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ASSISTANT GENERAL MANAGER
Robert Cheng

NOTICE OF PREPARATION & NOTICE OF PUBLIC SCOPING MEETING DRAFT ENVIRONMENTAL IMPACT REPORT WHITEWATER RIVER GROUNDWATER REPLENISHMENT PROJECT

The Coachella Valley Water District (CVWD), as Lead Agency under the California Environmental Quality Act (CEQA), is publishing this Notice of Preparation (NOP) to prepare an Environmental Impact Report (EIR) for the proposed Whitewater River Groundwater Replenishment Project (Project) in accordance with Public Resource Code §§21000 – 21189.57 and the 2020 CEQA Guidelines §§15000 – 15387.

The purpose of this NOP is to notify local, State, and Federal agencies, Native American tribes, and other interested organizations and individuals that CVWD plans to prepare an EIR for the proposed Project. CVWD is circulating this NOP to obtain input regarding the scope, content, and environmental issues relevant to the EIR. This NOP provides a summary of the Project description, Project location, and the expected scope of environmental analysis in the EIR.

To ensure that all potential environmental issues are considered and addressed within the Draft EIR, all comments regarding this NOP must be received, in writing, within the **30-day NOP public comment period, beginning February 3, 2020 and ending March 4, 2020**. If you wish to be placed on the mailing list to receive notices regarding the proposed Project, have any questions, or need additional information, please use the Contact Person information identified below.

Project Description

CVWD is requesting a right-of-way (ROW) grant from the Bureau of Land Management (BLM) for the continued operation and maintenance of CVWD's existing Whitewater River Groundwater Replenishment Facility (Facility). Since the early 1900's, CVWD has been replenishing the Coachella Valley Groundwater Basin (Basin) in Whitewater with natural flow, snow melt, and beginning in 1973 with imported water as part of cooperative program with the Desert Water Agency. The Facility is a critical component for management of the Basin. The Facility is located on CVWD-owned lands as well as public land managed by the BLM. CVWD's existing ROW grants with the BLM have expired, and CVWD has applied to renew and amend the ROW grants. The proposed ROW grant would allow CVWD to continue groundwater replenishment activities at the Facility by delivering Colorado River water into the Basin at a maximum rate of up to 511,000 acre-feet in any given year. The proposed Project does not involve any new construction or ground disturbing activities.

Project Location

The existing Facility is located in the northwest portion of the CVWD service area, in the City of Palm Springs within Riverside County. The Facility is generally bound by the Interstate 10 (I-10) to the north, Indian Canyon Drive to the east, and State Route 111 (SR-111) to the west and south. CVWD has requested a ROW grant from the BLM for two locations totaling approximately 690.73 acres:

- The renewal area (approximately 511.9 acres) consists of two individual areas originally included in ROW grant LA 052742, which was previously issued by the BLM in 1984 and expired in 2014, and ROW grant CA 19150, which was previously issued by the BLM in 1987 expired in 2012. The renewal area covers a portion the existing Facility, including portions of Ponds 6 through 19, the concrete-lined and earthen conveyance channels, and Intake Structure 2. This area is located within portions of Section 24 of Township 3 South, Range 3 East and Sections 20, 28, and 30 of Township 3 South, Range 4 East (approximately 509.7 acres). The renewal area also includes the existing low-flow dike and channel crossing on a portion of Section 14, Township 3 South, Range 3 East (approximately 2.2 acres).
- The amendment area consists of approximately 178.83 acres that was not included in either of the previous ROW grants issued by BLM, but is currently used by CVWD for maintenance of existing flood control berms. The amendment area includes two existing flood control berms within portions of Sections 23 and 24 of Township 3 South, Range 3 East (approximately 178.83 acres).

Environmental Effects to be Analyzed

The EIR will evaluate the potential environmental effects associated with the proposed ROW grant. The following environmental issue areas will be analyzed in the EIR: air quality; biological resources; cultural resources; energy; geology and soils; greenhouse gas emissions; hydrology and water quality; land use and planning; and tribal cultural resources. The EIR will also evaluate potential growth inducing effects, cumulative effects, irreversible environmental impacts, energy impacts, and may include other topics identified during scoping.

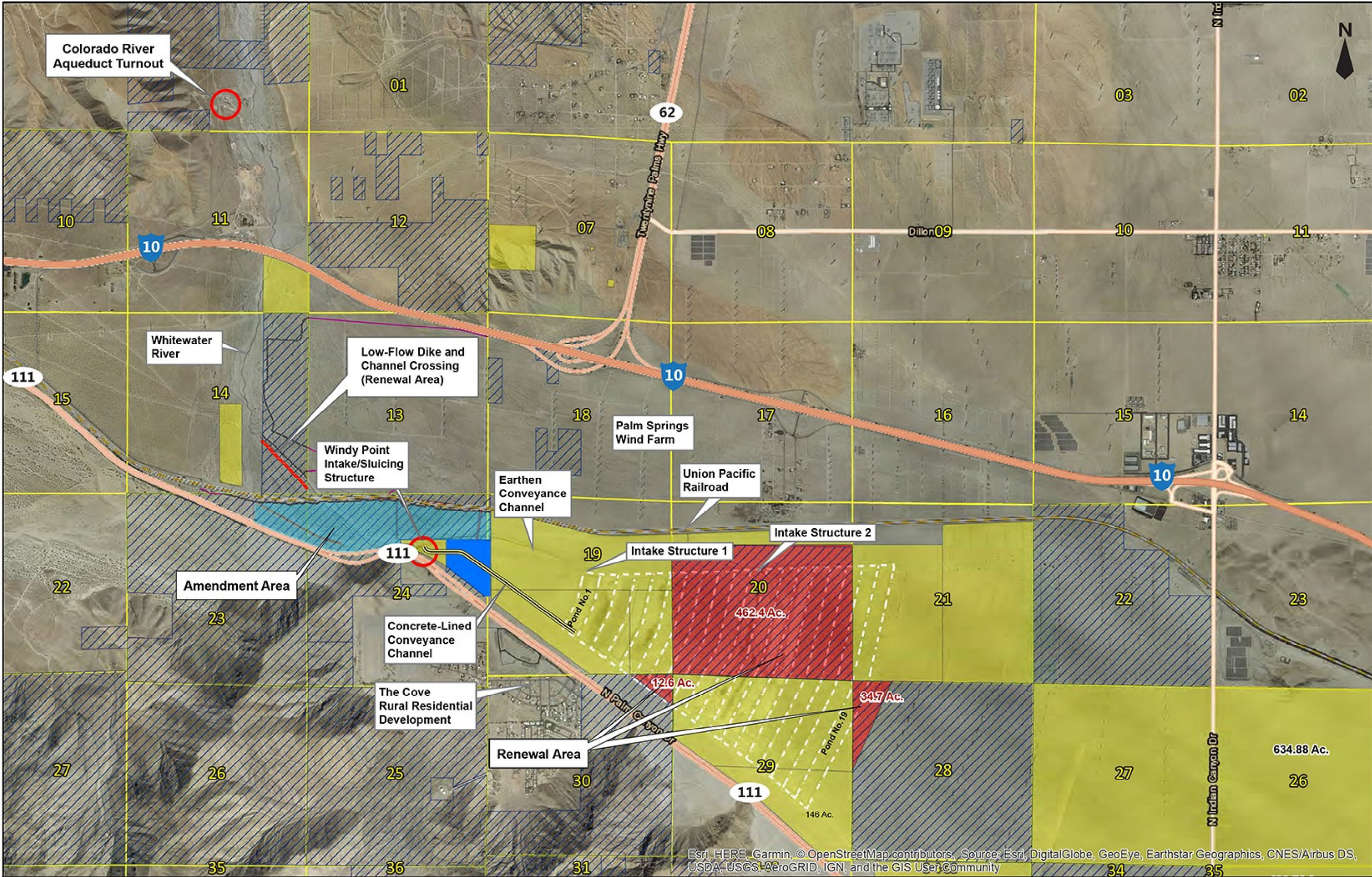
Public Scoping Meeting

CVWD will conduct a public scoping meeting to share information about the proposed Project, describe the environmental review process, and solicit written comments on the proposed Project. The **public scoping meeting will be held at 5:00 p.m. on Tuesday, February 18, 2020** at CVWD's Steve Robbins Administration Building, located at 75-515 Hovley Lane East, Palm Desert, California 92211.

How to Submit a Comment & Contact Person

You are invited to submit written comments regarding this NOP by standard mail to: William Patterson, Environmental Supervisor, CVWD, 75-515 Hovley Lane East, Palm Desert, CA 92211; or by email to wpatterson@cvwd.org

Due to the time limits mandated by State law, comments regarding this NOP must be received not later than 5:00 p.m. on March 4, 2020. All comments provided will become public record.



Legend

- Low Flow Crossing (approx. 1881' x 50'=2.20 Ac.)
- Roads Within BLM (approx. 2.97 mi. x 30'=10.83 Ac.)
- Roads Outside BLM (approx. 1.95 mi. x 30'=7.09 Ac.)
- BLM Amendment Area (approx. 168 Acres)
- BLM Parcel
- California State Lands Commission
- Existing BLM Right-Of-Way (ROW) Grant Renewal Area
- CVWD Fee Land

Total Acreage for BLM Renewal=511.9 Acres

Total Acreage for BLM Amendment=178.83 Acres

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Secretary/Treasurer

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Member

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Palm Springs, Ca 92264

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March 3, 2020

via email: wpatterson@cvwd.org

William Patterson, Environmental Supervisor
CVWD
75-515 Hovley Lane East
Palm Desert, CA 92211

Dear Mr. Patterson,

The Agua Caliente Water Authority (Authority) appreciates the opportunity to comment on the Notice of Preparation for the Draft EIR for the Whitewater River Groundwater Replenishment Project. The Authority's comments are below:

1. Please clarify the discretionary action that CVWD will be taking that creates the need for a CEQA EIR. Specifically, please identify:
 - a. the agencies that are expected to use the EIR in their decision-making
 - b. the permits and other approvals required to implement the project
 - c. A list of related environmental review and consultation requirements required by federal, state, or local laws, regulations, or policies. To the fullest extent possible, the lead agency should integrate CEQA review with these related environmental review and consultation requirements.
2. Please clarify the role that Desert Water Agency plays in the operation and management and financial support of the Facility.
3. The EIR should analyze the environmental conditions relating to the mass salt loading problem associated with imported water recharge. To date the project has introduced over 2.5 million tons of salt into the subsurface and aquifer, and each acre foot of imported water introduces another ton of salt. The Regional Water Quality Board has called this practice "unsustainable." Given these facts, the EIR needs to fully consider the regional Salt and Nutrient Management Planning process and how this project intersects with and impacts that process.
4. The EIR should address how the Project is consistent with the Alternative Groundwater Management Plans submitted for the Indio and Mission Creek basins under the Sustainable Groundwater Management Act (SGMA). Specifically, the Department of Water Resources' (DWR) July 2019 Staff Report provides guidance for water quality concerns that includes adopting: (1) an approved Salt Nutrient Management Plan; and, (2) water quality plans and management actions (Recommendations 2 and 2A). The EIR should address how DWR's July 2019 Staff Report recommendations for the existing alternative management plan, and 5-year updated plan, will be met under expanded recharge operations using Colorado River water.
5. The Coachella Valley Groundwater Basin is designated as a GAMA Priority 1 basin, and as such, must have Salt and Nutrient Management Plans



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(SNMPs) that “are tailored to address the water quality concerns of the basin and subbasin” and “include implementation measures, as appropriate, to address all sources of salt and/or nutrients to groundwater basins” (Water Quality Control Policy for Recycled Water § 6.2.1.1). Without an approved SNMP to use as reference, the EIR would not accurately describe the potential effects of the Project on basin water quality. Specifically, the following areas were found by the Regional Water Quality Control Board to be lacking in the submitted SNMP, and should be addressed: an adequate basin-wide groundwater monitoring program; evaluation of the aquifer capacity to assimilate salt and nutrient loading; implementation measures to sustainably manage salt and nutrient loading; and antidegradation analysis for salt and nutrient sources other than recycled water, such as Colorado River Water imported and recharged by the Project.

6. A groundwater quality report in support of the revisions to the SNMP is due to the Regional Water Quality Control Board in June 2020. Following this, a Coachella Valley Groundwater Basin Groundwater Quality Monitoring Program Work Plan is due to the Regional Water Board in December 2020. Prior to the preparation, submittal, and approval of these two items, an EIR would not be able to accurately describe existing conditions or assess future effects on basin water quality.
7. The full spectrum of contaminants introduced into the Coachella Valley aquifer through the imported Colorado River water CVWD recharges through the Facility must be fully revealed through the CEQA process. This spectrum should include contaminants of emerging concern (CEC) such as per- and poly-fluoroalkyl substances (PFASs). On August 22, 2019, the State Water Board issued notification levels (NL) and response levels (RLs) for two PFASs: perfluorooctanesulfonic acid (PFOS), and perfluorooctanoic acid (PFOA). On February 6, 2020 the response levels were lowered. The current NLs are 6.5 parts per trillion (ppt) and 5.1 ppt for PFOS and PFOA, respectively. The current RLs are 40 ppt and 10 ppt for PFOS and PFOA, respectively.
8. CVWD proposes to expand its project from 509 to 933 acres, and to increase annual recharge to a maximum of 511,000 acre feet, from the current 225,000 acre feet annual maximum. CVWD has an obligation to present a full discussion of existing baseline environmental conditions, so that alternatives can be responsibly evaluated. The EIR should include an analysis of the impacts on the aquifer from three viewpoints: historical use, current use and future use perspectives.
9. A numerical flow model (e.g. MODFLOW) and calibrated fate and transport model (e.g. MT3D) should be relied upon as part of the EIR analysis to describe how Project operations will affect groundwater and groundwater-related resources in Coachella Valley. Historical operations of the recharge facility should be used to calibrate the flow and transport models in order to assess the long-term impact of Project alternatives that account for existing groundwater management plans, water quality plans, and exchange agreements.

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10. The consideration of alternatives to the proposed project must be robust and include options to reduce the impact on the environment. Such options may include reverse osmosis treatment of Colorado River water prior to recharge in order to reduce concentrations of salts, nutrients, and potential CECs. The Tribe is on record noting that desalination to a particular TDS standard, or the completion of the State Water Project pipeline into the Coachella Valley, are alternatives that are less harmful to the aquifer long-term, and thus they must be carefully analyzed. CVWD is relying on outdated data and analysis to reject these alternatives and has an obligation to not reject these alternatives out of hand.

The Authority appreciates the opportunity to provide our comments on the Notice of Preparation. I can be reached at mpark@acwaterauthority.org or (760) 883-1326 if you have any questions.

Respectfully submitted,

Margaret E. Park, AICP
AGUA CALIENTE WATER AUTHORITY

C: Agua Caliente Water Authority Board
Charles Jachens, BIA

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United States Department of the Interior

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MAR 04 2020

IN REPLY REFER TO: Water Resources

William Patterson
Environmental Supervisor
Coachella Valley Water District
75-515 Hovely Lane East
Palm Desert, CA 92211

Mr. Patterson,

The Bureau of Indian Affairs (BIA) Pacific region is pleased to provide Public Scoping Comments for the Whitewater River Groundwater Replenishment Facility Right of Way (ROW) Project. BIA has primary trust responsibilities to the Federally Recognized Tribes in the Coachella Valley affected by this project. BIA has previously commented on the scoping of the Environmental Impact Statement (EIS), and for the separate Environmental Impact Report (EIR), BIA supports and submits the following comments:

1. Many areas within the project on Bureau of Land Management lands are not subject to disturbances and are not used for the project operations, normal maintenance or inspections. The scope should address impacts from project vehicle/equipment traffic to these areas and define specific areas where vehicle traffic/disturbances are permitted in the new ROW.
2. The project has the potential to flood the White Water River stream bed approximate eleven (11) months per year which is significant longer when compared to pre-project and operations of the project since 1984. The scope should address the effect on plants and animals adapted to the desert conditions; and what will the impact be from species now able to survive and live in the area due in the increased water regime?
3. Significant channelization and down cutting of the Whitewater River has occurred in the alluvial fan between the turnout out and the replenishment facility. The Colorado River water released in the Whitewater River channel has created an incised channel due to the lack of sediment in the Colorado River water when compared to the natural runoff from the Whitewater River watershed. Mitigation to restore the natural function of the alluvial fan needs to be explored in the EIR. Mitigation or restoration of loss of natural function which has negatively impacted the hydrology, recharge, terrestrial plant and animal species, and natural ecosystem due to stream channel to move Colorado River water to the replenishment area needed to be included in the alternatives.
4. A significant issue for this project is replenishing the Whitewater River groundwater basin with Colorado River water containing high total dissolved solids (TDS) which degrades the

present and future ground water quality in the basin. Additional, from a total-mass perspective, the most significant source of anthropogenic TDS in the western Coachella Valley is imported Colorado River water used for groundwater recharge. Regional Water Board has designated that the Coachella Canal only contains a "potential" beneficial use for drinking water, while its primary intent is agricultural. Division 7 of the Water Code (also known as the Porter-Cologne Water Quality Control Act) requires the Regional Water Board to consider past as well as present and probable future beneficial uses when establishing water quality objectives. Section 13050, subdivision (f), of division 7 describes "beneficial uses" as follows:

"Beneficial uses of the waters of the State that may be protected against quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves."

BIA recommends conducting an engineering and economic study for the removal of TDSs from the Colorado River water replenished in the Whitewater facility. The levels of removal should evaluate total loading of the replenished water to achieve the approximate TDS level of the ground water in 1974, and 2014.

5. In addition to the increase in stored water, an increase in constituents impacting the groundwater system should be considered. The waters from the Colorado River are still in excess of Secondary drinking water standards. As the Coachella Valley is a terminal groundwater system, the scoping should address the historical recharge quantities and total TDS loading during the past ROW agreement (1984 to 2014) and the proposed maximum of 511,000 acre-feet per year. A much lower annual maximum alternative(s) should be considered and evaluated.

6. In future consideration of the long term average and yearly maximum recharge quantities and total TDS loading, the Salt and Nutrient Management Plans (SNMP) required by the State Water Resources Control Board needs to carefully considered both on how this project may affect the future adopted SNMP and vis a versa. The scope should consider a limited time frame for the ROW.

AGUA CALIENTE BAND OF CAHUILLA INDIANS (Tribe) has raised a number of issues for the scoping of the project and BIA supports the inclusion of these issues.

1. A full spectrum of contaminants introduced into the Coachella Valley aquifer through the imported Colorado River water Coachella Valley Water District (CVWD) recharges through the Facility must be fully revealed through the CEQA process. A much lower annual maximum alternative(s) should be considered and evaluated to reduce the risk inclusion of these contaminants in the aquifer.

2. The environmental conditions relating to the mass salt loading problem associated with imported water recharge. To date the project has introduced over 2.5 million tons of salt into the subsurface and aquifer, and each acre foot of imported water introduces another ton of salt. The Regional Water Quality Board has called this practice "unsustainable." Alternatives need to be considered that are "sustainable".

3. The need to fully consider the regional Salt and Nutrient Management Planning process and how this project intersects with and impacts that process. Alternatives need to incorporate the comments from the Colorado River Basin Regional Water Quality Board dated Feb 19, 2020.

4. EIR must include the impacts on the aquifer not only from continued, but significantly expanded recharge activities for a permit term spanning decades. CVWD proposes to expand its project from 509 to 933 acres, and to increase annual recharge to a maximum of 511,000 acre feet, from the current 225,000 acre feet annual maximum. Future impacts should be compared to actual recharge quantities during the period defined by the last ROW agreement (1974 to 2014).

5. The consideration of alternatives to the proposed project must be robust and include options to reduce the impact on the environment. The Tribe is on record noting that desalination to a particular TDS standard, or the completion of the State Water Project pipeline into the Coachella Valley, are alternatives that are less harmful to the aquifer long-term, and thus they must be carefully analyzed. CVWD is relying on outdated data and analysis, new studies using up to date information is needed to evaluate these alternatives in the EIR.

6. CVWD has an obligation to present a full discussion of existing baseline environmental conditions, so that alternatives can be responsibly evaluated. The Tribe believes that this applies especially to the soil sampling plan proposed by ECORP. BIA has already commented on the deficiencies of the proposed plan. The revised plan is under review.

CENTER FOR BIOLOGICAL DIVERSITY (The Center) has raised a number of issues for the scoping of the project and BIA supports the inclusion of these issues.

1 Coachella Valley Water District (CVWD) filed an application for a right of way grant for the continued operation and maintenance of its existing Whitewater River Groundwater Replenishment Facility. Part of the facility is sited on 511 acres of public lands managed by the BLM. The facility had a prior right of way grant that expired in 2014, and this application would authorize the continued operation and maintenance of the existing facility on public lands. CVWD also seeks to add approximately 178 acres of public lands for access to maintain its facilities, for a total of 690 acres of public lands. The facility replenishes groundwater supplies by infiltrating water imported from the Colorado River through a series of shallow ponds. As a result it is unclear whether the access for maintenance on approximately 178 acres of public lands is a new proposal or already exists and was developed previously outside of the earlier right of way grant area. The notice also does not indicate whether the existing facilities fall within covered activities under the Coachella Valley Multiple Species Habitat Conservation Plan (CV MSHCP).

2 The proposed ROW occurs at a biologically unique area where the Transverse and Peninsular Ranges meet the Colorado Desert and South Coast geographic sub-provinces which result in great biological diversity. The location of the proposed project increases the potential for rare and listed species presence on and adjacent to the site. Because the project also involves a modified waterway and imported water infiltration, it creates the unique situation of ephemeral surface water being available to wildlife in a desert setting – a wildlife attractant—and for potential impacts to the quality of groundwater and to local hydrology.

3 The EIR needs to include an up-to-date inventory of the on-site resources that is used as a basis for impact analysis. The Center requested that thorough, seasonal surveys be performed for sensitive plant species and vegetation communities, and animal species under the direction and supervision of the BLM and resource agencies such as the US Fish and Wildlife Service and the California Department of Fish and Wildlife. Surveys for the plants and any existing plant communities should follow California Native Plant Society (CNPS) and California Department of Fish and Wildlife (CDFW) floristic survey guidelines. A full floral inventory of all species

encountered needs to be documented as a basis for management prescriptions. Surveys for animals should include an evaluation of the California Wildlife Habitat Relationship System's (CWHR) Habitat Classification Scheme. All rare species (plants or animals) need to be documented with a California Natural Diversity Data Base form and submitted to the California Department of Fish and Game using the CNDDDB Form as per the State's instructions.

The Center requested that the vegetation mapping be done on the proposed ROW area as well as its sphere of influence. The mapping must be at a large enough scale to be useful for evaluating the impacts over time. Vegetation, riparian areas and wildlife movement corridor mapping should be at such a scale to provide an accurate accounting of the proposed activities. A half-acre minimum mapping unit size is recommended, such as has been used for other projects. The mapping protocol needs to follow CDFW's Vegetation Classification and Mapping Standards and implement Alliance Level Mapping using a downloadable, blank geodatabase from California Dept. of Fish and Wildlife's VegCAMP. If rare vegetation types are encountered, the survey needs to implement CNPS' protocol for mapping of rare vegetation types.

Current surveys must be implemented and combined with existing data in order to evaluate the existing on-site conditions. A number of rare plants and animals are known to or have high potential to occur within the general area of the ROW and must be included in the impact analysis. They include but are not limited to:

Common Name	Scientific Name	Fed/State/Other Status
Plants		
chaparral sand-verbena	<i>Abronia villosa</i> var. <i>aurita</i>	BLM-S/1B.1/--
Coachella Valley milk-vetch	<i>Astragalus lentiginosus</i> var. <i>coachellae</i>	FE/1B.1/--
triple-ribbed milk-vetch	<i>Astragalus tricarlinatus</i>	FE/1B.2/--
white-bracted spineflower	<i>Chorizanthe xanti</i> var. <i>leucotheca</i>	BLM-S/1B.2/--
slender-horned spineflower	<i>Dodecahema leptoceras</i>	FE/CE, 1B.1/--
cliff spurge	<i>Euphorbia misera</i>	--/2B.2/--
California satintail	<i>Imperata brevifolia</i>	--/2B.1/--
Little San Bernardino Mtns. linanthus	<i>Linanthus maculatus</i> ssp. <i>maculatus</i>	BLM-S/1B.2/--
spiny-hair blazing star	<i>Mentzelia tricuspidis</i>	--/2B.1/--
slender cottonheads	<i>Nemacaulis denudata</i> var. <i>gracilis</i>	--/2B.1/--
Insects		
Coachella giant sand treader cricket	<i>Macrobaenetes valgum</i>	--/--/VU
Coachella Valley jerusalem cricket	<i>Stenopelmatus cahuilensis</i>	--/--/VU
Amphibians		
California red-legged frog	<i>Rana draytonii</i>	FT/SSC/VU
southern mountain yellow-legged frog	<i>Rana muscosa</i>	FE/CE/--
Reptiles		
southern California legless lizard	<i>Anniella stebbinsi</i>	--/SSC/--
orange-throated whiptail	<i>Aspidoscelis hyperythra</i>	--/WL/--
red-diamond rattlesnake	<i>Crotalus ruber</i>	--/SSC/--

desert tortoise	<i>Gopherus agassizii</i>	FT/CT/VU
coast horned lizard	<i>Phrynosoma blainvillii</i>	BLM-S/SSC/--
flat-tailed horned lizard	<i>Phrynosoma mcallii</i>	BLM-S/SSC/NT
two-striped gartersnake	<i>Thamnophis hammondi</i>	BLM-S/SSC
Coachella Valley fringe-toed lizard	<i>Uma inornata</i>	FT/CE/--
Birds		
golden eagle	<i>Aquila chrysaetos</i>	BLM-S,BCC /FP/--
burrowing owl	<i>Athene cunicularia</i>	BLM-S, BCC/SSC/--
prairie falcon	<i>Falco mexicanus</i>	BCC/WL/--
loggerhead shrike	<i>Lanius ludovicianus</i>	BCC/SSC/--
Le Conte's thrasher	<i>Toxostoma lecontei</i>	BCC/SSC/--
Mammals		
pallid San Diego pocket mouse	<i>Chaetodipus fallax pallidus</i>	--/SSC/--
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	BLM-S/SSC/--
San Diego desert woodrat	<i>Neotoma lepida intermedia</i>	--/SSC/--
desert bighorn sheep	<i>Ovis canadensis nelsoni</i>	BLM-S/SSC/--
Los Angeles pocket mouse	<i>Perognathus longimembris brevinasus</i>	--/SSC/--
Palm Springs round-tailed ground squirrel	<i>Xerospermophilus tereticaudus chlorus</i>	BLM-S/SSC/--
Federal Designation FE Federally listed as endangered. FT Federally listed as threatened. BLM-S BLM Sensitive Species. BCC – Bird of Conservation Concern - USFWS State Designation FP Fully Protected under State CE State listed as endangered. CT State listed as threatened. Species that although not presently threatened in California with extinction are likely to become endangered in the foreseeable future. SSC California Department of Fish and Wildlife's "Species of Special Concern." Species with declining populations in California WL – California Department of Fish and Wildlife's Watch List Rare Plant Rank 1B.1 Plant rare, threatened or endangered in California and elsewhere, and seriously threatened in CA. 1B.2		

The EIR must address direct impacts to these species (and other common species) from project activities, including maintenance activities and along access routes, and evaluate all measures to avoid and minimize impacts and, if necessary, fully mitigate any remaining impacts. The EIR also needs to specifically address the safety of wildlife attracted to the infiltration basins, explain past measures taken to protect wildlife, and the potential need for new or alternatives measures to avoid and mitigate impacts. The BLM should require monitoring and reporting to ensure protective measures are effective.

Indirect impacts to species that may not occur on site but which the on-site activities may affect must also be addressed including any on site activities that may disrupt "downstream processes" that would indirectly impact the species and habitats. For example, infiltration basins and other project facilities may affect the sand transport corridor that replenishes the downwind blow-sand

and stabilized sand dune habitat for the sand-dependent species including the insects, the flat-tailed horned lizard, the Coachella Valley fringe-toed lizard, and others.

A robust monitoring plan is needed that also includes pre-inundation and pre-maintenance surveys of the infiltration basins to assure that any sensitive wildlife would not be put in harm's way when the basins are filled or when maintenance of the basin occurs.

4. The EIR must provide baseline information on the quantity and quality of water in the basin taking into account past and ongoing water infiltration. The EIR must also identify the source of the water to be infiltrated in the future, the amount of each type of water to be infiltrated, and the quality of that water in order to evaluate impacts to the groundwater basin going forward.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA) has raised a number of issues for the scoping of the project and BIA supports the inclusion of these issues.

1. The Draft EIR prepared for the proposed action should include a comprehensive description of the regulatory context of the project which should include a description of the California Desert Conservation Area.

2. Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments" (November 6, 2000), was issued in order to establish regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, and to strengthen the United States government to-government relationships with Indian tribes. Executive Order B-10-11, an action by the State of California was issued to insure agencies of the State implemented similar engagement with Tribe in California. The Draft EIR should describe the process and outcome of government-to-government consultation between the District and each of the tribal governments within the project area which should include the basin as defined in the Sustainable Groundwater Management Act, issues that were raised (if any), and how those issues were addressed in the selection of the proposed alternative.

3. The document should identify all petitioned and listed threatened and endangered species and critical habitat that might occur within the project area. Quantify which species or critical habitat might be directly, indirectly; or cumulatively affected by each alternative. The BIA recommends engaging the California Fish and Wildlife, and the U.S. Fish and Wildlife Service as early in the analysis as possible to assure that the proposed alternatives account for the following:

- River restoration. flow and channel modifications, wetlands and habitat fragmentation regarding habitat requirements;
- Migratory Bird Treaty Act compliance; and
- Protection from invasive species.

4. The protection, improvement and restoration of wetlands and riparian areas are a high priority because- they increase landscape and species diversity, support many species of western wildlife, and are critical to the protection of water quality and designated beneficial water uses. In order to illustrate effects to wetlands in the area, EPA recommended that the Draft EIR specifically include the following analyses or descriptions:

- Description of impacts under individual or nationwide permits authorizing the discharge

of fill or dredge materials to waters of the U.S.;

- Maps, identifying wetland's and regional water features;
- Identify the direct, indirect, and cumulative impacts to wetlands in the geographic scope, including impacts from changes in hydrology even if these wetlands are spatially removed from the construction footprint. Include the indirect impacts to wetlands from loss of hydrology from water diversion/transfers, as well as the cumulative impacts to wetlands from future development scenarios based on population and growth estimates.
- For wetlands potentially impacted by project alternatives, include wetland delineations and functional analysis.

5. EPA would anticipate this project has the potential to both positively and negatively impact groundwater resources. In assessing the potential impacts of each alternative on groundwater systems in the project area, EPA recommended that the Draft EIR examine the potential for changes in the volume, storage, flow and quality of groundwater using available characterization of groundwater resources and groundwater use. Projected construction, operation or maintenance of a project may have significant impact on these facets of the natural system mentioned above. If the EIR identifies any adverse impacts to groundwater resources, EPA recommended considering alternatives, mitigation measures or operational controls that would avoid, reduce or minimize impacts on groundwater.

6. EPA recommended evaluating and disclosing current air quality conditions, identify any potential air quality impacts and, if necessary, detail mitigation steps that will be taken to minimize associated adverse impacts. EPA recommended that consideration be given to opportunities to reduce vehicle emissions by limiting unnecessary vehicle idling, as well as minimizing road and construction-related fugitive dust emissions through the application of best management practices such as dust suppression practices. Components to be presented in the Draft EIR documentation include the existing air quality conditions in the project vicinity, and an assessment of any impacts on National Ambient Air Quality Standards.

