SECTION 5
MONITORING NETWORK

The development of the monitoring network will involve a "phased approach." Integral with the phased approach will be the development and refinement of a number of water resources models as described in Section 3. The Management Plan will be implemented with an initial set of monitoring features and parameters developed by Metropolitan from the existing data. The BLM Authorized Officer will provide input and guidance throughout the development and refinement of the initial implementation. The BLM Authorized Officer will receive comments and recommendations from the TRP regarding the development and refinement of the initial implementation. The BLM Authorized Officer will approve the initial monitoring network in accordance with Section 10. As new data become available, the monitoring features defined below will be refined as necessary to protect critical resources in and adjacent to the project area. If Metropolitan proposes a refinement to monitoring features, it will submit a written proposal describing the refinement along with supporting data and materials to the BLM Authorized Officer. The BLM Authorized Officer will make a decision on Metropolitan's proposal through the decision-making process described in Section 10.

A total of 24 different monitoring features have been identified for assessing potential impacts to the four critical resources during the term of the Cadiz Project. As described in Section 2, these critical resources include springs located within the Mojave National Preserve and BLM-managed lands, the aquifer system, and Bristol and Cadiz dry lakes as relates to brine resources and dust mobilization from Bristol and Cadiz dry lakes. A summary of the types of monitoring features, as well as monitoring frequencies, is provided in Table 1. A detailed list of each monitoring feature is provided in Table 2. Generalized locations are shown in Figures 4 and 5.

Installation of certain monitoring features will be subject to site-specific approval and permitting by applicable regulatory agencies. The NPS and BLM will complete and deliver all needed permits for monitoring facilities in accordance with the schedule contained in the Record of Decision as soon as practicable within the pre-operational phase. The project will construct all facilities that are agreed to in the Management Plan and for which permits have been received. Construction of these facilities will be completed within one year of receipt of permits. If the implementation of monitoring features currently contained in the Management Plan is not approved, Metropolitan will evaluate and implement alternate monitoring sites subject to approval by the applicable regulatory agencies.

The following text describes in detail the various proposed monitoring features.

5.1 PROPOSED "S-SERIES" OBSERVATION WELLS (FEATURE 1)

A series of "early-warning" observation wells known as the "S-Series" wells will be established to monitor groundwater-level fluctuations in the project aquifer system, in order to detect any impacts to the aquifer system due to project operations before such impacts reach the boundary of the Mojave National Preserve. Water-level fluctuations in these observation wells will act as an "early warning" measure of potential adverse impacts that might extend to springs in the Mojave National Preserve or BLM-managed lands in the affected watersheds.

Four S-Series observation-well clusters will be established upgradient of the project wellfield and spreading basins, which are approximately equidistant between (1) the project wellfield and spreading basins and (2) the boundary of the Mojave National Preserve. One S-Series observation-well cluster will be established in each of the following four general locations, as shown on Figure 4: (1) in Orange

TABLE 2
SUMMARY OF MONITORING FEATURES AND PROTOCOLS

Critical Resource Area	Feature No.	Feature Type	When Monitored	Name	State Well Number	Location Coordinates[a]	Monitoring Protocol		
							Water Level	Water Quality	Other Monitoring
Springs in the Mojave National Preserve and BLM Managed Lands	1	S-Series Well Clusters[b] (2 to 3 per Cluster x 4 total Clusters)	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Section 6.1	See Appendices C & D	-
			Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Section 6.1	See Appendices C & D	-
			Pre-Operational Operational Post-Operational	TBD	TBD[c]	TBD	Transducer, See Section 6.1	See Appendices C & D	-
			Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Section 6.1	See Appendices C & D	-
	2	Initial Spring Survey (28+ total)	Pre-Operational	TBD	NA[d]	TBD	-	See Section 6.1 and Appendix D	See Section 6.1
	3	Springs, Monitoring (8 total)	Pre-Operational Operational Post-Operational	TBD	NA	TBD	Transducer, See Section 6.1	-	See Section 6.1
Aquifer System	4	Observation Well	Pre-Operational Operational	New Well	5N/14E-31L2	TBD	Transducer, See Sections 5 and 6.2	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	Dormitory	5N/14E-5F1	34° 32' 38" N 115° 31' 57" W	Transducer, See Sections 5 and 6.2	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	6/15-29	6N/15E-29Q1	34° 34' 20" N 115° 26' 04" W	Transducer, See Sections 5 and 6.2	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	SCE-11	5N/14E-13R1	34° 25' 52 N 115° 27' 25" W	Transducer, See Sections 5 and.6.2	See Appendices C & D	-

