotope study by Pima Association of Governments showed that
5 groundwater underflows from Davidson Canyon contribute a significant portion of the
6 base flow in Cienega Creek, which is already designated as a Unique Water.

7
8 b. Legal Framework

9
10 i. The Section 401 Process and Required Consideration under Federal
11 and Arizona Law

12
13 This matter arises under §401 (33 U.S.C. § 1341) of the Federal Water Pollution Control
14 Act (33 U.S.C. §§ 1251 to 1387; otherwise known as the Clean Water Act) and A.R.S. §
15 49-202. Rosemont applied for a § 404 (33 U.S.C. §1344) permit from the U.S. Corps of
16 Engineers for activities Rosemont plans related to the development of the Mine. As a
17 precondition to the issuance of a § 404 permit for the Mine, the State of Arizona must
18 issue a § 401 water quality certification. In that document, the State must certify that
19 Rosemont's § 404 activities will comply with applicable Arizona water quality standards
20 (WQS) and allow for maintenance of existing uses. Section 401(a)(1) provides:

21 Any applicant for a Federal license or permit to conduct any activity . . . which
22 may result in any discharge into the navigable waters, shall provide the licensing
23 or permitting agency a certification from the State in which the discharge
24 originates or will originate . . . that any such discharge will comply with the
25 applicable provisions of [the Clean Water Act].

26 33 U.S.C. 1341(a)(1).

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Both federal and Arizona law require the State to ensure compliance with all applicable WQS before issuing a § 401 water quality certification. If the Mine will violate water quality standards and cannot be reasonably expected to meet those standards through remedial measures, ADEQ must deny certification. *See* 33 U.S.C. § 1341(a)(1) and (a)(3). The Clean Water Act also authorizes the State to impose conditions on the Certification necessary to ensure compliance with WQS. 33 U.S.C. 1341(d).

ADEQ is statutorily designated as the State’s agency responsible for issuing § 401 Certifications. A.R.S. § 49-202(A). ADEQ is required to issue rules governing how it will evaluate §401 applications but has done so only in a limited sense. The rules pertaining to antidegradation provide that

[t]he Director shall conduct the antidegradation review of any discharge authorized under a nationwide or regional § 404 permit as part of the § 401 water quality certification prior to issuance of the nationwide or regional permit. The Director shall conduct the antidegradation review of an individual § 404 permit if the discharge may degrade existing water quality in an OAW or a water listed on the 303(d) List of impaired waters. For regulated discharges that may degrade water quality in an OAW or a water that is on the 303(d) List of impaired waters, the Director shall conduct the antidegradation review as part of the § 401 water quality certification process.

AAC R18-11-107.01(D).

1 Further, ADEQ is to evaluate “whether the effect of the discharge will comply with the
2 water quality standards for navigable water established by department rules adopted
3 pursuant to § 49-221, subsection A, and § 49-222.” A.R.S. § 49-202(C).

4
5 ADEQ, by rulemaking, established “Outstanding Arizona Water” (“OAW”) designations
6 for pertinent reaches of Cienega Creek and in Davidson Canyon. AAC R18-11-112(G)(8)
7 and (G)(21). Both of these waters are downstream of Mine activities. As OAW’s, both
8 streams warrant additional protection under Arizona law. Specifically, they are subject to
9 Tier 3 antidegradation protection pursuant to AAC R18-11-107(D). Tier 3
10 antidegradation protection requires that “existing water quality shall be maintained and
11 protected in a surface water that is classified as an OAW under R18-11-112. Degradation
12 of an OAW under subsection (C) is prohibited.” AAC R18-11-107, *emphasis added*.

13
14 Additional regulatory Tier 3 protections include:

- 15 • A new or expanded point-source discharge directly to an OAW is prohibited.
- 16 • A person seeking authorization for a regulated discharge to a tributary to, or
17 upstream of, an OAW shall demonstrate in a permit application or in other
18 documentation submitted to the Department that the regulated discharge will
19 not degrade existing water quality in the downstream OAW.
- 20 • A discharge regulated under a § 404 permit that may affect existing water
21 quality of an OAW requires an individual § 401 water quality certification to
22 ensure that existing water quality is maintained and protected and any water
23 quality impacts are temporary. Temporary water quality impacts are those
24 impacts that occur for a period of six months or less.

25 AAC R18-11-107.01(C)(2) through (4).

26

1 ii. Public Notice Requirements Under Federal and Arizona Law

2
3 Nowhere does Arizona law specifically address the Clean Water Act requirement that the
4 state “establish procedures for public notice in the case of all certifications by it and, to
5 the extent it deems appropriate, procedures for public hearings in connection with
6 specific applications.” 33 U.S.C. § 1341(a)(1). Arizona statutes include a general
7 provision for public participation in ADEQ processes. That provision requires ADEQ to,
8 by rule, “prescribe procedures to assure adequate public participation in proceedings of
9 the department under this chapter.” A.R.S. § 49-208(A). Further, the public participation
10 procedures, at a minimum, must “prescribe public notice requirements including the
11 content and publication of the notice, provide an opportunity for public hearings and
12 specify the procedures governing the hearings and require the public availability of
13 relevant documents.” *Id.*, *emphasis added*.

14
15 Arizona rules promulgated pursuant to A.R.S. § 49-208 require ADEQ to:

- 16 1. Publish the notice as a legal notice at least once, in one or more newspapers of
- 17 general circulation in the county or counties concerned;
- 18 2. Include in the notice the following information:
- 19 3. The major issue under consideration or a description of the reason for the
- 20 action;
- 21 4. The Department’s proposed action and effective date for that action;
- 22 5. The location where relevant, nonconfidential documents may be obtained and
- 23 reviewed during normal business hours;
- 24 6. The name, address and telephone number of a person within the Department
- 25 who may be contacted for further information;
- 26

1 7. The location where public comments may be addressed, and the date and time
2 by which comments shall be received.

3 AAC R18-1-401(A).

4
5 c. ADEQ Based a Portion of Its Decision on a Relevant Document that was not
6 Subject to Public Review and Comment

7
8 The Certification identifies, in section 3 (Information Reviewed), a document entitled
9 “Surface Water Mitigation Plan” (the “Plan”, a copy of the narrative portion of which is
10 attached hereto as Exhibit E), which was prepared by Rosemont in December, 2014. This
11 submittal by Rosemont to ADEQ came long after the close of the public comment period³
12 and approximately only a month prior to ADEQ’s decision to issue the Certification. At
13 no point during this period did either Rosemont or ADEQ make an attempt to inform the
14 public of the Plan’s existence or to solicit input on the Plan’s content. That it is included
15 in the “Information Reviewed” list signifies that it is a relevant document and, indeed,
16 represents a critical piece of information in ADEQ’s decision-making process.

17
18 The Clean Water Act requires Arizona to provide public notice of the § 401 process
19 consistent with Arizona public participation procedures. U.S.C. § 1341(A). Those
20 Arizona procedures require relevant documents to be publicly available (A.R.S. § 49-
21 208(A)) and the public to be notified where they can be viewed. AAC R18-1-401(A). A
22 relevant document, made part of the record at the last possible minute and with no notice
23 to the public until the decision has been made, does not comply with either the Clean
24 Water Act or Arizona statutes. The resulting Certification is, therefore, void.

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³ Extended comment period ended April 7, 2014

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d. Rosemont’s Surface Water Mitigation Plan is Fatally Flawed

i. The Plan, and therefore, the Certification, Improperly Relies on an As-Yet-to-be-Developed Surface Water Model

Section 4.0 of the Plan advises that a Surface Water Model (the “Model”) “is planned.” Plan, Sec. 4.0. This Model is to “quantify potential changes surface water runoff” and to “quantify potential flow reductions.” *Id.* The apparent intent is to identify whether Mine construction changes “affect, or have the potential to affect, downstream water quality.” *Id.* Rosemont’s schedule shows implementation of the Model in January, 2017, after nearly two years of development. Plan, Sec. 6.0

Since the downstream OAWs are covered by Tier 3 of the Arizona antidegradation standard, they cannot be degraded. AAC R18-11-107(D). There is no room for maybes and unknowns; this is an absolute prohibition. Despite the lack of a surface water model and, consequently, no idea of the Mine’s impacts on downstream OAWs, ADEQ issued the Certification based solely on Rosemont’s promise that it will develop the Model and implement it two years from now. Furthermore, without the model, there is no demonstration that the proposed mitigation measures can be effective. While ADEQ has some discretion in this matter, it must make a serious effort to determine whether the Mine will impact the OAWs and, if so, whether the mitigation measures will be effective. The lack of a surface water model leaves ADEQ with nothing but Rosemont’s promises. Until the model is developed, there is no comfort level that Mine activities will be protective of the OAWs. Further, without a model, there can be no demonstration that

1 Rosemont’s mitigation can be effective in offsetting the anticipated declines identified in
2 the FEIS and other documents.

3
4 An arbitrary and capricious decision is one where there has been “an unreasoning action,
5 without consideration and in disregard for facts and circumstances.” *Maricopa County*
6 *Sheriff’s Office v. Maricopa County Employee Merit Commission, et al.*, 211 Ariz. 219,
7 223 (2005). Issuance of the Certification without the model is arbitrary and capricious.

8
9 **ii. ADEQ has Improperly Approved Definitions Requiring any Impacts**
10 **Resulting from Regulated Construction Activities to be Include in the**
11 **“Baseline” and would Require these Impacts to be Deemed “Natural**
12 **Variation”**

13
14 ADEQ approved a definition of baseline water quality conditions that includes water
15 quality changes resulting from Phase 1 construction of impoundments. Including those
16 impacts as part of baseline and pre-judging any resulting changes as “natural variation” is
17 arbitrary and capricious and is contrary to law. These definitions were never provided to
18 the public until now, so there is no previous record of our commenting on this issue.
19 These definitions go far beyond the intent of describing how reductions in surface water
20 volumes will be mitigated.

21
22 The surface water mitigation plan’s definition of baseline also conflicts with the USFS
23 FEIS which states, “baseline conditions would be established prior to mine construction
24 (before pre-mining phase)” (see FEIS appendix B at B-16).

25
26 The Certification provides in Section 1:

1 Subject to the conditions in Section 5, ADEQ certifies that based on the
2 information in Section 3 and in consideration of comments received in response to
3 public notice of the draft Certification decision issued February 21, 2014, the
4 activities proposed for **Rosemont Copper Project** will not violate applicable
5 surface water quality standards (SWQS) in the subject water bodies including
6 McCleary, Wasp, Trail, Barrel and Davidson Canyons and Cienega Creek in the
7 Santa Cruz Watershed, near Greaterville, Pima County.

8 Certification, Sec. 1.

9
10 In reaching this decision, ADEQ cites both the draft memorandum entitled “Revised
11 Analysis of Surface Water” and the “Surface Water Mitigation Plan.” Certification, Sec.
12 3, Items 16 and 26, respectively. In the Certificate, ADEQ also approves the Surface
13 Water Mitigation Plan, whose purpose is stated below in the Certificate’s Specific
14 Conditions:

15 The applicant has prepared, and ADEQ has approved, a Surface Water Mitigation
16 Plan, December, 2014, to maintain aquatic and riparian resources at pre-project
17 levels in the Outstanding Waters portions of Davidson Canyon Wash and Lower
18 Cienega Creek. The purpose of the plan is to detail the measures that will be taken
19 to offset predicted reductions in surface water flows and sediment, resulting from
20 the construction and operation of the Rosemont Copper Project, and a schedule for
21 implementation of such measures.

22
23 Upon issuance of this Certification, the applicant shall begin implementing the
24 Surface Water Mitigation Plan. Any proposed changes to this plan by the applicant
25 shall be submitted in writing to ADEQ. ADEQ shall coordinate with the USDA
26

1 Forest Service and CoE to determine if the changes are warranted and they should
2 be approved.

3
4 Should the results of monitoring by ADEQ, the applicant or others and/or revised
5 hydrologic modeling (ROD Mitigation Measures FS-BR-22, FS-BR-27, FS-GW-
6 02, FS SR-05) demonstrate that, as a result of the certified activities, water quality
7 upstream of or in the OAW segments in Davidson Canyon Wash and/or Lower
8 Cienega Creek has been degraded, ADEQ will request that the CoE suspend the
9 CWA 404 Permit in order for ADEQ to evaluate the issues and require additional
10 mitigation measures should the impacts be more than temporary degradation.

11
12 Any unauthorized material changes in, or failure to implement the Surface Water
13 Mitigation Plan, as it is currently approved or as amended in the future by the
14 applicant and approved by ADEQ, may be grounds for ADEQ requesting the CoE
15 modify, suspend or revoke the CWA 404 permit pursuant to 33 CFR 325.4(a)(2).

16 Certification, Spec. Cond. 1.

17
18 While the purpose of the Plan is to detail the measures that will be taken to offset
19 predicted reductions in surface water flows and sediment, Section 1 of the Plan, on page
20 3, goes far beyond this intent. "Baseline" water quality is defined to include impacts that
21 could occur during construction activities:

22 Monitoring discussed in this Plan is separated into two phases: Phase 1 and Phase
23 2. Phase 1 monitoring includes the time period from 2006 to the present and to the
24 point when Project construction activities begin to affect stormwater flow and
25 drainage. The installation of additional monitoring stations/locations (see Section
26 2.2.2 of this Plan) is assumed phased in during this period and is based on Rights

1 of Way from the Arizona State Land Department (ASLD). This time period covers
2 the baseline monitoring that was initiated in 2006. As a note, any trends, water
3 quality changes, or other anomalies observed in the Phase 1 data are understood to
4 be due to natural variations or other activities not associated with the Project;
5 and
6 Phase 2 monitoring will begin when major construction activities occur at the
7 Project site, i.e., when larger-scale stormwater impoundments are constructed at
8 the Project site and used to contain stormwater.

9 Plan, Sec. 1.2.1.

10

11 Note that Phase 1 includes “to the point when Project construction activities begin to
12 affect stormwater flow and drainage”, but Phase 2 does not begin until “larger-scale
13 stormwater impoundments are constructed and used to contain stormwater”. This is
14 vague and confusing, especially because there are so many impoundments of different
15 sizes and none are specifically referenced in the Plan or description of activities being
16 certified. Clearly, though, Rosemont intends to perform substantial amounts of
17 construction during baseline development.

18

19 Activities being certified are described in the Certification, Section 2, in a way that is also
20 vague and confusing:

21

22 NOTE: During the development of the Final Environmental Impact statement
23 (FEIS), changes were made to the project design that modified certain activities
24 proposed in the CoE Public Notice/Application No. SPL-2008-00816-MB (Public
25 Notice). This Certification is based on activities described in the Public Notice,
26 with the exception of activities modified by the selected action in the USDA
Forest Service's Record of Decision and FEIS. These modifications to the planned

1 activities include the removal of the heap leach facility and process, elimination of
2 fill in McCleary Canyon and the removal of the flow-through drain systems under
3 the waste rock storage areas and dry stack tailings facilities.

4 Certification, Sec. 2.

5

6 However, the resubmitted § 404 application (the “404 Application”) describes Surface
7 Water Management on page 3. In that description, Rosemont advises:

8 For the purposes of stormwater management, the open pit, the heap leach facility,
9 and the plant site are closed systems, with all direct rainfall contained on site.

10 Currently designed stormwater diversions include the flow-through drain system,
11 process water temporary storage (PWTS), and open pit diversions. In addition to
12 the primary diversions, a storage and recovery system sump will be developed in
13 the waste rock storage area. Project water management facilities are intended to
14 have sufficient capacity to handle runoff generated from 100-year, 24-hour storm
15 events. Sediment control facilities are designed to reduce the total suspended solid
16 loads to the minimum practical level in the 10-year, 24-hour storm event, defined
17 as total suspended sold [*sic*] concentrations equal to existing conditions.

18

19 Stormwater flows from the plant site will be collected in the lined PWTS pond,
20 located immediately downgradient of the plant site. The PWTS pond functions as
21 a closed system with all water that is directed to the pond from the plant, in
22 addition to collected stormwater runoff, incorporated into the process water flows.

23

24 The buttresses of the dry stack tailings facility will advance ahead of the tailings
25 surface to provide containment while concurrent reclamation and best
26 management practices, such as settling ponds, will be used to limit soil erosion in

1 the outer slopes. The top of the tailings area is impervious and will be sloped
2 inward so precipitation falling on top of the active tailings area will remain on top
3 and evaporate. Ponded water may be pumped to the PWTS pond as needed to limit
4 infiltration into tailings mass. Stormwater management at the waste rock facilities
5 will be similar to that for the dry tailings facility.

6 404 Application, page 3.

7
8 As noted in the Certification, the project description and activities were modified in the
9 draft ROD and FEIS. The FEIS identifies an 18- to 24-month preconstruction period that
10 includes pit construction and diversion of the intercepted runoff to Barrel Canyon, not
11 impoundment. Specifically: see p. xvi of the FEIS executive summary:

12 The project would be located primarily within the Barrel Canyon drainage and its
13 tributaries. Diversion channels would be constructed to intercept runoff from
14 precipitation and route it around the mine facilities for discharge to lower Barrel
15 Canyon, downstream of the project. Over time, the northern tailing facility would
16 expand south and east and would cover a portion of the Barrel Canyon.

17 FEIS, p. xvi.

18

19 The FEIS further provides:

20 Preproduction stripping of overlying rock would require 18 to 24 months
21 (premining stage) to prepare for full-scale mining operations, train work crews,
22 construct access and haul roads, and clear and grub the pit and tailings and waste
23 rock facilities that would be disturbed during the initial years of operation.

24 FEIS, p. xvii.

25

26

1 Page 14 of the July 2013 Stormwater Pollution Prevention Plan (SWPPP), which was not
2 listed as a relevant document for the Certification and, therefore, apparently not reviewed
3 by ADEQ, provides much more explicit information regarding sequencing of stormwater
4 controls on the figures 4-13 submitted with the SWPPP. At the minimum, based on these,
5 there could be clearing, grubbing, construction of the crushing, milling and flotation
6 facilities, and at least partial construction of the pit diversion and the haul and access
7 roads during baseline.

8
9 In conclusion, it is clear the baseline is defined in a way that permits 404-regulated
10 activities to occur during baseline water quality data collection. This is illogical in
11 addition to arbitrary and capricious. While it is true under Arizona law that there can be
12 no discharges from the mine workings during active mining and that this prohibition does
13 not apply before mining commences, it is not logical to assume that construction
14 activities at the mine cannot cause any trends, water quality changes or other anomalies,
15 particularly when wholesale diversions of watersheds will occur during the earliest
16 phases of construction.

17
18 The monitoring plan goes further to define any trends, water quality changes or other
19 anomalies as “due to natural variations or other activities not related to the Project”
20 (Section 1 of the Plan at page 3). Approving an applicant’s statement requiring official to
21 interpret water quality data in the applicant’s favor is arbitrary and capricious, if not
22 contrary to law.

23
24 iii. Rosemont Will Use Improper Adaptive Management Techniques to
25 Modify the Plan
26

1 The Surface Water Mitigation Plan, dated December 2014, is a new document that is part
2 of the basis for Certification. This new document advises that a surface water model will
3 be used to identify runoff replacement as a means of mitigating reduction of surface
4 water discharges. At page 18, Rosemont states:

5 In addition to serving as a tool to quantify potential flow reductions due to Project
6 activities, the Model will be used to estimate runoff replacement quantities from
7 off-site mitigation locations. Project effects will be based on existing and new
8 monitoring points located throughout the watershed up-gradient of the USGS
9 Gaging Station. The USGS station is located at the intersection of SR 83 and the
10 Lower Barrel Canyon Drainage.

11 Plan, Sec. 4.0.

12
13 In the Plan, Rosemont proposes the use of an adaptive management process “to ensure
14 the initial intent of the Plan is being met, and that pertinent data is being collected and
15 reported and that site conditions are accurately represented.” Plan, Sec. 8.0. It identifies
16 three key components of adaptive management:

- 17 • Testing assumptions - collecting and using monitoring data to determine if
18 current assumptions are valid;
- 19 • Adaptation - making changes to assumptions and monitoring program to
20 respond to new or different information obtained through the monitoring data
21 and project experience: and
- 22 • Learning - documenting the planning and implementation processes and its
23 successes and failures for internal learning as well as the scientific community.

24 Plan, Sec. 8. Rosemont further provides a partial list of elements that may be modified as
25 part of the adaptive management process:

26 Monitoring locations;

1 Monitoring parameters;
2 Monitoring frequencies;
3 Assumptions associated with pollutant loading, runoff volume, and/or assimilative
4 capacity;
5 Modeling approach;
6 Mitigation opportunities or requirements;
7 Implementation process for mitigation; and
8 Information provided and included in the quarterly data summaries and in the
9 Annual Summary Report.

10
11 Approximately 30% of the surface water entering the OAW at Davidson Canyon
12 will be impounded as a result of the Mine, yet there is no plan proposed by
13 Rosemont to make up for that reduction in flow. Further, there is no connection
14 between the host of data proposed to be collected and a decision to engage in a
15 management action that can reverse or mitigate for damages caused. Instead, the
16 Certification allows Rosemont to invoke an “adaptive management” process
17 whose outcome is not avoiding, minimizing, or mitigation harm to the resource
18 (quantity and/or quality of surface water), but instead to refine models.
19 Characterizing such an approach as adaptive management is contrary to logic,
20 because adaptive management is inherently focused on management actions that
21 foster outcomes related the goal of the project, which is:

22
23 . . . no degradation to downstream water quality (compared to current water
24 quality) due to Project construction, operation, and/or closure activities.
25 Additionally, no degradation is anticipated to the water quality in the
26 Outstanding Arizona Water (OAW) segment of Davidson Canyon Wash.

1 Plan, Sec. 1.0.

2

3 The certification ignores a large body of literature and practice of adaptive management
4 in environmental decision processes in general (e.g., Walters 1986; Gregory and Keeney
5 2002; Williams et. al. 2007) and water management in particular (Richter et. al. 2003;
6 Zedler 2003; Richter and Thomas 2007; Medema et. al. 2008). Citations to this literature
7 with brief excerpts is attached hereto as Appendix 1. To our knowledge, no credible
8 application of adaptive management principles and practices are restricted to model
9 validation and refinement, as was certified for Rosemont. In short, while model
10 validation is a key step in adaptive management, such models only serve to improve the
11 outcome of management actions. Rosemont's reliance solely on model refinement is an
12 improper use of the adaptive management method and, consequently, ADEQ's
13 acceptance and approval of this approach as a key component of the Plan is arbitrary and
14 capricious.

15

16 In the case of surface water in the Davidson watershed, adaptive management—even as
17 practiced according to industry standards—is not an appropriate tool for surface water in
18 Davidson Canyon. Instead, the focus of the mitigation plan should be on avoidance,
19 minimization, and mitigation of impacts that are already modeled to occur, particularly
20 during construction. In light of the absolute antidegradation requirement of AAC R18-11-
21 107(D) for the OAWs involved, failure to require such a focus is arbitrary, capricious and
22 contrary to law.

23

24 iv. Rosemont's Surface Water Mitigation Plan Does not Include a
25 Stormwater Mitigation Plan nor any Immediate Contingency to Address
26 Stormwater Impacts

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Rosemont opines that it “does not anticipate any adverse changes to water quality or the stability of Davidson Canyon Wash or the OAW segment as the result of Project activities.” Plan, Sec. 5.0. For that reason, it offers only “general concepts” of what it will do should stormwater impacts occur. *Id.* ADEQ’s acceptance of Rosemont’s opinion and the resulting approval of the Plan without stormwater response contingencies is arbitrary and capricious and is contrary to law.

Both Davidson Canyon and Cienega Creek are OAWs (AAC R18-11-112(G)) and are protected by the Tier 3 antidegradation standard. AAC R18-11-107. Tier 3 protections in Arizona law are:

1. Tier 3 antidegradation protection applies only to an OAW listed in R18-11-112(G).
2. A new or expanded point-source discharge directly to an OAW is prohibited.
3. A person seeking authorization for a regulated discharge to a tributary to, or upstream of, an OAW shall demonstrate in a permit application or in other documentation submitted to the Department that the regulated discharge will not degrade existing water quality in the downstream OAW.
4. A discharge regulated under a § 404 permit that may affect existing water quality of an OAW requires an individual § 401 water quality certification to ensure that existing water quality is maintained and protected and any water quality impacts are temporary. Temporary water quality impacts are those impacts that occur for a period of six months or less.

1 AAC R18-11-107.01(C). Two of these protections, (3) and (4) are particularly relevant to
2 the instant discussion.

3
4 Protection (3) requires Rosemont to demonstrate that Mine-related discharges “will not
5 degrade existing water quality.” AAC R18-11-107.01(C)(3). Rosemont has not done so
6 with respect to stormwater discharges. It merely offers its belief that there will be no
7 impacts and advises that it will develop a mitigation plan “[w]hen it is determined that
8 mitigation is required.” Plan, Sec. 5.0.

9
10 Rosemont’s intent to delay development of a mitigation plan leaves open the likelihood
11 that impacts to the OAWs will last more than the “temporary” six-month duration
12 specified in Protection (4). Only after an impact is detected, will Rosemont develop the
13 mitigation plan and implementation of the plan’s response actions will be even further
14 postponed. This is particularly problematic given the inherent delay in reporting impacts
15 to the U.S. Forest Service (only on a quarterly basis) followed in delays in convening
16 meetings of the response committee.

17
18 Rosemont’s failure to make the demonstration necessary to meet the requirement of
19 Protection (3) is contrary to law. ADEQ’s approval of the Plan with the non-compliant
20 demonstration and the lack of an immediate mitigation plan is arbitrary and capricious.

21
22 e. ADEQ Relied Upon Faulty Technical Data in its Decision-Making Process

23
24 As noted above, Appellants submitted three letters during ADEQ’s review of the
25 Rosemont application. ADEQ has made no attempt to address any of these comments in
26 a written explanation of its decision-making process. It issued a final Certification that is

1 essentially identical to the draft version and merely makes passing reference, in the
2 “Information Reviewed” section of the Certification, to the many comments received.
3 This lack of a reasoned response to the comments coupled with the lack of significant
4 revisions between the draft and final Certification suggests the comments were, for the
5 most part, ignored.

6
7 ADEQ’s apparent refusal to consider comments filed is particularly troubling in light of
8 information contained in Appellants’ July 16, 2014 submittal (Exhibit D, hereto). While
9 this document was submitted outside the official comment period, it is not a comment,
10 *per se*, but represents supplemental technical information regarding streamflow and
11 groundwater in Cienega Creek and Davidson Canyon. Attached to the July 16, 2014
12 letter was a document entitled “Impacts of the Rosemont Mine on Hydrology and
13 Threatened and Endangered Species of the Cienega Creek Natural Preserve”⁴
14 (hereinafter, “Powell (2014)”) which points out a statistically significant link between
15 surface water flow extent and groundwater resources in lower Cienega Creek and
16 Davidson Canyon. In particular, Powell (2014) identifies and discusses faulty
17 topographical data relied upon by Rosemont. This new technical data makes invalid
18 Rosemont’s assertion that the Davidson Canyon surface-water system is disconnected
19 from the groundwater system. However, despite the obvious importance of this
20 information in the protection of OAW water quality and the resulting potential for Mine
21 impacts, ADEQ apparently chose to ignore Appellants’ submittal. ADEQ’s failure to
22 consider the data supplied in Appellants’ July 16, 2014 submittal and to factor that data
23 into the Certification is arbitrary and capricious.

24
25 _____
26 ⁴ Powell, Orchard, Fonseca, and Postillion (2014). Impacts of the Rosemont Mine on hydrology and Threatened and Endangered Species of the Cienega Creek Natural Preserve. The Powell document resulted from a federal workshop held on June 10 and 11, 2014 to identify new data and analyses pertaining to surface waters. The data therein was not available during the official comment period in this matter.

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Powell (2104) shows: 1) the corrected channel bed elevations are clearly within elevations that intersect the shallow groundwater table; and 2) groundwater supports intermittent surface flows in the OAW reach. There is, however, no recognition of this information in ADEQ’s final Certification nor is there any explanation as to why the information was ignored.

Figure 1 of Appendix 2 hereto is a graph⁵ produced by Rosemont purporting to show groundwater elevations significantly below stream bed levels. Figure 2 in Appendix 2 hereto is the same graph⁶ but with corrected stream bed elevations. The corrected cross-sectional data demonstrate that the following conclusions from Rosemont’s Davidson Canyon Conceptual Groundwater Monitoring Plan⁷ are incorrect:

- “DTW [depth to water] has been persistently 7 to 15 feet below the stream channel in the OAW Reach;”
- “Persistent DTW below the stream channel bottom, combined with ephemeral, short duration, low discharge, and limited surface-length expression of spring flow, indicates that the groundwater system is usually disconnected from the surface-water system;”
- “Groundwater is disconnected from the alluvial stream channel”; and
- “Potential impacts to the OAW Reach will be limited

(Groundwater Plan, page 12) and that ADEQ’s reliance⁸ on those conclusions was improper.

⁵ Figure 5 in Tetra Tech (2010a), Davidson Canyon hydrological conceptual model as assessment of spring impacts. Tetra Tech project 114-320869. Prepared for Rosemont Copper, Tucson, Arizona.
⁶ Figure 6 in Powell (2014).
⁷ Davidson Canyon Conceptual Groundwater Monitoring Plan, prepared by Engineering Analytics, Inc., March 2012.
⁸ Cited as document 13 in Certification, Section 3.0.

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Appellants, in their April 4, 2014 comments (Exhibit C) discuss ADEQ’s decision to ignore isotope work done by Montgomery and Associates in 2010⁹ that clearly supports a hydraulic connection between the OAW reach of Davidson Canyon and the regional aquifer. The statement in the Mitigation Plan that “no degradation is anticipated to the water quality in the Outstanding Arizona Water (OAW) segment of Davidson Canyon Wash” (Plan, Sec. 1.0), in part, presumes that the OAW reach is not connected to the regional aquifer as reported in Tetra Tech (2010a). This overlooks documentation suggesting otherwise, and therefore, contradicts the Certification’s assertion that mining activities will not cause degradation to water quality in the OAW.

Further, as also discussed in Appellants’ July 16, 2014 report (attached to Exhibit D), ADEQ failed to consider and comment on an analysis showing drawdown of the regional aquifer in amounts reported in (Montgomery 2010) can potentially reduce wetted stream length in Lower Davidson Canyon by 30%. This analysis is crucial to illustrate the potential damage to the OAW that will result from drawdowns in the regional aquifer. It undermines Rosemont’s argument that the streamflows in Davidson Canyon are unrelated to the regional aquifer and that groundwater is disconnected from the alluvial stream channel. When additional evidence is considered, it is apparent there is a much higher probability of Mine impacts on Lower Davidson Canyon and the Outstanding Arizona Waters. The data concerning these increased risks were apparently not considered by ADEQ in its decision to issue the Certification. That failure produced an arbitrary and capricious decision.

⁹ Montgomery and Associates, Inc. 2010. Revised report: Groundwater flow modeling conducted for simulation of proposed Rosemont pit dewatering and post-closure, Vol. 1: Text and tables. Prepared for Rosemont Copper. Tucson, Arizona.

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IV. CONCLUSIONS

For the reasons provided above, ADEQ's Certification that the activities proposed by Rosemont for the Rosemont Copper Project will not violate applicable surface water quality standards in Davidson Canyon and Cienega Creek is not supported by substantial evidence, is contrary to law, is arbitrary and capricious and is an abuse of discretion. For that reason, ADEQ's decision to issue the Certification must be reversed. Further, approval of the Rosemont Surface Water Mitigation Plan must be rescinded and amended to address the inadequacies discussed herein. Revision of the Plan should be followed by public review and comment. Finally, Rosemont must quantify the extent and duration of "temporary" impacts from Mine operations to the downstream OAWs.

BARBARA LAWALL
PIMA COUNTY ATTORNEY
CIVIL DIVISION

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RESPECTFULLY SUBMITTED March 5, 2015.

BARBARA LAWALL
PIMA COUNTY ATTORNEY

By 
Charles Wesselhoft
Deputy County Attorney

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CERTIFICATE OF SERVICE

I hereby certify that on March 5, 2015, a copy of the above Notice of Appeal, was served on the persons listed below by depositing said document into the U.S. Mail, postage prepaid (certified mail, return receipt requested) prior to 11:59 p.m.

Director
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

and

Hearing Administrator
ADEQ Office of Administrative Counsel
1110 West Washington Street
Phoenix, Arizona 85007

With a copy to:

Office of the Attorney General
Environmental Enforcement Section Administrative Appeals Desk
1275 West Washington Street
Phoenix, Arizona 85007

By: Stacey Beruman

Appendix 1 – Adaptive Management Literature

Literature Cited:

Gregory, R. S., and R. L. Keeney. 2002. Making smarter environmental management decisions. *Journal of the American Water Resources Association* 38:1601-1612.

Medema, W., B. S. McIntosh, and P. J. Jeffrey. 2008. From Premise to Practice: a Critical Assessment of Integrated Water Resources Management and Adaptive Management Approaches in the Water Sector. *Ecology and Society* 13.

Richter, B. D., R. Mathews, and R. Wigington. 2003. Ecologically sustainable water management: Managing river flows for ecological integrity. *Ecological Applications* 13:206-224.

Richter, B. D., and G. A. Thomas. 2007. Restoring environmental flows by modifying dam operations. *Ecology and Society* 12.

Walters, C. J. 1986. *Adaptive management of renewable resources*. Macmillan Press, New York, New York.

Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2007. *Adaptive management: The U.S. Department of the Interior technical guide*. U.S. Department of the Interior, Adaptive Management Working Group, Washington, D.C.

Zedler, J. B. 2003. Wetlands at your service: reducing impacts of agriculture at the watershed scale. *Frontiers in Ecology and the Environment* 1:65-72.

Excerpts:

Gregory and Keeney:

A common link among all these applications of good decision making approaches is that the essential insights are accessible to all thoughtful resource managers regardless of their specialty. To strike a balance between theoretical rigor and application usefulness, our own work (as reported in this paper) has led us to stress qualitative guidance for how to think clearly to make a smart choice rather than quantitative analysis to make an optimum decision. We recognize that it is worthwhile to quantify important concepts such as the probabilities of events, desirabilities of consequences, and tradeoffs among competing objectives, and for these aspects of decision analysis specialized techniques are needed. But for nonspecialists the main use of the approach should be to improve thinking and sharpen communication about the critical elements of resource management decisions, rather than to encourage any subsequent mathematical analysis. Pg. 1603.

A structured decision making approach helps resource managers by splitting a tough decision into its parts (referred to here as “elements”). For many complex decisions, making a better choice

requires that eight key elements be considered (see Table 1). The first five elements – Clarifying the Problem, Identifying Key Objectives, Creating Alternatives, Assessing Consequences, and Explicitly Addressing Tradeoffs (leading to the acronym PrOACT, a reminder to be proactive) – constitute the core of a structured approach to decision making (Hammond et al., 1999). The remaining three elements – Uncertainty, Risk Tolerance, and Linked Decisions – are more specialized concepts that are well known to many professional managers (and are not described further here).
Pg. 1603.

Understanding the technical information (e.g., impact studies, computer models, historical data bases) that will clarify the magnitude and probability of these impacts is obviously essential. Yet the technical information needs to address and inform tradeoffs that arise with respect to the values and objectives that are at issue.
Pg. 1610.

DOI Technical Guide, Williams (2007—the following below is the 2009 updated document):

Adaptive management as defined here involves ongoing, real-time learning and knowledge creation, both in a substantive sense and in terms of the adaptive process itself. It is described in what follows in a series of 9 steps, as summarized in section 4.1, involving stakeholder involvement, management objectives, management alternatives, predictive models, monitoring plans, decision making,

monitoring responses to management, assessment, and adjustment to management actions. An adaptive approach actively engages stakeholders in all phases of a project over its timeframe, facilitating mutual learning and reinforcing the commitment to learning-based management. Adaptive management in DOI is implemented within a legal context that includes statutory authorities such as the National Environmental Policy Act (NEPA), the Endangered Species Act, and the Federal Advisory Committee Act.

Adaptive management as described here is infrequently implemented, even though many resource planning documents call for it and numerous resource managers refer to it (13). It is thought by many that merely by monitoring activities and occasionally changing them, one is doing adaptive management. Contrary to this commonly held belief, adaptive management is much more than simply tracking and changing management direction in the face of failed policies, and, in fact, such a tactic could actually be maladaptive (14). An adaptive approach involves exploring alternative ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions (15). Adaptive management focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable resource systems (3).

Adaptive management openly acknowledges uncertainty about how ecological systems function and how they respond to management actions (20, 21). However, adaptive management is not a random trial-and-error process. Instead, it involves formulating the resource problem, developing conceptual models based on specific assumptions about the structure and function of the resource system, and identifying actions that might be used to resolve the problem. Through the monitoring of outcomes following management interventions, adaptive management promotes improved understanding about which actions work, and why.

Adaptive management is designed to improve understanding of how a system works, so as to achieve management objectives (20, 21). Models are used in adaptive management to embed hypotheses about system behaviors and enable managers to predict the impacts of their activities. These predictions are the basis for learning later on. Once activities are implemented, the testing of underlying model assumptions against monitoring data provides the foundation for learning and the improvement of management based on what is learned.

Zedler, 2003—Wetlands at your service: reducing impacts of agriculture at the watershed scale

Adaptive management involves the application of alternative management actions, the appraisal of their effects, and the integration of these findings into future actions (Christensen et al.

1996). Applying this strategy to watershed restoration, managers and researchers ideally work together to (1) develop conceptual or GIS models relating alternative restoration configurations (such as those in Figure 2b) to the ecosystem services they provide, (2) provide annual assessments of biodiversity support, water quality improvement, and flood abatement at the water-shed scale, (3) determine restoration effectiveness based on monitoring data, and (4) use these findings to improve models and revise restoration priorities. More effective watershed configurations should gradually emerge (Figure 2c). Because we do not know what the outcomes of these various restoration strategies will be, an adaptive approach becomes essential. It makes little sense to spend millions of restoration dollars every year without learning how to optimize the benefits. Pg. 70.

Appendix 2. Graphical Representations of Davidson Canyon Streambed versus Groundwater Elevations

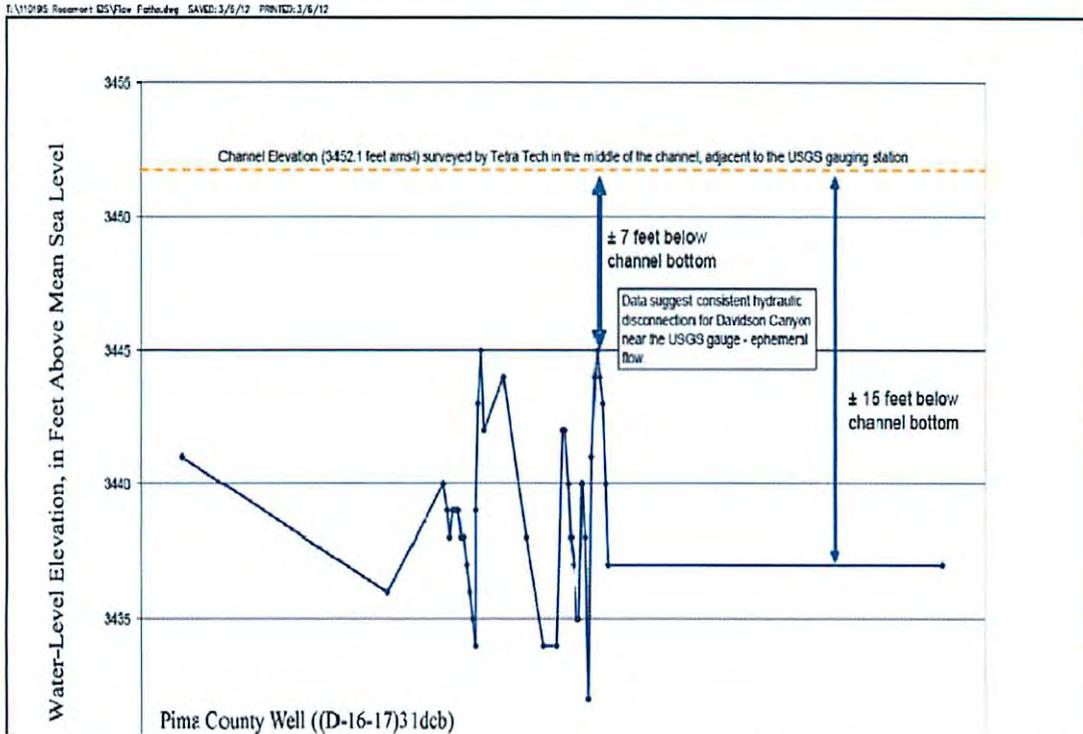


FIGURE 4
GROUNDWATER DISCONNECTED FROM THE
STREAM CHANNEL BOTTOM IN THE OAW REACH

Figure 1. Figure provided by Rosemont (Tetra Tech 2010a) which shows incorrect bed elevation.

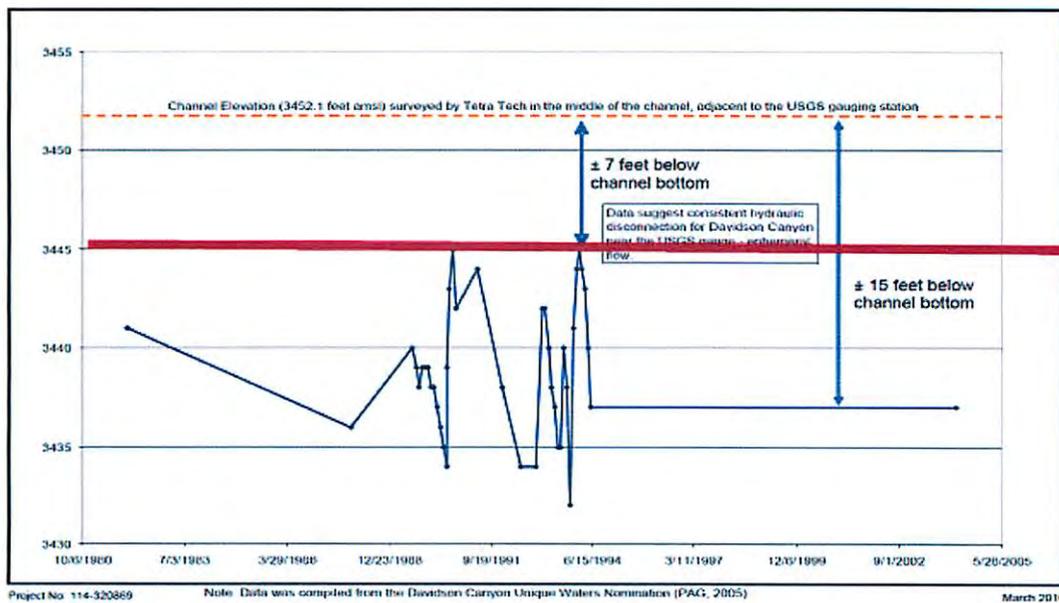


Figure 2. Powell (2104) correction of the stream bed elevation shown in Figure 1, above.



CERTIFICATION

STATE OF ARIZONA

Clean Water Act Section 401 Water Quality Certification

U.S. Army Corps of Engineers Public Notice / Application No.: **SPL-2008-00816-MB**

ADEQ LTF 55425

1. AUTHORIZATION

This State Water Quality Certification (Certification) is issued by the Arizona Department of Environmental Quality (ADEQ) under the authority of Section 401(a) of the federal Clean Water Act (CWA) (33 U.S.C. §1251 et seq.) and Arizona Revised Statutes Section 49-202. The conditions listed in Section 5.0 are in addition to conditions in the pending U.S. Army Corps of Engineers (CoE) Application No. SPL-2008-00816-MB. These Certification conditions are enforceable by the CoE and civil penalties, up to a maximum of \$37,500 per day of violation, may be levied if these Certification conditions are violated. Criminal penalties may also be levied if a person knowingly violates any provision of the CWA.

Subject to the conditions in Section 5, ADEQ certifies that based on the information in Section 3 and in consideration of comments received in response to the public notice of the draft Certification decision issued February 21, 2014, the activities proposed for the **Rosemont Copper Project** will not violate applicable surface water quality standards (SWQS) in the subject waterbodies including McCleary, Wasp, Trail, Barrel and Davidson Canyons, and Cienega Creek in the Santa Cruz River Watershed, near Greaterville, Pima County.

APPLICANT INFORMATION

Project Name: Rosemont Copper Project

Latitude/Longitude: 31° 49' 45.3"; 110° 44' 35.2"

Applicant: Rosemont Copper Company
Ms. Katherine Arnold, Vice President
Environmental & Regulatory Affairs

Applicant Address: 2450 W. Ruthrauff Road, #180
Tucson, AZ 85705

AUTHORIZING SIGNATURE



Michael A. Fulton, Director
Water Quality Division
Arizona Department of Environmental Quality

Signed this 3rd day of February, 2015

2. DESCRIPTION OF ACTIVITIES BEING CERTIFIED

NOTE: During the development of the Final Environmental Impact Statement (FEIS), changes were made to the project design that modified certain activities proposed in the CoE Public Notice/Application No. SPL-2008-00816-MB (Public Notice). This Certification is based on activities described in the Public Notice, with the exception of activities modified by the selected action in the USDA Forest Service's Record of Decision and FEIS. These modifications to the planned activities include the removal of the heap leach facility and process, elimination of fill in McCleary Canyon and the removal of the flow-through drain systems under the waste rock storage areas and dry stack tailings facilities.