7. Improving reliability of water for the Coachella Valley Water District may have the potential to result in indirect impacts by inducing growth in surrounding communities. EPA recommended that the Draft EIR include an analysis of potential growth-related impacts. Identify resources that may be affected by induced growth in the Coachella Valley, and include a discussion of strategies to reduce impacts if adverse effects cannot be avoided or minimized. If it is determined that there would be no impacts or insignificant impacts to resources of concern, provide a thorough explanation of the rationale used to support the impact determination.

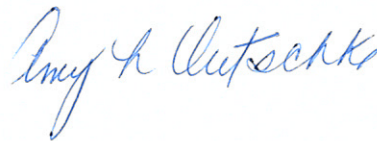
8. Cumulative impacts analyses are of increasing importance to EPA as they describe the threat to resources as a whole. Understanding these cumulative impacts associated with the proposed project can help identify opportunities for minimizing threats. Identify which resources are analyzed for cumulative impacts, which ones are not, and why. Define the geographic boundary for each resource and describe its current health and historic context. Identify other on-going, planned, and reasonably foreseeable projects in the study area that may contribute to cumulative impacts. Use existing studies on the environmental impacts of these other projects to quantify cumulative impacts where feasible. EPA suggested the methodology developed by Federal Highways Administration and Caltrans, with assistance from EPA, for use in assessing

cumulative impacts. While this guidance was prepared for highway projects in California, the principles and the 8-step process outlined therein can be applied to other types of projects. For this project, EPA recommended a thorough assessment of cumulative impacts to air quality, traffic and transportation, and noise. Propose mitigation for any adverse cumulative impacts identified. Clearly state BLM's mitigation responsibilities, the mitigation responsibilities of other entities (such as Coachella Valley Water District), and the mechanism to be used for implementation.

9. In analyzing cumulative impacts associated with each alternative, EPA recommended describing past diversion impacts in the project area including incremental impacts from historical water management operations and their impacts to streams, associated wetlands and aquatic habitat. If there are other reasonably foreseeable water diversion and water management projects that will have a relationship with this project, we recommend that the Draft EIR identify those relationships to aid in the disclosure of any cumulative impacts to the affected environment.

Should you have any questions, please contact Felix Kitto, Regional Environmental Scientist - Division of Environmental and Cultural Resources Management, and Safety Branch Chief, at (916) 978-6051 or Chuck Jachens, Regional Hydrologist, at (916) 978-6049.

Sincerely,

A handwritten signature in blue ink, reading "Amy R. Cluttschke". The signature is written in a cursive style with a large initial "A".

Regional Director

Meisinger, Nick

To: William Patterson
Subject: RE: Notice of Preparation: Whitewater Replenishment Project

From: William Patterson
Sent: Monday, March 2, 2020 5:31 PM
To: 'Lisa Belenky' <lbelenky@biologicaldiversity.org>
Cc: Ileene Anderson <IAnderson@biologicaldiversity.org>; Steve Bigley <SBigley@cvwd.org>
Subject: RE: Notice of Preparation: Whitewater Replenishment Project

Hello Ms. Belenky,

Thank you for your interest in the proposed Whitewater River Groundwater Replenishment Project (Project). CVWD issued a Notice of Preparation (NOP) on February 3, 2020 pursuant the requirements set forth in CEQA Guidelines Section 15082 for noticing Responsible and Trustee Agencies and providing a copy the NOP to the State Clearinghouse. Additionally, CVWD hosted a public scoping meeting on February 18, 2020 pursuant to CEQA Guidelines Section 15082(c). Unfortunately, CVWD published the NOP and public scoping meeting notice prior to the BLM's Scoping Report being made available and CVWD was not aware of Center for Biological Diversity's interest in the proposed Project. Although the scoping comment period will not be extended, CVWD is aware of your comment letter to the BLM, and will take those comments into consideration during preparation of the Draft EIR. If you would like to submit a formal NOP comment letter to CVWD, specifically, you can still do so by email up to the deadline of March 4, 2020. Please keep in mind there will also be another a comment opportunity in the future during the public comment period for the Draft EIR tentatively scheduled for publication in Summer 2020.

Sincerely,

William Patterson
Environmental Supervisor
Environmental Services Department
Coachella Valley Water District
75-519 Hovley Lane East
Palm Desert, CA 92211
(760) 398-2651



From: Lisa Belenky <lbelenky@biologicaldiversity.org>
Sent: Monday, March 2, 2020 10:34 AM
To: William Patterson <WPatterson@cvwd.org>
Cc: Ileene Anderson <IAnderson@biologicaldiversity.org>
Subject: Notice of Preparation: Whitewater Replenishment Project

Mr. Patterson, It was just brought to my attention today that the CVWD issued a Notice of Preparation and for Scoping meetings for and EIR for the Whitewater River Groundwater Replenishment Project. I then located the notice on the CEQANET site (attached). I have no record of the Center receiving this notice, although CVWD certainly knew of the Center's interest in the project as we commented on the BLM NOI (see attached). Given the lack of adequate notice, the Center requests 30 days from today to submit comments—until Wednesday April 1, 2020.

Thank you in advance for your prompt attention to this matter.

Lisa T. Belenky, *Senior Attorney*

CENTER *for* BIOLOGICAL DIVERSITY

1212 Broadway, Suite 800

Oakland, CA 94612

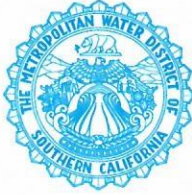
ofc (510) 844-7107 *fax* (510) 844-7150

cell (415) 385-5694

lbelenky@biologicaldiversity.org

<http://www.biologicaldiversity.org>

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THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

February 28, 2020

VIA EMAIL AND USPS

Mr. William Patterson
Environmental Supervisor
Coachella Valley Water District
75-515 Hovley Lane East
Palm Desert, CA 92211

Dear Mr. Patterson:

Notice of Preparation and
Public Scoping for the Whitewater River Groundwater Replenishment Project

The Metropolitan Water District of Southern California (Metropolitan) has reviewed the Notice of Preparation (NOP) and Public Scoping Meeting Notice for the Whitewater River Groundwater Replenishment Project (Project). Coachella Valley Water District (CVWD), as Lead Agency under the California Environmental Quality Act, has determined that an Environmental Impact Report (EIR) is necessary for analysis of the Project. This letter contains comments to the proposed project as a potentially affected public agency.

Metropolitan is a public agency and regional water wholesaler, providing an essential public service, drinking water. It is comprised of 26 member public agencies serving about 19 million people in portions of six counties in southern California, including Los Angeles, Ventura, Orange, Riverside, San Bernardino, and San Diego counties. Primary sources of Metropolitan's imported water are the California State Water Project (SWP) and the Colorado River via the Colorado River Aqueduct (CRA), which Metropolitan owns and operates. Metropolitan's mission is to provide its 5,200 square mile service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way.

CVWD is requesting a right-of way (ROW) grant from the Bureau of Land Management (BLM) for the continued operation and maintenance of CVWD's existing Whitewater River Groundwater Replenishment Facility (WRGRF). The proposed ROW grant would allow CVWD to continue groundwater replenishment at the WRGRF by delivering imported water from the CRA into the Coachella Valley Groundwater Basin (Basin). Since the early 1900s, CVWD has been replenishing the Basin with natural flow, snow melt, and beginning in 1973, with imported water as part of a cooperative program with the Desert Water Agency (DWA) and Metropolitan.

Mr. William Patterson
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February 28, 2020

Like Metropolitan, DWA and CVWD are SWP contractors. However, because of their remote locations, DWA and CVWD chose not build a physical connection to the East Branch of the SWP. Instead the agencies entered into exchange agreements with Metropolitan under which Metropolitan takes delivery of their respective SWP supplies, and in exchange, delivers a like amount of its Colorado River water from the CRA into the Northern Coachella Valley. In 1973, CVWD constructed the first ten percolation ponds to accept and percolate this exchange water, and in 1984, another nine ponds were constructed to accept additional exchange water from the CRA.

The exchange of water, which relies upon the ability to deliver and replenish water at the WRGRF, is mutually beneficial to Metropolitan, CVWD, and DWA, and essential to each agency's supply reliability. The agreements also allow Metropolitan to deliver up to 800,000 acre-feet (AF) of Colorado River water in advance of receiving DWA and CVWD's SWP supplies. The exchange of water provides Metropolitan, CVWD, and DWA greater certainty for water supply and financial planning, and improves dry-year water supply reliability.

CVWD utilizes imported water from the Colorado River for groundwater recharge as well as potable and irrigation purposes. Metropolitan delivers water to the Whitewater River from the CRA which mixes with natural flows before it reaches the groundwater replenishment facility. Metropolitan monitors and controls the quality of water through continuous sampling and treatment in order to maintain the highest standards.

Metropolitan has a significant interest in CVWD's request for ROW authorization because the ROW grant is necessary to the continued exchange of water and basin replenishment under the exchange agreements, providing significant benefits to DWA, CVWA, and Metropolitan. In addition to Metropolitan's interest in the exchange agreement, Metropolitan has special expertise and relevant information regarding Colorado River water quality and hydrology in the project area. For this reason, Metropolitan has requested to be included as a cooperating agency in the parallel NEPA process.

We appreciate the opportunity to provide input to your planning process and we look forward to receiving and reviewing future documentation on this project. Please add Metropolitan to your mailing list and send all future documentation to the following address:

The Metropolitan Water District of Southern California
Attn: Jennifer Harriger, Environmental Planning Section
700 North Alameda Street
Los Angeles, CA 90012

Mr. William Patterson

Page 3

February 28, 2020

If you have any questions, please do not hesitate to contact me at (213) 217-7658 or via email at jharriger@mwddh2o.com.

Very truly yours,



Jennifer Harriger

Interim Manager, Environmental Planning Section

DD:ds

SharePoint\NOP Coachella Groundwater Replenishment Project_Final



STATE OF CALIFORNIA

Gavin Newsom, Governor

NATIVE AMERICAN HERITAGE COMMISSION

FILE: 0122.12
0932.55

February 4, 2020

William Patterson
Coachella Valley Water District
75-515 Hovley Lane East
Palm Desert, CA 92211

CHAIRPERSON
Laura Miranda
Luiseño

VICE CHAIRPERSON
Reginald Pagaling
Chumash

SECRETARY
Merrí Lopez-Keller
Luiseño

PARLIAMENTARIAN
Russell Attebery
Karuk

COMMISSIONER
Marshall McKay
Wintun

COMMISSIONER
William Mungary
Paiute/White Mountain
Apache

COMMISSIONER
Joseph Myers
Pomo

COMMISSIONER
Julie Tumamait-
Stenslie
Chumash

COMMISSIONER
(Vacant)

EXECUTIVE SECRETARY
Christina Snider
Pomo

NAHC HEADQUARTERS
1550 Harbor Boulevard
Suite 100
West Sacramento,
California 95691
(916) 373-3710
nahc@nahc.ca.gov
NAHC.ca.gov

Re: 2020020004, Whitewater River Groundwater Replenishment Project, Riverside County

Dear Mr. Patterson:

The Native American Heritage Commission (NAHC) has received the Notice of Preparation (NOP), Draft Environmental Impact Report (DEIR) or Early Consultation for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code §21000 et seq.), specifically Public Resources Code §21084.1, states that a project that may cause a substantial adverse change in the significance of a historical resource, is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit. 14, § 15064.5 (b) (CEQA Guidelines § 15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an Environmental Impact Report (EIR) shall be prepared. (Pub. Resources Code §21080 (d); Cal. Code Regs., tit. 14, § 15064 subd.(a)(1) (CEQA Guidelines § 15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources within the area of potential effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a separate category of cultural resources, "tribal cultural resources" (Pub. Resources Code §21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment. (Pub. Resources Code §21084.2). Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code §21084.3 (a)). **AB 52 applies to any project for which a notice of preparation, a notice of negative declaration, or a mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements.** If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. §800 et seq.) may also apply.

The NAHC recommends consultation with California Native American tribes that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments.

Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project:

Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a lead agency shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:

- a. A brief description of the project.
- b. The lead agency contact information.
- c. Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code §21080.3.1 (d)).
- d. A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code §21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A lead agency shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code §21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or Environmental Impact Report. (Pub. Resources Code §21080.3.1 (b)).

- a. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code §65352.4 (SB 18). (Pub. Resources Code §21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:

- a. Alternatives to the project.
- b. Recommended mitigation measures.
- c. Significant effects. (Pub. Resources Code §21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:

- a. Type of environmental review necessary.
- b. Significance of the tribal cultural resources.
- c. Significance of the project's impacts on tribal cultural resources.
- d. If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code §21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code §6254 (r) and §6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code §21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:

- a. Whether the proposed project has a significant impact on an identified tribal cultural resource.
- b. Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code §21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code §21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:

- a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or
- b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code §21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code §21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code §21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code §21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code §21084.3 (b). (Pub. Resources Code §21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:

- a. Avoidance and preservation of the resources in place, including, but not limited to:
 - i. Planning and construction to avoid the resources and protect the cultural and natural context.
 - ii. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.
- b. Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:
 - i. Protecting the cultural character and integrity of the resource.
 - ii. Protecting the traditional use of the resource.
 - iii. Protecting the confidentiality of the resource.
- c. Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.
- d. Protecting the resource. (Pub. Resource Code §21084.3 (b)).
- e. Please note that a federally recognized California Native American tribe or a non-federally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code §815.3 (c)).
- f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code §5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An Environmental Impact Report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:

- a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code §21080.3.1 and §21080.3.2 and concluded pursuant to Public Resources Code §21080.3.2.
- b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.
- c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code §21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code §21082.3 (d)).

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires local governments to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code §65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf.

Some of SB 18's provisions include:

1. **Tribal Consultation:** If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code §65352.3 (a)(2)).
2. **No Statutory Time Limit on SB 18 Tribal Consultation.** There is no statutory time limit on SB 18 tribal consultation.
3. **Confidentiality:** Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code §65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code §5097.9 and §5097.993 that are within the city's or county's jurisdiction. (Gov. Code §65352.3 (b)).
4. **Conclusion of SB 18 Tribal Consultation:** Consultation should be concluded at the point in which:
 - a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
 - b. Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: <http://nahc.ca.gov/resources/forms/>.

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (http://ohp.parks.ca.gov/?page_id=1068) for an archaeological records search. The records search will determine:
 - a. If part or all of the APE has been previously surveyed for cultural resources.
 - b. If any known cultural resources have already been recorded on or adjacent to the APE.
 - c. If the probability is low, moderate, or high that cultural resources are located in the APE.
 - d. If a survey is required to determine whether previously unrecorded cultural resources are present.
2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
 - a. The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.
 - b. The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:

- a. A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.
- b. A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.

- a. Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, §15064.5(f) (CEQA Guidelines §15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.
- b. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.
- c. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code §7050.5, Public Resources Code §5097.98, and Cal. Code Regs., tit. 14, §15064.5, subdivisions (d) and (e) (CEQA Guidelines §15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

If you have any questions or need additional information, please contact me at my email address:
Andrew.Green@nahc.ca.gov.

Sincerely,



Andrew Green
Staff Services Analyst

cc: State Clearinghouse

Colorado River Basin Regional Water Quality Control Board

March 4, 2020

Coachella Valley Water District
Attn: William Patterson
75-515 Hovley Lane East
Palm Desert, CA 92211
wpatterson@cvwd.org

**SUBJECT: NOTICE OF PREPARATION AND PUBLIC SCOPING MEETING
DRAFT ENVIRONMENTAL IMPACT REPORT**

**SITE: WHITEWATER RIVER GROUNDWATER REPLENISHMENT PROJECT
SCH# 2020020004**

The California Regional Water Quality Control Board, Colorado River Basin Region (Regional Water Board) appreciates the opportunity to comment on the Notice of Preparation (NOP) to prepare an Environmental Impact Report (EIR) for the proposed Whitewater River Groundwater Replenishment Project (Project). The NOP provided a summary of the Project description, location, and the expected scope of environmental analysis in the EIR.

Coachella Valley Water District (CVWD) is requesting a right-of-way (ROW) grant from the Bureau of Land Management (BLM) for continued operation and maintenance of CVWD's existing Whitewater River Groundwater Replenishment Facility (Facility), located north of Palm Springs in the Whitewater River Channel. In the early 1900's, CVWD engineered holding ponds in the vicinity of the Facility to capture natural flow and snow melt, and in 1973 began diverting imported Colorado River water from the Colorado River Aqueduct to the Facility. The proposed ROW grant would allow CVWD to continue groundwater replenishment of up to 511,000 acre-feet (AF) of imported Colorado River water per year to the Facility. The NOP states that the EIR will evaluate the potential environmental effects associated with the proposed ROW grant including hydrology, water quality and other topics identified during scoping.

Regional Water Board Comments

As the principal agency with primary responsibility for the coordination and control of water quality in the region, the Regional Water Board provides the following comments regarding significant environmental issues resulting from the Project activities, alternatives, and mitigation measures.

NANCY WRIGHT, CHAIR | PAULA RASMUSSEN, EXECUTIVE OFFICER

Significant Environmental Issues

Imported Colorado River water used for groundwater replenishment at the Facility has higher total dissolved solid (TDS) concentrations, a measure of the salt content, than most native groundwater in the Coachella Valley. Prior to recharging with Colorado River water, concentrations of TDS in groundwater at the Facility were approximately 210 milligrams per liter (mg/L). In 1992¹, United States Geological Survey (USGS) evaluated the quality of groundwater in the vicinity and downgradient of the Facility and determined that after recharging the aquifer with approximately 960,000 AF of Colorado River water, TDS concentrations in groundwater near the Facility had increased to greater than 500 mg/L. TDS concentrations in groundwater near the Facility had more than doubled after just 14 years of recharging the groundwater with Colorado River water.

The Project description states up to 511,000 AF per year of Colorado River water will be recharged at the Facility. The 1992 USGS report established that the effect of recharging just 960,000 AF of Colorado River water over 14 years (an average of 68,000 AF per year) substantially increased the TDS concentration in groundwater, with the effect extending at least 4.5 miles downgradient of the Facility. The effect on groundwater quality of adding 511,000 AF per year of Colorado River water with an estimated salt mass of over 500,000 tons² is expected to be substantial. The Regional Water Board does not believe the aquifer has the assimilative capacity to accommodate this substantial salt loading in such a short period of time.

The EIR must assess changes in water quality resulting from the groundwater recharge activities. This must include detailed evaluation of historic (before groundwater recharge activities) and current groundwater analytical data for TDS, electric conductivity, chloride, sulfate, and other 'general mineral' constituents from prior to 1973 to present, and include predictions of how the proposed continued recharge activities will impact groundwater quality for a range of recharge scenarios.

Reasonable Alternatives

The 2002 Coachella Valley Water Management Plan and the 2010 Update³ state that importing water into the Coachella Valley is an integral part of the water management plan, but also recognize that recharging the local groundwater with Colorado River water has a significant impact on groundwater quality. Even while recognizing importation of water for groundwater replenishment as the most important activity to sustain the valleys water sources, CVWD only proposed two alternatives in these documents to mitigate the significant and irreversible effects to the environment from the recharge activities. Neither alternative was found to be environmentally or economically feasible at that time; CVWD

¹ Evaluation of a Ground-Water Flow and Transport Model of the Upper Coachella Valley, California. Eric G. Reichard and J. Kevin Meadows. U.S. GEOLOGICAL SURVEY, Water-Resources Investigations Report 91-4142. 1992.

² Draft Coachella Valley Salt and Nutrient Management Plan. MWH, In Association with GEI Consultants, Inc., Krieger & Stewart, Inc., and Michael Welch Consulting Engineer. June 2015.

³ Coachella Valley Water Management Plan 2010 Update. Administrative Draft-Subsequent Program Environmental Impact Report. SCH No. 2007091099. Coachella Valley Water District with Assistance from MWH Americas, Inc. and Water Consult, Inc. July 2011.

therefore adopted a Statement of Overriding Considerations for the water quality impact. No new alternatives have been proposed for consideration since 2002, and each subsequent environmental evaluation has relied on the same Statement of Overriding Considerations.

Maintaining the quality of the valley's only drinking water source warrants a vigorous evaluation of numerous importation, mitigation, and conservation alternatives that reduce the need for groundwater recharge with imported Colorado River water. Alternatives that should be considered include:

1. Reducing groundwater consumption through improved water conservation;
2. Reducing groundwater extraction and the need for subsequent recharge by blending imported Colorado River water with groundwater for direct use;
3. Increase the volume of Colorado River water used for non-potable purposes, thereby reducing the need for and use of Colorado River water for groundwater recharge;
4. Use of Colorado River water for groundwater recharge in areas of the basin where the receiving water has a higher TDS content, and therefore has less of an impact on water quality; and
5. Importing low TDS water from the California State Water Project for groundwater recharge at the Whitewater Facility.

Any use of the statement of overriding considerations must be supported by substantial evidence in the record. To claim that nothing can be done to mitigate and/or avoid the adverse impacts of added salts is not acceptable.

Mitigation Measures

The lack of adequate management practices to mitigate the effects of recharging the aquifer with ever-increasing volumes of imported Colorado River water at the Facility is not sustainable. To ensure that impacts to water quality from salt loading to the closed Indio Groundwater Subbasin via imported Colorado River water are addressed, a feasible mitigation plan must be included in the EIR. Project mitigation measures could include:

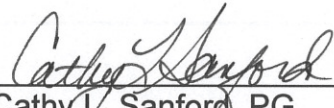
1. Reducing the salt content of the Colorado River water prior to infiltration using a desalination system;
2. Using imported Colorado River water to recharge areas of the basin with higher naturally occurring TDS concentrations;
3. Maximize storm water capture for groundwater recharge to decrease the need for imported Colorado River water;
4. Establish groundwater monitoring programs to ensure beneficial uses of the groundwater are being protected; and
5. Develop and implement a salt management and disposal plan that addresses all of the salt sources throughout the Coachella Valley, including importation of Colorado River water, and lays out a framework for maintaining high quality groundwater for decades to come.

March 4, 2020

The project mitigation plan should include a description of activities, time schedule for implementation of the activities, and a groundwater monitoring work plan to assure compliance with water quality objectives.

We appreciate the opportunity to review this NOP for the Facility draft EIR and are available to discuss our comments. When the draft EIR is prepared for this action and released for public review, please send a copy to cathy.sanford@waterboards.ca.gov. If you have questions regarding this matter, please contact me at (760) 776-8934 or cathy.sanford@waterboards.ca.gov.

Sincerely,



Cathy L. Sanford, PG
Engineering Geologist
Colorado River Basin
Regional Water Quality Control Board

cc: State Clearing House, Office of Planning & Research
state.clearinghouse@opr.ca.gov



March 4, 2020

William Patterson, Environmental Supervisor
CVWD
75-515 Hovley Lane East
Palm Desert, CA 92211

BY EMAIL TO: wpatterson@cvwd.org

Re: Notice of Preparation (NOP} to prepare an Environmental Impact Report (EIR) for the proposed Whitewater River Groundwater Replenishment Project (Project) SCH# 2020020004

Dear Mr. Patterson:

These scoping comments are submitted on behalf of the San Gorgonio Chapter of the Sierra Club and the Center for Biological Diversity (Center) regarding the Coachella Valley Water District (CVWD) Notice of Preparation (NOP} to prepare an Environmental Impact Report (EIR) for the proposed Whitewater River Groundwater Replenishment Project, SCH# 2020020004.

The Sierra Club is a national non-profit organization of with over 3 million members and supporters dedicated to exploring, enjoying, and protecting the wild places of the earth; to practicing and promoting the responsible use of the earth's ecosystems and resources; to educating and enlisting humanity to protect and restore the quality of the natural and human environment; and to using all lawful means to carry out these objectives. Many Sierra Club members reside in California and the San Gorgonio Chapter of the Sierra Club focuses on protecting lands and resources on in the California Desert including on public lands in Riverside County.

The Center is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center has 1.6 million members and supporters throughout California and the United States including members who live and recreate in the affected areas of the California Desert Conservation Area (CDCA). The Center has worked for many years to protect imperiled plants and wildlife, wildlife connectivity, open space, air and water quality, and water resources, in the CDCA and throughout the California

deserts. The Center submitted NEPA scoping comments to the Bureau of Land Management (BLM) regarding this project on December 26, 2019, those comments are attached hereto and fully incorporated herein by reference.

Sand Supply/Transport for Coachella Valley Fringe-Toed Lizard Habitat

In addition to the issues raised in the earlier scoping comments, Sierra Club and the Center are concerned that the site location and design of the infrastructure and project configuration has been shown to have impacts to sand transport for Coachella Valley fringe-toed lizard habitat.

The Long Term Sand Supply to Coachella Valley Fringe-Toed Lizard (*Uma inornata*) Habitat in the Northern Coachella Valley (USGS 2002) (attached), provided a detailed analysis of sand transport. The USGS found that the orientation of this project's galleries (levee and trough complex) create a significant barrier to critical sand transport for endangered Coachella Valley fringe-toed lizard. According to USGS, the effect is demonstrable and that the impacts could be avoided or reduced and/or mitigated. Specifically, the conclusions in the report state:

Do the retention dikes along the Whitewater River affect sand supply to the Whitewater Floodplain Reserve, and by how much? Could the design of the recharge ponds be modified to provide a continued sand supply to the reserve?

Answer: Given that 8.1 million ft³ of sediment was excavated from the retention ponds in 1996 the retention ponds clearly do trap fluvial sediment. This material may include a substantial amount of *Uma* sand, but an accurate estimate is not possible without evaluating both the time period over which this sediment was deposited as well as the proportion of *Uma* sand it contains. This sediment is entrained from the Whitewater River channel at flows of 200-400 ft³/s between the Colorado River aqueduct crossing and the infiltration galleries, although some of this material is deposited in the channel immediately upstream from the galleries. This sediment is trapped upstream from the Whitewater River depositional area owing to diversion dikes designed to channel water into the infiltration galleries and would be available for downstream transport if the diversion dikes are breached by a flood capable of transporting this sediment.

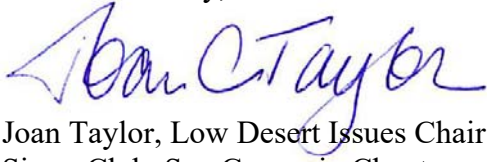
Alignment of the infiltration galleries perpendicular to the prevailing winds and the high slope angles on the downwind dikes minimize the amount of sand that can be entrained by eolian processes. Sediments dredged from the galleries and upstream channel could be spread in a flat surface in the historic Whitewater depositional area, allowing it to be entrained for eolian transport. Alternately, the galleries might be redesigned such that the long dimension is parallel to prevailing winds (long direction east-west instead of north-south), and the eastern dike of

each gallery could be designed with a shallow slope to allow eolian sand to escape.

(USGS 2002 at 42.) These significant impacts need to be fully identified and analyzed in the EIR and an alternative design/redesign must be considered in the EIR that would avoid these impacts, with any remaining impacts minimized and fully mitigated.

Thank you for the opportunity to comment. We look forward to reviewing the draft EIR. Please include both of the undersigned on all future notices regarding this project (email preferred).

Sincerely,



Joan Taylor, Low Desert Issues Chair
Sierra Club, San Geronimo Chapter
palmcanyon@mac.com



Lisa T. Belenky, Senior Attorney
Center for Biological Diversity
1212 Broadway, Suite 800
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(510) 844-7107
Cell (415) 385-5694
lbelenky@biologicaldiversity.org

Attachments:

Center for Biological Diversity, Scoping Comments on the Whitewater River
Groundwater Replenishment Facility, December 26, 2019

United States Geological Survey. 2002. The Long Term Sand Supply to Coachella Valley Fringe-Toed Lizard (*Uma inornata*) Habitat in the Northern Coachella Valley, Water-Resources Investigations Report 02-4013, authors Peter G. Griffiths, Robert H. Webb, Nicholas Lancaster, Charles A. Kaehler, and Scott C. Lundstrom (also available at <https://pubs.usgs.gov/wri/wri024013/pdf/WRIR4013.pdf>)

Attachments



VIA EMAIL

Miriam Liberatore
ATTN: Whitewater Replenishment Facility Project,
Bureau of Land Management,
Palm Springs-South Coast Field Office,
1201 Bird Center Drive, Palm Springs CA 92262
Email: blm_ca_whitewaterrecharge@blm.gov

December 26, 2019

RE: Scoping Comments on the Whitewater River Groundwater Replenishment Facility

Dear Ms. Liberatore,

These scoping comments are submitted on behalf of the Center for Biological Diversity (the "Center") for the scoping notice on the proposed Whitewater River Groundwater Replenishment Facility and associated Environmental Impact Statement. 84 Fed. Reg. 64914-15 (Nov. 25, 2019).

The Center is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center has 1.6 million members and supporters throughout California and the United States including members who live and recreate in the affected areas of the California Desert Conservation Area (CDCA). The Center has worked for many years to protect imperiled plants and wildlife, wildlife connectivity, open space, air and water quality, and water resources, in the CDCA and throughout the California deserts.

Unfortunately, the scope of the proposal is unclear. The Federal Register Notice states:

The applicant, the Coachella Valley Water District, has requested a right-of-way (ROW) authorization to operate and maintain a groundwater replenishment facility on approximately 690 acres of public lands managed by the BLM. *All the facilities are existing; no new construction is proposed.* The project site is located within the California Desert Conservation Area.

84 Fed. Reg. 64914 (emphasis added). However, BLM's eplanning site for the project states:

Coachella Valley Water District (CVWD) filed an application for a right of way grant for the continued operation and maintenance of its existing Whitewater River Groundwater Replenishment Facility. Part of the facility is sited on 511 acres of public lands managed by the BLM. The facility had a prior right of way grant that expired in 2014, and this application would authorize the continued operation and maintenance of the existing facility on public lands. CVWD *also seeks to add approximately 178 acres of public lands for access to maintain its*

facilities, for a total of 690 acres of public lands. The facility replenishes groundwater supplies by infiltrating water imported from the Colorado River through a series of shallow ponds.

DOI-BLM-CA-D060-2019-0031-EIS (Whitewater River Groundwater Replenishment Facility) eplanning page (emphasis added).¹ As a result it is unclear whether the access for maintenance on approximately 178 acres of public lands is a new proposal or already exists and was developed previously outside of the earlier right of way grant area. The notice also does not indicate whether the existing facilities fall within covered activities under the Coachella Valley Multiple Species Habitat Conservation Plan (CV MSHCP) and makes no reference to needed CEQA review.

The proposed ROW occurs at a biologically unique area where the Transverse and Peninsular Ranges meet the Colorado Desert and South Coast geographic sub-provinces which result in great biological diversity. The location of the proposed project increases the potential for rare and listed species presence on and adjacent to the site. Because the project also involves a modified waterway and imported water infiltration, it creates the unique situation of ephemeral surface water being available to wildlife in a desert setting – a wildlife attractant—and for potential impacts to the quality of groundwater and to local hydrology.

