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SEASIDE BASIN WATERMASTER MEMORANDUM 2011-02

Date: **November 15, 2011**
To: **Seaside Basin Watermaster**
From: **Jonathan Lear, PG, CHg, Senior Hydrogeologist**
Joe Oliver, PG, CHg, Water Resources Division Manager
Tom Lindberg, Associate Hydrologist

Subject: **Water Year 2011, Groundwater-Quality and Groundwater-Level Data Collected for the Seaside Groundwater Basin Watermaster**

SUMMARY

This memorandum transmits and summarizes groundwater-quality and groundwater-level data collected for the Seaside Groundwater Basin Watermaster Board (Watermaster) during Water Year (WY) [1] 2011. This report incorporates the data that were collected and reported for each quarter during the period from October 1, 2010 through September 30, 2011. This information is being provided to the Watermaster for information purposes, and is in compliance with the monitoring protocols described in the Watermaster's *Seaside Basin Monitoring and Management Program* (SBMMP, revision date September 5, 2006), which was prepared in response to the court decision filed March 27, 2006 (as amended by February 9, 2007 filing) in the Seaside Basin adjudication case. This document has been prepared by the Monterey Peninsula Water Management District (MPWMD) on behalf of the Watermaster.

This document is organized into the following four categories of data:

- Precipitation,
- Stream flow in Arroyo Del Rey,
- Water-quality data collected from MPWMD Quarterly wells, and
- Static water levels collected from MPWMD and other Watermaster basin wells.

[1] The WY begins on October 1, and ends September 30 of the indicated year.

PRECIPITATION

A continuous-recording precipitation gage is located at the south eastern corner of the Southern Coastal Subarea of the Seaside Groundwater Basin. Data from the precipitation gage are posted to the www.weatherunderground.com website and are available real time as well as archival data sets. **Figure 1** shows the location of the weather station and the average annual rainfall totals for the Seaside Groundwater Basin. **Figure 2** shows daily and cumulative rainfall recorded by the weather station for all four quarters of WY 2011. Average annual rainfall for the location of the weather station is 16 inches. As **Figure 2** illustrates, at the close of WY 2011, the weather station had logged over 21.2 inches, which is approximately 130% of normal rainfall.

STREAMFLOW

There is a distinct lack of surface drainages in the Seaside Groundwater Basin due to the high infiltration capacities of the dune sands which overlie the aquifers. The overlying soils have the capacity to infiltrate large storm events; therefore, water is not concentrated into channels. The Arroyo Del Rey drainage is the one distinct drainage in the Seaside Groundwater Basin. The headwaters of the drainage are in the Laguna Seca Subarea, which flow into the Southern Coastal Sub Area of the Groundwater Basin and collect in Roberts Lake.

A continuous stream flow gage was operated by the U.S. Geological Survey in Del Rey Oaks Park from 1966 to 1978. MPWMD re-occupied the site in 2002 and data collection is ongoing. The catchment area above the gage is 13.8 square miles. **Figure 3** contains the average daily flow record for the Arroyo Del Rey at Del Rey Oaks gaging station for WY 2011.

WATER-QUALITY DATA: MPWMD AND OTHER BASIN WELLS

MPWMD Coastal Monitor-Well Network

Under the current monitoring program conducted for the Watermaster, the MPWMD collects *quarterly* samples from six monitor wells at three locations that are closest to the coastline, and *annually* from six additional wells at three locations that are farther from the coastline. The well numbers, names and sampling schedule for the MPWMD coastal monitor wells currently being sampled for the Watermaster are listed below.

MPWMD Coastal Monitor Wells

Well Number	Well Name	Sample Interval
15S01E15N3	MSC-Shallow	quarterly
15S01E15N2	MSC-Deep	quarterly
15S01E15F1	PCA-W-Shallow	quarterly
15S01E15F2	PCA-W-Deep	quarterly
15S01E11Pa	FO-09-Shallow	quarterly
15S01E11Pb	FO-09-Deep	quarterly
15S01E15K5	PCA-E-Shallow	annually
15S01E15K4	PCA-E-Deep	annually
15S01E23Ca	Ord Terrace-Shallow	annually
15S01E23Cb	Ord Terrace-Deep	annually
15S01E12Fa	FO-10-Shallow	annually
15S01E12Fc	FO-10-Deep	annually

These sites are shown on **Figure 4** and completion data for these wells are shown in **Table 1.** At each site, a "shallow" and "deep" monitor well have been installed (either in separate boreholes or as multiple completions in a single borehole), generally corresponding to well completions within the two principal aquifer units that have been historically recognized in the Seaside Basin, the Paso Robles Formation (QTp and QTc for undifferentiated Continental Deposits) and Santa Margarita Sandstone (Tsm), respectively. More recently, it has been recognized that the Tsm deposits transition to the Purisima Formation (Tp) in the northern coastal subarea of the Basin. The monitor wells are constructed of 2-inch PVC casing, with screens adjacent to the more permeable (i.e., based on lithologic and geophysical logging analyses) sand "packages" within each aquifer unit. The aquifer units are separated from each other in the wells by cement strata-isolation seals.