The proposed Rosemont Copper Project will directly impact approximately 40.4 acres of waters of the U.S. (WUS) through the discharge of dredged/fill material. In addition, approximately 28.4 acres of WUS will be indirectly impacted by reduced flows in Barrel Canyon as well as downstream in Davidson Canyon, resulting from the development of the dry stack tailings and waste rock facilities in Barrel Canyon. Lastly, approximately 1.1 acres of WUS will be temporarily impacted by the water supply line crossing and road access for utility pole construction.

3. INFORMATION REVIEWED

During the development of this Certification, ADEQ had access to and reviewed the following documents (on file with ADEQ):

1. U.S. Army Corps of Engineers Public Notice / Application No. 2008-00816-MB. Comment period from December 6, 2011 through January 19, 2012.
2. CWA Section 401 Certification application package dated January 12, 2012, received by ADEQ on January 17, 2012; applicant: Katherine Arnold, Rosemont Copper; agent: Brian Lindenlaub, Westland Resources Inc. Review of application was suspended on January 25, 2012 pending completion of a federal action and reinitiated on January 3, 2014 following the publication of the draft Record of Decision for the Project by the USDA Forest Service, Southwest Region.
3. State of Arizona, Water Quality Standards for Surface Waters, A.A.C. Title 18, Chapter 11, Article 1. A portion of Davidson Canyon Wash and a portion of Lower Cienega Creek have segments that are designated as Outstanding Arizona Waters. The portion of Davidson Canyon designated as Outstanding Arizona Waters originates at an unnamed spring at 31°59'00"/110°38'49" (approximately 13 miles downstream from the subject project) and continues downstream from that point to its confluence with Cienega Creek at 32° 01' 05"/110° 38' 35". Available online at: http://www.azsos.gov/public_services/Title_18/18-11.htm
4. "Final Environmental Impact Statement for the Rosemont Copper Project", USDA Forest Service, Southwest Region, MB-R3-05-6, December, 2013. Available online at: <http://www.rosemonteis.us/>

5. "Draft Record of Decision and Finding of Nonsignificant Forest Plan Amendment for the Rosemont Copper Project", USDA Forest Service, Southwest Region, MB-R3-05-9, December, 2013. Available online at: <http://www.rosemonteis.us/>
6. Davidson Canyon Unique Water Nomination, prepared by Pima Association of Governments for Pima County Regional Flood Control District, January, 2005. Available at <http://www.rosemonteis.us/documents/pag-watershed-planning-2005>
7. "Contribution of Davidson Canyon to Base Flows in Cienega Creek", prepared by Pima Association of Governments, November, 2003. Available at: http://www.pagnet.org/wq/reports/wq_report_94.html
8. "Water Resource Trends in the Cienega Creek Natural Preserve, Pima County, AZ" prepared by Brian Powell, Pima County Office of Sustainability and Conservation, August 2013. Available at: <http://www.rosemonteis.us/files/references/powell-2013.pdf>
9. Technical Memorandum, "Rosemont Surface Water Quality Baseline Analysis", prepared by Mike Thornbrue, Tetra Tech, April 13, 2010.
10. "Davidson Canyon Hydrogeologic Conceptual Model and Assessment of Spring Impacts", Tetra Tech, July, 2010.
11. Technical Memorandum, "Rosemont Conceptual Barrel Alternative Stormwater Control Alternatives", by Ronson Chee, Tetra Tech, January 31, 2012.
12. "Davidson Canyon Conceptual Surface Water Monitoring Plan", prepared by Water and Earth Technologies, Inc., March, 2012.
13. "Davidson Canyon Conceptual Groundwater Monitoring Plan", prepared by Engineering Analytics, Inc., March, 2012.
14. "Integrated Watershed Summary - Rosemont Project", Rosemont Copper, June 2012.
15. Memorandum, "Estimates of Phasing of Stormwater Reductions during Operations", prepared by Chris Garrett, SWCA, April 5, 2013.
16. Draft Memorandum "Revised Analysis of Surface Water Quality", prepared by Chris Garrett, SWCA, August 25, 2013.
17. Arizona Game and Fish Department letter to Marjorie Blaine, ACOE Project Officer, dated January 17, 2012 Re: Public Notice No. 2008-00816-MB.
18. Bureau of Land Management, Tucson Field Office, Comments on Rosemont Mine 404 Permit Application, undated.
19. EPA letter to Colonel R. Mark Toy, ACOE District Engineer, LA District, dated January 5, 2012 Re: Public Notice No. 2008-00816-MB.
20. EPA letter to Colonel R. Mark Toy, ACOE District Engineer, LA District, dated February 13, 2012 Re: Public Notice No. 2008-00816-MB.
21. EPA letter to Colonel Kim Colloton, ACOE District Engineer, LA District, dated November 7, 2012 Re: Analysis of updated draft CWA §404 Compensatory Mitigation Proposals for Rosemont Mine, Pima County, AZ.
22. Rosemont letter to Colonel Kim Colloton, ACOE District Engineer, LA District, dated December 13, 2013 Re: EPA Evaluation of Rosemont Mine Compensatory Mitigation.
23. Pima County Administrator's Office letter to Colonel Kim Colloton, ACOE District Engineer, LA District, dated December 30, 2013 Re: EPA November 7, 2013 letter and Rosemont December 13, 2013 letters.

24. Rosemont Copper Company letter to ADEQ dated February 25, 2014
Re: Water quality reports and data sharing.
25. Comments received in response to the public notice of the draft certification published on February 21, 2014 in the **Arizona Daily Star**. The public comment period closed on March 24, 2014 but was extended, upon request, for two additional weeks until April 7, 2014.
26. "Surface Water Mitigation Plan", prepared by Rosemont Copper Company, December, 2014.

4. NOTIFICATION PROVISIONS

For any correspondence regarding this project, the ADEQ mailing address is:

Arizona Department of Environmental Quality
Nicole Coronado
Surface Water Section / State 401 Certification / mailstop 5415A-1
1110 West Washington Street
Phoenix, Arizona 85007

For questions or general comments:

email: nm1@azdeq.gov
Voice: (602) 771-4245

In any correspondence, reference:

Rosemont Copper Project
CoE File No.: **2008-00816-MB**
ADEQ LTF No.: **55425**
401 cert reading file: **rs314:005**

5. CONDITIONS FOR STATE 401 WATER QUALITY CERTIFICATION

For the purposes of this Certification the following definitions apply:

- "Waters of the United States" (WUS) as defined by the CoE and U.S. Environmental Protection Agency (EPA) under the Clean Water Act. This Certification applies only to activities conducted within the ordinary high water mark.
- "Temporary degradation" is defined as degradation that is six months or less in duration, i.e., water quality returns to baseline water quality within six months after the discharge commences; short-term degradation.
- "Native material/fill" is defined as soil, sand, gravel or similar material from the streambed or banks in the immediate area of the permitted work.

GENERAL CONDITIONS

1. The applicant is responsible to ensure certified activities do not cause or contribute to an exceedance of SWQS in any WUS.
2. If data collected by the applicant, ADEQ or others, demonstrates that, as a result of the certified activities, one or more conditions of this Certification have been violated, ADEQ may request the CoE modify, suspend or revoke the CWA 404 permit.
3. This State 401 Water Quality Certification of the CWA 404 permit activities does not affect or modify in any way the obligations or liability of any person for any damages, injury, or loss, resulting from these activities. This Certification is not intended to waive any other federal, state or local laws.
4. Issuance of this Certification does not imply or suggest that requirements for other permits including, but not limited to Aquifer Protection Permits, Arizona Pollutant Discharge Elimination System Permits, or Reclaimed Water Permits are met or superseded.
5. This Certification applies only to the activities described in Section 2 and is based upon the information listed in Section 3. This Certification is valid for the same period as the CWA 404 permit, when issued by the CoE. The applicant must apply for renewal, modification or extension of this Certification if the CWA 404 permit is renewed, extended or there is a modification to the certified activities. This Certification may be reopened, by ADEQ, at any time due to a change in a SWQS (i.e., a standard is lowered or becomes more stringent) for a pollutant likely to result from project activities. ADEQ may add or modify conditions in this Certification to ensure that the applicant's activities comply with the most recent SWQS.
6. This Certification does not authorize the discharge of mining, construction or demolition wastes, wastewater, process water, residues or other pollutants to any WUS except as specified in the application and supporting documents and allowed or not prohibited in the CWA 404 permit or elsewhere in this Certification.
7. The applicant shall provide a copy of this Certification to all appropriate contractors and subcontractors and post and maintain a legible copy in a location and manner as to not to be damaged by weather conditions at the construction site where it may be seen by the workers.
8. The applicant shall notify ADEQ within 30 days following suspension or stoppage of the project for a period greater than 30 days or upon project completion. The applicant shall notify ADEQ within 7 days of re-initiating activities following a suspension or stoppage of the project for 30 days or more.
9. The applicant shall provide ADEQ with a copy of the monitoring results report on a quarterly basis and notification of data not in compliance with SWQS in accordance with the USDA Forest Service "Draft Record of Decision and Finding of Nonsignificant Forest Plan Amendment for the Rosemont Copper Project" (ROD) General Stipulation #15.

10. The applicant shall provide ADEQ with a copy of the annual report in accordance with ROD General Stipulation #16.

SPECIFIC CONDITIONS

Except as specified in the application and supporting documents and allowed, specified or not prohibited in the CWA 404 permit or elsewhere in this Certification, the following specific conditions apply.

SURFACE WATER MITIGATION PLAN

1. The applicant has prepared, and ADEQ has approved, a Surface Water Mitigation Plan, December, 2014, to maintain aquatic and riparian resources at pre-project levels in the Outstanding Waters portions of Davidson Canyon Wash and Lower Cienega Creek. The purpose of the plan is to detail the measures that will be taken to offset predicted reductions in surface water flows and sediment, resulting from the construction and operation of the Rosemont Copper Project, and a schedule for implementation of such measures.

Upon issuance of this Certification, the applicant shall begin implementing the Surface Water Mitigation Plan. Any proposed changes to this plan by the applicant shall be submitted in writing to ADEQ. ADEQ shall coordinate with the USDA Forest Service and CoE to determine if the changes are warranted and they should be approved.

Should the results of monitoring by ADEQ, the applicant or others and/or revised hydrologic modeling (ROD Mitigation Measures FS-BR-22, FS-BR-27, FS-GW-02, FS-SR-05) demonstrate that, as a result of the certified activities, water quality upstream of or in the OAW segments in Davidson Canyon Wash and/or Lower Cienega Creek has been degraded, ADEQ will request that the CoE suspend the CWA 404 Permit in order for ADEQ to evaluate the issues and require additional mitigation measures should the impacts be more than temporary degradation.

Any unauthorized material changes in, or failure to implement the Surface Water Mitigation Plan, as it is currently approved or as amended in the future by the applicant and approved by ADEQ, may be grounds for ADEQ requesting the CoE modify, suspend or revoke the CWA 404 permit pursuant to 33 CFR 325.4(a)(2).

STORMWATER MANAGEMENT

2. Industrial stormwater discharges covered under Arizona's Mining Multi-Sector General Permit (Mining MSGP) and allowable non-stormwater discharges, identified in Part 1.1.3

of ADEQ's Mining MSGP, must not cause or contribute to an exceedance of an Arizona SWQS.

3. Stormwater that comes into contact with mine drainage that is subject to 40 CFR Part 440, Subpart J is not authorized to be discharged under this Certification.
4. Stormwater that has not been in contact with mine operations (e.g., unimpacted) may be diverted directly to surface water.

EROSION PREVENTION AND HYDRAULIC ALTERATIONS

5. Clearing, grubbing, scraping or otherwise exposing erodible surfaces shall be minimized to the extent necessary for each construction phase or location.
6. Dredged or fill material shall be placed in WUS so that it is stable after placement and not showing signs of excessive erosion. Indicators of excess erosion include but are not limited to: gullyng, head cutting, caving, block slippage, and material sloughing.
7. Erosion control, sediment control and/or bank protection measures shall be installed before construction and pre-operation activities, and shall be maintained during construction and post-construction periods to minimize channel or bank erosion, soil loss and sedimentation. Control measures shall not be constructed of uncemented or unconsolidated imported soil, or other materials easily transported by flow.
8. The effectiveness of all pollution control measures, including those preventing erosion and affecting sedimentation, shall be re-evaluated after each flow event and repaired/modified as needed.
9. Direct runoff of water used for irrigation or dust control shall be limited to the extent practicable and shall not cause downstream erosion or flooding nor cause an exceedance of applicable SWQS.
10. Except where the certified activities are intended to permanently alter any WUS, all disturbed areas within WUS shall be restored and (re)vegetated as indicated in the application documents if approved by the CoE. Denuded areas shall be revegetated as soon as physically practicable. Vegetation shall be maintained on unarmored banks and slopes to stabilize soil and prevent erosion. Fill used to support vegetation rooting or growth shall be protected from erosion.
11. If retention/detention basins are included in or added to the project, applicant will complete the grading necessary to direct runoff towards retention/detention basins immediately following initial land clearing or rough grading.
12. Retention/detention basins shall be sized to accept storm runoff and capture sediment prior to it entering any WUS. Detention basins will provide detention through the use of controlled outflow spillways and shall cause no significant change to the hydraulic conditions of the downstream WUS outside of the project boundaries. The basins shall be maintained as needed to maintain functionality.
13. Certified activities shall, as much as practicable, be performed during periods of no flow in any WUS. No work shall be done, nor shall any equipment or vehicles enter any WUS while flow is present, unless all conditions in this Certification are met.

14. When flow is present in any WUS downstream of the certified activities, neither the applicant nor any contractor will alter the flow by any means except to prevent erosion or pollution of any WUS.
15. The applicant will take measures necessary to prevent approaches to any WUS crossing from causing erosion or contributing sediment to any WUS.
16. The applicant shall ensure that the certified activities will not cause any adverse change in the stability of any WUS, with respect to stream hydraulics, erosion and sediment load downstream from the project. If the monitoring activities described in the Surface Water Mitigation Plan show such change has occurred as a result of the certified activities, the applicant shall propose and initiate steps to restore the pre-project stability of any impacted segments.

SEDIMENT LOADS

17. When flow is sufficient to erode, carry or deposit material, certified activities in WUS shall cease until the flow decreases below the point where sediment movement ceases, or control measures have been undertaken; e.g., equipment and materials easily transported by flow are protected with non-erodible barriers or moved outside the flow area.
18. Silt-laden or turbid water resulting from certified activities shall be settled, filtered or otherwise treated to ensure no exceedance of, or reduction from, natural background levels of sediment occurs in any WUS.
19. Any washing or dewatering of fill material must occur outside of any WUS prior to placement and the rinseate from such washing shall be settled, filtered or otherwise treated to prevent migration of pollutants, including sediment, or from causing erosion to any WUS. Other than replacement of native fill or material used to support vegetation rooting or growth, fill placed in locations subject to scour must resist washout whether such resistance is derived via particle size limits, presence of a binder, vegetation, or other armoring.

POLLUTION PREVENTION

20. Construction material and/or fill (other than native fill or that necessary to support re-vegetation) placed in any WUS, shall not include pollutants in amounts or concentrations that can cause or contribute to an exceedance of a SWQS.
 - Acceptable construction materials that will or may contact water in any WUS are: untreated logs and lumber; natural stone (crushed or not), crushed clean concrete (recycled concrete); native fill; precast, sprayed or cast-in-place concrete (including soil cement and unmodified grouts); steel (including galvanized); plastic and aluminum.
 - Other materials allowed for this project, only if placed in accordance with application and supporting documents, are mining residues including tires, waste rock, gangue and tailings.

21. The applicant shall erect barriers, covers, shields and other protective devices as necessary to prevent any construction materials, equipment or contaminants from falling into or otherwise entering any WUS downstream of the certified activities.
22. Area(s) for equipment staging, maintenance and storage must be located entirely outside of any WUS. In addition, the applicant must designate areas, located entirely outside of any WUS, for fuel, oil and other petroleum product storage and for solid waste containment. All precautions shall be taken to avoid the release of wastes, fuel or other pollutants to any WUS.
23. Upon completion of the certified activities (except as noted in Condition 24 below - concrete curing), areas within any WUS shall be promptly cleared of all construction related forms, piling, construction residues, equipment, and debris.
24. If fully, partially or occasionally submerged structures are constructed of cast-in-place concrete instead of pre-cast concrete, applicant will take steps to prevent contact between surface water (instream and runoff) and the concrete (e.g., sheet piling or temporary dams) until it cures and until any curing agents have evaporated or otherwise cease to be a pollutant threat.
25. Washout of concrete handling equipment must not take place in or be allowed to enter any WUS.

TEMPORARY AND PERMANENT STRUCTURES

26. Permanent pipes, temporary pipes and culvert crossings shall be adequately sized to handle expected flow and properly set with end section, splash pads, headwalls or other structures that dissipate water energy to control erosion.
27. Debris will be cleared as needed from culverts, ditches, dips and other drainage structures in any WUS to prevent clogging or conditions that may lead to washout.
28. Any temporary crossing, other than fords on native material, shall be constructed in such a manner so as to provide armoring of the stream channel. Materials used to provide this armoring shall not include anything easily transportable by flow. Examples of acceptable materials include steel plates, untreated wooden planks, pre-cast concrete planks or blocks; examples of unacceptable materials include clay, silt, sand and gravel finer than cobble (roughly fist-sized). The armoring must, via mass, anchoring systems or a combination of the two, resist washout.
29. All temporary structures constructed of imported materials and all permanent structures, including but not limited to, access roadways; culvert crossings; staging areas; material stockpiles; and berms, dikes and pads, shall be constructed so as to accommodate overtopping and resist washout by streamflow.
30. Any ford, other than fords on native material, shall be designed, and maintained as necessary, to carry the proposed traffic without causing erosion or sedimentation of the stream channel while dry or during a flow event equivalent to or less than the design flow event for the crossing.

- 31. No unarmored ford shall be subject to heavy-truck or equipment traffic after a flow event until the stream bed is dry enough to support the traffic without disturbing streambed material to a greater extent than in dry conditions.**
- 32. Temporary structures constructed of imported materials are to be removed no later than upon completion of the certified activity.**
- 33. Temporary structures constructed of native materials that obstruct flow, can contribute to or cause erosion, or can cause changes in sediment load, are to be removed no later than upon completion of the certified activity**



EXHIBIT B

COUNTY ADMINISTRATOR'S OFFICE

PIMA COUNTY GOVERNMENTAL CENTER
130 W. CONGRESS, FLOOR 10, TUCSON, AZ 85701-1317
(520) 724-8661 FAX (520) 724-8171

C.H. HUCKELBERRY
County Administrator

March 21, 2014

Robert Scalamera, Project Manager
Arizona Department of Environmental Quality
Surface Water Section, MC5415A-1
1110 West Washington Street
Phoenix, Arizona 85007

**Re: Arizona Department of Environmental Quality ADEQ Clean Water Action Section
401 certification for Rosemont Copper, Public Notice 27-14AZ LTF 55425**

Dear Mr. Scalamera:

This letter presents the combined comments of the Pima County Regional Flood Control District (RFCD) and Pima County regarding the proposed 401 certification for the Section 404 permit for the Rosemont Copper Project, Public Notice/Application No.: SPL-2008-00816-MB. The corresponding address is provided above.

Pima County and the Regional Flood Control RFCD have previously commented on the Clean Water Act (CWA) Section 404 application for this project and participated as a Cooperating Agency in the development of the Final Environmental Impact Statement (FEIS). We appealed the Aquifer Protection Permit (APP) for this project; and in view of the need for future significant modifications of that permit to conform to new mine designs, we negotiated with the applicant several provisions that addressed our concerns with that version of the APP.

In addition, the County and RFCD are affected parties by virtue of our downstream location (see Figure 1 below). The County and RFCD own the land and water rights in the Outstanding Waters reach of Davidson Canyon and the Outstanding Waters reach of Cienega Creek downstream of the Davidson Canyon that would be affected by this project. Further, the County and RFCD manage the Bar V Ranch and Cienega Creek Natural Preserve for wildlife and recreation purposes and oversee ranching at the Bar V Ranch.

Mr. Robert Scalamera

Re: ADEQ 401 Certification for Rosemont Copper, Public Notice 27-14AZ LTF 55425

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The CWA Section 401 certification for this project is an important test of the meaning of the anti-degradation provisions of the Outstanding Waters program. We proposed or supported the original state designations for Davidson Canyon and Cienega Creek as Outstanding Waters based on the belief that this designation would prevent ADEQ from issuing permits that would degrade the water quality of these streams.

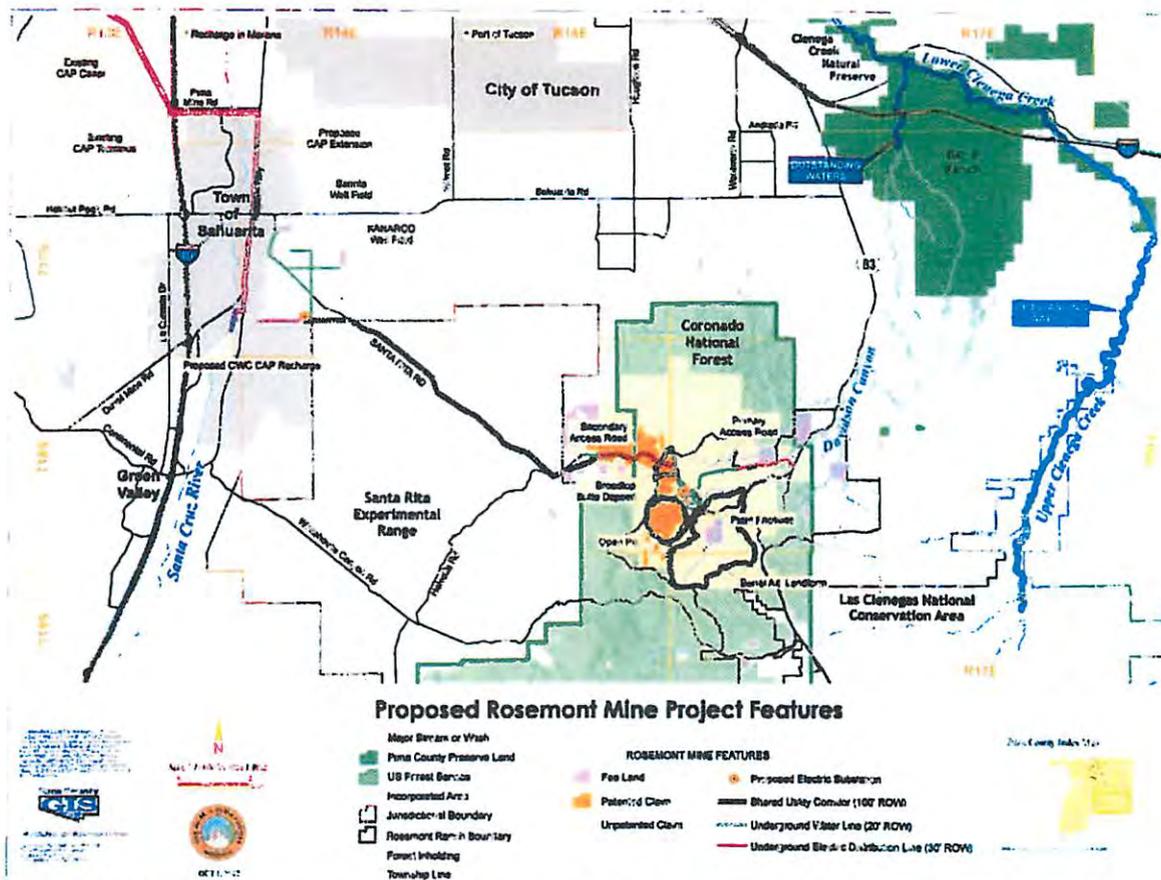


Figure 1. The Outstanding Arizona Waters reaches of Cienega Creek and Davidson Canyon, which will be impacted to the Rosemont Mine, flow through Pima County properties (Bar V Ranch and Cienega Creek Natural Preserve).

ADEQ's certification process is a grave responsibility. Residents of eastern Pima County have historically suffered contamination of groundwater from surficial discharges from mines and other industries. These events were seminal in the development of your agency.

Mr. Robert Scalamera

Re: ADEQ 401 Certification for Rosemont Copper, Public Notice 27-14AZ LTF 55425

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This particular certificate is important to residents of eastern Pima County because the Rosemont mine is in the contributing watershed and groundwater basin of Tucson's aquifers, which still provide water supply to Vail and other areas. Studies by The University of Arizona have found isotopic evidence that a considerable areal extent of Tucson's aquifer originates from the Cienega Basin and extends from Vail as far as The University of Arizona itself (see Figure 2 below and Attachment 1).

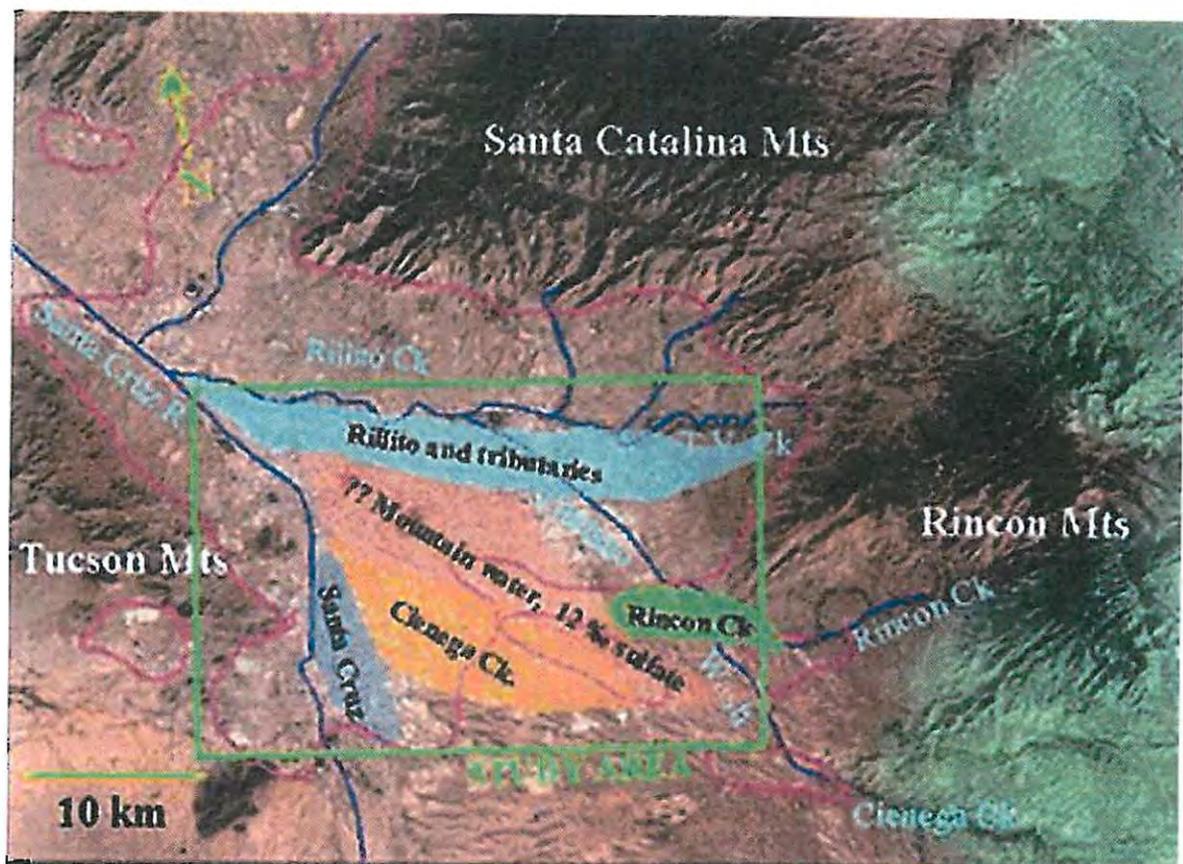


Figure 2. Groundwater recharge domains inferred from isotopic analysis showing the importance of Cienega Creek on the Tucson Basin Aquifer (Eastoe and others, 2003; Attachment 1).

ADEQ proposes to conditionally certify that this mine will not exceed water quality standards. However, we recommend the certification be denied for the following reasons:

1. The certification is based on an evaluation of inconsistent descriptions of activities provided by the applicant, all relating to differing mine designs;
2. Insufficient information has been provided to ADEQ by the applicant to certify the proposal or demonstrate compliance;

Mr. Robert Scalamera

Re: ADEQ 401 Certification for Rosemont Copper, Public Notice 27-14AZ LTF 55425

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- 3. There is no reasonable assurance the activity can be conducted in a manner that will not violate applicable water quality standards;**
- 4. ADEQ has not certified that the project will not degrade Outstanding Arizona Waters;**
- 5. Pima County believes the project will cause or contribute to degradation of water quality and violate State Water Quality standards;**
- 6. There are practical alternatives that would reduce impacts on water quality and the watercourse ecosystems;**
- 7. The certification is inconsistent with the Arizona Governor's Executive Order No. 89-15 on riparian resources and No. 91-6 on protection of riparian areas, which declare the importance of riparian areas and direct that "all state agencies shall rigorously enforce their existing authorities to assure riparian protection, maintenance, and restoration" (Executive Order 91.6); and**
- 8. The design of the Forest Service's preferred alternative is at odds in several respects with the proposed conditions of this permit, and therefore the mine cannot meet the terms of the certification.**

Overall, the proposed conditions appear to be largely a boilerplate imposed on a hopeless muddle of mine designs. There is little evidence of specific conditions that refer to the particular risks this mine presents. The language of this permit shows lack of coordination with the terms of the Forest Service approvals. In the event this mine is approved, it is essential that ADEQ's permits hew closely to what would be approved by the Forest Service.

We request that ADEQ deny the CWA Section 401 certification for Rosemont Copper based on the reasons summarized above and the detailed comments attached to this letter.

Sincerely,



C.H. Huckelberry
County Administrator

CHH/mjk

Attachments

c: Colonel Kimberly Colloton, Los Angeles District Engineer, US Army Corps of Engineers
Jared Blumenfeld, Region IX Administrator, US Environmental Protection Agency

**Pima County Staff Review of the Draft Arizona Department of Environmental
Quality 401 Certification for
Rosemont Copper (Public Notice 27-14AZ LTF 55425)**

Pima County staff offer the following comments on the proposed certification:

Part 1.0 AUTHORIZATION

1. This certification states that the proposed activities *“will not violate applicable water quality standards in the subject waterbodies....all ephemeral tributaries to Davidson Canyon....”* In order to make this certification, the Arizona Department of Environmental Quality (ADEQ) should complete the anti-degradation review, but there is no evidence that such a review has been completed. Until such has been completed, this authorization is premature.
2. This certification is based on applicable water quality standards for the subject waterbodies, but ADEQ has not demonstrated that the project activities will not violate the standards.
3. With reference to the “ephemeral” nature of the subject waterbodies, please note that applicant did not assert that the waterbodies are all ephemeral. Some of the waterbodies are intermittent springs and streams. The water table under many of the APP-regulated facilities is 20 feet or less (Rosemont APP-Regulated Facility Depth to Groundwater, Tetra Tech 2010; Attachment 2) and even less along portions of Barrel, Wasp and McCleary Canyons. Major recharge events in the project area have the potential to bring the water table to the surface.

Part 2.0: DESCRIPTION OF ACTIVITIES BEING CERTIFIED

4. The draft permit certification language describing the activities is too vague to be enforceable. This is a permit that has impact areas distributed in various small locations scattered over two watersheds—it will be unclear to contractors what is in the permit and what is not. This is complicated by the fact that during the past several years, Rosemont has changed the mine design, and thus the activities that occur within the Waters of the United States (WUS).
5. The permit makes unexplained reference to changes made during the development of the FEIS. Are we to understand that this certification is based on one of the alternatives as proposed in the FEIS? (If so, please state which one.) Or is the certification based on the mine as designed in the original 404 application?
6. Even the FEIS is internally inconsistent. For instance, the compliance point dam referenced on p. 46 of the FEIS is not described in figure 9 of the 404(b)(1) analysis, but

the sediment control dam on Trail Canyon (shown in figure 9 of the Corps alternative analysis) is not mentioned elsewhere. The original 404 application references only one dam. Please state which structures were included for the purpose of your review.

7. The application from Rosemont indicates a total of 101.6 acres of impacts to jurisdictional waters, but the certification indicates 38.6 acres. Furthermore, the 38.6 described in the 404 Public Notice (Application SPL-2008-00816-MB) is for a mine configuration that is no longer being proposed. For example, the heap leach pad is not in the FEIS, but was included in application SPL-2008-00816-MB.
8. The points of discharge authorized to the WUS should be described in this permit.

Part 3.0: INFORMATION REVIEWED

9. The January 12, 2012 certification package cited for this proposal was for a different mine design than is currently proposed as the Barrel alternative in the FEIS. On July 10, 2012, Rosemont Copper informed U. S. Forest Service that they would not “complete the leaching process and fully recover the copper from the oxide ore materials”. Does this certification reference the mine that includes the heap leach as proposed in the 404 and 401 applications? If so, please clarify. Does it include flow-through drains referenced in the 401 application or not?
10. Within draft 401 certification Section 3.0, there is no reference to a review of the draft or final Stormwater Pollution Prevention Plan (SWPPP) for AZPDES MSGP – 2010 (Permit No. AZMSG2010 – 003). ADEQ has authority under ARS 49-202 to request this supplemental information. ADEQ had been scheduled to provide Rosemont Copper review comments on the July 2013 draft of this document in February, 2014. The July 2013 draft SWPPP contained incomplete descriptions and information, and a number of missing figures. ADEQ should review the final SWPPP for the site—hopefully prepared in conjunction with facility design and operations described in the final MPO—prior to issuing a 401 certification, which states that discharges from the mine complex will not result in a violation of State surface water quality standards.
11. The public should be provided an opportunity to review the SWPPP document in its entirety prior to finalization.
12. The listing of information reviewed does not include the *Preliminary Site Water Management Plan for the Barrel Alternative* (Rosemont Copper Project, Tetra Tech, July 2012). Although not known or available to the public, a “final Site Water Management Plan” might be included within the final MPO.
13. ADEQ did not cite the 2010 Site Water Management Update and the “Site Water Volume [X] April 2010” referenced by the applicant’s 401 application. What did ADEQ use as the basis for the description of measures to be taken to control discharge of pollutants?

14. The document: “Rosemont Conceptual Barrel Alternative Stormwater Control Alternatives” (January 31, 2012) by Ronson Chee of TetraTech, is cited by ADEQ as a supporting document. This document predates many adjustments to the mine design that the company proposed later that year. If ADEQ’s relied on this outdated document, then it clouds the ability of the public, contractors or any other parties to understand the activities being certified, particularly given that the application itself references a different set of documents.
15. Within Section 3.0 of the draft 401 certification, there is no reference to a review of the *Final Mine Plan of Operations* (final MPO) referenced in the draft Record of Decision, which is also to include the *Final Reclamation and Closure Plan*. This document, which may now be available, apparently incorporates all modifications made to the proposed facility design, operations, and compliance as a result of the culmination of the entire EIS process, including federal, state, cooperating agency and public input. For this massive industrial complex, how can ADEQ certify that the discharge will not result in a violation of State surface water quality standards in McCleary, Scholefield, Wasp and Barrel Canyons without a review of the final MPO document? The permit should be denied on the basis of the inconsistent information provided by the applicant and reviewed by ADEQ.
16. ADEQ has no relief from the licensing timeframes imposed by the applicant’s decision to request a permit; however we request to have a public hearing on the anti-degradation review prior to finalization of this permit. In the event that ADEQ finalizes the permit without further public review, we request a public hearing be provided when the permit is amended.
17. SWCA (2013; memorandum from Chris Garrett entitled “Revised Analysis of Surface Water Quality”; cited in the FEIS) has provided information that stormwater flows on Barrel Canyon do not meet all applicable water quality standards. No further degradation of existing water quality is permitted in a surface water where the existing water quality does not meet applicable water quality standards. Thus, this certification is premature and needs to be coordinated with additional baseline characterization for Barrel Canyon, and potentially a 303(d) listing.
18. No relevant documents provide a basis for determining the source of the observed metals. While there are ore deposits at or near the surface to contribute to natural levels of metals in runoff, it may also be that there are point or non-point sources in the numerous small mine pits, shafts, adits, or mine wastes and tailings from previous mining activities.
19. The relevant documents should include Rosemont APP-Regulated Facility Depth to Groundwater (Tetra Tech 2010; Attachment 2). This document shows that the water table under many of the APP-regulated facilities is 20 feet or less. There is a substantial

potential for interchange between the aquifer and WUS at these locations and other areas where dredge and fill activities occur.

Part 5.0: CONDITIONS FOR STATE 401 WATER QUALITY CERTIFICATION

20. This certification requires that native material be free of pollutants, but this has not been demonstrated. In fact, SWCA (2013) provides evidence that sediment transported in flood flows is not free of pollutants. The source sites for these pollutants are unknown. We would like this to be demonstrated by the applicant, or know ADEQ's basis for such a determination.
21. If this condition would permit use of truck tires for revetments in WUS, please specify the conditions under which this would be considered.
22. The FEIS (page 470) states that "inert or acid-neutralizing waste rock shall be used to build haul roads and buttresses around waste rock and tailings facilities to provide a buffer zone that would isolate potentially acid-generating materials from water infiltration and storage". Furthermore, the mine would segregate any acid-generated rock as required by the APP. The FEIS is built around the assumption that the metals are mobilized only from acid-generating rock, but this assumption has not been proven.
23. Like Rosemont, the Oracle Ridge mine is a copper skarn with abundant limestone. At Oracle Ridge, the stormwater monitoring program has provided evidence of mobilization of metals in stormwater runoff and spring water from the mine, despite the fact that the host rock is limestone, the pH is alkaline, the hardness is very high. Dissolved copper often exceeds the applicable standard in base flows and stormwater, and total arsenic, beryllium, cadmium, copper, lead have exceeded standards in stormwater runoff.
24. The original 404 application states that "mine haul road will be constructed using material excavated from the open pit, typically consisting of limestone, skarn, arkose, andesite and quartz monzonite rock types." The FEIS says the road will be constructed of "inert or acid-neutralizing rock." The waste rock for the Barrel Alternative includes 65 million tons that were defined (at the time of the 2011 404 application) as oxide ores of copper (FEIS, page 33). This oxide material is located near the surface of the deposit (FEIS, page 32), and would need to be moved during the early years of the operation. It is therefore logical to require a demonstration that pollutants will not be discharged when waste rock is placed into road beds, dams and berms and discharged into WUS. We see elevated levels of metals, primarily copper, in runoff from the Oracle Ridge mine area, despite the abundance of limestone. If ambient runoff from the Rosemont area already exceeds standards for certain metals, then pollutant discharge cannot be avoided when soil and vegetation is removed, flows paths are shortened, and the waste

rock is further crushed and discharged into WUS at roadway crossings and other facilities.

Part 5.1: GENERAL CONDITIONS

25. *"If monitoring, by ADEQ or others, indicates that water quality is adversely affected by the activities certified herein, ADEQ will notify the CoE and request suspension of the CWA 404 permit"* (p. 4 of 9). Per this draft 401 certification statement, ADEQ should formally request the CoE suspend mining operations until such time that water quality non-compliance issue(s) have been remedied by Rosemont Copper.
26. Per the draft 401 certification at condition #1, contractors and subcontractors will receive a copy of the 401 Certification. A legible copy will also be available at the construction site *"where it may be seen by workers"*. These stated actions are wholly insufficient to ensure compliance with 401 Certification general and specific conditions. Similar to SWPP requirements, each and every worker employed by Rosemont Copper or contracted by Rosemont Copper should be trained regarding the 401 Certification general and specific conditions, provided a personal copy of the certification, and systematically monitored by designated individuals to ensure day-to-day compliance.
27. Per the draft 401 certification condition #2, *"The applicant shall notify ADEQ of project completion within 30 days following project completion"* (p. 5 of 9). Does "project completion" coincide with the final placement by Rosemont Copper of fill, waste rock or tailings in the permanent impact zones of WUS? This may require 10 or more years of mine operations. ADEQ should evaluate site conditions on a regular basis during each year of mine development, mining operations, and during the reclamation and post-closure period for compliance with CWA 401 certification conditions. Because many mining projects can be put on hold for long periods of time, it is important that provisions be put in place for stoppages of a significant amount of time.
28. With reference to condition #4, "the application and supporting documents" are for a variety of mine design alternatives. If all of these designs are the basis for this certification, then it is impossible to determine what ADEQ considered the covered activities in its review. If not all of the different designs were used in the review, it is entirely obscure and unclear. Either way, the permit must clearly provide reference for what the covered activities are or are not; otherwise the certification in 5.1 is meaningless.
29. With regard to condition #4, the certification *"does not authorize the discharge of mining, construction,....except as specified in the application and supporting documents..."*. This should not explicitly exclude the heap leach discharges described in the FEIS and original 404 application.

30. ADEQ should consider a mitigation plan that reduces the need to permanently place mine waste materials in WUS. ADEQ should require a closure design that places a significant amount of overburden and waste rock back into the mine pit. This would constitute one of the "...practicable alternatives to the proposed discharge, that is, not discharging into the waters of the U.S..." in accordance with 40 CFR 230(5)(c). Furthermore, the placement of mine waste in WUS may conflict with state surface water quality regulation found in A.A.C. R18-108(D) stating, "A surface water shall not contain solid waste such as refuse, rubbish, demolition or construction debris, trash, garbage, motor vehicles, appliances, or tires." The restrictions on discharge expressed in 40 CFR 230(10)(b)(1) would seem to discourage alternatives that may violate state water quality standards.
31. Backfill of the pit is technically practicable and may be economically feasible, since it has been practiced at other mine sites. This closure design is more frequently being incorporated into mine plans of operation because of more stringent regulations regarding mine pit lakes and water quality impacts, such as in California. Backfill of the pit is a reasonable measure because it offers a rational method to significantly reduce the amount of waste that must be disposed at surface facilities at the proposed mine site. It logically follows that such an approach would lessen impacts in specifically identified areas of concern in the 404B.1 Alternatives analysis and USFS Rosemont FEIS, such as recreation and wilderness, cultural resources, livestock grazing, surface water quantity and quality, and visual resources.
32. Backfilling would reduce the impact to the WUS to an acreage that is much less than the suggested preferred alternative-Barrel Canyon, allow for less impacts to Class IV and V riparian habitat and total riparian habitat, have significantly less reduction in annual down-gradient stormwater flow, and reduce significant environmental impacts overall.
33. With reference to condition #6, ADEQ should participate in the permit coordination committee as envisioned by the Forest Service.

Part 5.2: SPECIFIC CONDITIONS

The following two excerpts are from the draft 401 certification, section 5.2, condition #1. The comments that follow address these two excerpts:

"Within 180 days of the effective date of the CWA 404 permit, the applicant shall submit to ADEQ, for review and approval, a surface water mitigation program designed to maintain aquatic and riparian resources at pre-project levels in Davidson Canyon and Lower Cienega Creek. The program shall include, but is not limited to, a description of measures that will be taken to offset predicted reductions in surface water flow, in response to the project, along with a proposed schedule for implementation. The Final Environmental Impact Statement (FEIS) predicts a 17.2%

reduction in average annual post-closure stormwater runoff volume as a result of the proposed activities. The surface water mitigation program shall describe measures that will offset the reduced runoff volume should it occur.” (p. 5 of 9).

“Within 30 days of ADEQ approval of the program, the applicant shall implement the approved mitigation program in accordance with the schedule set forth in the approved program. Should the results of required monitoring and /or revised hydrologic modeling (FEIS Mitigation Measures FS-BR-22, FS-BR-27, FS-GW-02, FS-SR-05) indicate that water quality in Davidson Canyon or Lower Cienega Creek is adversely affected by the activities certified herein, ADEQ may request that the COE suspend the CWA 404 Permit and require additional mitigation.”

34. We agree that there is a need for a surface water mitigation program to reduce riparian impacts.
35. However, the timeframe provided in condition #1 is too long and sets no expectation for a timeframe for implementation. Please provide a schedule for implementation to lessen the damage caused by the reduced volume.
36. The statement “*should it occur*” should be deleted from condition #1. It is unreasonable to require a demonstration that this impact has occurred before requiring the mitigation. The FEIS analysis predicts with some certainty that it will occur, and Pima County Regional Flood Control District believes the impacts will be greater than predicted in the FEIS. If ADEQ makes the mitigation conditional on proof that harm has occurred, then resource base will diminish for many years unabated before any mitigation begins. This approach would be inconsistent with the Governor’s Executive Orders No. 89-15 on riparian resources and No. 91-6 on protection of riparian areas.
37. The mitigation should consider use of water derived from pit dewatering wells to offset the reduction in annual stormwater runoff during mine operation. The water should be tested for Arizona Surface water quality standards.
38. Regarding water quality, what modeling would prompt suspension of the permit? For water quality, direct monitoring should be required. Also, there needs to be thresholds for water quality that is “adversely affected” in the language of the permit. Cite relevant standards.
39. As written, the intent of the condition #1 seems to be focused on avoiding the 17.2% predicted reduction in post-closure conditions, but the reductions in flow volumes will be greater during the decades of operation. In addition, Pima County has disputed that the FEIS accurately describes the losses in runoff and recharge. Thus, the reference to the 17.2% reduction should be deleted.

