SECTION 6
MONITORING, TESTING AND REPORTING PROCEDURES

General and specific monitoring features, which are described in the context of critical resources in Tables 1 and 2, will be monitored at varying frequencies during three project phases: pre-operational, operational, and post-operational. It is the intent of Metropolitan that facilities for monitoring will be installed during the pre-operational phase, concurrent with construction of facilities for project operations. The pre-operational phase will commence upon final BLM approval of the Record of Decision for the Cadiz Project and Metropolitan's receipt of necessary grant(s) of right-of-way required to construct the project facilities. The pre-operational phase will last a minimum of 15 months and maximum of 24 months. Monitoring of existing wells identified in Section 5.3 will be commenced as soon as practicable prior to the operational phase to collect important baseline data regarding groundwater levels. Refinements to the monitoring network will be evaluated in accordance with the decision-making process for proposed changes to the Management Plan described in Section 10.

6.1 MONITORING OF SPRINGS ON MOJAVE NATIONAL PRESERVE AND BLM-MANAGED LANDS IN THE AFFECTED WATERSHEDS

6.1.1 PRE-OPERATIONAL MONITORING OF SPRINGS

During the pre-operational phase of the monitoring period, 28 springs will be characterized and approximately eight springs will be selected for ongoing monitoring during the term of the Cadiz Project. In addition, the S-Series wells will be installed and monitored.

Groundwater Levels in the S-Series Wells (Feature 1)

During the pre-operational phase, groundwater levels will be monitored in the S-Series observation wells on a continuous basis using downhole electronic pressure transducers, compensated for atmospheric pressure. Pressure transducers will be installed below the water table within the wells and record relative differences in head pressure above the transducer setting on a regular basis. Head pressures will be converted to water level data and stored in data loggers at each well site.

Springs (Features 2 and 3)

During the pre-operational phase, field reconnaissance will be conducted of 28 known springs in the Fenner and Orange Blossom Wash watersheds. Each of these springs will be classified based on discharge rate in accordance with the following criteria as specified by Meinzer (1942), as shown in Table 3.

TABLE 3
SPRING CLASSIFICATION CRITERIA

Magnitude	Discharge
First	100 cubic feet per second (cfs) or more
Second	10 to 100 cfs
Third	1 to 10 cfs
Fourth	100 gallons per minute (gpm) to 1 cfs
Fifth	10 to 100 gpm
Sixth	1 to 10 gpm
Seventh	1 pint per minute to 1 gpm
Eighth	Less than 1 pint per minute

Data to be collected and recorded at each spring will include:

- GPS coordinates
- Spring Type
- Geology of Immediate Surroundings
- Vegetation Type and Cover
- Flow Rate and/or Water Level in Associated Shallow Piezometer
- Temperature, Electrical Conductivity, and pH

All data will be recorded on standardized field data collection forms. Photographs of each spring will be taken to document pre-operational physical conditions.

- Based on the initial field reconnaissance, approximately eight springs will be identified for monitoring.
- Two springs will be monitored continuously during the pre-operational and operational phases of the Cadiz Project using small diameter (3/4- to 1-inch diameter) PVC piezometers installed in the immediate vicinity of the selected springs. The piezometers will be hand-driven to a point of refusal or a depth of 10 feet below the water table. Each piezometer casing will be screened from the total depth to the ground surface. The piezometers will be equipped with downhole pressure transducers for measuring relative changes in hydraulic head near the spring.
- The remaining springs will be monitored semi-annually during the rest of the pre-operational phase, and throughout the term of the project. The adequacy of the monitoring frequency will be reevaluated as needed.
- During the pre-operational monitoring, water quality samples from the approximately eight selected springs on a semi-annual basis will be collected and analyzed for general mineral and physical parameters, tritium/He^3, chlorofluorocarbons, and stable isotopes of hydrogen and oxygen to help determine the age and source of water from the springs (see Table D-2 in Appendix D for specific constituents). All samples will be collected in laboratory prepared containers and submitted to a State-certified analytical laboratory or other qualified laboratory for analysis according to the protocols described in Appendices C and D.

6.1.2 OPERATIONAL MONITORING OF SPRINGS

During the operational phase, groundwater levels will be monitored in the S-Series observation wells on a continuous basis using downhole electronic pressure transducers, compensated for atmospheric pressure.