TABLE 2
SUMMARY OF MONITORING FEATURES AND PROTOCOLS (Continued)

Critical Resource Area	Feature No.	Feature Type	When Monitored	Name	State Well Number	Location Coordinates[a]	Monitoring Protocol		
							Water Level	Water Quality	Other Monitoring
Aquifer System	4	Observation Well	Pre-Operational Operational	CI-3	5N/14E-24D2	34° 30' 40" N 115° 28' 01" W	Transducer, See Sections 5 and 6.2	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	Archer Siding #1	4N/15E-24E1	34° 25' 11" N 115° 21' 57" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	Essex	8N/17E-31	34° 43' 49" N 115° 14' 53" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	Fenner	8N/17E-2	34° 48' 59" N 115° 10' 40" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	Goffs	10N/18E-26	34° 54' 57" N 115° 03' 44" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	Labor Camp	5N14E-16H1	34° 31' 22" N 115° 30' 46" W	Transducer, See Sections 5and 6.2	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	SCE-5	5N/14E-31L1	34° 28' 38" N 115° 33' 09" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	SCE-9	5N/13E-14B1	34° 31' 36" N 115° 35' 18" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	SCE-10	5N/14E-34Q1	34° 28' 11" N 115° 30' 03" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational	SCE-17	5N/15E-29B1	34° 29' 45" N 115° 31' 57" W	Manual, See Appendix B	See Appendices C & D	-

TABLE 2
SUMMARY OF MONITORING FEATURES AND PROTOCOLS (Continued)

Critical Resource Area	Feature No.	Feature Type	When Monitored	Name	State Well Number	Location Coordinates[a]	Monitoring Protocol		
							Water Level	Water Quality	Other Monitoring
Aquifer System	4	Observation Well	Pre-Operational Operational	SCE-18	5N/13E-11R1	34° 26' 34" N 115° 34' 52" W	Manual, See Appendix B	See Appendices C & D	-
	5	Project Area Well Clusters[e]- Vadose Only (1 per Cluster x 3 total Clusters)	Operational	TBD	TBD	TBD	Manual, See Appendix B	See Appendices C & D	-
	6	Project Area Well Clusters[e]- Groundwater (2 per Cluster x 3 total Clusters)	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5 and 6.2	See Appendices C & D	-
	7	Existing Production Wells (4 total)	Operational	PW-1	5N/14E-24D1	34° 30' 41" N 115° 27' 53" W	-	-	See Sections 5 and 6.2
			Operational	22	5N/14E-22K1	34° 30' 21" N 115° 29' 01" W	-	-	See Sections 5 and 6.2
			Operational	27N	5N/14E-27B1	34° 29' 54" N 115° 29' 59" W	-	-	See Sections 5 and 6.2
			Operational	27S	5N/14E-27Q1	34° 28' 14" N 115° 29' 59" W	-	-	See Sections 5 and 6.2
	7	New Production Wells (26 total)	Operational	TBD	TBD	TBD	-	-	See Sections 5 and 6.2
	8	Recharge Water Quality	Operational	Lake Havasu	NA	TBD	-	See Sections 5 and 6.2	-

TABLE 2
SUMMARY OF MONITORING FEATURES AND PROTOCOLS (Continued)

