Environmental Consequences of the Proposed Rosemont Copper Mine: Significant Degradation to Waters of the United States
October 5, 2017 (Revised November 30, 2017)

EPA's 404(b)(1) Guidelines (Guidelines) have been applied in the review of proposed discharges of dredged or fill material into waters of the U.S. (waters) from the proposed Rosemont Copper Mine (Rosemont Mine) in Pima County, Arizona. Following a comprehensive analysis of the impacts on the physical, chemical and biological components of the aquatic environment, EPA has concluded that the Rosemont Mine will result in significant degradation to waters. This document explains the basis for EPA's determination.

The Rosemont Mine Will Cause or Contribute to Significant Degradation of Waters of the United States.

Fundamental to the Guidelines is the precept that dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern.[1] Specifically, the Guidelines provide that discharges are not permitted if they will cause or contribute to significant degradation of waters (40 CFR 230.10(c)).[2]

EPA's findings of significant degradation to the physical, chemical and biological components of the aquatic ecosystem are based upon factual determinations required under the Guidelines by Subparts B and G, and consideration of Subparts C-F, with special emphasis on the persistence and permanence of the direct and secondary effects outlined in these subparts.

Construction of the Rosemont Mine will result in the permanent filling and loss of 40.4 acres of jurisdictional substrate of streams covering 18 linear miles. An additional 8.9 acres of Sonoita Creek will be filled at Sonoita Creek Ranch. This will result in a permanent and irrevocable significant adverse effect to the aquatic ecosystem by altering the substrate elevations and bottom contours of waters; jurisdictional waters will be permanently filled and all ecological functions associated with the jurisdictional substrate will be lost.[3]

The direct filling of the stream substrate will result in direct and secondary adverse effects to the ecological functions at the discharge sites and in adjoining downstream tributaries through changes in flow patterns, water circulation, sediment storage and transport and various water quality parameters. The discharge of fill material into jurisdictional streams, seeps and springs and the associated denuding, grading and re-contouring of adjacent contributing watershed landscapes will permanently and adversely alter all existing natural physical and chemical characteristics, and functions of the aquatic ecosystem at the project site. In addition, the project will result in permanent significant adverse effects to flows and normal surface and groundwater fluctuations of high functioning receiving waters through the direct discharge of fill material and through secondary impacts resulting from stormflow diversion, changes in

[1] Guidelines for the Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230).
[2] As stated in Preamble to the Guidelines, Other Requirements for Discharge "significant" means more than trivial (p. 85343).
[3] See Appendix A: Environmental Setting and Significance and EPA Analysis dated November 30, 2017 of the *Final Habitat Mitigation and Monitoring Plan Permit NO. SPL-2008-00816-MB Rosemont Copper Project dated September 12,* 2017.

channel morphology through erosion, contamination and elevated levels of suspended sediment in the water column.

Secondary effects from increased scour will result in significant changes to water quality by increasing total suspended sediment and turbidity in surface water flows. Elevated levels of suspended sediment or moderate-to-high turbidity will have significant adverse effects on aquatic organisms in Barrel and Davidson Canyon Washes and Cienega Creek. Increased suspended sediment and turbidity will smother aquatic organisms as sediments settle out. Increases in turbidity can be expected to disrupt the feeding, movement, spawning, and rearing of aquatic organisms such as native fish and amphibians.

The discharge of fill material will permanently and significantly change the chemistry and the physical characteristics of the receiving water below the mine site through the introduction of heavy metals and constituents in suspended and dissolved forms. The addition of contaminants will reduce the suitability of downstream waters for populations of aquatic organisms. Decreases in surface (stormwater) discharges from the mine site will directly and permanently alter existing surface and baseflow hydrologic contributions to downstream receiving waters resulting in changes to the quantity and quality of existing high functioning waters. Thus, there will be adverse changes in the location, dimensions, structure, and dynamics of aquatic communities living in the receiving waters. Suitable living areas will be reduced and normal movement restricted for aquatic organisms. Normal water-level fluctuation patterns will be altered contributing to higher water temperatures and lower dissolved oxygen.

The discharge of fill material will result in direct and secondary effects on endangered species and other aquatic organisms and wildlife through the physical and chemical modification of the aquatic ecosystem. Exposure of aquatic food web organisms to elevated dissolved and suspended contaminants and suspended particulates and reductions in surface (stormwater) flows from the mine site will result in population declines or bioaccumulation in aquatic food web organisms at lower trophic levels, especially aquatic invertebrates consumed by other fish and wildlife. A reduction or elimination of food chain organism populations decreases the productivity and nutrient export capability of the aquatic ecosystem.

Three of the six Special Aquatic Site types described in Subpart E of the Guidelines occur on or adjacent to the proposed project and would be adversely affected by the Rosemont Mine. Because of their special ecological characteristics of high food-web productivity, physical habitat critical for all life stages of aquatic life, water quality functions, and other important and easily disrupted ecological functions, these aquatic resources are given special recognition under Clean Water Act (CWA) regulations.[4] Collectively, the Special Aquatic Sites in the project area play a regionally significant role in maintaining the existing, high quality functions and services in this watershed: sanctuaries and refuges; wetlands and riffle and pool complexes. The discharge of dredged and fill material at the mine site will disrupt breeding and migratory movement of resident and transient wildlife between designated sanctuaries and refuges. In addition, filling natural landscapes will create incompatible human uses and access, including the establishment of undesirable exotic plants adjacent to sanctuaries and refuges. Finally, the discharge of fill will change the balance of water supporting fish and wildlife habitat in downstream refuges.

Riffle and pool complexes are particularly valuable habitat for wildlife at the mine site. This is because flowing riffles and pools provide temporary breeding habitat for certain aquatic insects and amphibians, and provide sources of drinking water for organisms that persists following cessation of rainfall in an

[4] See Guidelines, Subpart E: Sanctuaries and refuges (40 CFR 230.40); wetlands (40 CFR 230.41) and riffle and pool complexes (40 CFR 230.45).

otherwise arid landscape. All pool and riffle complexes at the mine site receiving fill material will be permanently lost. Wetlands and riffle-pool complexes will also be adversely affected by the secondary effects of project-induced decreases in stormwater contributions to baseflow from the proposed project. Decreases in baseflow linked to decreased stormwater flows from the mine will change and disrupt breeding, spawning, rearing, and migratory movements, or other critical life history requirements of fish and wildlife resources.

For example, pools and riffles within the lower Cienega Creek used by Gila chub, Gila topminnow, and longfin dace would be especially vulnerable to desiccation during the typically driest months of May and June, and/or during droughts when these intermittent pools are embedded within long reaches of dry streambed. Seemingly small reductions in streamflow caused by the mine during critically dry months could cause portions of Cienega Creek to stop flowing.[5]

Desert springs, often the sole sources of water for wildlife, support wetland ecosystems including rare and endemic species.[6] Direct and secondary impacts to these seeps and springs because of the Rosemont Mine will adversely affect the aquatic biota dependent on the range of spring-associated water sources. Following mine construction, should springs continue to flow, the wetlands supported by the outflow would be truncated. The amount of area suitable to support wetland species would be greatly reduced and the species least tolerant of drying conditions would be extirpated first and eventually replaced by transition upland species.[7] Sixty-three springs are expected to be lost from direct disturbance or lowering of the groundwater table during construction and operation.[8]

Sanctuaries and refuges are areas designated under state and federal laws or local ordinances to be managed principally for the preservation and use of fish and wildlife resources. Portions of lower Davidson Canyon and Cienega Creek are designated by the State of Arizona as Outstanding National Resource Waters (ONRW) and are within the Cienega Creek Natural Preserve (CCNP), a 4,000 acre sanctuary along 12 stream miles noted for its ecological significance and natural beauty as a desert riparian oasis.[9,10] In addition, portions of Empire Gulch lie within the Las Cienegas National Conservation Area (LCNCA), administered by BLM, a 45,000 acre preserve set aside in large part to protect riparian wetlands and native aquatic organisms including endangered fish and amphibians.[11]

The Rosemont Mine will significantly degrade downstream reaches of Davidson Canyon and Cienega Creek. The state designation of Davidson Canyon and Cienega Creek as "Outstanding Arizona Waters" affords them special protection, prohibiting any lowering of water quality. Federal regulations for state-designated ONRWs similarly state, *Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.*[12]

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[5] DEIS, p. 387.
[6] Patten, P.T., Rouse, L., and Stromberg, J.C., 2007. Isolated spring wetlands in the Great Basin and Mojave Deserts, USA: potential response of vegetation to groundwater withdrawal. Environmental Management DOI 10.1007/s00267-007-9035-9. 16 pp.
[7] Ibid.
[8] DEIS, Table 108.
[9] Federal regulations for Outstanding National Resource Waters at 40 CFR 131.12(a)(3).
[10] http://rfcd.pima.gov/wrd/landmgt/cienegapreserve/
[11] https://www.gpo.gov/fdsys/pkg/PLAW-106publ538/pdf/PLAW-106publ538.pdf
[12] 40 CFR 131.12(a)(3).

The project will also have adverse effects on several human use characteristics of the site and surrounding natural landscapes.[13] A significant secondary adverse effect will result from the construction of the water conveyance pipeline to support mine operations. The pipeline will transport aquifer water to the mine that will cause significant reduction in the quantity of water and possibly the quality of water available for municipal and private water supplies.[14] In addition, the discharge of fill material associated with the mine will destroy and impair resources which support current recreational activities (*e.g.*, wildlife viewing, sightseeing, hiking, camping, hunting) at the mine site and on adjacent natural landscapes. The discharge of fill material will mar the beauty of the natural aquatic ecosystem for the public and property owners by degrading water quality, creating distracting activities, inducing inappropriate development, encouraging incompatible human access, and by destroying vital elements that contribute to constitutional harmony or unity. Finally, discharge of fill material will modify the aesthetic, educational, historical, recreational and scientific qualities of national forest lands and adjacent national and regional wildlife preserves.

Discharges of Fill Material into Streams and Springs to Construct the Mine Site Will Cause Unacceptable Adverse Impacts to Wildlife and Wildlife Habitat.[15]

Destruction of Highly Diverse Assemblages of Animals and Their Habitats.[16] The Rosemont Mine will result in the permanent loss or alteration of 5,431 acres of vegetation and will permanently fill 40.4 acres of waters, including an undisturbed hydrologic network of hundreds of headwater streams spanning over 18 linear miles. The mine will result in the direct loss of 5 springs and 15 stock tanks, with highly likely impacts to an additional 11 springs, and possible indirect impacts to another 60 springs.[17] These streams and associated springs and wetlands provide habitat for hundreds of species of native wildlife that will be either killed or displaced. The discharge of fill material will result in a permanent and irrevocable significant adverse effect to the aquatic ecosystem by altering the substrate elevations and bottom contours of waters; jurisdictional waters will be permanently filled and all ecological functions associated with the jurisdictional substrate will be lost. All immobile, sessile, or inactive organisms dwelling on the substrate at the discharge site will be smothered and killed, or mobile organisms will be forced to migrate to suitable habitat, if available. Immobile organisms will include plants, invertebrates, amphibians, reptiles, ground and nesting birds, and small mammals. Many other typically more mobile organisms will respond to the disturbance associated with land clearing and the discharges of fill material by seeking shelter in borrows or other cover at the disturbance site and will be smothered. The discharge of fill material will result in the loss of breeding and nesting areas, extensive overwintering and resting habitat for resident and migrating birds, escape cover, foraging habitat, critical migration corridors and habitat linkages, and preferred food sources for resident and transient wildlife species associated with the aquatic ecosystem.

Many plant and animal species depend on streams, riparian areas and adjacent terrestrial habitats at the mine site for their survival. Many plant and animal species will be directly impacted by the mine through the discharge of fill material into waters or from mine-related construction activities. Except for special status species, much of the information presented in the Final Environmental Impact Statement (FEIS) on species diversity within the mine project area is neither current nor comprehensive. This means that impacts to most plant and animal species at the mine site are underestimated. Vegetation

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[13] See Guidelines, Subpart F (40 CFR 230.50-230.54).
[14] DEIS, pp. 329-338.
[15] See Guidelines, Subpart B (40 CFR 230.11(e)).
[16] See Guidelines, Subpart D (40 CFR 230.30-230.32).
[17] FEIS, Table 116, p. 583.

sampling in the project area in the early 1970s recorded 416 plant species and subsequent surveys of similar vegetation communities at the mine site in the northern Santa Rita Mountains during 1986-1987 collected 628 plant species.[18, 19] Based on this information the number of plant species impacted over the entire 5,481-acre site is likely 500-600 species. Russell et al. (1977) identified 138 species of birds known to occur in the project area.[20] A total of 287 bird species have been recorded in the Santa Rita Mountains Important Bird Area (IBI) which encompasses the mine site, including numerous special status species recognized by the Forest Service (USFS).[21] Of note, the proposed project will result in the loss of 3,634 acres within the IBI; a 2.6% loss of IBI habitat.[22] Direct impacts include loss of nesting, overwintering, foraging, roosting, and molt migration habitat for migratory and resident birds. The mine will result in a decrease in food and water availability for some migratory species and loss of nest sites and cover. At least 70 species of migratory birds will be impacted by the mine through direct mortality or the loss of suitable nest, feeding, watering and migratory habitat.[23] At least 50 species of mammals will be directly impacted by the mine. [24] The mine site supports habitat for several large predatory mammals including jaguar, mountain lion, ocelot, bobcat, and black bear; an indication of the sites high quality habitat and unfragmented landscape. Seven amphibian and 46 reptile species are either known or likely to occur within the mine site.[25, 26, 27]

Collectively, it is reasonable to conclude that the mine will directly impact at least 700-750 plant and animal species by killing and displacing individuals, or altering or destroying their habitats. A large majority of the invertebrate, bird, mammal, reptile and amphibian species that will be directly impacted preferentially use stream, seep, spring and riparian habitats at the mine site, for all or a portion of their life cycles. The great diversity of species within several plant and animal groups that will be directly impacted by the mine is highly significant.

Endangered Species.[28] According to the U.S. Fish and Wildlife Service (FWS) Amended Biological Opinion dated April 28, 2016, construction and operation of the Rosemont Mine will result in significant adverse effects to twelve endangered and threatened species through the permanent modification of habitats and ecological processes upon which they depend for survival; ten of which rely in whole, or in

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[18] McLaughlin, S. and W. Van Asdall, W. 1977. Flora and vegetation of the Rosemont area. In An environmental inventory of the Rosemont area in southern Arizona, vol. 1: The present environment, edited by R. Davis and J.R. Callahan, pp. 64-98. Tucson: University of Arizona.

[19] McLaughlin, S., and J.E. Bowers. 1990. A floristic analysis and checklist for the northern Santa Rita mountains, Pima Co., Arizona The Southwestern Naturalist 35(1):61-75.

[20] Russell, S.M., Mills, G.S., and Silliman. n.d. [1977]. An inventory of the birds of the Rosemont area. *In*: An Environmental Inventory of the Rosemont Area in Southern Arizona, Vol. 1: The Present Environment, edited by R. Davis and J.R. Callahan. Tucson, AZ: University of Arizona.