Spring flow and spring water parameters (temperature, electrical conductivity, and pH) in six of the approximately eight springs selected will be monitored in the field on a semi-annual basis throughout the term of the Cadiz Project. Water levels measured in piezometers in the immediate vicinity of two of the approximately eight springs will be monitored continuously using downhole pressure transducers. Metropolitan will reevaluate spring monitoring frequency as needed.

6.1.3 POST-OPERATIONAL MONITORING OF SPRINGS

During the post-operational phase, groundwater levels will be monitored in the S-Series observation wells on a continuous basis using downhole electronic pressure transducers, compensated for atmospheric pressure.

Spring flow and spring water parameters (temperature, electrical conductivity, and pH) will be monitored in the field in six of the approximately eight springs selected on a semi-annual basis during the post-operational monitoring period until it is no longer warranted. Water levels measured in piezometers in the immediate vicinity of two of the approximately eight springs will be monitored continuously using downhole pressure transducers during the post-operational period until it is no longer warranted. Metropolitan will reevaluate spring monitoring frequency as needed.

6.2 AQUIFER SYSTEM

6.2.1 PRE-OPERATIONAL MONITORING AQUIFER SYSTEM

Groundwater Levels

During the pre-operational monitoring period, static groundwater levels will be monitored on a monthly basis in each of the observation wells identified as Feature 4 in Tables 1 and 2. Monthly groundwater level monitoring will begin upon project approval by Metropolitan and the BLM. Groundwater levels will be measured in accordance with the monitoring procedure presented in Appendix B.

Groundwater levels in the cluster wells that were screened below the static water table will be monitored continuously during the pre-operational phase of the Cadiz Project using downhole pressure transducers. Monitoring will begin immediately upon completion of installation and development of the cluster wells.

The initial project monitoring well network will be supplemented, if necessary to evaluate potential impacts, with a network of microgravity stations located in the immediate project vicinity (Feature 12). The microgravity stations are intended to measure changes in the depth to groundwater by identifying subsurface density differences. Such microgravity data will be used in conjunction with water levels measured in observation wells.

Groundwater Quality

Groundwater samples will be collected on a quarterly basis from five of the 15 wells specified as Feature 4 in Tables 1 and 2 during the pre-operational phase of the Cadiz Project. Groundwater samples will be collected on a quarterly basis from wells within each project area well cluster that are screened below the static groundwater level (Feature 6). It is important that samples collected to test for groundwater quality are representative of the aquifer groundwater. This implies that the wells are properly developed in order that the sampling obtains representative samples of aquifer ground-water quality. If this cannot be achieved, then alternative sampling will be conducted and may include production wells already equipped with deep well pumps.

Groundwater samples will be collected from the remaining 10 observation wells on an annual basis. All samples would be collected according to the protocol described in Appendix C. Field parameters such as groundwater temperature, pH, electrical conductivity, and total dissolved solids (TDS) will be collected at each well during well purging and prior to sampling. Samples from each well will be analyzed for the general mineral and physical parameters specified in Appendix D. In addition, all samples collected during the pre-operational phase will also be analyzed for bromide, boron, iodide barium, arsenic, nitrate, and perchlorate. The sample analytical protocol is presented in Appendix D.

Subsidence

All benchmarks will be established and surveyed on an annual basis by a California licensed land surveyor. Horizontal and vertical accuracy will be established in accordance with a second order Class I survey standard (1:50,000). 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, InSAR satellite data will be obtained during two different seasons during the pre-operational monitoring period and evaluated for use to supplement the land survey data.

Downhole Flowmeter (Spinner), Water Quality and Temperature Surveys

Downhole flowmeter surveys will be conducted in five selected extraction wells. Depth-specific water quality samples will also be collected at the time of the flowmeter surveys. Samples collected for water quality will be analyzed for general mineral and physical parameters: chloride, bromide, boron, iodide, barium, stable isotopes of oxygen and deuterium, tritium and isotopes of carbon. Vertical temperature surveys will be conducted on two of the existing extraction wells, at each cluster well location along the margins of the dry lakes,[1] and one upgradient observation well. The temperature surveys, in conjunction with field-measured temperature readings on observation wells, will be used to generate a depth-specific isotherm map of the project area.