Biological Surveys and Mapping

The EIS needs to include an up-to-date inventory of the on-site resources that is used as a basis for impact analysis. The Center requests that thorough, seasonal surveys be performed for sensitive plant species and vegetation communities, and animal species under the direction and supervision of the BLM and resource agencies such as the US Fish and Wildlife Service and the California Department of Fish and Wildlife. Surveys for the plants and any existing plant communities should follow California Native Plant Society (CNPS) and California Department of Fish and Wildlife (CDFW) floristic survey guidelines.² A full floral inventory of all species encountered needs to be documented as a basis for management prescriptions. Surveys for animals should include an evaluation of the California Wildlife Habitat Relationship System's (CWHR) Habitat Classification Scheme.³ All rare species (plants or animals) need to be documented with a California Natural Diversity Data Base form and submitted to the California Department of Fish and Game using the CNDDB Form as per the State's instructions.⁴

The Center requests that the vegetation mapping be done on the proposed ROW area as well as its sphere of influence. The mapping must be at a large enough scale to be useful for evaluating the impacts over time. Vegetation, riparian areas and wildlife movement corridor mapping should be at such a scale to provide an accurate accounting of the proposed activities. A half-acre minimum mapping unit size is recommended, such as has been used for other projects. The mapping protocol needs to follow CDFW's Vegetation Classification and Mapping

1 At <https://bit.ly/2kx76jY>

2 ¹ https://cnps.org/wp-content/uploads/2018/03/cnps_survey_guidelines.pdf and <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=18959> (respectively)

3 <https://www.wildlife.ca.gov/Data/CWHR/Wildlife-Habitats>

4 <https://www.wildlife.ca.gov/data/CNDDB/submitting-data>

Standards⁵ and implement Alliance Level Mapping using a downloadable, blank geodatabase from California Dept. of Fish and Wildlife's VegCAMP.⁶ If rare vegetation types are encountered, the survey needs to implement CNPS' protocol for mapping of rare vegetation types.⁷

Current surveys must be implemented and combined with existing data in order to evaluate the existing on-site conditions. A number of rare plants and animals are known to or have high potential to occur within the general area of the ROW⁸ and must be included in the impact analysis. They include but are not limited to:

Common Name	Scientific Name	Fed/State/Other Status
Plants		
chaparral sand-verbena	<i>Abronia villosa</i> var. <i>aurita</i>	BLM-S/1B.1/--
Coachella Valley milk-vetch	<i>Astragalus lentiginosus</i> var. <i>coachellae</i>	FE/1B.1/--
triple-ribbed milk-vetch	<i>Astragalus tricarinatus</i>	FE/1B.2/--
white-bracted spineflower	<i>Chorizanthe xanti</i> var. <i>leucotheca</i>	BLM-S/1B.2/--
slender-horned spineflower	<i>Dodecahema leptoceras</i>	FE/CE, 1B.1/--
cliff spurge	<i>Euphorbia misera</i>	--/2B.2/--
California satintail	<i>Imperata brevifolia</i>	--/2B.1/--
Little San Bernardino Mtns. linanthus	<i>Linanthus maculatus</i> ssp. <i>maculatus</i>	BLM-S/1B.2/--
spiny-hair blazing star	<i>Mentzelia tricuspidis</i>	--/2B.1/--
slender cottonheads	<i>Nemacaulis denudata</i> var. <i>gracilis</i>	--/2B.1/--
Insects		
Coachella giant sand treader cricket	<i>Macrobaenetes valgum</i>	--/--/VU
Coachella Valley jerusalem cricket	<i>Stenopelmatus californiensis</i>	--/--/VU
Amphibians		
California red-legged frog	<i>Rana draytonii</i>	FT/SSC/VU
southern mountain yellow-legged frog	<i>Rana muscosa</i>	FE/CE/--
Reptiles		
southern California legless lizard	<i>Anniella stebbinsi</i>	--/SSC/--
orange-throated whiptail	<i>Aspidoscelis hyperythra</i>	--/WL/--
red-diamond rattlesnake	<i>Crotalus ruber</i>	--/SSC/--
desert tortoise	<i>Gopherus agassizii</i>	FT/CT/VU
coast horned lizard	<i>Phrynosoma blainvillii</i>	BLM-S/SSC/--
flat-tailed horned lizard	<i>Phrynosoma mcallii</i>	BLM-S/SSC/NT
two-striped gartersnake	<i>Thamnophis hammondi</i>	BLM-S/SSC
Coachella Valley fringe-toed lizard	<i>Uma inornata</i>	FT/CE/--

⁵ <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=102342&inline>

⁶ <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=153394>

⁷ https://www.cnps.org/wp-content/uploads/2018/03/guidelines-rare_veg_mapping.pdf

⁸ CNDDDB 2019(White water and Desert Hot Springs quads)

Birds		
golden eagle	<i>Aquila chrysaetos</i>	BLM-S,BCC /FP/--
burrowing owl	<i>Athene cunicularia</i>	BLM-S, BCC/SSC/--
prairie falcon	<i>Falco mexicanus</i>	BCC/WL/--
loggerhead shrike	<i>Lanius ludovicianus</i>	BCC/SSC/--
Le Conte's thrasher	<i>Toxostoma lecontei</i>	BCC/SSC/--
Mammals		
pallid San Diego pocket mouse	<i>Chaetodipus fallax pallidus</i>	--/SSC/--
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	BLM-S/SSC/--
San Diego desert woodrat	<i>Neotoma lepida intermedia</i>	--/SSC/--
desert bighorn sheep	<i>Ovis canadensis nelsoni</i>	BLM-S/SSC/--
Los Angeles pocket mouse	<i>Perognathus longimembris brevinasus</i>	--/SSC/--
Palm Springs round-tailed ground squirrel	<i>Xerospermophilus tereticaudus chlorus</i>	BLM-S/SSC/--
Federal Designation FE Federally listed as endangered. FT Federally listed as threatened. BLM-S BLM Sensitive Species. BCC – Bird of Conservation Concern - USFWS State Designation FP Fully Protected under State CE State listed as endangered. CT State listed as threatened. Species that although not presently threatened in California with extinction are likely to become endangered in the foreseeable future. SSC California Department of Fish and Wildlife's "Species of Special Concern." Species with declining populations in California WL – California Department of Fish and Wildlife's Watch List Rare Plant Rank 1B.1 Plant rare, threatened or endangered in California and elsewhere, and seriously threatened in CA. 1B.2 Plant rare, threatened or endangered in California and elsewhere, and fairly threatened in CA. 2B.1 Plants rare, threatened, or endangered in California but more common elsewhere, and seriously threatened in CA. International Union for Conservation of Nature (IUCN) VU – Vulnerable NT – Near Threatened		

The EIS must address direct impacts to these species (and other common species) from project activities, including maintenance activities and along access routes, and evaluate all measures to avoid and minimize impacts and, if necessary, fully mitigate any remaining impacts. The EIS also needs to specifically address the safety of wildlife attracted to the infiltration basins, explain past measures taken to protect wildlife, and the potential need for new or alternatives measures to avoid and mitigate impacts. The BLM should require monitoring and reporting to ensure protective measures are effective.

Indirect impacts to species that may not occur on site but which the on-site activities may affect must also be addressed including any on site activities that may disrupt “downstream processes” that would indirectly impact the species and habitats. For example, infiltration basins and other project facilities may affect the sand transport corridor that replenishes the downwind blow-sand and stabilized sand dune habitat for the sand-dependent species including the insects, the flat-tailed horned lizard, the Coachella Valley fringe-toed lizard, and others.

A robust monitoring plan is needed that also includes pre-inundation and pre-maintenance surveys of the infiltration basins to assure that any sensitive wildlife would not be put in harm’s way when the basins are filled or when maintenance of the basin occurs.

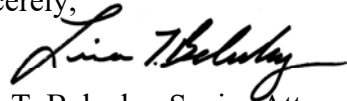
Infiltrated Water Quantity and Quality

The EIS must provide baseline information on the quantity and quality of water in the basin taking into account past and ongoing water infiltration. The EIS must also identify the source of the water to be infiltrated in the future, the amount of each type of water to be infiltrated, and the quality of that water in order to evaluate impacts to the groundwater basin going forward.

Conclusion

The Center looks forward to reviewing the draft Environmental Impact Statement when it is available. Please keep us on the list of interested public for all matters associated with this project as well as issues specific to the Palm Springs Field Office.

Sincerely,



Lisa T. Belenky, Senior Attorney
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Oakland, CA 94612
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U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
U.S. FISH AND WILDLIFE SERVICE

Long-Term Sand Supply to Coachella Valley Fringe-Toed Lizard (*Uma inornata*) Habitat in the Northern Coachella Valley, California

Water-Resources Investigations Report 02-4013

COVER PHOTOGRAPH

June 21, 1978. View of Mount San Gorgonio from the Bermuda Dunes, Coachella Valley (photograph by Phil Medica, used with permission).

Long-term Sand Supply to Coachella Valley Fringe-toed Lizard Habitat in the Northern Coachella Valley, California

By Peter G. Griffiths, Robert H. Webb, Nicholas Lancaster, Charles A. Kaehler, and
Scott C. Lundstrom

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 02-4013

Prepared in cooperation with the

U.S. Fish and Wildlife Service

Tucson, Arizona
2002

U.S. DEPARTMENT OF THE INTERIOR

GALE A. NORTON, *Secretary*

U.S. GEOLOGICAL SURVEY

Charles G. Groat, *Director*

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U.S. Geological Survey
345 Middlefield Road
Menlo Park, CA 94025
<http://water.usgs.gov/nrp>

Copies of this report can be purchased from:

U.S. Geological Survey
Information Services
Building 810
Box 25286, Federal Center
Denver, CO 80225-0286

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CONVERSION FACTORS AND DATUMS

CONVERSION FACTORS

Multiply	By	To obtain
inch (in)	25.41	millimeter
foot (ft)	0.3048	meter
yard (yd)	0.9144	meter
mile (mi)	1.609	kilometer
miles per hour (mi/hr)	1.609	kilometer per hour
knots	1.852	kilometer per hour
acre	0.4047	hectare
square foot (ft ²)	0.09290	square meter
square mile (mi ²)	2.590	square kilometer
cubic foot (ft ³)	0.02832	cubic meter
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second
pound, avoirdupois (lb)	0.4536	kilogram
ton, short (2,000 lb)	0.9072	megagram
ton per year (ton/yr)	0.9072	megagram per year
ton per year (ton/yr)	0.9072	metric ton per year
pound per cubic foot (lb/ft ³)	16.02	kilogram per cubic meter

VERTICAL DATUM

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

HORIZONTAL DATUM

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83), unless otherwise noted.

Long-Term Sand Supply to Coachella Valley Fringe-Toed Lizard (*Uma inornata*) Habitat in the Northern Coachella Valley, California

By Peter G. Griffiths, Robert H. Webb, Nicholas Lancaster, Charles A. Kaehler, and Scott C. Lundstrom

ABSTRACT

The Coachella Valley fringe-toed lizard (*Uma inornata*) is a federally listed threatened species that inhabits active sand dunes in the vicinity of Palm Springs, California. The Whitewater Floodplain and Willow Hole Reserves provide some of the primary remaining habitat for this species. The sediment-delivery system that creates these active sand dunes consists of fluvial depositional areas fed episodically by ephemeral streams. Finer fluvial sediments (typically sand size and finer) are mobilized in a largely unidirectional wind field associated with strong westerly winds through San Geronimo Pass. The fluvial depositional areas are primarily associated with floodplains of the Whitewater – San Geronimo Rivers and Mission Creek – Morongo Wash; other small drainages also contribute fluvial sediment to the eolian system. The eolian dunes are transitory as a result of unidirectional sand movement from the depositional areas, which are recharged with fine-grained sediment only during episodic floods that typically occur during El Niño years. Eolian sand moves primarily from west to east through the study area; the period of maximum eolian activity is April through June. Wind speed varies diurnally, with maximum velocities typically occurring during the afternoon.

Development of alluvial fans, alteration of stream channels by channelization, in-stream gravel mining, and construction of infiltration galleries were thought to reduce the amount of

fluvial sediment reaching the depositional areas upwind of *Uma* habitat. Also, the presence of roadways, railroads, and housing developments was thought to disrupt or redirect eolian sand movement. Most of the sediment yield to the fluvial system is generated in higher elevation areas with little or no development, and sediment yield is affected primarily by climatic fluctuations and rural land use, particularly livestock grazing and wildfire. Channelization benefits sediment delivery to the depositional plains upwind of the reserves by minimizing in-channel sediment storage on the alluvial fans.

The post-development annual sediment yield to the Whitewater and Mission Creek – Morongo Wash depositional areas are 3.5 and 1.5 million ft³/yr, respectively, covering each depositional area to a depth of 0.2 to 0.4 in. Given existing sand-transport rates, this material could be depleted by eolian processes in 8 to 16 months, a rate consistent with the presence of persistent sand dunes. However, these depletion times are likely minimum estimates, as some eolian sand is seen to persist in the immediate vicinity of depositional areas for longer time periods. Transport rates may be reduced by the presence of vegetation and other windbreaks.

Because they are perpendicular to prevailing winds, the infiltration galleries on Whitewater River trap fluvial and eolian sediment, reducing sediment availability. Also, the presence of the railroad and Interstate 10 redirect eolian sand movement to the southeast along their corridors,

potentially eliminating the Whitewater depositional area as a sand source for the Willow Hole Reserve. Using directional wind data, we discuss the potential for eolian sand transport from the Mission Creek – Morongo Wash depositional area to Willow Hole.

INTRODUCTION

The Coachella Valley fringe-toed lizard (*Uma inornata*) is a federally listed threatened species that inhabits active sand dunes and their margins in the vicinity of Palm Springs, California (fig. 1). As part of the Habitat Conservation Plan for this species (Nature Conservancy, 1985), a series of reserves has been established to benefit this species and other species that are restricted to active dunes and their margins. Two of these reserves, the Whitewater Floodplain and Willow Hole – Edom Hill Reserves, are in the northern Coachella Valley between the towns of Palm Springs, Thousand Palms, and Desert Hot Springs (fig. 1).

The U.S. Fish and Wildlife Service is concerned that flood-control and water-management structures on Whitewater River and other smaller desert washes are reducing the sand supply to these reserves, potentially stabilizing the dunes and thereby degrading *Uma* habitat. Development of alluvial fans, alteration of stream channels by channelization, in-stream gravel mining, and construction of infiltration galleries were thought to reduce the amount of fluvial sediment reaching the depositional areas upwind of *Uma* habitat. Also, the presence of roadways, railroads, and housing developments was thought to disrupt or redirect eolian sand movement. Most of the sediment yield to the fluvial system is generated in higher elevation areas with little or no development, and sediment yield is affected primarily by climatic fluctuations and rural land use, particularly livestock grazing and wildfire. Channelization benefits sediment delivery to the depositional plains upwind of the reserves by minimizing in-channel sediment storage on the alluvial fans.

Previous studies of sediment supply to *Uma* habitat have generally been non-quantitative and, to a lesser extent, divergent in their conclusions as to the long-term sand budget in the northern Coachella Valley and how it might change given modifications to the major watercourses that provide sand to the eolian

system. This study addresses specific questions of fluvial supply of fine-grained sediments to fetch areas upwind of two reserves in the northern Coachella Valley and eolian transport of these sediments to the reserves.

Purpose and Scope

The objective of this project is to describe the sand-delivery system and to quantify the sand budget for Coachella Valley fringe-toed lizard (*Uma inornata*) habitat in the northern Coachella Valley. This project will focus on the Whitewater Floodplain Reserve and the western half of the Willow Hole – Edom Hill Reserve – referred to in this study as the Willow Hole Reserve – and their sand sources, both before and after major development in the Coachella Valley. In particular, this study addresses the interrelations between fluvial and eolian processes that create the unique sand-delivery system to *Uma* habitat in the northern Coachella Valley and attempts to quantify sand transport rates.

In addition, this report addresses major questions asked of the U.S. Geological Survey by the U.S. Fish and Wildlife Service. These questions are:

- For both reserves, is the sand supply sufficient to maintain *Uma* habitat in the Willow Hole and Whitewater Floodplain Reserves?
- How would channelization of Mission and Morongo Creeks and urban development on their adjacent floodplains affect sand supply to both reserves?
- Do the infiltration galleries and associated retention dikes along the Whitewater River affect sand supply to the Whitewater Floodplain Reserve, and by how much? Could the design of the recharge ponds be modified to increase the sand supply to the reserve?
- How much of the floodplain of the washes supplying sand upwind of the reserves has to be preserved to ensure a perpetual sand supply? What areas are essential to preserve to maintain an adequate sand supply and sand-transport corridor for these two reserves?

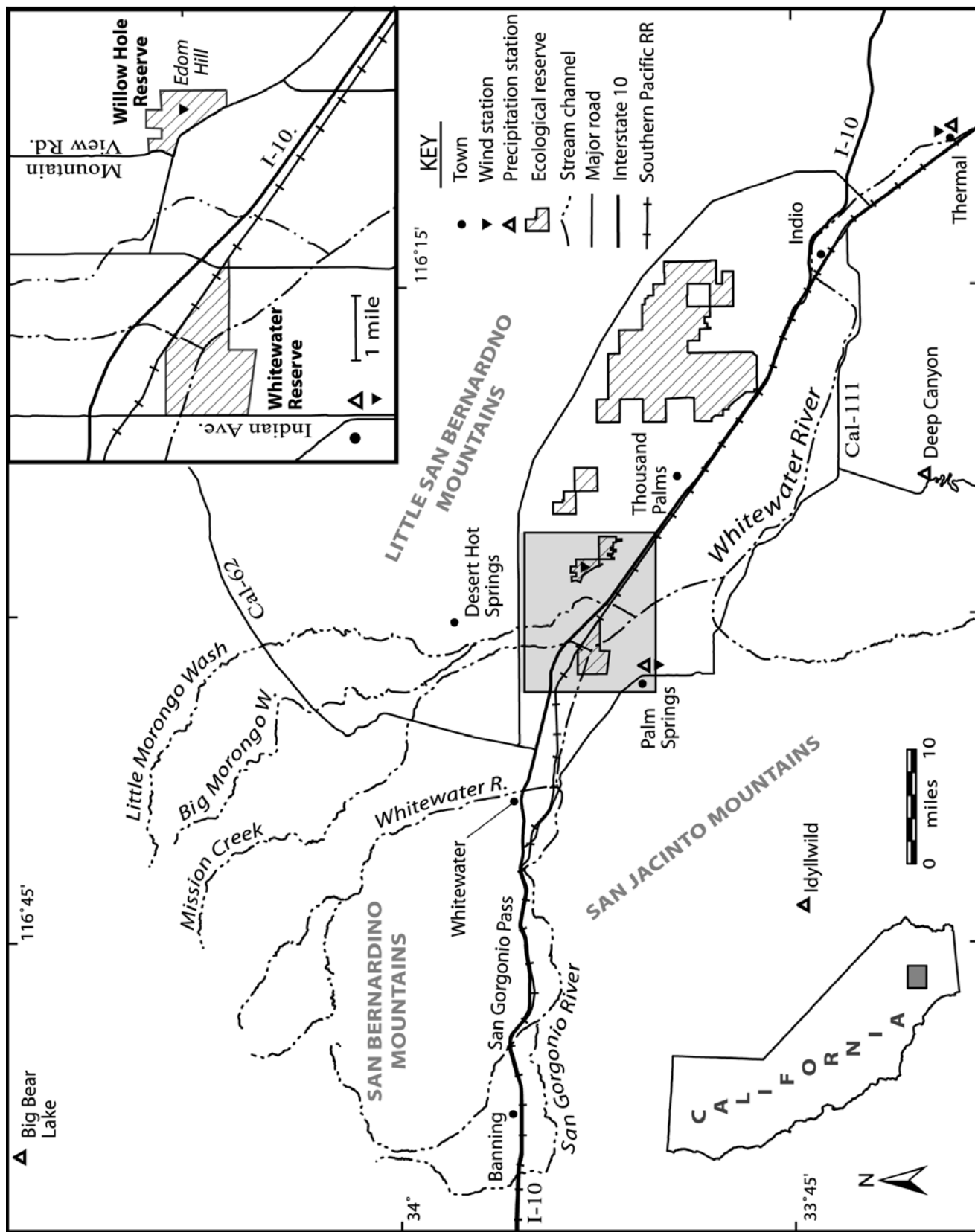


Figure 1. Map of the northern Coachella Valley. Inset shows details of the area including the Whitewater River and Willow Hole Reserves.

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The authors thank Jessica Young of the U.S. Geological Survey for her contributions to the geographical information system (GIS) analysis of the drainages contributing sand to the Coachella Valley. Mimi Murov of the U.S. Geological Survey helped considerably with the field work on this project. Daniel Farris of the Coachella Valley Water District supplied key wind and dredging data. Kurt Cupp of the Desert Research Institute collected and scanned the air photographs and Ed Corbett of the Desert Research Institute helped with image and wind-data analysis. We thank R.R. Shroba and J.C. Matti of the U.S. Geological Survey for helpful discussions during Quaternary geologic mapping of the area. Mark Fisher of the Boyd Deep Canyon Desert Research Center provided precipitation data for his facility. Van Williams, also of the U.S. Geological Survey, provided invaluable GIS support for the geologic mapping. The manuscript was critically reviewed by Fisher, Allan Muth, and Cameron Barrows, collectively known as the Science Advisory Committee of the Coachella Valley Multiple Species Habitat Conservation Plan; Bill Havert of the Coachella Valley Mountain Conservancy; and Pete Sorensen and Ken Corey of the U.S. Fish and Wildlife Service.

BACKGROUND

Habitat Requirements of *Uma inornata*

The Coachella Valley fringe-toed lizard (*Uma inornata*) is a sand-dwelling species that is narrowly endemic on active dunes and their stabilized margins in the northern Coachella Valley. One of its closest relatives is the Mojave fringe-toed lizard (*Uma scoparia*), which is a species of special concern in California (Trepanier and Murphy, 2001). *Uma scoparia* is endemic to eolian sand habitats in the Mojave Desert in California and western Arizona, particularly within eolian systems associated with the Mojave and Amargosa Rivers (Hollingsworth and Beaman, 1999). The remaining habitat for *Uma scoparia* is substantially larger than that of *Uma inornata*, and *Uma scoparia* is not a federally listed threatened species.

Uma inornata was once relatively common in the Coachella Valley, and its original range was about 324 mi². By 1976, the eolian habitat available to this species had decreased by 27 percent to 236 mi², and the most-suitable habitat was estimated to be only 120 mi² (England and Nelson, 1976). The 1985 Habitat Conservation Plan (Nature Conservancy, 1985) created the Willow Hole – Edom Hill Reserve of 3.8 mi² (2.2 mi² of suitable habitat) and the Whitewater Floodplain Reserve of 1.9 mi², all of which is considered suitable habitat. A larger Coachella Valley Reserve (also known as the Thousand Palms Reserve) was also created east of the study area.

The numbers of *Uma inornata* began decreasing because of habitat destruction for a variety of human uses, including agriculture, development of subdivisions, and construction of railroads and highways. The active sand dunes that are required for *Uma* appear to have decreased in area, in part owing to road construction, the erection of windbreaks using non-native *Tamarix* trees, and modifications to stream channels; the operation of power-generating windmills upwind may possibly have contributed to the decline (Turner and others, 1984). Because its habitat, which was never very large, was reduced by at least two thirds, *Uma inornata* was listed as a threatened species by the U.S. Fish and Wildlife Service in 1980. The habitat conservation plan developed to protect this lizard (Nature Conservancy, 1985) is often cited as a model for species preservation under the Endangered Species Act (Barrows, 1996).

Uma inornata habitat consists of active or minimally stabilized dunes of late Holocene age or active eolian surfaces on dunes of greater antiquity. The lizards may use active, relatively large barchanoid dunes, or their habitat may consist of relatively large coppice mounds around mesquite (*Prosopis glandulosa*), creosote bush (*Larrea tridentata*), or other shrubs. *Uma* requires loose sand to create burrows, and the range in b-axis diameter of sand must fall between 0.1 and 1.0 mm with a mean of about 0.2 to 0.4 mm, as reported by Turner and others (1984), or 0.180 to 0.355 mm as reported by Barrows (1997). Turner and others (1984) conclude that *Uma inornata* may be very sensitive to minor variations in eolian sand size. Therefore, small alterations of sand supply may have significant effects on this species.

These lizards prefer the leeward side of dunes and hummocks and seldom use the windward (or more stabilized) side. However, Turner and others (1984)

found positive correlations with the amount of surface crusting on the windward sides of dunes, indicating that some stabilization of dunes may be a desirable attribute of *Uma* habitat; they note that *Uma* may use the windward sides at night. Barrows (1997) found that sand compaction, as defined by a standardized penetration depth, was consistently the most important determinant of appropriate habitat for *Uma*; this species requires the deep, loose sand that generally occurs only in active sand dunes as protection from predators and summer heat.

Uma require some proximity to vegetation for their food supply, which suggests that the dune systems they occupy must be relatively small or have a thin cover of loose sand over more stable substrates anchored by vegetation. Barrows (1997) found that *Uma* preferred the presence of such native plant species as *Dicoria canescens* and *Atriplex canescens* as well as the non-native *Salsola tragus*. *Dicoria* is an important food source, particularly in late summer (Barrows, 1997). Another factor noted by Barrows (1996) is ground-water overdraft, which may be killing mature *Prosopis* and thereby facilitating degradation of coppice mounds that provide dune anchorage as well as negatively affecting food supplies.

The Fluvial System in the Coachella Valley

The fluvial system in the Coachella Valley consists of stream channels that are ephemeral downslope from the mountain front and that pass through large, coalescing alluvial fans called bajadas. These ephemeral streams, also known as washes, deliver sediment in flash floods that occur infrequently. These floods occur during large winter storms that drop most of their precipitation in the mountains west and north of the Coachella Valley (larger drainages), or during intense summer thunderstorms (smaller drainages). The last large flood on the Whitewater River was in 1938, and most floods that occur at a frequency of every 2 years or more often are relatively small and transport only small amounts of fine-grained sediments in comparison with the larger events.

Streamflow is the most common sediment-transport process that occurs in the washes entering the Coachella Valley. Streamflow typically has a sediment concentration of less than 40 percent by weight (Pierson and Costa, 1987). In addition to streamflow, “hyperconcentrated flow” and debris flows occur in the

Coachella Valley and particularly in the surrounding mountainous terrain (Sharp and Nobles, 1953). Hyperconcentrated flow, as originally defined by Beverage and Culbertson (1964) and modified by Pierson and Costa (1987), contains 40 to 70 percent sediment by weight. Debris flows are slurries of clay- to boulder-sized sediment with volumetric water concentration ranges from about 10 to 30 percent (Pierson and Costa, 1987; Major and Pierson, 1992) and are an important sediment-transport process in a variety of geomorphic settings throughout the world (Costa, 1984).

A variety of classifications has been proposed for distinguishing streamflow, “hyperconcentrated flows,” and debris flows, with the most recent work focused on rheological properties (Pierson and Costa, 1987) and the interactions of fluid and solid forces (Iverson, 1997). Hyperconcentrated-flow deposits are differentiated from those of streamflow and debris flow by sedimentological criteria based on differences in particle-size distribution, sedimentary structures such as slight laminar bedding, and an overall coarse-sand, upward-coarsening texture commonly containing erratic cobbles and boulders (Pierson and Costa, 1987). In this study, hyperconcentrated flow is grouped with streamflow in calculating sediment transport in the Coachella Valley, and the sediment contribution of debris flows is not calculated owing to lack of information on their occurrence.

Fluvial sediment is mostly generated in the headwaters areas of drainage basins within the mountains that surround the western and northern parts of the Coachella Valley. During infrequent floods, sediment is entrained from hillslopes and channels in the headwaters and is transported downstream into channels that pass through the bajadas. Some sediment is stored within channels in small terraces; during larger floods, sediment is stored on the bajada surface as floodplain deposits. Sediment transported through the bajada in the channelized washes is deposited over broad, low-angle depositional plains, referred to in this report as depositional areas. The largest of these areas is the Whitewater depositional area, most of which historically was west of Indian Avenue and south of Interstate 10 (fig. 1).

The particle-size distribution of sediments transported by these ephemeral streams varies depending on the transport process. Debris flows, which occur infrequently, transport particles ranging from clay to boulders; abundant debris-flow deposits

appear along the channel of Whitewater River upstream from Interstate 10 and on alluvial fans emanating from the San Jacinto Mountains. No historical debris flows have been reported, however. Most sediment transported by streamflow ranges in size from sand to small gravel, with a relatively small (<10 percent) component of silt and clay. This range in particle size reflects the sizes of particles generated from weathering of granitic terranes in the San Bernadino and San Jacinto Mountains.

At various times, flood-control and water-management projects that were proposed to solve regional problems were thought to reduce the sand supply issuing from major tributaries, particularly the Whitewater River. One flood-control project proposed but not implemented by the U.S. Army Corps of Engineers could have reduced the sand supply by half (Turner and others, 1984).

Water-spreading structures and earthen dikes are used to infiltrate low flows from the Whitewater River into the regional aquifer. A total of 19 infiltration galleries, also known as percolation ponds, are formed from these dikes. The initial diversion dikes into the infiltration galleries are designed to breach during floods; this has occurred several times since construction, particularly during floods in early 1977 and again in 1979 at the site of the spillway between the ponds (Daniel Farris and Patti Schwartz, Coachella Valley Water District, oral commun., 2002). The intake channel to the galleries is designed to trap much of the sand transported downstream in the Whitewater River, potentially making it available to downstream transport to the Whitewater River depositional area.

Flow in the lower Whitewater River is occasionally artificial. Water imported from the Colorado River is released into the channel of the Whitewater River about one mile upslope (north) of the Interstate 10 bridge at Whitewater (fig. 1). These aqueduct releases typically range from less than 100 to 500 ft³/s, and the releases are redirected from the main channel into the infiltration galleries. This flow too is episodic and aseasonal, depending on negotiations between the local water district and the Metropolitan Water District of Los Angeles. This sediment-free water quickly entrains fine-grained sediments of the size range required for *Uma* habitat and moves at least some of the sediment out of the fetch area that supplies sand to the Whitewater Floodplain Reserve. In addition, because of their steep windward sides, the

dikes impounding the infiltration galleries trap fluvial sand moving down the corridor of the Whitewater River and prevent eolian sand from escaping.

The Eolian System in the Coachella Valley

The sand dunes of the northern Coachella Valley have been described in several previous studies (Russell, 1932; Sharp, 1964, 1980; Beheiry, 1967; Lancaster and others, 1993; Lancaster, 1997). Abundant evidence of significant prehistoric eolian activity is preserved in ventifacts (sandblasted rocks), fossil dunes, and altered vegetation form and distribution (Proctor, 1968; Sharp and Saunders, 1978). The dune forms that have been previously described in the northern Coachella Valley range from knob dunes (now called nebkha or coppice dunes; Lancaster, 1995) – small and ephemeral mounds up to 6 ft high and 35 ft long and anchored by perennial vegetation – to barchan dunes up to 35 ft high and 100 ft long (Beheiry, 1967). Parabolic dunes occur in the Coachella Valley Reserve to the east. Sand veneers on surfaces that are not eolian in origin (also called sand sheets) are relatively common, particularly following pulses of fluvial sediment input, but mesquite-anchored coppice dunes are the only relatively permanent dune forms in the northern Coachella Valley.

The actual rates of dune movement and sand transport are determined by the supply of sediment for transport and its availability. Sand availability is limited by vegetation cover and soil moisture, the influence of which is indicated by the dune-mobility index (Lancaster and Helm, 2000). A climatic index of dune mobility developed to predict the mobility of sand dunes (Lancaster, 1988) has been used to understand dune mobility in a variety of environments, including the Kalahari Desert (Bullard and others, 1997), the Great Plains of the USA and Canada (Muhs and Maat, 1993; Wolfe and Nickling, 1997), and southern Washington State (Stetler and Gaylord, 1996). The index is based on the two factors of wind strength and the ratio of precipitation to potential evapotranspiration as a surrogate for vegetation cover. It has been shown to accurately reflect eolian sand transport measured at long-term monitoring sites in the southwestern United States (Lancaster and Helm, 2000). One major assumption is that dune movement and eolian activity are determined by sediment availability as determined by vegetation cover. Lancaster and others (1993) and

Lancaster (1997) used the dune mobility index to show that dunes in the Coachella Valley migrated on a temporal pattern that was predicted by the index.

As previously discussed, the sand supply for the eolian system comes from ephemeral washes, most of which have headwaters in either the San Bernardino or Little San Bernardino Mountains. Wasklewicz and Meek (1995) used geochemical analyses to attempt to quantify the sources of sands for the *Uma* reserves. These sources are predominantly the major watercourses, particularly the Whitewater River for the Whitewater Floodplain Reserve and Mission Creek and Morongo Wash for the Willow Hole Reserve. Floods down these watercourses occur infrequently, leading to episodic addition of fine-grained fluvial sediments to the channels and alluvial fans upwind of the reserves.