[21] http://ebird.org/content/ebird/

[22] SWCA. December 2013. Biologists' Report on the Affected Environment and Identification of Species for Disclosure of Effects, Rosemont Copper Mine Project, Pima County, Arizona, Table 13, p. 156.

[23] SWCA 2013, Migratory Bird Analysis

[24] Roth, E.L. n.d. [1977]. Mammals of the Rosemont Region. *In:* An Environmental Inventory of the Rosemont Area in Southern Arizona, Vol. 1: The Present Environment, edited by R. Davis and J.R. Callahan, pp. 195–217. Tucson, AZ: University of Arizona.

[25] FEIS, Chapter 3; SWCA 2013a, b

[26] Lowe, C.H. and T.B. Johnson. 1977. Fishes, amphibians, and reptiles of the Rosemont site. In: An Environmental Inventory of the Rosemont Area in Southern Arizona, Vol. 1: The Present Environment, R. Davis and J.R. Callahan, eds.

[27] http://eebweb.arizona.edu/collections/Herp/Amphibian.htm Accessed November-December 2015.

[28] See Guidelines, Subpart D (40 CFR 230.30)

significant part, for survival on the aquatic ecosystem (Table 1).[29] This includes corresponding critical habitat for seven of these listed species.

The FWS concluded the mine construction and operation will contribute to effects that will further diminish stream and spring surface flows, pool depths, sizes, and volumes, and reduce water quality, thereby…*resulting in significant degradation of the aquatic ecosystem on which the Gila Chub, Gila topminnow, desert pupfish, Huachuca water umbel, Chiricahua leopard frog, and northern Mexican gartersnake depend… Regardless of the ultimate determinations regarding the effects of the proposed action and its conservation measures on the affected species and critical habitats, the relatively minor mine drawdown-related effects (and mine effects plus the relatively greater climate change effects) in the main stem of Cienega Creek still represent* ***significant degradations*** **[emphasis added]** *of the aquatic ecosystem.*[30]

Impacts described EPA's Guidelines within Subpart D – Potential Impacts on Biological Characteristics of the Aquatic Ecosystem, including impacts to threatened and endangered species (§ 230.30) should be considered in making factual determinations and findings of compliance with Subpart B – Compliance with the Guidelines. The FWS Amended Biological Opinion findings support a finding under the Guidelines that the proposed mine will result in the significant adverse impairment and destruction of aquatic, wetland and riparian habitats upon which ten threatened and endangered species depend (Table 1). This includes, but is not limited to, significant adverse effects of the mine on elements of the aquatic environment which are particularly crucial to the health and survival of threatened and endangered species such as adequate quantities of good quality water, spawning and maturation (*e.g.,* rearing) and nesting areas, protective cover, adequate and reliable food supply, and resting areas for migratory species (Refer to 40 CFR §230.30(b)(2)).

[29] Amended Final Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona dated April 28, 2016.
[30] Ibid. Summary of Effects to Aquatic Ecosystem, p. 60

Table 1. Federally Listed Species and Critical Habitat Significantly Impacted by the Rosemont Mine and their Relationships to Aquatic Habitats

Species	Endangered Species Act Status[1]	Relationship to Aquatic Environment[3]	Will Degradation of Aquatic Habitat Adversely Affect Species?[4]
Gila chub (*Gila intermedia*)	E, CH	All life stages depend on aquatic resources for survival.	Yes
Gila topminnow (*Poeciliopsis occidentalis occidentalis*)	E	All life stages depend on aquatic resources for survival.	Yes
Chiricahua leopard frog *(Lithobates chiricahuensis)*	T, CH	All life stages depend on aquatic resources for survival.	Yes
Desert pupfish (*Cyprinodon macularius*)	E	All life stages depend on aquatic resources for survival.	Yes
Northern Mexican gartersnake (*Thamnophis eques megalops*)	T, CH	Relies on aquatic resources for food and water supply	Yes
Huachuca water umbel (*Lilaeopsis schaffneriana var. recurva*)	E, CH	All life stages depend on aquatic resources for survival.	Yes
Jaguar (*Panthera onca*)	E, CH	Relies on aquatic resources for food and water supply, wildlife corridor movement	Yes
Ocelot (*Felis pardalis*)	E	Relies on aquatic resources for food and water supply, wildlife corridor movement	Yes
Southwestern willow flycatcher (*Empidonax traillii extimus*)	E, CH	Relies on aquatic resources for breeding, foraging and protective cover	Yes
Western yellow-billed cuckoo (*Coccyzus americanus*)	T, CH[2]	Relies on aquatic resources for breeding and foraging	Yes
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	E	N/A	N/A
Pima pineapple cactus (*Coryphantha scheeri var. robustispina*)	E	N/A	N/A

[1]E = Endangered, T = Threatened, CH = Critical Habitat
[2]Critical habitat designation pending
[3]See Guidelines at 40 CFR 230.10(c)(2) and 40 CFR 230.30
[4]In other words, will the proposed activity result in the impairment and destruction of aquatic habitats to which these species are limited? This includes, but is not limited to, significant adverse effects on the elements of the aquatic environment which are particularly crucial to the survival of some threatened and endangered species such as adequate good water quality, spawning and maturation (*e.g.,* rearing) and nesting areas, protective cover, adequate and reliable food supply, and resting areas for migratory species. Refer to 40 CFR 230.30(b)(2).

Bird Overwintering Areas.[31] The Rosemont Mine site contains critically important grassland, woodland, stream, wetland and riparian habitats that support populations of many species of overwintering birds and thus constitutes a "key wintering area."[32] Riparian woodlands in the Southwest Avifaunal Biome (which encompasses the project site), including those adjacent to non-perennial waters, support the highest diversity of land bird species and the highest vulnerability to population declines in the United States.[33] The findings of Rich *et al.* (2004) and Berlanga *et al.* (2010) are consistent with the research of other scientists with respect to biological diversity of breeding and overwintering migratory birds; the critical significance of semi-desert grasslands, oak woodlands, and xeroriparian or ephemeral wash areas during winter to the health and survival of migratory and resident birds.[34,35]

Of significance and per SWCA (2013):[36]

> *At the more local level, in the vicinity of the proposed* [Rosemont Mine] *project, Russell et al. (n.d. [1977]) recorded 45 overwintering bird species on their four transects, conducted between January 26 and February 10, 1976, when migratory movements were expected to be lowest; this is therefore a conservative estimate of the number of species that may use the habitats outside this narrow window. Other species were opportunistically observed outside of the survey transects. Nevertheless, their results confirm a high diversity of overwintering species, including short-range migratory species, long-range migratory species, and resident species. Overwintering bird species that occur in the Rosemont area (Russell et al. n.d. [1977]) include (but are not limited to) at least 5 raptors (not including the golden eagle, observed in winter 2009 [see the "Bald and Golden Eagles" section in this document]), 4 woodpeckers, 3 corvids, 3 wrens, and at least 12 species of sparrows. The most-detected species during their winter transects included mourning dove (Zenaida macroura), Mexican jay, Bewick's wren, ruby-crowned kinglet (Regulus calendula), house finch (Carpodacus mexicanus), canyon (or brown) towhee, rufous-crowned sparrow (Aimophila ruficeps), black-throated sparrow, Brewer's sparrow (Spizella breweri), dark-eyed junco (Junco hyemalis), and huge numbers of chipping sparrows (Spizella passerina). Some of the short-distance migrants that wintered in the adjacent valleys but were present during breeding season in the Rosemont area include Cassin's sparrow, lark sparrow, Botteri's sparrow, northern cardinal (Cardinalis cardinalis), and pyrrhuloxia (Cardinalis sinuatus). Additionally, approximately 180 species of birds have been documented within the Santa Rita Mountains Important Bird Area* [which encompasses the mine site] *during the months of December, January, and February from 1900 to 2013 (eBird 2013b).*

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[31] See Guidelines, Subpart C (40 CFR 230.22) and Subpart D (40 CFR 230.32)
[32] SWCA 2013, Migratory Bird Analysis
[33] Rich, T.D., Beardmore, C.J., Berlanga, H., Blancher, P.J., Bradstreet, M.S.W., Butcher, G.S., Demarest, D.W., Dunn, E.H., Hunter, W.C., Iñigo-Elias, E.E., Kennedy, J.A., Martell, A.M., Panjabi, A.O., Pashley, D.N., Rosenberg, K.V., Rustay, C.M., Wendt, J.S., and Will. T.C. 2004. Partners in Flight North American Landbird Conservation Plan. Ithaca, New York: Cornell Lab of Ornithology.
[34] Ibid.
[35] Berlanga, H., Kennedy, J.A., Rich, T.D., Arizmendi, M.C., Beardmore, C.J., Blancher, P.J., Butcher, G.S., Couturier, A.R., Dayer, A.A., Demarest, D.W., Easton, W.E., Gustafson, M., Iñigo-Elias, E., Krebs, E.A., Panjabi, A.O., Rodriguez Contreras, V., Rosenberg, K.V., Ruth, J.M., Santana Castellón, E., Vidal, R.M., and Will. T. 2010. Saving Our Shared Birds: Partners in Flight Tri-National Vision for Landbird Conservation. Ithaca, New York: Cornell Lab or Ornithology.
[36]Ibid. SWCA 2013. p. 50.

Specifically, there will be 5,431 acres of direct impacts to natural vegetation types from the Rosemont Mine, including direct habitat impacts to 585 acres of riparian, 2,557 acres of grassland, and 2,690 acres of Madrean evergreen scrub.[37] The Madrean pine-oak woodlands ecoregion is an internationally recognized biodiversity hotspot featuring significant levels of biodiversity that is under threat from humans.[38] Although the most biologically diverse wintering ground for short- and long-range bird migrants in the United States, southeastern Arizona is threatened by habitat fragmentation and degradation. The Rosemont Mine's direct disturbance of over 5,000 acres would contribute to significant degradation in habitat quality and quantity for overwintering birds within the mine site and southeastern Arizona. Additionally, since grass cover and grass-seed production are important in both habitat selection and overwinter survival of southwestern grassland birds, any disturbance of large expanses of grasslands at the mine would be expected to have negative impacts on any migratory bird species that would winter in the area, including birds moving between habitat types (*e.g.,* between ephemeral wash/xeroriparian and grassland habitats).[39] A direct consequence of construction of the Rosemont Mine will be a significant reduction in the carrying capacity of riparian and other associated habitat types at the mine site for overwintering and resident birds. The mine will fill over 18 linear miles of ephemeral stream and associated xero-, meso- and hydro-riparian habitat causing significant degradation of the aquatic ecosystem used as a preferred food source and resting area by resident and overwintering birds.[40] The discharge of fill material will lower overwintering bird abundance and diversity and disrupt normal functions of the aquatic ecosystem leading to significant reductions in overall biological diversity.

Fragmentation of Critical Animal Migration Corridors.[41] The Santa Rita Mountains provide several critical regional animal movement corridors or wildlife linkages.[42] The natural topography of the mine site will be irreversibly changed by the re-contouring of the site and the filling of the extensive stream network. The mine will result in significant fragmentation of six animal movement corridors and this will significantly disrupt animal dispersal and migration patterns for many species currently using these corridors.[43] Within the six impacted corridors, a total of 1,626 acres of habitat will be directly impacted, including the permanent filling of jurisdictional waters comprising the stream network at the mine site.[44] Thus, the discharge of fill material will result in the loss of corridors critical to animal movement and migration for numerous resident and transient wildlife species. The fragmentation of animal migration corridors has the potential to adversely disrupt populations of animals utilizing adjacent mountain ranges through restrictions to their natural dispersal routes.

Reduction in Streamflow Will Cause Unacceptable Adverse Impacts to Waters in Barrel and Davidson Canyons and Lower Cienega Creek.[45]

Ephemeral and intermittent streams in arid environments perform the same critical hydrologic functions as perennial streams in wetter environments by moving water, sediment and debris through the stream

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[37]FEIS, Table 2, p. 666.
[38] Myers, N., Mittermeier, R.A., Mittermeier, C.G., Gustavo, A., da Fonseca, B., and J. Kent. 2000. Biodiversity hotspots for conservation priorities. Nature 403: 853-858.
[39]Bock, C.E., Bock, J.H. 1998. Response of winter birds to drought and short-duration grazing in southeastern Arizona. Conservation Biology 13(5):1117-1123.
[40] See Guidelines, Subpart D (40 CFR 230.22).
[41] See Guidelines, Subpart D (40 CFR 230.32).
[42]FEIS, Table 118, Figure 76
[43]FEIS, Table 129.
[44] Ibid.
[45] See Guidelines, Subpart B (40 CFR 230.11 (b)).

network and providing connectivity within the watershed.[46] Streams in semi-arid regions are complex systems due to wide fluctuations in the distribution, amount and timing of precipitation. This hydrologic variability is reflected in the storm flow data for Barrel and Davidson canyons. Surface flow monitoring stations in Barrel and Davidson canyons provide detail on the current frequency, magnitude, duration and volume of flows.[47] During 2013, Barrel Canyon experienced a total of 23 days of storm flow, while Davidson Canyon had a total of 2 days of stormflow. In 2014, stormflow was 47 days for Barrel and 8 days for Davidson, respectively. Peak summer stormflows in 2014 in Barrel and Davidson canyons measured nearly 300 and 500 cfs, respectively, an indication that even relatively small washes in mountainous areas can generate very high discharges over short periods of time. For 2013-2014, Barrel Canyon contributed much greater total flow volume (as measured immediately downstream from the confluence of Davidson and Barrel canyons) than Davidson Canyon upstream of their confluence;[48] another indication of the significance of surface flow contributions from Barrel Canyon at the mine site to Davidson Canyon. That Barrel Canyon provides a disproportionally high amount of surface water within the Davidson Canyon watershed relative to its drainage area is because Barrel Canyon drains most of the higher elevations of the watershed where the orographic effect produces greater precipitation and runoff.[49, 50]

All stream channels in the Davidson Canyon watershed are variously connected by surface and shallow subsurface hydrologic pathways to downstream waters.[51] Runoff generated by greater amounts of precipitation falling over higher-elevation headwater streams at the mine site concentrates as stormflow and as these stormflows travel downstream some water is lost as recharge to the shallow alluvial aquifer. Barrel Canyon contributes surface and shallow alluvial water to Davidson Canyon and lower Cienega Creek. The additive contribution of stormwater and shallow subsurface flows from Barrel Canyon increases the total amount of storm and alluvial water available to downstream reaches of Davidson Canyon and lower Cienega Creek, including ONRW reaches.

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[46] Levick, L. D., Fonseca, J., Goodrich, D., Hernandez, M, Semmens, D., Stromberg, J., Leidy, R., Apodaca, M., Guertin, D.P., Tluczek, M., Kepner, W., 2008. The ecological and hydrological significance of ephemeral and intermittent streams in the arid and semi-arid American southwest. U.S. Environmental Protection Agency and USDA/ARS Southwest Watershed Research Center, EPA/600/R-08/134, ARS/233046, 116 pp.