6.2.2 OPERATIONAL MONITORING OF AQUIFER SYSTEM

Groundwater Level Monitoring Procedures

Groundwater levels will be monitored on an annual basis and on a monthly basis for the first three months after start-up and shut-down of each recharge and extraction cycle in each of the observation wells identified as Feature 4 in Tables 1 and 2. In addition, continuous monitoring will be implemented on Well T6N/R15E-29Q1, shown on Figure 5, and another well to be selected. Groundwater levels will be measured in accordance with the monitoring procedure presented in Appendix B.

Microgravity surveys may be conducted on an annual basis during the operational phase to compare groundwater levels with previous surveys.

Groundwater Quality Monitoring Procedures

During the operational phase, groundwater samples will be collected on an annual basis from the observation wells specified in Table 2. All samples will be collected according to the groundwater sampling and analytical protocols specified for the operational phase of the Cadiz Project in Appendices C and D. Results of water quality analyses will be summarized in tables in the annual report. Measurement of vertical temperature profiles may also be performed on a periodic basis in selected wells.

Groundwater Production Monitoring

Data from the wellfield (project wells and Cadiz agricultural wells) will be collected to provide information on the groundwater levels and discharge rates. Production data from the project wells will be verified using totaled readings of flow at the Iron Mountain Pumping Plant.

Recharge Water Quality (Inflow to Spreading Basins)

During storage operations, deliveries of Colorado River water to the project spreading basins will be sampled at Lake Havasu. Water quality samples will be collected and analyzed on a weekly basis by Metropolitan. Annually collected samples of Colorado River water will be analyzed for a full suite of Title 22 analyses (see Appendix D).

Spreading Basins

All spreading activities will be monitored with periodic site visits for inspection and maintenance. Notes regarding spreading basin berm conditions, berm leakage, siltation, algal growth, and other observations

[1] At each cluster well location the deepest well will be surveyed.

will be recorded. Spreading basins will be inspected monthly during storage cycles of the Cadiz Project. During recharge operations the depth of surface water in the spreading basins will be measured on a regular basis using graduated staff gages located within each respective subbasin.

Subsidence Monitoring

A State of California licensed land surveyor would annually survey the benchmark network. Results will be included, along with any available InSAR satellite results and comparisons, in the annual report.

6.2.3 POST-OPERATIONAL MONITORING OF AQUIFER SYSTEM

During the post-operational phase of the Cadiz Project, groundwater levels will be monitored on a continuous basis in the project well clusters screened beneath the static groundwater level (Feature 6) until no longer necessary to evaluate potential impacts, and annually in the 15 observation wells (Feature 4) located in the project area. Metropolitan will reevaluate groundwater level monitoring frequency. Microgravity surveys would also be conducted as necessary to evaluate potential impacts, during the post-operational monitoring period to supplement the observation well data. Water quality samples will be collected on an annual basis during the post-operational phase.

6.3 BRISTOL AND CADIZ DRY LAKES

6.3.1 PRE-OPERATIONAL MONITORING OF BRISTOL AND CADIZ DRY LAKES

Groundwater Levels

During the pre-operational phase, static groundwater levels will be monitored on a continuous basis from each well cluster (Features 14 and 15) using downhole pressure transducers. Monitoring will begin immediately following well installation and development.

Data will be obtained documenting the initial depth to groundwater and soil moisture within this continuous soil column between the groundwater level and the lakebed surfaces during installation of well clusters at Bristol and Cadiz dry lake margins and on the dry lakes (Features 14 and 15).

Groundwater Quality

Groundwater samples will be collected on a quarterly basis from the dry lake well clusters (Features 14 and 15) after well installation but prior to startup of the Cadiz Project. All samples will be collected according to the protocol described in Appendix C. Field parameters such as groundwater temperature, pH, electrical conductivity, and total dissolved solids will be collected at each well during well purging and prior to sampling. Samples from each well will be analyzed for the general mineral and physical parameters specified in Appendix D. Samples from selected wells will also be analyzed for bromide, arsenic, nitrate, and perchlorate. The sample analytical protocol is presented in Appendix D.