40. The public and/or Cooperating Agencies must have an opportunity to review and comment on the draft Surface Water Mitigation Program.
41. We predict that if proof of damage must occur prior to the mitigation, Rosemont Copper's consultants will determine an observed reduction in average annual stormwater runoff volume is due to non-mining effects such as "natural variability" or "prolonged drought conditions", and thereby conclude there is no justification to implement "measures that will be taken to offset predicted reductions in surface water flow". Cooperating Agencies should be provided with an opportunity to review and comment on the monitoring, assessments and hydrologic modeling data which are used to justify these conclusions. We suggest a technical review team of individuals who are not invested in the outcome of such an analysis. Better yet, we recommend making conservative (i.e., erring on the side of caution) assumptions about the amount of water being withheld by the mine and require that amount to be compensated. This makes far more sense than trying to monitor and account for the many factors that can contribute to changes in runoff.
42. If the Surface Water Mitigation Program is to be prepared in response to a predicted reduction in average annual stormwater runoff volume during the post-closure period, then ADEQ should be prepared to specify for what period of time would Rosemont Copper be required to implement "*measures that will be taken to offset predicted reductions in surface water flow*" as part of ADEQ CWA 401 certification requirements. Should a persistent 20% reduction in average annual stormwater runoff volume be observed at the end of a 25-year mining operation (in contrast to the pre-mining average annual stormwater runoff volume), for what period of time would the mitigation measure be in effect?
43. Regarding long-term effects on Davidson Canyon and Lower Cienega Creek due to 401 certified mining activities, please specify whether or how any of the mitigation measures listed below will be utilized to quantify impacts to future downstream water quality specifically attributable to the filling of approximately 40 acres of WUS with tailings, waste rock and miscellaneous fill. As opposed to potential adverse impacts to surface water quality attributable to the entire mine complex related to discharges downstream into Barrel Canyon?
 - a. FS-BR-22: Monitoring to determine impacts from pit dewatering on downstream sites (monitor geomorphic changes to Davidson Canyon; surface and ground water monitoring in Davidson Canyon and Lower Cienega Creek);
 - b. FS-BR-27: Validation and rerunning of the groundwater model (every 5 years from pre-mining to five years after closure);
 - c. FS-GW-02: Water quality monitoring beyond point-of-compliance wells (groundwater sampling from wells and springs);

- d. FS-SR-05: Sediment transport modeling upstream of State Route 83 bridge (elevation changes to the channel bed between mine site and bridge).

Part 5.2: STORMWATER MANAGEMENT

44. The Mining MSGP coverage described in conditions #2 and #3 is not applicable. The MSGP specifically states that it has no applicability to discharges to Outstanding Arizona Waters (OAW), such as Davidson Canyon, and that “water quality cannot be lowered in OAWs”. To quote the MSGP:
“The MSGP Discharging into Outstanding Arizona Waters (Part 1.1.4.6). Per the antidegradation rules, coverage under the MSGP 2010 is not available for new discharges directly to waters designated as outstanding Arizona waters (OAW). ...The applicant must prepare a SWPPP that demonstrates the discharge will not degrade water quality in the OAW and outline basic information that must be included with the SWPPP, including a sampling and analysis plan (SAP) for required water quality monitoring”. (p.12 of the MSGP fact sheet).
45. Given the presence of an OAW “*exceedance of an Arizona Surface Water Quality Standard*” is not an adequate standard to evaluate whether water quality has been lowered. For example, total dissolved solids (TDS) have relevance for the character of the riparian vegetation and macroinvertebrate communities. Excessive salinities in particular can be damaging and encourage the growth of tamarisk. TDS levels at Oracle Ridge mine monitoring wells and tailings seep have been as high as 1200 mg/l. The Oracle Ridge mine is a skarn deposit similar to the Rosemont mine.
46. Given the presence of an OAW, and the requirement for an SWPP and SAP, Pima County requests that ADEQ exercise their authority under ARS 49-202 to request this supplemental information as part of the 401 Certification process.
47. With reference to condition #4, please specify what monitoring will be in place to determine if unimpacted stormwater has—or has not—come in contact with mine operations.

Part 5.2: EROSION PREVENTION AND HYDRAULIC ALTERATIONS

48. With reference to minimizing exposure of erodible surfaces (Condition #5), this is a very general and unspecific condition. Specifics are needed to prescribe how clearing, grubbing, scraping and erodible surface exposure will be minimized.
49. Please define “*excessive erosion*.” It is good to have examples (as noted), but standards are far better; what is considered excessive to one party may not match what excessive means to another. Best to avoid confusion and designate standards.
50. We agree with the intent of condition #5. Please work with U. S. Forest Service to reduce the removal of soil from WUS and other erodible surfaces. The Forest Service’s

proposed decision would allow clearing, grubbing, scraping and otherwise exposing erodible surfaces during the “soil salvage” process, a process we believe will remove material that would otherwise attenuate pollutants emanating from the rock surfaces. Their approach is at odds with minimizing exposure of erodible surfaces. By destroying soil integrity and relocating the material onto loose waste rock surfaces, the erodibility of the material will be enhanced.

51. The 401 application also references that *“the ground will be cleared and grubbed in an upgradient, or westerly direction, generally followed by placement of the finger drains and other flow-through drains”*. This approach is also at odds with condition #5.
52. Condition #6 needs to describe measures that can and will be used to control erosion, including rock weirs, waddles, straw bales, and other tools.
53. Harmful or toxic substances need definition as per Arizona State Revised Statutes. For example: as per ARS49-301.38.
54. With reference to condition #6, the referenced documents would support a conclusion that harmful or toxic substances would be discharged into streams. This certification cannot be offered until and unless the applicant offers a basis for meeting this condition.
55. Condition #7: Which *“erosion control, sediment control and/or bank protections measures”* are being referenced? Those in which FEIS alternative or permit application? They all differ.
56. Condition #8: please specify who shall re-evaluate the effectiveness of pollution control measures, and by when. Pima County suggests that the permittee provide ADEQ with a quarterly report of its evaluations and repairs/modifications in response to this condition.
57. Condition #8: The language: *“The effectiveness of all pollution control measures, including those preventing erosion and affecting sedimentation, shall be reevaluated after each flow event and repaired/modified as needed”* needs to be modified. Per information contained in the draft 2013 SWPPP, there are now three Compliance Point Dams (Sediment Control Structures) which *“will serve as the final sediment traps for stormwater runoff from the Project and where stormwater quality will be monitored and tested, i.e. outfalls.”* This is another example of inconsistent information provided by the applicant. This certification is premature and should be denied.
58. Also, as described within the Record of Decision (ROD) and the FEIS, stormwater runoff from large storm events may regularly overtop and destroy the compliance point dams due to their relatively small capacity of 2 acre-feet. These “large” storm events would likely also be carrying the most amount of sediment from the mine site for discharge into downstream drainages. Will sediment releases due to overtopping and/or failure of

- the Compliance Point Dams continue until such time ADEQ determines “subsequent discharges will meet Arizona Surface Water Quality Standards” (draft ROD, p. A-13)?
59. Condition #10 is very general. Specificity is needed such as: Fill used to support vegetation rooting shall be protected from erosion by anchoring with materials such as straw, mulch, hydro-seed and other material. Slopes shall be reduced to impede runoff and erosion.
 60. Condition #12: Pima County has a number of concerns about the adequacy of the compliance point dam. Cooperating agencies have commented on the potential for unregulated discharge of stormwater that has been in contact with ore bodies and mine processing facilities in the event that the compliance point dam is overtopped and destroyed, which could happen with some frequency. The stormwater reaching the compliance point dam is not halted or permanently retained by the dam in any way and will flow downstream in any case. The dam allows for some settling of sediment, detains stormwater temporarily, and allows for a convenient location to collect stormwater samples. The dam does not, however, prevent stormwater from flowing downstream.
 61. Conditions #11 & 12 reference the need for detention/retention structures. These are required to ‘cause no significant change to the hydraulic conditions downstream...’ However, the very purpose of detention/retention structures is to change hydraulic conditions downstream. Instead, we recommend they be built to mimic pre-mine hydrology, hydraulics and sediment transport regimes.
 62. On denuded areas, revegetation efforts need a performance standard to be met. Stating revegetation gives the applicant no standards to meet. Baseline vegetation needs density evaluation in the proposed denuded areas and at a minimum a performance standard is needed to meet for density and time to restore.
 63. Condition #15 is at odds with the applicant’s intention that compliance dams will be unstabilized. The dams will induce sedimentation and will be repeatedly eroded and rebuilt. The areas around the compliance dams will not be vegetated.
 64. Condition #15: If there can be no alteration of flow in the impacted WUS, this would require that Rosemont provide greater details about the chronology and location of impacts to WUS on the project site. We have not seen such a document. This is important, because especially early in the mine’s development there will be impacted areas that will be severely altered because any erosion control structures are in place. (At least this is all we can infer from the documents from Rosemont.)
 65. In order to ensure that there is no adverse change in stability with respect to stream hydraulics, ADEQ must require the applicant to establish and document pre-project conditions on the WUS for stream slopes, meander values, roughness, hydraulic radii, and other baseline values, otherwise condition #17 is meaningless.

Part 5.2: SEDIMENT LOADS

66. Condition #17 says that *“the applicant shall ensure no adverse change, due to the subject project, has occurred in the stability with respect to stream hydraulics, erosion and sediment load, of any WUS including downstream from the project.”* How will stability be defined and how will erosion and sediment load be monitored? We suggest including very specific thresholds.
67. We agree with the need to monitor sediment load, but believe conditions #18 to #20 require further specificity to be enforceable. In addition, a monitoring frequency and protocol should be referenced.
68. Condition #18 describing *“flow in any WUS is sufficient to erode, carry or deposit material”* should be modified to a specified flow (peak discharge or erosive velocity). Sediment movement and deposition occur in virtually all channels (even concrete lined ones).
69. Condition #19 references a comparison with *“natural background levels of sediment.”* Have these measures of silt content or turbidity been determined? If so, they should be cited. If not, there should be a requirement to provide a method to determine what these are.

Part 5.2: POLLUTION PREVENTION

70. With regard to the protection of Outstanding Waters of Arizona (OAWs), the FEIS (page 548) states that Rosemont Copper has not completed its demonstration to the State of Arizona that discharges from the proposed Rosemont Mine will not degrade existing water quality in the downstream OAWs. No analysis is presented in that document for the degradation of water quality for the OAWs, only Barrel Canyon.
71. ADEQ should evaluate of the assimilative capacity of Barrel Canyon or Davidson Canyon to absorb the pollutants emitted from the mine.
72. Has ADEQ independently concluded that the OAWs will not be affected? If so, what is the basis?
73. The FEIS offers contradictory statements about the effects to Barrel Canyon. In one place (page 663) that there will be no “exceedances of surface water quality standards that are not already exceeded in natural runoff in Barrel Canyon are expected from the proposed mine operations”. In another place (page 474), the FEIS says that “predicted runoff water quality from waste rock and soil cover meets surface water quality standards in Barrel Canyon”.
74. The baseline characterization of water quality in both Barrel Canyon and Davidson Canyon, as described in the SWCA (2013) report, is inadequate for the purposes of this certification. The water quality data presented in the FEIS provide evidence that ambient stormwater runoff in Barrel Canyon is elevated in metals. Pima County does

not understand how activities proposed can meet condition #21 of this permit. Total loading will be increased by dredging of top soil and filling with waste rock contemplated under this permit.

75. Furthermore, there is a likelihood of harm because the facility design relies on methods of stormwater control that direct surface waters into fractured bedrock aquifers that discharge to springs and seeps in the area. Also, the waste rock and tailings facilities will be placed on a surface from which topsoil and surficial rock (regolith) has been stripped for later use in reclamation. The removal of soil and regolith reduces opportunities for pollutant attenuation. The mixture of runoff and mine drainage will flow over a fractured bedrock surface. There is no liner to prevent infiltration into the fracture bedrock aquifer and there is no evaporation once the water infiltrates.
76. Subsurface discharge from the mine can enter a fractured bedrock aquifer that has springs and seeps as its surface discharge points. Springflow that supports aquatic and wildlife use is a down-gradient use in Barrel Canyon and at other area streams and springs. A.A.C. R18-11-405(B) states, "A discharge shall not cause or contribute to a violation of a water quality standard established for a navigable water of the state." Therefore, include in this permit a requirement to monitor at the aquifer points of compliance (POCs) for selenium, copper, arsenic, and mercury; set alert levels based on surface water quality standards for aquatic and wildlife (warm water).
77. There is also a likelihood of harm because the 404 application allows waste rock on top of Rosemont Spring and tailings near McCleary Spring. Both of these are located in WUS. Existing surface water uses and standards will be impaired at these sites, both physically and chemically.
78. The boilerplate language in condition #22 does not appear to be developed with reference to this mine proposal.
79. Condition #22 appears to be internally inconsistent as it prohibits pollutants in fill, but allows uses of mining residues including waste rock, gangue and tailings which, on the basis of referenced documents, contain pollutants that will contribute to degradation of water quality.
80. For condition #23, it is not clear what materials and techniques Rosemont is employing while they are working in WUS. This should be made clear. This permit should be conditioned on a sampling of source waters from the temporary and permanent water bodies created by the discharge of dredge or fill. Characterization of the water in these waterbodies is needed in order for ADEQ to know what constituents to sample for in downstream waters. Source sampling must be completed to characterize the potential pollutants associated with mine runoff.
81. The purpose of some of the proposed fill is to create new ponds to detain or retain stormwater. The permit should be conditioned upon monitoring to assure these water

bodies meet narrative and quantitative surface water standards. Some of these new water bodies will be in contact with tailings and wasterock, therefore are surface water impoundments that must be regulated through application of state surface water quality standards. Therefore, include periodic monitoring of narrative and quantitative water quality at planned surface waters.

82. We would predict that the waste and tailings will inadvertently create unplanned surface water bodies around the perimeter of the site where natural flows are blocked or where drainage collects. The permit should be conditioned upon quarterly or more frequent visual surveys for unplanned surface water bodies.
83. Therefore, please include conditions for monitoring narrative and quantitative surface water quality standards for Aquatic and Wildlife at the locations of unplanned surface water bodies, to include arsenic, selenium, copper and mercury.
84. Include annual reporting of the location of new surface water bodies, and observed conditions to ADEQ and share this information with the interagency permitting committee proposed by the Forest Service.
85. The pit lake that would be created by this permit would have a volume of 96,000 acre-feet, making it one of the largest water bodies in southern Arizona. The pit lake would be accessible to wildlife. The APP provides no monitoring for the pit lake. This permit should be conditioned upon post-mining surface water quality monitoring to assess potential toxicity to wildlife. The pit lake must meet water quality standards for Aquatic and Wildlife (warm water or cold water as temperature dictates) for arsenic, selenium, copper and mercury.
86. We agree with SWCA's (2013; memorandum from Chris Garrett entitled "Revised Analysis of Surface Water Quality"; cited in the FEIS) conclusion that "*stormwater quality appears never to have been sampled in Davidson Canyon*". Such would require special sampling equipment to be installed.
87. This permit should require baseflows in the Davidson Canyon OAW reach to be monitored for aquatic and wildlife standards, not just stormwater. Base flow volume and quality are critical parameters to wildlife.
88. The OAWs are located on County and District lands. We ask that ADEQ recognize our authority to permit and condition access to our lands and waters. Recently, Rosemont submitted to ASLD an application to site groundwater and surface water quality sampling devices on State Trust land at Davidson Canyon; we advise ADEQ that this sampling site is not located on the Davidson OAW.

Part 5.2: TEMPORARY AND PERMANENT STRUCTURES

89. Permanent structures should be sized to accommodate at least the 100-yr flow. Condition #29 states that 'Permanent pipes, temporary pipes, and culvert crossings be

adequately sized to handle the expected flow.’ Rosemont is left to estimate what ‘adequate’ is, and the people of Arizona are left to accept this assessment. Standard engineering practice is to identify a flow and design accordingly. Without specifying what this flow is, there is no assurance it can handle flows of concern to the people of Arizona. Pima County has determined that the methods used to determine flows in the FEIS are not adequately conservative or accurate to be used to size structures.

ATTACHMENT 1

Stable Isotope Tracers Reveal Flow Paths of Tucson Basin Groundwater

By Christopher Eastoe, Research Scientist, Ailiang Gu, Graduate Student, and Austin Long, Emeritus Professor

For many years, Tucson depended entirely on groundwater pumped from the regional aquifer in the Tucson basin and neighboring Avra Valley for a water supply. The Tucson basin is typical of the Basin and Range province in containing thousands of meters of sediment derived from the surrounding hard-rock ranges. Predominantly sand and gravel in the upper few hundred meters of the basin have been the principal source of water. The basin groundwater is replenished from streams that drain areas of high rainfall (relative to rainfall in the basin itself) in the mountains to the north and east, and in the uplands towards the Mexican border.

Colorado River water now supplements the city's water supply, and the pumping of groundwater is now greatly reduced under central Tucson. The city is growing unabated, nonetheless, and groundwater will continue to be a crucial water resource. Future exploitation of the aquifer will necessitate a better understanding of the ages, origins, and flow paths of the groundwater as basic information for the construction of groundwater flow models. It is difficult to locate zones of recharge at the surface, and even more difficult to track the movement of concealed groundwater. An essential first step towards understanding water movement is the construction of a map of static water levels. Using data from the hundreds of wells in the Tucson basin, such a map was assembled in the late 1990s (see www.ag.arizona.edu/AZWATER/publications/sustainability/index.html, Fig. 3.2).

Isotope studies provide additional information revealing the complexity of the recharge process. Stable oxygen and hydrogen isotopes label the water molecule itself, and their ratios vary as a function of condensation temperature during precipitation, evaporation, and water-rock interaction. These ratios can be used to distinguish waters of different origin — in the Tucson basin, for example, rain or snow from the surrounding high mountains can be distinguished from rain at the basin floor — and to detect mixing between waters of different origin. Isotopes in sulfate and bicarbonate ions provide information on sources of solutes. In Tucson, sulfur isotopes are useful because of the isotopic contrast between Permian (~250 million years ago) marine gypsum that is present to the southeast, and other sulfate sources in soil or sediment that represent a combination of sulfur from igneous rocks and dust. Natural radioactive isotopes such as tritium and radiocarbon provide information about the age of groundwater.

Over the last 20 years, the Laboratory of Isotope Geochemistry has assembled an isotope data set for hundreds of sample sites in Tucson, and for almost every measurable rain event. Past graduate students — notably Bob Kalin, Sofie Pasiis, Joy Gillick, John Lindquist, David Esposito, and Erin Cunningham — have constructed portions of the maps of O, H, S, and C isotopes. Recently, we have completed coverage of the central part of the basin. Much of the work was supported by our publicly-funded Laboratory as a service to the community; more

recently, the University and the SAHRA Science and Technology Center have supported us.

In this brief article, we present an interpretation of our S and O isotope results in the central part of the basin (Fig. 1).

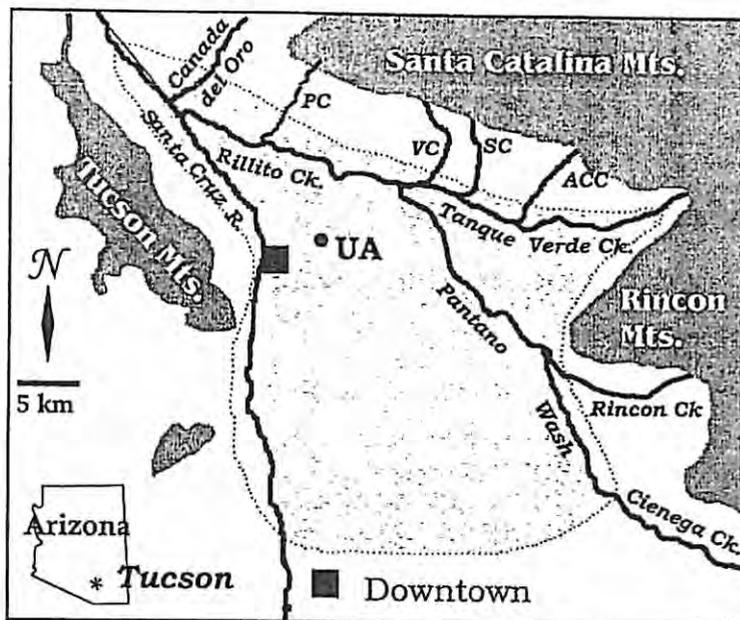


Figure 1. Location map of study area (patterned), showing major streams of the Tucson basin: PC = Pima Creek, VC = Ventana Creek, SC = Sabino Creek, ACC = Agua Caliente Creek.

Delta Notation and Isotope Fractionation

Using mass spectrometers, we measure isotope ratios R , e.g.

$$R = {}^{18}\text{O}/{}^{16}\text{O}, \text{ or } {}^{34}\text{S}/{}^{32}\text{S}$$

Using R values for samples, and for standard materials (VSMOW, a seawater standard, for O; and CDT, a meteoritic sulfide standard, for S), we define delta values as follows:

$$\delta^{18}\text{O} = [(R_{\text{sample}}/R_{\text{standard}}) - 1] \times 1000 \text{ ‰ (per mil); likewise } \delta^{34}\text{S}.$$

Evaporation of water enriches ${}^{16}\text{O}$ in the vapor relative to the composition of the liquid water. Such a separation of isotopes is termed fractionation. Condensation does not generally reverse this process completely, so that average rain in most places is enriched in ${}^{16}\text{O}$ relative to 0‰ seawater. Average rainwater and groundwater therefore have negative $\delta^{18}\text{O}$ values.

Isotopes in Tucson Basin Groundwater

We possess $\delta^{18}\text{O}$ data for groundwater from more than 300 sites, and $\delta^{34}\text{S}$ data for dissolved sulfate from 137 sample sites. A complete list of the data and isotope ...cont'd page 8

Tucson Basin Groundwater *cont'd...*

distribution maps can be found on the Internet at www.geo.arizona.edu/researchers/mbaker/AustinLong/.

As a working hypothesis, we proposed that most water in the upper part of the regional aquifer derives ultimately from the major streams that enter the basin. If the water in each stream has a characteristic isotope signature, and if a similar distinctive signature is found in part of the aquifer, then we may be able to infer that the stream is the main water source for that area.

Stream water could be sampled at the surface during flow events, but this approach yields a broad range of $\delta^{18}\text{O}$ values reflecting the isotopic variability of rainwater. A better estimate of the average isotopic content of water available to replenish the regional aquifer from each stream is obtained from shallow wells in the flood plain. Fig. 2 shows $\delta^{34}\text{S}$ and $\delta^{18}\text{O}$ data of flood plain groundwater. Several distinctions can be made — between Cienega Creek and the other streams on the basis of $\delta^{34}\text{S}$, and between Rincon Creek and the Santa Cruz River on the basis of $\delta^{18}\text{O}$. The empty ellipse corresponds to a water composition not known from the major flood plains.

The $\delta^{18}\text{O}$ and $\delta^{34}\text{S}$ distribution maps (see website) show basin-scale features with boundaries that do not coincide. The existence of large map features argues for the importance of recharge from basin-scale sources such as the major streams. The major feature of the $\delta^{18}\text{O}$ map is a boundary, near Interstate 10, between mountain-derived water with $\delta^{18}\text{O} < -9\text{‰}$ to the northeast, and basin-derived water with $\delta^{18}\text{O} > -8\text{‰}$ to the southwest. On the $\delta^{34}\text{S}$ map, the major feature is a plume of sulfate-rich water with $\delta^{34}\text{S} > 10\text{‰}$, derived ultimately from Permian gypsum, that extends across the basin from southeast to northwest. Surrounding water contains sulfate with $\delta^{34}\text{S} < 10\text{‰}$.

We can divide the basin map into domains using the $\delta^{18}\text{O}$ and $\delta^{34}\text{S}$ boundaries together (Fig. 3). Each domain contains water

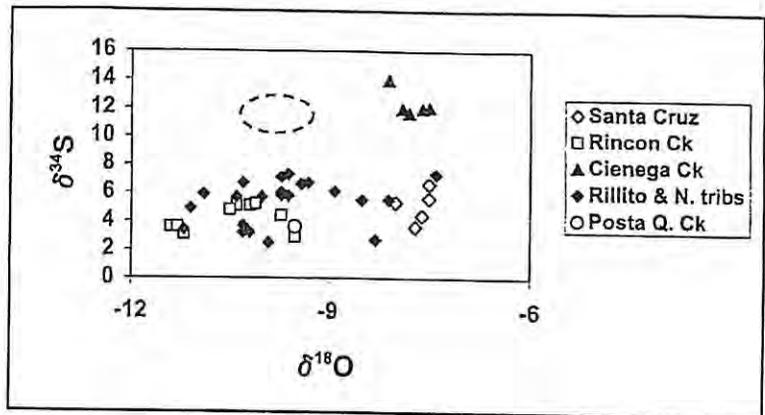


Figure 2. Plot of $\delta^{34}\text{S}$ vs. $\delta^{18}\text{O}$ in flood plain groundwater. The empty ellipse corresponds to groundwater compositions not represented in flood-plain groundwater.

with a characteristic combination of $\delta^{18}\text{O}$ and $\delta^{34}\text{S}$. Between domains C and D, the boundary is defined by a change in $\delta^{18}\text{O}$; between domains B and C, the boundary is defined by changes in $\delta^{34}\text{S}$. The domains match the major streams as follows:

Domain A, with $\delta^{18}\text{O} < -9\text{‰}$ and $\delta^{34}\text{S} < 10\text{‰}$, corresponds to water from Rillito and Tanque Verde Creeks and their northern tributaries.

Domain B, with $\delta^{18}\text{O} > -8\text{‰}$ and $\delta^{34}\text{S} < 10\text{‰}$, corresponds to water from the Santa Cruz River.

Domain C, with $\delta^{18}\text{O} > -8\text{‰}$ and $\delta^{34}\text{S} > 10\text{‰}$, contains water that matches flood plain groundwater from Cienega Creek.

Domain D, with $\delta^{18}\text{O} < -9\text{‰}$ and $\delta^{34}\text{S} > 10\text{‰}$, matches the empty ellipse in Fig. 2.

Domain E, with $\delta^{18}\text{O} < -10\text{‰}$ and $\delta^{34}\text{S} < 10\text{‰}$, corresponds to Rincon Creek.

Domain F has $\delta^{18}\text{O} > -8\text{‰}$ and $\delta^{34}\text{S} < 10\text{‰}$ like domain B, but is remote from the Santa Cruz River.

The domain map tells us a great deal about the origin of groundwater in different areas of the Tucson basin. For a domain having clear geographic and isotopic relationships with a specific stream, we deduce that the stream is the source of the groundwater. Domain C does not appear to be continuous at the southeastern end; all attempts to find samples to bridge the gap have failed so far. The water in this domain is following one or more Pleistocene courses of Cienega Creek, which has not always followed the present course into Pantano Wash. The water in Domain D must have originated at high elevation, probably in the Rincon Mountains, but has a Permian sulfate S-isotope signature. It appears to be upwelling in the southeastern corner of the basin, possibly dissolving gypsum at depth in the basin-fill sediments. Oligocene lacustrine gypsum, reworked from Permian strata, crops out in sediment closer to the southeastern edge of the basin.

Isotope maps showing the distribution of tritium and radiocarbon in groundwater (see website) help to confirm the domain boundaries established by S and O isotopes, and provide much additional information about the age of the groundwater. But that is a story for another time!

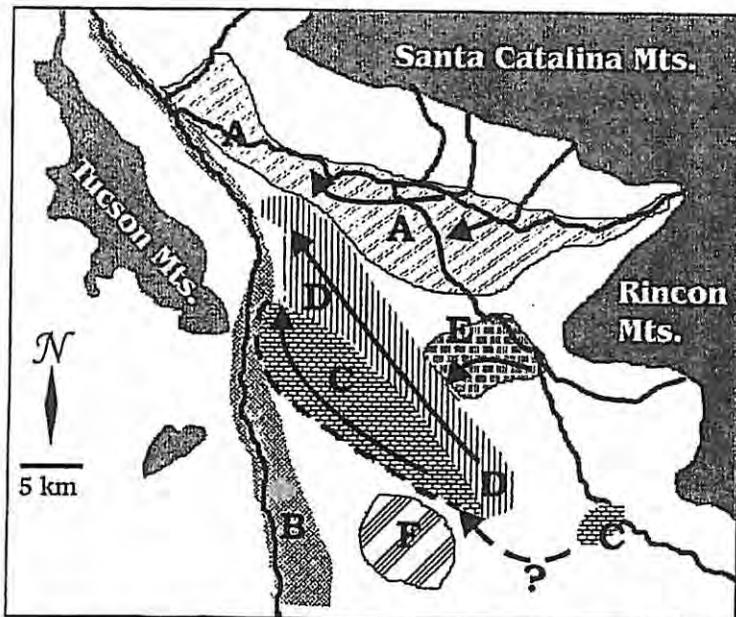


Figure 3. Map of Tucson basin showing groundwater isotope domains and flow directions. Domain designations are explained in the text.

ATTACHMENT 2



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3031 West Ina Road
Tucson, AZ 85741
Tel 520.297.7723 Fax 520.297.7724
www.tetrattech.com

Technical Memorandum

| | | | |
|----------|--|--------|-------------------|
| To: | Kathy Arnold | From: | David Krizek |
| Company: | Rosemont Copper Company | Date: | August 23, 2010 |
| Re: | Rosemont APP-Regulated Facility Depth to Groundwater | Doc #: | 228/10-320877-5.3 |
| CC: | Karen Schwab (Kimberlite) | | |

1.0 Introduction

This Technical Memorandum provides estimated depth to groundwater from existing ground and/or facility bottom elevations based on the updated locations (July 2010) of those facilities regulated under the Aquifer Protection Permit (APP) program at the proposed Rosemont Copper Project (Project) in Pima County, Arizona. Updated APP-regulated facilities were highlighted in the Technical Memorandum titled *Rosemont APP-Regulated Facility Locations* dated August 18, 2010 (Tetra Tech, 2010). Depth to groundwater estimated were based on well locations shown on a figure titled *Well and Spring Locations - Rosemont Area* by Errol L. Montgomery & Associates, Inc. dated May 19, 2009 and a summary excel table of groundwater level measurements titled *RosemontManualDataMaster_Jun 2010_Grazing Area* provided by Rosemont Copper Company (Rosemont).

This information is provided in response to the April 14, 2010 Comprehensive Request for Additional Information from the Arizona Department of Environmental Quality (ADEQ) to Rosemont Copper Company (Rosemont). Specifically, this Technical Memorandum answers item no. 34 on page 14 of 18.

- *Please develop a table of groundwater elevation and elevation (bottom) of the above-lying APP facility indicating estimated depth to groundwater at or in the vicinity of the facility footprint.*

2.0 APP-Regulated Facility Locations (updated locations)

Figures 04A and 05A in Attachment 1 show the current locations of the APP-regulated facilities as of the end of July 2010. These figures are from the August 18, 2010 Technical Memorandum and highlight the APP-regulated facilities (generally permitted and area-wide permitted) along with the non-discharging and other exempt facilities. Table 1 provides coordinates for the APP-regulated facilities. Figures 04A and 05A also show existing ground contours (50' contour interval shown).



Table 1 Updated Location of APP Regulated Facilities (revised Table 2.01 from February 2009 APP application)

| Facility Name | Facility Type (A.R.S. §49-241(B)) | Latitude (UTM NAD 83 Northing - ft) | Longitude (UTM NAD 83 Easting - ft) | Cadastral | | |
|--|--------------------------------------|---|---|------------|-------------|------------------|
| | | | | T | R | S |
| General Permit Facilities (not included in Area-wide APP) | | | | | | |
| Coarse Ore Stockpile | Intermediate Ore Stockpile | 31° 50' 24.91" (11,557,577.22) | 110° 44' 56.31" (1,718,342.14) | 18S | 16E | 30 |
| Temporary Run-of-Mine (ROM) Ore Stockpiles | Intermediate Ore Stockpile | 31° 49' 57.59" (11,554,817.82) | 110° 44' 52.69" (1,718,660.91) | 18S | 16E | 30 |
| Sewage Treatment Facilities | Septic Tanks and Leach Fields | Various locations in Plant Site | Various locations in Plant Site | 18S | 16E | 30 |
| Area-wide APP Facilities | | | | | | |
| Dry Stack Tailings Facilities | Tailings | 31° 50' 18.52" (11,556,944.78) | 110° 43' 51.40" (1,723,940.74) | 18S | 16E | 29 |
| Process Water Temporary Storage Pond (TS Pond) | Non-Stormwater Pond | 31° 50' 9.80" (11,556,056.78) | 110° 44' 27.39" (1,720,839.83) | 18S | 16E | 30 |
| Primary Settling Basin | Non-Stormwater Pond | 31° 50' 23.78" (11,557,468.36) | 110° 44' 28.51" (1,720,739.47) | 18S | 16E | 30 |
| Raffinate Pond | Process Solution Pond | 31° 50' 15.09" (11,556,589.72) | 110° 44' 35.99" (1,720,096.29) | 18S | 16E | 30 |
| Heap Leach Pad | Heap Leach Pad | 31° 49' 23.93" (11,551,418.85) | 110° 44' 48.37" (1,719,041.03) | 18S | 16E | 31, 32 |
| PLS Pond | Process Solution Pond | 31° 49' 32.20" (11,552,261.31) | 110° 44' 12.44" (1,722,137.55) | 18S | 16E | 32 |
| Stormwater Pond | Non-Stormwater Pond | 31° 49' 35.98" (11,552,644.27) | 110° 44' 9.32" (1,722,406.21) | 18S | 16E | 32 |
| Open Pit | Open Pit Mine | 31° 49' 56.84" (11,554,736.44) | 110° 45' 22.91" (1,716,054.54) | 18S | 16E, 15E | 30, 31 25, 36 |
| Waste Rock Storage Area | Waste Rock Dump | 31° 48' 56.20" (11,548,622.88) | 110° 44' 26.22" (1,720,958.50) | 18S 19S | 16E | 31, 32 05, 06 |
| Waste Management Area | Solid Waste Facility | 31° 50' 34.13" (11,558,506.91) | 110° 45' 4.04" (1,717,673.68) | 18S | 16E | 30 |

Note: Partial sections may not be shown for Dry Stack Tailings Facility and Waste Rock Storage Area.



There will be several sewage treatment facilities within the Plant Site area (generally permitted). These treatment facility locations are anticipated to be the following:

- **ND-PS-04:** Septic leach field by the Primary Crusher (ND-PS-01)
- **ND-PS-04:** Septic leach field by the SX-EW Building (ND-PS-13)
- **ND-PS-04:** Septic leach field by the Mine Truck Shop (ND-PS-15)
- **ND-PS-04:** Septic leach field by the Change House (ND-PS-20)
- **ND-PS-04:** Septic leach field by the Main Warehouse (ND-PS-21)
- **ND-PS-04:** Septic leach field by the Analytical Laboratory (ND-PS-22)
- **ND-PS-04:** Septic leach field by the Administration Building (ND-PS-23)

The assumed coordinates of these sewage treatment facilities are shown in Table 2.

Table 2 Updated Location of Sewage Treatment Facilities

| Facility Name | Facility Type (A.R.S. §49-241(B)) | Latitude (UTM NAD 83 Northing - ft) | Longitude (UTM NAD 83 Easting - ft) | Cadastral | | |
|--|--------------------------------------|---|---|-----------|-----|----|
| | | | | T | R | S |
| General Permit Facilities (not included in Area-wide APP) | | | | | | |
| Primary Crusher location | Septic Tanks and Leach Fields | 31° 49' 57.30" (11,554,790.76) | 110° 44' 45.17" (1,719,309.46) | 18S | 16E | 30 |
| SX-EW Building location | Septic Tanks and Leach Fields | 31° 50' 16.58" (11,556,739.44) | 110° 44' 40.64" (1,719,695.14) | 18S | 16E | 30 |
| Mine Truck Shop location | Septic Tanks and Leach Fields | 31° 50' 6.97" (11,555,767.92) | 110° 44' 41.86" (1,719,592.07) | 18S | 16E | 30 |
| Change House location | Septic Tanks and Leach Fields | 31° 50' 37.35" (11,558,836.95) | 110° 44' 41.91" (1,719,581.20) | 18S | 16E | 30 |
| Main Warehouse location | Septic Tanks and Leach Fields | 31° 50' 26.09" (11,557,699.94) | 110° 44' 39.87" (1,719,759.35) | 18S | 16E | 30 |
| Analytical Laboratory location | Septic Tanks and Leach Fields | 31° 50' 23.97" (11,557,483.58) | 110° 44' 52.04" (1,718,710.90) | 18S | 16E | 30 |
| Administration Building location | Septic Tanks and Leach Fields | 31° 50' 31.83" (11,558,281.97) | 110° 44' 28.64" (1,720,726.81) | 18S | 16E | 30 |

3.0 Depth to Groundwater (APP-Regulated Facilities)

Table 3 provides the estimated depth to groundwater in the area of each APP-regulated facility. The estimated depths to groundwater shown in Table 3 were interpolated from the well data indicated in Section 1.0 based on the depth to groundwater at the nearest well location to a APP-regulated facility. The basis of the estimated depth to groundwater, i.e., the well name, is also shown in Table 3.

Table 3 Estimated Depth to Groundwater

| Facility Number | APP-Regulated Facility Name | Estimated Existing Ground/Facility Bottom/Pad Elevation (ft amsl) | Estimated Groundwater Elevation Range (ft) | Approximate Estimated (Est.) Depth to Groundwater (ft) |
|-----------------|-----------------------------|---|--|--|
| AR-GP-01 | Coarse Ore Stockpile | 5,120' (ground) 5,100' (pad) | 4,785' – 5,149' (Plant Site area) | 20' (est.) |
| AR-GP-02 | Temporary ROM Ore Stockpile | 5,100' (ground) 5,050' (pad) | 4,785' – 5,149' (Plant Site area) | 20' (est.) |
| AR-GP-03 | Sewage Treatment Facilities | | | |
| | Primary Crusher | 5,020' (ground) 5,050' (pad) | 4,785' – 5,149' (Plant Site area) | 20' (est.) |
| | SX-EW Building | 5,020' (ground) 5,039' (lower pad) | 4,785' – 5,149' (Plant Site area) | 20' (est.) |
| | Mine Truck Shop | 5,030' (ground) 5,020' (pad) | 4,785' – 5,149' (Plant Site Area) | 20 (est.) |
| | Change House | 5,020' (ground) 4989 (pad) | 4,785' – 5,149' (Plant Site Area) | 20' (est.) |
| | Main Warehouse | 4,980' (ground) 4,995' (pad) | 4,785' – 5,149' (Plant Site Area) | 20' (est.) |
| | Analytical Laboratory | 5,100' (ground) 5,090' (pad) | 4,785' – 5,149' (Plant Site area) | 20' (est.) |
| | Administration Building | 4,980' (ground) 4,980' (pad) | 4,785' – 5,149' (Plant Site area) | 20' (est.) |

| Facility Number | APP-Regulated Facility Name | Estimated Existing Ground/Facility Bottom/Pad Elevation (ft amsl) | Estimated Groundwater Elevation Range (ft) | Approximate Estimated (Est.) Depth to Groundwater (ft) |
|-----------------|-----------------------------|---|--|--|
| AR-TF-01 | Dry Stack Tailings Facility | 4,770' (ground at center coordinate) | 4,499' – 4,816' | 30' at center coordinate point (est.) |
| AR-PS-01 | PWTS Pond (PW Pond) | 4,900' (ground) 4,892' (bottom) | 4,785' – 5,149' (Plant Site area) | 20' (est.) |
| AR-PS-02 | Waste Management Area | 5,280' (ground) | 4,785' – 5,149' (Plant Site area) | 130' (est.) |
| AR-PS-03 | Primary Settling Basin | 4,920' (ground) 4,913' (bottom) | 4,785' – 5,149' (Plant Site area) | 20' (est.) |
| AR-HL-01 | Raffinate Pond | 4,900' (ground at center coordinate) 4962' (bottom) ¹ (4,969' new location) ² | 4,785' – 5,149' (Plant Site area) | 160' (est.) |
| AR-HL-02 | Heap Leach Pads | 5,150' (ground at center coordinate) 5,143 (pad at center coordinate) ¹ | 4,730' – 5,057' | 100' at center coordinate point (est.) |
| AR-HL-03 | PLS Pond | 4880 (ground at center coordinate) 4,870' (bottom) ¹ | 4,730' – 4,818' 4,795' (ave) | 45' (est.) |
| AR-HL-04 | Stormwater Pond | 4870 (ground at center coordinate) 4,870' (bottom) ¹ | 4,730' – 4,818' 4,795' (ave) | 45' (est.) |
| AR-OP-01 | Open Pit | 5,140' (ground at center coordinate) | 5,046' – 5,196' | 45' at center coordinate point (est.) |
| AR-WR-01 | Waste Rock Storage Area | 4,990' (ground at center coordinate) | 4,730' – 5,034' | 45' at center coordinate point (est.) |

¹Based on May 2009 permit level design of Heap Leach Facility

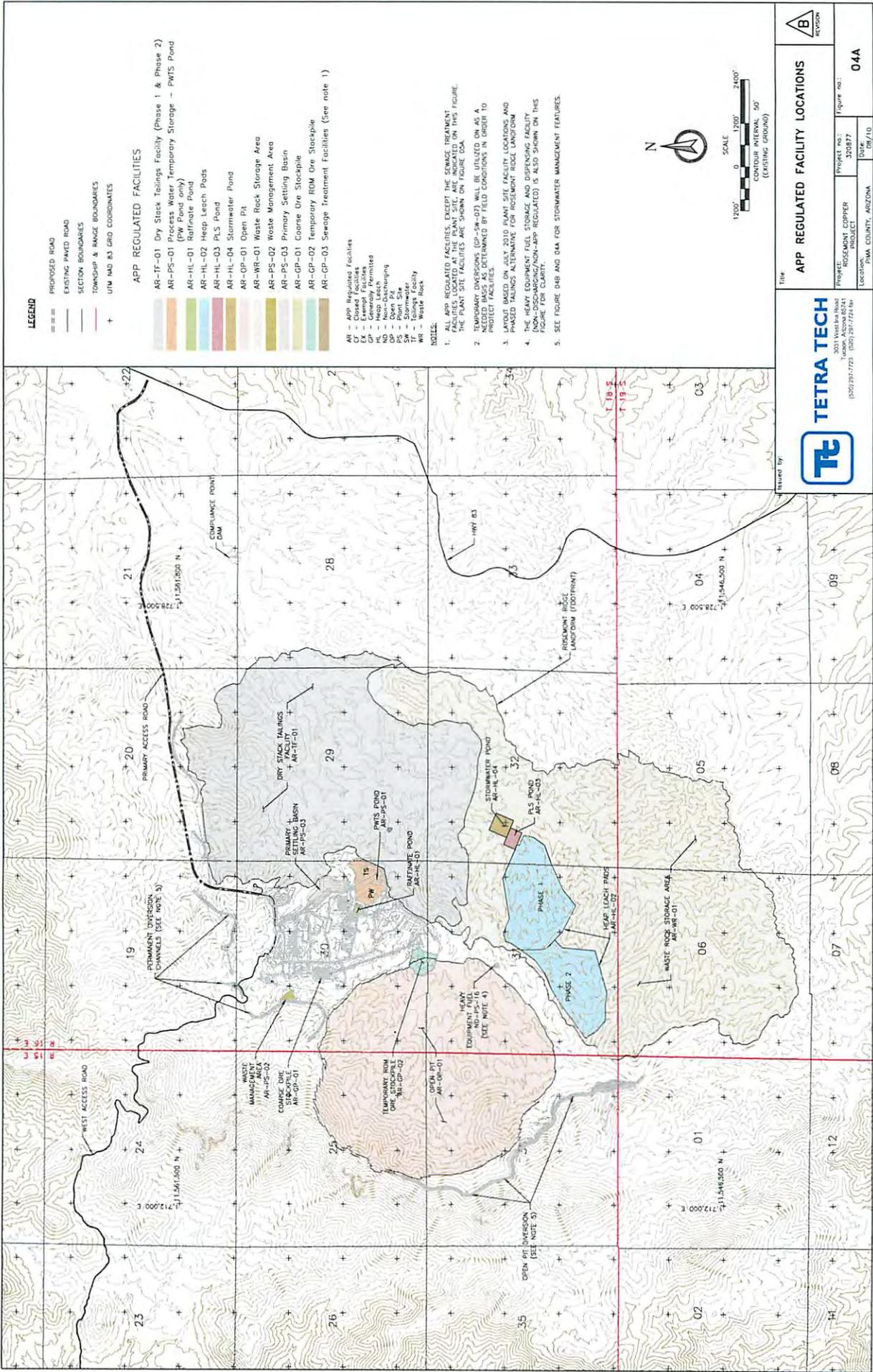
²Location shown on Figures 04A and 05A



REFERENCES

- Tetra Tech (2009). *Aquifer Protection Permit (APP) Application*. Prepared for Rosemont Copper Company. Report dated February 2009.
- Tetra Tech, Barrios, F.; Chee, R. (2010). *Rosemont APP-Regulated Facility Locations*. Technical Memorandum to Kathy Arnold (Rosemont Copper Company). Technical Memorandum dated August 18, 2010.
- Errol L. Montgomery & Associates, Inc. (2009). *Well Spring Locations Rosemont Area*. Figure 1 to Rosemont Copper dated (May 19, 2009).
- Rosemont Copper Company, (2010). *RosemontManualDataMaster_Jun2010_Grazing Area*. Excel Table to Tetra Tech dated June, 2010.