Critical Resource Area	Feature No.	Feature Type	When Monitored	Name	State Well Number	Location Coordinates[a]	Monitoring Protocol		
							Water Level	Water Quality	Other Monitoring
Aquifer System	9	Spreading Basins	Operational	Fenner Gap	NA	TBD	See Sections 5 and 6.2	-	-
	10	Benchmark Stations (20 total)	Pre-Operational Operational	TBD	NA	TBD	-	-	See Sections 5 and 6.2
		InSAR (2 per year, if warranted)	Pre-Operational Operational	NA	NA	NA	-	-	See Sections 5 and 6.2
	11	Extensometer (if warranted) (1 total)	Operational	TBD	NA	TBD	-	-	See Sections 5 and 6.2
	12	Microgravity Stations, if warranted (10 total)	Pre-Operational Operational Post-Operational	TBD	NA	TBD	See Sections 5 and 6.2	-	-
	13	Flowmeter Surveys (5 total)	Pre-Operational	TBD	TBD	TBD	-	-	See Sections 5 and 6.2
Bristol and Cadiz Dry Lakes	14	Bristol Dry Lake Well Cluster[f]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5 and 6.3	See Appendices C & D	-
		Bristol Dry Lake Well Cluster[f]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5 and 6.3	See Appendices C & D	-
		Bristol Dry Lake Well Cluster[g]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5 and 6.3	See Appendices C & D	-
	15	Cadiz Dry Lake Well Cluster[h]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5 and 6.3	See Appendices C & D	-
		Cadiz Dry Lake Well Cluster[h]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5 and 6.3	See Appendices C & D	-

TABLE 2
SUMMARY OF MONITORING FEATURES AND PROTOCOLS (Continued)

Critical Resource Area	Feature No.	Feature Type	When Monitored	Name	State Well Number	Location Coordinates[a]	Monitoring Protocol		
							Water Level	Water Quality	Other Monitoring
Bristol and Cadiz Dry Lakes	14	Cadiz Dry Lake Well Cluster[i]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5 and 6.3	See Appendices C & D	-
	16	ET Station (Bristol Dry Lake)	Pre-Operational Operational Post-Operational	TBD	NA	TBD	-	-	See Sections 5 and 6.3
		ET Station (Cadiz Dry Lake)	Pre-Operational Operational Post-Operational	TBD	NA	TBD	-	-	See Sections 5 and 6.3
	17	Staff Gage (Bristol)	Pre-Operational Operational	TBD	NA	TBD	See Sections 5 and 6.3	-	-
		Staff Gage (Cadiz)	Pre-Operational Operational	TBD	NA	TBD	See Sections 5 and 6.3	-	-
	18	Nephelometers (4 total) with Digital Cameras(2 total)	Pre-Operational Operational Post-Operational	TBD	NA	TBD	-	-	See Sections 5 and 6.3
	19	Resistively Survey (1 total)	Pre-Operational	NA	NA	TBD	-	-	See Sections 5 and 6.3
	20	Gamma/EM Logs (up to 6 total)	Pre-Operational	TBD	TBD	TBD	-	-	See Sections 5 and 6.3
Other (Basin-wide)	21	Weather Station	Pre-Operational Operational	Amboy	NA	34° 31' 52" N 115° 41' 42" W	-	-	See Sections 5 and 6.4
		Weather Station	Pre-Operational Operational	Mitchell Caverns	NA	34° 56' 06" N 115° 30' 58" W	-	-	See Sections 5 and 6.4
		Weather Station	Pre-Operational Operational	Fenner Gap	NA	TBD	-	-	See Sections 5 and 6.4

TABLE 2
SUMMARY OF MONITORING FEATURES AND PROTOCOLS (Continued)