Geophysical Surveys

A resistivity survey will be conducted along the margins of Bristol and Cadiz dry lakes to aid in the location of well clusters in this area.

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 (up to six total). Downhole geophysical logging will be conducted after the deep wells are installed.

6.3.2 OPERATIONAL MONITORING OF BRISTOL AND CADIZ DRY LAKES

Groundwater Levels

During the operational phase, static groundwater levels will be monitored on a continuous basis from each well cluster (Features 14 and 15) using downhole pressure transducers.

Groundwater Quality

Groundwater samples will be collected on a semi-annual basis from the dry lake well clusters (Features 14 and 15) over the term of the Cadiz Project. All samples will be collected according to the protocol described in Appendix C. Field parameters such as groundwater temperature, pH, electrical conductivity, and total dissolved solids will be collected at each well during well purging and prior to sampling. Samples from each well will be analyzed for the general mineral and physical parameters specified in Appendix D. The sample analytical protocol is presented in Appendix D.

Evapotranspiration

Evapotranspiration monitoring stations, located on Bristol and Cadiz dry lakes, will record ambient air temperature, vertical and horizontal wind speed and direction, humidity, water vapor density, solar radiation, net radiation, soil temperature, soil heat flux and soil water content or soil suction on an hourly basis.

Surface Water

During periods of flooding, measurements of surface water depth data will be obtained from automated instrumentation backed up by manual readings of the staff gages on each dry lake, as needed.

Geophysical Surveys

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 run gamma ray and dual induction electric logs on an annual basis for the deepest observation wells of each well cluster to be installed at the dry lakes (up to six total). Downhole geophysical logging will be conducted after the deep wells are installed.

6.3.3 POST-OPERATIONAL MONITORING OF BRISTOL AND CADIZ DRY LAKES

Groundwater Levels

During the post-operational phase, static groundwater levels will continue to be monitored on a continuous basis from each well cluster (Features 14 and 15) using downhole pressure transducers. The necessity of continuing the groundwater level monitoring will be reevaluated by Metropolitan on an ongoing basis.

Groundwater Quality

Groundwater samples will be collected on an annual basis from the dry lake well clusters (Features 14 and 15) during the post-operational phase of the Cadiz Project. All samples will be collected according to the protocol described in Appendix C. The necessity of continuing groundwater quality monitoring will be reevaluated by Metropolitan on an ongoing basis.

6.4 AIR QUALITY

6.4.1 PRE-OPERATIONAL AIR QUALITY AND RELATED MONITORING

During the pre-operational phase, air quality monitoring will consist of gathering baseline data with respect to (1) groundwater between the project area and the dry lakebeds, at the lakebed margins and on the dry lakebeds, (2) surface soil moisture at the dry lakebeds, and (3) ET, air temperature and wind velocity and direction on the dry lakebeds. Open-air nephelometers and automated digital cameras will be installed at the dry lakebeds to collect data on ambient dust mobilization from the dry lakebeds. Additionally, data will be collected with the installation of the well clusters on the lakebed margins and within the dry lakebeds establishing initial depth to groundwater and a soil moisture profile between the groundwater and surface of the dry lakebeds. In the case that the baseline data (monitoring, modeling, and/or statistical analyses) alters the understanding of the relationship between groundwater levels and dust mobilization from the dry lakebeds, the groundwater level action criteria for air quality may be modified.

Additionally, three 10-meter-tall meteorological towers with wind instrumentation will be installed in the region to establish patterns of regional wind speed and direction. Instruments on each tower will include an anemometer, wind vane, and data acquisition system. Conceptual locations for the towers are (1) in the vicinity of Orange Blossom Wash north of Bristol Dry Lake, (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, 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.

The purpose of the air quality monitoring is to anticipate, avoid, and confirm avoidance of the potential effects, if any, of project operations on air quality due to the mobilization of wind-blown dust on Bristol or Cadiz dry lakes. Information will be collected from a broad spectrum of monitoring features as described here.

Well Clusters

Well clusters will provide information regarding the natural moisture content of the soil above the groundwater surface as well as groundwater level information for different depth-specific zones beneath the dry lakes. Groundwater levels in the wells will be monitored as described in Section 6.3.

Evapotranspiration Stations

Evapotranspiration monitoring stations, located on Bristol and Cadiz dry lakes, will record 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 on an hourly basis.