MPWMD Coastal Monitor Wells Water-Sample Collection

Water-sample collection from the MPWMD coastal monitor wells for WY 2011 was accomplished by the Low-Flow Method. As a means to investigate alternative water-quality sampling technologies, MPWMD staff completed a test of different "low-flow" sampling methodologies at Watermaster database Well No. 258 (MW-B-23-180) in June 2009. Results from the methodology comparison along with cost estimates for implementation of each methodology were presented to the Watermaster Technical Advisory Committee (TAC) at the June 10, 2009 meeting. Following the recommendation of the TAC, MPWMD staff purchased a Micro Purge well sampling pump and pump controller from QED Environmental Systems, Inc. Motivation behind changing the sampling method included a desire to: (a) switch to a less invasive sampling method to prolong the life of the monitoring wells and (b) implement a less labor-intensive method that will be more cost effective to the Watermaster in the long run. Details of this sampling methodology are discussed below.

- **Low-Flow Sampling Method**

Low-flow/low-volume purging method is sample collection using a pumping mechanism that produces low-flow rates [less than 1 liter per minute (lpm) or less than 0.26 gallon per minute (gpm)] that cause minimal drawdown of the static water table and usually employs a flow cell in which geochemical parameters are continuously monitored. These parameters may include dissolved oxygen content, oxidation-reduction potential (redox), conductivity, turbidity, and/or pH. The intent of this sampling protocol is to collect a representative sample from the monitored groundwater zone. A representative sample may be obtained when all the monitored chemical parameters have stabilized, thus quantitatively demonstrating that the sample being collected is in equilibrium with the groundwater system. The low-flow/low volume purging method (purging to parameter stability) tends to isolate the interval being sampled, which provides more accurate water-quality measurements and reduces the volume of purge water generated. This method has an advantage in that it can limit vertical mixing and volatilization of any volatile organic compounds (VOCs) in solution within the well casing or borehole, as compared to high-flow purging and sampling (e.g., air-lift sampling method).

Figure 5 illustrates the QED Environmental Systems, Inc. low-flow sampling equipment. The bladder pump is placed in the monitor well and powered by a fuel source of compressed gas. The peristaltic action of the pump lifts water from the well and initiates flow through the well screen at the location where the drop tube and intake assembly have been placed. An electric wire sounder is used to measure drawdown to insure minimal drawdown is caused by pumping the well. Water-quality parameters are monitored at the flow cell as the well is purged.

The low-flow/low-volume purging method of sample collection has been described in groundwater monitoring literature since the mid-1980s with a defined methodology being accepted by the U.S. Environmental Protection Agency in 1995. These protocols are summarized below as adopted by MPWMD staff:

1. **Flow rate**

   The flow rate used during purging must be low enough to avoid increasing the water turbidity. The following measures should be taken to determine the appropriate flow rate: (a) The flow rate shall be determined for each well, based on the hydraulic performance of the well; (b) The flow must be adjusted to obtain stabilization of the water level in the well as quickly as possible; (c) The maximum flow rate used should not exceed 1 liter per minute (0.26 gpm); (d) Once established, this rate should be reproduced with each subsequent sampling event; (e) If a significant change in initial water level occurs between events, it may be necessary to re-establish the optimum flow rate at each sampling event.

2. **Measurement of water level and drawdown**

   Measurement of the water level in the well during purging is important when establishing the optimum flow rate for purging. The goal is to achieve a stabilized

pumping water level as quickly as possible with minimal drawdown, to avoid stressing the formation and mobilizing solids, and to obtain stabilized indicator parameters in the shortest time possible.

3. **Measurement of indicator parameters**

Continuous monitoring of water-quality indicator parameters is used to determine when purging is completed and sampling should begin. Measurement of indicator parameters (dissolved oxygen content, redox potential, specific conductance, temperature and pH) is required. This is most easily performed using an in-line flow cell (closed) system attached directly to the pump discharge tubing. For turbidity measurement, a separate field nephalometer should be used.

If portable systems are used, they must be placed carefully into the well and lowered into the screen zone as slowly as possible. Placement of the portable pump can disturb the groundwater flow conditions resulting in non-equilibrium conditions. As a result, longer purge times and greater purge volumes may be necessary to achieve indicator parameter stabilization. In general, this may require that after installation, the portable pump should remain in place for a minimum of 1-2 hours to allow settling of solids and re-establishment of horizontal flow through the screen zone. If initial turbidity readings are excessive (>50 NTU), pumping should cease and the well should rest for another 1-2 hours before initiating pumping again. In wells set in very fine-grained formations, longer waiting periods may be required. Continuous water-level measurement devices are preferred, such as down-hole pressure transducers, but electronic water-level tapes can be used. The devices used must be capable of measuring to 0.01-foot precision.

4. Sample Collection

Water samples for laboratory analyses must be collected before water has passed through the flow-through cell (use a by-pass assembly or disconnect cell to obtain sample). VOC samples should be collected first and directly into pre-preserved sample containers. All sample containers are filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere.

MPWMD Coastal Monitor Wells Water-Quality Results

Water chemistry analytical results for the samples collected during WY 2011 are provided in the table in **Appendix 1**. This table and other water-level data tables were prepared utilizing the recently re-tooled “report” feature of the groundwater resources database that was created for the Watermaster in 2011.