Westerly winds through San Geronimo Pass (fig. 1), which shift to northwesterly winds with distance into the Coachella Valley, provide the dominant force for moving fine-grained fluvial sediments deposited by major watercourses on the valley floor into eolian deposits that become *Uma* habitat (Lancaster and others, 1993). Winds can shift to other directions during occasional thunderstorms, but these events are sporadic and very localized. Wind energy is not a limiting factor to wind transport in this region (Lancaster, 1997). Because of the episodic nature of fluvial sediment input into the system and the high energy of the wind regime, depletion of upwind sand sources as well as ephemeral eolian landforms are expected. With increasing time after fluvial deposition, wind can erode fine sediments from both the channel margins and the downwind habitat, thereby depleting the source for eolian sand as well as *Uma* habitat.

Accumulation of eolian deposits requires: (1) a source of available sediment, (2) sufficient wind energy to transport that sediment, and (3) conditions that promote accumulation in the depositional zone. A key principle in the understanding of eolian sand deposits is the recognition that they occur as part of recognizable sediment transport systems in which sand is moved from source areas (e.g., distal fluvial deposits) and transported along distinct transport corridors to depositional sinks (Lancaster, 1995).

The dynamics of eolian sediment transport systems on any time scale are determined by the relations between the supply, availability, and mobility of sediment of a size suitable for transport by wind (Kocurek and Lancaster, 1999). In turn, sediment supply, availability, and mobility are determined in

large part by regional and local climate and vegetation cover. Sediment supply is the presence of suitable sediment that serves as a source of material for the eolian transport system. It may be affected by variations in flood magnitude and frequency, fluvial sediment-transport rates, and rates of bedrock weathering at sediment source areas. Climatic changes impact sediment availability (the susceptibility of a sediment surface to entrainment of material by wind) and mobility (transport rates) via vegetation cover, soil moisture, and changes in the magnitude and frequency of winds capable of transporting sediment.

Rates of eolian transport and deposition are affected by a number of factors. Wind fetch, or the length of unobstructed area exposed parallel to the wind, is the primary factor. Because the natural surfaces along the floor of the arid northern Coachella Valley are mostly flat with sparse perennial vegetation, fetch is generally not a restriction unless anthropogenic obstacles are present. Other factors influencing eolian transport include wind speed and duration, availability and size fractions of sand in channel bottoms, the presence and dimensions of natural or artificial windbreaks, and the density and size of natural vegetation in channels and among sand dunes. Lancaster and others (1993) add the factor of channel entrenchment and (or) change, which decreases eolian entrainment of particles and transport out of channels. Some of these factors – particularly wind speed, availability of appropriately sized sediment, channel stability, and natural vegetation – are affected by regional climatic variability on a decadal or longer time scale. Other factors – particularly wind fetch – are directly affected by development and modification of river channels and the landscape.

Eolian processes transport a relatively narrow range of sand sizes. In the mid-1960s, Beheiry (1967) found that the median diameter (D_{50}) of eolian sand at sixteen sites in the Coachella Valley ranged from 0.09 to 0.44 mm with an average of 0.28 mm. The particle-size distributions he measured had a bimodal component, suggesting that several sand sources were being mixed in transport. The range of eolian sand preferred by *Uma inornata* is 0.180 to 0.355 mm (Barrows, 1997), indicating that these lizards have a more narrow habitat preference than what is available throughout the eolian dune fields.

Accumulation of sand is the product of spatial changes in transport rates and temporal changes in sediment concentration such that:

$$\frac{dh}{dt} = -\left(\frac{dq_s}{dx} + \frac{dC}{dt}\right) \quad (1)$$

where

h is the elevation of the deposition surface,

t is time,

q_s is the spatially averaged bulk volume sediment-transport rate,

x is the distance along the transport pathway, and

C is the concentration of sediment in transport.

In this model, the transport rate (q_s) consists of two components, a first owing to bedform migration (bedform transport, q_b) and a second that is through-going (q_t) as a result of saltation or bedload transport. The sediment concentration (C) is a measure of the total amount of sediment in transport, and can be approximated by the average height of the dunes or other eolian bedforms (Havholm and Kocurek, 1994).

Although sediment-transport rates over sandy surfaces are almost always at the capacity of the wind to transport sediment (sediment saturated), those over other desert surfaces such as bedrock, alluvial fans, or playas are frequently below transport capacity, or undersaturated or metasaturated (Wilson, 1971) because the sediment supply is limited. Thus actual sand transport rates (q_a) may be less than potential rates (q_p) in proportion to the ratio q_a/q_p , which ranges between zero for completely undersaturated flows to 1 for fully saturated conditions. The wind is potentially erosional until its transport capacity is reached, regardless of whether the wind is accelerating, steady, or decelerating. Deposition occurs wherever there are local decreases in transport capacity (*e.g.*, deceleration in the lee of obstacles or change in surface roughness). The wind may still be transporting sand, as deposition only occurs until the transport rate is in equilibrium with changed conditions.

Following principles of sediment-mass conservation, if transport rates decrease in the direction of flow, deposition will occur. If, however, sediment-transport rates increase, then sediment will be eroded. If there is no spatial change in transport rates, then net sediment bypassing will occur (Havholm and Kocurek, 1994). The change in transport capacity in both time and space, defined as the ratio between the potential transport rate upwind and downwind of the area of

concern, determine the domains of erosion, bypass, and accumulation of sand. These concepts can be used to assess the nature of changes that may occur through time. For example, assuming that the basic wind regime characteristics of an area do not vary with time, changes in sediment availability from source zones and thus the saturation level of the input will determine the behavior of the system.

Sand depletion is considered an on-going problem in the northwestern part of the Coachella Valley because wind velocities and therefore sand-transport rates are highest in this area and the watercourses that supply sediment have been subjected to considerable modification. Lancaster and others (1993) concluded that the northern Coachella Valley has been strongly affected by changes in sand supply and transport rates through the 20th century. They note that eolian transport rates were relatively high between 1948 and 1974, which is generally regarded as a period of prolonged drought, and lower thereafter, a period that is relatively wet but with highly variable conditions. Lancaster (1997) concluded that variations in precipitation and perennial vegetation on dunes control the eolian systems in the California Deserts. Although the extreme flood events needed to supply large amounts of fine-grained fluvial sediments to alluvial fans are extremely episodic, higher frequency variations in annual precipitation and particularly prolonged periods of climatic shifts – to either wetter or drier conditions – may strongly affect the stability of *Uma* habitat. In addition, development increased dramatically after the mid-1970s and human effects on trapping sand through windbreaks and altering the sand supply cannot be ignored.

METHODS

Quaternary Geologic Mapping

Geologic units of Quaternary age (last 2 million years) were mapped for the Desert Hot Springs and Seven Palms Valley quadrangles (scale 1:24,000) as part of ongoing studies under the Southern California Areal Mapping Project (SCAMP) of the U.S. Geological Survey (Lundstrom and others, 2001; and unpublished mapping of Lundstrom, R. Shroba and J. Matti). The geology of the study area previously was mapped at a scale of 1:250,000 as compiled by Rodgers

(1966), but he had little differentiation of Quaternary surficial geologic units. Similarly, Proctor (1968) provided a map of the Desert Hot Springs area at a scale of 1:62,500 and differentiated Pleistocene units from Holocene but provided no subdivisions within these eras.

Our mapping improves upon that of Proctor and Rodgers by using a larger scale map base as well as differentiating the ages of geomorphic surfaces within the Pleistocene and Holocene eras and by distinguishing the deposits by the geomorphic processes that resulted in their deposition. Mapping was based mostly on National Aerial Photography Project (NAPP) false-color infrared imagery (nominal scale of 1:40,000) from August 18, 1989, supplemented by National Historical Aerial Photography (NHAP) black-and-white imagery (scale of 1:80,000) from 1984. For the Indio Hills mapping, we used natural color aerial photography (scale of 1:24,000) flown on April 9, 1999. The descriptions of mapping units appears in Appendix 1; readers are referred to Birkeland (1974), McFadden (1982), and Cooke and others (1993) for more information on the use of soils geomorphology for age discrimination of geomorphic surfaces.

Climatic and Hydrologic Data

We analyzed existing precipitation and hydrologic data concerning the Coachella Valley and its watercourses to evaluate the hypothesis that climatic change affects *Uma* habitat in three ways: (1) by altering flood frequency, and thereby affecting sediment supply; (2) by increasing landscape roughness by increasing the amount and size of perennial native vegetation; and (3) by increasing the perennial vegetation in the vicinity of dunes, leading to increased stabilization. Monthly precipitation data were obtained from the Western Region Climatic Center in Reno, Nevada (www.wrcc.edu), and the University of California Philip L. Boyd Deep Canyon Desert Research Center (Mark Fisher, written commun., 2001). Discussions of standardization techniques for monthly and seasonal precipitation appear in Hereford and Webb (1992).

Streamflow gaging data from the U.S. Geological Survey were obtained from the California District of the Water Resources Division; gaging data availability for the northern Coachella Valley appears

in Appendix 2. Streamflow data is relatively sparse in this region, and most records are only 10-20 years in length. In addition, many of the stations on major watercourses have been moved, in some cases repeatedly. The Southern Oscillation Index (SOI), the most commonly used indicator of El Niño conditions in the equatorial Pacific Ocean, is regularly updated on various web sites; for more information on this index, see Webb and Betancourt (1992) and Cayan and Webb (1992).

Delineation of Drainage and Depositional Areas

Drainage areas of principal washes that contribute sediment to depositional areas upwind of the Coachella Valley reserves were hand drawn on 7.5-minute topographic maps and digitized (fig. 2). Drainage areas were calculated within a GIS and are given in table 1. Topographic information associated with the drainage areas was obtained from U.S. Geological Survey 30-m digital-elevation models.

Predevelopment, or historic, depositional areas were identified as late Holocene surfaces on the Quaternary geologic map. Active channels and current, or modern, depositional areas were determined by a combination of digitization of SPOT imagery provided by C.W. Barrows (written commun., 2001) and field evaluation. The Mission Creek – Morongo Wash depositional area in particular was determined as the entire area between the west splay of Mission Creek and the east splay of Morongo Creek north of Interstate 10 and south of the Banning (San Andreas) Fault (figs. 1 and 2). In March 2001, after a small flow on Mission Creek, sediment appeared to be recently deposited throughout this area, indicating reasonably active deposition even during modest floods. Because of these observations, we could not quantitatively evaluate whether some parts of the Mission Creek – Morongo Wash depositional area were more active than other parts. In both the predevelopment and modern eras, the boundaries of the Willow Hole depositional areas are difficult to map at a landscape scale and we chose not to formally delineate them.

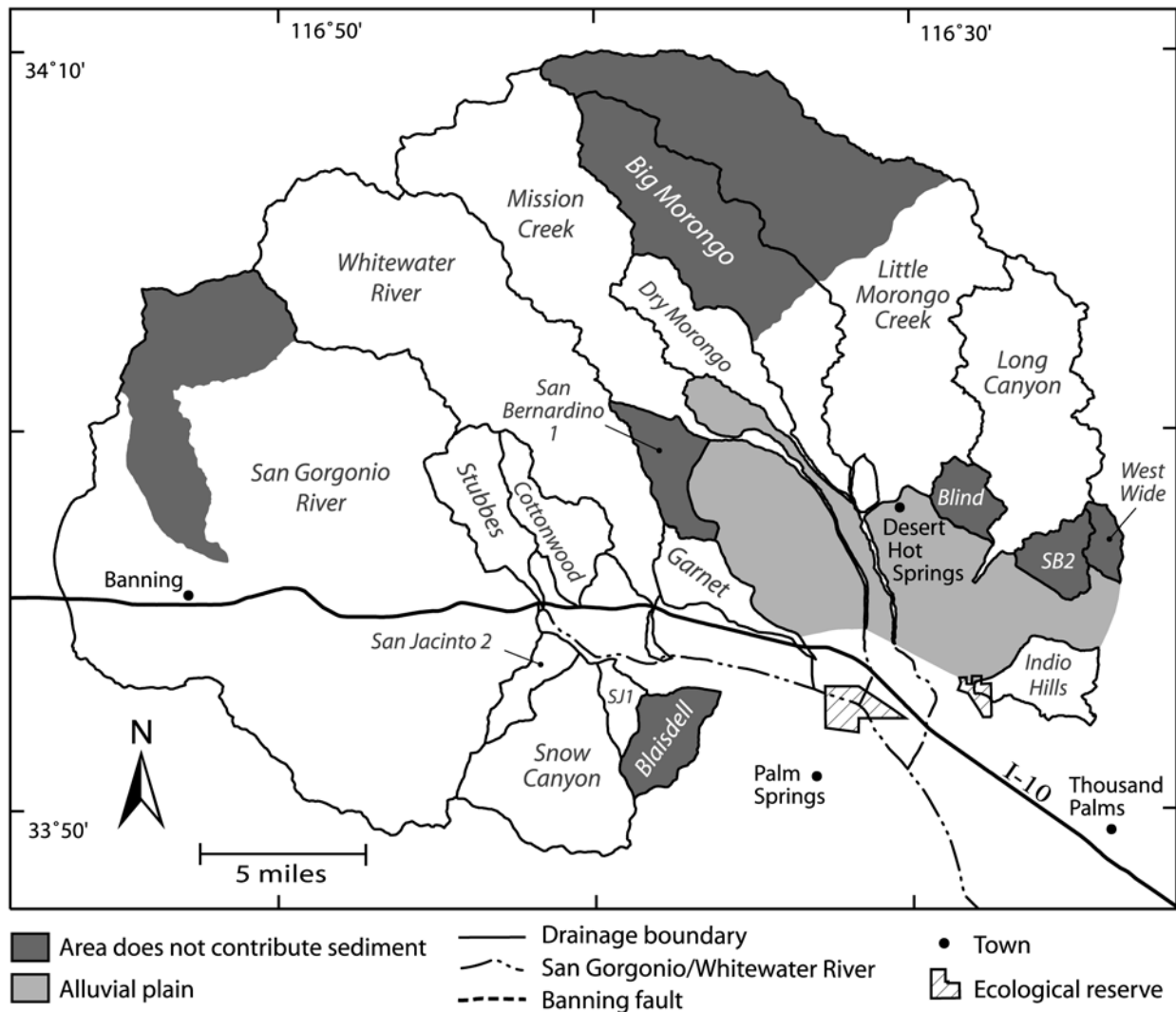


Figure 2. A. Drainage areas for principle watersheds contributing fluvial sediment to the northern Coachella Valley.

Fluvial Sediment Yield

Fluvial sediment yield (sediment moved by rivers) was analyzed using indirect techniques because little sediment-transport data has been collected in the study area (Appendix 2). We rejected standard approaches such as the Universal Soil Loss Equation (USLE; Wischmeier and Smith, 1978; Peterson and Swan, 1979), the CREAMS and WEPP models of the Agricultural Research Service (Knisel, 1980; Gilley and others, 1988), and the procedure outlined by the PSIAC (Pacific Southwest Inter-Agency Committee, 1968). The USLE was developed strictly for low-slope agricultural land and is not appropriate for the steep terrain of drainages entering the Coachella Valley.

Likewise, the CREAMS and WEPP models were developed for relatively low-slope agricultural and rangeland and require considerable watershed data for proper application. The PSIAC method involves rating a watershed on the basis of nine factors related to erosion (surface geology, soil, climate, runoff, topography, land use, upland erosion, and channel erosion/sediment transport) to produce an estimate of sediment yield. This method can be applied to large areas using pre-calculated PSIAC sediment-yield ratings mapped by the Soil Conservation Service (Soil Conservation Service, 1975). It generally produces high sediment-yield estimates in arid regions of high relief (Webb and others, 2000).

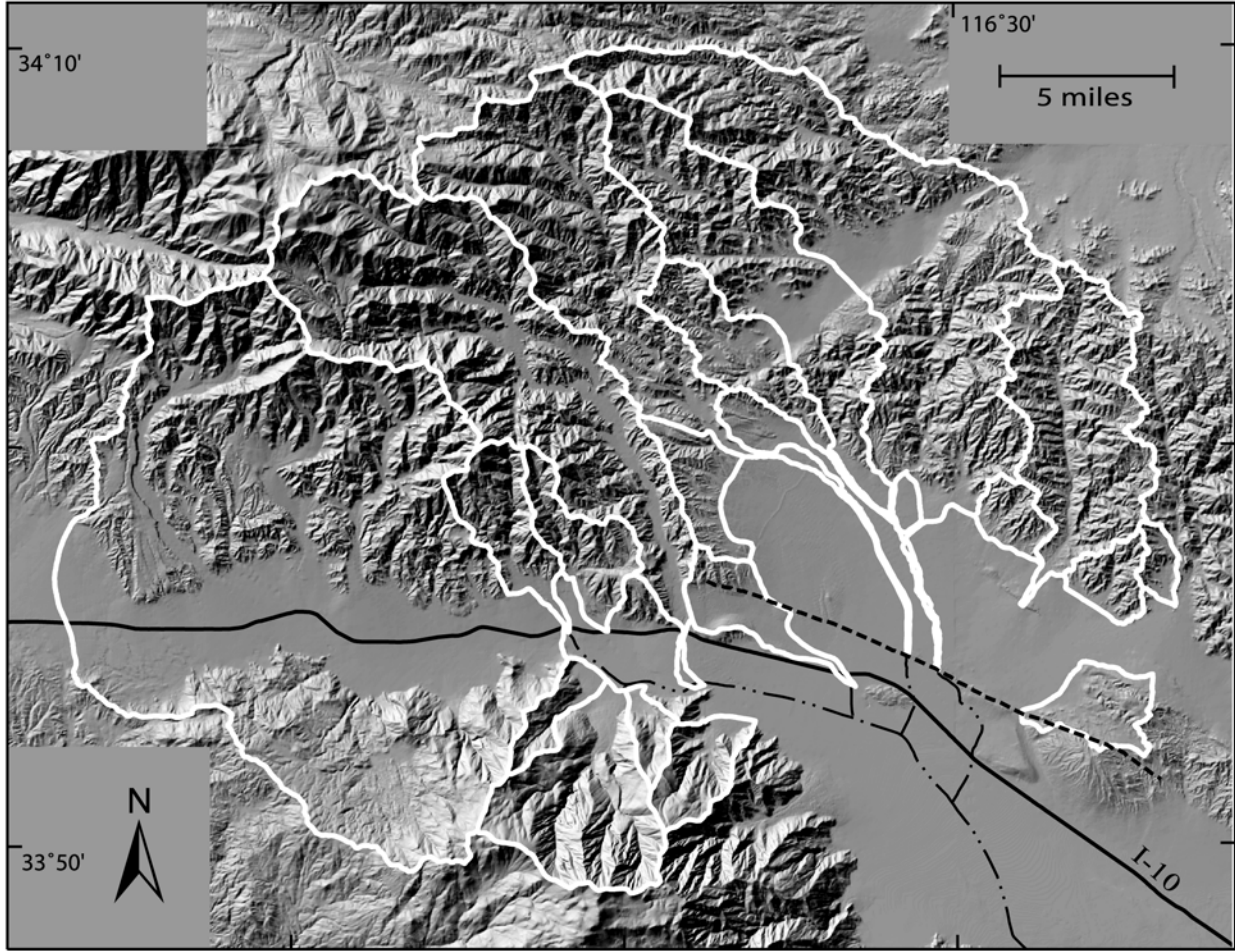


Figure 2. *Continued.*

B. The shaded relief map is based on a 30-m digital-elevation model of the northern Coachella Valley and the San Bernardino, Little San Bernardino, and San Jacinto Mountains. White lines indicate drainage boundaries.

The Power-Function Approach

The power-function method of estimating fluvial sediment yield is purely empirical and uses power functions fit to empirical data (*e.g.*, Renard, 1972). Some approaches include more-intensive statistical modeling (*e.g.*, Flaxman, 1972) and deterministic sediment-yield models that are data intensive (*e.g.*, Gilley and others, 1988). In places like the Coachella Valley, where little sediment data have been collected (Appendix 2), the best technique is to apply an empirical function from a similar region. For example, from the Colorado Plateau, one estimator based on regional data is of the form:

$$Q_s = 493 \cdot A^{1.04} \quad (2)$$

where

Q_s is sediment yield in short tons per year (t/yr), and

A is drainage area (mi²).

In relations of this type, sediment yield typically is a function of drainage area to a power close to 1.0, a nearly linear relation.

In the Coachella Valley, we elected to use the Renard (1972) equation, which, converted from units of volume to weight by assuming a sediment density of 0.0375 tons per cubic foot (t/ft³), is

$$Q_s = 895 \cdot A^{0.88}, \quad (3)$$

Table 1. Sediment source areas for the northern Coachella Valley.

Tributary	Area (mi ²)	Mean elevation (ft)	Depositional area ¹
San Gorgonio River ²	153.5	3612	San Gorgonio/Whitewater
Little Morongo Creek ³	67.7	3725	Mission/Morongo
Whitewater River	59.6	5540	San Gorgonio/Whitewater
Mission Creek	38.4	5488	Mission/Morongo
Big Morongo Creek ³	31.0	3988	Mission/Morongo
Long Canyon	26.3	3100	Willow Hole
Snow Canyon	19.3	5231	San Gorgonio/Whitewater
Dry Morongo Creek	10.7	3126	Mission/Morongo
Stubbes Canyon	8.4	3500	San Gorgonio/Whitewater
Cottonwood Canyon	7.5	2889	San Gorgonio/Whitewater
Garnet Wash	6.0	1407	San Gorgonio/Whitewater
Blaisdell Canyon ²	6.0	3101	San Gorgonio/Whitewater
“Indio Hills” ⁴	5.9	1132	Willow Hole
“San Bernardino 1” ⁴	5.8	2493	n.a.
“San Bernardino 2” ⁴	3.8	1748	n.a.
Blind Canyon	3.4	1835	Mission/Morongo
“San Jacinto 2” ⁴	3.4	2825	San Gorgonio/Whitewater
“San Jacinto 1” ⁴	2.4	2552	San Gorgonio/Whitewater
West Wide Canyon	1.9	2059	n.a.

¹na, not applicable; sediment does not reach deposition zones.

²Upper San Gorgonio River and Blaisdell Canyon do not supply sediment in the modern setting.

³Sediment from Upper Little Morongo and Upper Big Morongo Creeks does not reach deposition zones.

⁴Tributary has no official name.

where

Q_s is sediment yield in short tons per year (t/yr), and

A is drainage area (mi²).

Sediment yield (and therefore the sediment contribution) is estimated from the contributing drainage area alone. Other factors, such as variation in slope angle within the drainage area as well as elevational gradients in precipitation, are very important to sediment yield but are not considered in this approach because of lack of data. The Renard equation is based on watershed data collected in the southwestern United States and has been successfully applied to other arid landscapes of high relief in the southwest (Webb and others, 2000).

The Flood-Frequency, Rating-Curve Technique

We developed a flood-frequency, rating-curve technique to estimate streamflow sediment yield based loosely on the work of Strand (1975) and Strand and

Pemberton (1982). This technique requires numerous assumptions, one of the most important of which is that the decadal streamflow sediment yield in a tributary can be estimated by summing the sediment delivered by several floods of recurrence intervals described by regional flood-frequency relations (table 6; Thomas and others, 1997). Accordingly, we assumed that sediment yield can be calculated using:

$$Q_s = \Sigma[(m/n) \cdot \Theta(Q_n)] / m, \quad (4)$$

where

$\Theta(Q_n)$ is the sediment yield of a n^{th} year flood,
 m is the rarest flood return period (years) in the summation, and

n are the more frequent flood return periods (years) ranging irregularly from 2 to m .

We assumed that sediment yield could be calculated from an expected value for the number of floods to occur in a decade. This expected value

contains five 2-yr floods, two 5-yr floods, and one 10-yr flood which are thought to deliver most of the sediment in an arid region such as the Coachella Valley. We assume that the annual flood does not contribute significant sediment. Considering the intermittent-flow regime of these tributaries, which probably have flow less than one percent of the time, this is likely not an egregious assumption. Also, regional flood-frequency relations do not produce annual floods, so we have no means of determining the effect of neglecting the smallest events on ungaged tributaries, and we chose not to include the influence of long recurrence-interval floods in the analysis. The regional-regression equations reported by Thomas and others (1997) for the 2-year, 5-year, and 10-year floods in Region 10 (the Southern Great Basin Region, which includes the Coachella Valley) are listed in table 2.

In order to calculate sediment yield for an n-year flood, we derived two relations based on daily sediment data collected on the Whitewater River near Whitewater, California (10256000). Sediment-concentration data was collected daily from October 1, 1970, to September 30, 1972, with daily streamflow discharge ranging from 0.2 to 126 ft³/s (Appendix 2). The first relation was a sediment rating curve for that gaging station. Owing to evidence of channel change in the sediment data, data collected prior to December 21, 1971, was not used to calculate the rating curve. In addition, data for very low discharges (< 1.8 ft³/s) was clearly non-linear with a high degree of scatter and was also not used in the calculation of the rating curve relation. The rating curve relation took the form of:

$$Q_d = Q_a \cdot 10^b, \quad (5)$$

where

Q_d is sediment yield in short tons per year (t/yr),

Q is daily discharge in ft³/s, and

a, b are coefficients determined using linear regression.

We next calculated the relation between total event sediment yield and peak daily discharge for each of the 50 largest floods recorded at the Whitewater stream gage. The streamflow record is much longer than the sediment record, extending from October 1, 1948, to September 30, 1979 (Appendix 2). The 50 largest floods range between 59 and 4,970 ft³/s, with

Table 2. Regression equations for streamflow flood-frequency in Region 10 (Thomas and others, 1997).

Recurrence interval	Flood-frequency relation ¹
2-year flood	$Q_p = 12A^{0.58}$
5-year flood	$Q_p = 85A^{0.59}$
10-year flood	$Q_p = 200A^{0.62}$

¹ Q_p = peak discharge for flood (ft³/s); A = drainage area (mi²).

26 floods (52 percent) peaking at 126 ft³/s (the maximum flood in the sediment record). Total sediment yield for each flood event was calculated as the sum of all daily sediment yields for the duration of the flood. We then calculated the regression relation between peak discharge and total event sediment yield for each flood, resulting in an equation of the form:

$$Q(Q_p) = Q_p^a \cdot 10^b, \quad (6)$$

where

$Q(Q_p)$ is the total sediment yield for the flood in tons,

Q_p is peak daily flood discharge in ft³/s, and

a, b are coefficients determined empirically using regression techniques.

We used this final relation of peak discharge to total flood sediment yield to in the calculation of expected annual sediment yield from each tributary as expressed in (4).

Non-Contributing Drainage Areas

In estimating fluvial sediment yield, it became apparent that some drainage areas, although having the potential to produce sediment, do not deliver sediment to the main depositional areas on a regular basis. In the case of upper Little Morongo and upper Big Morongo Washes this is a factor of topography: sediment from these basins is mostly trapped in the low-gradient Morongo Valley and does not reach Coachella Valley (fig. 2). Other drainage areas – San Bernardino 1, Blind Canyon, and San Bernardino 2 – are too small to generate streamflow sufficient to move sediment across the alluvial fans. This is evident from the absence of significant channels or areas of Late Holocene sediment at the mouths of these tributaries. In the modern era, man-made impediments prevent the delivery of sediment from both the upper San Gorgonio

River, which feeds into a gravel pit near the town of Banning, and Blaisdell Canyon, which is cut off from the Whitewater depositional area by California Highway 111 (figs. 1 and 2). Similarly, flood control projects at the mountain front of the Little San Bernardino Mountains eliminate West Wide Canyon as a sediment source, although whether it was ever a significant source of sediment is unknown. These tributaries and sub-tributaries were deemed non-contributing and were not included in sediment-yield estimates.

Particle-Size Distributions

To evaluate the fraction of streamflow sediment yield that is of the appropriate particle size for use by *Uma*, we collected samples of streamflow sediment from most of the prominent stream channels in the study area (fig. 3). Most of these channels consisted of left and right overbank areas, which are typically inundated during most floods, as well as the center of the channel. In most cases, we collected samples from the left and right overbank areas as well as the center of the channel. For sediment particle sizes, we use the standard unit ϕ , defined as

$$\phi = \log^2 (D), \quad (7)$$

where D is the diameter, in millimeters, of the intermediate axis, also known as the b -axis (Folk, 1974). After sieving and analysis, the samples were composited into one sample for each channel cross section sampled.

The samples were oven dried and sieved following standard techniques (Kellerhals and Bray, 1971; Folk, 1974) using brass sieves at 1ϕ intervals and a rotational shaker. Particles retained on each screen were weighed and the percent of the subsample in each ϕ class determined and combined to yield a channel-averaged particle-size distribution.

Historical Wind Energy and Direction

The primary source of wind data used for this report was the weather station at Palm Springs International Airport; additional data were obtained for Thermal, California and Edom Hill (fig. 1). Neither the Palm Springs nor the Thermal stations are truly

representative of wind on the two reserves – Palm Springs is south of the study area and is slightly south of the main wind jet from San Geronio Pass, and Thermal is 25 miles southeast of Edom Hill and about 25 miles east southeast of Palm Springs International Airport – but these are the only available records of suitable length. Wind data collected at Palm Springs and Thermal from 1992 to May 2001 were analyzed. These data are available from the Western Region Climate Center. The Edom Hill data are of limited extent, with only the data collected in 2001 sufficiently complete (90 percent). Data from Edom Hill were collected by SeaWest on the western slopes of Edom Hill just east of Varner Road. These data are very well situated for directional analysis with regard to the Mission Creek – Morongo Wash depositional area, but are not applicable to any other depositional area.

Before 1998, observations at Palm Springs were made only 18 hours a day (6 am-12 am) and data availability averages about 67 percent. Starting in February 1998, observations were made on a 24-hr basis and data availability increases to about 95 percent. One result of this change in instrumentation is that the magnitude of the sand drift potential changes significantly after February 1998 and is reduced by a factor of 3.6, apparently because the new system appears to provide generally lower hourly average wind speeds. The other impact of this change is that there are differences in recorded wind directions, so that the vector direction of the sand-transport potential changes by approximately 30° . Because of these uncertainties, we have concentrated our analysis on the more recent continuously recorded data that began in 1998.

Wind directions at Palm Springs International Airport and Edom Hill were summarized by calculating the percentage of observations that fall within each of the sixteen standard compass directions, such as “west” or “west southwest.” This results a division of the compass into sixteen intervals, or sectors, of 22.5° each. Frequency values were calculated for all winds measured as well as for only sand-transporting winds. Sand-transporting winds are defined as those winds that exceed the minimum velocity necessary to transport sand at a given location. This threshold velocity varies between Palm Springs and Willow Hole owing to differences in the height at which winds are measured.