Evapotranspiration stations will be installed in the immediate vicinity of the well clusters on the dry lakes (see Section 5.3.3). The evapotranspiration stations will be equipped with instrumentation to monitor soil water content and soil suction on an hourly basis throughout the term of the project. Soil moisture data collected from the evapotranspiration stations during the pre-operational phase of the project, in conjunction with soil moisture analyses from continuous core samples collected during drilling, will provide a baseline soil moisture condition with which to compare data collected during the operational phase of the project. Soil moisture data will be evaluated in the context of measured groundwater levels to establish a relationship between changes in groundwater levels, soil moisture content, and potential for dust mobilization.

Surface Water Staff Gages

During periods of flooding, continuous monitoring of surface water depth will be obtained on each dry lake. Staff gages will be established at each evapotranspiration station to measure surface water accumulation on the dry lakes as a result of storm runoff (see Feature 17). Surface water effects on soil moisture and shallow groundwater levels will be evaluated to distinguish natural conditions from those attributable to project operations.

Open-Air Nephelometers and Digital Cameras

This air quality monitoring feature will detect wind-mobilized particulate matter from the dry lakebeds with the objective of detecting any increases in this wind-mobilized particulate matter due to project operations. Because this particulate matter is mobilized by wind storms and is intermittent, continuous monitoring will be employed using open-air nephelometers, which measure the light scattered by particles in the atmosphere. An automated digital camera will be installed in conjunction with each pair of nephelometers to further document dust mobilization events. This monitoring will allow comparison of wind velocity data to short-term increases in dust mobilization.

Weather Stations and Analysis of Air Quality and Related Data

Meteorological and other data collected as part of the groundwater monitoring program will be evaluated to identify the wind speeds and directions that lead to high emissions of wind-mobilized particulate matter. Both theory and measurements indicate that wind-mobilized particulate matter does not occur until the wind speed exceeds a threshold velocity and depend on characteristics of the surface, such as moisture content, surface particle size, presence of crusts, vegetative cover, etc. (Fugitive Dust Expert Panel Workshop Final Report, Western Regional Air Partnership, April 2001) Therefore, a decrease in the threshold wind speed associated with wind-mobilized particulate matter would be expected to occur if project operations cause changes in the lakebed surface characteristics that lead to an increase in wind-mobilized particulate matter. A variety of statistical analyses will be used to establish the threshold wind speeds associated with wind-mobilized particulate matter. The analyses will also include factors that could affect surface characteristics, such as precipitation, storm flow run-on and surface moisture. These analyses will be performed separately for data collected during pre-operational and operational monitoring to attempt to detect any statistically significant reductions in threshold wind speed. If statistically significant differences are identified, additional data, such as groundwater levels at the edges of the lakes, will be evaluated to help determine if the differences could have been caused by the project's operations.

The analyses used to establish these relationships will be based on data collected to develop an understanding of the behavior of wind-mobilized particulate matter from Bristol and Cadiz dry lakes. The following approaches are anticipated to be used for data collected during the pre-operational monitoring:

1. Examination of joint frequency distributions of wind speed and direction to determine if elevated wind speeds are associated with specific wind directions. These analyses would utilize short-term (e.g. five minute) average values, because wind gusts are more likely than longer-term average wind speeds to lead to particulate matter.
2. Examination of joint frequency distributions of wind speed and the standard deviation of wind direction to determine the variability of wind direction during higher wind speed periods. This information will be used to refine the siting of the upwind and downwind nephelometers.
3. Examination of histograms of the difference between the downwind and upwind nephelometer readings to determine the frequency of occurrence of wind-mobilized particulate matter.
4. Examination of the scatter plots of the difference between the downwind and upwind nephelometer readings to evaluate the relationships between wind speed and the onset of wind-mobilized particulate matter. Because the threshold wind speed is affected by surface characteristics, the data will be stratified by various other data, including soil moisture and the time since the last occurrence of precipitation. The objective of these analyses will be to establish the threshold wind speeds.