In general, the WY 2011 chemical data from these monitor wells do not show significant changes relative to the results provided in WY 2010, and are not indicative of seawater intrusion into the

basin at the locations and depths of the monitor well completions. This is consistent with the conclusions drawn in the Water Year 2011 Seawater Intrusion Analysis Report (SIAR WY2011) prepared by HydroMetrics, LLC.

Other Basin Monitor and Producer Wells Water-Quality Results

Water chemistry analytical results for the samples collected from other basin monitor wells and producer wells during WY 2011 are also provided in the table in **Appendix 1**. These include: (a) annual sample results from coastal and inland monitor wells that were added as part of the monitoring well network enhancement study that was conducted by MPWMD for the Watermaster in 2007; (b) annual sample results for the active Watermaster producer wells in the coastal subareas of the basin that are required to collect these samples under the Watermaster's MMP; and (c) annual sample results for the four dedicated coastal Watermaster Sentinel wells that were installed in 2007.

WATER-LEVEL DATA: BASIN MONITOR AND PRODUCER WELLS

Basin monitor wells and basin producer active and inactive wells with water-level data collected during WY 2011 are provided in **Appendix 2**. The general locations of these wells are shown on **Figure 6**. The Watermaster has requested that producers collect and report "static", i.e., non-pumping, water-level measurements. The purpose for this is so these measurements will more closely approximate ambient groundwater-level conditions, and facilitate the plotting and analysis of well water-level hydrographs. Occasionally, water-level measurements have been collected and reported while the well was in operation. In some cases, this may be due to the fact that the well can not be taken offline to collect a static water-level measurement because of pumping demand requirements. These occurrences have been recorded in the comments section of **Appendix 2**. These water-level data were collected primarily with manual water-level sounding devices by producers or by the MPWMD on behalf of the Watermaster.

These water-level data have been entered into the Watermaster database. The table in **Appendix 2** was generated by obtaining a data dump from the Watermaster database and using the report feature in MS Access. The new table format for this WY 2011 report includes additional information relative to each well and its monitoring schedule. This format will be used as a template to improve the web-based reporting feature of the database. Because this feature is still under development, future water-level tables may differ slightly from the one included in this report.

It should be noted that the table in **Appendix 2** includes the "reference-point elevations" that were surveyed in 2008 for each well, as part of work conducted for the Watermaster. The reference point elevations were established at the water-level data collection point at each wellhead. The reference point elevations are tied to the North American Vertical Datum of 1988 (NAVD88). The measurements in NAVD88 datum have been adjusted for the Watermaster's use by subtracting 2.97 feet to conform to local Mean Sea Level (MSL) reference, based on data provided by the

surveyor. The "depth to water" measurement at each well is subtracted from the reference-point elevation to obtain the "water elevation" relative to MSL, as shown in the column to the right of the "depth to water" column of the table.

Water-level hydrographs for the MPWMD monitor wells located in the Northern Coastal Subarea and the Watermaster Sentinel wells are included in **Appendix 3**. The long-term hydrograph figures for the MPWMD monitor wells were generated to provide historical static water-level data for the wells with longer data records in the Seaside Groundwater Basin. The Sentinel well hydrographs were included to comply with monthly water-level reporting requirements.

Appendix 4 contains graphs of the continuous water-level records collected from the Sentinel Wells for the first and second quarters of WY 2011. It should be noted the instrument in Sentinel Well #4 malfunctioned during the second quarter which resulted in data corruption for the device. Therefore, data from this well are not included in this appendix. The device has been sent back to the manufacturer for repair.

CONCLUSIONS

- Due to actions by the Watermaster in WY 2009 to notify and remind basin producers of their obligations to collect required groundwater level and groundwater quality data from their wells, the availability of these data to assist in analysis of the basin's groundwater resources has greatly improved compared to prior years.
- With the exception of Sand City Corporation Yard, the chemical data from WY 2011 for the MPWMD dedicated coastal monitor wells do not show significant changes relative to previous samplings, and are not indicative of seawater intrusion into the basin at the locations and depths of these monitor wells. This conclusion continues to be supported by work completed this year for the Watermaster as documented in the WY 2011 Seawater Intrusion Analysis Report prepared by HydroMetrics, LLC.
- Based on the long-term water-level hydrographs for coastal monitor wells presented in **Appendix 3**, the trend of declining groundwater levels is continuing in the deeper Santa Margarita aquifer monitor wells, but at a lesser rate in recent years. Groundwater levels have generally stabilized, and in a few cases displayed an overall increase in the shallower Paso Robles aquifer. The peaks in water levels in the Santa Margarita monitoring wells for WY 2011 seen in these plates are slightly lower than water levels from WY 2010. This slight decrease in peak recovery water levels is likely due to the timing of resumption of pumping in nearby municipal production wells, which occurred earlier in Spring 2011 relative to Spring 2010. It is notable that a record volume of 1,117 AF of water was injected into the Santa Margarita aquifer by the MPWMD and Cal-Am at the Phase 1 Aquifer Storage and Recovery site in Seaside in WY 2011.