[47] Letter to USFS from Hudbay dated January 22, 2015. Attachment: Water and Earth Technologies (January 6, 2014). Analysis of Barrel Canyon and Davidson Canyon Instrumentation Data December 1, 2013 - December 31, 2013. Prepared for the Rosemont Copper Company.

[48] Ibid.

[49] Powell, B., Fonseca, J. and F. Postillion. 2015. New analysis of stormflow and groundwater data from Davidson Canyon: evidence for influence of stormwater recharge of groundwater. Memorandum prepared by and for the Pima County Office of Sustainability and Conservation and Pima County Regional Flood Control District. December 13, 2015. 9 pp.

[50] Letter to Colonel D. P. Helmlinger, Commander, South Pacific Division, Corps of Engineers and Alexis Strauss, Acting Regional Administrator, EPA, Region 9, from C.H. Huckelberry, Pima County Administrator, RE: *Rosemont Copper Mine, Section 404 Clean Water Act*, dates June 6, 2017.

[51] Rosemont Copper Integrated Watershed Summary June 2012. Rosemont clearly acknowledges that precipitation falling at higher elevations of the mine site results in aquifer recharge and flows by deep, shallow and alluvial stream channel pathways into Barrel and Davidson canyons and lower Cienega Creek resulting in groundwater discharging to the surface as baseflow. EPA rejects the conclusions in the FEIS arguing that stormwater flows originating in the higher-precipitation areas of the mine site (representing 13% of the total Davidson Canyon watershed) are somehow entirely hydrologically isolated from, or provide insignificant contributions to, the downstream ONRWs in Davidson Canyon and lower Cienega Creek. Such speculation ignores our current scientific understanding of how water moves through surface and sub-surface pathways along hydrologic gradients in the Cienega Creek watershed (See Letter from C.L. Huckelberry, Pima County Administrator, to William James, U.S. Army Corps of Engineers and Kerwin Dewberry, Forest Supervisor, Coronado National Forest, regarding *New Information: Rosemont Copper Mine, Section 404 Clean Water Act*, dated September 28, 2017). The scientific literature supports our understanding that for arid regions such as the Cienega Creek watershed, water originating as surface or stormflow in the wetter headwaters can infiltrate into the alluvial stream channel and reappear at great distances downstream as stream surface flow/baseflow (*e.g.,* Levick *et al.* 2008).

Sub-flow that originates from stormflows in Barrel and Davidson canyons follows a hydraulic gradient downstream as water perched above bedrock overlain by shallow alluvium. The shallow groundwater aquifer of Davidson canyon is highly responsive to pulses of baseflow or stormflow.[52] As shallow groundwater levels rise and fall so does the length of flow in Davidson Canyon increase and decrease.[53] Stormwater-generated shallow alluvial water eventually reappears within Davidson Canyon and lower Cienega Creek ONRWs supporting low-surface flow, which is especially important to sustaining aquatic organisms and their habitats during the drier portions of the year.[54] Low-surface flow is critical to maintaining riffles and pools and wetlands; Special Aquatic Sites used by a variety of sensitive plant and animal species in Davidson Canyon and lower Cienega Creek.[55]

Effects of Rosemont Mine on Storm Flows. The Rosemont Mine will result in alteration of the natural surface hydrology through the direct fill of waters, the loss of contributing watershed area, and the modification of natural flow from the construction of in-channel stormwater basins and diversions designed to retain, slow or convey storm water around mine areas. During the active 20-25 years of mining at the site, the proposed project will reduce stormwater runoff from the project area by greater than 30-40%, reducing surface flow at the Davidson Canyon/Cienega Creek confluence by a minimum of 7.6 – 10.2%.[56, 57, 58]

The Pima Association of Governments (PAG) has conducted 20 years of hydrologic monitoring along Cienega Creek, including documentation of the relative contribution of surface and shallow subsurface flows from Davidson Canyon Wash to base flows in Cienega Creek.[59] Davidson Canyon Wash, an intermittent stream upstream of its confluence with Cienega Creek, contributes significant flood flows to Cienega Creek. Through analysis of water chemistry and stable isotopes, PAG found that between 8 and 24% of perennial flows during the lowest flow period in Cienega Creek are attributable to Davidson Canyon Wash's underflow contributions. Any decreases in the surface flows of Barrel Canyon and Davidson Canyon resulting from the mine will significantly reduce the contribution of water that sustains the low-water surface flows of Davidson Canyon and lower Cienega Creek OAWs.[60, 61, 62] Even seeming small statistical changes in low-water surface flows of a few percent will cause or contribute to

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[52] Ibid. Powell, B., Fonseca, J., and F. Postillion. 2015.
[53] Ibid.
[54] Pima Association of Governments. 2003. Contribution of Davidson Canyon to Base Flows in Cienega Creek, 40pp.
[55] Powell, B.L., Orchard, L., Fonseca, J. and Postillion, F. 2014. Impacts of the Rosemont Mine on hydrology and threatened and endangered species of the Cienega Natural Preserve. Pima County, AZ.
[56] Email from Chris Garrett, SWCA to Robert Leidy, EPA dated September 15, 2015. We believe the reduction in surface flow is underestimated.
[57] The FEIS likely significantly underestimates the reduction in stormwater discharge from the mine because their modeling uses inappropriate precipitation values. We believe that this results in a significant underestimation of the estimated reduction in stormwater runoff from the project area. Refer to comments in a letter from Pima County to ADEQ, dated April 4, 2014.
[58] Letter from C.H. Huckelberry, Pima County Administrator, to Rosi Sherrill, ADEQ, regarding *2017 Addendum to Water Quality Permit, Rosemont Copper Project ACOE Application No. SPL – 2008-00816-MB.*
[59] Ibid. Pima Association of Governments 2003.
[60] Rosemont Copper acknowledges that the surface recharge supporting low-water surface flows along the length of Davidson Canyon would be reduced by the mine and this would reduce surface flow in Cienega Creek. Rosemont Copper estimates that the surface recharge supporting low-water surface flows along the length of Davidson Canyon would be reduced by the mine by approximately 10% and this would reduce low-water surface flows in Cienega Creek by 0.8 and 2.3%. Integrated Watershed Summary. June 2012. Rosemont Copper.
[61]The FEIS recognizes the hydrologic connectivity between surface flow and sub-flow and further acknowledges that the predicted reduction in surface flow could result in a reduction in recharge to the shallow alluvial aquifer and sub-flow supporting low-water surface from Davidson Canyon into Cienega Creek (p. 554).
[62] Ibid. Powell, B., Fonseca, J., and F. Postillion. 2015.

significant degradation of the aquatic ecosystem through loss of aquatic habitat and declines in water quality in Davidson Canyon and lower Cienega Creek, especially during the June when stream flows are at their lowest levels.

Several recent reports by Pima County clearly establishes the strong positive relationship between the amount of surface water flow and shallow subsurface flow in Davidson Canyon and Cienega Creek.[63] These Pima County studies conclude that any reductions in groundwater, which includes shallow subsurface alluvial groundwater originating from stormflows, from the mine will significantly reduce low-water surface flows, and that as low-water surface flows decrease the reach and extent of surface flow will decrease and fragmentation of remaining pools will increase in Davidson Canyon and lower Cienega Creek ONRWs. Smaller, shallower and more fragmented pools in Davidson Canyon and lower Cienega Creek will significantly reduce the extent of surface water and habitat critical for the survival for aquatic organisms, including Gila Chub.[64] The presence of three fish and one frog (*i.e.*, Gila chub, Gila topminnow, longfin dace) three of which are listed as endangered by the FWS, have been recently documented from pools at the confluence of Davidson Canyon and Cienega Creek.[65, 66] Decreases in low-water flow in lower Cienega Creek will result in increased water temperatures.[67, 68] Relatively small increases in water temperature in remaining pools in lower Cienega Creek will cause or contribute to significant reductions in the amount and quality of suitable habitat for fish and other aquatic organisms, including riparian wetlands.[69]

In summary, reductions in surface and delayed shallow subsurface water contributions to low-water or base flows will result in decreases in water levels, adversely affect the flow and circulation of water, increase water temperatures[70], potentially result in increased harmful algal blooms, reduce aquatic plant and animal species abundance and diversity, and disrupt the normal functions of the aquatic ecosystem leading to reductions in overall biological productivity.[71] Reductions in stormwater runoff reduces the available assimilative capacity of the downstream waters increasing the concentration or load of pollutants in suspension or solution in the aquatic environment, modifying sediment transport and the water availability for downstream use. This will result in unacceptable adverse impacts to water quality, riparian vegetation and wildlife use, including endangered, threatened and sensitive aquatic species. Therefore, mine-related reductions in the surface flow and surface flow contributions to low-water flow in Davidson Canyon and lower Cienega Creek ONRWs will result in significant degradation of the aquatic ecosystem.

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[63] Ibid. Powell *et al.* 2014, Powell *et al.* 2015, and Letter from C.L. Huckelberry, Pima County Administrator, to William James, U.S. Army Corps of Engineers and Kerwin Dewberry, Forest Supervisor, Coronado National Forest, regarding *New Information: Rosemont Copper Mine, Section 404 Clean Water Act*, dated September 28, 2017.
[64] Ibid. Powell *et al.* 2014.
[65] Leidy, R.A. 2013. Transcribed Field Notes pertaining to observations made within the Cienega Creek Watershed, including Davidson Canyon and Empire Gulch, Pima Co., AZ. San Francisco, California: U.S. Environmental Protection Agency. June 28.
[66]SIR (2015).
[67] Pima County. October 5, 2015. Memorandum to Dr. Robert A. Leidy, EPA, San Francisco. Cienega Creek base flow and its relationship to water temperature. 5 pp.
[68] Amended Final Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona dated April 28, 2016.
[69]Ibid. Powell *et al.* 2014.
[70] Memorandum from Ian Murray, Pima County Office of Sustainability and Conservation to Dr. Robert A. Leidy, EPA, regarding *Cienega Creek Base Flow and its Relationship to Water Temperature*, dated October 5, 2015.
[71]See Guidelines, Subparts C and D (40 CFR 230.22-230.23 and 230.30-230.32).

Reduction in Sediment Delivery Will Cause Unacceptable Adverse Impacts to Waters in Barrel and Davidson Canyons and Lower Cienega Creek.[72]

At post mine conditions, the Rosemont Mine project will reduce sediment delivery by 32.4% from the project site, and by approximately 4% at the Davidson Canyon outlet.[73] These estimates were made based on average annual sediment delivery. Contrary to the conclusions made by the USFS, reduction in sediment delivery to downstream waters will result in unacceptable adverse impacts to waters, including ONRWs.[74]

Polyakov *et al.* (2010) analyzed 34 years of precipitation, runoff, and sediment data from eight watersheds in Arizona.[75] They found that runoff amount and runoff peak rate were the most important factors for explaining variation in sediment yield. Typical of ephemeral systems, large flows can move great quantities of sediment, and even smaller rainfall events can have notable contributions to sediment yield.[76] Material accumulated during drier periods is released downstream during large, infrequent storms.[77]

In addition, sediment is transported in suspension as well as bed load. Sediment may travel in suspension at steeper slopes (*e.g.,* Rosemont Mine site) and as bed-load at shallower slopes downstream.[78] Levick *et. al.* (2008) states, *Ultimately, as headwater streams equilibrate to the new flow regime and their importance as a sediment source declines, channel entrenchment will likely shift further and further downstream. The cumulative effect of many entrenching channels is a significant increase in sediment load in downstream waters.*[79]

Reductions in sediment delivery from the Rosemont Mine will degrade water quality by geomorphologically altering the stream bed, creating soil scour in some downstream areas and aggradation in others. Total suspended sediment will be increased in surface water flows in some reaches. Aggradation and scour will result in the filling and scouring of pools and riffles used by fish and other aquatic organisms. Elevated levels of suspended sediment or moderate-to-high turbidity will likely have significant adverse effects on aquatic organisms in Davidson Canyon Wash and Cienega Creek.

It has been suggested by the USFS that the presence of downstream bedrock grade control structures will prevent streambed degradation, and sediment transport capacity of flowing water will be maintained

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[72] See Guidelines, Subpart B (40 CFR 230.11(c)).
[73] FEIS, Table 104 and DEIS, Table 87.
[74] FEIS, p. 466- 467. The USFS concluded no change in the geomorphology of the channel is expected to occur because of the proposed Rosemont Mine. Their analysis evaluated average annual sediment delivery, underestimating sediment delivery during high intensity storm events, where runoff amounts and peak rates are key factors in sediment delivery. In addition, they did not use sediment transport models given the difficulty of applying models to ephemeral systems. The USFS' Patterson and Annandale (2012) technical memorandum made no reference to historic and recent flow data at the USGS gage in Barrel Creek at the time of the survey nor did it include any survey of Davidson Canyon Wash during their two-day observational field visit. See technical reports cited (Zeller 2010a, 2010b, 2012) and Technical Memorandum from Patterson and Annandale, Golder Associates, to Chris Garrett, SWCA Environmental Consultants, 2012.
[75] Polyakov, V.O., Nearing, M.A., Nichols, M.H, Scott, R.L., Stone, J.J., and McClaran, M.O., 2010. Long-term runoff and sediment yield from small semiarid watersheds in southern Arizona, Water Resource. Res. 46, W09512.
[76] Ibid.
[77] Ibid. Levick *et al.* 2008.
[78] Letter from C.H. Huckelberry, Pima County Administrator to ADEQ, dated April 4, 2014.
[79] Ibid, Levick *et al.* 2008. p. 34.

despite construction of the Rosemont Mine.[80] Although grade control structures may limit the upstream propagation of down-cutting, they do not correct downstream degradation. Downstream flows will adjust to new equilibrium conditions by increasing sediment discharge downstream of the grade control structure, thus increasing channel scour. This condition currently exists at Pantano Dam on Cienega Creek where, to date, there is ten feet of scour below the dam.

Discharge of Contaminants from the Rosemont Mine Will Cause Unacceptable Adverse Impacts to Waters in Barrel and Davidson Canyons and Lower Cienega Creek.[81]

Reduction in sediment transport and storm flow, and the predicted runoff of mine contaminants from the proposed Rosemont Mine will degrade water quality resulting in significant degradation to downstream waters, including ONRWs.

The Rosemont Mine, covering over 4,750 acres, will convert headwater streams which currently serve as sources of freshwater dilution into sources of pollution. This pollution, in the form of heavy metals and other constituents, will run off the mine site and degrade the water quality of downstream waters. The USFS speculates that the contamination coming off the mine will attenuate as it travels downstream to Davidson Canyon ONRW, but this is likely not case. In fact, contaminated mine runoff is additive; increasing concentrations of heavy metals to existing downstream waters and worsening water quality. Concentrations of heavy metals will increase more so, with the diversion of 30-40% of the stormwater that normally flows off the site during the life of the mine.