These analyses will be performed separately by season of the year to reduce the variability caused by seasonal differences in wind speeds and directions and in precipitation. At least one year of data is anticipated to be needed to establish the baseline threshold wind speeds associated with wind-mobilized particulate matter. Because of natural year-to-year variability, additional data will be used to further refine the analysis. In particular, additional data beyond the first year is expected to improve the estimates of threshold wind speeds.

Metropolitan will gather data and perform a quarterly analysis of air quality data during the first year of the pre-operational phase. Gathered data will be made available on a quarterly basis. The results of the analyses will be included in the annual report prepared for the Management Plan.

Spreading Basins

Metropolitan will install and operate digital cameras at the spreading basins during the pre-operational phase of the project in order to monitor the surface conditions of the spreading basins. This monitoring will continue throughout the operational and post-operational phases of the project. A monitoring and mitigation plan for the spreading basins, including a reporting mechanism, must be submitted and approved by the BLM Authorized Officer prior to installing and operating monitors at the spreading basins. The BLM Authorized Officer will consult with the TRP upon receipt of the spreading basin monitoring and mitigation plan to determine the adequacy of the plan with repect to protection of critical resources. If warranted, based on physical inspection of the spreading basins or digital images, appropriate mitigation measures will be implemented, including but not necessarily limited to application of a soil binder.

6.4.2 OPERATIONAL AIR QUALITY MONITORING

All air quality monitoring activities would continue on an ongoing basis, unless otherwise determined.

The analyses of the pre-operational monitoring data described above will be refined using the data from the operational monitoring. Threshold wind speeds for dust-mobilized particulate matter derived from data gathered during the operational monitoring will be compared with threshold wind speeds derived from data gathered during pre-operational monitoring to determine if statistically significant decreases occur.

Modifications of the air quality action criteria may be implemented should monitoring, modeling, and/or statistical analyses indicate it is appropriate to do so (see Section 9.2).

6.4.3 POST-OPERATIONAL AIR QUALITY MONITORING STATIONS

During the post-operational phase of the project, the nephelometers and digital cameras will continue to monitor airborne particulate matter on Bristol and Cadiz dry lakes. This information will be correlated with groundwater levels, wind velocities, and lakebed soil moisture. This air quality monitoring will be conducted for the same duration as groundwater level monitoring at the margins of Bristol and Cadiz dry lakes.

Weather Stations

During the post-operational phase of the project, wind direction and velocity and ET will continue to be monitored on Bristol and Cadiz dry lakes. This information will be correlated with nephelometer readings, groundwater levels, and lakebed soil moisture. This weather station monitoring will be conducted for the same duration as groundwater level monitoring at the margins of Bristol and Cadiz dry lakes.

Soil Moisture Sensors

During the post-operational phase of the project, soil moisture will continue to be monitored on Bristol and Cadiz dry lakes. This information will be correlated with nephelometer readings, groundwater levels, and wind velocities. This soil moisture monitoring will be conducted for the same duration as groundwater level monitoring at the margins of Bristol and Cadiz dry lakes.

Spreading Basins

During the post-operational phase of the project, the digital cameras will continue to monitor the surface conditions of the spreading basins.

6.5 OTHER MONITORING (REGIONAL)

6.5.1 PRE-OPERATIONAL REGIONAL MONITORING

Climatological Monitoring

Climatological monitoring will be undertaken during the pre-operational phase of the project utilizing the four weather stations. Data to be collected at the Mitchell Caverns and Amboy stations will include ambient air temperature, evaporation, and precipitation (including snow accumulation). Data to be collected at the Fenner Gap and a new weather station will include ambient air temperature, evaporation, precipitation, wind speed and direction, barometric pressure, relative humidity, and soil temperature. In addition, each weather station will be equipped with precipitation collectors to be used for chemical analyses. Data from the Mitchell Caverns and Amboy stations will be obtained in electronic form on a yearly basis from the San Bernardino County Flood Control District. Data from the Fenner Gap and new weather stations will be continuously recorded.

The project weather station will include a fresh water evaporation pan that is set up in accordance with National Weather Bureau standards. Water levels within this pan will be generally maintained between four and eight inches. Pan water levels will be measured using three internal gages located 120 degrees

from each other. The pan water level will be measured on a monthly basis as the average of the three gages.