ATTACHMENT 1
Updated APP-Regulated Facility Locations
Figure 04A
Figure 05A



LEGEND

- == PROPOSED ROAD
- EXISTING PAVED ROAD
- SECTION BOUNDARIES
- TOWNSHIP & RANGE BOUNDARIES
- + UTM MAD 83 GRID COORDINATES

APP REGULATED FACILITIES

- AR-TF-01 Dry Stack Tailings Facility (Phase 1 & Phase 2)
- AR-PS-01 Process Water Temporary Storage - PWTS Pond (PW Pond only)
- AR-HL-01 Refillable Pond
- AR-HL-02 Heap Leach Pads
- AR-HL-03 PLS Pond
- AR-HL-04 Stormwater Pond
- AR-OP-01 Open Pit
- AR-WR-01 Waste Rock Storage Area
- AR-PS-02 Waste Management Area
- AR-PS-03 Primary Settling Basin
- AR-GP-01 Coarse Ore Stockpile
- AR-GP-02 Temporary ROM Ore Stockpile
- AR-GP-03 Sewage Treatment Facilities (See note 1)

- AR - APP Regulated Facilities
- EX - Existing Facilities
- GR - Generally Permitted
- ND - Non-Disturbing
- PS - Permit Site
- SW - Stormwater
- WR - Waste Rock

NOTES:

1. ALL APP REGULATED FACILITIES, EXCEPT THE SEWAGE TREATMENT FACILITIES LOCATED AT THE PLANT SITE, ARE INDICATED ON THIS FIGURE. THE PLANT SITE FACILITIES ARE SHOWN ON FIGURE 00A.
2. TEMPORARY DIVERSIONS (GP-SW-01) WILL BE UTILIZED ON AS A PROTECT FACILITIES DETERMINED BY FIELD CONDITIONS IN ORDER TO PROTECT FACILITIES.
3. LAYOUT BASED ON 2010 PLANT SITE FACILITY LOCATIONS AND PHASED TAILINGS ALTERNATIVE FOR ROSEMONT RIDGE LANDFORM.
4. THE HEAVY EQUIPMENT FUEL STORAGE AND DISPENSING FACILITY (NON-DISCHARGING/NON-APP REGULATED) IS ALSO SHOWN ON THIS FIGURE FOR CLARITY.
5. SEE FIGURE 04B AND 04A FOR STORMWATER MANAGEMENT FEATURES.



Figure by:

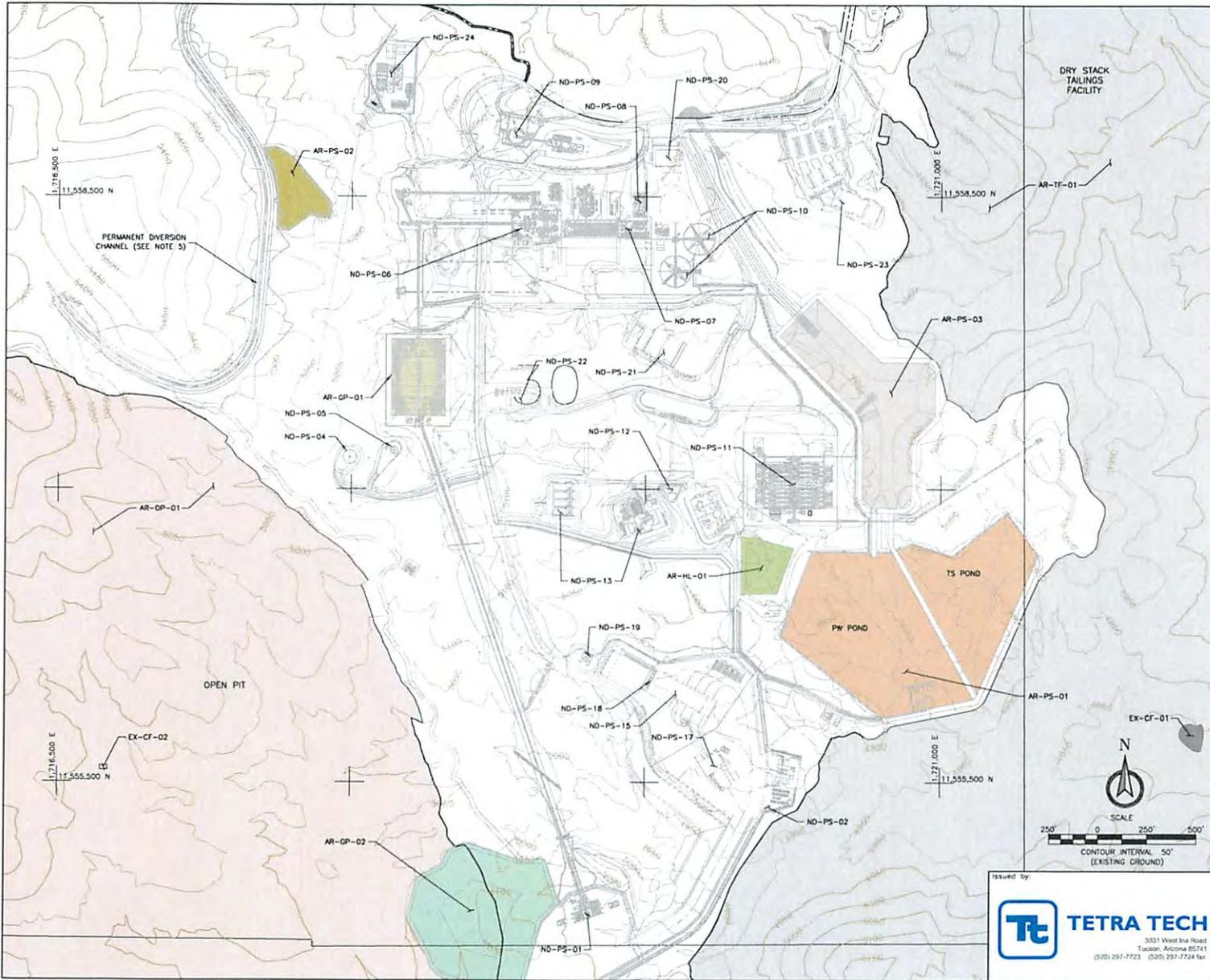


APP REGULATED FACILITY LOCATIONS



3501 N. Central Expressway
Tucson, Arizona 85745
(520) 297-7723 (520) 297-7724 fax

Project no.: 308877
Project: PROJECT
Location: SIENA COUNTY, ARIZONA
Figure no.: 04A
Date: 05/11/10



| Non-Discharging Exempt Facilities | |
|-----------------------------------|---|
| ND-PS-01 | Primary Crusher |
| ND-PS-02 | Mine Water Tank |
| ND-PS-03 | Santa Cruz Fresh Water Pipeline and Booster Stations (See Note 1) |
| ND-PS-04 | Fresh Fire Water Tank |
| ND-PS-05 | Process Water Tank |
| ND-PS-06 | Grinding and Classification Circuit |
| ND-PS-07 | Copper-Molybdenum Flotation and Regrid Circuit |
| ND-PS-08 | Copper-Molybdenum Concentrate Thickening and Filtration |
| ND-PS-09 | Copper Concentrate Product Storage |
| ND-PS-10 | Tailings Thickener |
| ND-PS-11 | Tailings Filter Plant |
| ND-PS-12 | Sulfuric Acid Storage |
| ND-PS-13 | Solvent Extraction - Electro-Winning (SX-EW) |
| ND-PS-14 | Explosive Storage Magazines and Ammonium Nitrate Storage (See Note 2) |
| ND-PS-15 | Mine Truck Shop |
| ND-PS-16 | Heavy Equipment Fuel Storage and Dispensing (See Figure 04A) |
| ND-PS-17 | Mine Truck Wash |
| ND-PS-18 | Lube Bay |
| ND-PS-19 | Light Vehicle Fuel Station |
| ND-PS-20 | Change House |
| ND-PS-21 | Main Warehouse |
| ND-PS-22 | Analytical Laboratory |
| ND-PS-23 | Administration Building |
| ND-PS-24 | Electrical Substation |

| Other Exempt Facilities | |
|-------------------------|--|
| EX-TS-01 | Topsoil Stockpile - Location Variable (See Note 3) |
| EX-CF-01 | Slag Pile |
| EX-CF-02 | Former Ore Leaching Building |

| APP Regulated Facilities | |
|--------------------------|--|
| AR-GP-01 | Coarse Ore Stockpile |
| AR-GP-02 | Temporary ROM Ore Stockpile - Location Variable (See Note 4) |
| AR-GP-03 | Sewage Treatment Facilities <ul style="list-style-type: none"> • Primary Crusher (ND-PS-01) • SX-EW Building (ND-PS-13) • Mine Truck Shop (ND-PS-15) • Change House (ND-PS-20) • Main Warehouse (ND-PS-21) • Analytical Laboratory (ND-PS-22) • Administration Building (ND-PS-23) |
| AR-TF-01 | Dry Stack Tailings Facilities |
| AR-PS-01 | Process Water Temporary Storage (PWTS) Pond (PW Pond only) |
| AR-PS-02 | Waste Management Area |
| AR-PS-03 | Primary Settling Basin |
| AR-HL-01 | Raffinate Pond |
| AR-HL-02 | Heap Leach Pad (Shown on Figure 04A) |
| AR-HL-03 | PLS Pond (Shown on Figure 04A) |
| AR-HL-04 | Stormwater Pond (Shown on Figure 04A) |
| AR-OP-01 | Open Pit |
| AR-WR-01 | Waste Rock Storage Area (Shown on Figure 04A) |

- NOTES:
1. FACILITY ND-PS-03, THE SANTA CRUZ FRESH WATER PIPELINE AND BOOSTER STATIONS, ARE LOCATED ALONG THE WEST ACCESS ROAD.
 2. THE LOCATION OF THE EXPLOSIVE STORAGE MAGAZINES, FACILITY ND-PS-14, IS NOT SHOWN DUE TO CODE RESTRICTIONS.
 3. TOPSOIL STOCKPILE, FACILITY EX-TS-01, WILL BE PLACED AS NEEDED THROUGHOUT THE PROJECT SITE.
 4. THE LOCATION OF THE TEMPORARY ORE STOCKPILE, FACILITY AR-GP-02, HAS BEEN GENERALIZED.
 5. SEE FIGURES 04B AND 04A FOR STORMWATER MANAGEMENT FEATURES.

AR = APP Regulated Facilities
 CF = Closed Facilities
 EX = Exempt Facilities
 GP = Generally Permitted
 HL = Heap Leach
 ND = Non-Discharging
 OP = Open Pit
 PS = Plant Site
 SW = Stormwater
 TF = Tailings Facility
 WR = Waste Rock

Issued by:



TETRA TECH
 3031 West Iba Road
 Tucson, Arizona 85741
 (520) 297-7723 (520) 297-7734 fax

Title: **PLANT SITE FACILITY LOCATIONS**

| | | |
|----------------------------------|---------------------|-----------------|
| Project: ROSEMONT COPPER PROJECT | Project no.: 320877 | Figure no.: 05A |
| Location: PIMA COUNTY, ARIZONA | Date: 08/10 | |





EXHIBIT C

COUNTY ADMINISTRATOR'S OFFICE

PIMA COUNTY GOVERNMENTAL CENTER
130 W. CONGRESS, FLOOR 10, TUCSON, AZ 85701-1317
(520) 724-8661 FAX (520) 724-8171

C.H. HUCKELBERRY
County Administrator

April 4, 2014

Robert Scalamera, Project Manager
Surface Water Section, MC5415A-1
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

Re: **Arizona Department of Environmental Quality 401 Certification for Rosemont Copper, Public Notice 27-14AZ LTF 55425**

Dear Mr. Scalamera:

This letter presents additional consolidated comments by the Pima County Regional Flood Control District and Pima County on the Draft 401 certification for the Clean Water Act Section 404 permit for the Rosemont Copper Project. After I sent our comments to you, the Arizona Department of Environmental Quality (ADEQ) extended the comment period until April 7, 2014. ADEQ has also provided a copy of the agency's basis for the proposed certification that was not available during our previous review. Thank you for making this document available.

The additional comments provided herein largely pertain to that document, formally titled "Basis for State 401 Certification Decision, Rosemont Copper Project, ACOE Application No. SPL-2008-00816-MB". This document makes clear that ADEQ's draft certification has relied upon faulty information in the Final Environmental Impact Statement (EIS) and unsubstantiated opinions in documents that were provided by Rosemont Copper. Pima County and many others object to many of the conclusions of the Final EIS. Our previous review also found that ADEQ relied upon data and designs that no longer represent the mine as proposed to the US Army Corps of Engineers and the US Forest Service.

Mr. Robert Scalamera
Re: Arizona Department of Environmental Quality 401 Certification for Rosemont Copper,
Public Notice 27-14AZ LTF 55425
April 4, 2014
Page 2

On behalf of Pima County and the Regional Flood Control District, I urge ADEQ to deny the 401 certification for the Rosemont Copper project.

Sincerely,



C.H. Huckelberry
County Administrator

CHH/mjk

Attachment

- c. Colonel Kimberly Colloton, Los Angeles District Engineer, US Army Corps of Engineers
Jared Blumenfeld, Region IX Administrator, US Environmental Protection Agency

**Additional Comments on State 401 Certification Decision –
Rosemont Copper Project ACOE Application No. SPL – 2008-00816-MB**

Prepared by

Evan Canfield and Akitsu Kimoto, Pima County Regional Flood Control District, and
Brian Powell and Julia Fonseca, Pima County Office of Sustainability and Conservation

On Behalf of

C. H. Huckelberry, County Administrator
130 W. Congress, Tucson, AZ 85701

Background

ADEQ has provided us their basis for 401 certification. Many of our additional comments to ADEQ restate previous concerns raised in the FEIS, because many of the findings in the Basis for State 401 Certification were supported with conclusions from the FEIS that we believe are in error. This document also presents new data and new concerns with ADEQ's basis for the certification.

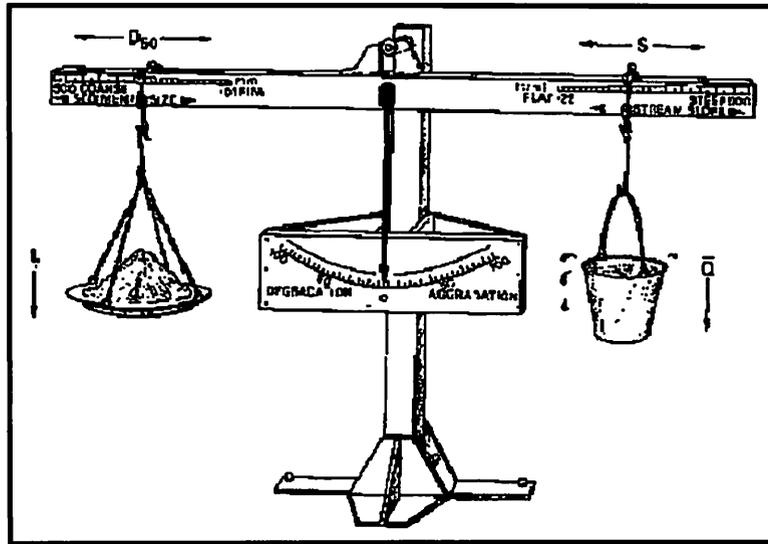
Stormwater and Sediment Transport Review

We have previously described concerns with the stormwater analysis and sediment transport analysis used in the FEIS (Attachment 1), and therefore believe that the Basis for State 401 Certification is based on erroneous analysis.

Summary:

- 1.) ***Factor: Changes in loadings and the nature, persistence and potential effects of the parameter: Sediment Delivery/Sediment Yield (p.8).***
 - a.) Previously-raised concerns: As we noted in our concerns about the FEIS there will be a reduction in sediment yield from Barrel Canyon watershed but no change in the geomorphology of the channel is expected. The FEIS only discusses annual average sediment delivery. The FEIS did not consider cumulative impacts of sediment delivery change over the active mine period and post-closure. Considering the proposed active mine life is over 20 years, the FEIS should assess long term impacts on sediment yield, delivery and channel geomorphology. County PAFEIS comments, p. 79.
 - b.) Concerns about the Patterson and Annandale 2012 assessment: The Basis for State 401 Certification cited an independent Forest Service Review (Patterson and Annandale, 2012; see Attachment 2). We have a number of concerns about this evaluation as follows:
 - a. *The level of effort is not adequate to establish that removal of the sediment supply will have no downstream effects.* While this is described as a 'study,' it is in fact a summary of observations from a two-day field visit labeled a 'Technical Memorandum' which includes five page of text and no measured field data.

- b. *It is not sealed by a Professional Engineer or Professional Geologist registered in the State of Arizona: This is particularly concerning because the evaluation, because it includes no data, is essentially a statement of professional judgment.*
- c. *It does not consider explicitly break out current and proposed conditions in the context of sedimentation processes: Two widely-accepted frameworks are:*
- i. *The Concept that there is a relationship between sediment supply, the capability of a channel to transport that sediment (Lane's balance: Lane, 1954):*



$$Q_s \cdot D_{50} \propto Q_w \cdot S$$

Where

Q_s = Sediment Discharge

D_{50} = Sediment Particle Size

Q_w = Streamflow

S = Stream Slope

- ii. *The Concept of Sediment Transport Capacity: Flowing water expends energy transporting sediment because sediment particles are about three times heavier than water. Therefore flowing water has more energy if it has less sediment.*

d. Existing conditions:

- i. Sediment transport rates are high.** We agree with the observation by Patterson and Annandale (2012) that ... '*Streams such as these have extremely high sediment transport rates (for example, Reid, et al., 1998 and Greenbaum and Bergman 2006).*'
- ii. Sediment is transported in suspension as well as bed load.** The evaluation done by Patterson and Annandale was unable to assess the importance of the suspended load in this environment because they did not evaluate conditions when water is flowing. Sediment may travel in suspension at steeper slopes (such as near the mine site) and as bed-load at shallower slopes (such as in Davidson Canyon).
- iii. Sediment supply rates are high and expected to be higher at the mine site:** Erosion equations such as the Revised Universal Soil Loss Equation (RUSLE; Renard et al, 1991) recognize that slope steepness and higher rainfall depths and intensities erode soils. Watersheds are steep with limited cover, and erosion rates are high even though rainfall may be low (e.g. Langbein and Schumm, 1958). Patterson and Annandale continue to build on the idea that impact of the mine is proportional to the catchment area and cite previous Rosemont Reports (they note that the mine is only 13% of watershed) without looking at the sediment supply potential differences across the watershed. The deep valley fill in the Tucson basin is generated by erosion of sediment off the mountains and depositing in the valley.
- iv. Natural and man-made grade controls exist on Barrel Creek:** Patterson and Annandale have identified some places where grade controls maintain channel grade under current conditions.

e. Proposed Conditions:

- i. Sediment Supply from the mine site will be nearly eliminated.** With the proposed compliance point dams, the sediment downstream of the compliance point dams will be cut off. In the context of Lane's balance, Q_s will go to nearly '0'.
- f. Effect of grade controls when sediment supply is cut off:** There are numerous examples of scour downstream of grade controls that capture sediment. A classic example is the Pantano dam on Cienega Creek, which has 10 feet of scour downstream of the dam. In the context of Lane's balance, when supply is cut off (Q_s goes down), scour occurs downstream of the grade control structure. In essence this is because a natural watercourse will attempt to come into equilibrium by increasing Q_s on the downstream of the dam.

While Patterson and Annandale contend that grade controls will maintain channel slope under proposed conditions where sediment supply is cut off by the mine site, it defies our observations in this area. Furthermore, we contend that the impact will be great because the current sediment supply and transport rates at the proposed mine site are extremely high.

2.) **Factor: Reduction in available assimilative capacity: Reduction in runoff volume (p.9).**

- a. To reiterate our concerns about the reliance on the FEIS in assessing impacts, the FEIS shows that the Barrel Alternative results in a predicted 17.2% reduction in average annual post closure runoff volume from the watershed. ADEQ failed to assess larger impacts on runoff loss during pre-mining and active mining periods, especially during the first 10 years of active mining. The FEIS (p.424) clearly stated that the impacts during these periods are high (FEIS, p. 424 The maximum loss of runoff to the watershed occurs during the first 10 years of active mining when runoff from these areas is retained onsite and recycled as process water. During this period, the loss of runoff would vary but is likely to approach a reduction in annual average runoff of about 30 to 40 percent, compared with undeveloped baseline conditions (SWCA Environmental Consultants 2013f)). As ADEQ cited, the 17.2% reduction could result in a potential loss of assimilative capacity and potential degradation of water quality. It is not clear why there was no discussion about the larger impacts during pre- and active mining periods.

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Impacts of Reduced flows and Increased Total Dissolved Solids (TDS) on the Riparian Vegetation of Cienega Creek

The cottonwood/willow forest and wetlands of the Cienega Creek Natural Preserve is keystone feature of the natural environment of eastern Pima County. Unfortunately, gallery forest and wetlands are highly stressed by the current drought conditions (Powell 2013). The shallow groundwater system that these trees rely on will be further stressed by the proposed Rosemont mine, which will reduce the flows to the creek. The quality of the water being lost to the creek is also important to consider. The water in Davidson Canyon is significantly lower in total dissolved solids (TDS) as compared to the water in Cienega Creek. Lower dissolved solids are a key reason for the designation of Davidson Canyon as an Outstanding Waters (Pima Association of Governments 2005). The reduction in the amount of this higher-quality water, along with the added dissolved solids from the mining operation, could have a profound effect on the cottonwood/willow forest of Cienega Creek. This has not been analyzed or acknowledged in the 401 application. This needs to be done in light of the fact that elsewhere in southern and western Arizona, the conversion of gallery cottonwood/willow forests to tamarix-dominated sites is correlated with higher concentrations of dissolved solids and impoundment of and regulation of streams (Vandersande et. al. 2001; Shafroth et. al. 2002; Pataki et. al. 2005; Stromberg et. al. 2007). The withholding of water in the upper reaches of Barrel would constitute stream regulation.

Lack of Analysis on Precipitation Timing, Recharge Rates, and Climate Change

The Rosemont Mine project will impact the amount of water flowing out of Barrel Canyon and into Davidson Canyon and Cienega Creek. Because ADEQ is required to ensure that there is no degradation to the Outstanding Arizona Waters of these sites, it is incumbent on the applicant to address impacts to water quantity. In our comments on the Forest Service's FEIS, Pima County took issue with the amount of water that is predicted to be impacted (i.e., held back) by the mine. For the purposes of the 401 application, it is imperative that the analysis look not just at the amount of water being withheld, but the timing of that impact. This is important because of southern Arizona's bi-modal precipitation pattern and the scientifically established fact that groundwater recharge is influenced by the seasonality of rainfall (Ajami et. al. 2012). The picture is further complicated by climate predictions, which estimate that groundwater recharge rates could be reduced by as much as 27% by the end of this century (Serrat-Capdevila et. al. 2007). There is no analysis of these factors, yet in order to ensure that no degradation of AOW will result from the mine, this analysis is critical. This analysis would at least identify the amount of water that Rosemont Mine needs to contribute to the system to make up for losses resulting from the proposed impoundment and use of water.

Increased Temperature and Lower Dissolved Oxygen

The analysis of the impacts of the Rosemont Mine do not consider two key variables in the water quality: increased water temperature and dissolved oxygen. As has been clearly established, the retention of stormwater that contributes baseflows in Davidson and Cienega Creek will reduce Cienega Creek baseflows. Rosemont has not modeled how this will impact water temperature and dissolved oxygen in Cienega Creek. Pima County believes that surface water temperatures in Cienega Creek will increase as a result of lower flows and less shading canopy as a result of a decline in the number and/or vigor of large cottonwood trees. (The decline in cottonwood trees would reduce evapotranspiration rates and thus result in a reduction in the loss of water from Cienega Creek, but this has not been investigated either.) This is a concern from the perspective of the aquatic species in Cienega Creek and the importance of the high-quality water coming from Davidson Canyon. The amount and quality of Davidson Canyon water on aquatic plants and animals of Cienega Creek was an important factor in

Davidson being designated as an AOW. With the prospect of increased water temperatures, this can lead to lowered dissolved oxygen, which can impact fish populations, especially with loss of canopy structure (Connor et. al. 2003). These issues, including how they will change under climate change scenarios must be addressed before the permit can be issued.

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Review of Isotope Data

ADEQ has decided that *“Lower Davidson Canyon is not hydraulically connected to the regional aquifer that would be impacted by the pit dewatering.”* ADEQ’s reasoning is flawed.

1. ADEQ has not conducted an independent review of the primary data. ADEQ should request the primary data and conduct its own review. ADEQ should not rely on opinions of others. ADEQ cites the FEIS for its information. The FEIS and ADEQ cite Tetra Tech (2010) for its interpretations. Tetra Tech (2010) in turn presents and interprets isotope and water quality data collected by PAG (2003) and Montgomery and Associates (2009). There is no evidence that ADEQ reviewed the Montgomery and Associates (2009) report, which contains the bulk of the primary data on water quality in the mine vicinity.
2. The FEIS also cites SRK’s review of Tetra Tech’s interpretation, but SRK did not review the primary data either. The FEIS preparers only reviewed Tetra Tech (2010) interpretation of data collected by others. SRK (2012) relied on Tetra Tech’s faulty interpretation that *“wells and springs in the upper reaches in Davidson Canyon have isotopic values indicating winter recharge from precipitation is a significant source of water (Tetra Tech 2010a). Water samples taken for Reach 2 Spring in Lower Davidson Canyon has a geochemical signature that indicates the spring water is primarily influence by summer rain: this suggest that bedrock groundwater is not a significant component of the Reach 2 Spring.”*
3. Tetra Tech’s interpretation, and hence ADEQ’s review, is not supported by the actual isotopic work performed by Montgomery and Associates. ADEQ cites Tetra Tech’s opinion as: *“Isotopic signatures of water from these two springs reflect the influence of summer precipitation, in contrast to wells in the regional aquifer which reflect the influence of winter precipitation”*. Our review of primary data supports a very different conclusion about wells in the regional aquifer. Please see Table 12, result of Laboratory Analyses for Delta Oxygen-18, Deuterium, and Tritium in Groundwater and Surface Water Samples, Rosemont Area, Pima County, Arizona (Montgomery and Associates, 2009). Oxygen isotopes in wells near the mine site are heterogeneous, varying from -6.9 at RP-8 to -12.4 at RP-4B. Thus it would be incorrect to say that *wells in the regional aquifer reflect the influence of winter precipitation*. In fact, groundwater shows a wide range of of $\delta^{18}\text{O}$ values. This review will demonstrate that the values reflect the influence of both winter and summer precipitation.

This is also shown graphically on Figure 8, Graph of Deuterium Versus Delta Oxygen-18 from Wells, Springs, and Surface Water Locations, April through October 2008, Rosemont Area (Montgomery and Associates, 2009). This figure is reproduced below. Wells are crosses. Note that the well delta oxygen values range from -12 to -7 on the horizontal scale. Note also that range of values for springs (diamonds) occupies nearly the same range, excepting the singular well value at RP-4B, which is a deep well screened in the Apache Canyon Formation.

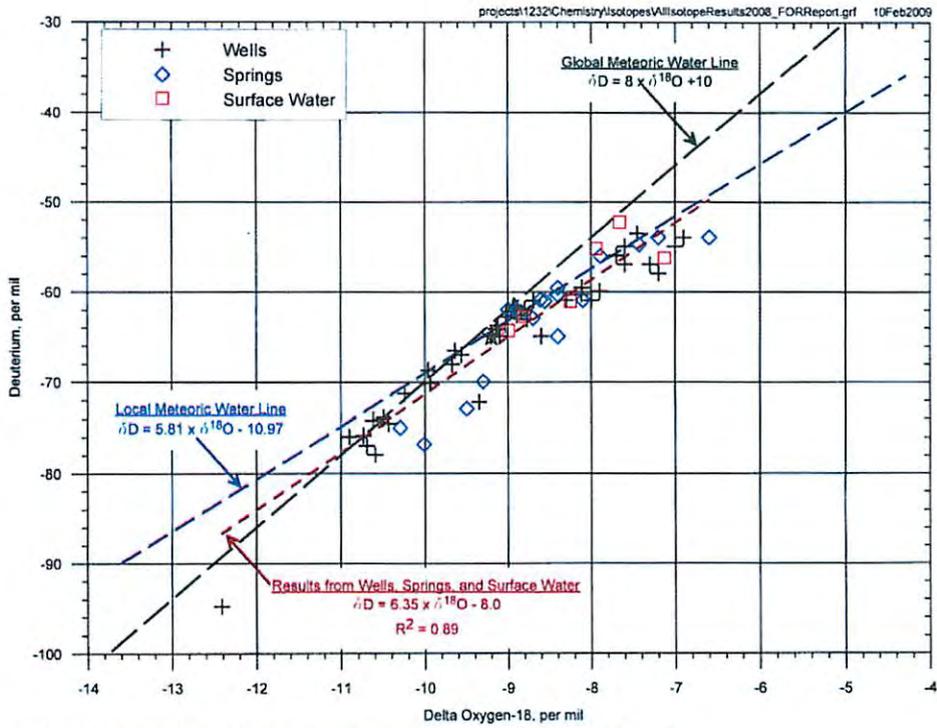
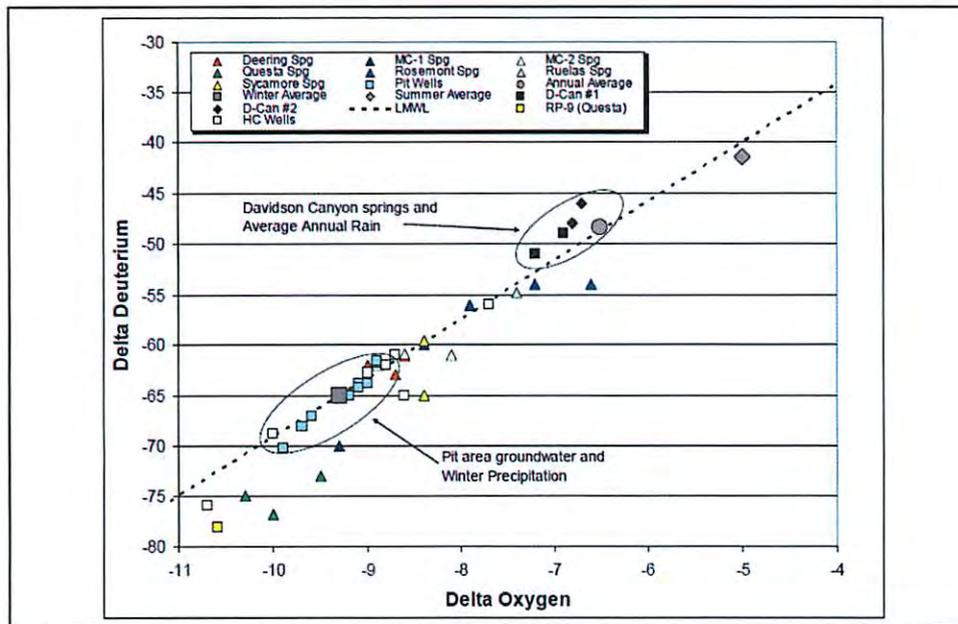


FIGURE 8. GRAPH OF DEUTERIUM VERSUS DELTA OXYGEN-18 FROM WELLS, SPRINGS, AND SURFACE WATER LOCATIONS, APRIL THROUGH OCTOBER 2008, ROSEMONT AREA



Montgomery Figure 8



Project No: 114-320809

March 2010



Tetra Tech Figure 17

Figure 17
Stable isotopes in Rosemont project site ground- and surface water

Some of these same data are shown on Figure 17 from Tetra Tech (2010), which differentiates the pit area groundwater (primarily PC well series) from other wells and springs in the mine vicinity. While it is true that the pit well data are largely grouped in the lighter oxygen values, many of Montgomery's other well and surface water data plot right along the red line calculated by Montgomery using the entire data set, suggesting that they are from the same population.

4. Referencing Montgomery's Figure 8 again, note that all of the samples, even the PC wells, plotted below the Global Meteoric Water Line. This is not disclosed by Tetra Tech, and in fact the Tetra Tech plot actually obscures this fact by plotting a dashed line that does not represent the Global Meteoric Water Line. It can be seen that the intercept of Tetra Tech's line is much lower than the Global Meteoric Water Line that Montgomery shows. The slope of the local data, and the values of the PC wells considered as a group *both show substantial influence from natural evaporation during precipitation, runoff and / or recharge*, as was noted by Montgomery and Associates in their 2009 report. Tetra Tech did not discuss Montgomery's observation of an evaporative effect, presumably because it did not fit their preferred interpretation.
5. Tetra Tech's Figure 17 includes a data point representing winter average rainfall. This value is important because it is the principal basis for the inference that the position of the "*pit area groundwater*" on figure 17 means that *winter precipitation* is the source of the groundwater for the PC wells. Tetra Tech says that the winter average value is based on "*stable isotope data for local precipitation*" by Wagner (2006). Page 124 of Wagner 2006 provided several years of precipitation data from the vicinity of Cave of the Bells, in the Santa Rita mountains farther south. There were too few years in Wagner's sample to define a local meteoric water line (Dr. Chris Eastoe, personal communication).
6. Figure 8 (Montgomery and Associates 2009) also has a local meteoric water line (LMWL) derived from data provided by Dr. Chris Eastoe. In attachment 3, Dr. Eastoe presents a more robust dataset for a LMWL. LMWL's are important because they provide a basis for interpreting sample results.
7. The effects of evaporation on isotopes in rainfall at Palisades Ranger Station (Santa Catalina Mountains) is much less developed than in the lower elevation Tucson data (Attachment 3, Figures 1A and 1B). According to Dr. Eastoe, the Rosemont pit site is at about 1500 masl, and precipitation at the site most likely has stable isotope distributions (ranges, and trends on the delta D vs. delta 18O plot) between those of the Tucson and Palisades stations.
8. Dr. Eastoe plots an evaporation trend based on the Montgomery data on his Figure 1A (Attachment 3). Tetra Tech did not consider any evaporation trends in their interpretation.
9. Tetra Tech's claim that Rosemont groundwater in the PC wells represents winter recharge is not supported by the interpretation that Dr. Eastoe presents in Attachment 3. The observed values would require a mix of summer and winter rains to produce the observed values of delta -9‰ at Rosemont (the origin point of the evaporation trend plotted on Figure 1A of Attachment 3). Only values of delta -11‰, or lighter would correspond with winter precipitation (see Fig. 2, Attachment 3).

10. Tetra Tech omitted well data that did not support their hypothesis. Tetra Tech's Figure 17 omits many of the wells and spring samples that plotted closer to the PAG dataset, but retained the "pit wells" that favored Tetra Tech's interpretation. The omitted samples that plotted closer to the PAG data set included wells RP-4A and RP-3A located in areas under the waste rock and tailings landform, and Rosemont spring, which would also be covered with waste rock and tailings.
11. The major ion chemistry of wells in the Rosemont mine area as documented in Montgomery (2009) reflects multiple water sources. A map which shows major ion chemistry in the form of Stiff diagrams is reproduced without attribution to the authors as Figure 18 in Tetra Tech (2010). The map at Figure 18 shows that the vicinity of the open pit, the groundwater is calcium bicarbonate, consistent with TetraTech's interpretation (2010). There is another type of water, dominated by CaSO₄ and having much higher TDS than most other wells, associated with Pit Characterization wells PC-3, PC-7, PC-6, and wells RP-7, and P-899. Thus, on the basis of major ion chemistry, water chemistry even in the pit area is seen to vary considerably.

Note also that the east of the pit, the groundwater is mix of calcium bicarbonate, sodium bicarbonate, and calcium sulfate type waters (Montgomery and Associates 2009). There is also a zone of Na-rich bicarbonate waters that runs NE along the axis of Barrel Canyon from HC2B NE through HV-1 and the RP-2 series.
12. Turning now to the Davidson surface flows, Tetra Tech fails to plot or discuss the sample results shown on Montgomery's Table 12 for lower Davidson Canyon Wash. **This sample has a $\delta^{18}\text{O}$ value equal to -9.** This is similar to the pit wells and the so-called winter precipitation. Thus, Tetra Tech's interpretation regarding the character of Davidson spring is not supported by the only sample which was contemporaneous with the well data to which it is compared. No explanation is offered in the Tetra Tech report for this omission.
13. While ignoring contemporaneous Montgomery data that does not support their hypothesis, Tetra Tech included PAG 2003 data for Davidson. Below I have plotted the PAG data by hand on Montgomery's graph above for convenience. The line defined PAG's 2003 Davidson samples plots is within the trend line defined by Rosemont area groundwater. It does not plot below the trend line, with a flatter slope, which is what you would expect if the Davidson discharges were "local springs".

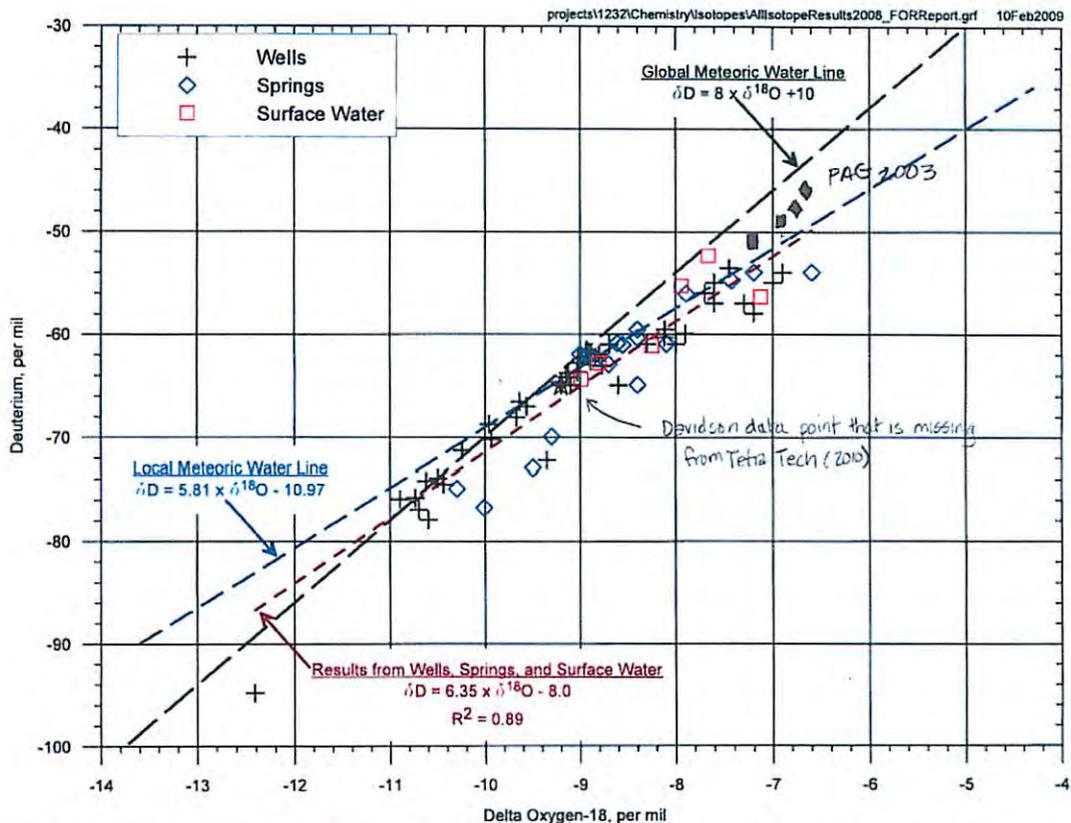


FIGURE 8. GRAPH OF DEUTERIUM VERSUS DELTA OXYGEN-18 FROM WELLS, SPRINGS, AND SURFACE WATER LOCATIONS, APRIL THROUGH OCTOBER 2008, ROSEMONT AREA

◇ PAG 2003 DATA
 □ PLOTTED BY HAND



14. Tetra Tech's interpretation ignored variability in dates for Davidson surface water samples they do include. The PAG isotope data were collected at a different time, June 2002 and May 2003 from Montgomery's Davidson Canyon sample. Tetra Tech makes no explanation regarding sources of variability between PAG and Montgomery data, because they omitted the Montgomery data.
15. Even PAG (2003) noted that *"the stable isotope data for Davidson Canyon base flows varied markedly between the Davidson #1 and Davidson #2 sample points. Davidson #1 is farther upstream and reflects a higher-elevation water source than Davidson #2."*
16. Montgomery collected their surface water sample in October 2008 at a location close to the confluence of Cienega Creek, near PAG's Davidson #2 site. This downstream site and collection date showed evidence for a mix of high elevation and low elevation runoff by virtue of its position within the trend line defined in red by the rest of the Rosemont data set. This can be seen by the position of the Davidson data point relative to other Rosemont area wells on the annotated graph above. The penciled arrow indicates the position of the 2008 Davidson sample, which plots in a very different location than the PAG values for Davidson samples, but solidly along the same trend.

17. During the term of PAG's study, Cienega Creek had consistently lighter delta O18 values than either of the two Davidson Canyon sites. During the term of Montgomery's study, Davidson had higher delta O18 values than either upper or lower Cienega Creek. Montgomery's data for Cienega Creek is not plotted, nor discussed by Tetra Tech. We can expect there to be year-to-year variation in values observed in spring flows, but Tetra Tech's interpretation obscures this phenomenon.
18. ADEQ's proposition that "*Lower Davidson Canyon is not hydraulically connected to the regional aquifer that would be impacted by the pit dewatering*" fails to address many of the direct and indirect effects of the dredge and fill activities related to the 404 permit. Pit dewatering is only one mine-related activity to be considered in making a determination regarding impacts upon Davidson Canyon water availability. Another significant impact is the alteration of transmission losses and thus recharge processes through the diversion, capture and impoundment of surface flows. ADEQ has not considered this in their basis for the anti-degradation finding. Another is the clearing and grubbing of soil above the bedrock—how will that affect transmission losses and recharge? How will recharge be affected by filling of entire valleys with waste rock and tailings? Given that these activities are directly related to the Section 404 permit, it is imperative that ADEQ consider the effects of these activities on infiltration losses. Another issue is how changes in the groundwater gradients induced by the pit lake (as opposed to *pit dewatering*) over time may alter the direction of underflow toward Davidson Canyon.
19. Pit dewatering strategies have changed since Tetra Tech (2010) and the FEIS failed to recognize this. New data show that pit dewatering can not be accomplished with wells. Rosemont will have to install costly drains in the Willow Canyon and basin fill in order to dig the pit. "*CNI recommends groundwater modeling to determine the anticipated horizontal drain spacing for dewatering approximately 100 to 200 feet behind the slope face. Because of the low conductivity values, a relatively tight spacing will be required resulting in a high cost to depressurize the [south] slope.....Because of the low hydraulic conductivities determined from pump tests mentioned previously, CNI did not consider a reduction in the phreatic surface level with the use of depressurization from vertical pumping wells.*"
Nicholas, Standridge and Pratt, 20 July 2012, p.3.

In conclusion, ADEQ erred by not conducting an independent review of the primary data sets, instead relying on the interpretations of others. Tetra Tech cherry-picked data to support their conclusion, ignored complexity, and over-extended the information to the regional aquifer. The isotopic data support an interpretation that there are multiple sources of recharge in the mine vicinity, and these occur at different elevations. ADEQ cannot conclude on the basis of the isotope data that construction of the mine will not interfere with one or more of these recharge locations and mechanisms. ADEQ also failed to consider effects on recharge, other than pit dewatering. ADEQ basis also relied on Tetra Tech's evaluation of the old mine design to draw its conclusions. Finally, pit dewatering will occur by means that have not been evaluated by either Tetra Tech (2010) or ADEQ.

ADEQ should request the primary data sources and evaluate effects of discharge of dredging the waters of the US of their native soil and filling the Waters of the US. These dredge and fill activities will affect recharge processes that result from mountain front and stream-bed infiltration processes at a variety of locations. ADEQ should rely on the same dataset as the Corps; in order to do that, ADEQ must request

additional information from the applicant, because the applicant has provided incomplete and outdated information to ADEQ, as indicated in our previous letter of comment about this certification.

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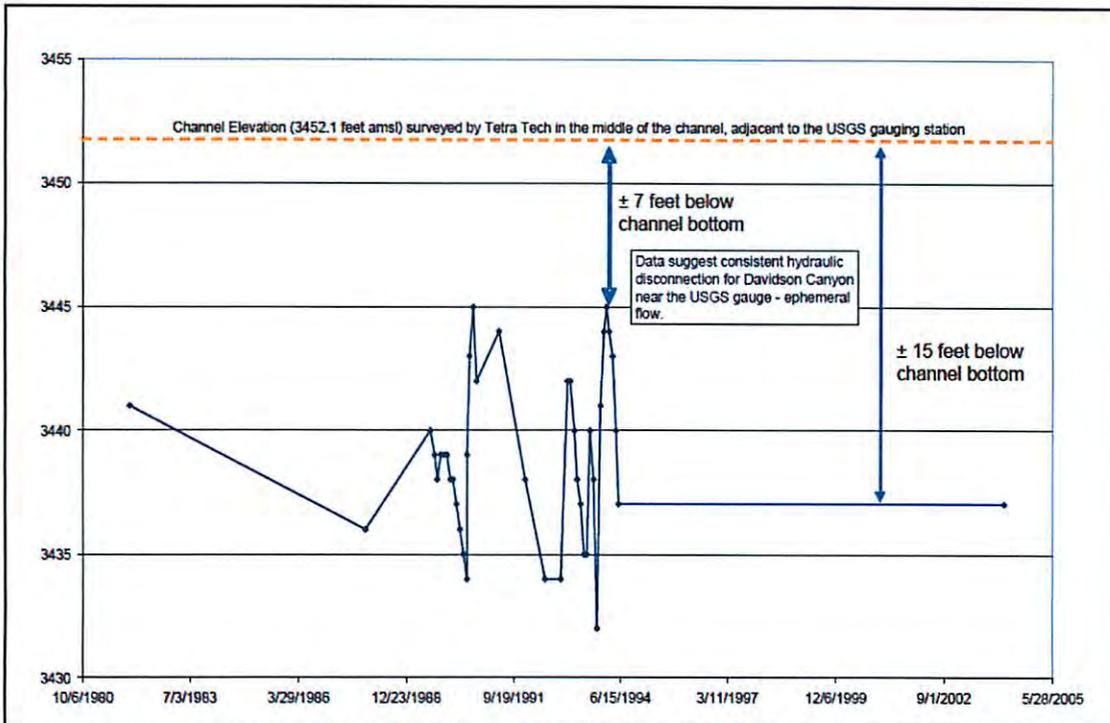
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Review of Assumptions regarding Regional vs Local Springs

On page 12, ADEQ's basis also relies on Tetra Tech's 2010 report that concludes that springs along Davidson Canyon are not likely connected to the regional aquifer because they have gone dry during the past few years, "*rather than being supported by perennial flow, as would be expected from a regional groundwater source (FEIS page 535).*"

It is not logical to assume that springs connected with the regional water table would not decline during times of drought or lack of recharge. Although perennial springs are likely to be fed by regional aquifer, it does not follow that a non-perennial spring is NOT related to the regional aquifer. In some areas, groundwater observations indicate that there have been declines in the regional aquifer, therefore cessation of flow at a nearby spring WOULD BE CONSISTENT with a connection to a regional aquifer.