RECOMMENDATIONS

- Groundwater quality samples should be obtained from the Camp Huffman well during the fourth quarter of WY 2012 to continue to establish a water-quality baseline for these monitor wells.
- MPWMD staff should investigate the feasibility of deploying a continuous water-quality monitoring data logger in a coastal monitoring well as a trial method of monitoring for seawater intrusion using this technology.
- Reporting of water levels and quality should continue to be conducted semi-annually. Quarterly water-quality reporting is problematic due to the time required to process and analyze water-quality samples.
- Consideration should be given to revising the boundary of the Seaside Groundwater Basin based on the more recent understanding of the basin boundaries than the depiction that is currently used by the Watermaster.

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Table 1. Summary of Well Completions, MPWMD Coastal Seaside Basin Watermaster Well.

SUMMARY OF MPWMD COASTAL SEASIDE BASIN GROUNDWATER QUALITY MONITOR WELLS

Site	Well Name	Location Description	Well Number	Date Drilled	DWR Drillers Log	Hole Depth (feet)	Well Depth (feet)	Screened Interval (feet)	Strata Seal (feet)	Casing Type	Geologic Unit	E-Log	Elevation (feet AMSL)
MSC		former MSC mine north of Playa Ave. and west of Hwy. 1											
	MSC-Shallow	approx. 10' S of north property line	15S/1E-15N3	5/25/1990	338413	720	695	490 - - 680	95 - 275	2" pvc	QTp	- - -	80.1
	MSC-Deep	approx. 7' E of MSC-Shallow	15S/1E-15N2	5/25/1990	338425	920	865	810 - 850	725 - 775	2" pvc	Tsm	yes	80.29
PCA WEST		former PCA mine W of Hwy. 1											
	PCA-W Shallow	approx. 200' SE of ocean bluff	15S/1E-15F1	3/28/1990	338400	600	585	525 - 575	120 - 150	2"pvc	QTp	- - -	64.22
	PCA-W Deep	approx. 50' E of PCA-W Shallow	15S/1E-15F2	3/90	338401	900	885	825 - 875	760 - 790	2" pvc	Tsm	yes	65.18
PCA EAST		vacant lot NE of Seaside High baseball field											
	PCA-E Shallow	approx. 300' E Monterey Rd, 50" N fence	15S/1E-15K5	4/16/1990	338402	863	410	350 - 400	110 - 150	2" pvc	QTp	- - -	68.51
	PCA-E Deep	(same borehole as shallow well)	15S/1E-15K4	4/16/1990	338402	863	710	650 - 700	580 - 620	2" pvc	Tsm	yes	68.54
ORD TERRACE		Ord Terrace School property south of Ord Grove Ave.											
	OT-Shallow	1700 block Ord Grove Ave.	15S/1E-23Ca	8/5/1999	- - -	530	340	280 - 330	0 - 260	2" pvc	upper Tsm	- - -	228.65
	OT-Deep	(same borehole as shallow well)	15S/1E-23Cb	8/5/1999	- - -	530	450	390 - 440	350 - 377	2" pvc	lower Tsm	yes	228.63
MPWMD #FO-09		E of Hwy.1, SE of Okinawa Rd.											
	#9-Shallow	50' east of utility service rd.	15S/1E-11Pa	8/16/1994	- - -	1,110	660	610 - 650	500 - 540	2" pvc	QTp (?)	- - -	118.89
	#9-Deep	(same borehole as shallow well)	15S/1E-11Pb	8/16/1994	- - -	1,110	840	790 - 830	700 - 765	2" pvc	Tsm (?)	yes	118.85
MPWMD #FO-10		south of Light Fighter Drive, behind Barker Theater Building											
	#10-Shallow	20' north of access road curb	15S/1E-12Fa	9/3/1996	- - -	1,500	650	620 - 640	480 - 500	2" pvc	QTp	- - -	200.85
	#10-Deep	(same borehole as shallow well)	15S/1E-12Fc	9/3/1996	- - -	1,500	1,420	1380 - 1410	1280 - 1300	2" pvc	Tsm (?)	yes	201.03

NOTES:
1. Official State well numbers end with a numeral; unofficial MPWMD well numbers end with a small case letter.
2. Geologic Unit refers to the unit adjacent to the screened interval: QTp = Paso Robles Formation; Tsm = Santa Margarita Sandstone.
3. Elevation refers to the water level reference point elevation surveyed by Central Coast Surveyors. For additional information, see "Documentation of 2008 Well Elevation Surveys", MPWMD Seaside Basin Watermaster Memorandum 2008-05.
4. Well completion data at site MSC are documented in "Installation of Monitoring Well Cluster, Monterey Sand Company", Staal, Gardner & Dunne, Inc. (SGD), July 1990.
5. Well completion data at sites PCA West and PCA East are documented in "Hydrogeologic Investigation, PCA Well Aquifer Test", SGD, July 1990.
6. Well completion data at site MPWMD FO-09 are documented in "Summary of 1994 Fort Ord Monitor Well Installations", MPWMD Technical Memorandum 94-07.
7. Well completion data at site MPWMD FO-10 are documented in "Summary of 1996 Seaside Basin Monitor Well Installations", MPWMD Technical Memorandum 97-04.
8. Two dashes (i.e., "- -") indicate multiple screened intervals.
9. Three dashes (i.e., "- - -") indicate not applicable or not available.