In the FEIS, the USFS stated that a screening-level analysis of runoff from waste rock indicated two constituents may be elevated in mine runoff at levels that could present antidegradation problems: total and dissolved molybdenum, and total and dissolved sulfate.[82] In the analysis of soil cover runoff, dissolved arsenic, dissolved iron, and dissolved sodium could present antidegradation problems.[83] Dissolved and total mercury is substantially higher than the water quality of downstream waters indicating a potential for degradation from stormwater interacting with soil cover.[84]

Based on our analysis of the water quality data, stormwater runoff from the mine's waste rock and soil cover contaminated with lead, mercury, molybdenum, selenium, silver, sodium and sulfate will degrade the water quality of Barrel Canyon, Davidson Canyon and Cienega Creek. As shown in Table 2, the water quality of predicted runoff from waste rock and soil cover exceeds the water quality of downstream waters. Mine runoff containing metals such as lead (dissolved) and mercury (dissolved and total) are predicted to be 1-2 orders of magnitude greater than the water quality of Davidson Canyon, an ONRW.[85]

EPA believes compliance point dams will exacerbate the unacceptable downstream water quality impacts. These dams will likely release contaminated runoff in concentrations exceeding predicted stormwater runoff water quality as shown in Table 2. Each dam would be approximately 6 feet tall and approximately 100-200 feet wide with a storage capacity of 2 acre-feet. The dam allows for the settling

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[80] FEIS, p. 466
[81] See Guidelines, Subpart B (40 CFR 230.11(d)).
[82] FEIS, p. 549.
[83] Ibid.
[84] Ibid. Most waste rock samples contained mercury concentrations below detection limit and therefore were not incorporated into the analysis (the detection limit is higher than surface water standard). One legitimate sample had a very high concentration of mercury (0.03 mg/L).
[85] Runoff from heavy metals, including mercury runoff, is significantly underestimated due to averaging of test samples.

of sediment, detains stormwater temporarily and is the final onsite location where stormwater will be monitored.[86] During storm events, water that has been in contact with waste rock and soil cover, would be temporarily impounded and slowly released through the porous rock-fill dam. Large storm events may overtop or destroy the dam and proceed downstream.[87] It is anticipated that localized storm events will blow out these storage zones resulting in discharges of concentrated sediment and water-soluble metals contaminating downstream waters.

Studies analyzing the patterns of storage, transfer and sediment-associated metal dilution in arid systems reveal the presence of metal contaminants downstream of mine sites. Ciszewski (2001) discusses high magnitude flood events on metal contamination patterns in surface bottom sediments. Sediment associated metals accumulate in the river during periods of low discharge and are suspended and transported during flood events especially during higher-magnitude floods where the risk of metal mobilization increases.[88] This study comports with Navarro *et al.* (2008) which found metal transfer from mines is strongly influenced by a semi-arid climate with heavy rainfall during short rainy seasons contributing largely to the dispersion of pollutants over an extensive area.[89]

Riverbank desiccation and the lack of vegetation in ephemeral channels during the dry season make these areas vulnerable to oxidation and transport during the wet season. Remobilization of metals within slack water channel environments via evaporation or during seasonal flooding presents a potential risk to remnant aquatic biota that utilize this aquatic resource.[90]

Heavy metals can cause significant harm to human health and the environment. Heavy metal contamination from the mine is persistent, impairs aquatic life use, and cannot be easily mitigated or removed from stream channels. A heavy metal such as mercury, can bioaccumulate, biomagnify in aquatic food chains causing significant toxicity in the aquatic environment.[91,92] Mobilization of mercury in an aqueous phase can be influenced by many processes primarily precipitation and dissolution of solids, complex formation and redox reactions. In semi-arid environments, dissolution of mercury and metal-sulfate salts results in their transport during episodic high intensity storm events. Per Navarro (2008), this is likely the case for other heavy metals such as iron, lead and zinc.[93]

Uptake of selenium by biota causes toxicity in aquatic organisms. Several studies have concluded that selenium expresses its' toxicity in mammals, birds and fish primarily through the food chain, with bioaccumulation of selenium in aquatic plants and invertebrates leading to toxicological impact and change in aquatic communities.[94] Maier *et al.* (1998) as cited in Hamilton (2004) found that short pulse

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[86] FEIS, p. 46-47.
[87] Ibid.
[88] Ciszewski, D., 2001. Flood-related changes in heavy metal concentrations within sediments of the Biala Przemsza River. Geomorphology 40: 205-218.
[89] Navarro, M.C., Perez-Sirvent, C., Martinex-Sanchez, M.J., Vidal, J., Tovar, P.J., Bech, J., 2008. Abandoned mine sites as a source of contamination by heavy metal: a case study in a semi-arid zone. Journal of Geochemical Exploration 96:183-193.
[90] Taylor, M.P., Hudson-Edwards, K.A., 2008. The dispersal and storage of sediment-associated metals in an arid river system: The Leichhardt River, Mount Isa, Queensland, Australia. Environmental Pollution 152:193-204.
[91] Navarro, A., 2008. Review of characteristics of mercury speciation and mobility from areas of mercury mining in semi-arid environments. Rev. Environ. Sci. Biotechnol. pp. 287-306.
[92] U.S. Environmental Protection Agency. 1997. Mercury study report to Congress: An ecological assessment for anthropogenic mercury emissions in the United States. Vol. 6. EPA-452/R-97-008. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards and Office of Research and Development. December.
[93] Ibid. Navarro. 2008.
[94] Hamilton, S., 2004. Review of selenium toxicity in the aquatic food chain. Science of the Total Environment 326: 1-31.

precipitation events can quickly load selenium into an aquatic environment where it can remain in the ecosystem.[95]

Downstream contamination of surface waters underestimated. We believe impacts to downstream water quality resulting from the Rosemont Mine will be greater than estimated by USFS. Although Rosemont Copper Company proposes several design and mitigation measures to try to prevent release of mine influenced waters, the hydrological and geochemical analysis presented by the USFS underestimates the level of contamination to downstream waters including ONRWs, if the Rosemont Mine is constructed.[96, 97]

- ***Infiltration and seepage***. While the mine is designed to retain runoff from the tailings facility, uncertainty remains regarding seepage of contaminants to downstream waters from both the tailings facility and the waste rock storage area. A technical review of the infiltration and seepage models by SRK Consulting found that estimates of infiltration and seepage in dry stack tailings facility have the potential to be underestimated annually or seasonally owing to the use of average daily precipitation in the model given that rain occurs year round with greater daily amounts during the winter months and late summer "monsoon" season.[98,99] In addition, SRK Consulting states, *SRK's experience shows that field construction errors are another source of seepage that is greater than expected or modeled* (pp. 2-4). A study by Kempton and Atkins (2000) found evaporation in unvegetated rock slows dramatically as the surface dries and only the top few centimeters in waste rock or pit benches are dry enough to slow oxidation.[100] Given that sulfide oxidation in waste rock is typically limited by oxygen transport and higher moisture content reduces the diffusivity of oxygen, it is suggested that sulfide oxidation rates in mine waste may be faster in dryer climates than in wet.[101]
- ***Averaging of waste rock types and sample results.*** Samples analyzing mine runoff were averaged by waste rock type and weighted based on the percentage of each waste rock type to be present in the waste rock facility. These values do not reflect the upper and lower bounds of

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[95] Ibid.

[96] A study on the predicted and actual water quality of 25 hard rock mines found 24% exhibited inadequacies in hydrologic characterization, 44% in geochemical characterization, 64% exhibited failures in mitigation (16% of the mines had ineffective waste rock mixing and segregation). Kuipers, J.R. Maest, A.S., MacHardy, K.A., Lawson, G. 2006. Comparison of Predicted and Actual Water Quality at Hardrock Mines: The reliability of predictions in Environmental Impact Statements.

[97] A 2012 study on 14 of 16 currently operating U.S. copper mines found 100% experienced pipeline spills or accidental releases, 92% had water collection and treatment systems fail, 28% had partial tailings impoundment failures and 64% had tailing spills. U.S. Copper Porphyry Mines: The track record of water quality impacts resulting from pipeline spills, tailings failures and water collection and treatment failures. Gestring. B. Earthworks. July 2012.

[98] SRK Consulting. Hoag, P.G., M. Sieber, J. Rasmussen. Memo to Chris Garrett, SWCA dated July 18, 2012. Rosemont Copper DEIS – Response to EPA Geochemistry Comments – Final.

[99] In a June 2012 Infiltration, Seepage, Fate and Transport Modeling Report by Tetra Tech, additional seepage and infiltration models were developed. In this analysis, average climate conditions were still used for the dry stack tailings facility. For the waste rock storage area, daily measured climate conditions utilizing rainfall data at the University of Arizona (UA) Tucson Meteorological Station (2,440' elevation) were used in the model. At a higher elevation of 5,350', the Rosemont Mine is susceptible to greater rainfall amounts and intensity due to the orthographic effects. Therefore, the UA daily climate measurements are not comparable. Pima County Regional Flood Control District (PCRFCD) found the storm water analysis unacceptable and provides detailed comments on the problems associated with using precipitation values not representative of the site (letter to ADEQ from PCRFCD dated February 2, 2012 regarding the Draft Aquifer Protection Permit).

[100] Kempton, H., Atkins, D., 2000. Delayed environmental impacts from mining in semi-arid environments. In Proceedings from the Fifth International Conference on Acid Rock Drainage 2:1299-1308. May 20-24, Denver, Colorado. Published by Society for Mining, Metallurgy, and Exploration, Inc.

[101] Ibid.

metal concentrations that would occur in runoff from the mine site.[102] For example, per the FEIS, predicted waste rock runoff for copper is 0.0085 mg/L, yet individual samples range from ND – 0.3 mg/L. Davidson Canyon stormwater water quality for copper ranges from 0.0029-0.017 mg/L. Therefore, some samples were over 17x greater than the highest concentration found in Davidson Canyon. In addition, the weighted average represents the mine over the entire life. However, a storm event resulting in significant runoff can occur at any given time throughout the project life. Depending upon what waste rock material is exposed in the waste rock pile, or other disturbed areas at the time of such an event, runoff water quality would be reflective of the rock types exposed, rather than the overall weighted average within the pit. Therefore, degradation of water quality downstream of the mine has the potential to be significantly greater than is presented in the FEIS and SIR for any given storm event.[103,104]

- ***Ability to segregate waste rock***. Rosemont Mine is proposing to segregate waste rock to mitigate the exceedance of the water quality standard for silver. There is great uncertainty in the ability to effectively segregate waste rock, particularly singular constituents. It is often dependent on whether the constituent is distinct (*i.e.,* clear boundaries) in the waste rock and whether the operator, based on methodology, is effective and committed to segregation.[105]
- ***Assumption that attenuation reduce downstream contamination***. The USFS predicted the water quality of mine runoff would be attenuated based on: 1) the assumption that the mine area covers 14% of the watershed; and 2) the remaining undisturbed portion of the watershed would attenuate contaminants contained in mine influenced runoff before reaching downstream ONRWs. These assumptions are incorrect. The impacts of the mine are not proportional to the catchment area. In addition, the analysis leading to this assumption does not consider the spatial and temporal nature of precipitation in the region or the additive effect of mine pollutants in downstream waters.[106]

Contamination of the Mine Pit Lake Will Cause Unacceptable Wildlife Impacts.[107]

The post-mine closure mine pit lake would have a volume of 96,000 acre feet, making it one of the largest water bodies in southern Arizona.[108] Surface water features such as lakes are an attractant to animals and their prey in arid environments. Invertebrates, birds, amphibians, reptiles and potentially small mammals would be able to either access or consume prey from the mine pit lake. Mine pit lake water quality will likely exceed wildlife standards for three contaminants that are known to bioaccumulate, including cadmium, mercury and selenium and for other contaminants as well (*i.e.*, copper, lead, zinc and ammonia)[109] As such, the mine pit lake water would serve as a chronic source of toxic heavy metals to wildlife species through consumption of contaminated water or food chains.[110]

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[102] Draft Memorandum Revised Analysis of Surface Water. Chris Garrett, SWCA. August 25, 2013 http://www.rosemonteis.us/files/references/045677.pdf

[103] FEIS, p. 472. For both the SPLP and MWMP samples analyzed, there were instances where laboratory detection limits were greater than the surface water quality standard (*e.g.*, silver).

[104] *The result is that actual water quality is literally always different than predicted, with the general expectation that it is generally consistent.* Mark A. Williamson, PhD, Geochemical Solutions, LLC to Kathy Arnold, Rosemont Copper Company dated December 23, 2011. *Perspectives on Uncertainty in Water Quality Predictions.*

[105] SIR, p. 34.

[106] SIR, p. 135.

[107] See Guidelines, Subpart B 40 CFR 230.11(d) and (e).

[108] Pima County letter dated March 21, 2014.

[109] SWCA Environmental Consultants. 2012. Memorandum: comparison of pit lake water quality to surface water quality standards. July 29, 2012., FEIS, p. 664.

[110] SIR, p. 28-29.

Of sixty-nine species of migratory birds listed by SWCA as potentially impacted by the mine, 53 species are identified as being susceptible to mine pit contamination primarily from eating invertebrates originating from the pit lake, including sixteen species listed by the Forest Service or BLM as special status.[111,112] In addition, two amphibian, three reptile and six mammal species listed as special status would be exposed to mine pit contaminants by ingesting prey items originating in the mine pit lake.[113] Bats are known to forage locally or travel considerable distances to drink or forage over water on aquatic and terrestrial insects.[114] Six sensitive bat species (*i.e.*, pale Townsend's big-eared bat, western red bat, western yellow bat, fringed myotis, cave myotis, pocketed free-tailed bat and big free-tailed bat) feed on insects, and because the mine pit water quality could exceed wildlife standards for the three contaminants known to bioaccumulate, secondary impacts will likely occur from bats eating aquatic contaminated invertebrates originating from the mine pit lake, thereby altering bat health and overall predator-prey relationships.[115] Some bats preferentially forage over waterbodies in arid environments.[116] Insectivorous bats require daily water and in arid Southwestern states artificial waterbodies may provide the nearest local source of surface water.[117] Given the large size of the pit lake and the tendency for many organisms to either breed within, or drink and acquire prey from large waterbodies, it is highly likely that various animal species will be adversely impacted by consuming contaminated invertebrates originating from the mine pit lake. It is also likely that many animals that ingest and bioaccumulate contaminated prey from the mine pit lake and subsequently disperse to other nearby aquatic habitats will be eaten by other predators in the food chain. For example, Chiricahua leopard frogs could be directly exposed to contaminants should individuals disperse to and occupy the pit lake. Effects to species could also occur from eating winged aquatic invertebrates originating from the mine pit lake site.[118]

The Rosemont Mine Will Result in a Violation of Water Quality Standards in Barrel and Davidson Canyons and Lower Cienega Creek, Including the ONRWs.