With respect to Davidson Canyon, Tetra Tech presents PAG well observations at a well located near the OAW reach:



Project No: 114-320869

Note: Data was compiled from the Davidson Canyon Unique Waters Nomination (PAG, 2005)

March 2010



Figure 5
Pima County Well Hydrograph

Tetra Tech misrepresents the PAG (2005) data by plotting a line connecting individual observations separated by years. Tetra Tech further misrepresents the data by adding a text box on the graph interpreting the time between 1994 and 2005 as data suggesting a hydraulic disconnection, when it actually represents a data gap in the cited report (PAG 2005).

During the data gap shown on Figure 5 (1994-2005), Pima County obtained observations of flow and absence of flow from Sky Island Alliance. The observations were made at locations of animal tracks observed in the Davidson Canyon stream bed from the Interstate 10 bridge to 1.5 miles south. This reach includes Davidson adjacent to the County well mentioned above. During 2002-2005, there was either damp soil, running water, or standing water on 12 of 26 (46%) of the Sky Island sampling occasions. These observations were made during the 2002-2006 drought.

| | |
|----------------|----|
| Damp | 6 |
| Dry | 14 |
| Running Water | 3 |
| Standing water | 3 |

The well is located downstream and outside reach 2. Observations of groundwater levels at the well do not represent conditions at the reach 2 spring. The 2005 PAG report identifies several reaches of Davidson Canyon as having perennial and intermittent flow based on PAG observations, independent of the Sky Island Alliance data.

Seepage to Waters of the US and Seepage Monitoring

Page 5 and 6 of ADEQ's Basis refers to the potential for seepage from the waste rock and tailings piles to Waters of US. Pima County and Pima County Regional Flood Control District have objected to the inadequacy of the EIS with respect to seepage and seepage monitoring. The Forest Service is the process of reviewing objections. One objection is that the FEIS modeling of waste rock seepage is faulty. Another objection is that FEIS ignores the high probability of preferential seepage flow in the tailings and waste rock piles. A third objection is that the FEIS waste rock seepage monitoring plan will not result in adequate seepage impact evaluation .

Objection: The modeling of waste rock seepage is faulty.

The EIS must justify the parameters used and complete a sensitivity analysis of the parameters to demonstrate that the results of the seepage modeling are feasible; this is especially needed since there is no data to calibrate to. They must also justify ignoring preferential flow paths through the waste rock. The mine facility seepage analysis predicts there will be essentially no seepage through waste rock facilities, a result that is simply not feasible. The modeling used parameters in which the conductivity for relatively dry rock is six orders of magnitude less than when saturated. These parameters would allow a wetting front to move through unsaturated waste rock only very slowly; even most of a large event would be stored in the top few feet. After the storm ends, the close proximity of most of the seepage to the ground surface would allow the water to be evaporated away because evaporation would quickly establish an upward matric potential gradient.

The EIS repeats this error, which affects the quality of the organic constituent analyses. It does not seem reasonable that infiltration from waste rock be close to zero because natural recharge in this area is not zero. Blasted waste rock is almost certainly more conductive than the in-situ rock. It is also unlikely that the one-foot thick cover will result in less infiltration than the natural soil and vegetation regime.

Similarly, it is not reasonable for the seepage through a leach pad to cease. Leach pads are designed to conduct flow. All water that gets through the cover will become seepage. Based on experience, the long-term seepage through heaps in more arid climates in Nevada do not approach rates as experience has shown that waste rock dumps in much drier climates will have seepage.

These three comments refer to the estimates of infiltration through waste rock, which have been estimated to be near zero. These comments had been made without reviewing the waste rock seepage study.

The modeling is effectively water balance modeling among layers in the facility, with [f]low between layers controlled by unsaturated flow equations, or saturated in areas where saturation occurs. Unsaturated flow modeling solves the equations of soil physics, most specifically the flow equation relating the matric potential gradient to the conductivity,

which varies as a function of matric potential. Unsaturated flow is toward the lower matric potential which occurs at the point where the media is drier, all other conditions being equal. When saturated the equation becomes Darcy's law and the matric potential gradient becomes the head gradient. Matric potential becomes negative as soil dries, so during dry conditions water from depth can be drawn to the surface and evaporated in a process known as exfiltration.

Tetra Tech utilized a two-dimensional variably saturated flow model, VADOSE/W, for this simulation (Tetra Tech 2010c, p. 20). The code solves the flow equations using a finite element routine. Two-dimensional means flow in a vertical cross section. Tetra Tech emphasizes that it "can simulate heterogeneous material, and can account for changes in material conditions due to compaction and underlying alluvial and/or bedrock formations" (Id.). This simply means that different model elements may be defined by different material property parameters and that those parameters can represent any material including compacted waste rock. The modeling presented in this Tetra Tech study is strictly based on conceptual flow models for the various materials because there are no data to which to calibrate. Material parameters depend on textbook or smallscale test values. The predicted values are not verified in any way to previously observed data.

The model simulates precipitation and evaporation, using various sequences of climate data for the simulations. Climate data provides the daily precipitation, temperature, wind speed, and evaporation. Using data from the Nogales site (Tetra Tech 2010c, p. 21) is not unreasonable, but the scenario using average daily values is not representative. TT states that the average conditions "dataset has small amounts of precipitation everyday because of the averaging of many years of data" (Id.) and call this "conservative". In a response to a review memorandum, TT (2011) responded that "[t]he average conditions dataset, as noted in previous memos, has precipitation nearly every day of the year. This is not likely to occur in Arizona, but would be a worst case scenario. Water is more likely to readily infiltrate into a facility if the upper surface is wet, so considering a climate conditions with a small amount of precipitation each day would produce such a condition and provide a result of the worst case infiltration" (TT, 2011, p. 2, emphasis added). Tetra Tech apparently considers this to be conservative, but the evaporation likely exceeds precipitation most days so there would rarely be an excess of precipitation to infiltrate. Even during winter, average precipitation may exceed the average evaporation by only a small amount, but the model would accumulate moisture in the top layers. This modeled soil moisture may just be stored and later evaporated as conditions warm and dry in the spring. Infiltration through the surface zone would occur when moist antecedent conditions precede a large daily rainfall; this type of situation which would result in seepage has been ignored in the Tetra Tech study. This is not uncommon during late winter or spring snow melt and subsequent spring showers.

The mine development periods and reclamation scenarios simulated are reasonable (TT, p. 22). Whether the parameters used for the scenarios were proper remains a question.

Tetra Tech discusses steady state modeling as a means of determining starting moisture concentrations for the transient simulations (Tetra Tech 2010c, p 37). In a system that should be event driven, steady state should never be approached, much less achieved.

The assumed parameters for the waste rock control the seepage through the waste rock facilities. The so-called permeability reported by Tetra Tech is actually saturated hydraulic conductivity (K). The values are very high, but the unsaturated values decrease very rapidly.

The figures showing the relationship of conductivity with matric suction and moisture with matric suction are poorly labeled. For example, Illustration 5.6 shows the relations for run-of-mine (ROM) rock, with saturated K equal to 174 ft/hr; the matric suction on the conductivity graph does not obviously match the axis for the moisture content, and does not have labels. Even the conductivity axis does not have labels for ROM rock.

Considering Ill 5.7 for semi-consolidated rock, the conductivity decreases over five orders of magnitude from saturated to dry (moisture 0.4 to 0.05). At the beginning of a storm with dry antecedent conditions, infiltrating precipitation increases the moisture content which increases the effective conductivity. As noted, the parameters for the surface ROM layer are hard to read, but dry (moisture about 0.16), the conductivity is significantly less than 174 ft/hr. Assuming no runoff, the ROM would rapidly saturate at a wetting front. Because of the low conductivity the wetting front would advance very slowly with conditions above the front being saturated. This means that significant amounts of ROM above a wetting front would be saturated. According to Ill 5.6, the difference between saturated and dry moisture content is the difference between 0.27 and 0.18, or about 0.09. Using these numbers, a three-inch infiltration event would be completely stored in just 33 inches of initially dry ROM, based on the available porosity between 0.18 and 0.27 being 0.09. The modeling assumes that it completely fills. Once the infiltration event ends, water would continue to seep downward, drawn by gravity and a negative matric potential. However, evaporation would begin at the upper end and, as the surface soil dries, a negative matric potential would develop on the surface and begin to counter the downward movement of the stored water.

The example just given allows the soil above the wetting front to become saturated because of the large difference in effective conductivity at the wetting front, which keeps the water close enough to the ground surface for evaporation to begin to quickly remove the water after the precipitation event ends. During summer, when the larger short duration events are most likely, the daily potential evaporation is as much as half an inch per day which means that most of the precipitation stored in upper layers of the waste rock would quickly evaporate; it is clear why the modeling does not simulate deeper seepage of water.

The figures showing water content through a model cross-section are clear (Ill 5.15 and 5.16). Near the surface, the moisture content is about 0.1 which increases initially with depth to about 0.14 but then decreases to 0.04 in the consolidated zone. This moisture content is less than the lowest moisture content presented in Illustration 5.8 for consolidated material, so the accuracy of the data is questionable. Clearly the effective conductivity at that moisture is 10^{-7} ft/hr (2.4×10^{-6} ft/d), an almost negligible conductivity.

The effective gradient due to high negative matric potential may be significantly higher than 1. Even at 1000, the water would move only about 2.4×10^{-3} feet in a day. These numbers should make clear why the model does not simulate seepage through the waste rock. The small amount of moisture below the unconsolidated ROM can be simulated to move only very slowly. These numbers suggest that increasing the moisture available significantly would not result in substantial differences in moisture content at depth, meaning that whether the model considers runoff accumulating at a location is irrelevant.

Many of the water balance figures, such as Illustrations 5.12 and 5.14, show precipitation entering the system and evaporation leaving the system; because the evaporation exceeds the precipitation, water leaves storage so that the moisture content decreases. These figures present a year's results, but

presumably the waste rock would just become drier with time and evaporation would have to approach precipitation as stored water available to evaporate would dissipate. The figures also demonstrate that the model simulate almost no runoff.

The modeling does not account for preferential flow which can allow flow to move quickly through the piled waste rock. A preferential flow path in a waste rock dump is a pathway of larger pore spaces through which groundwater flow tends to funnel; it is similar to flow through fractures in in-situ bedrock. By ignoring preferential flow, the model underestimates seepage through any of the mine components, although waste rock would likely be most heterogeneous.

Tetra Tech's mention of preferential flow (TT, p. 20) refers to the fact that hydraulic conductivity for unsaturated flow varies with moisture content; different materials are preferentially more conductive at different moisture contents. More flow occurs through clay at low matric potential than through coarser sand because the sand is actually drier. The curves in TT Figure 5.5 may apply in a given facility but they would not apply at the same point (due to differing soil types at each point) so the flow cannot transition from one to the other.

The FEIS reports results from modeling seepage through waste rock dumps that are unreasonably low. This is because the modeler used unrealistic unsaturated parameters and used climate data from the wrong location.

The FEIS responded to comments by having Rosemont consider additional scenarios. The scenarios had to do with the length of simulation but with inappropriate climate values the antecedent conditions were never wet enough to allow additional seepage beyond the surface. The FEIS did not amend or address the fact that the precipitation data was wrong and the ET data was from Tucson. The presence of seepage through waste rock all over the country including in areas much drier than Rosemont demonstrates that seepage can occur.

The FEIS also does not respond to the comment about the wrong hydraulic parameters for the soil – specifically that the unsaturated conductivity was incredibly low which prevented any water entry to the waste. The FEIS did not address these problems or have Rosemont test the sensitivity of the waste rock parameters in their model

Conclusion and Recommendations

The EIS must present data justifying the conductivity parameters. It is not reasonable for ROM rock with saturated $K = 170$ ft/hr to only allow seepage to move a few feet before being removed by exfiltration.

The study should be redone to include a sensitivity analysis.

If the conductivity for high matric potential rock is set higher and there is still no seepage, then the EIS may be able to conclude there is no seepage. Otherwise, the results of this seepage study are simply uncalibrated estimates based on very unrealistic parameters.

Objection: The FEIS ignores the high probability of preferential seepage flow in the tailings and waste rock piles

The DEIS must justify the parameters used and complete a sensitivity analysis of the parameters to

demonstrate that the results of the seepage modeling are feasible; this is especially needed since there is no data to calibrate to. They must also justify ignoring preferential flow paths through the waste rock. The mine facility seepage analysis predicts there will be essentially no seepage through waste rock facilities, a result that is simply not feasible. The modeling used parameters in which the conductivity for relatively dry rock is six orders of magnitude less than when saturated. These parameters would allow a wetting front to move through unsaturated waste rock only very slowly; even most of a large event would be stored in the top few feet. After the storm ends, the close proximity of most of the seepage to the ground surface would allow the water to be evaporated away because evaporation would quickly establish an upward matric potential gradient.

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FEIS claims that seepage would not be concentrated but would rather be spread across the entire area of the facility. The FS rejects good science and observations at literally every waste rock seep showing that seepage discharges from a point, not spread around the base of the facility.

Preferential flow would cause seepage through waste rock (and tails) to reach the ground surface at concentrated locations rather than spread over the entire area of the facility. This is unaccounted for in the modeling and the FEIS in general. Because preferential flow has the potential to significantly impact downstream waters and habitats, the models should be re-run to account for this phenomenon.

Objection: The FEIS waste rock seepage monitoring plan will not result in adequate seepage impact evaluation.

The monitoring plan calls for two points to be monitored for moisture content. The waste rock dumps cover a large area, but the FEIS suggests there will be no seepage. Objection 7 deals with the high probability of preferential flow in the piles, which means that actual seepage will likely be concentrated. The mitigation plan in the FEIS calls for monitoring seepage in just two locations. Because preferential flowpaths could develop almost anywhere, there is little chance that the proposed monitoring will actually detect seepage if it occurs.

ADEQ's Basis states that "should the seepage reach surface waters, an individual AZPDES permit would be required and discharges would have to meet the appropriate surface water quality standards individual antidegradation." However, neither ADEQ nor Forest Service have provided for monitoring to

detect seepage that has reached surface waters, except if the seepage reaches the compliance point dams. ADEQ should require detection and reporting of any inadvertently created surface water features created in and around the mine site upstream of the Barrel Canyon compliance dam. Detections should trigger monitoring to assure that any unplanned water bodies are meeting state water quality standards.

Attachment 1

Objections Related to Stormwater Management

Throughout the EIS process, the County has commented on the issue of stormwater management at the Rosemont site and the impacts of the proposed management methods on downstream waters, both above-ground and below. The County continues to believe that the impacts on those waters will be substantially greater than predicted in the FEIS.

Comments filed by the County include:

- a. The reduction of flows to downstream during the first 10 years of operations will put the offsite riparian areas at risk. County PAFEIS comments, p. 68.
- b. Cumulative impacts of the reduction of storm flows downstream of the project site have not been evaluated. The FEIS focuses on the changes in either annual runoff or storm peak flow but ignored the cumulative impacts over the 20 years active mining life. Long-term, cumulative impacts of the reduction of flow from the project site on Davidson Canyon and Cienega Creek need to be evaluated. County PAFEIS comments, p. 73.
- c. The impacts of mining activities on sediment transport could change over time during the active mine life and after the closure. The FEIS reported that the reach of Davidson Canyon is currently a sediment transport-limited system. However, with a reduction in sediment load from the project area over time, it is possible that loose sediment is washed out and as a result the sediment transport system could be changed. The changes in sediment balance could affect the fluvial geomorphology of the Davidson Canyon and Cienega Creek. Appropriate sediment transport analysis is necessary to estimate long-term impacts of mining activities on channel geomorphology, vegetation and fluvial system of the "Potential Waters of the United States". Cumulative impacts of possible changes in sediment transport system on "Potential Waters of the United States" over time should be disclosed. County PAFEIS comments, p. 78.
- d. The FEIS acknowledged that there will be a reduction in sediment yield from Barrel Canyon watershed but no change in the geomorphology of the channel is expected. The FEIS only discusses about annual average sediment delivery. The FEIS did not consider cumulative impacts of sediment delivery change over the active mine period and post-closure. Considering the proposed active mine life is over 20 years, the FEIS should assess long term impacts on sediment yield, delivery and channel geomorphology. County PAFEIS comments, p. 79.
- e. The FEIS acknowledges that the modification of stormwater peak flows and volume is important in multiple aspects. However, the FEIS does not include any plans to address possible issues resulting from the modification of storm flow. For example, what would happen if the reduction of runoff volume significantly affects Davidson Canyon and Cienega Creek? The FEIS lacks a "backup" plan. Please explain what actions would be taken when problems are identified. County AFEIS comments, p.72.
- f. The FEIS acknowledges that some water sources would be impacted (p.31, L.30). However, the FEIS did not clearly explain who would be responsible of addressing issues. Please cite a responsible party to address potential issues, threat to health and natural resources and explain how to address issues when identified. County PAFEIS comments, p.73.
- g. How will the monitoring data be used? What would happen if the monitoring data shows problems? The FIES should explain what actions would be taken when a problem arises. County PAFEIS comments, p. 73.

- h. What action would be taken if monitoring data shows the impacts to surface water quality in the Davidson Canyon during active period and post-closure? County PAFEIS comments, p. 79.
- i. How long will the Rosemont Copper fund USGS to monitor the flow after the closure? The monitoring should continue after the closure to assess the mitigation effectiveness. County PAFEIS comments, p. 73.
- j. The analysis of downstream water volume effects on Davidson Canyon and Cienega Creek is flawed, because *Predicting Regulatory (100-yr) Hydrology and Average Annual Runoff Downstream of the Rosemont Copper Project* (Zeller, 2011a) ignores the fact that greater rainfall occurs higher on the high elevations like the mine site, and will contribute more water to downstream areas than low elevation watersheds. By assuming that all areas contribute runoff equally underestimates the impact the mine site will have on surface water and riparian habitat in Davidson Canyon and Cienega Creek. Therefore, Rosemont should revise the analysis to more accurately reflect the effect the differences in rainfall depths on downstream runoff and its impact on riparian habitat. County PAFEIS comments, p. 68.
- k. The recognition that fires occur in the project area, that the largest burn areas have occurred since 2005 and that fires can dramatically impact the hydrologic regime should include a plan to address these concerns. There is no acknowledgment of associated hazards which occur in post-fire conditions including gullying/erosion and debris flows which could impact drainage infrastructure both during operations and post closure. There are many examples of gullying and post fire debris flows, including the Schultz fire that occurred near Flagstaff in 2010. Therefore, PAEIS does not offer a plan to address a likely hazard to occur in the project area during the operations and post-closure of the mine (i.e. fire and the associated flooding and debris flow hazard) and it should. County PAFEIS comments, p. 68.
- l. *The method used to estimate erosion is not appropriate to evaluate the impact of mining alternatives and is far below industry standards.* While Rosemont's consultant, Tetra Tech, has justified their use of the PSIAC method (Tetra Tech, August 18, 2011, comment 2), the two studies cited by Tetra Tech (Rasely, 1991; Renard and Stone 1982 [Tetra-Tech neglected to mention the co-author Stone]), clearly state that the PSIAC method is inappropriate for site level assessment. County PAFEIS comments, p. 80.
- m. The PAEIS erroneously states that Pima County recommends the PC-Hydro model for determining peak flows. Instead, RFCD Tech Policy 015 describes which hydrologic model should be used in different situations, and Tech Policy 018 describes how these models should be applied. County PAFEIS comments, p 67.
- n. Because of the need to reassess the hydrologic information provided in the DEIS, a Supplemented Environmental Impact Statement (SEIS) should be provided that includes the following studies:
 - 1.) *Evaluation of the impact of mine on habitat in Davidson Canyon – An Outstanding Water of the State of Arizona.* Because the DEIS describes an approach that captures rainfall on the mine site, and limits downstream discharge, the impact of this approach on downstream resources should be evaluated, especially in light of the fact that Davidson Canyon is an Outstanding Water of the State of Arizona.
 - 2.) *Hydrologic evaluation that uses 'critical' storms and approved hydrologic methods to design structures for peak flow rates.* Design should adopt the FEMA criteria for flood peak determination rather than use 24-hr storms. In Pima County, these are peak from

Intensity-Duration curves, such as used in PC Hydro, and shorter duration high intensity rainfall events, such as 3-hr storms.

- 3.) *Hydrologic values that consider longer-term storm durations (1-week) for volume design.* Because recent events have shown that rainfall over several days can cause flooding and overwhelm ponds, a more critical (and conservative) evaluation of the hydrology used to design volume control is required.

County DEIS comment, No. 386.

- o. Hydrologic evaluation that uses 'critical' storms and approved hydrologic methods to design structures for peak flow rates. Design should adopt the FEMA Criteria for flood peak determination rather than use 24-hr storms. In Pima County, these are peak from Intensity-Duration curves, such as used in PC Hydro, and shorter duration high intensity rainfall events, such as 3-hr storms. County DEIS comment, No. 63.
- p. The Forest recognizes the ephemeral stormwater flow from the project area would change, primarily as a result of the retention of water at the project site. Although the FEIS acknowledged that several cooperating agencies expressed concerns of the amount of water removed and a resulting serious impact to downstream riparian resources, the FEIS did not evaluate how the water removal could impact downstream riparian resources over time (pre-mining, active mining and postclosure periods). Please disclose cumulative impacts of the reduction of storm water to riparian vegetation, channel geomorphology and groundwater drawdown. County PAFEIS comment, p. 71.

Objection 1. Impacts on outstanding Arizona Waters for all mining life phases (especially first 10 years) not disclosed.

The FEIS states that "the only potential effect on the Outstanding Arizona Waters in Lower Davidson Canyon and Lower Cienega Creek would be the result of a decrease in runoff that would occur because portions of the Davidson Canyon watershed would be cut off in perpetuity by the mine site. This reduction in ephemeral flow is estimated to be 4.3 to 11.5 percent in lower Davidson Canyon." In comment reference "a", above, the County points out that these flow reductions will put the riparian habitat at risk. However, the FEIS never discusses the resulting impacts. It focuses only on the "post-closure" conditions. As mentioned above, during first 10 years active mining phases, estimated runoff reduction from Barrel Canyon is significant. FEIS should disclose the impacts on Outstanding Arizona Waters for different phases by using estimated runoff during that period. Failure to disclose and analyze these impacts is contrary to the Forest Service's charge under NEPA.

Objection 2. Cumulative impacts on downstream riparian and water resources, Davidson Canyon, and Cienega Creek not fully disclosed.

As pointed out in comment reference "b", above, the FEIS fails to assess cumulative impacts of the runoff reduction (it focuses only on the post-closure condition) on downstream riparian and water resources and Outstanding Arizona Waters. These impacts are not fully analyzed in "Cumulative Effects" section in the FEIS. The FEIS should assess cumulative impacts of runoff reductions from the active mining period to the post-closure. Failure to disclose and analyze these impacts is contrary to the Forest Service's charge under NEPA.

Objection 3. Long-term impacts of reduction of sediment yield have not been fully disclosed.

The FEIS does not address the two comments referenced in “c” and “d”, above. The impacts of mining activities on sediment transport could change over time during the active mine life and after the closure. The FEIS's statement of "As a whole, these changes are unlikely to be significant when assessed in the context of the watershed as a whole." is not reasonable without long-term analysis for all phases of mining life. Long-term and cumulative impacts of the reduction of sediment yield on Arizona Outstanding Waters should be analyzed. Failure to disclose and analyze these impacts is contrary to the Forest Service's charge under NEPA.

Objection 4. There is no explanation about possible actions to be taken to restore damages of downstream water and riparian resources.

There is no question that the Rosemont mine will impact downstream and riparian resources. However, as pointed out in referenced comments “e”, “f”, “g”, and “h”, above, the FEIS and draft ROD lack any discussion of what step will be taken to address these impacts when they become apparent. The FEIS should identify contingency mitigation steps for likely impacts and the ROD should include obligations to implement the mitigation measures when impacts become apparent.

Objection 5. Unclear description of the storm water monitoring plan.

As pointed out in referenced comment “i”, above, there must be a plan for post-closure monitoring to ensure that mitigation efforts are effective. The FEIS and draft ROD fail to fully explain how this monitoring will be funded. It is critical that post-closure monitoring occurs and that the responsible funding source be identified in the ROD.

Objection 6. The FEIS underestimates the reduction of Surface Water and Impacts to Outstanding Waters of the State of Arizona

Referenced comment “j”, above, identifies flaws in the methods of estimating impacts to Surface Water and Impacts to Outstanding Waters of the State of Arizona. Appropriate runoff volume calculation is important. The potential reduction of average annual runoff losses for Davidson Canyon are calculated based on the reduction of area only, but we know that runoff is derived from rainfall and more rain occurs at higher altitudes, such as the mine site.

The analysis of downstream water volume effects on Davidson Canyon and Cienega Creek is flawed, because *Predicting Regulatory (100-yr) Hydrology and Average Annual Runoff Downstream of the Rosemont Copper Project* (Zeller, 2011a) ignores the fact that greater rainfall occurs higher on the high elevations like the mine site, and will contribute more water to downstream areas than low elevation watersheds.

This indicates that the impacts on Outstanding Arizona Waters are underestimated. Reduction of annual post-closure runoff volume will be larger. The FEIS fails to properly address the County's flow estimates and, as a result, fails to fully identify the significant environmental impacts and potential mitigation steps, as required by NEPA regulations.

Objection 7. The FEIS does not consider risk from the likelihood of post-fire sediment impacts.

Comment reference “k”, above, points out that the mine area has a significant potential for fire impacts. A fire could substantially impact stormwater management systems related to the mine and cause them to fail. The FEIS fails, despite the County comment, to adequately consider fire impacts on stormwater

flows and quality and potential steps to mitigate those impacts. This failure is contrary to the NEPA obligation to identify significant environmental impacts and means to mitigate those impacts.

Objection 8. The method used to estimate erosion is not appropriate to evaluate the impact of mining alternatives (as determined by the developers of the methods themselves) and is far below industry standards.

In referenced comment “l”, above, the County explained that the erosion estimating model, the PSIAC method, is inappropriate for use in scenarios like the Rosemont. This viewpoint is consistent with prior statements by the models’ author. Despite this knowledge that the model developer does not recommend the model for this purpose, the model continues to be a basis for the FEIS analysis of erosion impacts. Use of inappropriate models is arbitrary and capricious.

Objection 9. The Hydrologic Analysis is Inadequate and the Report Misrepresents the Hydrologic Analysis performed

Pima County clearly stated that the consultant should consider the results of a 3-hr storm (comment reference “n”), which was never done, and the FEIS implies that Pima County's concerns were addressed in the analysis they did, while they were not. In referenced comment “m”, above, Pima County reiterated that the consultant erroneously stated that Pima County recommends the PC Hydro model for determining peak flows, and stated that Pima County has technical policies 15 and 18 that describe which models should be used for which application.

The FEIS inaccurately states that the methods presented in the 'Golder Model (p. 402)' (assumed to be Baxter and Patterson, 2012) follows the methods 'prescribed' by Pima County in the 01-12-12 comment letter. Referenced comment “o”, above, specifically states that modeling should consider 'shorter duration high intensity rainfall events, such as 3-hr storms.' These were not included in any analysis we have seen supporting the surface water evaluation. Use of improper data and modeling for EIS purposes is arbitrary and capricious.

Objection 10. Potential impacts on downstream riparian and water resources for all phases of mine life are not fully disclosed

In comment reference “p”, above, the County points to a lack of disclosure regarding stormwater impacts to downstream riparian and water resources during earlier phases of the mine life. The estimated reduction of annual runoff flow volume to downstream is 30-40% during pre-mining and active mining phases (SWCA, 2013). This substantial reduction of runoff to downstream could significantly affect downstream riparian and water resources. Although the potential impacts of the runoff reduction are briefly discussed in "Seeps, Springs and Riparian Areas", the FEIS only focused on the post-closure 17% reduction and did not fully analyzed the runoff reduction impacts on downstream vegetation and water resources for all phases of mine life. This failure is contrary to the NEPA obligation to identify significant environmental impacts and means to mitigate those impacts.

Attachment 2



TECHNICAL MEMORANDUM

Date: July 18, 2012
To: Chris Garrett, P. HGW.
From: Jennifer Patterson and George Annandale
Project No.: 093-81962.0007
Company: SWCA Environmental Consultants
Email: JMPatterson@Golder.com
GAnnandale@Golder.com
RE: GEOMORPHIC ASSESSMENT OF BARREL CREEK

Golder Associates Inc. (Golder) was requested to conduct a qualitative geomorphic assessment of Barrel Creek. The goal was to determine the current geomorphic condition and develop an opinion on potential geomorphic changes that could occur with the development of the Rosemont Mine. This letter presents observations from the fieldwork and opinions on potential geomorphic changes that might result due to proposed development of Rosemont Mine.

1.0 INTRODUCTION

Barrel Creek is an ephemeral arroyo located about 25 miles southwest of Tucson (Figure 1). Historic downcutting is evidenced by relatively high banks that are near vertical. This cross-sectional geometry is typical for streams in the arid and semi-arid West. Water flows in the creek only after local precipitation events occur within the watershed. The average annual precipitation estimated at the Rosemont Mine site is 17 inches (USFS 2011). The majority of the precipitation falls during the monsoon period from early July to late August. During the monsoon period, intense thunderstorms build in the late afternoon causing heavy precipitation and flash floods. Streams such as these have extremely high sediment transport rates (for example, Reid, et al., 1998 and Greenbaum and Bergman 2006).

2.0 FIELD OBSERVATIONS

Ms. Jennifer Patterson and Dr. George Annandale conducted a field assessment of Barrel Creek from the headwaters to the confluence with Davidson Canyon on May 1 and 2, 2012. Photographic documentation of the site is recorded from upstream to downstream in the Photographs section below. The photographs illustrate the typical observations from the site.

Two important, geomorphic observations were made during the field visit. The first is that the system is sediment-transport limited. The second is that there is bedrock grade control within the creek upstream of the confluence with Davidson Canyon. Each of these observations is detailed below.

2.1 Sediment-transport Limited

When evaluating the potential impacts for a system, one should consider whether the system is sediment-supply limited or sediment-transport limited. Sediment-supply limited means that the river is transporting as much sediment as is available. The riverbed in a sediment-supply limited system will be composed of

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an armor layer that is transported only during relatively high flows or the bed may be composed of bedrock. An extreme example of sediment-supply limited is "hungry water" that can occur downstream of a dam.

Sediment-transport limited is the exact opposite. There is more sediment in the system than the river can transport during normal or even flood-flow conditions. The sediment-transport limited system is common in ephemeral streams, because of the flashy nature of these systems. A large precipitation event will create a pulse of water flowing down the creek. On the rising limb of the hydrograph, the water picks up more and larger particles of sediment and transports them downstream. However, the hydrograph is short. Typical hydrographs contain multiple peaks due to slugs of precipitation from different areas of the watershed (Reid, et al., 1996). The sediment is dropped out of suspension on the falling limb of the hydrograph. Sediment is transported downstream, but it is deposited a relatively short distance from the source. In a sediment-transport limited system, the bed material will be poorly sorted (i.e., all gradations are present). The bed material will be loose, and an armor layer will not be present (Hassan, et al., 2005).

Barrel Creek is a classic example of a sediment-transport limited system. It is ephemeral, which means that the water only flows occasionally and usually after a precipitation event. The flashy nature of the flows means that sediment is not transported on a regular basis. The bed is composed of a thick layer of unconsolidated sands, gravels, and cobbles. These types of sediment are readily transported during any significant flows within the creek, but the transport stops as quickly as it starts.

Evidence observed in the field confirming that Barrel Creek is a sediment-transport limited system includes the following:

- Deep, unconsolidated, poorly sorted bed material
- Angular particles
- Localized erosion that is not propagating upstream
- Deposited materials on top of bedrock and under bridge

The deep, unconsolidated, poorly sorted bed material also indicates that the system is dropping particles out of suspension in a relatively short time. If the tail of the hydrograph were long, the bed materials would be sorted with coarser material underlying the fine-grained sands. However, the material is just dropped out of suspension at roughly the same time as the water infiltrates into the substrate and quickly disappears. It is deep and unconsolidated, which indicates that it is readily transported with any significant flow. The system has the materials ready to be transported, but it is transport-limited because it is ephemeral.

The angular particles in the bed material indicate that the sediment is not being transported for long distances or for long periods of time. When sediment is transported, it rubs against the bed, bank, and other suspended particles. This will make each grain smoother and rounded. The presence of angular gravels and cobbles indicates that the system is only transporting materials for short times.

Localized erosion was observed in the field in a few locations (for example Photographs 8 and 12). However, this erosion is not propagating upstream. If the system were actively down cutting, the apron on the downstream side of the Barrel Creek Bridge would be severely undercut. But instead, there is a small drop indicating that sediment is not being actively eroded.

The loose sands being deposited on top of bedrock (Photograph 19) and under the bridge (Photograph 11) illustrate the deposition of material at the falling limb of the hydrograph. The grain size is small enough to be transported during any significant flow event. The system is sediment-transport limited.

2.2 Downstream Grade Controls

The second critical geomorphic observations made in the field are the downstream grade controls. A grade control is a critical component of a stream, because it limits the extent of any potential change in the stream gradient. The schematic in Figure 2 illustrates how a grade control limits the extent of erosion both upstream and downstream of the structure. The grade control will stop any upstream migration of head cuts. The grade control acts as a pivot point for the gradient of a river, so erosion upstream of the grade control is also limited.

During the field investigation, two grade controls were identified, as follows:

- Bridge at Barrel Creek (Photograph 9)
- Bedrock across river bottom (Photograph 23)

The upstream grade control is the bridge at Barrel Creek; it is a man-made structure. Because it is man-made, there is the potential that this structure may fail at some time in the future. The downstream grade control is made of bedrock that is erosion resistant, so it will continue to control the stream gradient for an extremely long time. These structures control the hydraulic gradient and therefore the stream power of the creek. The grade controls will limit the erosion capacity of the stream (Figure 2) and a control on depositional processes.

3.0 GEOMORPHIC IMPLICATIONS FOR DEVELOPMENT IN WATERSHED

Concerns have been expressed about the potential impact of the development of the proposed Rosemont Mine on the geomorphology of Barrel Creek and Davidson Canyon. Degradation of these channels, should it occur, could potentially affect the Outstanding Waters of Arizona located in lower Davidson

Canyon. The geomorphologic investigation that was conducted addresses this concern, indicating that the proposed mine development will have no significant impact on the geomorphology of either Barrel Creek or Davidson Canyon.

The geomorphology of fluvial systems is largely dependent on three factors: i.e., water flow, sediment characteristics and availability, and the geometry of stream channels. The justification for stating that the mine will not have a significant impact on Barrel Creek and Davidson Canyon can be formulated in terms of these three variables:

3.1 Sediment

- The area affected by the mine is roughly equal to about 13% of the entire catchment area upstream of the Outstanding Waters of Arizona, located in Davidson Creek (SWCA 2012). Changes in sediment load and runoff from such a small portion of the entire catchment will not have a significant impact on the fluvial geomorphology of the stream system.
- In the worst case, it is estimated that the impact of the mine on total sediment load upstream of the Outstanding Waters of Arizona will amount to a reduction of about 4% (SWCA 2012). This difference between current and predicted sediment load is within the statistical noise of the fluvial system. An estimated change of about a couple percent is therefore deemed insignificant.
- Abundant availability of loose sediment on the surface of the catchment surrounding Barrel Creek and Davidson Canyon will continue to supply directly sediment to the streams during rainstorm events, regardless of the presence of the mine. The amount of sediment thus supplied is greater than what the flowing water can carry, characterizing the transport-limited nature of the stream system.

3.2 Geometry

- The natural grade control that is characteristic of the stream system prevents riverbed degradation and will maintain the sediment transport capacity of the flowing water, regardless of the planned mine development. Maintaining the sediment transport capacity at historic levels and not significantly altering the sediment load to the stream will retain the current geomorphologic character of Barrel Creek and Davidson Canyon, regardless of mine development.

3.3 Water Flow

- It is uncommon for the catchment of Barrel Creek and Davidson Canyon to be subjected to large storm events covering the entire area. Instead, convective storms of limited size occur over portions of the catchment when it rains. The scattered nature of such storm events results in generation of sediment supply from diverse locations in the catchment at different points in time. It rarely happens that sediment would be generated simultaneously from the entire catchment. The nature of sediment supply based on the isolated nature of storms will remain and not be significantly impacted by the mine.
- The transport-limited nature of Barrel Creek and Davidson Canyon explains the non-degrading nature of the stream system. The nature of the stream system will remain unchanged because the change in sediment supply due to the presence of the mine is insignificant, and the sediment transport capacity of the water will essentially remain the same due to the presence of naturally occurring grade control features. It is therefore

reasonable to expect that the creek will not degrade; particularly not near the Outstanding Waters of Arizona in Davidson Canyon and beyond. The creek will remain in a state of quasi-equilibrium; expected from a semi-arid, ephemeral stream.

4.0 REFERENCES

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Attachment 3

Comments on the interpretation of isotope data at Rosemont

C.J. Eastoe

Prepared for Julia Fonseca, April 4, 2014

Abbreviations

TT = Tetrattech

ELM = E.L. Montgomery and Associates

LMWL = Local Meteoric Water Line

GMWL = Global Meteoric Water Line

masl = meters above sea level

Local Meteoric Water Line at Rosemont

Figure 8 of ELM (2009) shows a LMWL with a slope of 5.8. This is based on data I provided at the request of ELM, but as I remember it is a relatively small subset of the total data set we have for Tucson, 740 masl (Fig. 1A). A longer-term view of the data suggests that LMWLs vary from year to year (Wright, 2001). In the long term, there are two lines in Tucson. For $\delta^{18}\text{O} < -7\text{‰}$, the line has a slope of 7.6 and closely approximates the GMWL. For $\delta^{18}\text{O} > -3\text{‰}$, a second line emerges, with slope of 4.6. This is a typical evaporation trend. The intersection of the two lines occurs near $\delta^{18}\text{O} = -5.5\text{‰}$.

These lines can be compared with data for Palisades Ranger Station, 2420 masl (Wright, 2001, and unpublished data; Fig. 1B). The data form a trend of slope near 8 (compare the GMWL), with a suggestion of an evaporation trend at $\delta^{18}\text{O} > -5\text{‰}$, but the evaporation effect is much less developed than in the Tucson data. Together, the two plots imply that the evaporation line in Tucson results from the falling of rain through dry, hot air at low elevations, an effect that diminishes in importance towards to mountain tops. The Rosemont pit site is at about 1500 masl, and precipitation at the site most likely has stable isotope distributions (ranges, and trends on the δD vs. $\delta^{18}\text{O}$ plot) between those of the Tucson and Palisades stations.

Recharge seasonality at Rosemont

The data for the Tucson and Palisades stations, weighted for precipitation amount, are the basis of the altitude dependence lines shown in Fig. 2. These lines represent long-term precipitation records; altitude effects from year to year are variable (Eastoe and Dettman, submitted). This figure can be used in the following way: a spring discharging at 1500 masl, for instance, yields

water that fell as precipitation between 1500 masl and the crest of the local topography. For groundwater that represents mixing of recharge over several years, and undergoes minimal evaporation prior to recharge, the diagram provides constraints on the seasonality of recharge in the catchment of the spring. If such groundwater had a $\delta^{18}\text{O}$ value of -5‰ at 1500 masl near Rosemont, predominant summer recharge would be indicated. For a $\delta^{18}\text{O}$ value of -9‰ , combined summer and winter recharge would be indicated, and for -10‰ , predominant winter recharge.

The isotope data for springs and wells in ELM's Figure 8 have been interpreted by ELM (2009) as a linear trend approximating a LMWL, the latter probably an inadequate estimate of the true LMWL(s) as suggested above. An alternative interpretation is that the data compose two trends: for $\delta^{18}\text{O}$ values $< -9.5\text{‰}$, a trend close to the GMWL for least evaporated samples, and for $\delta^{18}\text{O}$ values $> -9.0\text{‰}$, an evaporation trend of slope near 5 (Fig. 1A).

If the isotopic variation in precipitation in the Santa Rita Mountains resembles that in Tucson and the Santa Catalina Mountains, the intersection point near -9.5‰ does not reflect evaporation of falling rain. An alternative explanation for the isotope data is that infiltration of surface water with original (as precipitation) $\delta^{18}\text{O}$ values of -9.0 to -11.0‰ predominates. For -9‰ , the recharge corresponds to mixed summer and winter precipitation, and for -11‰ , to winter precipitation (Fig. 2). Infiltration of water that fell as rain with $\delta^{18}\text{O}$ values of long term average near -9.5‰ is common, accounting for more than half of the groundwater data points in ELM's Fig. 8. Evaporation of surface water prior to infiltration is also common, and evaporated versions of precipitation having $\delta^{18}\text{O}$ values of -9.0 to -14.0‰ are present in the data set. Precipitation with $\delta^{18}\text{O} > -9\text{‰}$ does not appear contribute to recharge in a detectable quantity.

The outlying data point with $\delta^{18}\text{O} = -12.4\text{‰}$ cannot be explained by average winter recharge either on the ridge above Rosemont pit, or in the high elevations of the Santa Rite Mountains. This sample has a ^{14}C content of 16 pMC, (ELM, 2009) and appears to represent precipitation from a period of cooler, wetter climate.

Davidson Canyon subflow

In TT's Fig. 17 (TT, 2010), four data points from springs in the bed of Davidson Canyon plot with $\delta^{18}\text{O}$ values near -7‰ . An extra data point, not plotted, is listed in ELM's Table 12, and has $\delta^{18}\text{O} = -9\text{‰}$. It is understood that these samples were collected with the aim of obtaining a long-term average for the isotope composition of Davidson Canyon subflow. The presence of a variation of more than 2‰ in such samples over a short period of time suggests that the

isotopes in the subflow groundwater respond to variations in isotopes in precipitation at a timescale corresponding to individual precipitation events or seasons. Using these data as an indication of the characteristic seasonality of recharge in the Davidson Canyon watershed constitutes an over-interpretation of a small data set for an incompletely understood groundwater system. In particular, the data point omitted from TT's Fig. 8 leaves open the possibility that groundwater abundant in the area of the Rosemont pit can contribute to Davidson Canyon subflow.

Figure Captions

1. A. Plot of δD vs. $\delta^{18}O$ for individual rain events at the University of Arizona station, central Tucson. Data in near the inflection point have been omitted to enable determination of trend lines. The red trend line is the evaporation trend for groundwater at Rosemont (cf. ELM's Fig. 8). B. Plot of δD vs. $\delta^{18}O$ for individual rain events at the Palisades ranger station, Santa Catalina Mountains.
2. Plot of elevation vs. $\delta^{18}O$, with altitude³ dependences of $\delta^{18}O$ based on data from the University of Arizona and Palisades stations. Elongate rectangles indicate altitude ranges in the Rosemont area. Other rectangles indicate isotope data ranges for springs in the altitude range show.