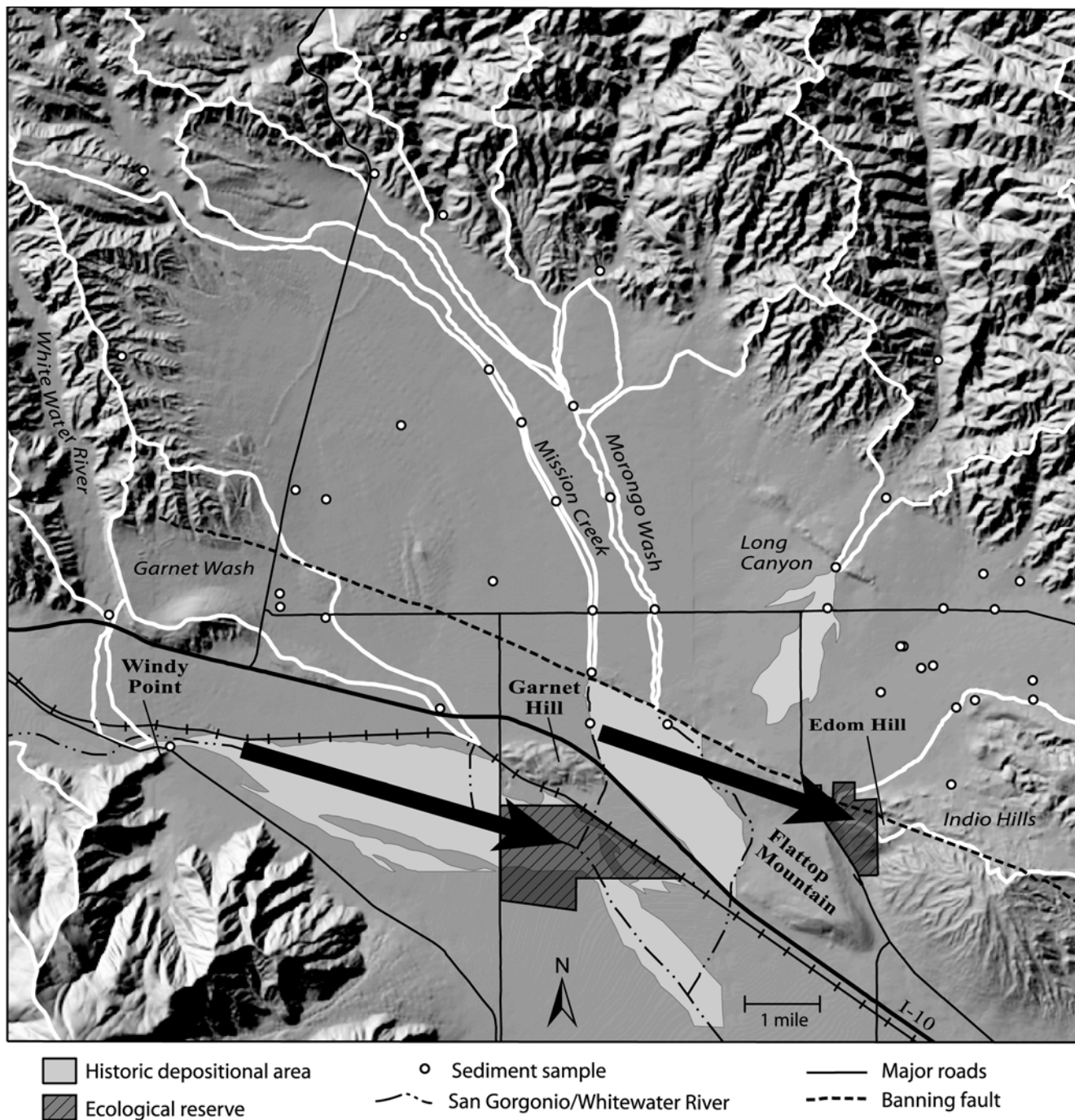


Figure 3. Shaded relief map of the northern Coachella Valley showing general paths of eolian transport from areas of fluvial deposition to the Whitewater Floodplain and Willow Hole Reserves and locations of sampled fluvial sediment. White lines indicate drainage boundaries.

Because the Edom Hill wind data were collected at the approximate center of the Willow Hole Reserve, wind-direction frequency derived from these data for a given compass sector can also be used as a measure of the percent frequency of time – expressed as a probability – that winds crossing that sector in the neighborhood of the Reserve are headed directly toward the center of the Reserve. For example, if winds at Edom Hill come from the North sector 7.3 percent of the time, then, conversely, winds across the Northern sector will be headed directly toward Edom Hill 7.3 percent of the time. We applied this principle to the Mission Creek – Morongo Wash depositional area for sand-transporting winds, presenting the frequency with which sand-transporting winds are headed directly towards the center of Willow for each sector that crosses the depositional area. For increased resolution over the depositional area, we recalculated frequencies for smaller 10° sectors, which resulted in seven sectors between 235° and 305° crossing the Mission – Morongo depositional area. These frequencies reflect the probability that a sand-transporting wind can deliver sand to the Reserve from each sector in the Mission Creek – Morongo Wash depositional area and give one measure of the relative value of different parts of the Mission Creek – Morongo Wash depositional area as it relates to sand transport to Willow Hole. Slight differences in summed percentages result from the differences between defining 22.5° and 10° sectors and the accuracy with which the original wind data were collected.

Sand-Transport Potential

Sand-transport potential is a measure of how much sand can be transported by the wind, assuming that: (1) there is a supply of sand for transport by wind and (2) this sand is available for transport. That is, the surface is not protected by vegetation, the sand is dry, and the surface is not crusted (Kocurek and Lancaster, 1999).

A commonly-used method for analyzing wind data was developed by Fryberger (1979). This method assigns a weighting to the measured wind speed based on how much it exceeds a threshold velocity for transport to estimate a potential sand transport rate (q). Thus:

$$q = V^2 (V - V_t) \cdot t, \quad (8)$$

where

q is the sand transport potential in arbitrary velocity units (VU),

V is the wind speed,

V_t is the threshold wind speed for sand transport at the height of the wind recorder, and

t is the percentage of the time the wind blows from a given direction.

Values of q are calculated for each wind speed class and summed to estimate a sand drift potential (DP) in vector units for all winds above threshold at a given location. In addition, a vector sum (resultant drift potential, or RDP) and direction is calculated for sand transport potential.

Fryberger (1979) presented a classification scheme in which the DP of a location could be grouped into low-, intermediate-, and high-energy environments based on values of the drift potential (DP). For a station where wind speed is measured in knots (1 nautical mile/hour), low-energy environments have a $DP < 200$, intermediate-energy environments have $200 < DP < 400$, and high-energy environments have $DP > 400$.

The Dune Mobility Index

Whether or not eolian dunes are expected to be mobile or stable under specific wind regime and climatic conditions can be calculated as a function of wind conditions and climate. The dune mobility index (M) is calculated as:

$$M = W / (P/PE), \quad (9)$$

where

W is the percentage of the time that the wind is above the threshold for sand transport,

P is the annual precipitation (mm),

PE is the threshold wind speed at the height of the wind recorder, and

t is the annual potential evapotranspiration (mm) calculated using the Thornthwaite method (Thornthwaite and Mather, 1957).

Threshold values of the mobility index are: $M < 50$, dunes are inactive (stabilized by vegetation); $50 < M < 100$, only crests of dunes are active;

100<M<200, dunes are active but lower slopes are vegetated; and >200, dunes are fully active (Lancaster and Helm, 2000).

Historical Changes in Eolian Deposits

Following Lancaster and others (1993), we analyzed aerial photography taken in various years to evaluate changes in the spatial extent of eolian deposits (table 3). Aerial photography was analyzed in a geographical information system (GIS) by georeferencing the aerial photography to 7.5' topographic maps. Using these techniques, we have revisited the findings of Lancaster and others (1993) and also qualitatively assessed the areas of active sand in the vicinity of the two reserves and extended the temporal coverage of these eolian systems.

A CONCEPTUAL MODEL OF THE SAND-DELIVERY SYSTEM IN THE NORTHERN COACHELLA VALLEY

This section provides a qualitative description of the sand-delivery system that ultimately produces the eolian habitats in the northern Coachella Valley. Basic geomorphic terms and the elements of the delivery system are defined for clarity and for use in later sections. The sections that follow will provide quantitative estimates of fluvial and eolian transport that logically follow from this conceptual model.

Sand-size particles that eventually become eolian sand in the northern Coachella Valley are generated in the headwaters and steep areas of the San Jacinto, San Bernardino, and Little San Bernardino Mountains. Most sediment is produced on steep slopes at higher elevations in these mountains, where precipitation is more than five times greater than precipitation on the valley floor (table 4). Floods are of higher magnitude below 7,500 ft elevation (Thomas and others, 1997), primarily because most precipitation at higher elevations falls as snow in winter or gentle rainfall in other seasons. Development has not affected sediment sources significantly because most of the areas where sediment is produced is currently under federal or state management. The alluvial fans that coalesce to form the Desert Hot Springs bajada produce insignificant amounts of sediment from most of their surfaces because of the low precipitation, the sandy substrate that readily absorbs rainfall, and the low slope angle of the fan surface.

Sediment is transported from headwaters to depositional areas in Coachella Valley in episodic streamflow floods that are not necessarily even annual in recurrence. Channels through the alluvial fans in the northern Coachella Valley are mostly sediment conduits with little change in storage. Some of these channels, particularly Mission Creek and Morongo Wash, were naturally channelized because the south branch of the Banning (San Andreas) Fault crosses both washes (figs. 2b and 3). Vertical fault offsets prehistorically created nickpoints that migrated upstream on both Mission Creek and Morongo Wash, creating entrenched channels known as arroyos.

Table 3. Aerial photography of the Whitewater and Willow Hole Reserves used to analyze historical changes in eolian deposits.

Photo year	Series title	Date of photograph	Number of photographs	Type of photograph ¹	Photo scale	Coverage of Whitewater?	Coverage of Willow Hole?	Comments
1996	USGS Orthophotos	June	4	Digital	1:12,000	Yes	Yes	1m pixels
1989	USGS NAPP	7/25, 8/16	9	CIR	1:40,000	Yes	Yes	
1984	USGS NHAP	8/24	4	CIR	1:58,000	Yes	Yes	
1979	Oblique	11/15	1	B&W	n.a. ²	Yes	Yes	one oblique
1977	7	2/4	1	B&W	1:40,000	Partial	Partial	single photo
1972	472	8/17	9	B&W	1:40,000	Yes	Yes	
1965	Universe Special	unknown	2	B&W	1:24,000	No	Yes	
1959	AXM-6W & 10W	June	9	B&W	1:20,000	Yes	Yes	
1953	AXM-1K, 3K, 9K, & 10K	8/19, 9/19, 10/24	22	B&W	1:20,000	Yes	Yes	
1939	C6060	12/7	4	B&W	1:18,000	No	Yes	

¹Digital, orthophotographs derived from aerial photography; CIR, color infrared; B&W, black-and-white aerial photography.

²A scale is not applicable because the photograph is oblique.

Table 4. Mean and range in annual precipitation at selected long-term stations in or near the Coachella Valley, California.

Location	Elevation (ft)	ANNUAL PRECIPITATION ¹		
		Annual	Minimum	Maximum
Idyllwild Fire Department	5,400	26.09	10.60	56.87
Big Bear Lake	6,760	22.44	6.99	55.76
Deep Canyon	800	5.78	1.37	18.82
Palm Springs	420	5.00	0.76	13.72

¹Data are from Western Region Climate Center (period of record through 2000), except for University of California Philip L. Boyd Deep Canyon Research Center (M. Fisher, Deep Canyon Preserve, written commun., 2001).

Downstream from the confluence of the San Gorgonio and Whitewater Rivers, and particularly downstream (east) from Windy Point, the Whitewater River channel broadens into what historically was a depositional plain more than a mile in width. This flat depositional plain historically had several channel splays with low banks and may have originated from prehistoric debris-flow deposition. The combined floodwaters of the San Gorgonio and Whitewater Rivers debouch onto the depositional plain, depositing fluvial sediments in a low-energy environment (fig. 3). Because little non-anthropogenic topography is present on these floodplains, fluvial sediments can be assumed to be deposited evenly over the area instead of in discrete packets of relatively thick floodplain deposits as occurs on more entrenched rivers.

Sediment is entrained from the Whitewater depositional area by the unidirectional wind field and is moved across eolian plains downwind from the depositional areas (fig. 3). Much of this eolian transport is unimpeded across the Whitewater Floodplain Reserve, but flow on the north and south sides of the depositional area and the Reserve is influenced by local obstructions. Interruptions in a continuous fetch by buildings, windbreaks, or small or large dikes will create local windbreaks that store eolian sand. Because of this, the windbreaks, as well as raised roadbeds of both the railroad and Interstate 10, interrupt the flow of sand from the Whitewater flood plain, likely storing much of that sand along the windbreaks and embankments and diverting some of it towards the southeast. Other artificial features, such as excavations on the south side of Garnet Hill and recharge and flood-

control levees, create sand-storage sites on their lee (downwind) sides even if sand does not overtop the surface.

The Mission Creek – Morongo Wash depositional area is bounded on the north by the vertical offset of the south branch of the San Andreas Fault, which creates a natural channelization of these water courses upstream (fig. 3). Downstream from the fault, and upstream from the embankments and dikes associated with Interstate 10, floodwaters spread over a broad floodplain with little significant topography other than local bar-and-swale features. This depositional area is bounded on the west by the westerly splay of Mission Creek and on the east by the main splay of Morongo Creek at the footslope of Flattop Mountain (fig. 3). Dikes associated with the raised roadbed of Interstate 10 enhance deposition on this floodplain because floodwaters are forced to pass under the freeway at relatively constricted culverts.

Eolian sand is entrained from the Mission Creek – Morongo Wash depositional area in the same manner as from the Whitewater depositional area. The prevailing wind direction is westerly and impinges directly upon Flattop Mountain and a low pass just north of this hill. Flattop Mountain has a gentle slope on its west side, possibly shaped by wind erosion, and this slope allows sand transport over the hill and into the Willow Hole Reserve and to another deposit locally known as Stebbins Dune. During very intense windstorms, and presumably when fluvial sediment is not limiting, some eolian sediment is swept over the Willow Hole Reserve area and is transported onto the hillslopes of the Indio Hills drainage to the north of Edom Hill. Certainly urbanization and the introduction of windbreaks – particularly *Tamarix* trees – has reduced the amount of eolian sand transported by an unknown amount. However, many windbreaks were in place by 1925, and aerial photography since then indicates that a substantial amount of sand has still been transported over Flattop Mountain and into Willow Hole.

Historically, Long Canyon deposited sediment across a two-mile long area stretching south from the mouth of the canyon across the Hot Springs bajada (fig. 3). With the Willow Hole Reserve positioned slightly east of south from this depositional area, only a small fraction of available sand likely would have been transported directly to the Reserve in the prevailing winds. Predominantly westerly winds transport most eolian sand either along the northern edge of the Indio

Hills or into the Indio Hills drainage north of Edom Hill. That the Indio Hills drainage acts as a trap for eolian sand from fluvial deposits to the west is evidenced by the deposits of eolian sand several yards thick that blanket the hillslopes of this area. Much of this sand was likely deposited during the Pleistocene, but sand may still be transported from the Mission – Morongo area during very intense windstorms, as well as from the Long Canyon area. Trapped in a fluvial source area, this eolian sand is recycled into the system as fluvial sediment, entrained and transported out of the Indio Hills drainage during intense summer thunderstorms. Historically, this sediment was deposited locally within the Willow Hole Reserve, where it was available for local redistribution by eolian processes. However, recent storms have entrenched the channel through Willow Hole with the result that much of the fluvial sediment is now deposited just outside the southern boundary of the Reserve where the channels are less entrenched. This material has the potential to be carried back into the Reserve by eolian processes only if sufficient southerly winds occur along the topographic low between Flattop Mountain and the western end of the Indio Hills (fig. 3).

FLUVIAL SEDIMENT TRANSPORT

Quaternary Geologic Units

The Desert Hot Springs bajada is comprised of a mosaic of geomorphic surfaces of Pleistocene and Holocene age (fig. 4). This mosaic is useful for evaluating the potential sediment contributions from the Desert Hot Springs bajada to the depositional areas of Whitewater River and Mission Creek – Morongo Wash. A total of 15 mapping units were identified on this bajada (table 3); descriptions of these units are given in Appendix 1.

Active channels and depositional areas (**Qayy**) comprise 22.3 percent of the mapped bajada area (table 5), and much of this area defines the Whitewater, Mission Creek – Morongo Wash, and Long Canyon depositional areas. These areas are considered to be the most significant to the sand-delivery system of the northern Coachella Valley. Most of the bajada (50.1 percent) is mapped as young fan alluvium of both Holocene and latest Pleistocene age (**Qay**). Units of early Holocene to Pleistocene age comprise 18.1

Table 5. Quaternary geologic units of the Desert Hot Springs and Seven Palms Canyon 7.5' quadrangles, California.

RANKED BY AGE			RANKED BY SURFACE AREA		
Quaternary unit	Area (mi ²)	Coverage (percent)	Quaternary unit	Area (mi ²)	Coverage (percent)
Afd	1.0	1.0	Qay	48.3	50.1
Qd	0.5	0.5	Qayy	21.5	22.3
Qe	5.4	5.6	Qe	5.4	5.6
Qayy	21.5	22.3	Qai	4.8	5.0
Qayi	2.4	2.5	Qayo	4.1	4.2
Qay	48.3	50.1	Qao	3.1	3.3
Qayo	4.1	4.2	Qayi	2.4	2.5
Qfy	0.7	0.7	Qtps	2.0	2.1
Qaiy	0.7	0.7	Qtpc	1.1	1.2
Qai	4.8	5.0	Afd	1.0	1.0
Qao	3.1	3.3	Qaiy	0.7	0.7
Qau	0.7	0.7	Qfy	0.7	0.7
Qcf	0.2	0.2	Qau	0.7	0.7
Qtpc	1.1	1.2	Qd	0.5	0.5
Qtps	2.0	2.1	Qcf	0.2	0.2

percent of the alluvial fans. These units, combined with **Qay**, likely produce little fluvial or eolian sediment that reaches the depositional areas for reasons of low precipitation, high infiltration rates, and low slope angles. Reflecting the ephemeral nature of eolian deposits in this part of the Coachella Valley, only 6.1 percent of the area was mapped as eolian sand (**Qe**) or sand dunes (**Qd**). Most of these units are in the southeast corner of the mapped area in the Willow Hole Reserve (fig. 4). Despite this, **Qayy** and **Qay** units on the south edge of the mapping area (fig. 4) historically have had significant ephemeral dune migration across their surfaces.

Fluvial Sediment Yield and Delivery

Flood-Frequency, Rating-Curve Relation

The sediment rating curve calculated for the Whitewater River near Whitewater took the form:

$$Q_d = Q^{2.72} \cdot 10^{-1.21}, \quad (10)$$

where

Q_d is the daily sediment yield (t/day), and

Q is the daily flood discharge (ft³/s).

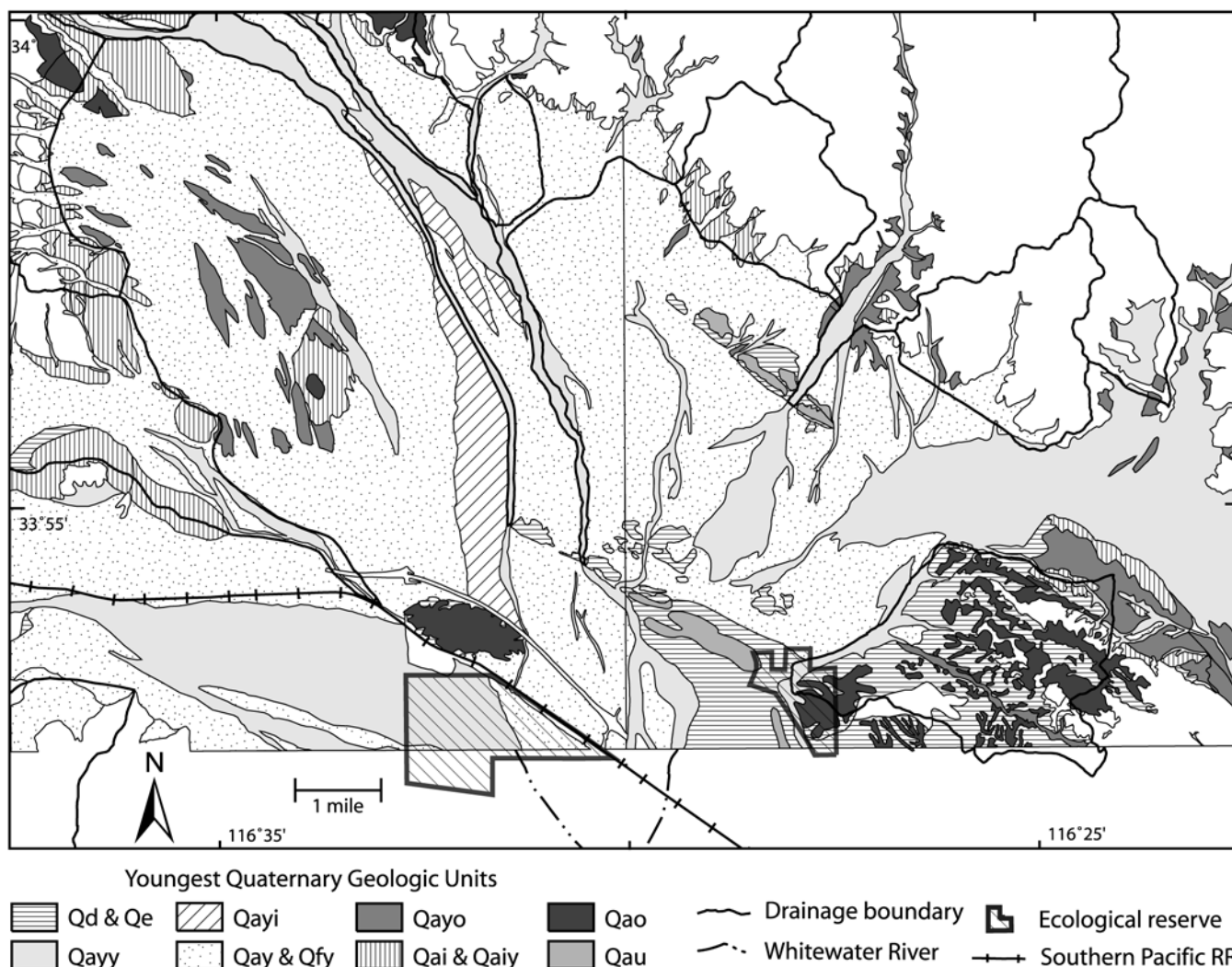


Figure 4. The eleven most recent Quaternary geomorphic surfaces and deposits in the Desert Hot Springs and Seven Palms Valley 7.5' Quadrangle Maps in the northern Coachella Valley, California (Lundstrom and others, 2001). See Appendix 1 for a description of map units.

R^2 is 0.90 for this rating curve, indicating a high degree of relation between streamflow discharge and sediment yield (fig. 5). Using this relation to calculate total event yield for the 50 largest floods on the Whitewater River, we derived the relation between event sediment yield [$\Theta(Q_p)$] in tons/yr and peak discharge (Q_p) in ft^3/s as:

$$\Theta(Q_p) = Q_p^{2.751} \cdot 10^{-1.092}. \quad (11)$$

R^2 for this relation is 0.91. Equation (11) was used in combination with flood frequency relations (table 2) to estimate annual sediment yields for drainages contributing sediment to the northern Coachella Valley.

Sediment-Yield Estimates

Sediment-yield estimates calculated using the flood-frequency/rating-curve technique (equation (11)) were in reasonably close agreement with those calculated using the Renard (1972) relation (equation (3)), being of the same order of magnitude and consistently twice the quantity (table 6). Estimates from both techniques are given in the tables to provide minimum and maximum estimates of sediment yield. For simplicity, the following discussion and analysis will only use the estimates based on Renard (1972).

Sediment yield to the Whitewater depositional area in the modern era is slightly less than in the predevelopment period owing to the absence of the

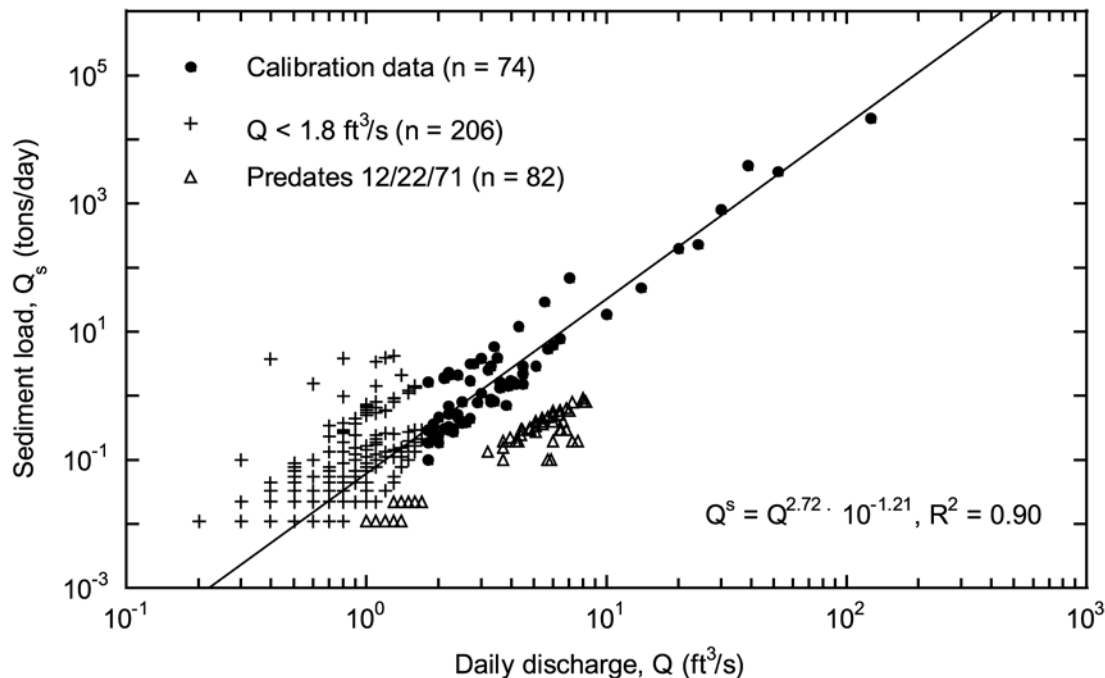


Figure 5. Sediment-rating curve for the Whitewater River near Whitewater, California (station number 10256000). Daily sediment samples were collected between October 1, 1970, and September 30, 1972

upper San Gorgonio River and Blaisdell Canyon as sources of sediment. The in-stream mining operation on the upper San Gorgonio River appears to reduce sediment yields in the entire San Gorgonio basin by 14 percent (table 6). Reflecting differences in drainage area, the volume of sediment delivered to the Whitewater depositional area at 3.5 million ft³/yr is roughly double that delivered to the Mission Creek – Morongo Wash depositional area at 1.5 million ft³/yr. Long Canyon delivers 0.42 million ft³/yr and the Indio Hills drainage area 0.11 million ft³/yr. Actual sediment yield from the Indio Hills may be higher than this estimate due to the abundant loose sediment available on hillslopes in these drainages.

Sediment yield from the non-channel area (all but **Q_{ayy}**) of the Desert Hot Springs bajada, also calculated using the Renard (1972) relation, is an estimated 0.74 million ft³/yr (table 6), or about 12 percent of the total estimate for all tributary drainage areas. The flood-frequency, rating-curve technique for estimating sediment yield could not be applied to these poorly-defined drainage areas. However, the estimate using the Renard equation should be considered a maximum value, at best, because the sediment-yield

relation used was developed for an area with more than twice the mean annual precipitation than occurs on the alluvial fans.

Most sediment production occurs in high-relief parts of the San Bernardino, Little San Bernardino, and San Jacinto Mountains. On average, 56 percent of the area of contributing drainages has a ground slope in excess of 30 percent (table 7), with an additional 27 percent having a slope of 10 to 30 percent. The steepest drainages, such as Snow Canyon, which heads at San Jacinto Peak (10,804 feet), can have more than 80 percent of their area steeper than a 30 percent slope. In contrast, 95 percent of the alluvial fans have less than a 10 percent slope (table 7), and sediment production would be expected to be much lower than from the steeper mountain drainages. This interpretation is supported by the Quaternary geologic mapping, which labels most of the alluvial fans as alluvium that dates to as long ago as the late Pleistocene (**Q_{ay}**), in contrast to the younger, more active sediment of the tributary channels (**Q_{ayy}**; fig. 4).

Table 6. Estimates of sediment yield from drainages entering the northern Coachella Valley for historic (predevelopment) and modern periods.

Tributary	HISTORIC SEDIMENT YIELD ¹ (10 ⁶ · ft ³ /yr)			MODERN SEDIMENT YIELD ¹ (10 ⁶ · ft ³ /yr)		
	Drainage area (mi ²)	Renard (1972) equation	Flood-frequency method	Drainage area (mi ²)	Renard (1972) equation	Flood-frequency method
San Gorgonio/Whitewater depositional area						
San Gorgonio River ²	154	2.1	3.3	132	1.8	2.5
Whitewater River	60	0.87	1.5	60	0.87	1.5
Snow Canyon	19	0.32	0.78	19	0.32	0.78
Stubbes Canyon	8	0.16	0.47	8	0.16	0.47
Cottonwood Canyon	7	0.14	0.44	7	0.14	0.44
Garnet Wash	6	0.11	0.38	6	0.11	0.38
Blaisdell Canyon ³	6	0.11	0.38	0	0	0
San Jacinto 2	3	0.069	0.27	3	0.069	0.27
San Jacinto 1	2	0.051	0.22	2	0.051	0.22
TOTAL	266	3.9	7.8	238	3.5	6.6
Mission/Morongo depositional area						
Mission Creek	38	0.59	1.18	38	0.59	1.18
Little Morongo (lower)	34	0.54	1.10	34	0.54	1.10
Dry Morongo	11	0.19	0.55	11	0.19	0.55
Big Morongo (lower)	9	0.16	0.49	9	0.16	0.49
TOTAL	92	1.5	3.3	92	1.5	3.3
Long Canyon depositional area						
Long Canyon	26	0.42	0.94	26	0.42	0.94
Willow Hole depositional area						
Indio Hills	6	0.11	0.38	6	0.11	0.38
TOTAL (all drainage areas)	390	6.0	12.4	362	5.5	11.2
Alluvial fans	49	0.74	—	49	0.74	—

¹Estimates have been converted from mass to volume by assuming a sediment density of 0.0375 tons/ft³.

²The San Gorgonio River above Banning, California, does not contribute sediment in the modern era.

³Blaisdell Canyon does not contribute sediment in the modern era.

Historical Changes in the Size of the Depositional Areas

Fluvial sediment from each contributing drainage area is deposited onto one of four depositional areas (figs. 3 and 6, table 6). The nine westernmost tributaries deposit sediment downstream from the confluence of the San Gorgonio and Whitewater Rivers in the Whitewater depositional area, which extends from Windy Point to the east and from the railroad south (figs. 3 and 6). Immediately to the east, Mission Creek and Morongo Wash (a composite of three drainages) deposit in an area between the west splay of Mission Creek and the east splay of Morongo Creek

north of Interstate 10 and south of the Banning (San Andreas) Fault (figs. 3 and 6). Long Canyon deposits at a third area, stretching southwest from the mouth of the wash onto the Desert Hot Springs bajada. Sediment from the Indio Hills tributary was historically deposited directly into Willow Hole and the Willow Hole Reserve. As stated previously, recent storms have channelized the reach through Willow Hole, causing sediment to be deposited outside the southern boundary of the Reserve and temporarily decreasing the potential for eolian additions directly from the channel. This poorly defined area was not evaluated as a distinct depositional area.

Table 7. Slope classes of sediment source areas and alluvial fans in the northern Coachella Valley.

Tributary	DRAINAGE AREA IN SLOPE CLASS (percent)			
	Drainage area (mi ²)	> 30 percent slope	10 - 30 percent slope	< 10 percent slope
San Gorgonio River	153.5	46	22	32
Little Morongo	67.7	63	25	13
Whitewater River	59.6	78	14	8
Mission Creek	38.4	74	19	7
Big Morongo	31.0	62	21	17
Long Canyon	26.3	73	24	4
Snow Canyon	19.3	84	10	6
Dry Morongo	10.7	54	31	15
Stubbes Canyon	8.4	78	12	10
Cottonwood Canyon	7.5	70	22	9
Garnet Wash	6.0	11	28	62
Blaisdell Canyon	6.0	77	15	9
“Indio Hills” ¹	5.9	8	50	42
“San Bernardino 1” ¹	5.8	37	47	16
“San Bernardino 2” ¹	3.8	55	30	15
Blind Canyon	3.4	52	39	9
“San Jacinto 2” ¹	3.4	69	11	20
“San Jacinto 1” ¹	2.4	69	17	14
West Wide Canyon	1.9	49	31	20
MEAN	–	56	27	17
Alluvial fans	49.3	1	4	95

¹Tributary has no official name.