EPA has determined that contamination from the Rosemont Mine will lower existing water quality in Davidson Canyon and Cienega Creek ONRWs. Designated as Tier 3 waters, lowering of water quality is prohibited and therefore in violation of State Water Quality Standards.[119] Violation of water quality standards is also prohibited under the Guidelines (40 CFR 230.10(b)). EPA has discussed the analysis of the Rosemont Mine's impact on water quality with the Corps and ADEQ since 2012, concluding the state's CWA §401 certification lacks sufficient specific preventative actions to safeguard the water

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[111] SWCA Environmental Consultants. 2013. Migratory Bird Analysis. Proposed Rosemont Copper Mine, Nogales Ranger District, Coronado National Forest. Tucson, Arizona: SWCA Environmental Consultants. December.
[112] SWCA Environmental Consultants. 2013b. Biological Evaluation, Rosemont Copper Project, Santa Rita Mountains, Nogales Ranger District. Prepared for U.S. Forest Service, Coronado National Forest. Tucson, AZ: SWCA Environmental Consultants.
[113] FEIS, pp. 681-696.
[114] O'Shea, T.J., Clark, D.R., and Boyle, T.P., 2000. Impacts of mine-related contaminants on bats. pp. 276-292, *in* Proceedings of Bat Conservation and Mining: A Technical Forum. K.C. Vories and D. Throgmorton eds., St. Louis, MO.
[115] FEIS, p. 696.
[116] Ibid.
[117] Kurta, A., 2000. Bats on the surface: the need for shelter, food and water. pp. 264-275, *in* Proceedings of Bat Conservation and Mining: A Technical Forum. K.C. Vories and D. Throgmorton eds., St. Louis, MO.
[118] USFWS Amended Biological Opinion dated April 28, 2016. p. 152.
[119] Federal antidegradation policy prohibits any degradation of Tier 3 waters, regardless of economic or social development needs (40 CFR 131.2(a)). Arizona's antidegradation rules reinforce this prohibition (ACC R118-11-107). Minor, short-term impacts are considered if they do not interfere with the character of the ONRW. The temporary exception is limited to an impact of 6 months or less. If constructed, the Rosemont Mine will cause persistent, permanent significant impact to the biological, chemical and physical integrity of the ONRWs.

quality of Tier 3 waters in the Cienega Creek watershed.[120] We recognize there are water quality aspects which may be outside the scope of the state's §401 review. These aspects must be considered in determining compliance with the Guidelines. In Mingo Logan v. EPA, the court ruled that under 401, *the CWA has identified state requirements as a floor that must be met, not a limit on federal authority*.[121] The ruling goes on to state there is nothing in the statute that forecloses EPA from imposing stricter requirements than those required by the state standards.[122]

Our determination of significant degradation to the existing water quality of the ONRWs is based upon the following considerations:

- Change in ambient concentrations predicted at the appropriate critical flow condition(s);
- Change in pollutant loadings;
- Reduction in available assimilative capacity;
- Nature, persistence and potential effects; and
- Potential for cumulative effects.

As shown in Table 2, mine runoff consisting of heavy metals such as mercury, lead, molybdenum, selenium and silver as well as sulfate will be released in concentrations exceeding the stormwater quality for Davidson Canyon ONRW. These heavy metals and other constituents will be transported downstream through stormwater and lower the water quality of Davidson Canyon and Cienega Creek in violation of water quality standards.[123] Changes in stream hydrogeomorphology from the mine will result in increases in total dissolved solids, suspended sediments, lowering of dissolved oxygen and increases in temperature from declining pool levels resulting lower water quality in lower Cienega Creek, in violation of water quality standards.[124] In the amended Biological Opinion, the FWS analyzed the effect of the Rosemont Mine on water quality examining the significant relationship between reductions in stream flow, increases in temperature, and decreases in dissolved oxygen. The FWS concluded that reduced stream flow in lower Cienega Creek, *will increase the incidence of poorer water quality that adversely affects aquatic life in Pima County, CCNP*.[125]

Accordingly, Section 131.12(a)(1) of the antidegradation policy is not satisfied regarding fills in wetlands or other waters if the discharge results in "significant degradation" to the aquatic ecosystem as defined under Section 230.10(c) of the 404(b)(1) Guidelines.[126]

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[120] ADEQ issued the §401 CWA certification to Hudbay on February 3, 2015. See EPA letter to ADEQ dated April 7, 2014 and EPA letter to the Corps dated April 14, 2015 regarding the mine's ability to comply with §401 CWA.

[121] Mingo Logan Coal Company v. U.S. Environmental Protection Agency. Memorandum Opinion, U.S. District Court for the District of Columbia. September 30, 2014. p. 56.

[122] This ruling is consistent with the August 15, 1979 legal opinion of the Office of General Counsel on the designation and protection of ONRW. They concluded, "if a State voluntarily designates an ONRW, EPA can take whatever action is necessary (against point sources) to protect the ONRW."

[123]Designated uses in the OAW section for Davidson Canyon include Aquatic and Wildlife (ephemeral) and Partial Body Contact. The designated uses in the OAW section for lower Cienega Creek are Aquatic and Wildlife (warm water) and Partial Body Contact. http://www.azdeq.gov/environ/water/standards/download/SWQ_Standards-1-09-unofficial.pdf

[124] The Arizona Water Quality Standards narrative biological criteria (WQS) (R118-11-108) for lower Cienega Creek is: A wadable, perennial stream shall support and maintain a community of organisms having a taxa richness, species composition, tolerance, and functional organization comparable to that of a stream with reference conditions in Arizona. ADEQ doesn't have a temperature WQS, but temperature is a pollutant and the designated use of A&W must be protected. Raising a temperature to a level that harms the organisms in the waterbody would be in violation of the standard.

[125] Amended Biological Opinion dated April 28, 2016. p. 48.

[126]See. Questions and Answers on: Antidegradation, Question #13, EPA, Office of Water Regulations and Standards, August 1985.

Table 2. Predicted contaminant runoff from Rosemont Mine compared to existing downstream water quality for Davidson Canyon and Barrel Canyon

Metals and other constituents	Predicted Runoff Water Quality from Waste Rock (mg/L)[1]	Predicted Runoff Water Quality from Soil Cover (mg/L)[1]	Davidson Canyon Stormwater Water Quality Data (mg/L)[2]	Barrel Canyon Stormwater Water Quality Data (mg/L)[3]	Surface Water Standard for Aquatic and Wildlife Ephemeral -Acute (mg/L)	Surface Water Standard for Partial Body Contact (mg/L)
Lead (total)	0.0048	0.0151	0.011-0.266	ND-6.5 (0.01-0.1)	No Standard	0.015
Lead (dissolved)	0.0048	0.0151	<0.00059-<0.00099	ND-1.2 (0.002-0.15)	0.05657	No Standard
Mercury (total)	0.0002	0.0101	<0.001	ND-0.0029 (0.0001-0.01)	No Standard	0.28
Mercury (dissolved)	0.0002	0.0101	<0.001	ND (0-0.002)	0.005	No Standard
Molybdenum (total)	0.0405	0.0117	<0.01	ND-0.024 (0.01-0.1)	No Standard	No Standard
Molybdenum (dissolved)	0.0405	0.0117	ND	ND-0.095 (0.01-0.1)	No Standard	No Standard
Selenium (total)	0.0200	0.0200	0.006-0.018	ND-19.1 (0.002-0.25)	0.033	4.667
Silver (dissolved)	0.0025	0.0025	<0.00082-<0.0014	ND-0.0341 (0.001-0.05)	0.00081	No Standard
Sulfate (total recoverable)	33.13	1.98	<5.0-5.5	ND-66 (3-5)	No Standard	No Standard
Sodium (dissolved)	4.167	6.1	Not recorded	2.518		
Sodium (total)	4.167	6.1	<5.0	7.008	No Standard	No Standard

[1]Predicted runoff water quality (mg/L) from the mine. Red denotes concentrations exceeding water quality of Davidson Canyon at upstream end of OAW reach. Results reflect the average of the test samples (FEIS, Table 105, pp. 475-477 and SIR, p. 33-34).
[2]Water quality data for Davidson Canyon (4 dates). Memo of Water Quality/Water Level Data for USFS from Karen Herther, Hudbay, to file dated January 16, 2015. ND=Not Detected.
[3]Barrel Canyon range of results (8 locations on 15 dates). Lab detection limits in parentheses (FEIS, Table 105).

Mitigation Proposed for the Rosemont Mine Will not Prevent Water Quality Degradation of ONRWs.

The State's Certification relies on a requirement for Rosemont Mine to develop a Surface Water Mitigation Plan (SWMP).[127] The SWMP lacks detailed measures demonstrating Rosemont Mine's ability to arrest and reverse the heavy metal contamination in stormwater which will degrade downstream water quality. In summary:

- The SWMP relies on voluntary monitoring which will not prevent the contamination of downstream waters;
- The surface model used as a predictive tool to quantify changes in surface water runoff from the mine has not been developed; and
- Rosemont Copper Company has not demonstrated a measurable water supply and delivery to mitigate reduction in surface flow caused by the mine.[128]

The Rosemont Mine Will Cause Unacceptable Adverse Effects to Municipal and Private Water Supplies.[129]

Municipal and private water supplies. The Guidelines require consideration of the potential effects of the project on municipal and private water supplies. Effects to the quality and quantity of surface water and ground water supplies must be evaluated. EPA has determined the proposed Rosemont Mine will result in unacceptable adverse impacts on municipal and private water supplies through reduction in water quantity and the degradation of water quality.

The proposed Rosemont Mine is located within the Tucson Active Management Area (AMA). The AMA was established to manage the state's finite groundwater resources.[130] As of 2013, water use within the AMA consists of 47.7% groundwater and 37.9% Central Arizona Project (CAP) along with 4.6% effluent and 9.3% in lieu groundwater.[131] Although the AMA has a statutory goal of achieving and maintaining safe-yield by 2025, the ability to attain safe yield is uneven.[132] Some basins achieve safe yield while other wide areas continue to experience significant overdraft.[133] The impact of mining

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[127] CWA§401 Certification, Specific Condition dated February 3, 2015, #1, p. 6

[128] See EPA letter to the Corps dated April 14, 2015. A predictive tool is highly questionable given the asynchronous nature of precipitation in the semi-arid region and in consideration of climate change and drought.

[129] See Guidelines at Subpart F (40 CFR 230.50).

[130] http://www.azwater.gov/AzDWR/WaterManagement/AMAs/default.htm. To establish an AMA, at least 1 criteria must be met: 1) preserve existing groundwater for future use; 2) land subsidence is endangering property or groundwater storage; or 3) actual or threatened water quality degradation due to groundwater use.

[131] Email dated November 5, 2015 from Pam Muse, Supervisor, AMA Planning and Data Department, ADWR to Elizabeth Goldmann, EPA.
http://www.azwater.gov/azdwr/StatewidePlanning/WaterAtlas/ActiveManagementAreas/documents/Volume_8_final.pdf, p. 46.

[132] http://www.azwater.gov/azdwr/WaterManagement/AMAs/TucsonAMA/TAMAOverview.htm. Safe yield means that the amount of groundwater pumped from the AMA on an average annual basis does not exceed the amount that is recharged.

[133] Cabello, V., N. Hernandez-Mora, A. Serrat-Capdevila, L. Del Moral, E. Curley. 2016. Water use and sustainability in the Tucson basin: Implications of spatially neutral groundwater management. In Gupta H., Gupta M., Poupeau F., Serrat-Capdevila A., (Eds) Water Banruptcy in the land of plenty. Steps towards a transatlantic and transdisciplinary assessment of water scarcity in Southern Arizona, pp. 289-316.

on local water table levels is very significant.[134] Significant ground water pumping for projects like the Rosemont Mine may further jeopardize the ability of the AMA to achieve a "safe yield" by 2025.

Two groundwater basins within the AMA would be impacted by the proposed mine, adversely affecting overall groundwater availability.[135] Rosemont Mine proposes to pump water supply for the mine from wells located in the Santa Cruz Valley near Sahuarita in the Upper Santa Cruz Subbasin.[136] In addition, active pumping of the mine pit within the Cienega Basin would remove groundwater from the regional aquifer. Groundwater declines can lead to increased pumping costs, decrease in water quality, riparian damage, land subsidence and land fissuring and permanent compaction of the aquifer all of which have occurred in the AMA.[137]

Upper Santa Cruz Subbasin. Groundwater levels in the Upper Santa Cruz Subbasin have historically decreased by 1 to 3.5 feet per year and are projected to decrease by 3.5 to 6.5 feet per year.[138] It is estimated that water supply pumping for the mine over the 20-year active mine period will result in an increase in the rate of groundwater drawdown to a total decrease of 5 to 8 feet in groundwater levels per year. This represents a 6 to 7% increase over the current pumpage demand.[139] With the Upper Santa Cruz Subbasin already in decline, pumping of water from the regional aquifer for the operation of the proposed mine would lower groundwater levels, which would reduce groundwater availability to existing wells and water users. Because of pumping water supply for the mine, an estimated 500-550 private and municipal wells would be significantly impacted by drawdown in groundwater levels.[140] Groundwater-level drawdown is estimated to be as great as 90 feet immediately adjacent to the pumping locations and 10 feet or less approximately 3-4 miles (42 square miles) from the Rosemont Copper properties during active mining.[141] The cone of depression will not stop expanding until 100-140 years after pumping ceases. The 10-foot drawdown is projected to expand an additional 1 to 2 miles laterally before it stops expanding, encompassing approximately 78 square miles.[142] When pumping ceases, recovery would not occur unless water levels in the regional aquifer begin increasing.[143,144]

Davidson Canyon/Cienega basin. The watershed where the Rosemont Mine is located provides 20% of the groundwater recharge in the Tucson basin.[145] Water originating from Cienega Creek can be

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[134] Ibid. "Disconnection of recovery from recharge sites entails local impacts over water table levels driven by mines and new developments." P. 1.
[135] FEIS, p. 338.
[136]During the life of the proposed Rosemont Mine, total water use pumped from the Upper Santa Cruz Subbasin is estimated at 100,000 acre-feet. This averages 5,000 acre feet per year (afy) of fresh water during operations. The water would be pumped from 4-6 wells near Sahuarita in the Santa Cruz Valley at 5,000 gallons per minute. FEIS, p. A-11.
[137] http://www.azwater.gov/azdwr/StatewidePlanning/WaterAtlas/ActiveManagementAreas/documents/Volume_8_final.pdf. p. 54.
[138] By 2030, projected water deliveries of groundwater in the Sahaurita area will almost double, and private wells will likewise double their groundwater withdrawal. FEIS, p. 356.
[139] FEIS, p. 338 and p. 356.
[140] Shallow wells are not assessed. Drawdowns could occur but the model is not able to predict these specific impacts.
[141] If active mining is extended to 25 years (estimated upper range), the additional drawdown due to the mine water supply pumping would range from 7.5 to 17.5 feet. FEIS p. 336.
[142] FEIS, p. 336.
[143]FEIS, p. 330.
[144]FEIS, Table 58, p. 337.
[145]Letter to ADEQ from Pima County Administrator, Chuck Huckelberry dated March 21, 2014. Eastoe, C., A. Gu and A. Long. 2003. *Stable Isotope Tracers Reveal Flow Paths.* Geoscience News. 2 pp.

identified in the groundwater of the Tucson basin.[146] According to the FEIS, the mine pit would create a permanent drawdown of the water table. During active mining, groundwater would be pumped directly from the mine pit or from dewatering wells next to the mine pit. After closure, the pit will gradually fill with groundwater, forming a mine pit lake. The mine pit lake is expected to act as a permanent regional hydraulic sink, resulting in long-term impact on groundwater hydrology in the vicinity of the mine.[147,148] During active mining, estimates of pit dewatering are as high as 650 gallons per minute, resulting in approximately 13,000 – 18,500 acre-feet of water removed from the aquifer.[149,150] Groundwater drawdown from the mine's pit within the Davidson Canyon/Cienega Basin, would significantly impact an estimated 360-370 well owners with water level declines over 10 feet.[151] If mine contamination of groundwater occurred, water supplies for Tucson and Vail could be at risk.[152]

Water quality impacts from groundwater depletion in wells. In addition to a reduction in well water quantity for owners and users, groundwater depletion in wells may adversely impact water quality. Withdrawal of good quality water from the upper parts of inland aquifers can allow underlying natural or manmade pollutants to concentrate in the remaining groundwater degrading water quality.[153,154]

Mitigation Proposed by Rosemont Copper Will Not Offset Significant Adverse Impact to Municipal and Private Water Supplies.