References

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and Monitoring Program, Rosemont Project, Pima County, Arizona

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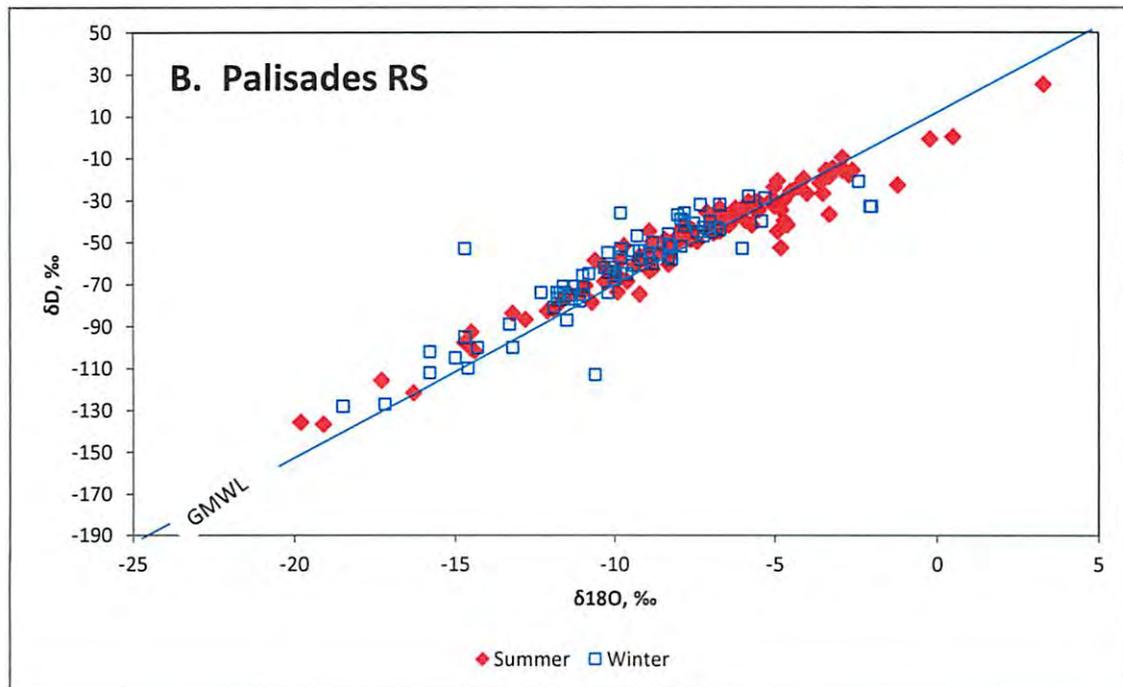
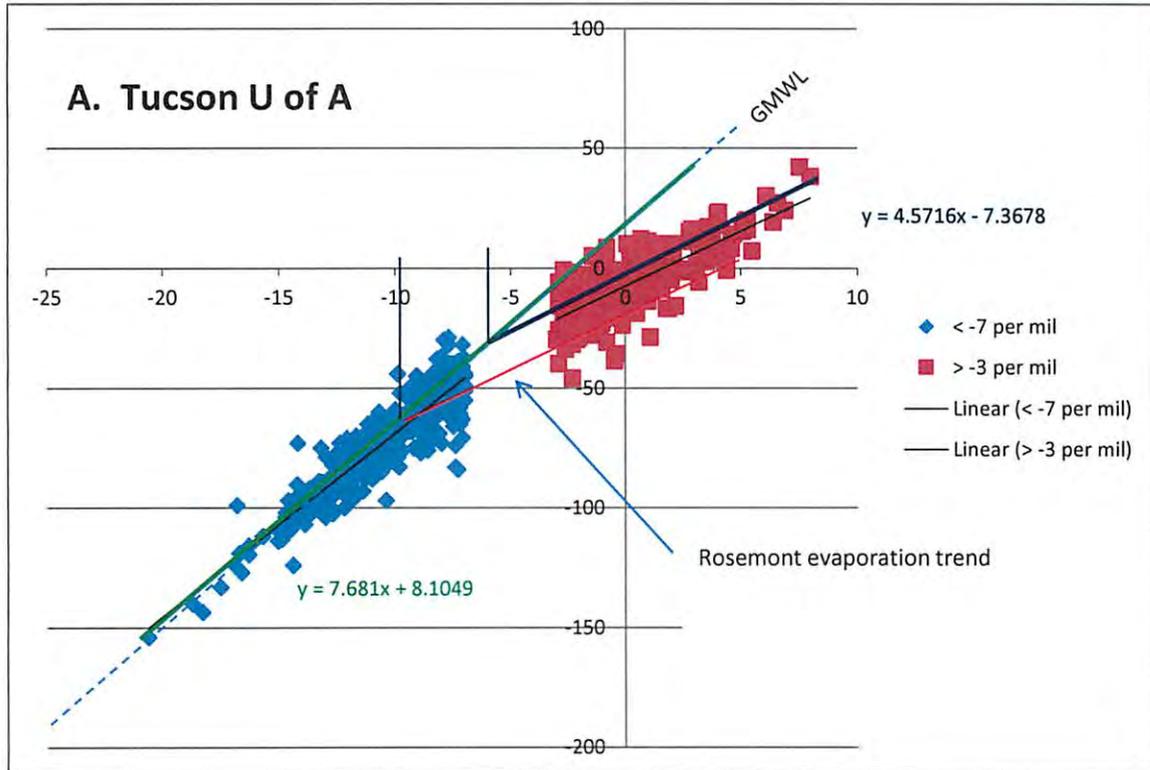
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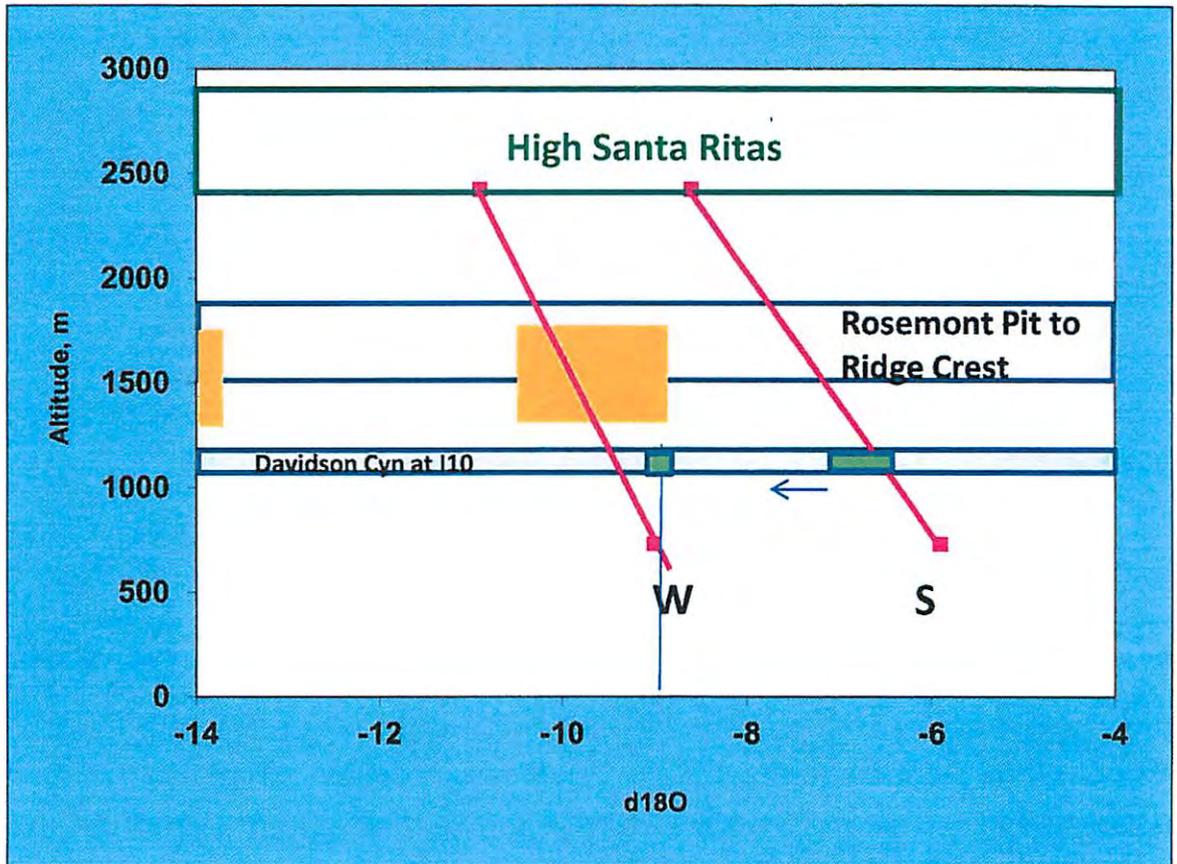
Wright, W.E. 2001. δD and $\delta^{18}O$ in mixed conifer systems in the U.S. Southwest: The potential

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Department of Geosciences, The University of Arizona, Tucson, Arizona, 328 p.

This calculation omits 6 summer outliers





- Springs and wells, Rosemont
 - Base flow in Davidson Cyn at I10
 - Possible evaporation shift
- Altitude dependences from Sta. Catalinas



EXHIBIT D

COUNTY ADMINISTRATOR'S OFFICE

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C.H. HUCKELBERRY
County Administrator

July 16, 2014

Robert Scalamera, Project Manager
Arizona Department of Environmental Quality
Surface Water Section, MC5415A-1
1110 W. Washington Street
Phoenix, Arizona 85007

**Re: Arizona Department of Environmental Quality 401 Certification for Rosemont
Copper, Public Notice 27-14AZ LTF 55425**

Dear Mr. Scalamera:

Pima County Regional Flood Control District and Pima County provide herein additional information for your consideration that is relevant to the proposed 401 certification for the Clean Water Act Section 404 permit for the Rosemont Copper Project, Public Notice/ Application No: SPL-2008-00816-MB.

Our previous comments to you took issue with some of the key assumptions that underlie the Final Environmental Impact Statement's (FEIS's) conclusions regarding effects to Davidson Canyon. These comments included a new interpretation of Rosemont's isotopic data by Dr. Chris Eastoe that differs from conclusions provided by Rosemont's consultants. Since then, we have identified additional technical flaws in the information provided by Rosemont's consultants, TetraTech and WestLand Resources, for the FEIS that we would like to bring to your attention via the attached report.

As you may know, the federal agencies convened a hydrology group meeting on June 10 and 11, 2014 to identify new data sources and analyses for impact analysis. In response, we identified additional observations and data from the Pima Association of Governments and Pima County. The resulting report, *Impacts of the Rosemont Mine on Hydrology and Threatened and Endangered Species of the Cienega Creek Natural Preserve*, provides the best available dataset for understanding the relationship between groundwater levels,

Mr. Robert Scalamera

**Re: Arizona Department of Environmental Quality 401 Certification for Rosemont
Copper, Public Notice 27-14AZ LTF 55425**

July 16, 2014

Page 2

surface water availability, and habitat for federally listed wildlife. The key results of our analyses are that:

- 1. There is an important and highly statistically significant link between surface water flow extent and groundwater resources in Lower Cienega Creek and Davidson Canyon. The correlations found in our new analyses are so significant, in fact, that their possibility of occurring by chance is nearly impossible.**
- 2. Analyses by WestLand, TetraTech and SWCA for the FEIS have consistently underestimated the length of streamflow in Cienega Creek and Davidson Canyon that will be impacted by the mine.**
- 3. The net result will be a loss of habitat and take of endangered species that exceeds previous considerations.**

Please advise me as to whether the Arizona Department of Environmental Quality will consider the attached information in the 401 certification for this project.

Sincerely,



**C.H. Huckelberry
County Administrator**

CHH/mjk

Attachment

**c: The Honorable Chair and Members, Pima County Board of Supervisors
Marjorie Blaine, Senior Project Manager, US Army Corps of Engineers
Jared Blumenfeld, Region IX Administrator, US Environmental Protection Agency**

Impacts of the Rosemont Mine on Hydrology and Threatened and Endangered Species of the Cienega Creek Natural Preserve

Brian Powell¹, Lynn Orchard², Julia Fonseca¹, and Frank Postillion²

July 14, 2014



¹Pima County Office of Sustainability and Conservation

²Pima County Regional Flood Control District

Suggested Citation

Powell, B., L. Orchard, J. Fonseca, and F. Postillion. 2014. Impacts of the Rosemont Mine on hydrology and threatened and endangered species of the Cienega Creek Natural Preserve. Pima County, Arizona

Cover Photo: End of flow for one section of Cienega Creek at the Cienega Creek Natural Preserve. May 2014.

Introduction

If constructed, the Rosemont mine will reduce streamflow and groundwater inputs into Cienega Creek and Davidson Canyon. The uncertainty and discussions have been about the magnitude of that impact and how much, if any, projected changes will compromise populations of threatened and endangered (T&E) species and their habitats (e.g., Tetra Tech 2010a, b, WestLand Resources Inc. 2011, Pima County 2012, SWCA Environmental Consultants 2012, Pima County 2013). This is a critical question; lower Cienega Creek (herein, Cienega Creek unless otherwise noted) in the Cienega Creek Natural Preserve (CCNP) and in Davidson Canyon¹ provide both a critical water supply to the Tucson Basin and are a refugia for aquatic and riparian plants and animals found in few other places in Pima County.

This report provides the most comprehensive evaluation of the extensive water resource data that has been collected at CCNP as it relates to potential impacts from the Rosemont mine. We focus first on developing robust predictive models, apply those models to estimate a range of impacts to baseflow and length of streamflow, question some past analyses and assumptions about the lack of connection between surfacewater and groundwater, highlight key uncertainties that inhibit our ability to understand the full breadth of impacts from the mine, and finally, we combine the water resources data with our best understanding of the distribution of habitat for the aquatic and riparian T&E species that currently occur or recently occurred at the CCNP to estimate loss of habitat as a result of the mine.

A Note About Models and Their Use. Previously, estimated effects of the proposed mine on streamflow—particularly in reaches of perennial or intermittent flow—have been addressed primarily through groundwater modeling (e.g., Montgomery and Associates Inc. 2010, Tetra Tech 2010b, SWCA Environmental Consultants 2012). These models have then been used to estimate impacts on species in Cienega Creek and its major tributaries (U. S. Fish and Wildlife Service 2013). The final environmental impact statement (FEIS; U.S. Forest Service 2013) for the Rosemont project states that predicting sub-foot scale drawdowns at great distance and time scales is “beyond the ability of these groundwater models, or any groundwater model, to accurately predict.” Nevertheless, sub-foot model results were presented as a basis to determine mine impacts on Outstanding Arizona Waters in Davidson Canyon and Cienega Creek (WestLand Resources Inc. 2011, 2012) and to draw conclusions about effects on T&E species. In this report, we also use subfoot groundwater model results as the best available information, but draw different conclusions than those of WestLand (2011, 2012).

¹ In this report, data collected in Davidson Canyon refer to areas in the CCNP and/or in Pima County’s Bar-V Ranch.

In striving to understand the potential impacts of water loss on these critical riparian areas and the T&E species they support, it is prudent to investigate a range of potential impacts in areas where the existing analysis is inadequate to provide the level of detail needed to understand the Rosemont projects' effects on the downstream environment. Analysis provided in this paper endeavors to aid in "informing the decision" by presenting a range of potential impacts based on empirical data systematically collected from wells and field excursions over several years (e.g., Pima Association of Governments 2009a, 2011). This analysis of well depth vs. baseflow and length of streamflow and other analyses in Cienega Creek and Davidson Canyon acknowledges the limitations of the groundwater models and presents a range of groundwater drawdown effects that are reasonable to consider given the uncertainties of groundwater models and natural variation experienced during the monitoring period at the CCNP.

Methods

Field Methods. To determine the loss of surface water, we first developed models using data from the depth of water in wells and baseflow and total length of streamflow at two sites: (1) Cienega Creek and (2) Davidson Canyon. Much of the data collection methods and location maps are summarized in Powell (2013). For this effort we used data collected as recently as 2014 (Cienega Creek) and 2013 (Davidson Canyon), the most up-to-date information that we could receive from the Pima Association of Governments, which collects the data. June data were used to determine the relationship between depth to groundwater and streamflow length from 2000-2014 for Cienega Creek, but for Davidson Canyon, all data were aggregated to model this relationship, in part because of the smaller sample size (sample collections were started in late 2005 at Davidson). June samples were selected for Cienega Creek for a number of reasons such as length of record and because streamflow length data represents a critical low-flow for the system. Depth to water was measured at the Cienega Well (Cienega Creek) and Davidson #2 Well (Davidson Canyon²). Depth to water in wells and mapping of streamflow length were always measured on the same day. We also developed models for the relationship between streamflow volume (cubic feet/second; herein referred to as baseflow), which is measured quarterly at the Marsh Station Bridge (again, see Powell 2013 for the more information) and depth to water at the Cienega Well. We used all quarterly sampling data from June 2001 to June 2014 for this analysis.

Data Analysis

² The Davidson #2 Well and streamflow reach are located in "Reach 2", as defined by Tetra Tech.

Relationship between streamflow, depth to groundwater, and baseflow. We used linear regression to model the relationship between depth to water (in feet) and streamflow length (in miles) and baseflow (ft³/sec). To model these changes, we interpolated the regression model to predict what changes in the response variables (i.e., baseflow and streamflow length) would result from a lowering of the water table by 0.1, 0.2, and 0.25 feet. This represents a look at the potential impacts to baseflow and streamflow length if the modeled results in Montgomery and Associates Inc. (2010) and Tetra Tech (2010b) occur as predicted (0-0.1 feet drawdown at Cienega Well, 0.10-0.98 feet at Davidson Well³ for streamflow length). At Cienega Creek we looked at scenarios where drawdown will be slightly greater than predicted by the models to describe potential impacts if model results are not accurate (e.g., 0.2 - 0.25 feet drawdown at Cienega Well). For baseflow estimates we calculated total annual acre feet of baseflow lost, as well as seasonal estimates. Because baseflow was measured four times per year, we assumed these flow estimates represented seasonal averages. We used the annual and seasonal average baseflow to estimate the percentage of baseflow that would be reduced from groundwater drawdown. We log-transformed flow volume data to fit assumptions of the normal distribution for the regression analysis.

Fragmentation of Flow. One of the concerns about the loss of streamflow length is that the stream may also become more fragmented, which might isolate populations of fish, in particular. Fish caught in small, fragmented reaches would be more susceptible to extirpation due to a variety of factors, including predation and of course, loss of habitat. To model this for Cienega Creek, we first calculated the number and length of individual stream reaches (derived from individual start and stop points collected in the field). We then calculate intra-annual summaries, including the coefficient of variation in stream length⁴ and total number of flow length segments over time. Finally, we used the results of the modeled changes in streamflow length as a function of depth to water in wells to understand how this might further fragment the system. Based on the modeled results for a drawdown of 0.25 feet, we calculated the number of streamflow lengths measured from 2001-2012 (the most complete set of information for which four seasonal measurements are each year) that were equal to or less than the predicted loss in streamflow length (1,085 feet), which we call the *threshold length*.

³ Davidson Well #2 is located approximately 1.8 miles north of the Montgomery and Associates 5-foot drawdown contour (in Montgomery and Associates Inc. 2010). That modeling effort showed a 0.31 foot drawdown at 150 years in Reach 2, and 0.98 feet at 1,000 years.

⁴ Coefficient of variation (CV) is the standard deviation divided by the mean. For this study, CV provides a good method of comparison among years, because the mean flow length has changed considerably over time. Therefore, comparing standard deviations is not as informative.

We then developed a multiple regression model to determine the relationship between the number of flow segments that met or exceeded this threshold and other factors thought to influence flow segments including length of flow, year, month, and month*year interaction⁵.

Testing accuracy of groundwater-surface water relationship. We used 2008 and 2011 LiDAR to evaluate the accuracy of the groundwater-surface water relationship at the Davidson Well #2 and compared these data to figures and language in Tetra Tech (2010a) to determine if the Tetra Tech analysis was correct. A review of the LiDAR data collection can be found in Swetnam and Powell (2010).

Results and Discussion

Cienega Creek: Baseflow. From 2001-2014 average annual baseflow was 0.73 ft³/sec but this varied considerably by month: March = 1.12 ft³/sec, June = 0.32 ft³/sec, September = 0.91 ft³/sec, and December = 0.65 ft³/sec. Baseflow declined as depth to groundwater increased, as explained by a linear function ($F_{1,56} = 157.2, P < 0.001, R^2 = 0.74$) (Figure 1). All four sampling

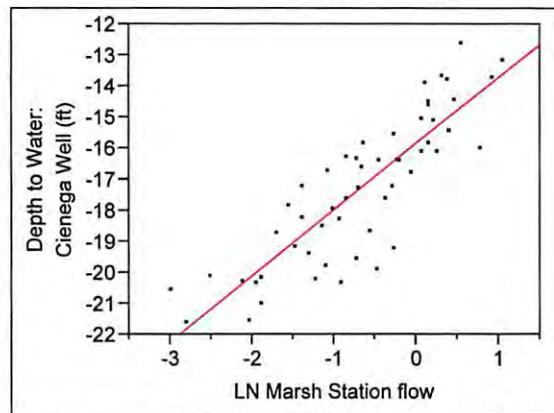


Figure 1. Relationship between flow (log [LN] of cubic feet/second) and depth to water at the Cienega Well. The linear model (red line) explains 74% of the variation in the data. Model used all data from June 2001-June 20014.

⁵ In regression analysis (and for this situation), *interaction* occurs when a relation between two variables is modified by another variable. In other words, the strength or the sign (i.e., direction) of a relation between two variables is different depending on the value of some other variable.

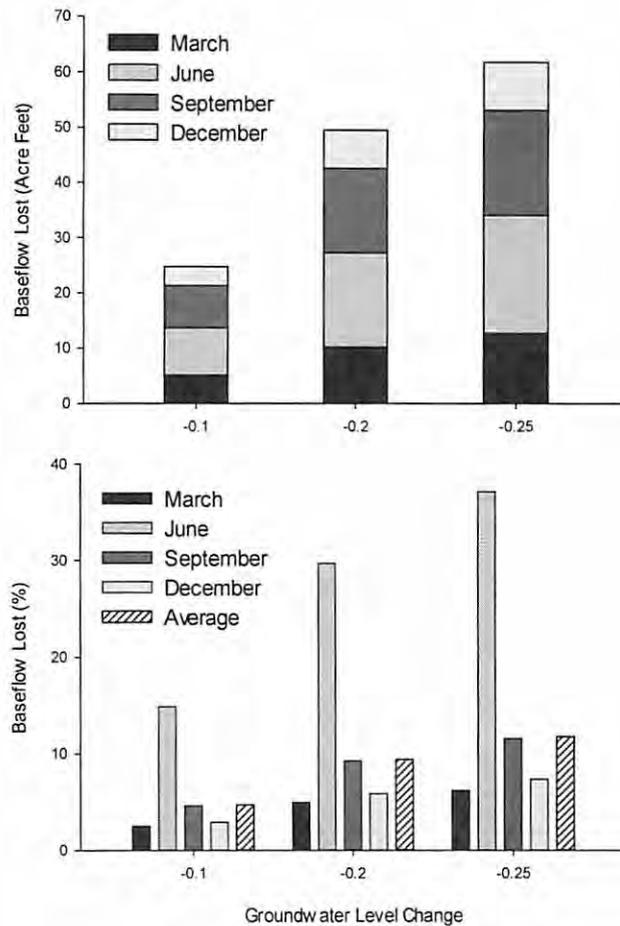


Figure 2. Modeled loss of streamflow volume (acre feet [top] and percent [bottom]) as a function of changes in groundwater level, by season. While total flow loss for the June period is similar to that of September, for example (top graph), this greater percentage of baseflow lost results from the lower baseflow volume during June.

periods (March, June, September, and December) showed a similar relationship ($P < 0.004$), with the strength of the model fit (as expressed by R^2) ranging from 0.54 for December to 0.81 for March. Using the regression equations, we were able to calculate that with a 0.1 feet decline in groundwater elevation would lead to an average annual loss of 25 acre feet of water (Figure 2). Annual losses increase to 63 acre feet with 0.25 feet reduction in groundwater level at the Cienega Well.

Perhaps more important than total volume of water lost is the percentage of baseflow predicted to be lost. Average annual estimates of baseflow reduction range from 4.7% with a 0.1 feet reduction of groundwater level to 11.8% reduction with a 0.25 feet reduction (Figure 2)

As reported earlier, baseflow varied among months and this made inter-month percent loss in baseflow quite different than total loss. June is especially important to notice; it showed an estimated 14.9% loss of baseflow at Marsh Station with a 0.1 feet decline in the aquifer to as high as 37% with a 0.25 feet decline in the aquifer (Figure 2).

Cienega Creek: Streamflow length. Streamflow length and depth to water was explained by a linear function ($F_{1,12} = 67.2$, $P < 0.001$, $R^2 = 0.84$)⁶ (Figure 3). Using this model, we would expect that a groundwater drawdown of 0.1 foot would result in a loss of 434 linear feet of Cienega Creek (Table 1). Because of uncertainty about the models and the high value of Cienega Creek, we also modeled drawdown of 0.25 feet, which results in a reduction of streamflow length of 1,085 feet. The mean extent of streamflow within the CCNP from 2000-2013 has been approximately 12,500 feet. A reduction of 434 feet would reduce surface water extent by 3.4% and 1,085 feet would be equal to approximately 8.6% reduction in flow extent.

It is important to note that the Cienega Well was used in the report by Westland (2012; page 5), but they claim that their model of depth to water and quarterly flow length showed an unusual statistical distribution and therefore use of that well was discounted in favor of data from the Jungle well. The June length of flow data in relation to the Cienega Well do not show this issue (Figure 4) and the Cienega Well is certainly useful for estimating loss of streamflow length.

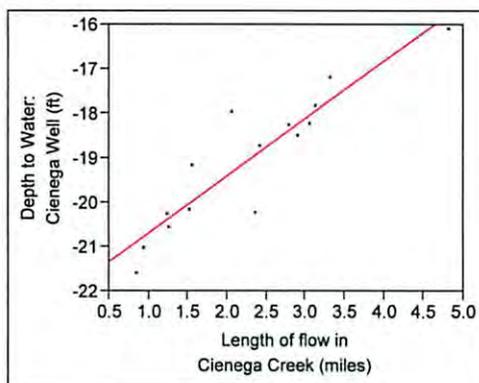


Figure 3. Relationship between length of flow of Cienega Creek at the Cienega Creek Natural Preserve and depth to water at the Cienega Well. The linear model (red line) explains 84% of the variation in the data.

⁶ It is important to note that we also modeled the relationship using a 2nd and 3rd order polynomial, which improved results somewhat, particularly for the 3rd order polynomial ($R^2 = 0.87$). However, for simplicity, we use the following formula to model the impact in groundwater drawdown on Cienega Creek within the CCNP: Length of flow (miles) = 14.662 + 0.650*depth of water at the Cienega Well (feet).

Table 1. Modeled reduction in streamflow length of Cienega Creek at the Cienega Creek Natural Preserve. Percent reduction is based on the mean June streamflow length of 2.38 miles (12,566 feet).

| Draw-down (feet) | Arbitrary starting well depth (feet) | Streamflow length | | Feet lost due to draw-down | Percent reduction in streamflow length |
|------------------|--------------------------------------|-------------------|--------|----------------------------|--|
| | | Miles | Feet | | |
| 0 | -18 | 3.10 | 16,347 | 0 | 0.0 |
| -0.1 | -18.1 | 3.01 | 15,913 | -434 | -3.4 |
| -0.2 | -18.2 | 2.93 | 15,479 | -868 | -6.9 |
| -0.25 | -18.25 | 2.90 | 15,262 | -1085 | -8.6 |

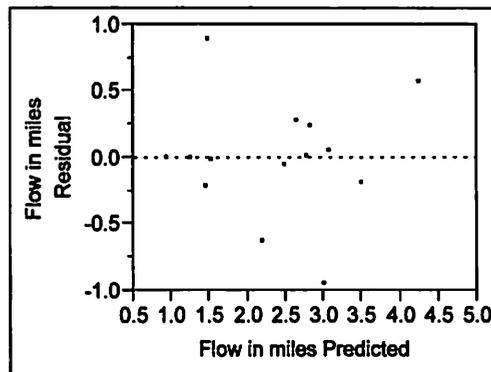


Figure 4. The dispersion of residuals from the model of streamflow length in Cienega Creek to depth to water in Cienega Well (June; Figure 1) shows that a linear model for this relationship is a valid statistical approach. Westland (2012), using data from all intra-annual streamflow lengths measurements, argued that this was not a statistically valid relationship. (Myers [2014] had similar issues with data from Empire Gulch). However, by using June data only, a linear model is appropriate.

It is critical to note that the results between the modeling results by Westland (2012) and those reported here are significantly different. Using data from the Jungle Well, Westland (2012) found that with a 0.1 foot decline in depth to water there would be 176 foot reduction in flow length; just 41% of our results. They also did not model a scenario that may result from a mine impact that is greater than other projections but may be within the realm of possibility (i.e., a 0.25 foot reduction in depth to water).

Davidson Canyon: Groundwater and Baseflow Extent. Streamflow length and depth to water was explained by a linear function ($F_{1,26} = 89.9, P < 0.001, R^2 = 0.78$) (Figure 5), which we used to model the impact in groundwater drawdown on Davidson Canyon: Length of flow (miles) = $2.180 + 0.085 \cdot \text{depth of water at the Davidson \#2 Well (feet)}$ (Figure 5).

Using this model, we would expect that a groundwater drawdown of 0.1 foot would result in a loss of 45 linear feet of Davidson Canyon and a drawdown of 0.25 feet resulted in a reduction of

streamflow length of streamflow of over 112 feet (Table 2). Percent reductions are very similar to that of Cienega Creek and ranged from 3.0% to 7.6%. Using the 150 and 1,000 year estimates of impacts on groundwater (0.31 feet and 0.98 feet, respectively; Montgomery and Associates, 2010) would result in 9.4% and 30% loss of surface flow in Davidson Canyon, respectively. For comparison, the groundwater model by Montgomery and Associates (2010) equates the 0.98 feet of drawdown with a 0.29 miles (1,530 feet) reduction in stream length based on the drying of several of the 800 x 800 foot model grid cells where leakage to the aquifer exceeds streamflow into the reach.

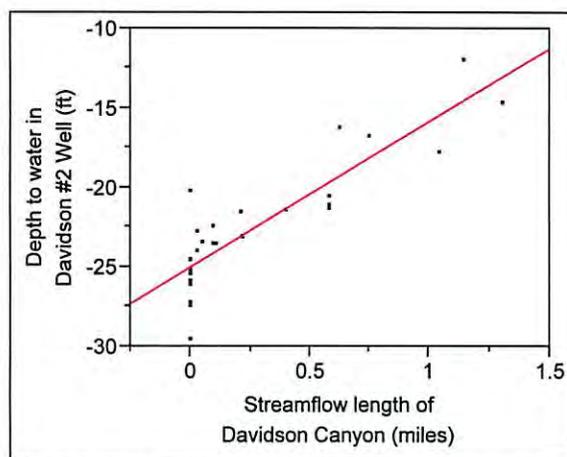


Figure 5. Relationship between length of flow of Davidson Canyon at the Cienega Creek Natural Preserve and depth to water at the Davidson #2 Well. The linear model (red line) explains 77% of the variation in the data. This model does not take into consideration changes in surface water runoff from the mine site.

Table 2. Modeled reduction in streamflow length for Davidson Canyon. Percent reduction is based on the mean June streamflow length of 0.28 miles (1,478 feet).

| Draw-down | Arbitrary starting well depth in feet | Streamflow length | | Feet of streamflow lost due to draw-down | Percent reduction in streamflow length |
|-----------|---------------------------------------|-------------------|-------|--|--|
| | | Miles | Feet | | |
| 0 | -20 | 0.4885 | 2,579 | 0 | 0.0 |
| -0.1 | -20.1 | 0.4800 | 2,534 | -45 | -3.0 |
| -0.2 | -20.2 | 0.4716 | 2,490 | -89 | -6.0 |
| -0.25 | -20.25 | 0.4673 | 2,467 | -112 | -7.6 |
| -0.31 | -20.31 | 0.4622 | 2,441 | -138 | -9.4 |
| -0.98 | -20.98 | 0.4071 | 2,141 | -438 | -30.0 |

Unlike in Cienega Creek, the groundwater model results used here to calculate drawdown are taken from locations within or very near the 5-foot drawdown contour and are assumed to be more reasonably certain than model results for Lower Cienega Creek. Accordingly, the stream length losses associated with nearly a foot of drawdown must be taken into consideration when evaluating the Rosemont mine's impact on lower Davidson Canyon. The stream length losses (0.29 miles; 1,530 feet) predicted by Montgomery and Associates (2010) are larger than those predicted in this study using the well depth to stream length regression analysis (Table 2). Taken together however, they provide a range of possible outcomes resulting from increased depths to groundwater due to the Rosemont mine.

Tetra Tech (2010a) suggests that this reach of Davidson Canyon is not connected to the regional groundwater system, and that streamflow impacts due to drawdown of the regional aquifer therefore are unlikely to occur. Yet the results of our analysis (Figure 5) provide very convincing evidence that contradicts this position.

We also take issue with Tetra Tech (2010a) data. Underpinning Tetra Tech's assertion is an illustration and a channel bed measurement at the Davidson Canyon stream gage (Figure 6). The accuracy of this figure relies on a "mid-channel bed" measurement taken by Tetra Tech (2010a). We examined Pima County LiDAR-generated elevation data at the same location and found that Tetra Tech's "mid-channel" bed elevation is five feet higher than the channel bed in 2008. We then examined 2011 LiDAR bed-elevations at the same location, which rule out the possibility that five feet of aggradation occurred, as would be required by Tetra Tech channel bed measurement. Instead, the actual bed elevations in 2008 and 2011 vary by less than 0.6 feet (Figure 7). Thus, the actual channel-bed is within a foot or two of the water table as measured in Davidson #2 Well.

The water-level measurements presented by Tetra Tech came from the Outstanding Waters nomination submitted by Pima Association of Governments (2005), which identified this reach as intermittent. Tetra Tech (2010a) uses the same data to infer that this portion of the channel is ephemeral. It is unreasonable to assume that groundwater never could discharge to the surface, or that it has been persistently below the bed between 1994 and 2004, as is indicated by Tetra Tech with the horizontal line connecting the last two groundwater measurements (Figure 6). It is even more unreasonable to extend that inference to the entire upstream reach, as is done by Tetra Tech (2010a).

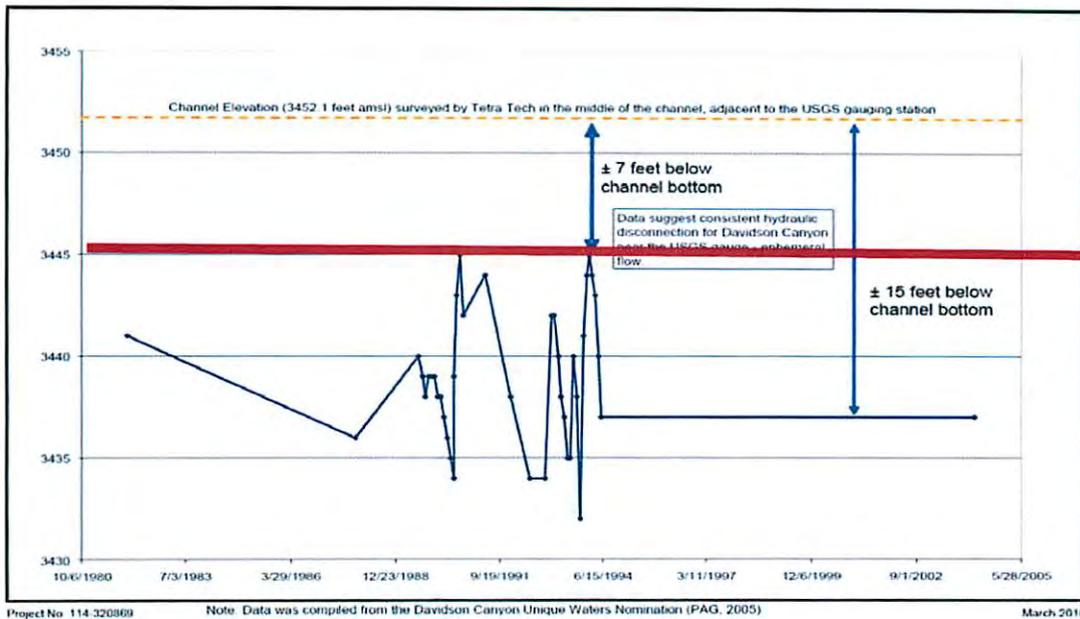


Figure 6. Tetra Tech’s (2010a) Figure 5, amended to show actual channel bed elevation at the location. Red line shows position of the 2008 and 2011 channel bed based on LiDAR data.

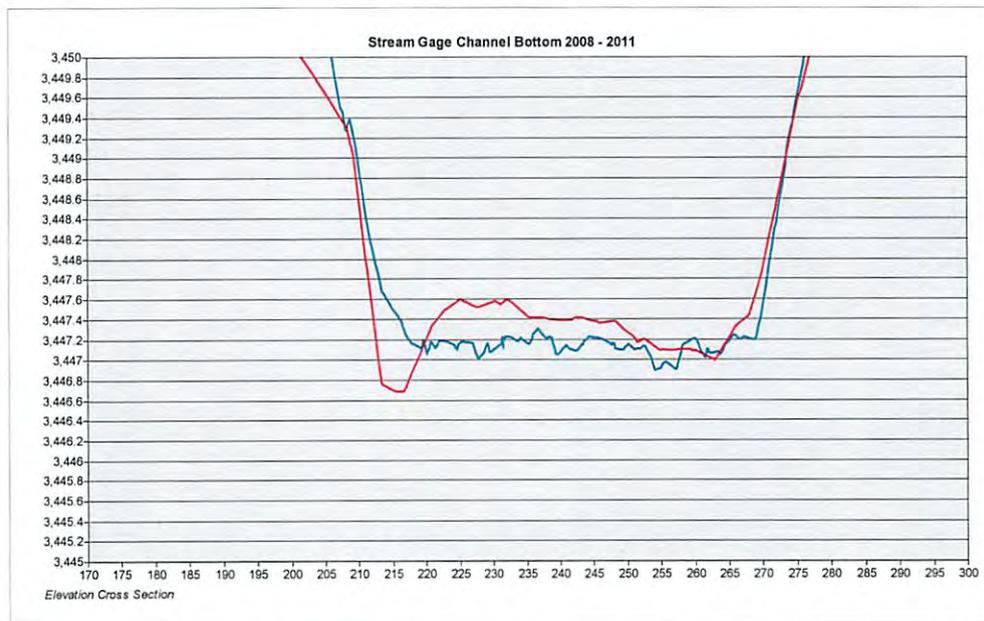


Figure 7. LiDAR channel cross-sections, 2008 in red, 2011 in green. Bed elevation varies by less than 0.6 feet.

Additionally, the work of Montgomery and Associates (2010) supports a connection to the regional aquifer in lower Davidson Canyon. The pre-mining steady state model simulated the interaction between the regional aquifer and the stream. The model produced results for both discharge and streamflow length that approximately matches past observations of flows and the extent of the Davidson perennial reach. If the regional aquifer was disconnected from the perennial reach, or so far below it that it does not impact surface flows, then one would expect that to be reflected in the model simulation showing a dry reach. It does not. Further evidence supporting a connection to the regional aquifer comes from interpretation of isotopic data by Dr. Chris Eastoe (Letter from County Administrator's Office to Robert Scalamera, Project Manager, Arizona Department of Environmental Quality (ADEQ); letter dated April 4, 2014).

These various lines of evidence, combined with errors and omissions by Tetra Tech, undermines Tetra Tech's argument that the intermittent baseflows in Davidson are unrelated to the regional aquifer. Combined, these analyses suggest that the impacts of Rosemont mine on Davidson Canyon and the Outstanding Arizona Waters have been understated in both the final environmental impact statement (U.S. Forest Service 2013), the draft water quality certification by ADEQ (Arizona Department of Environmental Quality 2014), and the biological opinion (U. S. Fish and Wildlife Service 2013). Based on this new information, the impact to the Davidson Canyon Outstanding Arizona Waters reach by the Rosemont project should be reevaluated regarding the potential take of endangered species and the impact to riparian and water resources.

Davidson Canyon: Effect on Runoff. Key to understanding the mine's full impact on water resources requires a better understanding of the surface water runoff changes in the Barrel and Davidson canyons. Pima County has repeatedly objected to the methodology and the findings from Rosemont and their consultants as well as data that have been incorporated into the final environmental impact statement and biological opinion including that:

- Potential runoff reduction impacts on downstream riparian and water resources for all phases of the mine life are not fully disclosed.
- Cumulative runoff reduction impacts on downstream riparian and water resources, Davidson Canyon and Cienega Creek, are not fully disclosed.
- Deficiencies in the analysis of downstream water volume effects on Davidson Canyon, Cienega Creek and Outstanding Arizona Waters have resulted in the underestimation of reduction in surface water flows in FEIS.
- The hydrological analysis supporting the surface water evaluation is inadequate, as the modeling should have considered shorter duration, high-intensity rainfall events' and the FEIS misrepresents the methods followed as those prescribed by Pima County.
- Rosemont Copper still intends to capture and retain surface water from watersheds northeast of the tailings, west of the mine pit, and south of the waste rock disposal

area. Instead, this water should be released downstream to mitigate reductions in stream flows and impacts to riparian vegetation.

To inform the decision regarding the impact to riparian resources and potential take of endangered species, these runoff-related objections need to be addressed. In addition to the above mentioned objections, the Biological Opinion cites work by SWCA (2012) that has not been made available for Pima County's review, either as a Cooperator or as a participant in the Hydrology Work Group recently convened by the Federal agencies. The SWCA work apparently extrapolates runoff volume reductions in Barrel Canyon and Davidson Canyon above the Highway 83 bridge to the Outstanding Arizona Water reach downstream.

Acceptable methods for determining flood routing are described in Pima County Regional Flood Control District Technical Policy 18. In this document, the methods entitled "*Acceptable Model Parameterization for Determining Peak Discharges*" should be employed to determine the reduction in streamflow in Lower Davidson Canyon and Cienega Creek as a result of changes in the upper watershed due to the Rosemont project. Myers (2014) provides an additional critique of Westland's (2012) methodology to evaluate impacts of surface water impoundments on Davidson Canyon and highlights that the methods used are deficient to provide an understanding of the impacts.

Rosemont and their consultants have reported that reductions in the volume of channel infiltration in the headwaters, reductions in total annual runoff volume, and reductions in peak flood magnitude all will have minimal effects on the OAW reach (WestLand Resources Inc. 2011, Zeller 2011, SWCA Environmental Consultants 2012). Combined with previously discussed Tetra Tech (2012a, 2012b) interpretations, these arguments would suggest that:

- When groundwater is considered, surface water is the most important factor in supporting lower Davidson Canyon.
- When mine impacts that effect surface water are considered, lower Davidson is too distant from the headwaters to be impacted.
- When shallow groundwater and channel subflow from precipitation recharge in the headwaters are considered, the OAW reach is not connected to the upper watershed due to bedrock constrictions in the shallow aquifer.

These arguments, when summed up, suggest that the OAW reach of Davidson Canyon is isolated from its watershed entirely and apparently without a water source. In short, these studies reveal a disturbing pattern of minimizing impacts from the Rosemont mine on all aspects of the hydrologic cycle.

Fragmentation of Flow in Cienega Creek. As has been reported elsewhere (WestLand Resources Inc. 2012, Powell 2013), streamflow length of Cienega Creek has declined precipitously since the 1980's and 1990's (Figure 8). In part because of this decline, streamflow length became highly variable as the streamflow responded to a shallow aquifer that was declining because drought and groundwater pumping. Looking more closely at the streamflow length data, not only was the streamflow length declining, but the streamflow segments were becoming more fragmented. This variability can be seen a number of ways, including the coefficient of variation (Figure 9) and number of segments per year (Figure 10).

From June 2001 to September 2012, there were a total of 341 recorded stream segments, 161 of which (47%) were at or below the threshold length established for this analysis (i.e., 1,085 feet). The number of stream segments below the threshold length was most influenced by length of flow in Cienega Creek (multiple regression, $F_{4,40} = 5.4$, $P = 0.0015$, $R^2 = 0.35$; Table 3) and not by any other factor (Table 3).

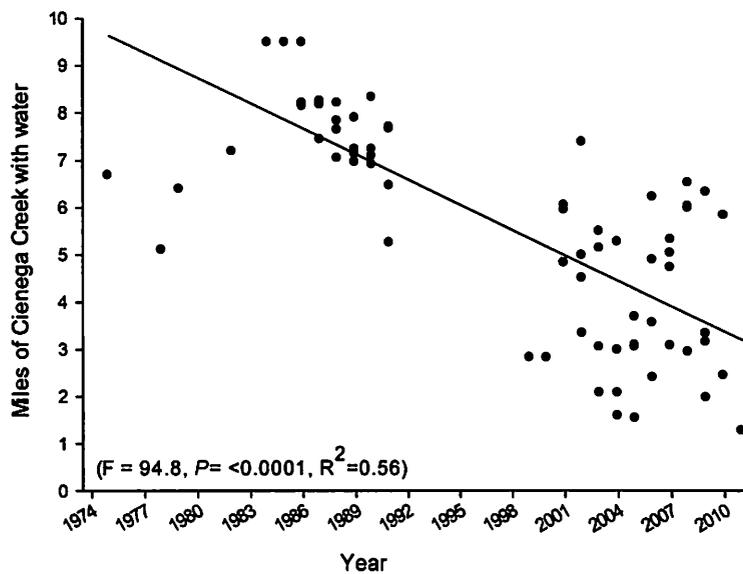


Figure 8. Extent of stream flow at Cienega Creek Natural Preserve (from Powell 2013) has both declined (solid line shows linear regression model) and shown more intra-annual variability. Maximum flow extent is 9.5 miles.

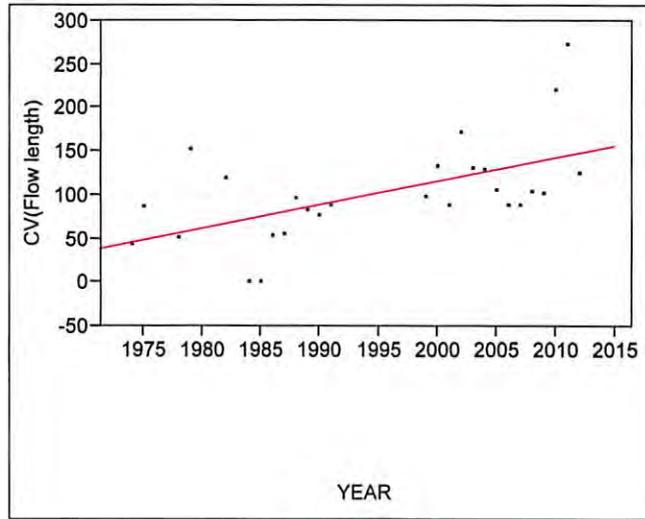


Figure 9. An increase in the coefficient of variation of streamflow length demonstrates that streamflow length is becoming increasingly variable over time. Increased variability can lead to instability of the system.