Critical Resource Area	Feature No.	Feature Type	When Monitored	Name	State Well Number	Location Coordinates[a]	Monitoring Protocol		
							Water Level	Water Quality	Other Monitoring
		Weather Station	Pre-Operational Operational	TBD	NA	TBD	-	-	See Sections 5 and 6.4
Other (Basin-wide)	22	Stream Gage	Pre-Operational Operational	Caruthers Canyon	NA	35° 14' 42" N 115° 17' 53" W	-	-	See Sections 5 and 6.4
		New Stream Gages (2 total)	Pre-Operational Operational	TBD	NA	TBD	-	-	See Sections 5 and 6.4
	23	Soil Moisture Sensors (2 total)	Operational	TBD	NA	TBD	-	-	See Sections 5 and 6.4
	24	Meteorological Towers (3 total)	Pre-Operational Operational	Orange Blossom Wash, Valley between Clipper and Marble Mtns & Unnamed Valley	NA	TBD	-	-	See Sections 5 and 6.4

NOTES:

a – Location coordinates to be verified in the field during initial Pre-Operational activity.

b – Four S-Series well clusters: (1) in Orange Blossom Wash; (2) in Clipper Wash (between the Marble Mountains and the Clipper Mountains); (3) directly south of the Clipper Mountains (generally south of Bonanza Spring); and (4) in Schulyler Wash.

c - To Be Determined.

d – Not Applicable.

e – Three new well clusters to be installed within project area.

Each cluster will consist of 2 groundwater monitoring wells and 1 unsaturated zone monitoring well.

f – Two new well clusters to be installed at eastern margin of Bristol Dry Lake.

g – One new well cluster to be installed on Bristol Dry Lake.

h – Two new well clusters to be installed north of Cadiz Dry Lake.

i – One new well cluster to be installed on Cadiz Dry Lake.

Blossom Wash; (2) in Clipper Wash (between the Marble Mountains and the Clipper Mountains); (3) directly south of the Clipper Mountains (generally south of Bonanza Spring); and (4) in Schulyler Wash. Each S-Series observation-well cluster will consist of two or three separate well casings installed within their own individual boreholes, and completed and screened at different depths including wells screened in the production aquifer(s) and one screened across the water table. These well clusters will be used to provide information regarding potentiometric head and water quality with depth.

A typical observation well cluster completion is illustrated on Figure 6. Screened intervals for each of the wells within each cluster will be determined from logging of cuttings and geophysical logging of the deep borehole which will be drilled first. Each deep well will be completed with PVC or other suitable well casing and screen to allow for dual induction geophysical logging. Shallow and intermediate wells will be completed with PVC or other suitable well casing and screen.

All new observation well drilling and well installation will be conducted in accordance with the protocols specified in ASTM D5092-90 (see Appendix A). During drilling, selected core intervals will be collected and classified from the borehole for each of the deepest cluster wells. All soil samples will be classified in the field according to the Unified Soil Classification System (USCS). Selected cores will be submitted to a State certified laboratory for analysis of vertical permeability by ASTM D5084.

5.2 SPRINGS (FEATURES 2 AND 3)

An inventory of 28 known springs within the Fenner and Orange Blossom Wash watersheds will be prepared in cooperation with the agencies within the Department of the Interior, as described in Section 5. During the term of the Cadiz Project, approximately eight springs will be selected as long-term monitoring sites, as described in Section 5. Likely long-term monitoring sites include: (1) one spring site on the south side of the Granite Mountains (e.g. Budweiser Spring, Willow Spring Basin, or Cove Spring); (2) one spring in the Van Winkle Mountains (Van Winkle spring); (3) one spring on the east side of the Providence Mountains (e.g. Quail spring or Foshay spring); (4) one spring on the south side of Wild Horse Mesa (most likely Whiskey spring); (5) one spring on the east side of the Fenner Valley within the Mojave National Preserve (probably Vontrigger spring); (6) Bonanza spring on the south side of the Clipper Mountains; (7) one spring in the Clipper Mountains Wilderness Area (e.g. Hummingbird spring), and (8) one spring in the Old Woman Wilderness Area (e.g. Barrel spring).