To address the impacts to groundwater from the mine, Rosemont proposes measures to mitigate impacts to well owners and the aquifer of the AMA, but these measures will not offset significant impact to the quantity and quality of private and public water supplies.

Residential Well Protection Program. Rosemont Copper Company offered a voluntary Well Protection Program for private residential well owners against the risk of mine-associated groundwater drawdown. These agreements were offered to well owners in "well protection areas" identified by the Rosemont Copper Company that may be subject to well draw down from operation of the proposed mine. The program is two-fold: 1) a pump warranty program for well components; and 2) a water well deepening program to deepen a well that has failed.[155] An In Lieu Cash payment of $5000.00 and

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[146] Eastoe, C.J., Ailang, G. 2016. Groundwater depletion beneath downtown Tucson, Arizona, a 240-year record. Universities Council on Water Resources Journal of Contemporary Water Research and Education. Issue 159, pp. 62-77.

[147] After 150 years, the area within the 5-foot contour encompasses approximately 50,000 acres.

[148] Once mining has ceased, water lost to evaporation in the mine pit would be partially offset by groundwater flowing into the mine pit lake, perpetuating the aquifer drawdown caused by the mine pit dewatering. Models estimate equilibrium would not be reached until 700 to 7,000 years after mine closure. FEIS, p. 291 and p. 329.

[149] FEIS, p. 353.

[150] SIR, p. 24.

[151] Some well owners may experience up to 85 feet of water level decline if the wells are connected to the regional aquifer. FEIS, p. 350- 352.

[152] Letter from C.L. Huckelberry, Pima County Administrator, to William James, U.S. Army Corps of Engineers and Kerwin Dewberry, Forest Supervisor, Coronado National Forest, regarding *New Information: Rosemont Copper Mine, Section 404 Clean Water Act*, dated September 28, 2017.

[153] http://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/USGS_Groundwater%20Depletion%20Across%20the%20Nation.pdf

[154] http://waterinthewest,standord.edu/groundwater/overdraft/

[155] Rosemont Copper Company decides whether the decline in water levels is greater than the natural annual or seasonal fluctuations experienced in the area because of monitoring at key monitoring sites chosen by the company. Deepening is limited to the existing registered well depth plus 50%, or a maximum of 600 feet below land surface, whichever is less and is limited to one attempt to deepen the well. This does not include wells for irrigation. Well owners entering this contract waive all claims against Rosemont Copper Company for interference with the water levels in the area. In addition, this contract does not include protection from any water quality degradation. There is no protection for well owners who choose not enter into this legally binding agreement. *Rosemont Copper Company Eastside Well Protection Program.*

$15,000.00, respectively, is also offered.[156] Pump damage or well depletion is determined solely by Rosemont Copper Company. The length of the warranty is unclear. Property owners have voiced concerns to EPA regarding the threat to a clean and reliable water source, and economic hardship should the mine be constructed.[157,158]

Groundwater Recharge. Rosemont Copper Company has committed to recharging 105 percent of water pumped from the Santa Cruz Basin (105,000 acre feet).[159] As of 2009, 45,000 acre-feet have been recharged by the company, yet only 600 acre feet of that total have been recharged within the Upper Santa Cruz Subbasin where impacts to private well owners will occur. Given the uncertain location where water would be recharged in the future, it is unknown whether actual drawdown in the Upper Santa Cruz Subbasin would be offset.[160] Also, groundwater recharge is a voluntary measure and given the likely water shortages in the Colorado River over the next few decades, it is unlikely Rosemont Copper Company will be able to meet their commitment to recharge with excess water from CAP. Arizona Department of Water Resources is currently negotiating cuts on Colorado River water deliveries.[161,162] If necessary, excess water deliveries, such as those utilized by Rosemont Copper Company would be reduced and portions of CAP recharge operations would cease. If further reductions are required, CAP would even recover water stored to meet Arizona's obligations.[163]

The adverse effect of the Rosemont Mine on private and municipal water supplies is significant. Groundwater pumping for the mine will reduce available groundwater supply, possibly degrade water quality and cause significant economic hardship for private and municipal water users. Voluntary measures proposed by the Rosemont Copper Company to mitigate for impacts to water supplies are unreliable and unenforceable and will not offset the significant impacts to water users in the AMA.

The Rosemont Mine Will Cause Unacceptable Adverse Effects to Water-Related Recreation and Aesthetics.[164]

Water-related Recreation. Several water-related recreational opportunities exist on lands within and adjacent to the Rosemont Mine. These include wildlife observation, bird watching, camping, biking, and hiking along streams within the Cienega Creek watershed. The Rosemont Mine would alter and destroy aquatic resources which support these recreational activities, as well as restrict use adversely affecting recreationists.

Per the FEIS, Rosemont Mine will result in a loss of 6,177 acres of National Forest Service (NFS) lands available for recreational use. Currently, commercial outfitter and guides operate throughout the forest,

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[156] It is not known how many private well owners signed up for the program.
[157] Letter from property owners, Gregory and Carol Shinsky to EPA, February, 2012.
[158] As depth to water increases, power costs to drive the pump increases with the yield of the well declining below usable rates.
http://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/USGS_Groundwater%20Depletion%20Across%20the%20Nation.pdf
[159] This is a voluntary measure in a License for a Right-of-way Encroachment agreement with the Town of Sahuarita. Recharging would be based on "available" CAP water. FEIS, p. 360.
[160] FEIS, p. 360.
[161] http://www.cap-az.com/public/blog/508-arizona-is-rising-up-to-meet-the-challenges-of-falling-water-levels-at-lake-mead, http://tucson.com/news/local/big-cap-cuts-coming-as--state-water-agreement-nears/article_876e3aa6-6cf0-53ec-bd0c-95be8c6468ae.html
[162] Central Arizona Project Issue Brief Strategic Initiatives and Public Policy dated October, 2014.
[163] http://www.cap-az.com/documents/public-information/Shortage-Issue-Brief.pdf and http://www.azwater.gov/azdwr/ColoradoRiverShortagePreparedness.htm
[164] See Guidelines, Subpart F (40 CFR 230.52 and 40 CFR 230.53)

including 20 different birdwatching guides.[165] Bird-watching and hiking would be restricted in the Cienega Creek watershed due to exclusion of public access from the area within the perimeter fence.[166] In addition, 7.3 miles of Arizona National Scenic Trail would need to be relocated. Activities affecting birding in and adjacent to the project area include direct loss of habitat, noise, dust, lighting, increased traffic, changes to springs, riparian vegetation and pit lake water quality.[167] Industrial noise would be noticed near the perimeter fence and along much of the Arizona National Scenic Trail.

Economics. Construction of the mine will adversely affect outdoor recreation and quality of life enjoyed by the public and private property owners. The loss of values for consideration include impairment of natural resources (*e.g.*, degradation of habitat) which support recreation activities such as birdwatching, hiking and sightseeing. Arizona Game and Fish Department noted the mine's impacts would, "render the northern portion of the Santa Rita Mountains…worthless for wildlife recreation.[168] A study conducted by the Sonoran Institute shows that approximately 2.95 billion is spent annually for tourism and outdoor recreational activities in Pima and Santa Cruz Counties. Their analysis states that if the proposed project displaces only one percent of travel and tourism-related spending in the region, the economic loss would be greater than the entire annual payroll of the mine.[169] According to the USFS, the change in tourism ranges from a $1.0 million to $3.6 million dollar annual reduction in visitor spending, and a 15 -50% decrease in nature-based tourism from 0 to 10 miles from the mine per year.[170] The FEIS estimated the total annual economic losses in the greater Tucson area from reduced tourism at $1.2 million to $6.5 million.[171] Increase in sky brightness as a result of the proposed project will impair observatories near the project area which could result in a decrease in state revenues generated from astronomy, space, and planetary resource and tourism.[172]

Aesthetics. The Rosemont Mine would impact regional visibility resulting in adverse scenic quality well beyond the mine footprint.

The Coronado National Forest's (CNF) mountain ranges known as "sky islands" reach elevations exceeding 10,000 feet providing high quality scenery and a diverse range of habitats.[173] A national Forest Service survey showed more than 67% of visitors to CNF participate in viewing nature; affirming the importance of the aesthetics of the area. Twenty-five percent of CNF visitors travel on a forest scenic byway.[174] Per the FEIS, *Approval of the forest plan amendment would allow actions that would result in impacts to visual resources. With all action alternatives, the proposed mine would result in permanent detrimental impacts to visual quality. While design features and mitigation measures would result in minor reductions in negative impacts to scenic quality, they would not be sufficient to obscure the impacts or visibility of residents, visitors, and travelers in the planning area.*[175]

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[165] FEIS, p. 851.
[166] SIR, p. 233.
[167] FEIS, p. 853.
[168] Letter from Joan E. Scott, Habitat Manager, AZGFD to Beverly Everson, CNF dated July 8, 2008.
[169] Marlow, J.E., 2007. Mining's potential economic impacts in the Santa Rita and Patagonia mountains region of southeastern Arizona. Sonoran Institute Study.
[170] SIR, p. 262.
[171] FEIS, p. 1113.
[172] SIR, p. 262.
[173] FEIS, p. 767.
[174]FEIS, p. 767.
[175] FEIS, p. 833.

The proposed project, when added to past, present and future actions and combined with trends that impact visual quality, would result in cumulatively adverse, permanent impacts on scenic quality within the region because of the surface disturbances and landscape contrasts associated with these activities. Additionally, fugitive dust production from the mine would increase the adverse impacts to long-distance scenic viewing of the Santa Rita Mountains and other scenic mountain ranges within the region in the short and long term.[176]

The USFS uses a Forest Service Scenery Management System to apply a systematic and consistent method to analyze impacts to forest scenic quality. This methodology was applied to the proposed Rosemont Copper Project.[177] The proposed Rosemont Mine would create significant changes to the landscape in perpetuity as follows:[178]

- 186,893 acres will have visibility of the mine area;
- 2.8 miles of Arizona National Scenic Trail will have direct line-of-sight views of the mine area;
- Permanent, major adverse impacts from highly visible waste rock and tailings piles; and
- Strong contrasts and adverse impacts from highly visible pit face and diversion channel.

In summary, the Rosemont Mine would impact regional visibility and would result in adverse scenic quality well beyond the mine footprint. Visual impacts would be significant and adverse.[179] The proposed Rosemont Mine project would mar the beauty of natural aquatic ecosystem by degrading water quality, creating distracting disposal sites, inducing inappropriate development, and destroying vital elements that contribute to the compositional harmony or unity, visual distinctiveness, or diversity of an area.

The Rosemont Mine Will Cause Unacceptable Adverse Effects to Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites and Similar Preserves.[180]

The Rosemont Mine would significantly degrade the following national and regional conservation lands.

Las Cienegas National Conservation Area. BLM's Las Cienegas National Conservation Area (NCA) was established by Congress, in large part, to conserve, protect and enhance the unique and nationally important aquatic, wildlife, vegetation and riparian resources of the Cienega Creek watershed. Six types of rare ecosystems are protected within the NCA, including aquatic ecosystems such as cienegas (marshlands), cottonwood-willow riparian wetlands, and mesquite bosques. Because of its ecological significance, Congress and the President designated the NCA as part of BLM's National Landscape Conservation System. The National Landscape Conservation System was established to protect some of the most remarkable public lands in the American West. Additionally, a 10.5 mile stretch of Cienega Creek has been rated eligible for national wild and scenic river designation (BLM 2003).[181]

At its nearest point, the mine site lies only 3 to 4 miles from the NCA boundary. The consequence of the groundwater drawdown from the mine pit is the secondary loss or conversion of hundreds of acres of

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[176] FEIS, p. 867
[177] FEIS, p. 770- 771.
[178] FEIS, Table 148. Summary of Effects.
[179] FEIS p. 833.
[180] See Guidelines, Subpart F (40 CFR 230.54)
[181] FEIS, p. 839.

riparian vegetation, including wetlands, and the drying of streams currently characterized by permanent flow. These impacts are permanent and persistent resulting in significant degradation and loss of rare and largely intact mosaics of some of the highest quality stream and wetland ecosystems in Arizona; adversely affecting federally listed endangered and threatened species[182,183] The proposed mine project will degrade and destroy the resources Congress sought to protect.

Pima County Cienega Creek Natural Preserve. Pima County has identified the Cienega Creek Natural Preserve as the "crown jewel" of their natural resource conservation lands.[184] The approximately 4,000-acre preserve was established in 1986 and contains some of the region's most significant aquatic and riparian habitat extending a length of 12 miles along Cienega Creek. Surrounded by the arid environment of the Sonoran Desert, the Cienega Creek riverine wetlands provide shelter and foraging habitat for wildlife species. Within the Preserve, portions of Cienega Creek run perennially providing habitat for federally listed as endangered, Gila topminnow, Gila chub, and the Huachuca water umbel. The Preserve also provides a corridor link for movement of larger wildlife between the Santa Rita, Whetstone and Rincon Mountain Ranges.

The Preserve was established for the "purposes of preservation and protection of the natural scenic resources of the property…for the benefit and protection of the County, its resources, residents, and visitors."[185] Construction of the proposed Rosemont Mine through the filling of Cienega Creek's headwater streams, diversion of streamflow and groundwater drawdown will dramatically alter in perpetuity the surface and subsurface hydrology of the Cienega Creek watershed causing stress and degradation of aquatic habitat resulting in dramatic and persistent changes to the preserve.

Bar V Ranch Preserve. Pima County's 14,400-acre Bar V Ranch Preserve is a located adjacent to the County's Cienega Creek Natural Preserve in the Cienega Creek watershed. It includes significant portions of Davidson Canyon. It is designated as Biological Core and Important Riparian Area within Pima County's Conservation Lands System, supporting habitat for 34 Priority Vulnerable Species identified in the Sonora Desert Conservation Plan and is a vital wildlife corridor link in Cienega Valley.[186]

Construction of the proposed Rosemont Mine through the filling of Cienega Creek's headwater streams, diversion of streamflow and groundwater drawdown will dramatically alter in perpetuity the surface and subsurface hydrology of the Cienega Creek watershed causing stress and degradation of aquatic habitat resulting in dramatic and persistent changes to the Bar V Ranch Preserve.