Surface Water Flow

An existing stream gage located in Caruthers Canyon in the New York Mountains will be utilized to monitor stream flow in the higher elevations of the watershed. The gage site will be inspected in the field to assess:

- Hydraulic Control (in an area where the stage discharge relationship is constant and measurable);
- Channel Geometry (well established single flowing channel that is relatively straight and doesn't meander); and
- Local Tributary Inflow.

If warranted, two additional stream gage locations would be identified as a result of additional rainfall/runoff modeling. Each new gage would be constructed and monitored in accordance with Rantz et al., 1982 (Appendix B) and the United States Geological Survey's *Surface Water Quality Assurance Plan for the California District of the United States Geological Survey* (Meyer, 1996).

Infiltration Monitoring

If necessary, subsurface soil moisture sensors installed in boreholes strategically located in major washes and nearby terraces would record soil moisture on a daily basis unless otherwise determined. If feasible, the soil moisture sensor boreholes would be positioned to correspond to stream gage locations so surface water runoff/infiltration relationships in the sandy-bottomed washes can be quantified.

6.5.2 OPERATIONAL REGIONAL MONITORING

Climatological Monitoring

Climatological data will be collected throughout the term of the Cadiz Project using the weather stations and procedures described in Section 6.4. Meteorological towers to collect wind data will continue to operate in the early years of the operational phase, and will conclude after five years of data collection. Data collection from 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.

Stream Gage Monitoring

Surface water flow at the Caruthers Canyon stream gage will be downloaded periodically from the United States Geological Survey website. Surface water flow at this gage is recorded on a continuous basis. Surface water data will be tabulated and summarized in the annual reports. Stream flow data from any newly installed gages will also be recorded on a daily basis.

Infiltration Monitoring

If soil moisture sensors are utilized, subsurface soil moisture beneath the washes selected during the pre-operational phase would be monitored as described in Section 6.5.1.

6.6 QUALITY ASSURANCE/QUALITY CONTROL

For this project, quality assurance (QA) is defined as the integrated approach designed to assure reliability of monitoring and measurement data. Quality control (QC) is defined as the routine application of specified procedures to obtain prescribed standards of performance in the monitoring and measurement process (ASTM D-18). Metropolitan will be responsible for assuring that the precision, accuracy, and completeness of data collected during the project are known and documented.

All groundwater samples collected during the pre-operational and operational phases will be placed in laboratory-prepared sample containers and properly labeled, packaged and preserved, prior to submittal to the laboratory. All groundwater samples will be submitted to the laboratory under chain-of-custody protocol within 24 hours of collection.

All analytical work will be conducted by a State of California certified analytical laboratory. Laboratory calibration procedures will be conducted in accordance with approved Environmental Protection Agency (EPA) guidelines and the recommendations promulgated in Title 21 of the Code of Federal Regulations Part 58 "Good Laboratory Practices" (see Appendix D). All groundwater samples will be analyzed in accordance with standard EPA or ASTM methods.

QA/QC reports from the laboratory will be provided with the analytical reports and included with the annual reports. All data will be validated with respect to accuracy, precision, and completeness to ensure that they are representative of actual field conditions.

Use of the nephelometers will follow protocols to be developed that will include procedures for routine operational checks, calibrations and data validation. The instrumentation on the meteorological towers will be calibrated using guidelines set forth in the EPA *Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements*, March 1995.

6.7 DATA MANAGEMENT

During the course of the Cadiz Project, a large amount of data will be collected, stored, processed, analyzed, tabulated, and presented in annual reports. Detailed procedures for the management of the project database are presented in Appendix E.

6.8 REPORTING PROCEDURES

Annual reports summarizing all monitoring data will be prepared as described below. The annual report will include a refinement of the basin parameters, monitoring data, and input and output from refined groundwater models. The BLM Authorized Officer may require preparation of other reports as necessary, such as a baseline conditions report or a pre-operational report.

6.8.1 ANNUAL REPORTS

Baseline groundwater level and groundwater quality conditions will be established for comparison with the data compiled for each annual report. Historical records, pre-dating Cadiz Project operations, will be used to establish baseline conditions whenever feasible. The results of the first land survey and any initial InSAR data obtained will serve as the baseline condition for annual comparison.