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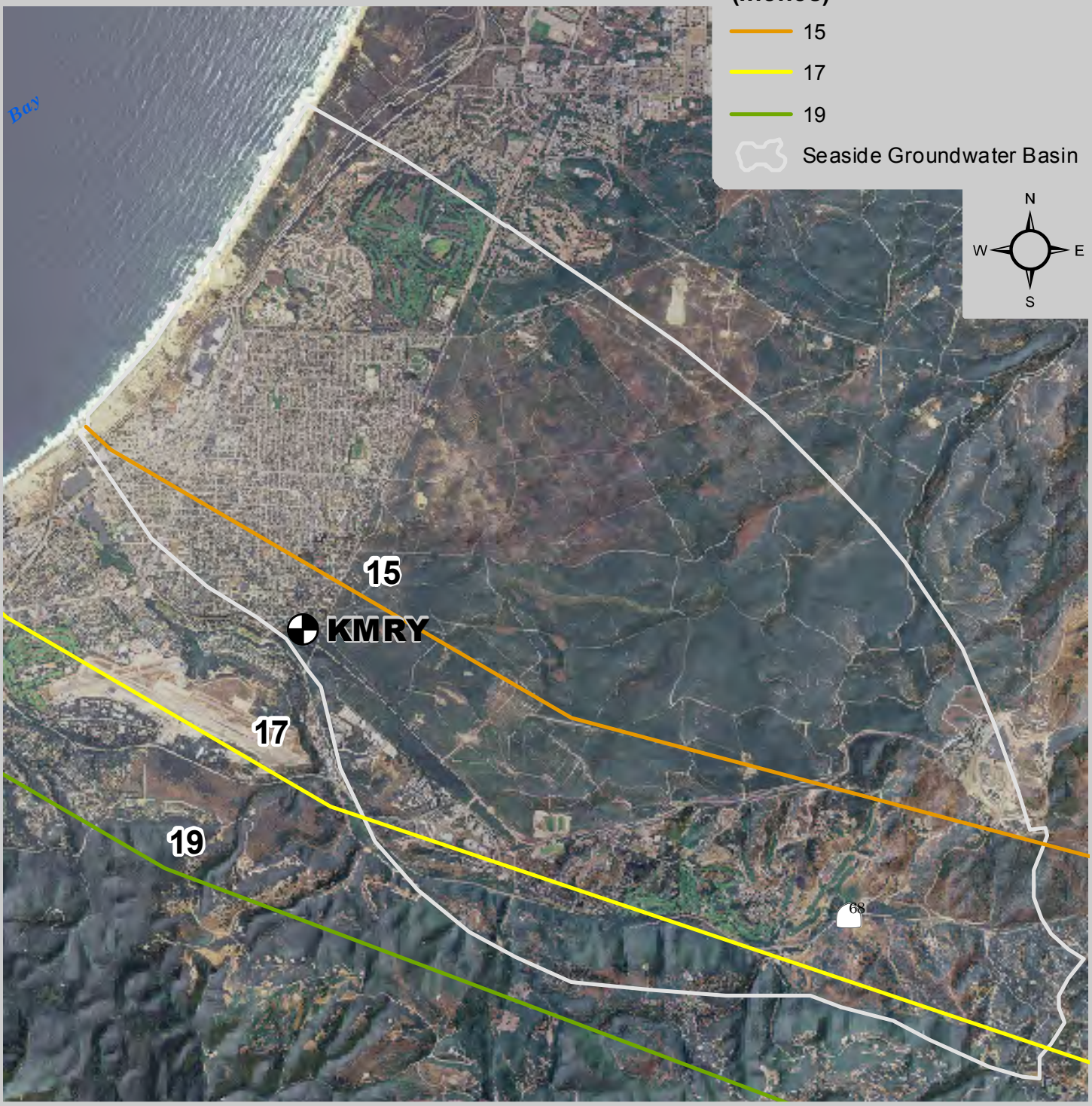

Figure 1. Location of Weather Station KMRY and Average Annual Rainfall for the Seaside Groundwater Basin, Seaside, CA

0 0.5 1 2 Miles

Datasources: Rainfall Totals - Monterey County
Photobase - AMBAG 2005

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Locations are approximate based on MPWMD files.