5.3 OBSERVATION WELLS (FEATURES 4 THROUGH 6)

A total of 14 existing observation wells will be used to monitor groundwater levels during the project (see Tables 1 and 2). Locations of these wells are shown on Figures 4 and 5. Six of these wells were installed in the 1960's by Southern California Edison as part of a regional investigation (wells whose designation begins with "SCE"). Three of the observation wells (Labor Camp, Dormitory, and 6/15-29) are owned and monitored by Cadiz as part of their agricultural operation. Well CI-3 was installed in Fenner Gap during the pilot spreading basin test for the project. Wells at Essex, Fenner, Goffs, and Archer Siding #1 are related to railroad operations or municipal supply. Wells will be utilized provided that appropriate permission and approval is obtained.

The project will incorporate 14 existing observation wells and 1 new (to be installed) observation[1] well for the purposes of monitoring groundwater levels and collecting water quality samples in the vicinity of the project. Two different types of observation wells will be monitored: existing single completion observation wells and proposed multiple completion cluster wells. A total of 14 existing observation wells (each consisting of a single cased well with one screened interval) will be used as monitoring wells

[1] Installation of any new monitoring facilities will be subject to approval by the applicable regulatory agencies.

during the project. One new deep observation well will be installed adjacent to existing observation well SCE-5. A total of three new observation well clusters will be installed in the immediate project vicinity and monitored during the project[2].

5.4 PROPOSED OBSERVATION WELL CLUSTERS WITHIN THE IMMEDIATE PROJECT AREA (FEATURES 5 AND 6)

Three well clusters will be established in the immediate vicinity of the project spreading basins and wellfield (see Figure 5). The uppermost screened interval of each cluster location will be above the pre-operational static water table (in the saturated zone of the future storage mound) to enable monitoring of elevated total dissolved solids water that would result from the leaching of salts out of the unsaturated zone during the initial infiltration of Colorado River water. The middle and lower screened intervals will be in the upper and lower aquifers, respectively. One well cluster will be developed around existing well CI-3, which is screened in the upper aquifer.

5.5 PROJECT PRODUCTION WELLS (FEATURE 7)

5.5.1 EXISTING CADIZ AGRICULTURAL WELLS

The Cadiz agricultural operation owns and operates seven agricultural wells used for irrigation, which are located west and southwest of the project spreading basins (see Figure 2). Three of the seven Cadiz irrigation wells could be incorporated into the project wellfield (Wells 22, 27N, and 27S). In addition, one production well (PW-1) has already been constructed as part of the pilot spreading basin test and is located in the vicinity of the proposed project spreading basins.

5.5.2 NEW PRODUCTION WELLS

The project wellfield would consist of approximately 26 additional production wells to be located as shown on Figure 2. Each new well would be completed to a depth of about 1,000 feet (see Figure 7). The total capacity of the wellfield would range from 200 to 250 cfs.

5.6 RECHARGE WATER QUALITY (FEATURE 8)

Delivery of Colorado River water to the project spreading basin facilities would be recorded from totalizer readings of flow at the Iron Mountain Pumping Plant. During operation of the project spreading basins, analyses of Colorado River water quality would be conducted on a weekly basis from samples collected at Lake Havasu.

5.7 SPREADING BASINS - WATER LEVEL STAFF GAGES (FEATURE 9)

Calibrated water level staff gages would be placed in each subbasin of the project spreading basin. Each staff gage would be located on the floor of the basin but close enough to the berm slope so as to be readable from the top of the berm.

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[2] Tables 1 and 2 separate features 5 and 6 to indicate that monitoring will occur in both the unsaturated and saturated zones. However, features 5 and 6 together total 3 clusters (not 3 clusters for each feature).

