The following is an excerpt from the Seawater Intrusion Management Monitoring Method [MM-08]

SGM Grant Program Requirements for Post-Performance Monitoring and Reporting

Seawater Intrusion Management Monitoring Method

Project / Action Type	Seawater intrusion management projects with stated goal to prevent undesirable results for seawater intrusion.
Similar / Related Project Types	Typical projects to provide seawater intrusion management include variations of groundwater recharge (including injection barrier), indirect potable reuse, and water demand reduction. Similar Monitoring Methods are those that assess specific sustainability indicators such as subsidence and depletion of interconnected surface water.
Metric	Water quality constituents (chloride concentrations). Groundwater levels. Groundwater storage. Groundwater dependent ecosystems (situationally).
Measurement Unit	Concentration or measurement of applicable groundwater quality constituents, specifically, salinity (mg/L) and specific conductance concentrations (µS/cm at 25 °C). Groundwater levels measured in feet in a consistent vertical datum. Recharge/demand volumes in acre-feet. Vegetation vigor and plant surveys (root zone index, wetland species) of groundwater dependent ecosystems habitats.
Beneficial User	Municipal and domestic water supply (MUN) Industrial service supply (IND) Industrial process supply (PROC) Agricultural water supply (AGR) Freshwater replenishment to surface waters (FRSH)

Seawater Intrusion Monitoring

A project's ability to prevent undesirable results associated with seawater intrusion can be evaluated based upon changes in salinity at monitoring locations. SGMA requires that the seawater intrusion sustainable management criteria applied under a GSP include a chloride concentration isocontour as a minimum threshold. Therefore, chloride concentrations should be monitored for seawater intrusion for SGMA projects. Groundwater elevation proxies can be included in the seawater intrusion evaluation. Groundwater elevations and recharge/pumping reduction volumes also can be used to demonstrate that progress toward preventing seawater intrusion can be attributed to the project. Other data may be useful to support evaluation of seawater intrusion.

Background and Context

The monitoring method for seawater intrusion management projects evaluates whether seawater intrusion advances and facilitates the evaluation of the effect of the project on preventing significant and unreasonable seawater intrusion. The method includes collection of the following categories of data:

1. **Monitoring should include groundwater salinity data to evaluate seawater intrusion**:
   - SGMA requires a chloride concentration isocontour to be used as management criteria for seawater intrusion. Sampling for chloride concentrations at wells along the isocontour in each principal aquifer is required.
   - A project should identify data gaps for monitoring seawater intrusion. If the project is expected to affect conditions in any of the data gap areas, monitoring points filling those data gaps should be established for the project to demonstrate efficacy.
   - A project may establish groundwater elevation proxies management criteria for seawater intrusion. If so, monitoring of groundwater elevations at monitoring points with groundwater elevation proxies is required.
2. **Monitoring should include additional data to evaluate the benefit of the project**:
   - Monitoring groundwater levels should be conducted to demonstrate that the project or action is successfully preventing or reducing seawater intrusion. Monitoring points should be located between the project location (recharge location or wells with reduced pumping) and the area of seawater intrusion, any representative monitoring points for salinity concentrations, and monitoring points of groundwater elevations.
   - Measurement of **water budget** components (e.g., recharge and pumping volumes) also should be conducted to evaluate a connection between project and action, and groundwater levels or salinity concentrations.

Water budgets are form of accounting for the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.

3. **Monitoring may include optional data to support both evaluation of seawater intrusion and associated benefits with the project:**
   - Sampling for general minerals to evaluate cation/anion ratios for changes in groundwater chemistry
   - Sampling for minor constituents such as iodide, bromide, boron, and barium as indicators of seawater intrusion
   - Continuous monitoring of electrical conductivity at wells to track changes in salinity
   - Geophysical surveys at wells to evaluate depth of seawater interface
   - Geophysical surveys to evaluate areal extent and depth of seawater interface.

A Step-by-Step Guide to Applying the Seawater Intrusion Monitoring Method

1. **Area of groundwater influence:** Determine project's area of groundwater influence and determine if a basin's Groundwater Sustainability Plan applies to the project, and if so, whether the Plan indicates if seawater intrusion occurs in the area.