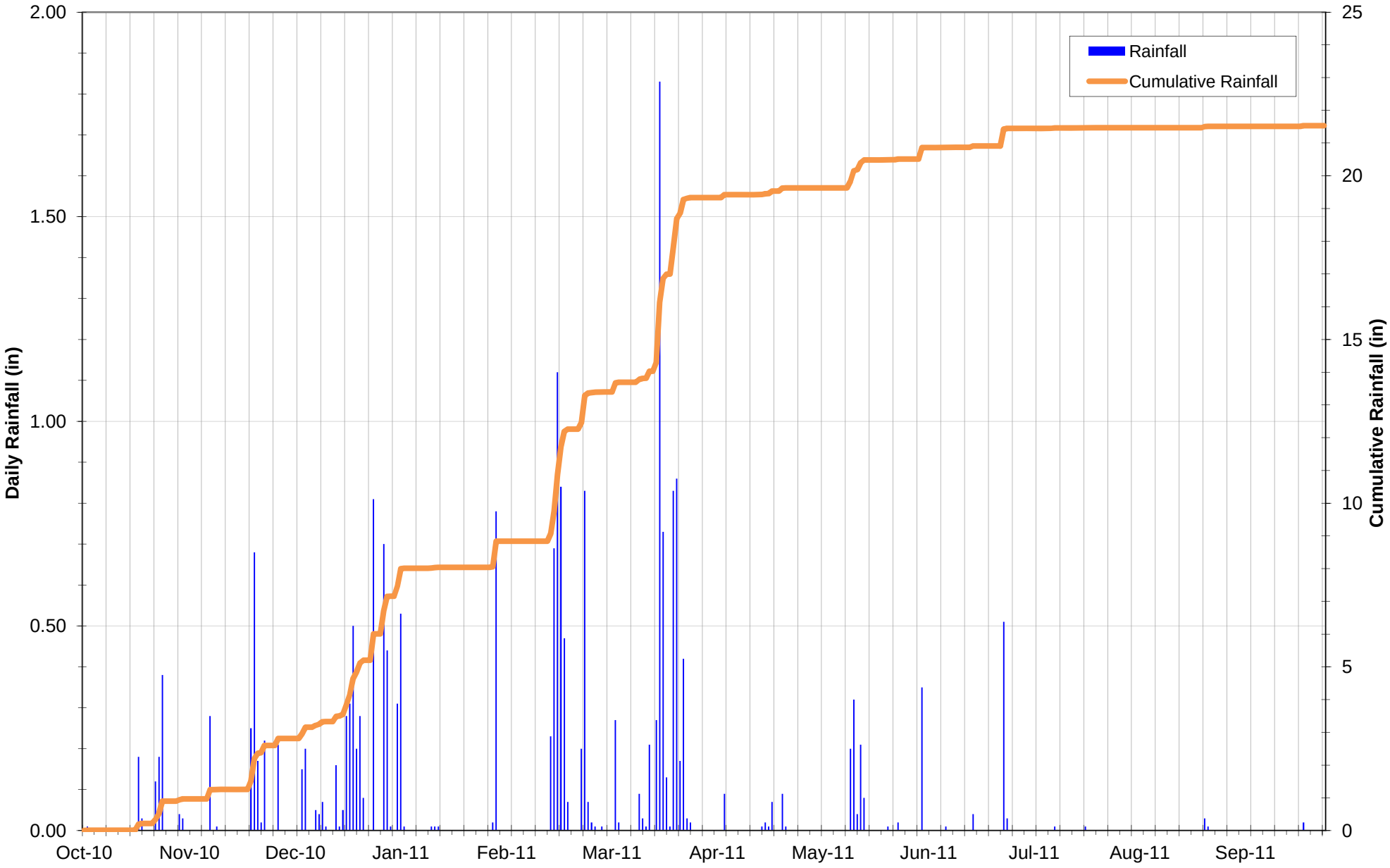

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Figure 2. Daily and Cumulative Rainfall for Water Year 2011 recorded at Weather Underground Weather Station KMRY , Seaside, California

Data from www.weatherunderground.com
Station Coordinates 36.59, -121.84

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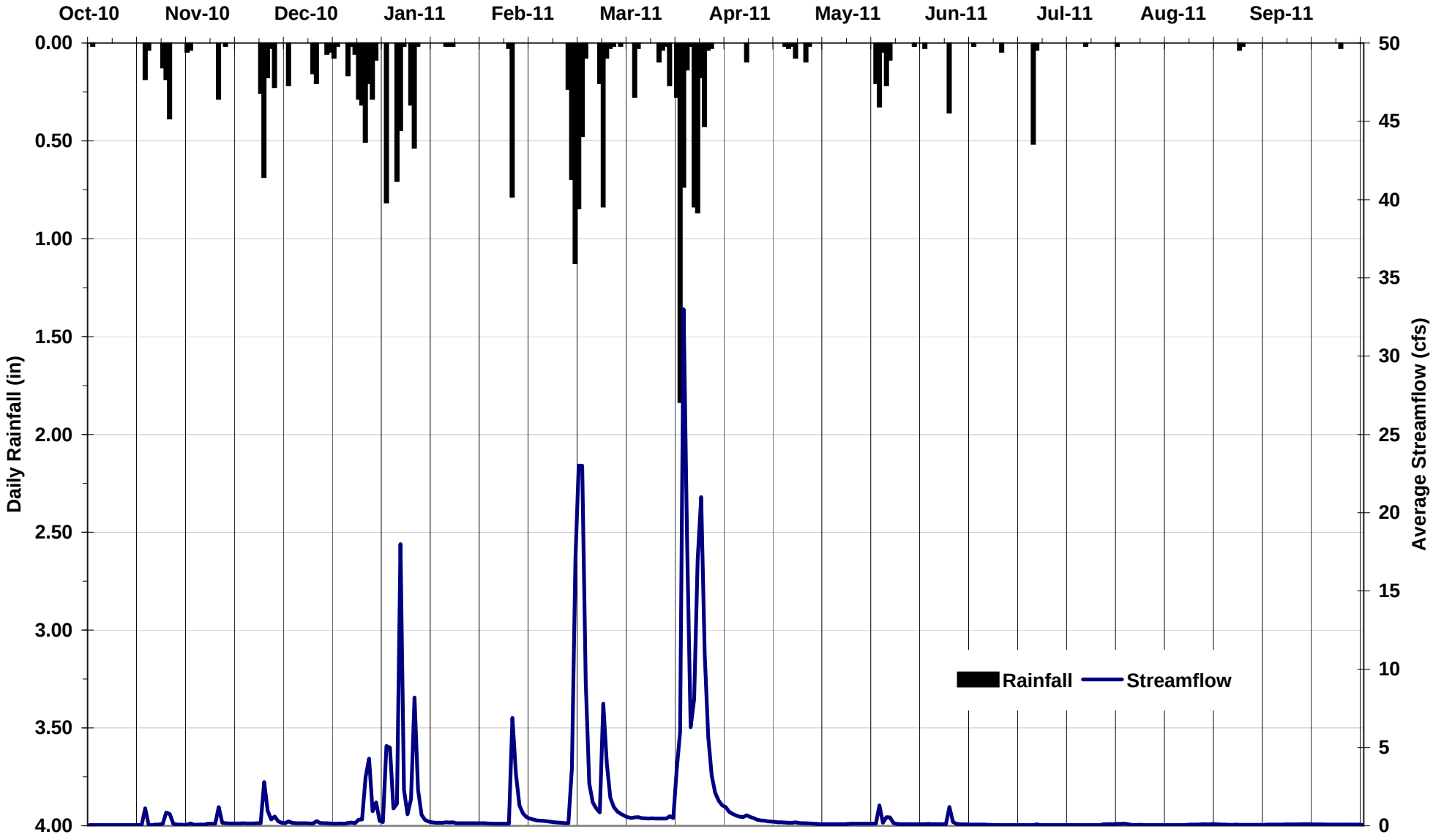