5.8 LAND SURFACE MONITORING (FEATURE 10)

A network of approximately 20 survey benchmarks will be installed at the approximate locations shown on Figure 5 to monitor changes in land surface elevation should they occur. Each benchmark will be established and surveyed by a California licensed land surveyor. All locations will be dependent upon permitting from the appropriate agencies. Benchmark surveys will be conducted on an annual basis during the term of the Cadiz Project (see Table 1).

Pre-operational baseline Interferometric Synthetic Aperture Radar ("InSAR")[3] data may be necessary to evaluate potential impacts. If determined by Metropolitan to be necessary, or required by the BLM Authorized Officer in accordance with the decision-making process described in Section 10, Metropolitan will obtain surveyed baseline land surface elevations which then will be compared to each other along with any InSAR data collected during the course of the project. The InSAR data would be used to monitor relative changes of land surface elevation, which could be related to aquifer system deformation in the project area. This pre-operational InSAR data (collected at two separate times during the year prior to the operational phase of the project) would complement the land survey data to establish changes in land surface elevations. The InSAR images would be obtained and evaluated semi-annually during the project, as necessary to evaluate potential impacts.

5.9 EXTENSOMETERS (FEATURE 11)

If necessary to evaluate potential impacts, as determined by the annual benchmark surveys, Metropolitan would construct one extensometer well in the area of the highest probability of subsidence (see Figure 5). The extensometer would be constructed to measure non-recoverable compaction of fine-grained materials interbedded within the alluvial aquifer systems.

5.10 MICROGRAVITY REFERENCE STATIONS (FEATURE 12)

If determined by Metropolitan to be necessary, or required by the BLM Authorized Officer in accordance with the decision-making process described in Section 10, Metropolitan will install up to 10 surveyed reference points for use in conjunction with gravity surveys within the project area (see Figure 5). The gravity method (or gravimetry) is a potential field method based on the principle that density differences in subsurface materials (e.g. between unsaturated sediment and saturated sediment) would cause minute, but measurable, changes in the gravity field. Microgravity surveys would be evaluated for estimating changes in the depth to groundwater in areas where wells have not been installed. If utilized, the microgravity surveys will be calibrated against groundwater levels measured in observation wells. The surveyed reference points will allow comparison of gravity data at the same location during subsequent surveys. Other surveyed features (i.e. wells, land surface elevation benchmarks, etc.) will also be used as reference points for the gravity surveys.

Microgravity surveys, if utilized to evaluate potential impacts, will be conducted annually throughout the term of the Cadiz Project to help assess changes in groundwater levels in areas where no data are available or where access is limited for the installation of observation wells. Reference point locations will be determined from groundwater modeling results during the pre-operational phase of the project.

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[3] InSAR measures changes in the distance between the radar antenna and the land surface with an accuracy of +/- 2 to 4 mm (0.08 to 0.16 inches) (Amelung, et al., 1999).

5.11 FLOWMETER SURVEYS (FEATURE 13)

Downhole flowmeter surveys will be generated in five selected extraction wells. The flowmeter surveys will provide data regarding vertical variation in groundwater flow to the well screens. Depth-specific water quality samples will also be collected to assess vertical variation of groundwater quality in the project wellfield area. Data will be used to help refine geohydrologic parameters regarding layer boundaries used in the groundwater models.

5.12 PROPOSED OBSERVATION WELL CLUSTERS AT BRISTOL DRY LAKE (FEATURE 14)

A total of three new observation well clusters will be installed and monitored in the vicinity of Bristol Dry Lake during the initial phases of the Cadiz Project (see Table 1 and Figure 4). Two well clusters will be located along the eastern margin of Bristol Dry Lake to monitor the effects of project operations on the movement of the fresh water/saline water interface (see Figure 4). One additional well cluster will be installed on the Bristol Dry Lake playa to monitor brine levels and chemistry at different depths beneath the dry lake surface. This well cluster will be positioned in relation to the well clusters at the margin of the dry lake so as to provide optimum data for the density dependent transport model.