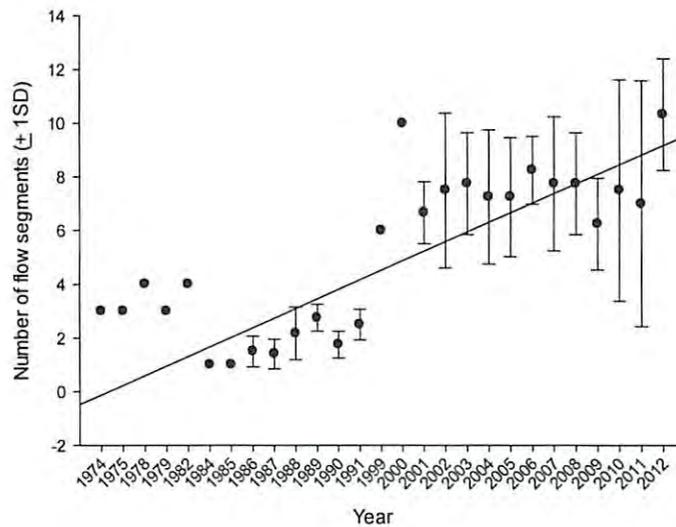


Figure 10. The number of streamflow segments has increased over time. As with flow length, increased variability can lead to isolation and loss of organisms that rely on open water, including Gila chub, Gila topminnow, and Huachuca water umbel. Analysis of variance test (solid line) shows this relationship to be significant ($F_{1,25} = 11.8$, $P = 0.002$, $R^2 = 0.32$).

Table 3. Results of multiple regression analysis on the relationship between number of flow segments that met the threshold (<1,085 feet) and other variables thought to influence the number of segments.

| Effect | Estimate | F | P |
|---------------------------------|----------|------|---------|
| Length of flow in Cienega Creek | 51.1 | 19.5 | <0.0001 |
| Year | 0.2 | 0.1 | 0.804 |
| Month | 6.0 | 1.6 | 0.217 |
| Year*Month interaction | 0.3 | 0.1 | 0.781 |

Discussion: Impacts on Species

Habitats of aquatic and mesic-riparian species in Cienega Creek and Davidson Canyon are decreasing in size and quality as the result of the reduction in the amount of available groundwater and surfacewater. This section highlights the likely impact on individual species, but looking broadly at the impacts of loss, fragmentation, and isolation that could result from threats to shallow groundwater and stormwater is instructive.

Cienega Creek is currently under stress. Water, the lifeblood of the system, is declining by every measure. There is a large and growing body of literature on the causes and consequences of ecosystems under stress (e.g., Odum 1985, Rapport et al. 1998, Rapport and Whitford 1999, Scheffer et al. 2001, Folke et al. 2004) and key among these findings is that as threats increase, habitat extent and quality declines, variability increases, and a system is more susceptible to threats that would not otherwise have impacted the system, such as loss of native species, increase in invasive species, etc. In essence, the system becomes less resilient.

Of course, the current state of Cienega Creek has nothing to do with the Rosemont mine. Yet it should be clear from the data presented here that any future impacts to the surface and groundwater resources of the system could have a far greater impact than indicated by either Rosemont or the permitting agencies. Another way to look at the impacts of the Rosemont mine is to say that if it was already built and impacting groundwater during the current drought, then Cienega Creek could lose as much as 37% of the baseflow during the critical pre-monsoon season, potentially leading to severe population declines of T&E species.

Gila topminnow. The habitat of Gila topminnow can be a broad range of water types such as pools and riffles and seem to prefer stream margins. Preferred habitats contain dense mats of algae and debris, usually along stream margins or below riffles, with sandy substrates sometimes covered with organic mud and debris. The largest natural populations of Gila topminnow occur in Cienega Creek (Bodner et al. 2007). Gila topminnow have recently been

monitored at the CCNP (Marsh et al. 2009, 2010)⁷ and in some areas are found in stream reaches that often classify as intermittent based on PAG wet-dry data, as well as perennial reaches. The aquatic habitats in the CCNP are a patchwork of disconnected habitat patches that are only connected during high-volume stormflows.

The modeled decline of habitat highlighted in this report, which includes reduction in the amount of baseflow and surface water extent (Figures 1-3, Table 1) and increase fragmentation (Table 3) will impact this species, especially during this critical June period. For the topminnow, which can live in very shallow water, further fragmentation and loss of key refugia could have significant impacts. This is acknowledged by the U.S. Fish and Wildlife Service in the Biological Opinion (U. S. Fish and Wildlife Service 2013; page 287), but their analysis is qualitative in nature. The results presented here can help a more robust analysis.

Gila Chub. Gila chub have an affinity for deeper pools (as compared to Gila topminnow) in slow velocity water and are often associated with cover such as undercut banks, root wads, and instream debris piles. At the CCNP, their distribution is largely restricted to three pools, one of which is found in an intermittent reach (Figure 11). The drawdown of the aquifer that supports critical base flows for this species will likely reduce the size and volume of the pools in which the Gila chub live.

The data in this report (e.g., Figures 1-3, Table 1) should cause a reevaluation of the impacts of groundwater decline for this species. For the Gila chub, the U.S. Fish and Wildlife Service (2013, page 267) use the analysis by Westland Resources Inc. (2012) as a basis for determination of impact. As we have noted, that report underestimated impacts to stream reaches. Our report points to a need to recognize that if drawdowns eliminate the shorter, persistent reaches, then recolonization of intermittent aquatic habitats when joined by flooding will depend on fewer, more widely spaced perennial refugia. Also, as drawdown occurs, occupied Gila chub pools will reduce in surface water depth, thereby leading to a possibility of increased water temperatures. This could be a problem for this species (and not for Gila topminnow) because of their lower tolerance of high water temperatures (Carveth et al. 2006).

⁷ These studies have noted numbers of Gila chub caught at the CCNP but the survey methods were not designed to estimate populations or even catch-per-unit effort. The Biological Opinion (U. S. Fish and Wildlife Service 2013) does not take this into account (page 254; though it states later [page 273] that the methods were not meant to enumerate trends). Though restricted to a few pools at CCNP, there are many more individuals than are reported by these monitoring efforts.

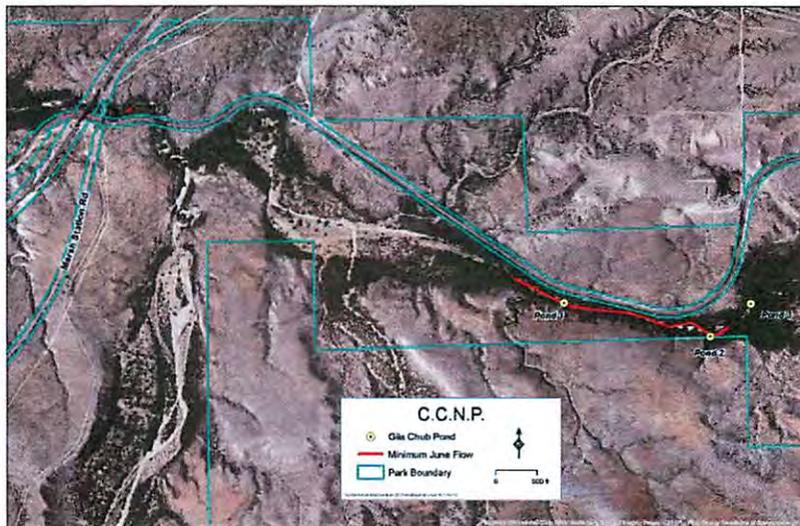


Figure 11. Location of pools with Chub in relation to areas that have a minimum June flow. Pool 3 is located in an intermittent stretch of the Creek, but that pool is very dynamic, as are the presence of chub. Pool 1 and Pool 2 contain chub more consistently. Figure by Mike List (Pima County IT).



Figure 12. This adult northern Mexican gartersnake was found feeding on lowland leopard frog tadpoles at the Cienega Creek Natural Preserve on June 13, 2014. Predicted surface water declines because of the mine would impact the extent of habitat and the species' primary food sources: fish and tadpoles. Photograph by Julia Fonseca.

Northern Mexican Gartersnake. This species is highly aquatic and only ventures a short distance away from water for hibernation and occasionally for foraging (U.S. Fish and Wildlife Service 2014). Its diet primarily consists of small fish and frogs, which are found on the CCNP. Though observations of this species at the Preserve are very rare, they have been found there (Rosen and Schwalbe 1988, Rosen and Caldwell 2004), including as recently as June 13, 2014 when one adult was confirmed (Figure 12). An additional juvenile may also have been found, but no positive identification was made. The historical decline in the amount and extent of

surface water (Figure 8) and the modeled decline in these resources as a result of the mine (Figures, 1-3, Tables 1, 2) will impact the extent of habitat and the aquatic prey base upon which these species depend. The northern Mexican gartersnake was not a part of the consultation for the biological opinion for the mine (U. S. Fish and Wildlife Service 2013), but will be part of the reinitiated consultation process (letter from USFWS Field Supervisor Steve Spangle to Forest Service Supervisor Jim Upchurch, dated May 16, 2014). The presence of the species and the modeled impacts should be considered as part of those deliberations.

Yellow-billed cuckoo. The yellow-billed cuckoo prefers large willow and cottonwood trees for nesting and foraging. The status of the population at the Cienega Creek NP is not entirely certain, but a single-pass survey by Powell (*unpublished data*) in 2013 revealed at least 11 individuals. Based on the work by Corman and Magill (2000), we know that the yellow-billed cuckoos populations at the CCNP and on the Las Cienegas NCA are some of the largest among small creeks in Arizona. Unfortunately, the slow desiccation of some areas of the CCNP in the last years has significantly impacted the gallery riparian forest on which the cuckoo depends for nesting, even as other forest patches continue to gain canopy volume and height (Figure 12, Swetnam et al 2013).



Figure 12. Photo from Cienega Creek NP showing impacts of the current drought on the thinning canopy of cottonwood trees, the primary tree used for nesting and foraging by the yellow-billed cuckoo. Loss of groundwater from the Rosemont mine will exacerbate this problem. Photo taken on May 30, 2014 very close to where yellow-billed cuckoos were detected in 2013. Cuckoos would be unlikely to nest in an area with such an open canopy.

There has been a considerable amount of research on cottonwood and willow trees as it relates to depth to water and tree species composition in the desert southwest (e.g., Stromberg et al. 1996, Horton et al. 2001, Harner and Stanford 2003, Stromberg et al. 2007, Hidalgo et al. 2009, Merritt and Poff 2010). The work by Lite and Stromberg (2005) and Leenhouts et al. (2006) is particularly relevant to the situation at CCNP. Studying the threshold between groundwater depth and flow permanence on the presence and vigor of cottonwood trees, Lite and Stromberg (2005) found that flow permanence was the single greatest hydrologic predictor for the presence of cottonwood trees. Flow permanence of 76% was viewed as important, as was depth to water of approximately 3m, a result that has been found by other studies (Horton et al. 2001). Lite and Stromberg (2005) believe that flow permanence is probably a surrogate for other (not studied) hydrological characteristics, but it provides a good starting place for thinking about how changes in groundwater drawdowns will impact the habitat of yellow-billed cuckoos. Flow permanence is a particularly helpful measure because it is easily observed, as opposed to depth to water, which can be measured at various wells but varies spatially. Pima County is currently pursuing an analysis of surface water extent and vegetation change over time. We hope to have results in the coming weeks.

Huachuca water umbel. The Huachuca water umbel requires permanent water and grows on the margins of streams. First detected in 2001 within patches of cattail and bulrush (Engineering and Environmental Consultants Inc. 2001), the umbel appeared to have colonized a location in the CCNP from larger populations upstream. The cattail-bulrush wetland in which umbel colonized was considered a perennial reach in 2000-2001, but subsequently desiccated because of the headcut, which was studied intensively by the Pima Association of Governments (PAG; 2009b). The PAG study included piezometers which documented the loss of near-surface waters and dewatering of sediment during pre-monsoonal droughts that precede headcutting during subsequent floods. The dewatering of sediment during pre-monsoonal months likely rendered umbel habitat unsuitable, even if no headcutting occurred.

The umbel has not been seen in the CCNP for a number of years, in spite of casual searches during quarterly walk-throughs, and a dedicated search during 2013. Colonization events may be infrequent, and with reductions in areas of permanent water from the impacts of the Rosemont mine, there will be less available habitat for natural establishment and persistence.

Conclusions

To our knowledge, this is the first attempt to use water resource data collected at the CCNP and Davidson Canyon to better understand the range of potential impacts that the mine might have on water resources and the T&E species that rely on this resource. Our analysis shows:

- The statistical relationship between depth to water and baseflow and streamflow extent is outstanding for the paired relationships of Cienega Creek and Cienega Well (Figure 1) and Davidson Canyon and Davidson Canyon #2 well (Figure 3);
- These data, along with a critique of Rosemont-sponsored data collection efforts that relied on faulty data and assumptions, provide the strongest support to date for the connection between surface water and groundwater resources in Davidson Canyon and Cienega Creek.
- Using models that express this relationship, we show that previous modeling efforts (WestLand Resources Inc. 2012) significantly underestimated the loss of streamflow length that could result from the mine. We also estimate, for the first time, the amount and percentage of baseflow that will be lost with a drawdown of the aquifer that supports the aquatic and riparian resources of lower Cienega Creek and Davidson Canyon.
- Groundwater drawdowns of the magnitude predicted and within possibility show that there will be significant and measurable impacts on the extent of surface water and habitat for the Gila topminnow and Gila chub (Table 1) and other species (Tables 1 and 2). This is particularly critical during June when the creek is at its lowest baseflow and extent;
- Fragmentation of aquatic habitat shows an inverse relationship to flow extent (Table 3); that is, as extent declines, fragmentation will increase. This will lead to additional take and threat to T&E species that has not been previously considered;
- There is still considerable uncertainty about the impacts of surface water diversions into Cienega Creek and Davidson Canyon. Developing a better understanding of these impacts will allow a more refined accounting of impact on the aquatic system of Cienega Creek and Davidson Canyon and the species that call these places home.

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Surface Water Mitigation Plan

401 Certification ADEQ LTF No. 55425

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Monitoring and Reporting Schedule

| Task Schedule | Purpose/Description/ Timing | Generic Year | | | | |
|---|--|--------------|---|---|---|---|
| | | C | Q | R | S | A |
| Collect precipitation samples | After rain event | | | X | | |
| Collect stormwater samples | After rain event | | | X | | |
| Spring monitoring | Surface water/groundwater interactions | | | | X | |
| Record groundwater level on data logger | Pressure transducers | X | | | | |
| Record temperature data on data logger | Temperature probes | X | | | | |
| Collect groundwater samples | Water level measurement at each sampling event | | X | | | |
| Download data from data logger | Inspect station during download | | X | | | |
| Geomorphic monitoring (including pebble counts/gradation and vegetation monitoring) | Annually after monsoon season (every year for 5 years and every 5 th year thereafter) | | | | | X |
| Surface Water Model | Update and run model, define and implement mitigation as needed | | | | | X |
| Reporting (data summaries) | To ADEQ | | X | | | |
| Reporting (data and analysis) | To ADEQ | | | | | X |

C = Continuously (pressure transducers); Q = Quarterly; R = As needed; S = Semi-annually; A = Annually

Revision Log

| Revision Number | Revision Lead | Purpose of Revision | Revision Date |
|-----------------|---------------|---------------------|---------------|
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1.0 PLAN OBJECTIVE AND DESCRIPTION

This Surface Water Mitigation Plan (Plan) was prepared by Rosemont Copper Company (Rosemont) as a requirement of the 401 Certification to be issued by the Arizona Department of Environmental Quality (ADEQ) for the Rosemont Copper Project (Project). The need for a Plan prior to issuance of the 401 Certification was raised during public comment. Rosemont's draft 401 Certification for review was issued on February 21, 2014.

Rosemont anticipates no degradation to downstream water quality (compared to current water quality) due to Project construction, operation, and/or closure activities. Additionally, no degradation is anticipated to the water quality in the Outstanding Arizona Water (OAW) segment of Davidson Canyon Wash. This assessment is based on:

- Implementation of Best Available Demonstrated Control Technology (BADCT) design for the Project facilities and best management practices;
- Extensive stormwater management and erosion prevention controls, including pollution prevention and control measures;
- Development of a surface water model. To the extent that downstream water quality may be affected by water quantity changes, the model will serve as a predictive tool to quantify potential changes in surface water runoff from the Project site based on staged development. The model will correspondingly used as a tool to estimate runoff replacement quantities from off-site mitigation locations;
- Geochemical evaluations of waste rock;
- Numerous monitoring programs that will allow evaluation of trends in water quality and water quantity within the Davidson Canyon watershed, including monitoring that will specifically inform the surface water model; and
- A distance of about 12-miles between the downstream toe of the Project and the OAW segment of Davidson Canyon Wash.

1.1 PLAN OBJECTIVE

The objectives of this Surface Water Mitigation Plan are to:

- Provide details on the development and use of the surface water model planned for the Project site;
- Propose and describe mitigative measures that could be employed to offset and/or replace Project-related reductions in stormwater flow volume (per the surface water model) and sediment to Davidson Canyon Wash, should it occur;
- Ensure that any water used to mitigate (offset and/or replace) reduced stormwater flow volume meets applicable Arizona surface water quality standards; and
- Present and describe the various monitoring programs that will be conducted by Rosemont throughout the life of the Project that will be used to evaluate water quality and quantity as well as monitoring downstream resources.

The monitoring described in this Plan will be conducted during the pre-construction, construction, operational, and closure phases of the Project and this data will be used to develop and maintain the surface water model and also to monitor overall watershed conditions. Conditions in the watershed could change based on a variety of reasons such as potential impacts from the Project, natural climatic fluctuations, increased development in the area, and/or other non-Project related activities.

In addition to the Surface Water Mitigation Plan described herein, Rosemont has developed other plans, such as stormwater management plans, a spill prevention control and countermeasure plan, and various other water monitoring plans, specified by either ADEQ or the U.S. Forest Service (USFS), in order to monitor water resources in the Project area. Water resources include groundwater, stormwater, and springs. Appendix B of the Final Environmental Impact Statement (FEIS; USFS, 2013a) and draft Record of Decision (ROD; USFS, 2013b) lists the various mitigation and monitoring measures required by the USFS and by other agencies.

The monitoring programs described in this Plan will generate extensive data regarding stormwater and stream water quality, water quantity, stream erosion, groundwater/surface water interactions, and other related concerns. For example, Mitigation Measure FS-SR-05 requires monitoring of sediment transport in Barrel Canyon. Mitigation Measure FS-SSR-02 requires monitoring of springs that will yield data relevant to water quality. Mitigation Measure FS-BR-22 requires monitoring of stormwater and groundwater in Barrel and Davidson Canyon washes. Monitoring of vegetation (field inventory and description of existing conditions) in Barrel and Davidson Canyon will also be conducted. These specific plans are described and included herein for reference as they provide the majority of data gathering activities located down-gradient of the Project site. These and other plans specific to the USFS will require review by that agency prior to finalization. Any changes made to these USFS plans will be reviewed with ADEQ.

1.2 PLAN DESCRIPTION

This Surface Water Mitigation Plan includes the following components:

- General monitoring of stormwater, streamflow, springs, groundwater, precipitation, and stream geomorphology, including review and evaluation of this monitoring data;
- Monitoring and operational planning specifically related to the surface water model, including review and analysis of model inputs and results;
- Mitigation implementation; and
- Reporting.

Sections 1.2.1 through 1.2.5 provide a brief description of the components associated with this Plan while Sections 2.0 through 9.0 provide details. Section 10.0 provides a list of references.

1.2.1 General Monitoring Component

Although no monitoring is required under the 401 Certification to maintain compliance, Rosemont proposes to provide ADEQ with the results and analyses from various stormwater, groundwater, spring, geomorphology, and precipitation monitoring programs conducted under other agency requirements. Monitoring will provide both ADEQ and Rosemont with a better understanding of the normal variation of an ephemeral fluvial system, including changes in flow, sediment load/deposition, and water quality, and overall watershed conditions. The general monitoring program will only be

used to monitor watershed conditions and to use that data to understand and monitor trends in the system. Section 2.0 of this Plan provides details on the general monitoring plan and the data that will be gathered. Section 3.0 provides a description of how that data will be presented.

In general, groundwater, stormwater, spring, and precipitation monitoring were initiated by Rosemont in 2006 to define pre-mining, or baseline, conditions. Additional monitoring locations have been added throughout the years and will continue to be added as required by the USFS and other agencies. Stormwater monitoring described in this Plan will consist of stormwater sampling and analysis and stream stage and discharge measurements in the ephemeral washes. Geomorphological (stream channel) and vegetation monitoring will also be performed. The geomorphological monitoring data will be used to evaluate ephemeral stream channel stability, sediment loading/deposition, and scour within the channels (Lower Barrel Canyon and Davidson Canyon). Vegetation monitoring data will determine if the existing vegetation shows symptoms of stress.

Monitoring discussed in this Plan is separated into two phases: Phase 1 and Phase 2.

- Phase 1 monitoring includes the time period from 2006 to the present and to the point when Project construction activities begin to affect stormwater flow and drainage. The installation of additional monitoring stations/locations (see Section 2.2.2 of this Plan) is assumed phased in during this period and is based on Rights of Way from the Arizona State Land Department (ASLD). This time period covers the baseline monitoring that was initiated in 2006. As a note, any trends, water quality changes, or other anomalies observed in the Phase 1 data are understood to be due to natural variations or other activities not associated with the Project; and
- Phase 2 monitoring will begin when major construction activities occur at the Project site, i.e., when larger-scale stormwater impoundments are constructed at the Project site and used to contain stormwater. Phase 2 monitoring will include that data collected during construction, operation, and closure phases. Additional monitoring stations/locations will have been installed prior to the beginning of this period or, again depending upon access by ASLD, during the first six (6) months of this period. Trends, water quality changes and anomalies observed in the Phase 2 monitoring will be evaluated to determine the potential cause(s). The Project will be monitored and required to maintain compliance with the permits as issued; however, the monitoring program can also be used to evaluate changes in the watershed that may not be associated with the Project.

Monitoring will be conducted from pre-mining through construction, operation, and closure. There will be no cessation or gaps of monitoring between Phase 1 and Phase 2. Only the designation of the monitoring phase will change. All water quality sampling, water level measurements, spring flow measurements, and other monitoring activities conducted for the USFS, ADEQ, and other regulatory agencies will be in accordance with the Rosemont's Water Programs Quality Assurance Project Plan (QAPP).

1.2.2 General Data Review and Evaluation Component

As monitoring data is obtained and compiled, Rosemont will review the analytical data for validity and representativeness, and evaluate the results for variations, trends, anomalies, etc. Review and evaluation of the data are discussed in Section 3.0 of this Plan.

1.2.3 Site Specific Data Review and Modeling Component

Section 4.0 of this Plan describes the surface water model to be developed for the Project. Monitoring data to be used in the development and maintenance of the model is also summarized in Section 4.0. A portion of the general monitoring data will be used as inputs to the surface water model. Additional data gathering requirements specific to the model are also specified.

1.2.4 Mitigation Component

The model will be used to quantify Project related changes in stormwater flow to Davison Canyon and then proactively mitigate or offset those changes, as needed. Potential storm water quantity mitigation approaches are described in Section 5.0. Section 5.0 also includes a discussion on offsetting changes to stormwater and to sediment loading from the Project site.

1.2.5 Schedule

Section 6.0 provides a schedule for the development of the surface water model.

1.2.6 Reporting Component

Data summaries will be prepared quarterly and provided to ADEQ as they are required for submittal to the Forest Service. The quarterly data will provide only the latest monitoring data generated during that period. Additionally, an Annual Summary Report will be prepared for ADEQ that provides current quarterly data along with the entire previous years' data. The annual report will also include analyses, statistical calculations, and updates summarizing any mitigation activities. Details on this report are provided in Section 7.0.

2.0 GENERAL MONITORING

2.1 PHASE 1 MONITORING

Phase 1 monitoring began on a voluntary basis by Rosemont in 2006 and will continue until major construction of the Project begins (i.e., start of Phase 2 monitoring). In addition to the continuation of the voluntary monitoring elements, certain portions of the monitoring required by the USFS and other regulatory agencies will be initiated during Phase 1. Data from the following monitoring programs will be provided to ADEQ in support of this Surface Water Mitigation Plan:

- Baseline stormwater quality data collected under Rosemont's voluntary Baseline Stormwater Sampling Program. This monitoring was initiated in 2010 and initially consisted of collecting stormwater samples at eight (8) Nalgene sampler locations in the ephemeral washes located within and outside of the Project footprint (see Figure 1). Two (2) automated monitoring stations, described in the third bullet, were added to this monitoring program in December 2012;
- Stormwater monitoring under the AZPDES MSGP. Stormwater monitoring under the AZPDES MSGP was implemented in conjunction with the Phase 1 Drilling Program. Baseline stormwater monitoring, as described above, will be occurring simultaneously;
- Surface water/groundwater monitoring under USFS Mitigation Measure FS-BR-22. Currently, there are two (2) automated surface water/groundwater monitoring stations (one in Barrel Canyon Wash and one in Davidson Canyon Wash) as shown on Figure 1. Monitoring parameters at these stations include: stream stage and discharge; stormwater quality; precipitation; shallow subsurface soil moisture, temperature, and conductivity; and groundwater quality and groundwater levels of bedrock and alluvial aquifers in Barrel and Davidson Canyon washes. Monitoring plans for these surface water/groundwater monitoring stations were previously reviewed by ADEQ and are provided in Appendix A of this Plan. The list of stormwater monitoring parameters initially proposed in the Water & Earth Technologies, Inc. (WET) 2012 *Davidson Canyon Conceptual Surface-Water Monitoring Plan* (provided in Appendix A) has been modified; the actual analyte list currently used for the baseline stormwater samples is listed below in Section 2.1.1. Mitigation Measure FS-BR-22 includes monitoring of these two (2) stations as well as several others, as practicable, in Barrel and Davidson Canyon washes, and in Cienega Creek. Appendix B provides a draft monitoring plan associated with Mitigation Measure FS-BR-22;
- Streamflow monitoring at United States Geological Survey (USGS) Gaging Station No. 09484580 in Barrel Canyon, just west of State Route 83 (SR 83);
- Stormwater and precipitation monitoring in unaffected washes. Rosemont proposes to install two (2) automated stormwater monitoring stations in the ephemeral washes (McCleary and Scholefield Canyons) located outside the Project footprint. These washes will not be directly affected by Project operations. Depending on location, installation of these stations will be subject Federal approval; and
- Spring monitoring of 25 springs and seeps in the vicinity of the Project under USFS Mitigation Measure FS-SSR-02. Under this monitoring program, Rosemont will monitor a suite of 25 springs and seeps, as shown on Figure 2, for presence/absence of water, and flow measurements, if possible, on a semi-annual basis.

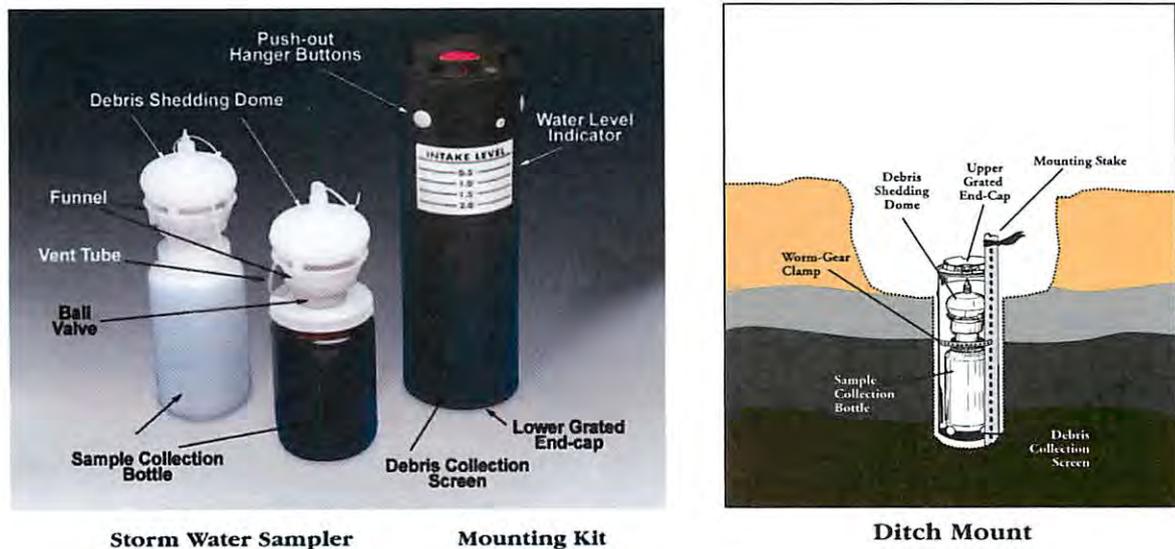
2.1.1 Baseline Stormwater Monitoring

Baseline (pre-mining) monitoring for stormwater quality in various on-site drainages was initiated in January 2010 and will continue into the initial stages of Project construction. There are currently ten (10) stormwater sampling locations (stations). These ten (10) stations consist of eight (8) locations where stormwater is collected using Nalgene sampler systems and two (2) locations where automated surface water/groundwater monitoring stations have been constructed. The ten (10) locations are either within the disturbance boundary of the Project or monitor washes that are likely to drain stormwater from the disturbance area.

Since inception of the voluntary Baseline Stormwater Monitoring Program, there have not been any significant site activities, only exploratory drilling and reclamation test plot construction. Therefore, the data collected to date characterize the quality of stormwater in the washes as baseline, or pre-mining, conditions.

Illustration 1 below is a picture of a typical first-flush Nalgene sampler used at eight (8) of the ten (10) current stormwater sampling locations. Section 6.3 of the Rosemont Copper Project Stormwater Pollution Prevention Plan (SWPPP) for the Arizona Pollutant Discharge Elimination System (AZPDES) General Permit for Stormwater Discharges Associated with Industrial Activity – Mineral Industry (AZMSG2010-003 [MSGP-2010]) describes the installation of the samplers and stormwater quality sample collection procedures. The other two (2) stormwater sampling points are located at the automated surface water/groundwater monitoring stations (described below in Section 2.1.2).

Illustration 1. Nalgene Sampler and Installation



The eight (8) monitoring locations that employ Nalgene stormwater mounting kits are located in the following washes:

- PSW-1, located in Upper Barrel Canyon Wash
- PSW-2, located in Wasp Canyon Wash
- PSW-3, located at Rosemont Junction, in Barrel Canyon Wash
- PSW-4, located in McCleary Canyon Wash

- PSW-5, located in Lower Barrel Canyon Wash
- PSW-6, located in Scholefield Canyon Wash
- PSW-7, located in Lower Barrel Canyon Wash at the USGS Gage, just upstream of SR 83
- PSW-8, located in Trail Creek

The two (2) automated monitoring stations were installed in December 2012 and are located in:

- Lower Barrel Canyon Wash, just upstream of SR 83 (BC-2); and
- Davidson Canyon Wash, downstream of the confluence with Barrel Canyon (DC-3).

Stormwater quality samples collected under the voluntary Baseline Stormwater Monitoring Program are submitted for the following parameters (as sample volumes allow):

| Indicator Parameters and Major Ions | Total Metals | Dissolved Metals |
|--|------------------------------|--------------------------|
| pH – lab | Antimony | Arsenic |
| Specific conductance – lab | Arsenic | Cadmium |
| Temperature - lab | Barium | Chromium VI ² |
| Total dissolved solids (TDS) | Beryllium | Copper |
| Total suspended solids (TSS) | Boron | Iron |
| Turbidity | Cadmium | Lead |
| Total alkalinity | Chromium, total ¹ | Mercury |
| Carbonate | Copper | Nickel |
| Bicarbonate | Iron | Silver |
| Hydroxide | Lead | Zinc |
| Hardness | Manganese | |
| Chloride | Mercury | |
| Fluoride | Molybdenum | |
| Sulfate | Nickel | |
| Calcium | Selenium | |
| Magnesium | Silver | |
| Potassium | Thallium | |
| Sodium | Uranium | |
| Nitrate (as N) | Zinc | |
| Nitrate + Nitrite (as N) | | |
| Total Nitrogen (calculation) | | |
| Total Kjeldahl nitrogen (TKN) | | |

¹ – Analysis will be for Total Chromium, not Chromium III or Chromium VI.

² – Analysis will be for Chromium VI, the most stringent standard for chromium.

As practicable, Rosemont will continue collecting baseline stormwater quality samples on the Project site through completion of construction; however, as construction proceeds some of the sampling sites may need to be eliminated or relocated. Stormwater monitoring was also implemented under the AZPDES MSGP as associated with the Phase 1 Drilling Program. Stormwater monitoring sites will be located so that the requirements of the MSGP program are met. Stormwater samples collected under the AZPDES MSGP will be submitted for the parameters listed in Table 8.G-8.2 in the MSGP and in Section 2.2.1 of this Plan.

2.1.2 Surface Water/Groundwater Monitoring Under FS-BR-22

In December 2013, Rosemont installed two (2) surface water/groundwater monitoring stations. One of the monitoring stations (BC-2) is located approximately 1,600 feet upstream of the USGS gaging station (No. 09484580) in Barrel Canyon Wash. The other station (DC-3) is located approximately four (4) miles downstream of BC-2 in Davidson Canyon Wash. Figure 1 shows the locations of the two (2) existing monitoring stations. Both stations have co-located groundwater wells and surface water data collection systems for the purpose of evaluating potential surface water/groundwater interactions as well as to assist in the determination of hydrologic systems analysis, runoff, groundwater infiltration, effects of localized precipitation, soil moistures, and stormwater quality.

Each of the existing surface water/groundwater monitoring stations is equipped to monitor the following:

- Groundwater levels and water quality in the shallow, alluvial sediments (shallow well);
- Groundwater levels and water quality in the deeper, bedrock aquifer (deep well);
- Groundwater temperature, in both the shallow and deep water zones;
- Soil moisture at different depths, ranging from 1 to 6 feet beneath the wash channel;
- Soil temperature and conductivity at different depths in the wash channel;
- Stream level (stage);
- Stream discharge (in cubic feet per second);
- 15-minute and cumulative precipitation measurements; and
- Precipitation water quality (specifically stable isotopes).

Each monitoring station consists of two (2) groundwater wells (one shallow, one deep), three (3) to four (4) soil temperature probes, a standpipe housing, an instrumentation enclosure, and a foundation block at wash level. Each of the two (2) wells has a pressure transducer installed to monitor groundwater levels. A third pressure transducer is installed in a perforated pipe just below the surface of the wash to monitor the stream level. A data collection unit (DCU), located in a standpipe canister, is programmed to sample, store, and transmit all sensor data via a commercial satellite. Data are downloaded from the satellite data provider and stored in a database, which can be viewed over the internet. The DCU also activates a pump sampler when a stream level exceeding the trigger elevation is detected and confirmed by a float switch. The stormwater sampler is programmed to collect a 1-liter water sample every 5 minutes while the level in the stream is above the float switch activation level.

Precipitation is currently measured at four (4) stations: the USGS gaging station (No. 09484580) at SR 83 at Barrel Canyon; the Rosemont weather station located in the Open Pit area; and the two (2) surface water/groundwater monitoring stations discussed above (see Figure 3). Precipitation measurement stations are located at least one (1) mile from each other to quantify the spatial variability throughout the watershed. Additionally, the two (2) surface water/groundwater monitoring stations described above in Section 2.1.1 are equipped with precipitation collectors. The weather station located in the Open Pit area also has a precipitation collector and rain gage. Precipitation water samples are submitted to the University of Arizona laboratory for stable hydrogen/oxygen isotope analysis.

2.1.3 Streamflow Monitoring at USGS Gaging Station for Barrel Wash

As part of the most recent agreement between Rosemont and the USFS, and described in USFS Mitigation Measure RC-SW-01, Rosemont is required to fund the maintenance of the USGS gaging

station (No. 09484580) through construction and operation and for at least five (5) years after operations cease. This agreement ensures that monitoring for streamflow will continue throughout the life of the Project.

The description of the USGS gage is:

- Latitude 31°51'42"N, Longitude 110°41'26"W, NAD27
- Pima County, Arizona
- Hydrologic Unit 15050302
- Drainage Area: 14.2 square miles
- Datum of the gage: 4,264 feet above NGVD29

The data available for the USGS gage includes:

- Current/historical observations from 23Jan2009 through present
- Daily discharge data in cubic feet per second (cfs) from 23Jan2009 to present
- Daily discharge statistics, in cfs from 23Jan2009 to present
- Monthly discharge statistics, in cfs from Jan2009 to present (prior month)
- Annual discharge statistics, in cfs from 2009 to present
- Peak streamflow, 1962 through 9Sept2013 (19 values available)
- Field measurements, 22Jan2010 through 11Sept2012 (7 visits)
- Annual water-data reports, 2010 through 2013 (see Appendix C for 2013 report)
- Precipitation data, data is stored only for 120 days by USGS

This USGS gaging station will play a key role in determining what, if any, potential mitigation measures will be implemented as part of this Plan. Along with other site specific monitoring data, the surface water model to be developed for the Project site will incorporate actual storm flow monitoring data recorded at this station as a basis of evaluating potential Project related impacts.

The previous estimate of average-annual runoff from the site was based on estimated or extrapolated values presented in a previously-developed hydrologic model (Tetra Tech, 2011). Rosemont understands that the average-annual runoff estimated by this model indicated an average-annual runoff of 1,407 acre-feet for the Barrel Canyon watershed at the USGS gaging station; however, no such average annual runoff has been measured since installation of the USGS gaging station on Barrel Canyon Wash at State Route 83. Total streamflow recorded by the USGS gaging station from 2010 to 2013 ranged from 41 acre-feet (0.058 cfs) to 185 acre-feet (0.26 cfs; see Appendix D).

2.1.4 Stormwater Monitoring for Unaffected Washes

As stormwater passes the measuring point at the USGS gaging station (No. 09484580), the aggregated flows at this point are made up of five (5) tributary drainages that all report to the SR 83 bridge along Lower Barrel Canyon:

- Upper Barrel Canyon Wash
- Wasp Canyon
- McCleary Canyon
- Scholefield Canyon

- “Trail Creek” (named for the Arizona Trail that currently passes through and along the drainage. The Arizona Trail will be moved out of Trail Creek as part of Project construction activities.)

While runoff from Upper Barrel Canyon Wash, Wasp Canyon Wash, and a portion of “Trail Creek”, will be affected by Project operations, McCleary Canyon Wash and Scholefield Wash are outside of the Project footprint, i.e., these drainages are considered unimpacted by Project activities.

At Rosemont's request, Water and Earth Technologies (WET) recently prepared a plan to install two (2) surface water monitoring stations (one in McCleary Canyon Wash and one in Scholefield Canyon Wash) for the specific purpose of monitoring stormwater flows. WET's proposal is provided in Appendix E. Depending on location, the installation of monitoring equipment in these drainages may require Federal permits.

2.1.5 Spring Monitoring

USFS Mitigation Measure FS-SSR-02 requires semi-annual monitoring of 25 springs/ seeps/ enhanced/constructed waters (springs) for presence/absence of water and measurement of flow, if possible. Rosemont has prepared a draft Plan (see Appendix F) to comply with this requirement. Rosemont has monitored 23 of the 25 springs for flow conditions since summer 2008. However, beginning in April 2014, all 25 springs have been monitored (see Figure 2).

2.1.6 Additional Stormwater Monitoring in Davidson Canyon

Other than the property that Rosemont already owns, such as the property on which the DC-3 automated station is located, legal access restrictions to other areas in and along Davidson Canyon Wash currently make monitoring baseline stormwater conditions impossible for Rosemont. Rosemont understands that baseline stormwater samples collected by other agencies (federal, state, or county) within the Davidson Canyon system may be made available to Rosemont for use in making the analysis required by this Plan.

Rosemont believes that due to the numerous activities that are on-going within Davidson Canyon drainage, i.e., vineyards, well drilling, septic systems, road crossings, agriculture uses, recreational uses of the washes as roads, and other residential household uses such as gardens, off-roading in the washes, maintenance of vehicles and houses, and other general rural land use, it will be necessary for ADEQ to take more than one (1) stormwater sample in Davidson Canyon. It is assumed that several sampling locations will be needed to monitor the tributary flows into Davidson Canyon to determine appropriate stormwater contaminant loading and assimilative capacities. There is no baseline that exists covering multiple tributary flows; however, as required by USFS Mitigation Measure FS-BR-22, Rosemont will install and maintain five (5) surface water/groundwater monitoring stations in Davidson Canyon Wash. If property access can be obtained, two (2) additional surface water/groundwater monitoring stations will be installed in Cienega Creek. One of the five (5) Davidson Canyon monitoring stations (DC-3) is already constructed and operating. Appendix A provides the WET report that selected and described the specific locations for the all of the surface water/groundwater monitoring stations. Note that field adjustments were made to the DC-3 and DC-4 stations as related to the WET (2012) report (see Figure 4 versus WET report in Appendix A). Although not in Davidson Canyon, the BC-1 monitoring location was also modified. Additionally, BC-1 is anticipated to be only a surface water monitoring station.

Rosemont is concerned that existing water quality data from the OAW segment of Davidson Canyon Wash consists of a limited suite of analysis - and no samples specifically related to stormwater. It is

Rosemont's anticipation that any baseline monitoring would include a suite of analytes similar to the suite in Section 2.1.1 prior to the initiation of Project construction.

2.2 PHASE 2 MONITORING

Within six (6) months of initiation of construction activities within the Project footprint, Phase 1 monitoring described will transition to Phase 2 monitoring. Construction will be defined by earthmoving activities rather than data gathering or mitigation work such as geotechnical drilling or archaeological mitigation. No gaps in monitoring will occur, only the designation of one phase (pre-construction) to another (construction/operations). In addition to continuing some of the monitoring described above in Section 2.1, Phase 2 monitoring will consist of the following components:

- Stormwater monitoring under the AZPDES MSGP. Stormwater monitoring under the AZPDES MSGP will continue. Additionally, baseline stormwater monitoring, as described above in Section 2.1.1, may be occurring simultaneously and will cease when each respective wash is disturbed due to Project construction. Additional discussion on this monitoring component is provided in Section 2.2.1;
- Continued monitoring at two (2) existing surface water/groundwater monitoring stations (one in Barrel Canyon Wash and one in Davidson Canyon Wash) under Mitigation Measure FS-BR-22 and as described in Section 2.1.2 and in Appendix B of this Plan;
- Additional surface water/groundwater monitoring as required under Mitigation Measure FS-BR-22. This will include construction of several other automated surface water and surface water/groundwater monitoring stations in Barrel and Davidson Canyon washes, and also in Cienega Creek depending upon property access. Monitoring parameters at these stations will include: stream stage and discharge; stormwater quality; precipitation; shallow subsurface soil moisture, temperature, and conductivity; groundwater quality and groundwater levels of bedrock and alluvial aquifers. Additional discussion on this monitoring component is provided in Section 2.2.2;
- Implementation of geomorphological monitoring under USFS Mitigation Measure FS-BR-22 at four (4) of the surface water/groundwater stations in Davidson Canyon Wash for channel stability, sedimentation, scour, and aggradation. Additional discussion on this monitoring component is provided in Section 2.2.3;
- Continued monitoring of streamflow at the USGS gaging station No. 09484580 in Barrel Canyon as described above in Section 2.1.3;
- Stormwater flow and water quality monitoring within McCleary and Scholefield Canyons as described in Section 2.1.4 (see Appendix E for proposal). These two (2) automated stormwater monitoring stations would measure precipitation and stream level, in addition to stormwater runoff;
- Continued semi-annual flow monitoring of 25 springs and seeps located downstream, but in the vicinity, of the Project area, as described above in Section 2.1.5 and as required by Mitigation Measure FS-SSR-02 (see Appendix F for plan);
- Implementation of sediment transport monitoring at two (2) locations in lower Barrel Canyon Wash to monitor stream channel stability, sediment deposition, and scour within the channel, as required by USFS Mitigation Measure FS-SR-05 (see Appendix G for plan). Additional discussion on this monitoring component is provided in Section 2.2.4. Monitoring under this program will begin prior to major site disturbance; and

- Addition of pebble counts and particle size analysis, and vegetation monitoring to the geomorphological monitoring requirements (FS-SR-05 and FS-BR-22) in Barrel and Davidson Canyon washes. Additional discussion on these monitoring components is provided in Sections 2.2.5 and 2.2.6, respectively.

2.2.1 MSGP Stormwater Monitoring

Upon implementation of the Phase 1 Drilling Program, Rosemont began stormwater monitoring under the AZPDES MSGP permit (AZMSG2010-003). Additional monitoring under Rosemont's voluntary Baseline Stormwater Monitoring Program also continues. The AZPDES MSGP stormwater monitoring and Rosemont's voluntary Baseline Stormwater Monitoring Program will overlap during the initial stages of construction. This will continue until such time that the individual drainages are disturbed and/or blocked off due to construction of stormwater impoundments within the Project area.

Outfall No. 1 (Sediment Control Structure No. 1) is proposed to be located in Lower Barrel Canyon Wash, just upstream of the confluence with McCleary Canyon Wash and just downstream from the northeast toe of the planned Dry Stack Tailings Facility. Outfall No. 2 (Sediment Control Structure No. 2) will be located south of Sediment Control Structure No. 1, at the upstream portion of Trail Creek, and downstream from the eastern edge of the planned Waste Rock Storage Area. Figure 5 shows the proposed locations of the two (2) AZPDES MSGP stormwater monitoring locations.