Before the construction of infiltration galleries, retention dikes, railroad, and major highways (the predevelopment period), the areal extent of the three main depositional areas strongly reflected the amount of annual sediment deposited in each zone (tables 6 and 8; fig. 6a). The historic Whitewater depositional area received roughly three times the sediment received by the Mission Creek–Morongo Wash depositional area and was about 2.5 times larger (7 mi² as opposed to 3 mi²). Similarly, the Mission Creek–Morongo Wash depositional area received roughly three times the sediment deposited in the Long Canyon depositional area and was also about three times larger (3 mi² as opposed to 1 mi²).

In the modern era, the extent of two depositional areas – the Whitewater and Long Canyon depositional areas – has been reduced by alteration of channels and

Table 8. Change in depositional areas upwind of reserves in the Northern Coachella Valley

Depositional area	Historic area (mi ²)	Modern area (mi ²)	Change (mi ²)	Change (percent)
San Gorgonio/ Whitewater	7.1	3.6	-3.5	-49.2
Mission/Morongo	2.7	2.7	0	0
Long Valley	1.1	0.2	-0.9	-80.2
TOTAL	10.8	6.5	-4.3	-40.1

floodplains (fig. 6b, table 8). The Whitewater depositional area has been reduced by nearly 50 percent to 3.6 mi² by the installation of the infiltration galleries along the south edge of the river (fig. 6b). These galleries necessarily trap fluvial sediment, which is then unavailable for eolian transport owing to the geometric arrangement of the galleries perpendicular to wind direction. In addition, there is a loss of fetch area between the infiltration galleries and the reserve; the Whitewater depositional area has been reduced to a thick band along what was the northern edge of the river. Similarly, the Long Canyon depositional area has been truncated by major roads on three sides, reducing depositional area by over 80 percent to 0.2 mi². Although small culverts pass beneath the roads, most sediment appears to be effectively trapped within the reduced depositional area unless flow substantially overtops the roads.

The modern Mission Creek – Morongo Wash depositional area is approximately the same size as the historic area. Dikes associated with Interstate 10 and railroad construction limit the depositional area to mostly north of the freeway and reduce the connectivity with the Whitewater depositional area. Because these washes fan out over a broad depositional area upstream from the freeway dikes, most habitat-building sand is likely deposited in a position that makes it available for eolian transport. This condition may have been the case in the predevelopment period.

Depth of Deposition

After converting sediment-yield estimates from mass to volume, we distributed fluvial sediment over the three historic depositional areas, both as a check on the magnitude of the fluvial sediment yields and to determine if prevailing winds could entrain this amount of sediment. The depth of fluvial sediment deposited in the historic period is very consistent among the three

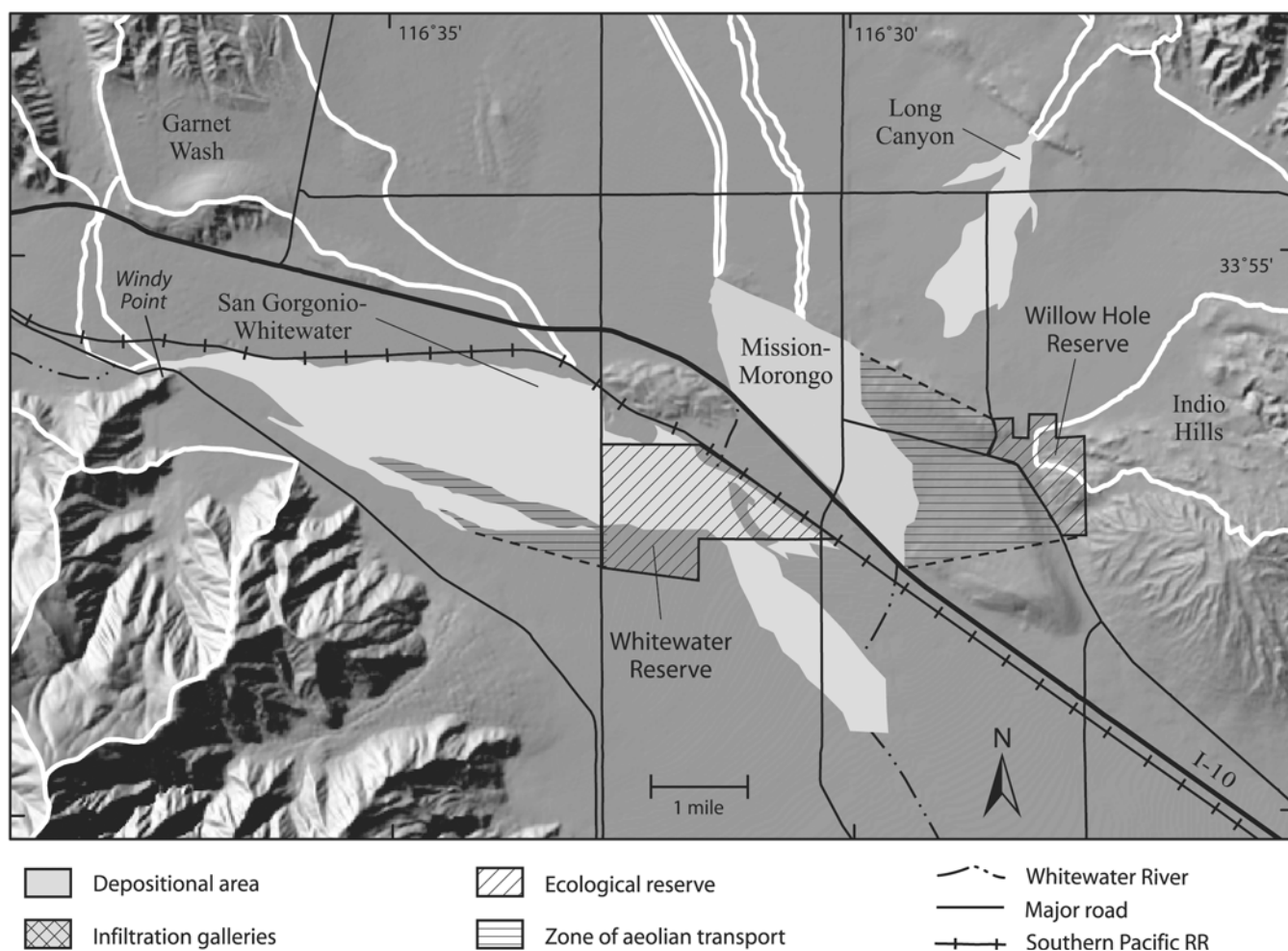


Figure 6. Shaded relief map showing the location of historic and current areas of fluvial deposition for the San Gorgonio – Whitewater River, Mission Creek – Morongo Wash, and Long Canyon drainages. White lines indicate drainage boundaries.

A. Historic (predevelopment) areas of fluvial deposition.

depositional areas, about 0.2 in./yr (table 9). This depth agrees well with field observations made at the depositional areas and suggests that the sediment-yield estimates made using both approaches are of an appropriate order of magnitude.

The artificial reduction of the size of the depositional areas is clearly evident in the large increase in estimated deposition depth on the Whitewater depositional area from 0.2 (predevelopment) to 0.4 in./yr (modern). Similarly, the increase is particularly large on the Long Canyon depositional area (from 0.2 to 0.9 in./year). The modern estimate of depth of deposit at Long Canyon is high, perhaps too high, with an unknown quantity of material spilling over the adjacent roads at higher flows to be deposited further downstream. The estimate for

the Whitewater depositional area, however, does not take into account the trapping of sediment in the infiltration galleries and therefore should be considered a maximum.

Given that the diversion dikes are designed to breach above a given flood level, it is difficult to effectively estimate the amount of sand actually trapped by the infiltration dikes. In 1996, 8.1 million ft³ of “silt” was dredged from 3 of the 19 percolation ponds (Daniel Farris and Patti Schwartz, Coachella Valley Water District, oral commun., 2002), and the remaining ponds were ripped to enhance infiltration. Without knowing the period over which the trapping occurred, it is impossible to evaluate precisely what percentage of total sediment yield from the San Gorgonio – Whitewater system this sediment

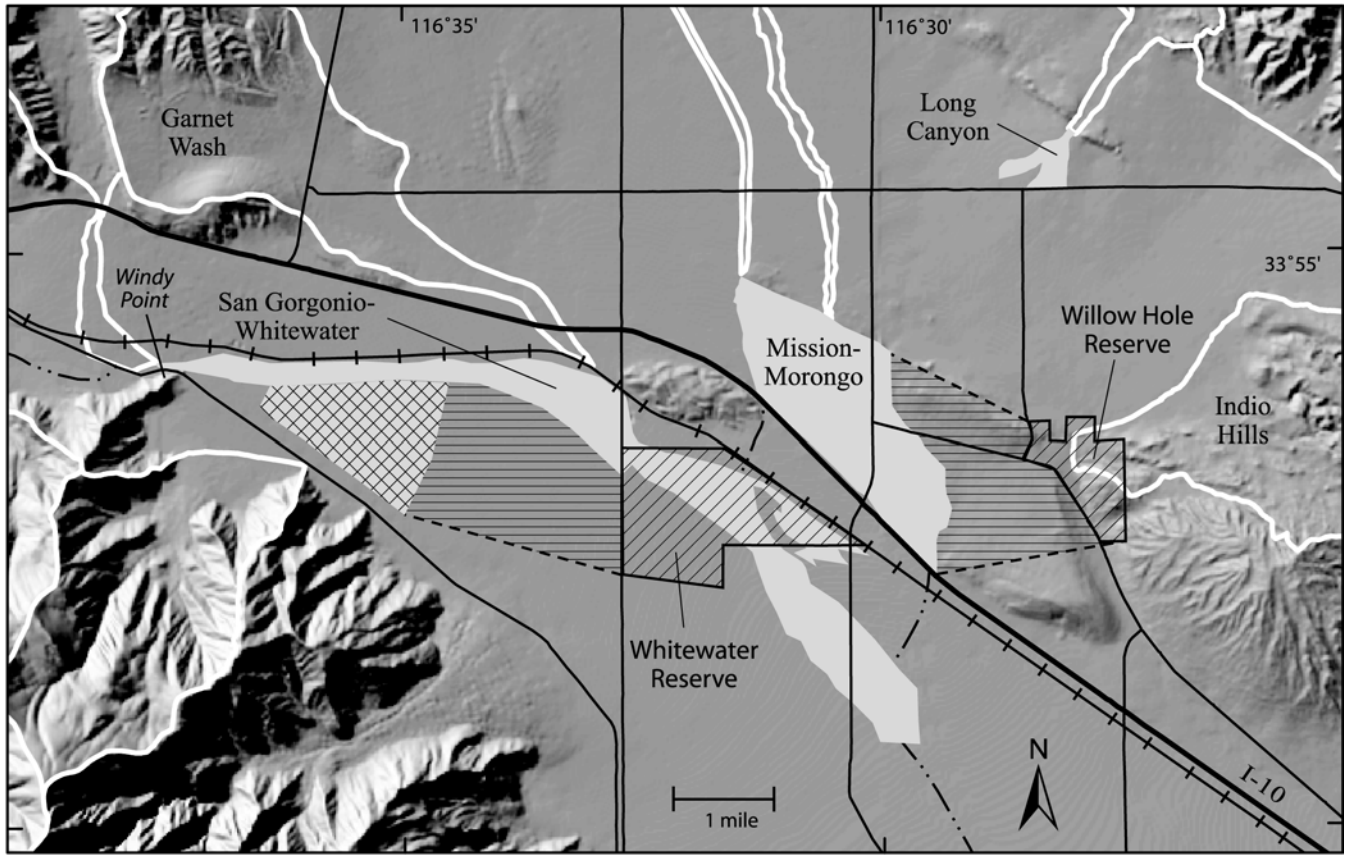


Figure 6. *Continued.*

B. Current (1993) areas of fluvial deposition and the infiltration galleries (also known as percolation ponds) in the Whitewater River.

Table 9. Estimates of total sediment delivered to zones of deposition in the northern Coachella Valley.

Depositional area	HISTORIC SEDIMENT YIELD (in/yr)			MODERN SEDIMENT YIELD (in/yr)		
	Depositional area (mi ²)	Renard (1972) equation	Flood-frequency method	Depositional area (mi ²)	Renard (1972) equation	Flood-frequency method
San Gorgonio/Whitewater	7.1	0.24	0.47	3.6	0.41	0.79
Mission/Morongo	2.7	0.24	0.53	2.7	0.24	0.53
Long Canyon	1.1	0.17	0.38	0.2	0.86	1.91
MEAN	—	0.22	0.46	—	0.51	1.08

represents. In its entirety, this volume of sediment represents 100 to 230 percent of the average annual sediment yield. However, the same amount of sediment distributed over a twenty-year period results in an average annual sediment loss of 5 to 12 percent. Actual sediment loss probably is somewhere between these extremes. In addition, the particle-size distribution of the trapped sediment must be known in order to calculate what percentage of this sediment is eolian

sand, let alone lizard habitat sand. If this trapped material was largely silt-sized particles with very little sand, its loss has had little direct effect on *Uma* habitat. Both the time period of trapping as well as an accurate understanding of the particle-size distribution of the trapped sediment is necessary to understand the long-term sediment trapping that occurs in these infiltration galleries and the effects it has on the sediment-delivery system in the northern Coachella Valley.

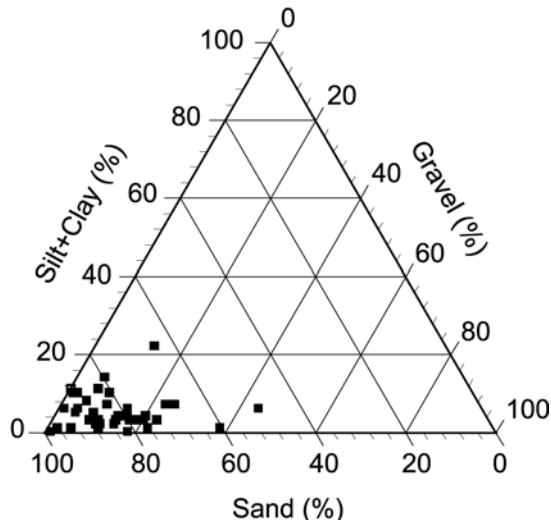


Figure 7. Ternary diagram showing sediment particle-size distributions for samples collected from washes in the northern Coachella Valley.

Particle-size Distributions

The sediment transported in channels of the northern Coachella Valley is relatively well sorted and is composed of 82.5 percent sand-size particles (fig. 7). The proportion of fluvial sediment in the 0.172 to 0.328 mm range preferred by *Uma* was remarkably consistent across the study area and had a mean value of 18.5 ± 8.3 percent (table 10). By source area, sand in the 0.172 - 0.328 mm range comprised 18.7 percent of the San Gorgonio – Whitewater River sediment yield, 17.6 percent of the Mission Creek – Morongo Wash sediment yield, 17.1 percent of the Long Canyon sediment, and 35.0 percent of the Indio Hills sediment yield. The eolian origin of much of the Indio Hills sand is evident in the significantly higher percentage of preferred sand – double that of the other sand sources – making this a particularly rich potential source of sand for *Uma* habitat.

Climate, Precipitation, and Flood Frequency

As shown in table 4, mean annual precipitation varies by a factor of five within the drainages that supply sediment to the northern Coachella Valley. Because the valley floor receives only 5 in. of precipitation, sediment yields from alluvial fans such as those that comprise the Desert Hot Springs bajada would be lower than the overall average sediment yield from the higher elevation sites. Because of this, the

Table 10. Percent of total fluvial sediment yield composed of sand sizes preferred by *Uma inornata*.

Source	Preferred sand ¹ (wt percent)	Standard deviation ($\pm$ wt percent)	Sample (n)
San Gorgonio – Whitewater River	18.7	8.6	8
Mission Creek – Morongo Wash	17.6	6.3	15
Long Canyon	17.1	8.3	15
Edom Hills	35.0	9.1	2
ALL SITES	18.5	8.3	41

¹The range in sand preferred by *Uma* has an intermediate diameter ranging between 0.172 and 0.328 mm ($1.6 < \phi < 2.5$; Barrows, 1997).

sediment contribution from the Desert Hot Springs bajada is expected to be much lower than the 11 percent calculated by assuming equal contributions from the entire drainage area.

The range in annual precipitation at each station is even larger than the elevational differences in annual precipitation. Interannual precipitation ranges by a factor of more than 5 at higher-elevation sites to a factor of more than 15 on the valley floor. This climatic variability undoubtedly affects fluvial sediment delivery to the Coachella Valley in significant ways. During drought years, little sediment is expected to be delivered from the headwaters to the valley floor. During wet periods, sediment delivery is greatly increased.

Periods of negative Southern Oscillation Index (SOI), otherwise known as El Niño conditions, have a large influence on the climate of the Coachella Valley and its surrounding mountains. Although El Niño strictly speaking is an oceanic phenomena off the western coast of Peru, the term has come to apply to overall changes in the equatorial Pacific Ocean that create conditions favorable to increases in winter precipitation in the southwestern United States. One definition of El Niño calls for 5 or more months of negative SOI (Cayan and Webb, 1993); El Niño recurs every 4-7 years in the equatorial Pacific Ocean with no definite historical change in frequency (Webb and Betancourt, 1992). The SOI is shown in (fig. 8a).

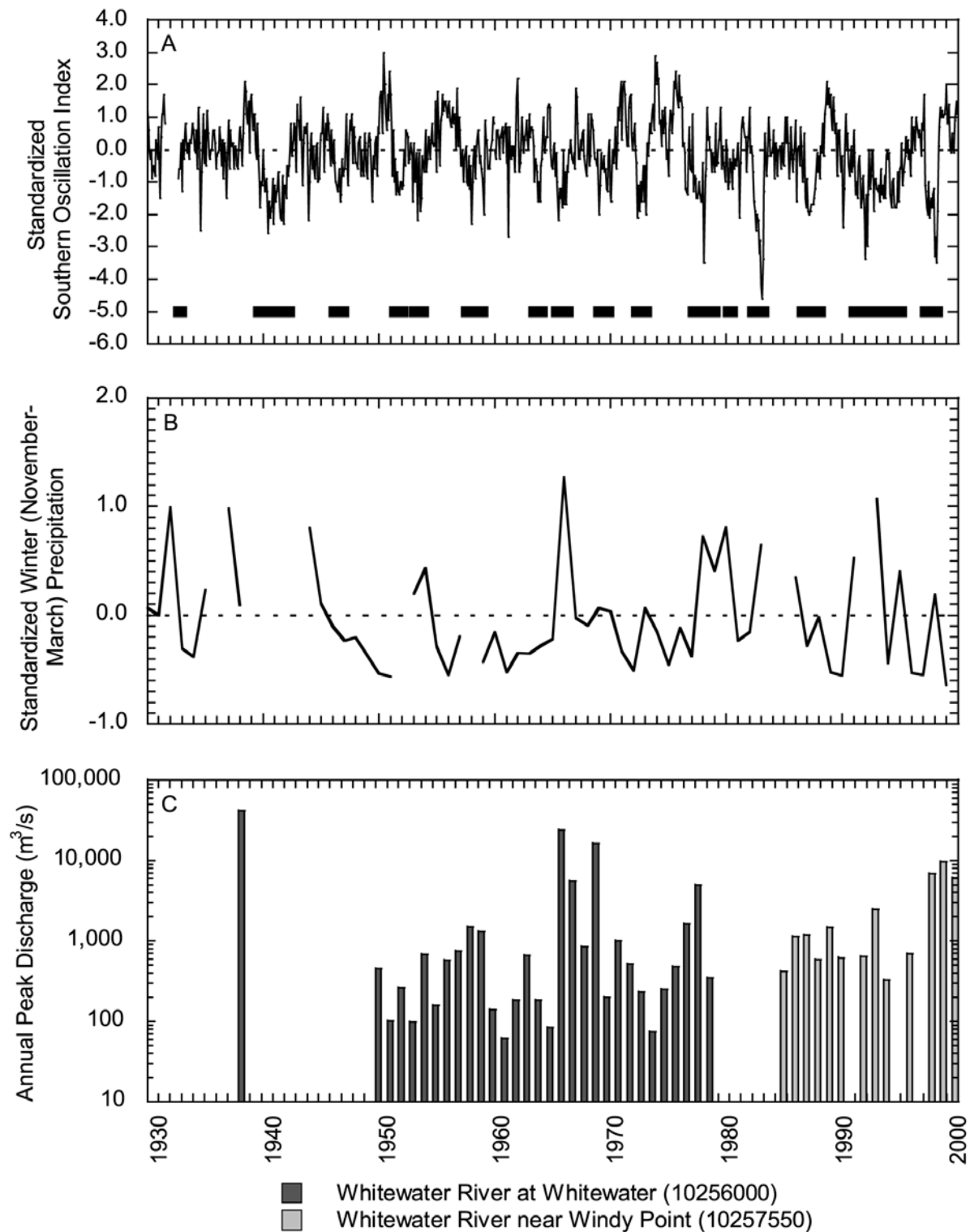


Figure 8. Climate, precipitation, and flood-frequency data for the northern Coachella Valley.

A. The Southern Oscillation Index (in standardized form) from 1930-2000. El Niño conditions are considered to occur when the SOI is negative for protracted periods (*e.g.*, greater than about 5 consecutive months) and are shown in thick lines at bottom. B. Standardized precipitation for Palm Springs, California. C. The annual flood series for the Whitewater River, combined from the gaging stations at Whitewater and Windy Point, California.

Precipitation within the Coachella Valley is affected by the SOI (fig. 8b). El Niño periods are generally periods of above-average precipitation at Palm Springs. Unfortunately, the Palm Springs precipitation record has many missing values (fig. 8b), which precludes a quantitative assessment of El Niño effects. As is evident in a close comparison of figures 8a and 8b, not all periods with El Niño conditions correspond to periods of increased precipitation. For example, average or below-average conditions prevailed at Palm Springs during 3 of 4 El Niño periods in the 1960s.

With the exception of 1938, most significant floods on Whitewater River have occurred during El Niño conditions (fig. 8c). In the last 25 years, floods have occurred in 1978, 1983 (not recorded in the gaging record of figure 8c), 1993, and 1998, which represent four of five El Niño episodes in that period. Streamflow is greatly increased in the southwestern United States during El Niño conditions (Cayan and Webb, 1993), and historically El Niño conditions produce wet periods and some of the largest flood years in the history of the southwestern United States (Webb and Betancourt, 1992), but drought conditions may occur also, as was the case in many areas during the El Niño conditions of 1986-1987.

La Niña conditions are the opposite of El Niño conditions and are likewise defined as a protracted period of positive values of the SOI. Unlike El Niño, however, La Niña conditions reliably produce drought conditions. As is apparent in figure 8, periods of positive SOI are related to both below-average precipitation at Palm Springs and low-flood years on the Whitewater River.

Some observers have forecasted 20-30 years of protracted drought for the region, partially in response to expected future patterns of the Pacific Decadal Oscillation (PDO), which is related to the SOI (Schmidt and Webb, 2001). If such protracted drought were to occur, the delivery of fluvial sand to the northern Coachella Valley would be reduced because of the decrease in flood occurrence. However, as discussed in a later section, drought could potentially increase eolian sand-transport rates by decreasing the cover of perennial vegetation and thereby decreasing surface roughness, although the amount of sand available for transport would be greatly reduced owing to less frequent floods.

EOLIAN TRANSPORT

Historical Wind Speed and Direction

Abundant wind energy is available in the northern Coachella Valley to transport eolian sand. Data are available for National Weather Service stations at Palm Springs and Thermal, and for instruments maintained by SeaWest at Edom Hill during the period 1999-2002. Because the wind data were recorded for different purposes and with different instrumentation, rigorous inter-comparison of wind speeds, for example, is not possible, but the data provide useful information about changes in wind regimes in this part of the Coachella Valley (Tables 11 and 12). Table 12 shows the annual frequency of winds from different directions recorded at Palm Springs for the period 1998-2001 (these data are also shown as a rose diagram in fig. 9a). About 63 percent of all winds at this station are from directions between northwest and north, giving rise to a wind vector of 343° or northwesterly. This concentration of winds from one directional sector is because wind directions are strongly controlled by the topography of the area, in which winds are funneled through the San Gorgonio Pass and blow down the Coachella Valley.

Table 12 also shows the percentage of winds from different directions at Edom Hill (these data are also shown as a rose diagram in fig. 9b). At this locality, 47 percent of all winds are from directions between west and northwest, with westerly directions dominating (20.4 percent of all winds). The annual wind vector for Edom Hill is 298° or west-northwest. Because suitable data at Edom Hill are available for only one year (2001), the remaining analyses are for the wind data from Palm Springs International Airport, which has a longer record. We assume that the characteristics of wind other than direction are similar between Palm Springs and Edom Hill.

The strongest winds experienced at Palm Springs are from the NW and NNW (average speed = 11.7 mi/hr) and occur mostly during the afternoon (fig. 10). There is a regular daily cycle of wind speed, as shown in figure 10. In the early morning hours, wind speed is low (< 5 mi/hr) and direction is variable. After about 8 am, wind speed increases, and wind direction becomes steady at 310-320° (NW). Maximum wind speed usually occurs in the late afternoon or early evening (4 to 8 pm). Average scalar wind speed varies through the

Table 11. Percentage frequency of winds at Palm Springs International Airport (1998-2000).

Direction	WIND SPEED (mi/hr)									All speeds
	0-5	6-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	
N	22.7	3.0	1.0	0.5	0.2	0.0	0.0	0.0	0.0	27.4
NNE	0.4	0.6	0.2	0.1	0.1	0.0	0.0	0.0	0.0	1.4
NE	0.3	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.9
ENE	0.3	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.0
E	1.0	2.8	0.3	0.1	0.0	0.0	0.0	0.0	0.0	4.2
ESE	1.0	3.9	0.8	0.1	0.0	0.0	0.0	0.0	0.0	5.8
SE	1.3	2.8	0.4	0.1	0.0	0.0	0.0	0.0	0.0	4.6
SSE	1.3	1.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	3.0
S	1.8	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
SSW	1.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7
SW	1.2	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.0
WSW	1.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
W	1.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
WNW	1.4	2.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	4.1
NW	1.7	6.2	5.0	3.4	1.0	0.1	0.0	0.0	0.0	17.4
NNW	1.5	8.2	3.9	3.0	1.3	0.2	0.0	0.0	0.0	18.1
All directions	40.1	37.3	12.3	7.4	2.6	0.3	0.1	0.0	0.0	100.0

Table 12. Comparison of winds at Palm Springs Airport and Edom Hill.

Wind direction	PROBABILITY OF OCCURRENCE (percent)			
	All winds		Sand-transporting winds	
	Palm Springs	Edom Hill	Palm Springs (>12 mi/hr)	Edom Hill (>14.3 mi/hr)
N	27.4	7.3	6.8	1.9
NNE	1.4	4.1	1.9	1.0
NE	0.9	1.9	1.0	0.1
ENE	1.0	1.0	0.0	0.0
E	4.2	1.7	1.0	0.2
ESE	5.8	5.0	1.0	1.1
SE	4.6	6.6	1.0	0.0
SSE	3.0	6.0	0.0	0.0
S	3.0	2.9	0.0	0.0
SSW	1.7	1.4	0.0	0.0
SW	2.0	1.8	0.0	0.5
WSW	2.1	5.1	0.0	7.3
W	3.3	20.4	0.0	50.5
WNW	4.1	12.4	0.0	23.8
NW	17.4	14.0	43.7	12.6
NNW	18.1	8.3	43.6	1.0
Wind Vector Direction	343°	298°	282°	282°

year, but the months of maximum wind speed typically are April through June, with May having the highest average wind speed (9.9 mi/hr), as shown in figure 11. The overall character of the wind regime at Thermal is similar to that at Palm Springs International Airport, but with much lower wind speeds. For example, mean annual wind speed at Palm Springs International Airport is 7.2 mi/hr, but the mean annual wind speed is only 6.1 mi/hr at Thermal. The wind regime at Edom Hill follows a similar pattern to elsewhere in the valley, but average wind speeds in this area are somewhat higher, with a mean annual wind speed of 11.4 mi/hr. Therefore, eolian transport calculations based on wind data from Palm Springs International Airport should be considered minimums, given that actual velocities upwind of the reserves may be more than 50 percent higher.

Sand-Transport Potential

Wind data from Palm Springs and Edom Hill were analyzed using the methods of Fryberger (1979) as described in the Methods section. For the period 1998-2000, Palm Springs has a drift potential (DP) of 277 VU and an RDP of 261 VU (velocity units). This classifies the area as a moderate-energy, near unimodal

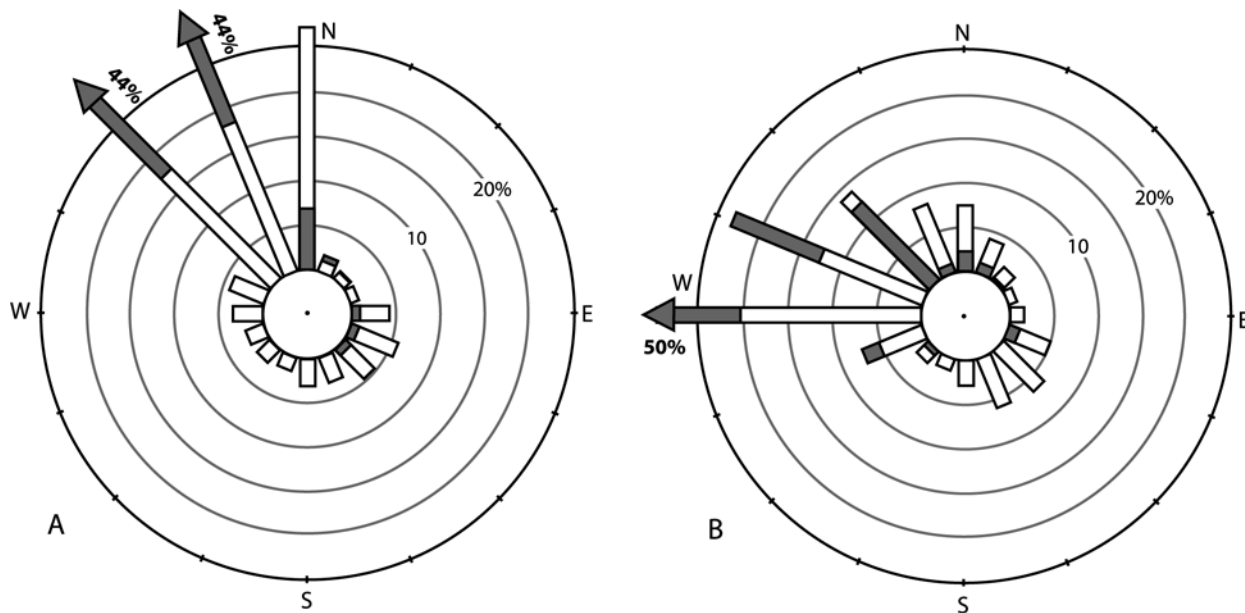


Figure 9. Rose diagram showing annual directional frequency of winds at selected sites in the Coachella Valley.

A. Palm Springs International Airport for the period 1998-2000. B. Edom Hill (Willow Hole Reserve) for the period of 2001. White bars represent all wind velocities; gray bars represent winds of sufficient velocity to transport sand.

wind regime. The annual resultant (vector sum) potential sand transport direction is 342° . For Edom Hill, the total DP is 646 VU, with a RDP of 556VU and a resultant direction of 282° .

For the period 1998-2000, 89 percent of the annual drift potential at Palm Springs is generated by winds from the NW and NNW directions. These directions are important in all months with a range from 15 percent in December to 97 percent in May. Winds from the NNE and N contribute significantly (up to 74 percent) to drift potential during the winter months of November-February, but these months are a time of generally low drift potentials (fig. 12). At Edom Hill, 72 percent of the potential sand transport is generated by winds from the west and west-northwest, with the majority from the west.