5.13 PROPOSED OBSERVATION WELL CLUSTERS AT CADIZ DRY LAKE (FEATURE 15)

Two well clusters will be located along the northern margin of Cadiz Dry Lake to monitor the effects of project operations on the movement of the fresh water/saline water interface in this area (see Figure 4). One additional well cluster will be installed on the Cadiz Dry Lake playa to monitor brine levels and chemistry at different depths beneath the dry lake surface.

5.14 EVAPOTRANSPIRATION STATIONS (FEATURE 16)

Two evapotranspiration (ET) monitoring stations will be established, one each on Bristol and Cadiz dry lakes (see Figure 4). Each station will be instrumented to enable the calculation of evapotranspiration using a turbulent flux (eddy correlation) method. Each station will be capable of measuring ambient air temperature, vertical and horizontal wind speed and direction, humidity, water vapor density, solar radiation, net radiation, soil temperature, soil heat flux, precipitation, and soil water content or soil suction. Each ET station will be equipped with a data logger for data collection and data storage.

5.15 SURFACE WATER MONITORING STATIONS ON THE DRY LAKES (FEATURE 17)

A staff gage will be established at the locations of the ET stations on each of the dry lakes. These staff gages will be established to measure surface water accumulation on the dry lakes from storm runoff. A staff gage will consist of a calibrated measuring rod vertically mounted into the lakebed surface. During periods of storm water runoff and surface water accumulation, continuous monitoring of surface water depth will be obtained on each dry lake.

5.16 AIR QUALITY MONITORING (FEATURE 18)

5.16.1 MONITORING AT BRISTOL AND CADIZ DRY LAKES

This air quality monitoring feature will evaluate wind-mobilized particulate matter from the dry lakebeds. The objective of monitoring is to detect any increases in the frequency of occurrence and magnitude of wind-mobilized particulate matter from the dry lakebeds caused by the project. Because these

mobilization events are intermittent, continuous monitoring will be employed in order to most accurately integrate dust mobilization and wind data. A pair of open-air nephelometers (instruments that measure the light scattered by particles in the atmosphere), a digital camera, and an ET station (Feature 16) will be used on each dry lake.

5.16.2 REGIONAL METEOROLOGICAL MONITORING

Beginning in the pre-operational phase of the project and extending into the initial years of the project operational phase, three meteorological towers will be installed in the region for five years to establish patterns of regional wind speed and direction (see Feature 24).

This baseline wind data will be used in conjunction with lakebed data for wind speed and direction and groundwater levels and soil moisture to determine whether (a) the project could contribute to lakebed dust mobilization and (b) if any project-mobilized lakebed dust could be transported throughout the region. This review will consider whether existing dust storms on the dry lakebeds occur simultaneously with regional winds that are capable of transporting lakebed dust beyond the localized lakebed areas. Data collection from any or all of the meteorological towers may be extended if warranted.

5.17 RESISTIVITY SURVEY (FEATURE 19)

If necessary to evaluate potential impacts, resistivity profiles would be conducted at the margins of Bristol and Cadiz dry lakes, to assess the lateral distribution of brine concentrations in the groundwater in this area. Resistivity is a measure of the specific resistance of a material to the flow of electric current (opposite of electrical conductivity). Groundwater resistivity is based on the ion concentration of the water such that the higher the concentration of ions (salts), the lower the resistivity. This principle may be used to map variation in brine concentrations and lithology at selected locations of the margins of Bristol and Cadiz dry lakes using resistivity profiles.

Results from the resistivity profiles could aid in the location of observation well clusters at the margins of Bristol and Cadiz dry lakes and, if deemed necessary, would be conducted during the pre-operational phase of the Cadiz Project.

5.18 GAMMA-RAY/DUAL INDUCTION DOWNHOLE GEOPHYSICAL LOGS (FEATURE 20)

Gamma-ray and dual induction electric logs will be run for the deepest observation wells of each well cluster to be installed at the dry lakes (six total). These downhole geophysical techniques allow for the measurement of groundwater electrical conductivity with depth and could be conducted in observation wells constructed of PVC casing and screen.