For the purposes of this Plan, Rosemont will evaluate the analytical results from the MSGP sampling to determine if changes or variabilities in those data can be correlated to sediment transport monitoring data, discussed below in Section 2.2.6. Data will also be evaluated to identify any water quality changes, possible cause(s) of the change, and any potential effects on assimilative capacities or pollutant loadings. Best stormwater management practices will be adjusted accordingly to ensure downstream water quality is not negatively affected.

Monitoring of the following analytical parameters is required under Permit AZMSG2010-003:

- Hardness (calculated from calcium and magnesium)
- pH
- Calcium
- Magnesium
- Antimony - analyzed as total recoverable (total)
- Arsenic - total
- Beryllium - total
- Cadmium - total and dissolved
- Copper - total and dissolved
- Iron - total and dissolved
- Lead - total and dissolved
- Mercury - total and dissolved
- Nickel - total and dissolved
- Selenium - total
- Silver - total and dissolved
- Zinc - total and dissolved

Because the receiving waters are ephemeral, monitoring of Total Suspended Solids (TSS) and Turbidity is not required under the MSGP. However, in an attempt to monitor suspended sediments in stormwater, TSS will be included as a monitoring parameter.

2.2.2 Additional Surface Water/Groundwater Monitoring Under FS-BR-22

Additional surface water and/or surface water/groundwater monitoring stations required under USFS Mitigation Measure FS-BR-22 will be constructed once property ownership/access issues and other factors are resolved. These monitoring stations will be equipped to monitor the same parameters as the existing two (2) stations currently monitored, and as listed above in Section 2.1.2.

In addition to a weather station, and excluding the installed stations BC-2 and DC-3, the original list of additional surface water/groundwater monitoring sites listed in FS-BR-22, contingent upon access agreements and restriction, included:

- BC-1 – to be located at the compliance point dam in Barrel Canyon;
- DC-1 – to be located in upper Davidson Canyon, below Questa Spring and above confluence with Barrel Canyon;
- DC-2 – to be located in Davidson Canyon, below the confluence with Barrel Canyon;
- DC-Dike – to be located in Davidson Canyon, near the hypothesized intrusive dike;
- DC-4 – to be located in Davidson Canyon, above the confluence with Cienega Creek, near downstream end of the OAW segment;
- CC-1 – to be located in Cienega Creek, upstream of the confluence with Davidson Canyon; and
- CC-2 – to be located in Cienega Creek, downstream of the confluence with Davidson Canyon.

The locations of the seven (7) additional surface water and surface water/groundwater monitoring stations, plus the existing two (2) stations, are shown on Figure 4. As noted in Section 2.1.6, the locations of BC-1, DC-3 and DC-4 have been modified from their original locations. Additionally, station BC-1 will only monitor surface water.

Each of the additional monitoring stations will be constructed to collect the same data as the existing surface water/groundwater monitoring stations (see Section 2.1.2).

2.2.3 Davidson Canyon Sediment Transport Monitoring

In addition to the surface water/groundwater monitoring, Mitigation Measure FS-BR-22 requires stream geomorphology monitoring at four (4) locations in Davidson Canyon Wash for channel stability, sedimentation, scour, and aggradation. These four locations will be established at specific points in Davidson Canyon Wash, ideally adjacent to or very near to the surface water/groundwater monitoring stations. Additional sediment monitoring locations can be added as needed.

Rosemont will conduct geomorphological monitoring (sediment transport and channel stability) at the established points every year for five (5) years. After five (5) consecutive annual geomorphological monitoring events, the frequency of geomorphological monitoring will be reduced to every fifth (5th) year as required in the Biological Opinion (BO) throughout the remaining operational and reclamation phases, plus one monitoring event in the closure phase of the Project, i.e., 5th year of closure. Monitoring will occur during the same month every monitoring event (for example, after the monsoon season in the October-November timeframe). The specific location across the wash will be selected

following discussions with the USFS and ADEQ.

Rosemont has proposed using a ground-based LIDAR (Light Detection and Ranging) scanner to scan/map the stream channel at each of the Davidson Canyon Wash monitoring points/locations. The LIDAR scanner is an active remote sensing technology that uses light pulses to measure relative distance from the scanner, as well as other characteristics (texture, hardness, etc.) of terrain and objects. This generates a 3-dimensional point "cloud" of the area that also includes light intensities and RGB color values from a digital camera. (RGB stands for the three primary luminance or light colors: red, green and blue. Depending on the signal levels of each of these components, secondary colors, including black, white, or gray, can be produced on a viewing screen.)

It is anticipated that areas less than 100 feet x 100 feet will be scanned at each monitoring point, focusing on the stream channel. Details are included in Appendix B (Draft Barrel/Davidson Wash Monitoring Plan – FS-BR-22).

Geomorphological monitoring will be implemented once property access/right-of-way approvals are received and approval of methods and locations.

2.2.4 Barrel Canyon Sediment Transport Monitoring

Under USFS Mitigation Measure FS-SR-05, Rosemont will establish two (2) monitoring points/locations in lower Barrel Canyon Wash to monitor and assess changes in stream geomorphology (see Appendix G for plan). The monitoring points/locations will be located as follows:

- Approximately 800 feet downstream of the proposed Sediment Control Structure No. 1; and
- Co-located with the BC-2 surface water/groundwater monitoring station – approximately 11,500 feet downstream of the proposed Sediment Control Structure No. 1.

Similar to the geomorphological monitoring in Davidson Canyon (Section 2.2.3), sediment transport monitoring in Barrel Canyon will be conducted initially every year for the first five (5) years. After five (5) consecutive annual monitoring events, the frequency of sediment transport monitoring will be reduced to once every fifth (5th) year throughout the remaining operational and reclamation phases, plus one monitoring event in the closure phase, i.e., 5th year of closure. The initial five (5) year annual monitoring period will begin in the pre-construction period.

2.2.5 Pebble Counts and Particle Analysis

In addition to the sediment transport measurements, Rosemont will perform pebble counts, particle size analysis, and field observations at the stream geomorphology monitoring points in Davidson and Barrel Canyons and at the same monitoring frequencies (see Section 2.2.3 and 2.2.4, respectively). The pebble count and particle analysis will be conducted in the same locations as the LIDAR survey.

Pebble counts and particle analyses will initially be conducted at the specific locations every year for five (5) years. After five (5) consecutive annual monitoring events, the frequency of pebble counts and particle analysis (as well as geomorphological monitoring) will be reduced to once every five (5) years throughout the remaining operational and reclamation phases, plus one event during the closure phase. Monitoring will occur during the same month every monitoring event.

2.2.6 Vegetation Monitoring

Rosemont proposes to conduct vegetation monitoring at the stream geomorphology monitoring locations in Davidson and Barrel Canyons and at the same monitoring frequencies (see Section 2.2.3 and 2.2.4, respectively). Vegetation monitoring will consist of a field assessment, consisting of descriptive and photographic documentation, of the existing vegetation at each monitoring point. Vegetation monitoring will document the volume, extensiveness, and overall health of the vegetation.

As a note, in previous field investigations, WestLand Resources assessed the riparian resources associated with the Project site and immediately downstream (WestLand, 2007; WestLand, 2010; WestLand, 2012). Most of the vegetation along Davidson Canyon wash currently consists of xeroriparian habitat. Estimates provided in Pima County mapping (that were used in development of the FEIS) were found to significantly overstate the riparian resources, average onsite measurements resulted in less than 40% of the anticipated riparian vegetation. This would result in an associated overstatement of impacts to a similar degree; therefore, Rosemont will use an actual measured baseline rather than the analysis in the FEIS.

3.0 GENERAL DATA REVIEW AND EVALUATION

The volume of data that will be collected and managed through the various monitoring programs described above will be quite substantial. As discussed above in Section 2.0, Rosemont will provide ADEQ with the following data on an on-going basis under this Surface Water Mitigation Plan:

- Precipitation volume;
- Streamflow stage, discharge, and peak;
- Stream channel stability, sedimentation, scour, and aggradation (geomorphology);
- Pebble count and particle analyses;
- Stable isotope analytical results for precipitation samples;
- Analytical results from stormwater quality samples;
- Shallow subsurface soil conductivity, temperature, and moisture;
- Shallow and bedrock aquifer water quality and water levels; and
- Spring flow conditions.

All field data collected through these monitoring programs, as well as all other monitoring programs conducted by Rosemont, will be entered into an electronic data management system.

Field data and laboratory analytical data will be reviewed upon receipt to ensure that the data are reliable, unbiased, accurate, and complete, and have full documentation. Personnel who have knowledge and expertise within the technical discipline of the specific monitoring activity will conduct a technical evaluation of the data within 90 days of receipt of data. The evaluation will consist of compiling and organizing the data; assessing potential trends and seasonal variability; and documenting findings. Graphs will be developed to illustrate any trends and outlier data points. Statistical tests may be used in combination with the graphs. Water quality data will be compared with applicable water quality standards.

Sections 3.1 through 3.3 provide a summary of some of the monitoring data collected at the Project site along with a brief analysis of that data.

3.1 RESULTS FROM CURRENT MONITORING DATA – STREAMFLOW

Streamflow data recorded in 2013 from the two (2) existing automated surface water/groundwater monitoring stations reveal 23 total days of measured streamflow in lower Barrel Canyon Wash compared to two (2) days of measured streamflow in Davidson Canyon Wash, just four (4) miles downstream (WET, 2014). This disparity is evidence of the huge volume of unsaturated fluvial sediments and assimilative capacity that exists in the ephemeral wash system between lower Barrel Canyon Wash and Davidson Canyon Wash just within four (4) miles. The conclusion that can be drawn from these data is that streamflow in lower Barrel Canyon Wash does not necessarily result in streamflow in Davidson Canyon Wash.

In addition to physical parameters, the surface water/groundwater monitoring stations also collect stormwater quality samples via an automated ISCO pump sampler system. Existing stormwater quality data (albeit limited) indicates that the quality of stormwater samples collected at the Davidson Canyon Wash station is similar to water quality in stormwater samples collected from the Barrel Canyon Wash station.

3.2 RESULTS FROM CURRENT DATA – STORMWATER QUALITY

Analysis of existing water quality data from the voluntary Baseline Stormwater Monitoring Program (discussed above in Section 2.1.1) indicate that existing water quality already exceeds the applicable surface water quality standard for lead. These concentrations could be an indication of impacts from leaded gasoline fuel used in vehicles for decades, lead bullets or shot from target shooting, or the inherent mineralization of the mining district within the national forest. Any or all of these may be having an effect on downstream surface water quality.

Removing or covering resources at the Project site will likely provide source control for various possible contaminants during construction and may very well improve downstream stormwater quality. In addition to this, the implementation of BADCT design for the Project facilities, best management practices, and the numerous monitoring programs, suggests no degradation to downstream water quality will occur due to Project construction, operation, and/or closure activities. Additionally, no degradation is anticipated to the water quality in the OAW segment of Davidson Canyon Wash due to Project construction, operation, and/or closure activities.

3.3 RESULTS FROM CURRENT DATA – PRECIPITATION

As mentioned above in Section 2.1.2, precipitation water samples are currently collected at three (3) stations on and downstream of the Project area: 1) the weather station located near the Open Pit; 2) the lower Barrel Canyon Wash automated surface water/groundwater monitoring station; and 3) the Davidson Canyon Wash automated surface water/groundwater monitoring station. Precipitation water samples are submitted to the University of Arizona laboratory for stable hydrogen/oxygen isotope analysis. Winter precipitation results range from -2.4/-4.0 ($^{18}\text{O}/^2\text{H}$) on January 25, 2013 to -13.2/-102.0 on January 28, 2013. Summer precipitation results range from -2.6/-31.0 on July 2, 2013 to -19.6/-149 on August 30, 2013. The only conclusion that can be made from the precipitation data is that there are more rainfall events (20 events) between July and September than there are between October and June (11 events).

4.0 SURFACE WATER MODEL

The development of a Surface Water Model (Model) is planned. As indicated in Section 1.0, this Model will be used as a predictive tool to quantify potential changes in surface water runoff from the Project site based on staged development. To the extent that these changes affect, or have the potential to affect, downstream water quality, ADEQ has requested mitigation for these changes.

In addition to serving as a tool to quantify potential flow reductions due to Project activities, the Model will be used to estimate runoff replacement quantities from off-site mitigation locations. Project effects will be based on existing and new monitoring points located throughout the watershed up-gradient of the USGS Gaging Station. The USGS station is located at the intersection of SR 83 and the Lower Barrel Canyon drainage.

Modeling will be performed with software such as KINEROS2 (a kinematic runoff and erosion model). This computerized distributive runoff model accommodates a spatial variation of rainfall, infiltration, runoff, and erosion parameters and can be used to determine the effects of development within a watershed such as the staged progression of the Rosemont Project.

Because of the variable nature of storms in the semi-arid environment encompassing Rosemont, the Model will need to be calibrated based upon the spatial and temporal distribution and intensity of recorded individual storm events before total yearly runoff volumes can reasonably be predicted. The outcome of the Model calibration is the development of rainfall-runoff relationships. The Model will be used to simulate two conditions: a 'baseline' condition (undisturbed watershed condition) that will be calibrated based on approximately two years of observed rainfall-runoff data; and 'concurrent' condition (disturbed watershed condition) that will continuously be updated to reflect development changes in the watershed and will be re-calibrated on a yearly basis. Using the same design precipitation input, the difference in calculated runoff volume between the two model conditions will be used to estimate potential impacts as a result of the Project (see Illustrations 2 and 3).

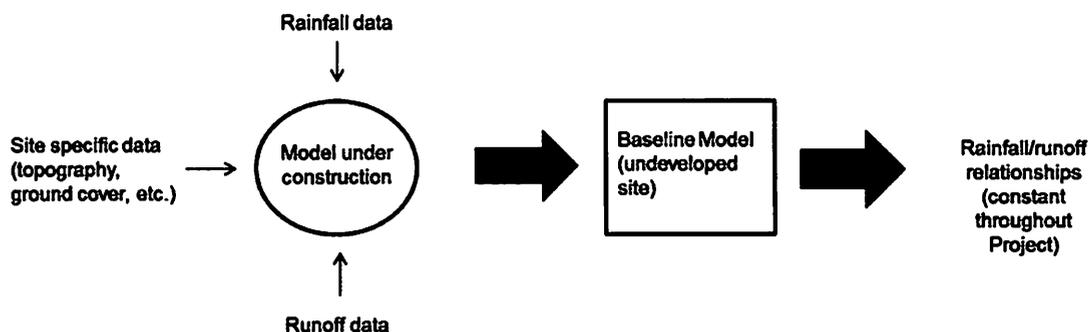


Illustration 2: Baseline Model

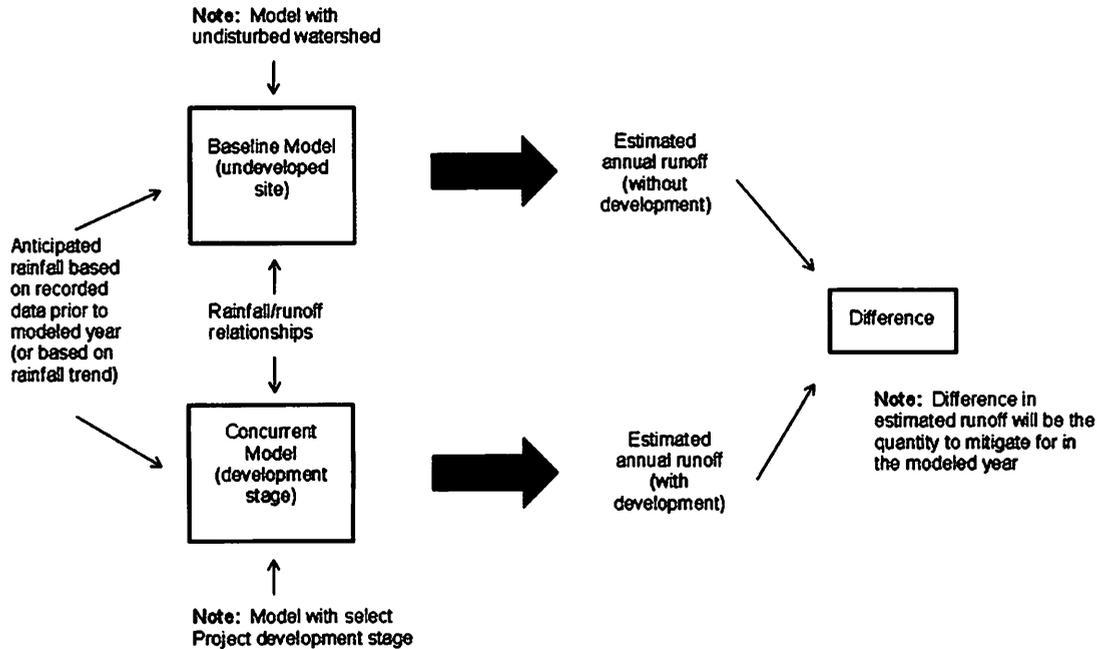


Illustration 3: Concurrent Model versus Baseline Model

Up until the point when major construction occurs, all watersheds within the Project area will be used for calibration of the 'baseline' Model. Once major construction starts, and stormwater flow paths become impacted by development, the 'baseline' Model will remain constant throughout the remainder of the Project. Other regionally instrumented watersheds, such as the Santa Rita Experimental Watershed, may also be used to help determine reasonable event-based, rainfall-runoff relationships.

The 'concurrent' Model will be used proactively. The estimated annual runoff will be calculated for the upcoming year based on mine development plans. Predicted runoff volume estimates (determined from the 'concurrent' Model) will be based on actual recorded precipitation events in the watershed from the previous year (or multiple years depending on rainfall trends). The summation of these individual recorded precipitation events will be input into the 'concurrent' Model to estimate the next year's runoff totals. This same rainfall will be input into the 'baseline' model and the results compared to the 'concurrent model'. This comparison will result in a difference in stormwater volumes that will require mitigation (see Illustration 3).

The runoff volume estimates, as determined from the 'concurrent' Model, will then be compared against actual stream flow and precipitation measurements recorded during the year modeled. The projected surface runoff volume estimates from the 'concurrent' Model will then be reconciled against recorded streamflow data to determine the effect of Project development over that year (see Illustration 4).

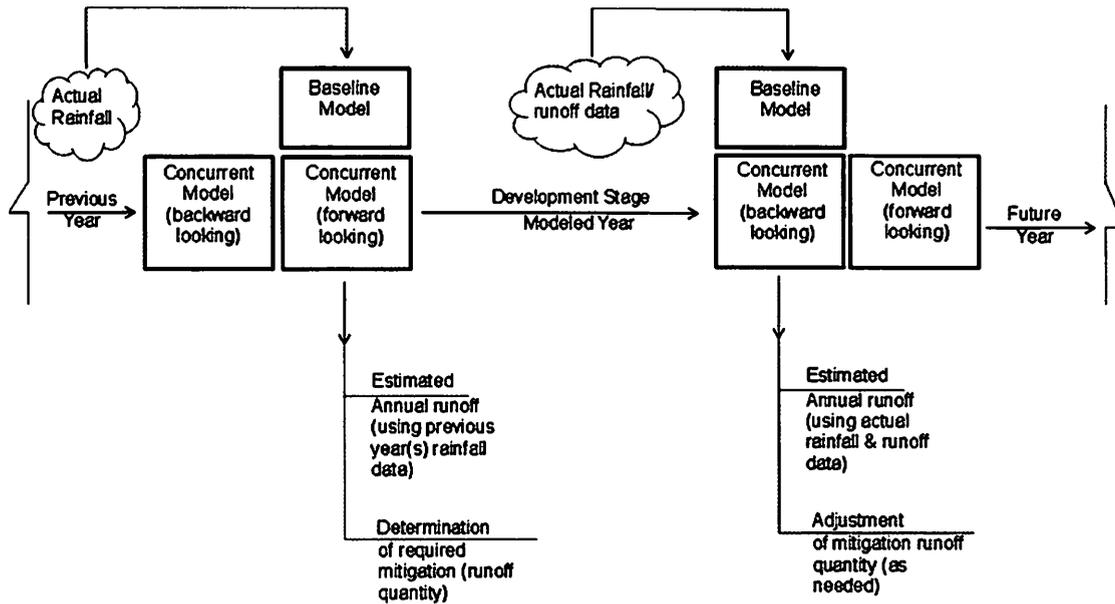


Illustration 4: Model Progression

Once mitigation requirements have been determined based on an estimated annual runoff deficiency, mitigation sites will be reviewed and runoff credits will be calculated. Since the calculation will be forward looking (assumed weather conditions), the updates will also look backward at the data to determine if additional credits are required based on actual data. The yearly analysis will produce a table summarizing the yearly runoff reductions and/or runoff additions, including adjustments. In terms of mitigation credit, the goal will be to balance the credits and impacts over the long-term.

In summary, at a minimum the table will include:

- Anticipated runoff reduction for upcoming year (onsite);
- Anticipated runoff credit for upcoming year (offsite);
- Adjustment of the previous year's reduction and/or credit based on actual monitoring data, i.e., adjustment to the annual runoff number; and
- Running total of mitigation sites and their yearly contribution

Development of the Model will include a review of all existing and planned monitoring stations and, as needed, a recommendation for additional instrumentation; i.e., rain gages and flow recording stations, that will assist in developing a more accurate accounting of rainfall (and infiltration) within the Project site.

As indicated in Section 2.0, existing monitoring points located within or downstream of the Project area include the following:

- USGS gage stream flow data;
- BC-2 monitoring station data;
- DC-3 monitoring station data; and
- Rainfall gage data (open pit station, BC-2/DC-3 monitoring stations, etc.).

Also indicated in Section 2.0, anticipated future instrumentation includes the following:

- BC-1 surface flow monitoring station in Lower Barrel Canyon (Sediment Control Structure No. 1 location);
- Additional Davidson Canyon and Cienega Creek surface flow monitoring stations similar to BC-2 and DC-3 stations;
- Additional rainfall gages;
- Surface flow monitoring stations in Scholefield and McCleary Canyons; and
- Weather station(s) associated with ADEQ's Air Quality Permit and/or other Mitigation Measures listed in Appendix B of the FEIS.

5.0 MITIGATION

Rosemont does not anticipate any adverse changes to water quality or the stability of Davidson Canyon Wash or the OAW segment as a result of the Project activities. However, as a condition of the 401 Certification and as tied to potential water quality changes, mitigation measures are proposed that are related to the replacement of stormwater and sediment based on Project site activities. Replacement of stormwater will be based on the surface water modeling results described in Section 4.0. This section proposes and discusses, in general, a number of mitigation measures that could be employed to offset and/or replace reduced stormwater flow volume from the Project site if attributable to site activities. Stormwater Mitigation (Section 5.1) includes the following sections:

- Section 5.1.1 – On-site stormwater management
- Section 5.1.2 – Water rights assignment
- Sections 5.1.3, 5.1.4 and 5.1.5 – Closure of stock watering locations
- Section 5.1.6 – Additional Mitigation Opportunities
- Section 5.1.7 – Mitigation Selection Order

Section 5.2 covers sediment mitigation as well as providing a review of planned monitoring related to sediment loading/deposition.

The mitigation measures proposed and described below are in terms of a general concept. When it is determined that mitigation is required, and to what extent, a Mitigation Plan will be prepared by Rosemont that describes the specific and appropriate mitigation measure to be implemented, including the timeline for implementation and term of the activity.

Even though potential stormwater losses (and corresponding sediment losses) will be resolved based on mitigation sites, monitoring within the Davidson Canyon watershed will still take place. Should water quality conditions change at the OAW in Davidson Canyon, the general monitoring data will be used to help determine potential causes.

5.1 STORMWATER MITIGATION

5.1.1 On-Site Stormwater Management

During development of the Rosemont Project, a number of stormwater catchments and sediment traps (collectively referred to as “catchments”) are currently anticipated based on the Project development plans. Until actual field activities start, it is impossible to ascertain if all of the catchments will be required to ensure conformance with the MSGP. Where practicable, Rosemont has determined that the first mitigation efforts will be on-site flow diversion, installation of culverts, or management of activities to eliminate the need for impounding stormwater runoff waters onsite. This technique addresses both stormwater flow and sediment flow.

5.1.2 Water Rights Assessment

Rosemont has acquired an option to purchase a number of the highest priority surface water rights at Pantano Dam. These rights are currently used to provide irrigation water to a nearby golf course. As far as Rosemont has been able to determine, these priority rights have never been exercised to protect the water resources at the dam from upstream water users, or from other permitted consumptive uses. These uses affect downstream flows and ultimately the delivery of water to the system.

Rosemont proposes to sever and transfer the youngest of the water rights at the Pantano Dam (a 1935 right) and transfer it to ASLD, Arizona Game and Fish, or other State Agency allowed by law to hold a water right for the expressed right to protect the resources of the OAW segments in Davidson Canyon, i.e., eliminate upstream uses. This right is for 46 acre-feet and can be exercised to eliminate the rights that are newer than 1935. There are no rights that exist in the Davidson Canyon watershed that Rosemont is aware of that predate 1935 (other than Rosemont's own rights). It is anticipated that the State Agency and ADEQ will cooperatively work to examine opportunities for protection of the OAW in relation to this water right. It is noted that based on the flow information recorded in Lower Barrel Canyon Wash (as measured by the USGS gaging station No. 09484580 located at the SR 83 bridge; see Appendix D), this 46 acre-foot surface water right represents the entirety of the stormwater flow recorded at the USGS gage in 2013.

5.1.3 Closure of Stock Well in Davidson Canyon Wash

Rosemont currently owns a shallow, hand-dug well that is located on the northwest bank of Davidson Canyon Wash, approximately ½ mile upstream from the confluence with Barrel Canyon Wash. This well is part of the Rosemont grazing allotment and provides water to cattle while grazing on the east side of SR 83 highway. Water is pumped as needed for grazing. For the purposes of mitigation, Rosemont would propose to close this well along the stream channel.

ADEQ staff viewed the well during a field visit conducted with Rosemont in December 2013, which included areas within the Project site and down Davidson Canyon Wash to the confluence with Cienega Creek. Closing this well will provide a direct effect to the alluvial system of Davidson Canyon and provide a direct "wet water" replacement/offset for any potential Rosemont's impacts.

5.1.4 Cessation of Stock Watering at Questa Spring

One of Rosemont's properties in Upper Davidson Canyon includes a spring (Questa Spring), which currently has a well-developed cattle watering tank/system developed around it. This spring system reports to a tank rather than discharging to the ground, which increases the evaporation associated with the spring discharge and takes water from the natural system.

For the purpose of mitigation, Rosemont would propose to work with the appropriate agencies (i.e., Arizona Game and Fish, State Land, etc.) to eliminate the stock watering system associated with this spring and divert the discharge back into its natural channel. This return to a natural spring system will allow water to feed the Davidson Canyon system rather than be lost to evaporation.

5.1.5 Closure of Stock Ponds and Tanks

Rosemont owns the water rights to a number of stock ponds/tanks within or downstream of the Project area. While a number of those stock ponds will be directly impacted by the Project, a number of them are outside of the disturbance area. For the purpose of mitigation, Rosemont would propose to systematically close stock ponds and replace them with wells and stock drinkers, which overall would put storm flows back into the system. Removal of stock ponds would also put sediment currently trapped by the ponds back into the system, naturally offsetting any potential sediment losses to the system.

Because these stock ponds are part of on-going monitoring at Rosemont in relation to biological resources, any systems used to replace the ponds will need to be coordinated with the appropriate agency. The opportunities for potential replacement/elimination of the stock ponds are listed and

described below. The biological descriptions, IDs, cadastral locations, and other information of the following stock ponds are cited from the draft FEIS (Table 88) and WestLand Resources annual ranid (frog) surveys conducted from 2008 through 2011 (WestLand 2009a, 2009b, 2011a, 2011b). Surveys of these stock pond locations, and associated watersheds, would be conducted by Rosemont as part of developing the mitigation site portion of the surface water model.

A survey of the stock tanks will be initiated in the pre-construction period to verify storage volumes and to determine the overall watershed condition up-gradient of the tanks.

5.1.5.1 Wasp Canyon Tank No. 38-70881

Tank ID: Surface water right no. 38-70881 / cadastral location (D-18-15) 25dd

This tank corresponds with the "South Upper Stock Tank (ID 10)", and is described as:

- Small stock tank (80 by 30 feet); appears to be recently developed. Westernmost of four tanks along FR 4501. Three site visits – August 25, August 26, and September 5, 2008. Tank supported 60-by-30-foot surface water in August and September 2009. Tank supported 20 m by 20 m of surface water in April 2011, was dry on August 16, 2011, and contained approximately 10 m by 5 m surface water on August 29, 2011.

The tank depth is unknown; therefore the actual volume is also unknown. However, based on the description, the tank holds at least 0.1 acre-feet of water.

5.1.5.2 Davidson Canyon No. 38-63384

Tank ID: Surface water right no. 38-63384 / cadastral location (D-17-17) 30ab / approximate UTM: 533815, 3532715 / (ID 11)

There is no specific description on this tank; however, it has an assigned water right. Rosemont is in the process of determining the specifics contained in the water right and the actual capacity of the stock pond.

5.1.5.3 Davidson Canyon No. 38-66914

Tank ID: Surface water right no. 38-66914 / cadastral location (D-17-17) 30ab / approximate UTM: 533815, 3532715 / (ID 11)

There is no specific description on this tank. Rosemont is in the process of determining the specifics contained in the water right and the actual capacity of the stock pond.

5.1.5.4 Davidson Canyon (D-17-16) 36a

Tank ID: Cadastral location (D-17-16) 36a / approximate UTM: 532400, 3531350 / (ID 13)

There is no specific description on this tank. Rosemont is in the process of determining the specifics contained in the water right and the actual capacity of the stock pond.

5.1.5.5 Davidson Canyon (D-17-17) 07b

Tank ID: Cadastral location (D-17-17) 07b / approximate UTM's: 533031, 3537204 / corresponds with Davidson Canyon at diversion dam (ID 14)

The description from the 2011 rapid survey included:

- During the May 23, 2011 visit the pond was dry. On August 26, 2011 the surface water area was approximately 125 m by 50 m.

The pond depth is unknown; therefore the actual volume cannot be calculated. However, it is estimated that the pond holds at least 3 acre-feet of water.

5.1.5.6 McCleary Canyon (D-18-16) 19cc

Tank ID: Cadastral location (D-18-16) 19cc; corresponds McCleary Stock Tank (ID 20)

The description from the 2009 rapid survey included:

- This stock tank contained a 60-by-45-foot (20-by-15-m) area of surface water in August and September 2009.

The tank depth is unknown; therefore the actual volume is also unknown. However, based on the description, the tank holds at least 0.1 acre-feet of water

5.1.5.7 Barrel Canyon/East Dam Tank

Tank ID: Barrel Canyon / East Dam Tank; cadastral location (D-18-16) 128ac; corresponds to East Dam Tank (ID 21)

The description from the 2008 rapid survey included:

- Small wet area (25 by 10 feet [8 by 3 m]) in unnamed ephemeral tributary to Barrel Canyon, about 0.7 kilometers (km) south of USFS Road 231 (FR 231) during the September 12, 2008 site visit. Mud/silt and gravel substrate, extremely clear. Small wet area fed by water from East Dam. The stock pond is located on Coronado National Forest (CNF) land.

The stock tank depth is unknown; therefore the actual volume cannot be calculated. However, it is estimated that this large stock tank holds at least 5 acre-feet of water.

5.1.5.8 Davidson Canyon (D-18-16) 01ab

Tank ID: Cadastral location (D-18-16) 01ab / (ID 24)

There is no specific biological description on this tank. Rosemont is in the process of determining the number and specifics of the associated water right, including the capacity of the tank.

5.1.5.9 Summary

The stock ponds/tanks listed above have an aggregate storage capacity of at least 8.2 acre-feet. Assuming two fill periods, one during the monsoon flows and one during the winter rains, the volume of storage that could potentially be replaced in Davidson Canyon Wash could exceed 15 acre-feet per year. An assumption of three fills from storm events would approximate 25 acre-feet per year. Actual quantities will be determined via measurement and then modeling as described in Section 4.0.

Prior to closing any of the stock ponds, Rosemont proposes to evaluate the usefulness of each pond, ensure that the estimates of storage are appropriate and can be documented, and work with the Forest Service, State Lands, and the Arizona Game and Fish to ensure habitat for frogs and access to water for other wildlife are not adversely effected. Installing replacement drinkers with habitat features would also be considered for these sites, as appropriate.

Each stock tank closure would require a plan to breach the containment, manage the sediment, and salvage the riparian resources. It will also include a plan to stabilize the area with plantings or rip-rap as appropriate.

5.1.6 Additional Mitigation Opportunities

Several additional opportunities for mitigation exist for future consideration but are not preferable at this time. Those opportunities could be evaluated if the measures previously described do not bring about the desired mitigation effects and include:

- A change in the current design of the on-site Project stormwater management systems to provide mitigation to surface flows;
- Using pit dewatering water on an episodic basis to mitigate for temporal losses associated with stormwater reduction;
- Installing a well to provide water to the system on a regular basis to offset stormwater reductions; or
- Identifying off-site source control efforts in conjunction with ADEQ to eliminate pollutant loading within the Davidson Canyon drainage that is not associated with the Project. Such sources may be easily and inexpensively controlled at their source, and Rosemont could identify such solutions with funding.

5.1.7 Mitigation Selection Order

The following illustration (Illustration 5) provides a general order of selection of mitigation opportunities related to stormwater replacement, as needed, based on preserving surface water quality downstream of the Project. As noted, the initial course of action will be to delay, as long as practicable, the impoundment of stormwater once site development begins. Opportunities to reroute stormwater will be determined as part the annual Surface Water Model review. The closure of stock wells/tanks and the reassignment of water rights will be explored as initial mitigation options followed by the modification of earthen stock watering ponds. As noted, other options may be explored if needed. In any case, model results and calculated stormwater differences between the baseline and concurrent model will be reviewed with ADEQ prior to selecting and implementing stormwater mitigation options.

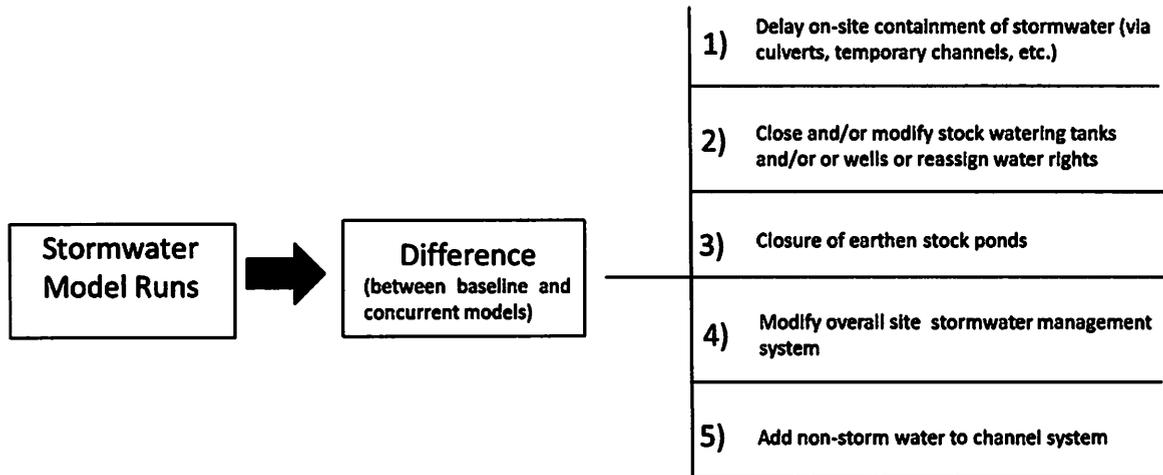


Illustration 5: General Surface Water Mitigation Selection Order

5.2 SEDIMENT MITIGATION

Replacement of sediment within the system will require ADEQ to balance the requirements of its varying permitting programs. The AZPDES MSGP program requires sediment control and specific best management practices to ensure sediments are not released in amounts that will effect water quality. Rosemont will consider adjustments to the MSGP requirements if ADEQ deems it necessary to increase sediment loading from the Project site.

In terms of mitigating for sediment loss, the removal of stock ponds/tanks will directly mitigate for sediment losses by allowing sediment currently being trapped to naturally enter the system. And as stated above and depending on water quality issues, the removal of the sediment control structures located down-gradient of the planned facilities may also be viewed in terms of functionally adding sediment back into the system.

As noted in previous sections of this Plan, locations along Lower Barrel Canyon Wash and along Davison Canyon Wash will be assessed for changes in geomorphology. The following will be monitored/assessed at these locations:

- Topographic surveys (using LIDAR). This will help determine whether the stream-bed at that specific location is aggrading or degrading, i.e., adding sediment or losing sediment. Since changes within the stream-bed can be dramatic following flow events, this monitoring will be looking at long-term trends in sediment deposition. Photographic documentation will also take place along with the topographic surveys.
- Pebble counts and particle size analysis. This will help determine whether the characteristics of the flow events are changing in relation to carrying capacity. As with the topographic surveys, this data will be viewed in the context of a long-term trend analysis.

In addition to topographic surveys and pebble counts/particle size analysis, stormwater samples from surface water/groundwater monitoring stations, such as Station BC-2 and DC-3, will be analyzed for TSS. A trend analysis will be performed for TSS in an attempt to give an indication of the sediment load carried by the steam.

7.0 REPORTING

Summaries of monitoring data will be prepared quarterly and provided to ADEQ as they are required for submittal to the Forest Service. The quarterly data will provide only the latest data gathered during that period.

An Annual Summary Report will be prepared for ADEQ that provides current quarterly data along with the entire previous years' data. The report will also include analyses, statistical calculations, and updates on the following:

- Precipitation reported from the various rain gages described in this Plan;
- Streamflow data from the USGS gaging station and the automated surface water/groundwater monitoring stations (as installed) in Barrel Canyon and Davidson Canyon washes;
- Soil moisture, conductivity, and temperature recorded from the automated surface water/groundwater monitoring stations (as installed);
- Groundwater level data for both alluvial and bedrock wells associated with the surface water/groundwater monitoring stations (as installed);
- Geomorphological (sediment transport and channel stability data) and vegetation monitoring data results;
- Summaries and graphs, if necessary, of stormwater quality data from the designated AZPDES outfall points as well as the surface water and surface water/groundwater monitoring stations in Barrel and Davidson Canyon washes and Cienega Creek (as installed). Analytical results will be tabulated and compared with applicable water quality standards;
- Graphs, hydrographs, statistical analysis, and tables, as needed, to illustrate and represent the above data;
- Information regarding the development and/or maintenance of the surface water model, including implementation of mitigative measures that may include, but not limited to, the following:
 - Status of the sever/transfer of water rights;
 - Plans for closure of stock tanks;
 - Storage capacity and sediment loading estimates with the stock pond/tank closures, including an analysis of the quality of the water in the ponds/tanks; and
 - Identification of other water rights and wells in the alluvium that have been eliminated from consumptive use and their associated measurements.

Additionally, all monitoring data and reports required by other agencies and/or programs will also be available to ADEQ upon request.

8.0 ADAPTIVE MANAGEMENT

Rosemont will incorporate the adaptive management process into the monitoring and analysis associated with this Surface Water Mitigation Plan. This process will ensure that the initial intent of the Plan is being met and that pertinent data is being collected and reported and that site conditions are accurately represented. The three key components of adaptive management are:

- Testing assumptions – collecting and using monitoring data to determine if current assumptions are valid;
- Adaptation – making changes to assumptions and monitoring program to respond to new or different information obtained through the monitoring data and project experience; and
- Learning – documenting the planning and implementation processes and its successes and failures for internal learning as well as the scientific community.

Elements that may be modified as part of the adaptive management process for this Plan include, but are not limited to, the following:

- Monitoring locations;
- Monitoring parameters;
- Monitoring frequencies;
- Assumptions associated with pollutant loading, runoff volume, and/or assimilative capacity;
- Modeling approach;
- Mitigation opportunities or requirements;
- Implementation process for mitigation; and
- Information provided and included in the quarterly data summaries and in the Annual Summary Report.

9.0 DATA MANAGEMENT

Data will be managed as specified in the various plans referenced herein. With regard to the 401 Certification, data that is specifically associated with reporting to ADEQ will be kept for ten (10) years following the submission of the information. Annual summary reports will be kept for ten (10) years after the expiration of the Certification or until facility closure, whichever date is sooner.

10.0 REFERENCES

- Tetra Tech, 2011. *Predicted Regulatory (100-Yr) Hydrology and Average-Annual Runoff Downstream of the Rosemont Copper Project*. Consultant report prepared by Michael E. Zeller, Tetra Tech, for Rosemont Copper Company. July 21, 2011.
- USFS, 2013a. *Final Environmental Impact Statement for Rosemont Copper Project, Appendix B Mitigation and Monitoring Plan*. November 2013.
- USFS, 2013b. *Draft Record of Decision and Finding of Nonsignificant Forest Plan Amendment for the Rosemont Copper Project*. December 2013.
- WestLand Resources, Inc., 2007. *Rosemont Copper Project: Preliminary Springs Assessment [Issue No. SW-2; Item No. 12]*. Consultant report prepared for Rosemont Copper Company. December 3, 2007.
- WestLand Resources, Inc., 2009a. *2008 Ranid Survey of the Rosemont Holdings and Vicinity*. Consultant report prepared for Rosemont Copper Company. April 24, 2009.
- WestLand Resources, Inc., 2009b. *2009 Ranid Survey of the Rosemont Holdings and Vicinity*. Consultant report prepared for Rosemont Copper Company. December 21, 2009.
- WestLand Resources, Inc., 2010. *Onsite Riparian Habitat Assessment*. Consultant report prepared for Rosemont Copper Company. April 2010.
- WestLand Resources, Inc., 2011a. *2010 Ranid Survey of the Rosemont Holdings and Vicinity*. Consultant report prepared for Rosemont Copper Company. October 26, 2011.
- WestLand Resources, Inc., 2011b. *2011 Ranid Survey of the Rosemont Holdings and Vicinity*. Consultant report prepared for Rosemont Copper Company. December 23, 2011.
- WestLand Resources, Inc., 2012. *Rosemont Copper Project: Seeps and Springs Survey 2011 – 2012*. Consultant report prepared for Rosemont Copper Company. July 11, 2012.
- WET (Water & Earth Technologies, Inc.), 2012. *Davidson Canyon Conceptual Surface-Water Monitoring Program*. Consultant report prepared for Rosemont Copper Company. March 2012.
- WET, 2014. *Scholefield and McCleary Canyon Surface-Water Monitoring Instrumentation Proposal*. Proposal prepared for Rosemont Copper Company. March 13, 2014.
- WET, 2014. *Analysis of Barrel Canyon and Davidson Canyon Instrumentation Data, December 1, 2013 – December 2013*. Consultant report prepared for Rosemont Copper Company. January 6, 2014.

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11 **ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY**

12 **PIMA COUNTY, a body politic; and**
13 **PIMA COUNTY REGIONAL FLOOD**
14 **CONTROL DISTRICT,**

15 **Appellants,**

16 **vs.**

17 **THE STATE OF ARIZONA, and**
18 **THE ARIZONA DEPARTMENT OF**
19 **ENVIRONMENTAL QUALITY,**

20 **Respondents.**

REQUEST FOR HEARING

21 On March 5, 2015, Appellants Pima County and Pima County Regional Flood Control
22 District filed a Notice of Appeal challenging the Arizona Department of Environmental
23 Quality’s (“ADEQ”) issuance of a § 401 Water Quality Certification (“Certification”) to
24 Rosemont Copper Company (“Rosemont”) for its Rosemont Copper Project (the
25 “Mine”). As of the date of this Request, no docket has been opened by ADEQ or the
26 Office of Administrative Hearings so the above caption does not specifically reference
the matter being appealed.

1 A.R.S. § 41-1092.03(B) provides a party to an appealable action the right to obtain a
2 hearing by filing a notice of appeal. “Party” is not defined in A.R.S. title 41, chapter 6.
3 However, A.R.S. § 49-202(H) provides “[a]ny person who is or may be adversely
4 affected by the denial or imposition of conditions on the certification of a nationwide
5 permit or general permit” (A.R.S. § 49-202(H)) the right to appeal the certification
6 “pursuant to title 41, chapter 6, article 10.” *Id.* By implication, a person who has a right
7 to appeal pursuant to a specified process is a “party” for purposes of that process. To
8 deny Appellants the right to a hearing in this matter would make the right to appeal
9 pursuant to A.R.S. § 49-202(H) meaningless. Appellants therefore request a hearing in
10 this matter.

11
12 RESPECTFULLY SUBMITTED March 19, 2015.

13
14 BARBARA LAWALL
PIMA COUNTY ATTORNEY

15
16
17 By 
18 Charles Wesselhoft
Deputy County Attorney

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CERTIFICATE OF SERVICE

I hereby certify that on March 19, 2015, a copy of the above Request for Hearing, was served on the persons listed below by depositing said document into the U.S. Mail, postage prepaid (certified mail, return receipt requested) prior to 11:59 p.m.

Director
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

and

Hearing Administrator
ADEQ Office of Administrative Counsel
1110 West Washington Street
Phoenix, Arizona 85007

With a copy to:

Office of the Attorney General
Environmental Enforcement Section Administrative Appeals Desk
1275 West Washington Street
Phoenix, Arizona 85007

By: 