Coronado National Forest. The Rosemont Mine would result in the direct removal of up to 6,990 acres (5.1 percent of NFS lands within the Santa Rita Ecosystem Management Area) from public entry.[187] The national forest is located within the Sky Island region of southeastern Arizona, southwestern New Mexico and northwestern Mexico. Elevations within the national forest range from 3000 feet to 10,720 feet in widely scattered mountain ranges or "sky islands." These mountain forested ranges separated by

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[182] FEIS, Chapter 3, Seeps, Springs and Riparian Areas
[183] Per the B.O., these species and/or their critical habitat include the: Chiricahua leopard frog, northern Mexican gartersnake, Gila chub, Gila topminnow, desert pupfish, Huachuca water umbel, yellow-billed cuckoo, and southwestern willow flycatcher.
[184] Brian Powell, Pima County Office of Sustainability and Conservation, Water Resource Trends in the Cienega Creek Natural Preserve, Pima County, Arizona dated August 2013.
[185] Ibid.
[186] http://www.sonorandesert.org/properties/barv/
[187] FEIS, p. 862.

vast expanses of desert and grassland plains, are among the most diverse ecosystems in the world because of their great topographic complexity.[188, 189]

Construction of the Rosemont Mine would change the existing undeveloped, semi primitive recreation setting on lands surrounding the project area to a developed, industrialized setting.[190] Restricted public access due to the perimeter fence would result in a reduction of recreational activities with indirect effects such as increased noise, vibration, artificial lighting, traffic, loss of native vegetation and general industrial activities.[191] The mine would exclude hunters from access to approximately 4 to 5 percent of NFS lands resulting in the loss of 775 hunter days annually.[192] A 12.8 mile section of the Arizona National Scenic Trail would be relocated and increased traffic on the Patagonia-Sonoita Scenic Road will likely result in a reduction in use for cyclists and pedestrians.[193]

Outstanding National Resource Waters (ONRW). The State of Arizona has designated reaches of both Davidson Canyon and Cienega Creek as ONRWs due to, among other factors, their exceptional ecological and recreational significance and the presence of federally endangered and threatened species. This state designation affords them special protection, prohibiting any lowering of water quality. Federal regulations for state-designated outstanding waters similarly state "Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected" (40 CFR 131.12(a)(3)).

The proposed mine will result in the lowering of water quality in the ONRW through: 1) heavy metal contamination; 2) increasing total sediment in surface water flow; and 3) alteration of the physical, chemical and biological integrity of the stream. These adverse water quality impacts to downstream ONRWs will be permanent.

The Rosemont Mine Will Result in Unacceptable Adverse Cumulative Effects on the Aquatic Ecosystem.[194]

The USFS evaluated the cumulative effects on biological resources from the Rosemont Mine and concluded; *When considered together, these foreseeable actions, when combined with the expected impacts from the proposed project (no matter which action alternative is selected), and with climate change and human population growth and associated development, would cumulatively contribute to impacts such as loss of fragmentation of habitat, vibration, noise, dust and air pollutants, and artificial lighting. The overall result would be a continuation of the long-occurring trend of reduced habitat quantity, and quality; distribution of movement and genetic flow; and continued increase in risk and threat to sensitive species.*[195]

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[188] www.fs.usda.gov/coronado
[189] Skyislandalliance.org
[190] FEIS, p. 862.
[191] Recreational activities include; birding, scenic touring, solitude, hunting, off-highway vehicle use, camping, hiking, horseback riding, and mountain biking. Restricted access would result in a direct loss of acres to the Santa Rita Backcountry Touring Area and National Forest roads. FEIS, p. 853 and p. 862.
[192] FEIS, p. 853.
[193] As many as 88 roundtrip truck traffic shipments would occur per day. FEIS, p. 856.
[194]See Guidelines, Subpart B (40 CFR 230.11(g)).
[195] FEIS, p. 712.

The USFS conclusion underscores the significance of the cumulative effects on the aquatic ecosystem attributable from the Rosemont Mine. In evaluating the cumulative impacts, one must consider the additive nature of the mine's effects on the Cienega Creek watershed, the effects of drought and climate change, as well as the environmental impacts from future mining in the Cienega Creek watershed. Cumulative impacts on the aquatic ecosystem include those associated with past, present, and reasonably foreseeable discharges to waters of the U.S. The cumulative impacts stemming from the Rosemont Mine alone, without even considering foreseeable impacts associated with other activities in the watershed, would be severely damaging to the aquatic ecosystem.

Less than 1 percent of Arizona's landscape has wetlands. Since the late 1800's, streams and wetlands throughout Arizona have been modified or drained, resulting in the loss of more than one-third of the State's original wetlands.[196] The proposed project will contribute to the significant cumulative loss of wetlands in Arizona. At a regional level, changes in the aquatic ecosystem of the Cienega Creek watershed from the Rosemont Mine and other cumulative effects will result in a significant impairment of the water resources, including the productivity and water quality of existing aquatic ecosystems.

Mining. The Rosemont Mine has a predicted life of 25-30 years. The cumulative effects of this mine are significant as impacts from reduce stormflow, reduced sediment delivery and contaminated mine runoff are additive and will persist long after mining has ceased. Metal contaminated sediments are sources of future contamination and pose ongoing long term risk to the environment.[197] This mine will cause wide and pervasive changes to the ecosystem through a reduction in the diversity and spatial distribution of waters over large geographic areas and will cause habitat fragmentation, water quality degradation and risk to federally listed endangered and threatened species.

Rosemont Copper Company currently has three mineral deposits near the Rosemont Mine: Broad Top Butte, Copper World, and Peach-Elgin with potential mineral resources of 8.8 million tons for Broad Top Butte and 23.4 million tons for Peach-Elgin.[198] These deposits are located on the northwest corner of the proposed Rosemont Mine. It is Rosemont Copper Company's intention to conduct further work at these sites to evaluate the mineral potential, stating that these deposits have potential as satellite areas of production.[199] Mining of these areas would expand and prolong the significant degradation of the Cienega Creek watershed.[200] Additional mining would further deplete groundwater levels currently experiencing overdraft conditions threatening municipal and private water supplies. For example, extending the Rosemont Mine life alone from 20 to 25 years will require additional mine water supply pumping resulting in an additional drawdown of 7.5 to 17.5 feet.[201]

Drought and Climate Change. The adverse effects of the project's changes to the regional hydrological regime would be further exacerbated by drought and projected climate change. The long-term trend in surface flows in Cienega Creek is one of steep, continuing decline due to several factors including increasing domestic groundwater pumping and persistent natural drought. Long-term ground and surface water monitoring within the Cienega Creek watershed indicates that the duration and extent of streamflow is very susceptible to drought; the length of stream segments that support perennial flow

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[196] http://pubs.usgs.gov/wsp2425/state_highlights_summary.html
[197] Taylor and Hudson-Edwards. 2008.
[198] Rosemont Copper Project CWA Section 404(b)(1) Alternatives Analysis (SPL-2008-00816-MB) prepared by WestLand Resources dated September 2013 pp. 23-26. No information was available on size of mineral resource for Copper World.
[199] Ibid.
[200] Additional potential future mining has been identified in the FEIS including the Charles Seel leases and Andrada Mine in Davidson Canyon and the Twins Buttes Mine near Sahuarita (FEIS, p. 437).
[201] FEIS, p. 336.

have been reduced beginning with the drought of the 1980s.[202] Between 1990 and 2011, surface water discharge in Cienega Creek declined 83%, while stream flow extent declined by 88 percent.[203] Davidson Canyon has also exhibited a drying trend.[204] Evaluation of baseline trends in temperature and precipitation in Tucson, Green Valley and Vale show a statistically significant trend toward lower precipitation, and a statistically significant relationship between reductions in stream flow, increases in temperature and decreases in dissolved oxygen.[205]

Climate change research and modeling predict a 10-20 percent reduction in precipitation in the desert southwest within the next 75 years, resulting in more arid conditions.[206] Changes in rainfall and runoff will result not only in increasing dryness, but also more frequent flood events. Change in storm intensity is particularly significant in areas containing erodible metal-bearing sediment increasing the flux of metals from alluvial storage further degrading downstream aquatic resources.[207,208]

The USFS states predicted changes in weather patterns could influence the quantity of stormwater that is stored at the surface and available for beneficial use by riparian vegetation. Increased temperatures and reduced precipitation will increase the vulnerability of springs and riparian systems relying on the groundwater system whether regional or local.[209] The potential cumulative effect of drought, aridity from climate change, and projected reductions in surface water flows and groundwater drawdown attributable to the Rosemont Mine proposed will result in significant adverse impacts to the aquatic environment.

The Mitigation Proposed by the Rosemont Mine Will Not Offset Impacts to Waters of the U.S. Below the Level of Significant Degradation.

The Rosemont Copper Company's compensatory mitigation plan, *Final Habitat Mitigation and Monitoring Plan Permit No. SPL-2008-00816-MB Rosemont Copper Project Revised September 12, 2017* (HMMP), does not prevent or replace the impacts that give rise to the significant degradation finding.[210]

For compensatory mitigation to bring a project into compliance with the significant test of the Guidelines, it must satisfy two conditions: it must prevent or replace the impacts that give rise to the significant degradation finding, and it must provide reasonable assurance of success. Without a reasonable assurance that the mitigation will function as intended, it cannot be fairly relied upon to reach a finding that otherwise significant adverse impacts would no longer be so.

The environmental scale of the HMMP plan is not commensurate with the environmental scale of its project impacts. What is lacking is a clear nexus between the impacts of the project and the proposed

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[202] http://www.pagnet.org/tabid/912/default.aspx
[203] Powell, B. F. 2013. Water resource trends in the Cienega Creek Natural Preserve, Pima County, Arizona. An unpublished report to the Pima County Flood Control District, Tucson, AZ.
[204] FEIS, p. 420.
[205] SIR, p. 50-53.
[206] Letter from Pima County to US Army Corps of Engineers, RE: SPL-2008-00816 Rosemont Mine, dated January 19, 2012.
[207] Longfield, S.A., Macklin, M.G. 2008. The influence of recent environmental change on flooding and sediment fluxes in Yorkshire Ouse basin. Hydrological Processes 13:1050-1066.
[208] Walsh, K., Cai, W., Hennessy, K., Jones, R., McInnes, K., Nguyen, K., Page, C., Whetton, P., 2002. Climate Change in Queensland under Enhanced Greenhouse Conditions, CSIRO, Australia, 83 pp. cited in Taylor and Hudson-Edwards. 2008.
[209] FEIS, p. 565-566.
[210] See *EPA Analysis of the Final Habitat Mitigation and Monitoring Plan Permit NO. SPL-2008-00816-MB Rosemont Copper Project. September 12, 2017* dated November 30, 2017.

mitigation. The mitigation, located outside of the watershed where the impacts occur, cannot offset significant degradation within the Cienega Creek watershed itself or account for the loss of ecological services arising from the interrelationship of the headwater streams and the surrounding terrestrial ecology at a regional scale. In fact, the HMMP effectually reduces the diversity of ecosystem types and results in a loss of hydrologic function and the biological communities the ecosystem supports.

There is high risk and uncertainty associated with the proposed mitigation. The mitigation proposed at Sonoita Creek Ranch involves significant and risky hydrologic modifications and long term maintenance, thereby posing an extremely high risk of failure.[211] The proposed engineered channels are not designed as self-sustaining, unconstrained or naturally functioning floodplain channels, so they will not provide significant and lasting ecological benefits to the aquatic ecosystem. Highly questionable modeled predictions put the ecological benefits of the proposed constructed channels in question. As designed, it is highly questionable whether these constructed channels will flow at a frequency and duration sufficient to offset many of the stream functions directly and indirectly lost at the proposed mine site.[212] In addition, the proposed mitigation itself will result in the filling of 8.9 acres of Sonoita Creek.

EPA has reviewed the *Final Habitat Mitigation and Monitoring Plan Permit NO. SPL-2008-00816-MB Rosemont Copper Project dated September 12, 2017* (HMMP*)*. The mitigation proposed in the final HMMP includes two components: the Sonoita Creek Ranch (SCR) project and the onsite stock tank removal. Rosemont submitted the mitigation package to compensate for impacts to waters of the United States by the proposed Rosemont Copper Mine. EPA comments on this HMMP are reviewed in an analysis dated November 30, 2017.

Our review of the HMMP affirms our position that the mitigation does not comply with EPA's 404(b)(1) Guidelines and the requirements of the Mitigation Rule. The HMMP proposed by Rosemont fails to offset the proposed mine's impacts to aquatic resources in the Cienega Creek watershed:

- The SCR mitigation does not offset any of the pervasive damage to aquatic resources in the Cienega Creek watershed;
- Rosemont's qualitative methodology comparing functional loss associated with the mine's impact site and the functional gain at the mitigation sites is scientifically flawed and unsupportable and therefore, not valid;
- Rosemont's application of the mitigation terminology to the HMMP erroneously inflates the credit value of the mitigation;
- The onsite stock tank removal relies on erroneous assumptions on stormflow, is not scientifically valid and fails to offset 28.4 acres of secondary impact to Cienega Creek and its' downstream Outstanding Arizona Waters; and
- The Lower San Pedro In-Lieu Fee Project Site has not been approved by the Interagency Review Team and would not compensate impacts at the remote mine site.

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[211]Technical Memorandum on the Conceptual Design for Sonoita Creek, AZ from Dr. Mathias Kondolf, UC Berkeley and James Ashby, PG Environmental to Dr. Robert Leidy, USEPA dated February 18, 2015.

[212] In a Corps Memorandum to the Field dated October 29. 2003, the Corps provides compensatory mitigation guidance as part of the implementation of the National Wetlands Mitigation Action Plan. The purpose of the Guidelines is to identify the basic requirements for mitigation success and to assist in mitigation site selection. This guidance identifies: 1) restoration over creation; 2) avoiding over-engineered structures in the wetland's designs; 3) restoring or developing naturally variable hydrologic conditions; 4) considering the hydrogeomorphic and ecological landscape and climate; and 5) attention to subsurface conditions, including soil and sediment geochemistry and physics, all of which the RM mitigation plan fails to do.

Conclusions and Basis for Finding of Significant Degradation

The Rosemont Mine will degrade and destroy waters in the Cienega Creek watershed containing regionally rare, largely intact mosaics of some of the highest quality stream and wetland ecosystems in Arizona. These environmental consequences are substantial and unacceptable and contrary to the goals of the CWA. Mitigation proposed by Rosemont Copper Company will not prevent unacceptable adverse effects to these waters from the proposed mine. Therefore, EPA Region IX maintains that impacts associated with this project will result in significant degradation (40 CFR 230.10(c)) of our Nation's waters.[213]

The environmentally-damaging nature of the Rosemont Mine (*i.e.,* large-scale, long-lasting, extractive mineral mine) will cause or contribute to significant persistent degradation of the aquatic environment. As a direct consequence of the § 404 CWA permit action, direct and secondary impacts from the proposed project will result in the loss, conversion and functional habitat degradation/destruction of aquatic, wetland and terrestrial habitats supporting 12 federally listed endangered or threatened species. This region includes vast areas of the Coronado National Forest, the Las Cienegas National Conservation Area, Pima County preservation areas and state-designate ONRWs recognized as being of regional and national importance.