Gamma-ray/dual induction geophysical logs will be run as a one-time measurement to be conducted during observation well cluster installation during the pre-operational phase of the Cadiz Project.

5.19 WEATHER STATIONS (FEATURE 21)

Data from three existing weather stations will be collected over the course of the project (see Figures 4 and 5). Existing weather stations include the Mitchell Caverns weather station (located in the Providence Mountains), the project weather station (located in Fenner Gap adjacent to the spreading basins), and the Amboy weather station (located near Bristol Dry Lake in the town of Amboy).

One additional weather station will be established in the higher elevations of the Fenner Watershed (e.g. the Providence or New York Mountains) based on a statistical analysis of regional precipitation patterns from the precipitation stations summarized on Figure 8. The statistical analysis will provide a basis for placement of the new weather station in an area that will provide the most meaningful data for further evaluation of available precipitation. Because potential sites for the new weather station are in the Mojave National Preserve, final site selection and installation would be dependent upon approval from the appropriate agency.

The Mitchell Caverns weather station and new weather stations would provide precipitation, temperature, and other climatic data for the mountain regions of the Fenner watershed, with the new station providing additional control for the highest elevations of the watershed. The Fenner Gap weather station would provide climatic data in the immediate vicinity of the project area. The Amboy weather station would provide climatic data representative of the lowest area of the regional watershed.

5.20 STREAM GAGE (FEATURE 22)

Stream flow in the mountainous areas of the Fenner watershed will initially be monitored using an existing stream gage located in Caruthers Canyon in the New York Mountains near the northerly extent of the watershed (see Figure 4). As more data are collected and the surface water and groundwater flow models are expanded and refined, up to two additional gages may be established in areas identified as critical data gaps (see Figure 4).

5.21 SOIL MOISTURE SENSORS (FEATURE 23)

If necessary to evaluate potential impacts, soil moisture sensors would be installed to monitor infiltration from natural surface water runoff (as during storm events). If utilized, soil moisture sensors would be installed within boreholes drilled at strategic locations near the project area (e.g. Schulyler Wash near Danby). Final location of the infiltration sites, if deemed necessary, would be based on evaluation of aerial photographs, analysis of available storm runoff records in the upper Fenner watershed, preliminary analysis of storm runoff routing from the revised rainfall runoff model, field reconnaissance, and permission for physical access to the monitoring sites.

If utilized, soil moisture sensors would be installed in the unsaturated zone to measure surface water infiltration below the root zone of plants. Soil cores would be collected at selected intervals during drilling and logged according to the USCS standards. Selected soil samples would be analyzed for physical parameters of relative permeability, water characteristic curves, porosity, and bulk density. Other samples would be analyzed for moisture content, water potential, chloride, and tritium.

5.22 METEOROLOGICAL TOWERS (FEATURE 24)

In addition to the four weather stations (Feature 21), three 10-meter-tall meteorological towers with wind instrumentation will be installed in the region to establish patterns of regional wind direction and speed. Instruments on each tower will include an anemometer, wind vane, and data acquisition system. The meteorological towers will be located throughout the region to determine where dust emissions from Bristol and Cadiz dry lakebeds could be transported. Conceptual locations for the towers are (1) in the vicinity of Orange Blossom Wash, (2) in the vicinity of the S-series observation well at Danby, and (3) in the unnamed valley between the Sheephole and Calumet Mountains and between Bristol Dry Lake and the northern boundary of Joshua Tree National Park (see Figure 3). These locations will be refined or revised, as appropriate. The meteorological towers will be installed in the pre-operational phase of the Cadiz Project and will operate for a period of five years. Data collection for any or all of the

meteorological towers may be extended if determined by Metropolitan to be necessary or required by the BLM Authorized Officer in accordance with the decision-making process described in Section 10.

For an implementation schedule of these 24 monitoring features, see Figure 9.