2. **Safety plan:** All projects with fieldwork related activities should produce a Safety Plan. Planning for fieldwork and availability of access to the site, such as monitoring wells, is necessary to maintain project safety. Projects with an impact on seawater intrusion may require a Safety Plan to address these and other potential safety concerns.
3. **Monitoring network:** Identify and/or install groundwater monitoring wells. The well network should be established based on Department of Water Resources (DWR) *BMP 2 Monitoring Networks and Identification of Data Gaps* (DWR, 2016). An established Groundwater Sustainability Plan monitoring network may be suitable for monitoring impacts from regional projects; however, additional monitoring sites may be necessary to monitor the benefits or impacts of local-scale projects. The location of the monitoring network should be easily accessible such that gaining access to the site does not inhibit gathering and downloading data (refer to Step 2).
4. **Data collection:** Conduct "baseline monitoring" in the monitoring wells prior to project commencement to document groundwater levels and trends, and to characterize ambient groundwater quality and trends. While baseline monitoring for groundwater levels and quality should be conducted at a minimum prior to project commencement, collecting baseline monitoring for at least one year before project commencement during prior seasonal low and seasonal high groundwater level periods would provide a more robust dataset to compare to project implementation data should groundwater level or quality impacts occur.
5. **Data analysis:** Implement the monitoring plan to evaluate seawater intrusion isocontours to evaluate project benefits.
   - Generating isocontours involves measuring groundwater salinity, commonly represented by chloride concentrations or other measurements convertible to chloride concentrations, at monitoring wells on a regular basis, at least once annually. Isocontours of the measured salinity concentrations are then prepared using industry standard spatial interpolation techniques. For SGMA projects, each basin's Groundwater Sustainability Plan should identify the chloride isocontour management criteria established for the area. Identify areas and any monitoring points most likely to show benefits from project.
   - Identify data gaps and install new monitoring wells in areas identified to show likely benefits of the project. Implement monitoring at data gaps.
   - Monitor groundwater levels at monitoring wells in the project network to correlate project with effects on groundwater levels and seawater intrusion.
   - Review data at least annually to evaluate whether seawater intrusion is occurring and progress toward preventing seawater intrusion is being achieved. For SGMA projects, the Groundwater Sustainability Agency should include this evaluation in its annual report.
6. **Reporting:** Review and report optional data as planned by project proponent.
   - Upload project-specific monitoring data to the DWR SGMA data portal on an annual basis. For SGMA projects, this step should be coordinated with and completed by the basin's Groundwater Sustainability Agency (See Data Management and Monitoring Method [MM-12]).
7. **Adaptive management**: Expand or refine the monitoring network adaptively, as needed.

Data and Protocols - Fundamentals

Monitoring for seawater intrusion involves monitoring groundwater quality, groundwater levels, and volumes related to the project or action. The primary monitoring requirements and tools include the following:

- Monitoring wells in aquifers near the area of concern for seawater intrusion where groundwater quality can be sampled, and groundwater levels can be monitored.
- For SGMA projects, monitoring wells that allow groundwater quality and groundwater level monitoring in aquifers located between the project or action and the critical chloride isocontour.
- Water quality should be sampled and analyzed at least semi-annually with timing corresponding with seasonal highs and lows in groundwater levels.
- Groundwater levels should be measured at least quarterly.

- Primary "tools" for measuring groundwater quality include pumps, low-flow sampling equipment and passive diffusion samplers as presented in DWR's *Best Management Practice (BMP) 1 Monitoring Protocols Standards and Sites* (DWR, 2016).
- Primary "tools" for measuring groundwater levels include electrical sounders and pressure transducers lowered into and/or installed in monitoring wells (DWR's BMP 1 Monitoring Protocols Standards and Sites, 2016). The use of dataloggers in association with pressure transducers allows automated collection and storage of groundwater level measurements at frequent intervals.
- Primary "tools" for measuring recharge or demand reduction volumes achieved by the project or action are flow meters or other tools described in Monitoring Methods for Groundwater Recharge Project (MM-01 to MM06) and Demand Reduction Monitoring Methods (MM-13) projects.

Table 1 provides an example of summary parameters to use in a monitoring report for seawater intrusion management projects.

Table 1. ***Example Data Monitoring Report (Generally Annually)***

Annual Monitoring Report	
Groundwater Basin Name	XXX
Average change in salinity at monitoring wells	XXX mg/L
Average change in groundwater levels at monitoring wells	XXX feet
Annual change in area of seawater intrusion	XXX square miles

Data Standards

Groundwater, surface water, and water quality monitoring data should conform to the technical and reporting standards of the California Water Code (CWC) §352 *et seq*. Standards for chloride concentration precision and accuracy (+/- 10 mg/L) should be met for measurements close to the threshold isocontour values.

Groundwater elevation measurements should be recorded relative to a consistent **vertical datum.** It is worth noting that the vertical datum recommended by DWR's BMP 1 Monitoring Protocols, Standards, and Sites (DWR, 2016) is the **North American Vertical Datum of 1988 (NAVD88)**, which is 2-4 feet higher than mean sea level along the California coast. This distinction is important for seawater intrusion. Coastal Groundwater Sustainability Agencies may choose to consistently use an alternative vertical datum such as the **National Geodetic Vertical Datum of 1929 (NGVD29)** because it is generally closer to mean sea level.

VERTICAL DATUMS

Along the California coast NAVD88 is 2-4 feet higher than mean sea level. NAVD88 was established in 1991 by the minimum-constraint adjustment of the Canadian-Mexican-United States leveling observations.

NGVD29 is generally closer to mean sea level. Mean sea level was held fixed at the sites of 26 tide gauges across the United States and Canada.

NGVD29 = NAVD88 – 3.6 feet

Key Protocols

The following protocols should be followed for required monitoring:

- Standard water quality sampling protocols as described in DWR's BMP 1 Monitoring Protocols Standards and Sites (DWR, 2016).
- Standard groundwater level measurement protocols as described in DWR's BMP 1 Monitoring Protocols Standards and Sites (DWR, 2016).
- Standard measurements for recharge or demand reduction volumes as described in Monitoring Methods for recharge and demand reduction projects.
- Technical and reporting standards included in CWC §352 *et seq*.

Suggested references for optional data include:

- Evaluating cation/anion ratios as indicators of seawater intrusion (Jones et al., 1999).
- Use of minor constituents as indicators of seawater intrusion (Hem, 1989).
- Areal geophysical surveys (Schamper et al., 2013 and Pidilisecky et al, 2015).