Drift potential varies with the percentage of the time that the wind is blowing with higher velocity. At Palm Springs, monthly drift potential varies with the seasons, and reaches a peak in May (fig. 12). About 65 percent of the annual drift potential (DP) and 67 percent of the resultant drift potential (RDP) occurs in the period March through June. There is very little drift potential (15 percent of the annual total) during the winter months (November-February). The pattern at Edom Hill is similar.

In February 1998, the system used to measure wind speed at Palm Springs International Airport changed. One result of this change is that the magnitude of DP and RDP changes significantly after that time and is reduced by a factor of 3.6, compared to the period 1992-1998. However, the interannual variability of the sand drift potential does not change. Annual drift potential varies from 67 to 122 percent of the mean value and is mainly caused by changes in the duration and frequency of strong winds from year to year.

Spatial Variations in Sand-transport Potential

There is a very large drop in wind energy between Palm Springs and Thermal, as evidenced by the change in DP values from 277 VU at Palm Springs to only 7 VU at Thermal. This change reflects the expansion of airflow and reduction in wind speed away from the San Geronio Pass. Such expansion of the airflow and reduction of wind speed leads to deposition of sand down valley, as evidenced by the areas of dunes occurring in this part of the valley (*e.g.*, Coachella Valley Reserve). As expected, the acceleration of wind over Edom Hill produces a high energy wind regime at this location, with a total DP of

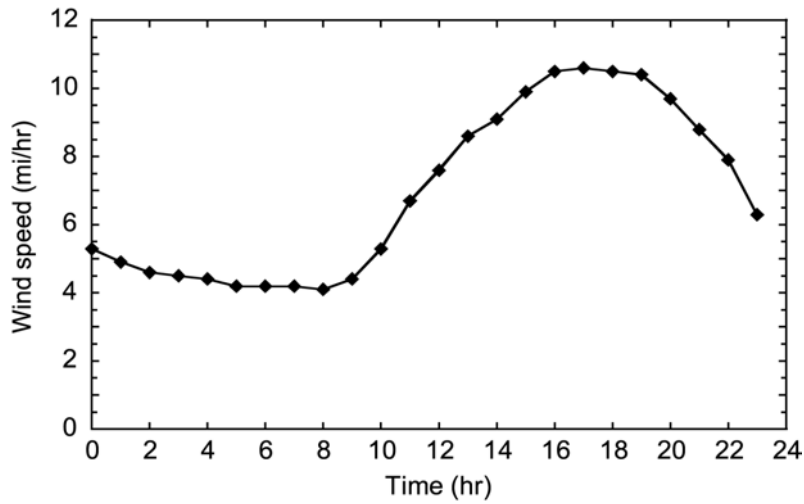


Figure 10. Diurnal cycle of winds at Palm Springs International Airport.

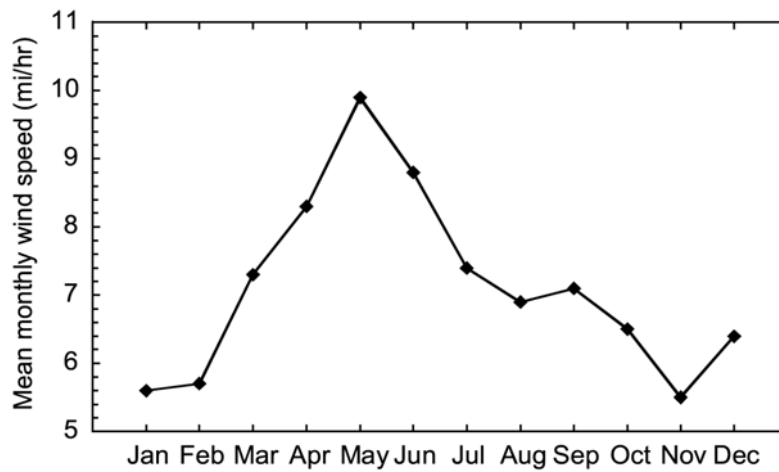


Figure 11. Variation in monthly wind speeds at Palm Springs International Airport.

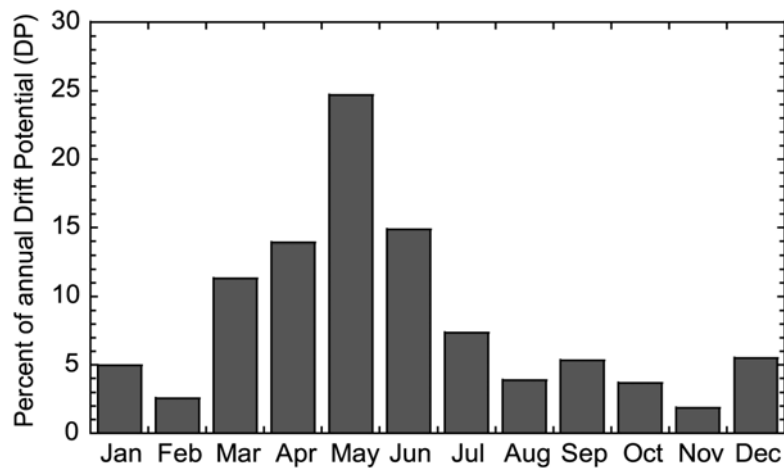


Figure 12. Variation in monthly values of Drift Potential (DP) calculated from wind data at Palm Springs International Airport.

646 VU. There is also a change in the vector sum sand-transport potential direction from 295° at Edom Hill to 332° at Palm Springs and 312° at Thermal.

Dune Mobility

The dune mobility index, *M*, was calculated from the wind data at the Palm Springs. Values of *W*, or the percentage of time the wind was above the sand-transport threshold, were estimated using a threshold value of 12.3 mi/hr (10.6 knots). Wind exceeding this threshold were observed 25-30 percent of the time on an annual basis before 1998 and dropped to 15-20 percent of the time once 24-hour readings became available. This is an artifact of the inclusion of the usually calmer early morning period of 12 am to 6 am. Because of the change in the recording system in 1998, increasing the amount of valid data, the mobility index values for 1998 on were adjusted to take account of this extra time.

Over the period of record, the average *M* for Palm Springs was 557, indicating that the northern Coachella Valley is a very active eolian environment with fully active dunes. As in many other parts of southern California, the actual state of dunes tends to be less active than predicted by the mobility index (Bach, 1995), and field observations suggest that locally this is the case in the Coachella Valley. Over the period of record, changes in the amount of rainfall received gave rise to changes in the mobility index (fig. 13a). The index was above the threshold value of *M*=200 (dunes fully active) for 71 percent of the period of record (1973-2000), and within the range $100 < M < 200$ (dunes are active but lower slopes are vegetated) for 28 percent of the time (fig. 13b). The period 1984-1991 was the longest interval in which the index was consistently above 200. Intervals and individual years when dune mobility was low occurred in 1978-1980, 1983, and 1992-1993. The temporal variation in the dune mobility index was generally similar to that observed elsewhere in the southwestern United States (Lancaster and Helm, 2000), with low values of the index being recorded in or following El Niño years.

Actual Sand Transport

The calculated sand drift potential discussed above represents the amount of sand that could be transported by the winds of the area, assuming that sand is available for transport (i.e., the sand supply is unlimited). In the case of the flood plain of the Whitewater River, this is unlikely, given the seasonal or ephemeral nature of flow in the river and the armoring of the surface by gravel.

Some information on actual rate of sand transport in the area is provided by Sharp (1964, 1980). He maintained sand traps in the area of the Whitewater River, just south of Garnet Hill and likely within the current boundaries of the Whitewater Floodplain Preserve, for 5 periods from 1953 through 1955. His data on sand-transport rates were later analyzed by Williams and Lee (1995). Sand-transport rates in the study area varied from $1.0 - 6.5 \cdot 10^{-6}$ lbs ft⁻¹ s⁻¹ (table 13).

The variation in sand transport rates could be explained by reference to changes in the discharge of the Whitewater River (fig. 5). The highest sand-transport rates follow periods of high discharge in the river, and low rates either preceded or coincided with high runoff. These data suggest that changes in fluvial sediment supply significantly influence rates of eolian sediment transport in this environment.

Table 13. Eolian sand transport rates in the Whitewater River floodplain (from Williams and Lee, 1995).

Measurement interval	Sand transport rate (lbs ft ⁻¹ s ⁻¹ · 10 ⁶)
2/3 – 3/4, 1953	3.0
7/18 – 12/11, 1953	1.0
4/16 – 11/25, 1954	1.6
3/2 – 5/27, 1954	6.5

Historical Changes in Area of Sand Dunes

Historical changes in the area of sand dunes proved difficult to quantify for the Whitewater Floodplain Preserve and the area between the Mission Creek – Morongo Wash depositional area and Willow Hole. Existing aerial photography lacked a consistently sufficient resolution to allow differentiation of the small coppice dunes characteristic of these eolian plains from perennial vegetation or other features on

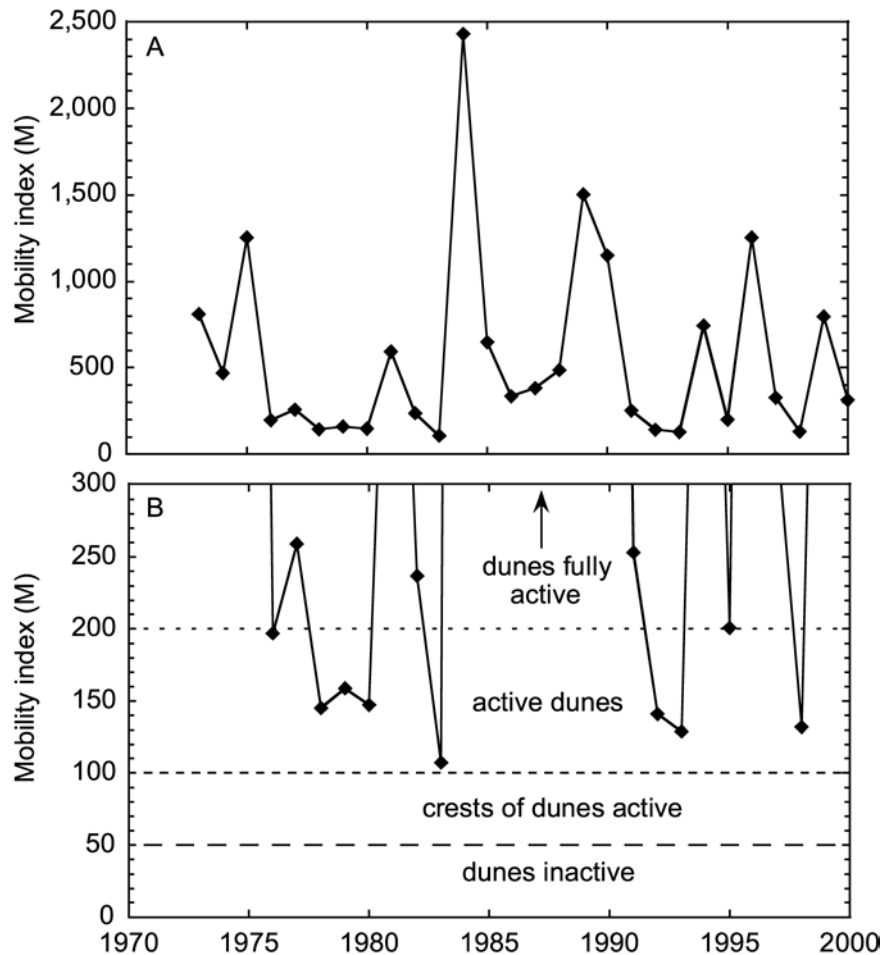


Figure 13. Dune Mobility Index calculated for the northern Coachella Valley. A. Variation of the Dune Mobility Index (M) from 1973-2000. B. The same data for M up to 300 showing exceedence of several classes of dune activity.

the landscape. A summary of the observations from the aerial photography of the study area appears in tables 14 and 15.

The 1939 aerial photography shows active channels and abundant fluvial sediment in the aftermath of the 1938 floods on both the Whitewater River and Mission Creek. By 1953, modifications were significant on the Whitewater River floodplain, and the infiltration galleries were established by 1984 (table 14; fig. 14a). In 1953, sand cover and nebkha dunes were extensive on the Whitewater Floodplain Reserve, and even by the late 1980s, active sand sheets extended eastward from active fluvial channels. By 1996, this sand cover appeared to be depleted.

Comparison of the aerial photographs from 1939 to 1996 indicate that there have been minor changes in the vegetation cover in the Willow Hole area but

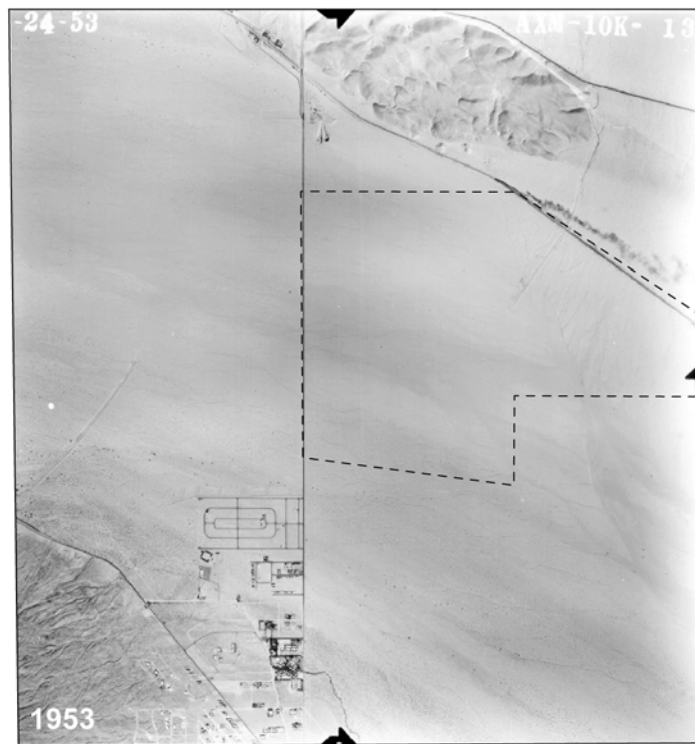
important changes to the channels of some of the washes in the area, and significant changes in land use in the areas immediately north and west of the dunes (table 15; fig. 14b). From 1939 to 1953, there are slight decreases in the density of mesquite in both western and eastern parts of the dunes; vegetation cover also decreased in the lower reaches of Wide and Long Creeks. In 1953, there is more bare sand in the northern part of the Willow Hole area that at any other time. Between 1953 and 1972, vegetation cover decreases in the western parts of the area, but increases slightly in the east. The outlet channel to the south from Willow Hole is less vegetated, and becomes vegetation free after 1972. From 1972 to 1996, there are no significant changes in the mesquite cover, but the area of bare sand

Table 14. Historical changes in the eolian environment of the Whitewater depositional area detected in aerial photographs, 1939-1996.

Year	Observed Changes
Cultural features in channel west (upwind) of Whitewater Preserve	
1953	Large dike across western channel; small dike on western side
1972	Cross channel dike breached in several places
1977	Percolation ponds breached causing outwash channel
1979	Percolation ponds breached causing outwash channel
1984	Infiltration basins established west of preserve, southern dike is re-aligned
1989	Wind generators constructed by this year
Fluvial and aeolian features	
1939	Effects of the 1939 flood deposition are considerable along Whitewater River and Mission Creek; a channel avulsion appears in Mission Creek on the Desert Hot Springs bajada
1953	Active channel (darker tone) in center of preserve area Extensive sand cover and nebkha dunes
1972	Area east of road is very featureless either as a result of a poor photograph or extensive thin eolian sand sheet cover
1977	Well-developed active channel to south of preserve formed after breaching of percolation ponds by flood. Alluvial morphology very clearly developed
1984	Flow in Whitewater River to gaging station Clear fluvial morphology with bars and channels visible Wide active channel to south
1989	Active flow in Garnet Wash (August) and across flood plain in eastern part of Reserve Drainage channel across southern part of preserve Active sand sheets extend east of fluvial channels
1993	Well developed channel with active flow south of Garnet Hill and gravel pit
1996	Fine-grained fluvial deposits appear to be stripped from the Whitewater depositional area downstream of infiltration galleries

Table 15. Historical changes in the eolian environment of the Willow Hole area detected in aerial photographs, 1939-1996.

Year	Observed Changes
Cultural features	
1972-1975	Mission Creek channelized
1984-1989	Golf course established north west of Willow Hole Reserve
Fluvial and aeolian features	
1953	Thin sand sheets cover most of area east of depositional zone of Mission Creek and Morongo Wash
1972	Thin sand sheets cover most of area east of depositional zone of Mission Creek and Morongo Wash
1984	Sand sheets replaced by sand streaks extending from depositional area
1989	Sand streaks very thin
1996	Sand streaks extremely thin and discontinuous east of depositional zone
Vegetation changes	
1939-1953	Slight decreases in density of mesquite in Willow Hole area
1953-1972	Decrease vegetation cover to west, increased to east
1972-1996	No significant changes in mesquite cover infiltration galleries



1 mile

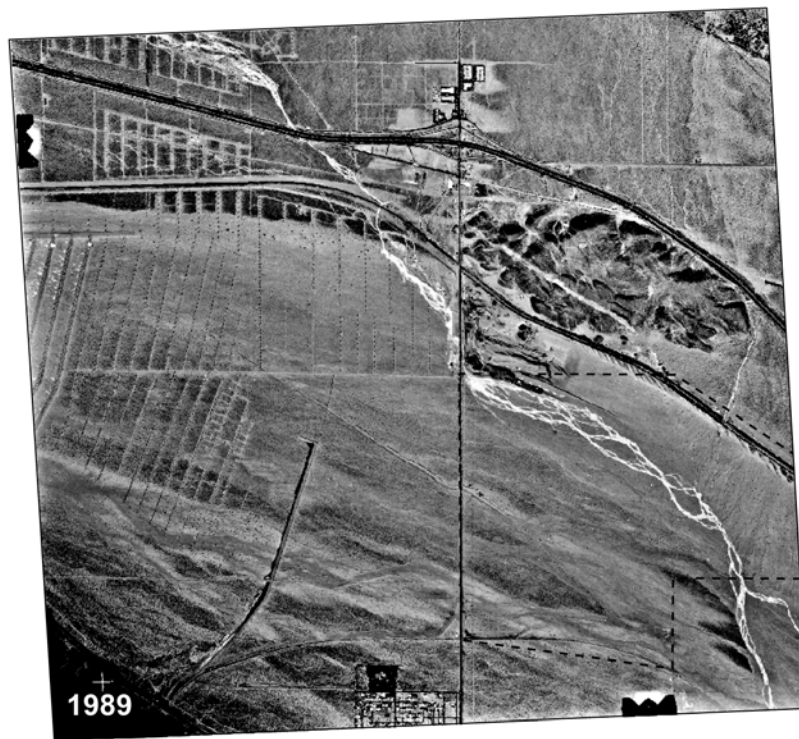


Figure 14. Aerial photographs showing historical changes in sedimentary deposits in the Whitewater depositional area.

A. Aerial photographs of the Whitewater River floodplain in the area of the Whitewater reserve (dashed lines) in 1953 and 1989. Note extended dike across river and extensive wind-generator arrays in 1989. There also appears to be much more extensive sand cover in 1953 compared to 1989.



1 mile



Figure 14. *Continued.*

B. Aerial photographs of the area of the Willow Hole reserve (dashed lines) in 1953 and 1989. Amount of change in mesquite dunes appears to be minimal.

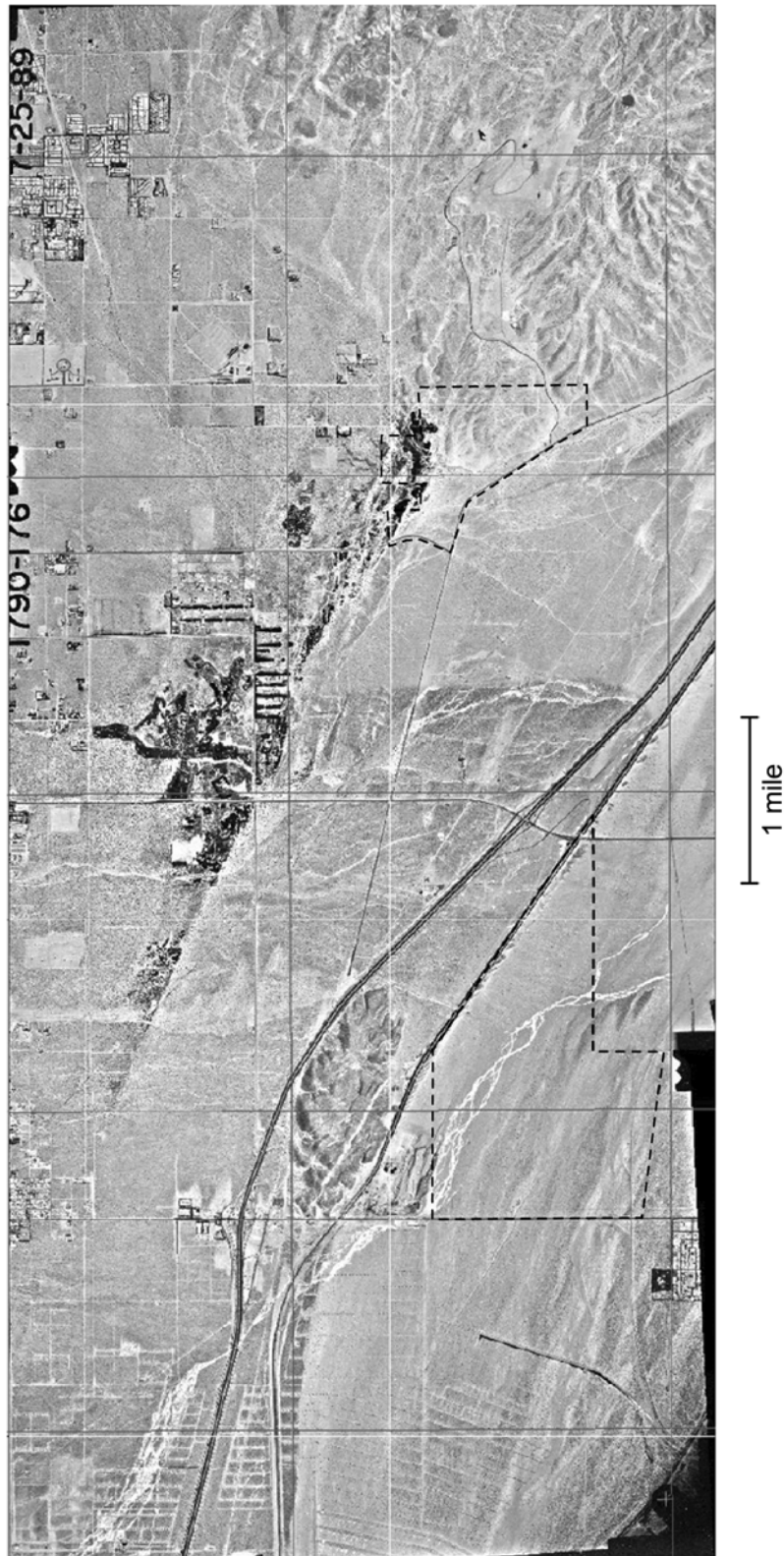


Figure 14. *Continued.*

C. Photomosaic of the depositional areas and eolian-transport zones upwind of both reserves in 1989. Dashed lines indicate reserve boundaries.

near Mountain View Road decreases in size. A golf course was constructed immediately north of the dunes in the late 1980s.

The 1953 photographs indicate thin sand sheets covering as much as 75 percent of the area east of Mission Creek and especially Morongo Wash. The sand sheets persisted in this manner until at least 1972, and probably 1977, although Mission Creek had been artificially channelized by the latter date. By 1984, the extensive sand sheets had largely dispersed, and the most prominent eolian features were sand streaks and tongues of sand (sand sheets) that extend east or east-southeast from the depositional area of these washes for several hundred yards. By 1989, these sand sheets appear to have thinned considerably (fig. 14c). This trend is continued to 1996, when these features are barely discernible on the images.

LINKAGES BETWEEN THE FLUVIAL AND EOLIAN TRANSPORT SYSTEMS

Rates of Eolian Transport

The supply of wind-blown sediment to the Whitewater and Willow Hole Reserves is determined by two factors: (1) the supply of sand-size sediment by the fluvial system (as discussed in the previous section on Fluvial Sediment Yield) and (2) the rates of eolian transport. Comparison of these two sediment-transport systems was carried out the following way. Data on fluvial sediment yields and the area of the depositional zones (table 9) was used to estimate a volume of sediment being deposited in each of these areas on an annual basis. The total volume of sediment was adjusted in proportion to the amount of this material that is of sand size (mean = 82.5 percent), as well as the proportion of the sediment that is of a size preferred by *Uma* (table 10).

Rates of eolian sediment transport potential were derived from the Palm Springs wind record and the velocity units were converted to an estimate of sediment volume transported based on the relation illustrated by Fryberger (1979). This relation is expressed as volume per unit width per year. The rate of eolian sediment removal from each of the depositional zones was estimated as:

$$Q_e = A^{0.5} \cdot q_r, \quad (12)$$

where

Q_e is the eolian transport rate,
 A is the area of entrainment, and
 q_r is the volumetric transport rate.

The relations between eolian and fluvial deposition can also be expressed in terms of the time required for the fluvial sediment supply to be depleted. This is expressed as:

$$t_{ed} = V / Q_e, \quad (13)$$

where

t_{ed} is the time for eolian depletion (months),
 and
 V is the volume of fluvial sediment available for transport (ft³).

These relations assume that all available sediment can be transported, and the surface cannot be armored with the accumulation of sediment that is larger than the eolian system can transport.

The estimated depletion times for both historic and modern scenarios, using the Renard (1972) and flood-frequency methods for estimating fluvial sediment yield are given in table 16. Our results indicate that periods ranging from several months to two years are required for eolian processes to deplete sediment supplied by the fluvial system. In the predevelopment setting, all sand was removed from the Whitewater area in 13 months, from the Mission – Morongo area in 8 months and from the Long Canyon area in 4 months. With reduced fetch areas and deeper fluvial deposits in the modern scenario, it requires 16 months to remove all sand from the Whitewater area and 8 months to do so from the Long Canyon depositional area. Rates of sand removal from the Mission – Morongo depositional area remain constant. In all cases, sand of a size suitable for *Uma* habitat is removed in about one-fourth the time required for all sand (table 16).

When the record from the aerial photographs is compared to depletion estimates, it is clear that eolian sand persists in the immediate vicinity of the fluvial-depositional zones for periods that are much longer than the estimated depletion times discussed above. This is likely because the amounts of sediment deposited in episodic floods to these zones are much

greater than the time-averaged rates used in this analysis. It is also likely that the eolian-transport rates are less than used in this analysis, because they are reduced by the presence of vegetation in the transport corridors. As a result, the depletion times in table 16 should be regarded as minimum values. In general, however, the eolian removal of expected annual sediment yields in approximately one year – both before and after development – is consistent with the presence of persistent sand dunes in the Coachella Valley.

Table 16. Eolian depletion rates of fluvial sediment deposited in depositional areas upwind of the Coachella Valley reserves.

Depositional area	MONTHS TO REMOVE ALL SAND		MONTHS TO REMOVE "UMA SAND"	
	Renard (1972) equation	Flood- frequency method	Renard (1972) equation	Flood- frequency method
Historic record				
San Gorgonio/ Whitewater	12.9	25.3	2.5	4.9
Mission/Morongo	8.0	17.6	1.7	3.8
Long Canyon	3.6	7.4	0.8	1.7
Modern record				
San Gorgonio/ Whitewater	15.7	30.3	4.1	8.1
Mission/Morongo	8.0	17.6	1.7	3.8
Long Canyon	7.8	17.3	2.0	4.4

Mission Creek – Morongo Wash Depositional Area

Although the Indio Hills drainage area – and Long Canyon by way of the Indio Hills drainage – has the potential to contribute sand to the Willow Hole Reserve, almost all sand delivered to the Reserve in the modern setting comes from the Mission Creek – Morongo Wash depositional area. The existence of wind data collected within the Willow Hole Reserve itself allows us to begin to differentiate subsections within the Mission Creek – Morongo Wash depositional area in terms of potential to contribute sand to the Reserve. By analyzing the frequency of wind directions bearing on Willow Hole, we calculated the probability that a given sand-transporting wind will be headed toward the Willow Hole Reserve for subsections of the Mission Creek – Morongo Wash

depositional (table 17 and fig. 15). (Absence of local wind data precludes a similar analysis for the San Gorgonio – Whitewater depositional area.) Across the Mission Creek – Morongo Wash depositional area as a whole, winds of velocity sufficient to transport sand are headed toward Willow Hole 83 percent of the time. Segregating these data into the seven 10° compass sectors, keyed from one sector that represents westerly winds from directions of 265° to 275°, that cross the depositional area, the probability that sand-transporting winds will be headed toward Willow Hole is highest through the middle of the depositional area, drops off rapidly to the south to a low of 1.1 percent, and declines less rapidly to the north to a low of 10.4 percent (figure 15).

These probability values can be used as a rough measure of the relative value of each subsection of the depositional area in terms of potential sand transport to Willow Hole. A more precise measure of the relative amounts of sand actually contributed to Willow Hole from each subsection would require the consideration of other variables in addition to wind direction. The depositional subsection illustrated in figure 15 are not of equal area, and the larger subsections to the north would consequently contribute more sand to Willow Hole than the smaller southern subsections. Additionally, it is unlikely that fluvial sediment is distributed equally over the depositional area. Sand deposited per unit area likely decreases in the downstream direction so that sand deposits thin from north to south. Similarly, particle-size distribution typically varies in the direction of flow, with mean particle sizes decreasing with flow energy from north to south, resulting in a variation in the presence of preferred sand. The presence of local wind breaks may also vary from subsection to subsection hindering the eolian transport of *Uma* sand to varying degrees. The proximity of the interstate and railroad to the southern subsections may be a significant factor in this regard. A more precise measure of relative sand contribution from the Mission Creek – Morongo Wash sectors would require the quantification of these variables. However, it is evident that such data would weight sand contribution toward the northern subsections of the depositional area.