The pre-operational phase and initial years of the operational phase will be used to collect baseline air quality dust mobilization data on Bristol and Cadiz dry lakes, and to establish patterns of regional wind speed and direction. The dust emissions data from the dry lakebeds will be used to establish a baseline

for future evaluations of project effects, as described in Section 6.4.1. The regional wind data will be used to determine if any project mobilized dust could be transported throughout the Mojave Desert region.

Metropolitan will be responsible for preparation of the annual reports beginning one year after commencement of project construction, which will contain the following components:

- Baseline water level and water quality conditions (to be defined in the first annual report). Presentation of baseline conditions will include water level elevation contours, water quality contours, and a figure showing the results of the initial land survey;
- Tables summarizing groundwater production for each project extraction well;
- Tables summarizing depth to static water level and groundwater elevation measurements for all observation wells;
- Inventory of springs;
- Hydrographs for all observation wells;
- Groundwater elevation contours;
- Tables summarizing water quality analyses for the observation wells;
- Results of land subsidence monitoring surveys and any changes relative to baseline;
- Summary tables of any data collected from wells owned by neighboring landowners in proximity to the project area (provided that permission was granted for such data collection);
- Summary of project developments, such as changes in storage or extraction operations or construction of new production wells;
- Discussion of project storage and extraction operations, and trends in groundwater levels and groundwater quality as compared to the baseline conditions;
- Updated groundwater flow and quality model results;
- Tables summarizing changes in frequency and severity of dust mobilization recorded on Bristol and Cadiz dry lakes and analysis correlating dust emissions with wind speed and direction, groundwater levels underlying the dry lakebeds, and soil moisture on the lakebed surfaces;
- Tables and figures (wind roses) summarizing wind data from regional meteorological towers addressing wind speed and direction, and stability frequency distributions. This data would be collected for five years. Data collection for any or all of the meteorological towers may be extended if required by the BLM Authorized Officer.
- Summary of Metropolitan's assessments, proposed refinements to the Management Plan, and corrective measures.

All annual reports will include electronic data files and model input and output files. The annual reports will be available to agencies, organizations, interest groups and the general public upon request from Metropolitan. The annual reports will be distributed to the lead and cooperating federal agencies, San Bernardino County, and made available to the public electronically.

6.8.2 FIVE-YEAR REPORT

Metropolitan will prepare a five-year report five years from commencement of construction, which will contain the following components in addition to the components of previous annual reports:

- Summary of total project storage and extraction operations;
- Documentation of any trends in groundwater levels evident from the monitoring data;
- Documentation of any trends in water quality measurements evident from the monitoring data;

- Contours of the most recent static groundwater level elevations and groundwater level elevation changes over the previous five years;
- Documentation of any impacts to wells owned by neighboring landowners (provided that permission was granted to monitor such wells);
- Tables summarizing changes in frequency and magnitude (to the extent that can be determined from the data) of dust mobilization recorded on Bristol and Cadiz dry lakes and analysis correlating wind-mobilized particulate matter with wind speed and direction, groundwater levels underlying the dry lakebeds, and soil moisture on the lakebed surfaces; and
- Summary of regional wind data (in the first five-year report, and subsequent reports as applicable) with conclusions for potential for project-mobilized lakebed dust to be transported throughout the Mojave Desert region.

As part of the evaluation of the hydrogeology of the project area, the five-year report will also include:

- Hydrogeologic analysis and interpretation of all project storage and extraction operations during the five-year period;
- Hydrogeologic analysis and interpretation of all water level elevation, water quality, and land survey data collected during the five-year period;
- Results of refined model output from the rainfall-runoff model, unsaturated and saturated groundwater flow and solute transport models, the density dependent groundwater flow model and the solute transport model;
- Detailed evaluation of impacts (if any) of project operations on surface or groundwater resources;
- Proposed refinements to the Management Plan to address any identified inadequacies; and
- Summary of project operations designed to prevent declines in static groundwater levels in excess of 100 feet from pre-operational levels at the end of project operations or lead to projections of adverse impacts to critical resources during or after the post-operational phase.

All five-year reports will include electronic data files and model input and output files. The annual reports will be available to agencies, organizations, interest groups and the general public upon request from Metropolitan. The five-year report will be distributed to the lead and cooperating federal agencies, San Bernardino County, and made available to the public electronically.