EPA has determined the Rosemont Mine will result in the following effects which individually and cumulatively contribute or cause significant degradation:

1) Significantly adverse effects of the discharge of pollutants on human health or welfare, including but not limited to effects on municipal water supplies, plankton, fish, wildlife and special aquatic sites;
2) Significantly adverse effects of the discharge of pollutants on life stages of aquatic life and other wildlife dependent on aquatic ecosystems, including the transfer, concentration, and spread of pollutants or their byproducts outside of the disposal site through biological, physical and chemical processes;
3) Significantly adverse effects of the discharge of pollutants on aquatic ecosystem diversity, productivity, and stability; and
4) Significantly adverse effects of the discharge of pollutants on recreational, aesthetic, and economic values.

[213] Jim Upchurch, Forest Supervisor, Coronado National Forest, stated in the Draft Record of Decision for the FEIS, *I recognize that each of the action alternatives would result in significant environmental and social impacts and that the no action alternative is the environmentally preferable alternative…* (p. 11).

APPENDIX A

Project Description and Environmental Setting and Significance

Project Description

The Rosemont Copper Company proposes to develop the Rosemont Mine within the Cienega Creek watershed in Pima County, AZ, approximately 30 miles south of the city of Tucson. The mine would occupy ~4,750 acres of National Forest Service, Bureau of Land Management and some privately-owned lands, with the primary land holding being Coronado National Forest. The mine is projected to produce ~4.7 billion pounds of copper, 90 million pounds of molybdenum and 54 million pounds of silver over the proposed 25-30-year mine life.

Mining will be conducted using conventional open-pit techniques. The mine pit would measure between 6,000 – 6,500 feet in diameter, with a final depth of 1,800-2,000 feet. The mine would produce a total of approximately 550 million tons of ore and 1,288 million tons of waste rock. Waste rock will be blasted and transported by haul truck to a storage area. Ore will be blasted, crushed and loaded onto a conveyor for conventional sulfide milling (sulfide ore). Tailings will be stored using a dry stack tailings technique. The placement of waste rock will include perimeter buttresses, with placement of the perimeter of the dry stack tailings storage areas to provide structural and erosional stability of the tailings pile. The copper concentrate from the milling operations will be shipped off site to a smelter.

The proposed project includes a 950-acre mine pit, 1,460-acre waste rock storage areas, 987 acre dry-stack tailings facility, ancillary facilities and structures, access and haul roads, and off site water and power and transmission lines.[214]

Environmental Setting and Significance

We considered several additional environmental factors in our evaluation of the significance of the aquatic resources that will be impacted by the Rosemont Mine. These include the landscape setting, quality and rarity of the aquatic resources that will be impacted, and the severity, permanence and persistence of project impacts. These considerations include the status of the aquatic resources as Aquatic Resources of National Importance (ARNI) and Special Aquatic Sites.

Geographic Scope- Landscape Setting. Essential to evaluation of the environmental effects of the Rosemont Mine is the geographic scope, or landscape setting, of the project within the Cienega Creek watershed.[215] The proposed Rosemont Mine lies on the eastern slopes of the Santa Rita Mountains and is bisected by an intricate network of 154 individual ephemeral and intermittent drainages that encompass over 18 linear stream miles. The mine footprint would cover 13% of the uppermost Barrel/Davidson Canyon watershed where annual precipitation ranges between 13-23 inches, amounts of rainfall comparable to more mesic regions near San Francisco, California.[216] At the proposed mine site the stream network functions as an important headwater source area for stormwater runoff and mountain-front recharge. Significantly, water falling as precipitation at the mine site is directly linked through

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[214] For more detailed description of the proposed mine, see FEIS, Volume 1.

[215] *The Corps will fully consider comments regarding the site from a watershed or landscape scale, including an evaluation of the potential cumulative and secondary impacts*. Regulatory Guidance Letter 92-01.

[216] FEIS, Table 31

surface and subsurface hydrologic pathways to surface flows in nearby downstream waters. In addition to serving as a water source area for streams and wetlands, and their associated fish and wildlife, the site contributes a significant amount of water to municipal and residential users' water through surface and sub-surface hydrologic pathways. The ecological significance of this setting is best understood from a landscape-scale, hydrologic accounting unit perspective. As such, the sites' water yielding drainages and groundwater aquifers distribute water through interconnected surface and subsurface pathways to support the functioning of down-gradient streams, riparian forests, springs, seeps, wetlands and human users. The persistence and health of aquatic resources associated with Cienega Creek and its major tributaries of Barrel Canyon, Davidson Canyon, Empire Gulch, and Gardner Canyon are dependent on contributions of abundant and clean surface water originating as overland and stream flow from the proposed mine site.

Quality of Resource – Ecological Health. The Cienega Creek watershed is the most intact natural major valley bottom aquatic wetland ecosystem in Arizona.[217] It is an aquatic resource of conservation value exceeding or equal to any other in the American Southwest. The aquatic ecosystem of the Cienega Creek watershed functions as the lifeblood that sustains a near pristine landscape rich in biodiversity.

The mine site lies within the Madrean sky islands which is part of the Madrean pine-oak woodlands ecoregion; an internationally recognized biodiversity hotspot featuring significant levels of biodiversity that is under threat from humans.[218] Several major drainages occur within the project assessment area: Wasp, McCleary, Scholefield, Barrel, and Box canyons; Empire Gulch; Gardner Canyon; and Ciengea Creek. Scholefield, Wasp and McCleary canyons drain to Barrel Canyon which joins Davidson Canyon approximately 4 miles east of the site. The site also supports ninety-five seeps and springs that are critical to the survival of many wildlife species. Almost all the drainages support xero-, meso-, or hydroriparian riparian habitats. Empire Gulch, Gardner Canyon, and Cienega Creek contain perennial stream reaches and support hundreds of acres of high quality riparian and palustrine emergent wetlands, many of which would qualify as jurisdictional waters.

Special aquatic sites **-** Three of the six Special Aquatic Site types described in Subpart E of the Guidelines occur on or adjacent to the proposed project. Because of their special ecological characteristics of high food-web productivity, physical habitat critical for all life stages of aquatic life, water quality functions, and other important and easily disrupted ecological functions, these aquatic resources are given special recognition under CWA regulations. Collectively, the Special Aquatic Sites in the project area play a regionally significant role in maintaining the existing, high quality functions and services in this watershed.

The project will adversely affect three types of "Special Aquatic Sites" including wetlands, sanctuaries and refuges, and riffle and pool complexes (40 CFR 230.40 – 45)), as well as Tier 3 "unique" waters (portions of Davidson Canyon and Cienega Creek that are designated by the State of Arizona as ONRWs). These aquatic resources and adjoining habitat support ten federally listed endangered or threatened species

[217] Rosen, P.C. and D.J. Caldwell. 2004. Aquatic and Riparian Herpetofauna of Las Cienegas national Conservation Area, Empire-Cienega Ranch, Pima County, Arizona. Prepared for Bureau of Land Management, Tucson Office, September 1, 2004.

[218] Myers, N., Mittermeier, R.A. Mittermeier, C.G., Gustavo, A., da Fonseca, B., and J. Kent. 2000. Biodiversity hotspots for conservation priorities. Nature 403: 853-858.

Sanctuaries and refuges are areas designated under state and federal laws or local ordinances to be managed principally for the preservation and use of fish and wildlife resources.[219] Portions of lower Davison Canyon and Cienega Creek are designated by the State of Arizona as ONRWs (see discussion, below) and are within the Cienega Creek Natural Preserve (CCNP), a 4,000 acre sanctuary along 12 stream miles noted for its ecological significance and natural beauty as a desert riparian oasis.[220] In addition, portions of Empire Gulch lie within the Las Cienegas National Conservation Area (LCNCA), administered by BLM, a 45,000 acre preserve set aside in large part to protect riparian wetlands and native aquatic organisms including endangered fish and amphibians.

Wetlands and riffle-pool complexes are also Special Aquatic Sites that will be affected directly through the discharge of fill material at the mine site and by the secondary effects of reductions in surface water, changes in sediment delivery, and groundwater drawdown from the proposed project.[221] Riffle and pool complexes are especially valuable as habitat for fish and wildlife, supporting important feeding, spawning, rearing, and refuge functions for aquatic and life-cycle dependent terrestrial species.

Outstanding Arizona Waters. The state of Arizona has designated reaches of both Davidson Canyon and Cienega Creek as ONRWs due to, among other factors, their exceptional ecological and recreational significance and the presence of federally threatened or endangered species.[222] Davidson Canyon Wash is a rare, spring-fed, low elevation desert stream, supporting a variety of uncommon flora and fauna. Cienega Creek contributes flows to the Santa Cruz River via Pantano Wash, and contains remnants of a historically extensive cienega system, defined by springs and marsh areas supporting habitat for wildlife and plant species, included threatened and endangered species. As ONRWs, their water quality meets or exceeds applicable water quality standards and lowering of water quality is prohibited.

Aquatic Resources of National Importance. The EPA has determined that Cienega Creek and its major tributary, Davidson Canyon Wash, are aquatic resources of national importance for the purposes of Part IV of the August 1992 Memorandum of Agreement between the EPA and the Department of the Army regarding Section 404(q) of the Clean Water Act. These aquatic resources are extraordinary, rare and intact ecosystems in a desert environment, and their protection is an explicit priority of local, state and federal agencies, environmental organizations, and the public.[223]

Important riparian areas. In December 2001, Pima County incorporated the Sonoran Desert Conservation Plan into its comprehensive land use plan by establishing the Conservation Lands System as the regional environmental vision. This system classifies lands into a variety of designations to reflect their relative value and importance in maintaining the biological diversity of Pima County. Davidson Canyon is identified under the plan as Biological Core area, and, along with Cienega Creek, an Important Riparian Area. By connecting the Empire, Santa Rita, and Rincon Mountain ranges—a network identified by the Arizona Department of Game and Fish, BLM and Pima County as critical wildlife movement corridor-Davidson Canyon, Cienega Creek and other riparian areas provide a natural habitat mosaic for the wide dispersal and migration of many species (*e.g.,* black bear, mountain lions, bobcats, coyotes).[224]

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[219] See Guidelines, Subpart E (40 CFR 230.40).
[220] http://rfcd.pima.gov/wrd/landmgt/cienegapreserve/
[221] Wetlands are defined at 40 CFR § 230.41. Riffle-pool complexes are defined at 40 CFR § 230.45.
[222] There are only 22 OAWs in the state of Arizona. http://www.azdeq.gov/environ/water/permits/download/oaw.pdf
[223] See EPA 3(a) and 3(b) letters to the Corps dated January 5, 2012 and February 13, 2012.
[224] DEIS, p. 370.

Extent of Resource – Rarity. Less than one percent of Arizona's landscape supports wetlands. Since the late 1800's, streams and wetlands throughout Arizona have been modified or drained, resulting in the loss of more than one-third of the State's original wetlands.[225]

Desert springs. Often the sole sources of water for wildlife, desert springs support wetland ecosystems including rare and endemic species.[226] Human changes to groundwater are one of the greatest threats to long-term sustainability of groundwater dependent ecosystems in arid and semi-arid regions.[227]

Cienegas. Desert wetlands also called Cienegas are located within the impact zone of the mine. They are high in biodiversity and provide habitat for migratory birds and wildlife, which is critical in an arid environment. Nineteen percent of federally listed endangered or threatened species in Arizona are directly associated with cienegas.[228] Endangered species, such as the jaguar and ocelot utilize this habitat, as well. Cienegas have been reduced or degraded since the late 19th and 20th century and are provided little protection. On US Forest Service Lands in the Apache Highlands Ecoregion, all cienegas are extant, while only two remain on BLM lands.[229] Minckley *et al.* (2013) found near-surface water availability as the limiting factor for the persistence of the Cienega. Given the rarity of these resources, Minckley *et al.* (2013) identifies conservation of this habitat as beneficial to the maintenance of global biodiversity.[230]

Severity of Impacts – Functional Loss. Rosemont Mine is a large scale (*i.e.*, 4,750-acre footprint), long lasting (*i.e.,* >25 years of active mining with significant impacts lasting in perpetuity), high water consumption, extractive mineral mine anchored within a vast, interconnected, high-functioning, and undisturbed landscape. Thus, there will be significantly adverse direct and secondary project impacts to waters that will amplify throughout the watershed well beyond the immediate area of the project footprint. The environmental effects of direct and secondary impacts merge at the landscape scale of assessment through a break in the connectivity of aquatic resources (*e.g.*, stream networks) caused by a direct discharge of fill material resulting in significant adverse ecological effects. Sustaining important landscape-scale functions is not possible if supporting headwater streams are significantly degraded.[231] The filling of streams, the construction of a massive mine pit 2,000 feet in depth, and associated land clearing and related disturbances will dramatically alter in perpetuity project site topography, and surface and subsurface hydrology within the greater Cienega Creek and Santa Cruz River watersheds.[232]

Temporal Scope of Impacts –Permanence and Persistence. All the direct and most the secondary impacts to the aquatic ecosystem would be permanent and would persist in perpetuity. The construction of the mine would permanently fill 40 acres of waters and in doing so, would result in the fragmentation

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[225] http://pubs.usgs.gov/wsp2425/state_highlights_summary.html
[226] Patten, P.T., Rouse, L., and Stromberg, J.C., 2007. Isolated spring wetlands in the Great Basin and Mojave Deserts, USA: potential response of vegetation to groundwater withdrawal. Environmental Management DOI 10.1007/s00267-007-9035-9. 16pp.
[227] Ibid.
[228] Minckley, T.A., Turner, D.S., Weinstein, S.R., 2013. The relevance of wetland conservation in arid regions: a re-examination of vanishing communities in the American southwest. Journal of Arid Environments. p. 216.
[229] Ibid.
[230] Ibid.
[231] Ibid. Levick *et al.* 2008.
[232] Using Figure 58 of the PAFEIS and USEPA's NEPAssist mapping tool, EPA calculates that 1,000 years after active mining, the 5-foot drawdown contour will extend across approximately 42,000 acres of Cienega Creek watershed based on the Tetra Tech model and 64,000 acres based on the Montgomery model.

of a vast, intact, hydrologic landscape unit composed of hundreds of drainages covering many linear miles. The placement of fill would result in the loss of breeding and nesting areas, escape cover, movement corridors, and food sources for wildlife associated with existing waters on the mine site. Wildlife species and communities that depend on large, intact habitat blocks would be irreparably harmed by the mine project.

Secondary impacts will cause serious degradation or complete destruction of special and regionally unique aquatic resource areas downstream of the project. Many of those aquatic resources are unique because of their ecological diversity, and because they are difficult to restore once lost or degraded. Impacts from the mine would be irreversible.