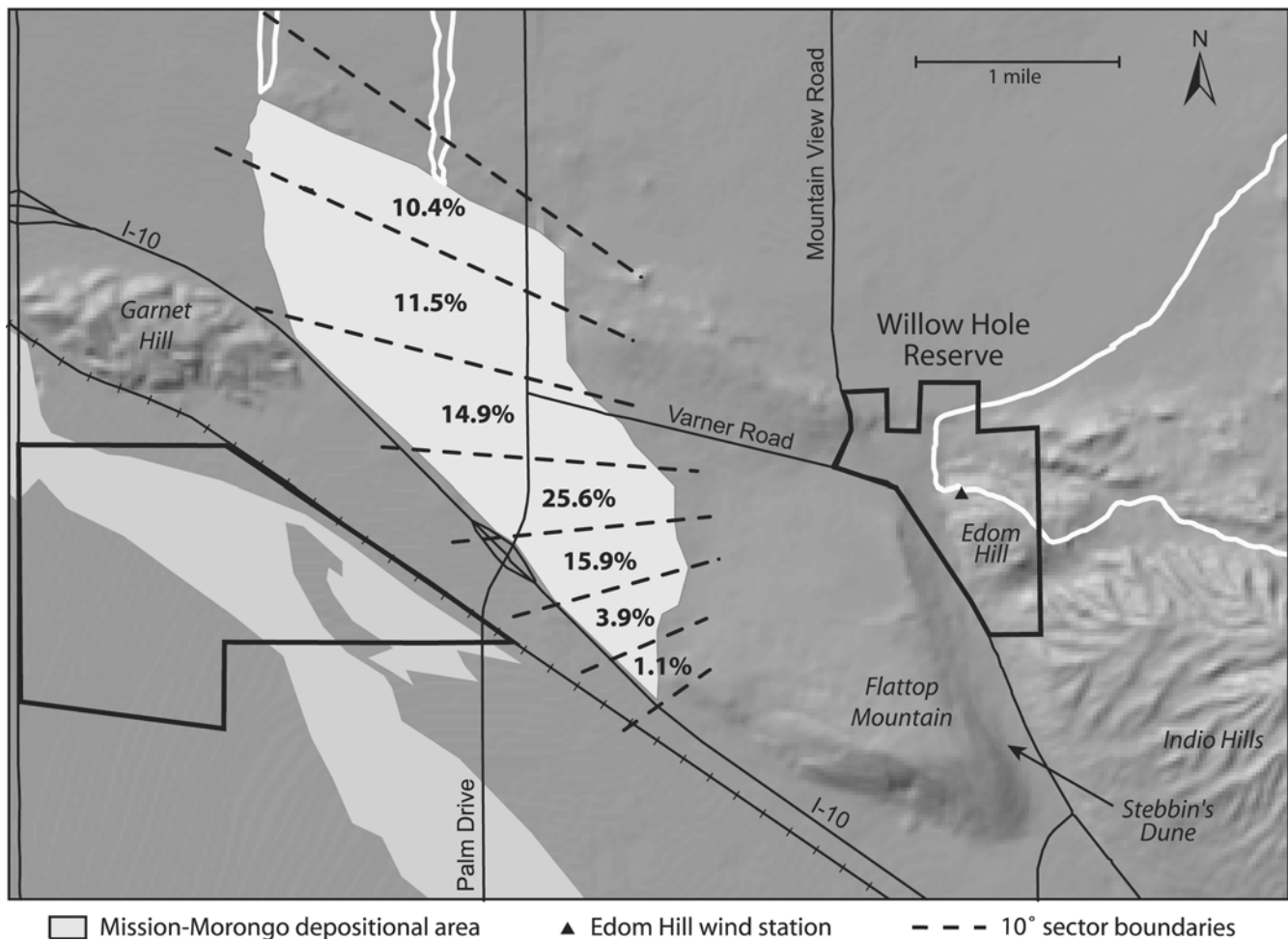


Figure 15. Map showing the percent probability that any sand-transporting wind (>14.3 mi/hr) headed directly toward the center of the Willow Hole Reserve will cross a given 10° sector of the Mission – Morongo depositional area. White lines indicate drainage boundaries.

Winds favorable for sand transport directly to Willow Hole cross some part of the depositional area 83.4 percent of the time. Sector boundaries are arbitrary lines that divide a continuous wind field into discrete 10° segments. Probabilities that sand transporting wind is headed to any other point location – such as Stebbin's Dune – would require a separate set of data collected at that point location and result in different sector boundaries.

Table 17. Percent probability that a sand-transporting wind headed toward Willow Hole will cross each sector of the Mission Creek-Morongo Wash depositional area.¹

COMPASS SECTORS (22.5°) ²		10° SECTORS	
Sector	Probability (percent)	Sector	Probability (percent)
		295-305°	10.4
281 - 304° / WNW	23.8	285-295°	11.5
		275-285°	14.9
259 - 281° / W	50.5	265-275°	25.6
		255-265°	15.9
236 - 259° / WSW	7.3	245-255°	3.9
		235-245°	1.1

¹Data is for winds >14.3 mph measured at Edom Hill in 2001.

²Complete compass sector data is presented in Table 12.

CONCLUSIONS

The sand-delivery system to Coachella Valley fringe-toed lizard reserves in the northern Coachella Valley have been significantly altered historically. Much of the alteration has been in the stream channels that deliver fluvial sediment from the headwaters to the depositional areas upwind of the reserves. With the exception of the San Geronio River upstream from Banning, California, the fluvial part of the sediment delivery system is intact to the edges of the valley floor.

Modifications of channels within the northern Coachella Valley have had both positive and negative effects on sediment delivery to the depositional plains. The construction of dikes and infiltration galleries on

the Whitewater River downstream from Windy Point has both trapped some fluvial sediments upstream from the Whitewater depositional area as well as blocked westerly eolian sand transport from crossing much of the depositional area. Channelization of Mission Creek probably has increased delivery of sediments from the bedrock headwaters to the depositional area by minimizing within-bajada sediment storage. Recent flooding has incised channels through Willow Hole that drain the western Indio Hills, shifting at least some of the deposition of fluvial sand from within the Willow Hole Reserve (and just south of the main mesquite-stabilized dunes) to just south of the Reserve, potentially limiting eolian contributions from this sediment source.

Estimated eolian-transport rates predict that annual sand yields delivered to depositional areas are entrained and removed in 8 to 16 months given modern conditions, suggesting a continued balance between the fluvial and eolian transport systems and a constant sand supply to *Uma* sand dunes at present. Analysis of local wind directions at Willow Hole suggests that the potential to supply sand to the Willow Hole Reserve is not uniform among subsections of the Mission – Morongo depositional area. Quantification of the actual amounts of sand contributed by depositional area subsections would require the collection of additional data concerning the evenness of fluvial sediment deposition across the depositional area, as would the making of similar distinctions at other depositional areas.

Abbreviated Answers to Questions Posed by the U.S. Fish and Wildlife Service

Is there sufficient sand supply (in the fluvial system) to maintain the Willow Hole and Whitewater Floodplain Reserves?

Answer: The answer is a very tentative yes, there appears to be a sufficient sand supply to maintain the reserves, but the following issues are pertinent. (1) Sediment delivery in the northern Coachella Valley is highly episodic, and long periods of no delivery must be anticipated during drought conditions. These periods of deficient fluvial sediment supply will likely result in degraded *Uma* habitat irrespective of anthropogenic factors. Therefore, separation of human-induced from climate-induced changes to sediment

supply will be difficult to determine with confidence. (2) The sediment-delivery system is largely intact except the headwaters section of the San Geronio River, which currently is blocked by a sand-and-gravel in-stream mining operation, resulting in an estimated 14 percent reduction in sediment yield. (3) Sediment source areas are largely unaffected by development and are mostly managed by the State of California and the federal government. (4) Depositional areas have been reduced, but some of this reduction may be reversed by redesign of the infiltration galleries east of Windy Point. (5) Historical alteration of the channel issuing from Long Canyon for flood-control purposes may affect the already much reduced depositional area within the northern Coachella Valley, further limiting eolian transport to the Indio Hills and – indirectly – to Willow Hole. (6) Fluvial sediment from the Indio Hills that once deposited directly within Willow Hole now is mostly deposited downstream and south of the reserve due to recent channel entrenchment, making this a potential but unreliable source of eolian sediment for Willow Hole.

Problems: The infiltration galleries at Windy Point affect the Whitewater depositional area, pushing this critical depositional area downstream from where eolian sand is desired. Redesign of these galleries to allow for throughflow of eolian sediment and entrainment of fluvial sediment may be expensive.

How would channelization of Mission and Morongo Creeks and urban development on their adjacent floodplains affect sand supply to both reserves?

Answer: Channelization, if designed to minimize sediment storage on the alluvial fans, would probably benefit the sand-delivery system to the reserves by minimizing in-channel storage of sediments on the Desert Hot Springs bajada. Channelization would not reduce sediment yields because most of the sediment that reaches the depositional areas is not generated within the Desert Hot Springs bajada.

Problems: This conclusion involves only the sediment-delivery system and does not consider other biological impacts of channelization. Channelization in the depositional areas would decrease wind entrainment of fluvial sediment by decreasing the area available for fluvial sediments to accumulate as well as disrupting the wind fetch.

Do the retention dikes along the Whitewater River affect sand supply to the Whitewater Floodplain Reserve, and by how much? Could the design of the recharge ponds be modified to provide a continued sand supply to the reserve?

Answer: Given that 8.1 million ft³ of sediment was excavated from the retention ponds in 1996 the retention ponds clearly do trap fluvial sediment. This material may include a substantial amount of *Uma* sand, but an accurate estimate is not possible without evaluating both the time period over which this sediment was deposited as well as the proportion of *Uma* sand it contains. This sediment is entrained from the Whitewater River channel at flows of 200-400 ft³/s between the Colorado River aqueduct crossing and the infiltration galleries, although some of this material is deposited in the channel immediately upstream from the galleries. This sediment is trapped upstream from the Whitewater River depositional area owing to diversion dikes designed to channel water into the infiltration galleries and would be available for downstream transport if the diversion dikes are breached by a flood capable of transporting this sediment.

Alignment of the infiltration galleries perpendicular to the prevailing winds and the high slope angles on the downwind dikes minimize the amount of sand that can be entrained by eolian processes. Sediments dredged from the galleries and upstream channel could be spread in a flat surface in the historic Whitewater depositional area, allowing it to be entrained for eolian transport. Alternately, the galleries might be redesigned such that the long dimension is parallel to prevailing winds (long direction east-west instead of north-south), and the eastern dike of each gallery could be designed with a shallow slope to allow eolian sand to escape.

Problems: The redesign and modification of the infiltration galleries may be expensive.

How much of the floodplain of the washes supplying sand upwind of the reserves has to be preserved to ensure a perpetual sand supply? What areas are essential to preserve and maintain an adequate sand supply and sand-transport corridor for these two preserves?

Answer: Floodplains on the bajadas produce minimal sediment owing to the arid environment and infrequent nature of high-intensity rainfall. Most of the sediment that eventually is deposited upwind of the reserves is generated in mountainous headwaters areas

to the west and north of the valley floor. Channelization of major washes is beneficial to the sand-delivery system in the Coachella Valley reserves because sediment storage on the bajada upslope from the depositional areas is minimized. Thus, it is the channels on the fans that should be preserved, or enhanced, as they are the critical feature linking fluvial sediment sources in the mountains to the eolian sediment source areas downstream.

Low-elevation drainages at the western end of the Indio Hills north of Edom Hill are a potential source of eolian sand and should be preserved in their entirety. These drainages are not strictly part of the alluvial floodplain, nor are they typical of the high-elevation fluvial source areas in other drainage areas. This source is unique in that it has already been sorted by eolian processes, so that it is nearly twice as rich in potential habitat sand than other sources, and the sand supply, though largely a relict of the Pleistocene and not strictly renewable, is very large. Transport of this sand to Willow Hole is dependent on fluvial, rather than eolian processes. Given the potential of increased urbanization to further interrupt eolian sources of habitat sand, this fluvial source may become increasingly important in the future. Current natural channelization of the washes through Willow Hole reduces the potential for entrainment of this sand, but this channelization could be healed through natural processes or human intervention and should not be eliminated as a potential source of fluvial-eolian sand.

In contrast to the alluvial floodplains, the historical depositional plains at the downstream end of the channels depicted in figure 6a should be preserved in their entirety or developed with respect to the relative contribution of different area subsections to the overall *Uma* sand budget. Variables that should be measured to determine relative sand contribution include differential distribution of fluvial sediment across depositional areas, both in terms of volume and proportion of *Uma* sand, plan area of subsections, and frequency with which sand-transporting winds are directed toward the appropriate reserve, as illustrated in figure 15. The San Geronio – Whitewater and Mission Creek – Morongo Wash depositional areas are the fundamental source areas of eolian sand that maintain lizard habitat in both reserves. The construction of infiltration galleries to the west of the Whitewater Reserve has reduced the amount of sand available for eolian transport both by trapping sand and reducing the total area of sand exposed to the wind. At a minimum,

areas between historic deposition zones and downwind reserves should also be preserved to maintain an unobstructed eolian transportation corridors (fig. 6). Similarly, general consideration should be given to the effect that development of additional windbreaks in the area of the deposition zones would have on available wind energy.

The substantial reduction of the Long Canyon depositional area to the northern 20 percent of its historic extent has the dual effect of greatly decreasing the rate at which fluvial sediment is removed by eolian transport and shifting the dominant direction of transport northward, reducing sand supplied to the Indio Hills drainage north of Edom Hill. This alteration is unlikely to have an immediate effect on Willow Hole given that this sand is only indirectly supplied to the reserve through the Indio Hills, that there is an substantial amount of relict sand stored in the Indio Hills drainage area, and that fluvial sediment from the Indio Hills drainage currently pass through the reserve entirely. The long term effects of the Long Canyon alterations, however, are unknown.

Problems: This conclusion does not consider other potential biological impacts of channelization, including loss of ephemeral wash habitat and disruption of migration corridors.

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APPENDICES

APPENDIX 1. DESCRIPTIONS OF QUATERNARY GEOLOGIC MAP UNITS

Alluvial Units

Alluvial units mapped in the northern Coachella Valley include deposits created by the processes of streamflow, hyperconcentrated flow, and debris flow. The following characteristics apply to all alluvial units below, which are further subdivided on soil development and associated characteristics related to age. Alluvial deposits consist of sandy gravel and interbedded sand. Gravel clasts are angular to subrounded, range in size from pebbles to boulders, and generally are composed of granitic and gneissic rock types from the San Bernardino and Little San Bernardino Mountains, as well as reworked from older gravel sedimentary units. Deposits commonly are matrix-supported, but include some clast-supported beds. Bedding is massive to crudely stratified, and is defined by changes in clast size and sorting, which ranges from well sorted to poorly sorted.

Qayy. Youngest fan alluvium is of late Holocene age and is associated with intermittently active channels. Vegetation is absent to sparse in intermittently active channels, which are more abundant in this unit than in adjoining units. In the fan that emanates from the Wide Canyon area, the top of **Qayy** generally includes a cemented coarse-sand-rich, clast-poor bed, and a discontinuous eolian sand mantle. The eolian sand is usually fine sand that includes common biotite. Surface soil is very weakly developed with almost no oxidation. There is some cementation mainly as case-hardening along natural exposures. Depositional bar and swale morphology generally is well expressed but is more muted in areas of high rates of eolian sand deposition.

Qay. Young fan alluvium is of Holocene and latest Pleistocene age. Surface soil is generally very weakly developed, similar to that of **Qayy** and **Qayi** which are locally subdivided from this unit, but **Qay** includes areas of greater soil development up to the degree found in **Qayo** (see below) which is also locally subdivided from this unit. Pedogenic carbonate morphology does not exceed stage I–II, and occurs as thin carbonate and silica coatings on clast undersides. Depositional bar and swale morphology generally is

characteristic of this unit, but its expression decreases with maximum clast size, which generally decreases away from upland source areas.

Qayi. Intermediate young fan alluvium is of late Holocene age. This unit is only locally differentiated as a subdivision of **Qay** along Mission Creek and Morongo Wash where sharper bar and swale morphology occurs relative to adjoining areas of **Qay**.

Qayo. Older young alluvium of fan remnants and terraces is of early Holocene and latest Pleistocene age. The surface soil of this unit has a distinctive oxidized, eolian dust-rich cambic Bw horizon but has not attained the development of the reddened argillic horizon that is characteristic of **Qai** and older units. Pedogenic carbonate morphology does not exceed stage I–II, and occurs as thin carbonate and silica coatings on clast undersides. Depositional bar and swale morphology is apparent but is muted relative to adjacent **Qay**. Surface clasts include greater varnish, and give this unit a darker tone on aerial photographs.

Qfy. Young fan alluvium of the San Jacinto Mountains includes debris-flow deposits of Holocene and latest Pleistocene age. This unit is extremely bouldery. Surface soil is generally very weakly developed. Pedogenic carbonate morphology does not exceed stage I–II and occurs as thin carbonate and silica coatings on clast undersides. Depositional bar and swale morphology generally is characteristic of the unit, but its expression decreases with maximum clast size, which generally decreases away from upland source areas.

Qai. Intermediate age alluvium in fan remnants and terraces is of late and middle (?) Pleistocene age. Strong soil development (McFadden, 1982) includes a characteristic red-brown argillic horizon within the top 1 ft of the unit. Pedogenic carbonate morphology is variable within the map area and probably related to a climatic gradient of effective moisture decreasing eastward from San Geronio Pass. Along the west side of the Desert Hot Springs quadrangle, carbonate morphology does not exceed stage I–II and is probably largely Holocene. In the Seven Palms Valley quadrangle, carbonate morphology is typically stage III, with the deposit moderately to well cemented below the argillic horizon. Depositional morphology is generally absent; instead the surface has been somewhat reworked and eroded during and preceding formation of the argillic horizon. Surface clasts are commonly highly pitted and eroded, though some resistant rock types have developed dark coatings of

desert varnish. Along Mission Creek in the northwestern part of the map area, a sample from a silty sand bed at a depth of about 13 ft yielded a thermoluminescence date of about 60 ka to 80 ka, depending on assumptions about moisture history (S. Mahan, written commun., 2001).

Qaiy. Younger intermediate alluvium of fan remnants and terraces is of late Pleistocene age. **Qaiy** is a locally distinguished subdivision of **Qai** where **Qaiy** forms an inset terrace within the **Qai** fan remnant complex at the mouth of Mission Creek in the northwest part of the map area. It has a similar surface soil to **Qai** and is characterized by a red-brown argillic Bt horizon within 1.6 ft of the surface.

Qao. Older alluvium of Pleistocene age is characterized by erosional surface morphology and the lack of remnants of an upper depositional surface. This unit forms resistant ridges in the Indio Hills, is generally poorly exposed, and is mantled and flanked by eolian sand (**Qe**) and colluvium (**Qcf**). Much of the surface area of **Qao** in the Indio Hills and Garnet Hill includes marble and other metasedimentary rock types that are probably derived from the San Jacinto Range. **Qao** forms poorly exposed deformed sediments cemented by pedogenic carbonate at Garnet Hill.

Qau. Undivided Pleistocene alluvium includes faulted and folded alluvial gravel and sand in ridges along the Banning and Mission Creek strands of the San Andreas fault system.

Qtpc. As mapped by Allen (1957) and Proctor (1968), the Painted Canyon Formation is a deformed and dissected conglomerate that occurs between the

Banning and Mission Creek Faults near the western boundary of the map area. This map unit includes the intercalated basalt flow near Devils Garden (Matti and Morton, 1993).

Qtps. The Palm Spring Formation consists of unconsolidated gravel, sand, silt, and mud to consolidated conglomerate, sandstone, siltstone, and mudstone and is exposed in badlands in the dissected, folded core of the Indio Hills.

Colluvial and Eolian Deposits

Colluvial deposits in the northern Coachella Valley are created by mass wasting processes, such as landslides, avalanches, and isolated rockfalls. Eolian deposits in the map area generally are thin, ephemeral sand dunes or sheets that change greatly in size with time as the fluvial sand supply on the depositional areas increases after a flood or is depleted by wind erosion.

Qcf. Colluvium and interbedded alluvium and eolian deposits generally occur in a footslope position.

Qe. Eolian sand and sandy colluvium and alluvium form sheets and sand ramps on slopes.

Qd. Eolian sand dunes of Holocene age are intermittently active but may be locally vegetated with mesquite.

Afd. Artificial fill and disturbed ground are created by human disturbance or development.

APPENDIX 2. AVAILABLE DAILY STREAM-FLOW DATA FOR THE NORTHERN COACHELLA VALLEY THROUGH 2001

Station name ¹	Period of record (water year) ²	Missing record (water years)	Drainage area (mi ²)	USGS station umber	Latitude ³	Longitude ³
Whitewater River at Whitewater	1949-1979 (discharge)	None	57.5	10256000	33°56'48"	116°38'24"
	1972 (suspended sediment)	None	57.5	10256000	33°56'48"	116°38'24"
Whitewater MWC Diversion at Whitewater	1966-1981	1971, 1974, February 1977	–	10256050	33°56'44"	116°38'25"
Whitewater River at Whitewater Cut at Whitewater	1986-1987, 1989-1990	None	59.1	10256060	33°55'31"	116°38'07"
San Gorgonio River near Banning	1976-1977	None	14.8	10256200	33°59'54"	116°54'29"
San Gorgonio River at Banning	1981	First 4 months	44.2	10256300	33°55'52"	116°49'37"
San Gorgonio River near Whitewater	1963-1978	First 5 months	154.0	10256400	33°55'14"	116°41'45"
Snow Creek near Whitewater	1921-1931 (missing 36 months), 1960-2001	1932-1959	10.9	10256500	33°52'14"	116°40'49"
Snow Creek and Div Combined	1921-1931 (missing 36 months), 1960-2001	1932-1959	10.9	10256501	33°52'14"	116°40'49"
Snow Creek Div near Whitewater	1978-2000	1985, 1989	–	10256550	33°52'14"	116°40'49"
Falls Creek Div near Whitewater	1995-2001	None	4.1	10257499	33°52'10"	116°40'15"
Falls Creek near Whitewater	1923-1926, 01/28- 07/31, 1995-2001	1932- 1994	4.1	10257500	33°52'10"	116°40'15"
Combined Flows Falls Creek near Whitewater + Diversions	1995-2000	None	–	10257501	33°52'10"	116°40'15"
Whitewater River at Windy Point Main Channel	1999-2001	13 days	264.0	10257548	33°53'56"	116°37'13"
Whitewater River at Windy Point Overflow Channel	1999-2001	14 days	264.0	10257549	33°53'56"	116°37'13"
Whitewater River at Windy Point near Whitewater	1985-1987, 1989-2001	September 1989	264.0	10257550	33°53'56"	116°37'13"
Mission Creek near Desert Hot Springs	1968-2001	9 days	35.6	10257600	34°00'40"	116°37'38"
Chino Canyon Creek near Palm Springs	1975-1985	13 days + last 2 months	3.8	10257710	33°50'21"	116°36'45"
Chino Canyon Creek below Tramway near Palm Springs	1987-2001	10 days	4.7	10257720	33°50'39"	116°36'16"
Long Canyon Creek near Desert Hot Springs	1964-1971	None	19.6	10257800	33°57'53"	116°26'35"

¹R, river; MWD, Metropolitan Water District; Div, diversion; BL, below

²Records are daily-value streamflow discharge, unless otherwise noted.

³Referenced to the North American Datum of 1927 (NAD 27).

Griffiths, Webb, Lancaster, Kaehler, and Lundstrom—LONG-TERM SAND SUPPLY TO COACHELLA FRINGE-TOED LIZARD HABITAT IN THE NORTHERN
COACHELLA VALLEY, CALIFORNIA—U.S. Geological Survey Water-Resources Investigations Report 02-4013



Gavin Newsom
Governor

STATE OF CALIFORNIA
Governor's Office of Planning and Research
State Clearinghouse and Planning Unit



Kate Gordon
Director

IC-ENGINEERING

IC-ENVIRONMENTAL SERVICES

Notice of Preparation

File: 0122.10

February 3, 2020

To: Reviewing Agencies

Re: Whitewater River Groundwater Replenishment Project
SCH# 2020020004

Attached for your review and comment is the Notice of Preparation (NOP) for the Whitewater River Groundwater Replenishment Project draft Environmental Impact Report (EIR).

Responsible agencies must transmit their comments on the scope and content of the NOP, focusing on specific information related to their own statutory responsibility, within 30 days of receipt of the NOP from the Lead Agency. This is a courtesy notice provided by the State Clearinghouse with a reminder for you to comment in a timely manner. We encourage other agencies to also respond to this notice and express their concerns early in the environmental review process.

Please direct your comments to:

**William Patterson
Coachella Valley Water District
75-515 Hovley Lane East
Palm Desert, CA 92211**

with a copy to the State Clearinghouse in the Office of Planning and Research at state.clearinghouse@opr.ca.gov. Please refer to the SCH number noted above in all correspondence concerning this project on our website: <https://ceqanet.opr.ca.gov/2020020004/2>.

If you have any questions about the environmental document review process, please call the State Clearinghouse at (916) 445-0613.

Sincerely,

Scott Morgan
Director, State Clearinghouse

cc: Lead Agency

1400 TENTH STREET P.O. BOX 3044 SACRAMENTO, CALIFORNIA 95812-3044
TEL 1-916-445-0613 state.clearinghouse@opr.ca.gov www.opr.ca.gov

3
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Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
 For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

2020020004
 SCH #

Project Title: Whitewater River Groundwater Replenishment Project

Lead Agency: Coachella Valley Water District

Contact Person: William Patterson

Mailing Address: 75-515 Hovley Lane East

Phone: (760) 398-2651

City: Palm Desert

Zip: 92211

County: Riverside

Project Location: County: Riverside

City/Nearest Community: City of Palm Springs

Cross Streets: State Route 111 and Overture Drive

Zip Code: 92262

Longitude/Latitude (degrees, minutes and seconds): 33 ° 53 ' 33.65 " N / 116 ° 35 ' 49.32 " W Total Acres: 690.73

Assessor's Parcel No.: Various

Section: 20, 28, 30 Twp.: 3S

Range: 4E

Base: San Bernardino

Within 2 Miles: State Hwy #: 111

Waterways: Whitewater River

Airports: N/A

Railways: Union Pacific

Schools: N/A

Document Type:

CEQA: ☒ NOP

☐ Draft EIR

NEPA: ☐ NOI

Other: ☐ Joint Document

☐ Early Cons

☐ Supplement/Subsequent EIR

☐ EA

☐ Final Document

☐ Neg Dec

(Prior SCH No.) _____

☐ Draft EIS

☐ Other: _____

☐ Mit Neg Dec

Other: _____

☐ FONSI

Local Action Type:

☐ General Plan Update

☐ Specific Plan

☐ Rezone

☐ Annexation

☐ General Plan Amendment

☐ Master Plan

☐ Prezone

☐ Redevelopment

☐ General Plan Element

☐ Planned Unit Development

☐ Use Permit

☐ Coastal Permit

☐ Community Plan

☐ Site Plan

☐ Land Division (Subdivision, etc.)

☒ Other: ROW Renewal

Development Type:

☐ Residential: Units _____ Acres _____

_____ Acres _____

Employees _____

☐ Transportation: Type _____

☐ Office: Sq.ft. _____

_____ Acres _____

Employees _____

☐ Mining: Mineral _____

☐ Commercial: Sq.ft. _____

_____ Acres _____

Employees _____

☐ Power: Type _____

☐ Industrial: Sq.ft. _____

_____ Acres _____

Employees _____

☐ Waste Treatment: Type _____

☐ Educational: _____

☐ Hazardous Waste: Ty _____

☐ Recreational: _____

☐ Other: _____

☒ Water Facilities: Type Groundwater Replenishment MGD - _____

Governor's Office of Planning & Research

FEB 03 2020

STATE CLEARINGHOUSE

Project Issues Discussed in Document:

☒ Aesthetic/Visual

☐ Fiscal

☐ Recreation/Parks

☒ Vegetation

☒ Agricultural Land

☒ Flood Plain/Flooding

☐ Schools/Universities

☒ Water Quality

☒ Air Quality

☐ Forest Land/Fire Hazard

☐ Septic Systems

☒ Water Supply/Groundwater

☒ Archeological/Historical

☒ Geologic/Seismic

☐ Sewer Capacity

☒ Wetland/Riparian

☒ Biological Resources

☐ Minerals

☒ Soil Erosion/Compaction/Grading

☒ Growth Inducement

☐ Coastal Zone

☒ Noise

☐ Solid Waste

☒ Land Use

☒ Drainage/Absorption

☐ Population/Housing Balance

☒ Toxic/Hazardous

☒ Cumulative Effects

☐ Economic/Jobs

☐ Public Services/Facilities

☒ Traffic/Circulation

☐ Other: _____

Present Land Use/Zoning/General Plan Designation:

Groundwater Replenishment Facility / Watercourse Zone / Watercourse Zone & Watercourse Zone (Wind Energy Overlay)

Project Description: *(please use a separate page if necessary)*

See attached.

Note: The State Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

Revised 2010

NOP Distribution List

County: Riverside

SCH#

2020020004

Resources Agency

☒ Resources Agency
Nadell Gayou

☐ Dept. of Boating & Waterways
Denise Peterson

☐ California Coastal Commission
Allyson Hitt

☒ Colorado River Board
Elsa Contreras

☒ Dept. of Conservation
Crina Chan

☒ Cal Fire
Dan Foster

☐ Central Valley Flood Protection Board
James Herola

☒ Office of Historic Preservation
Ron Parsons

☒ Dept of Parks & Recreation
Environmental Stewardship Section

☐ S.F. Bay Conservation & Dev't. Comm.
Steve Goldbeck

☒ Dept. of Water Resources
Nadell Gayou

Fish and Wildlife

☐ Depart. of Fish & Wildlife
Scott Flint
Environmental Services Division

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Curt Babcock

☐ Fish & Wildlife Region 1E
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Leslie Newton-Read
Habitat Conservation Program

☒ Fish & Wildlife Region 6
Tiffany Ellis
Habitat Conservation Program

☐ Fish & Wildlife Region 6 I/M
Heldi Calvert
Inyo/Mono. Habitat Conservation Program

☐ Dept. of Fish & Wildlife M
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Marine Region

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Monique Wilber

☐ Food & Agriculture
Sandra Schubert
Dept. of Food and Agriculture

☐ Dept. of General Services
Cathy Buck
Environmental Services Section

☐ Housing & Comm. Dev.
CEQA Coordinator
Housing Policy Division

Independent Commissions, Boards

☐ Delta Protection Commission
Erik Vink

☐ Delta Stewardship Council
Anthony Navasero

☒ California Energy Commission
Eric Knight

☒ Native American Heritage Comm.
Debbie Treadway

☒ Public Utilities Commission
Supervisor

☐ Santa Monica Bay Restoration
Guangyu Wang

☒ State Lands Commission
Jennifer Deleong

☐ Tahoe Regional Planning Agency (TRPA)
Cherry Jacques

Cal State Transportation Agency CalSTA

☐ Caltrans - Division of Aeronautics
Philip Crimmins

☐ Caltrans - Planning
HQ LD-IGR
Christian Bushong

☒ California Highway Patrol
Suzann Ikauchi
Office of Special Projects

Dept. of Transportation

☐ Caltrans, District 1
Rex Jackman

☐ Caltrans, District 2
Marcelino Gonzalez

☐ Caltrans, District 3
Susan Zanchi

☐ Caltrans, District 4
Mark Leong

☐ Caltrans, District 5
Larry Newland

☐ Caltrans, District 6
Michael Navarro

☐ Caltrans, District 7
Dianna Watson

☒ Caltrans, District 8
Mark Roberts

☐ Caltrans, District 9
Gayle Rusander

☐ Caltrans, District 10
Tom Dumas

☐ Caltrans, District 11
Jacob Armstrong

☐ Caltrans, District 12
Maureen El Harake

Cal EPA

Air Resources Board

☐ Airport & Freight
Jack Wursten

☐ Transportation Projects
Nesamani Kalandiyur

☒ Industrial/Energy Projects
Mike Tollstrup

☐ California Department of Resources, Recycling & Recovery
Kevin Taylor/Jeff Esquivel

☐ State Water Resources Control Board
Regional Programs Unit
Division of Financial Assistance

☐ State Water Resources Control Board
Cindy Forbes - Asst Deputy
Division of Drinking Water

☐ State Water Resources Control Board
Div. Drinking Water #

☒ State Water Resources Control Board
Student Intern, 401 Water Quality
Certification Unit
Division of Water Quality

☒ State Water Resources Control Board
Phil Crader
Division of Water Rights

☒ Dept. of Toxic Substances
Control Reg. #
CEQA Tracking Center

☐ Department of Pesticide Regulation
CEQA Coordinator

Regional Water Quality Control Board (RWQCB)

☐ RWQCB 1
Cathleen Hudson
North Coast Region (1)

☐ RWQCB 2
Environmental Document Coordinator
San Francisco Bay Region (2)

☐ RWQCB 3
Central Coast Region (3)

☐ RWQCB 4
Teresa Rodgers
Los Angeles Region (4)

☐ RWQCB 5S
Central Valley Region (5)

☐ RWQCB 5F
Central Valley Region (5)
Fresno Branch Office

☐ RWQCB 5R
Central Valley Region (5)
Redding Branch Office

☐ RWQCB 6
Lahontan Region (6)

☐ RWQCB 6V
Lahontan Region (6)
Victorville Branch Office

☒ RWQCB 7
Colorado River Basin Region (7)

☐ RWQCB 8
Santa Ana Region (8)

☐ RWQCB 9
San Diego Region (9)

☐ Other

☒ Coastella Waters
Conservancy