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Figure 3. Daily Rainfall at Weather Station KMRY and Average Daily Flow at Arroyo Del Rey at Del Rey Oaks Stream Gage for Water Year 2011 , Seaside, California

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Legend

Monitor Well

Data Type and Frequency

- Water Level - Monthly
- Water Level - Monthly, Water Quality - Annual
- Water Level - Monthly, Water Quality - Quarterly
- Water Level - Quarterly
- Seaside Groundwater Basin

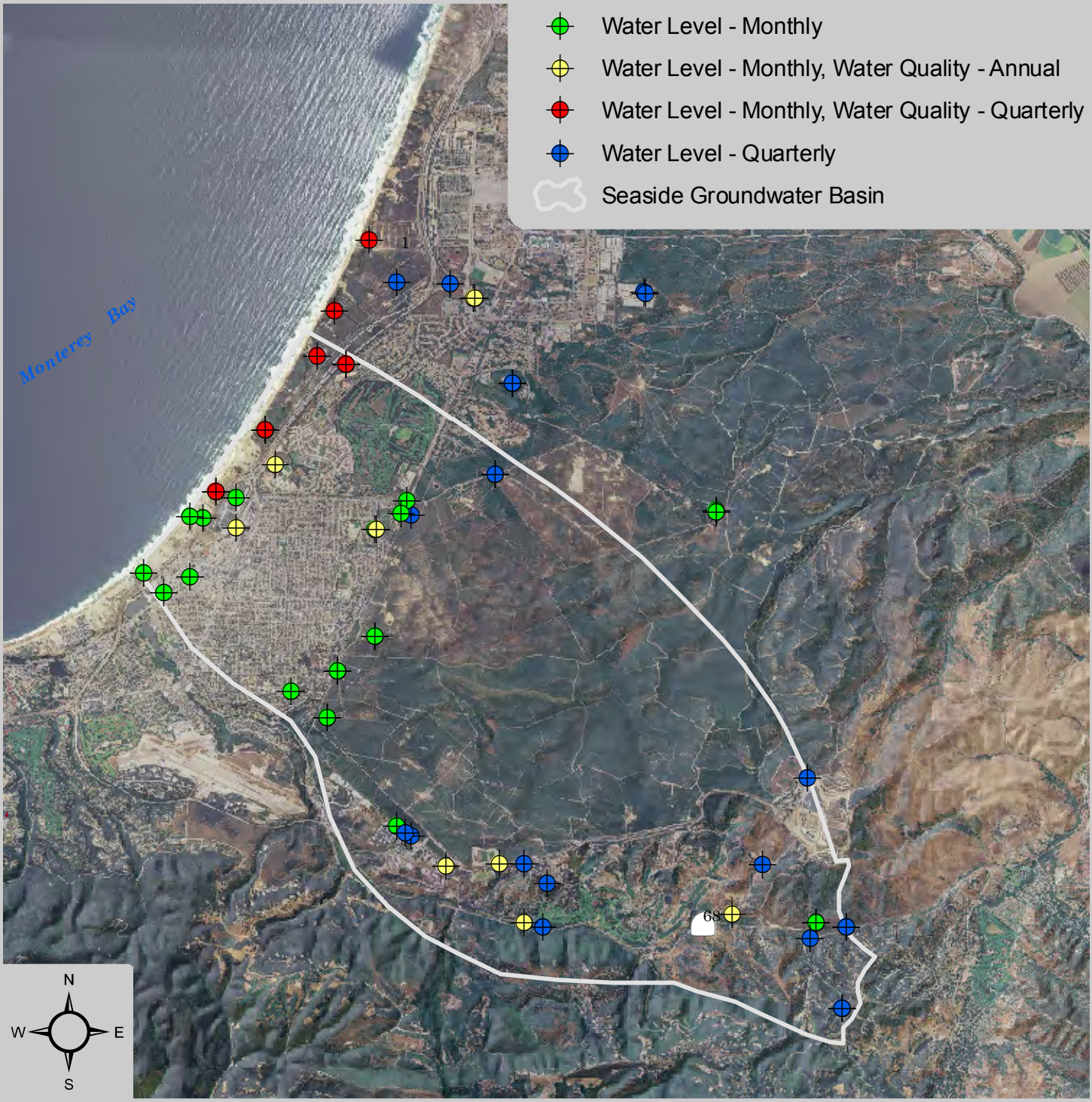

Figure 4. Seaside Groundwater Basin Watermaster Monitoring Well Network, Seaside, CA

0 0.5 1 2 Miles

Datasources: Rainfall Totals - Monterey County
Photobase - AMBAG 2005

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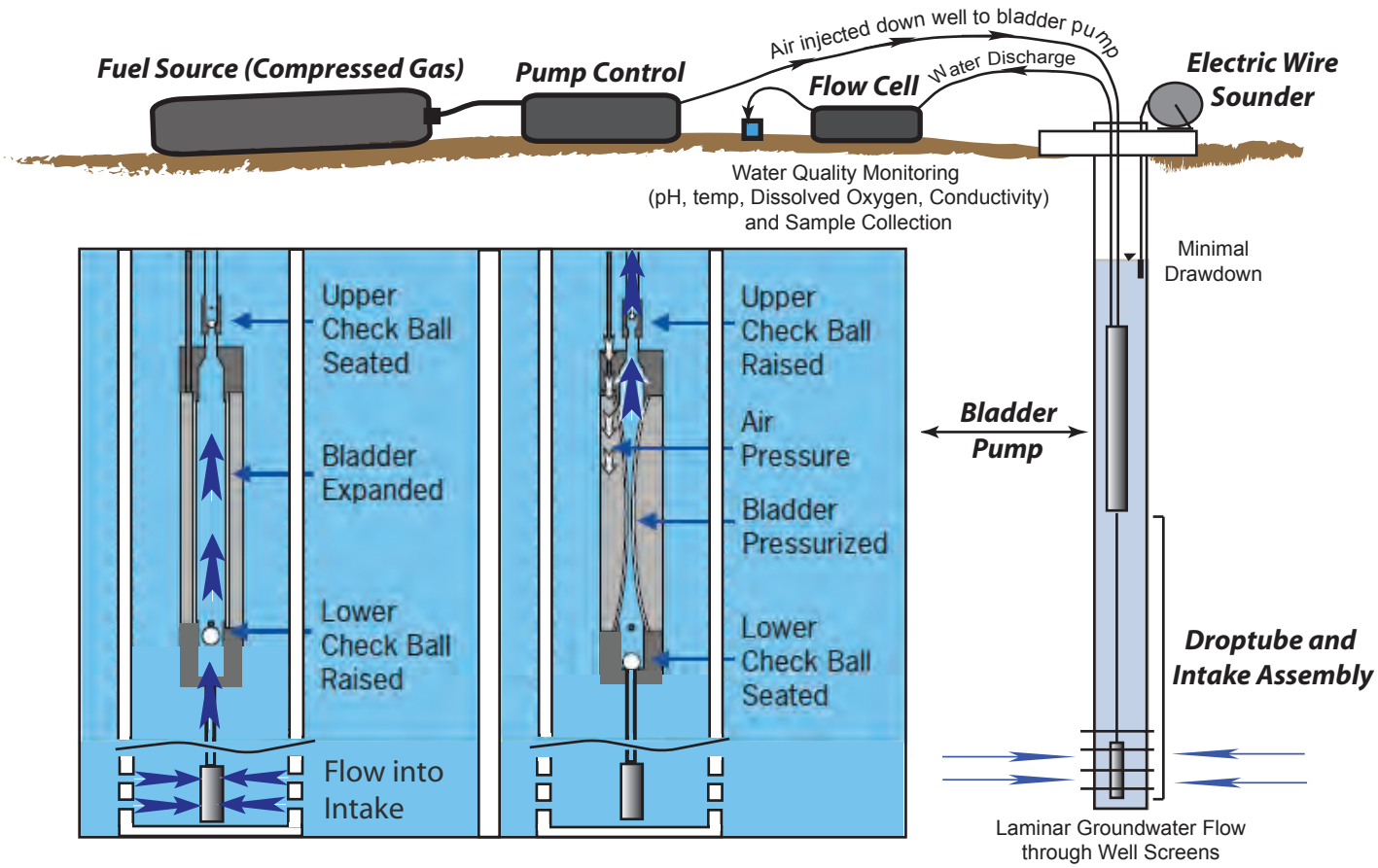
Locations are approximate based on MPWMD files.



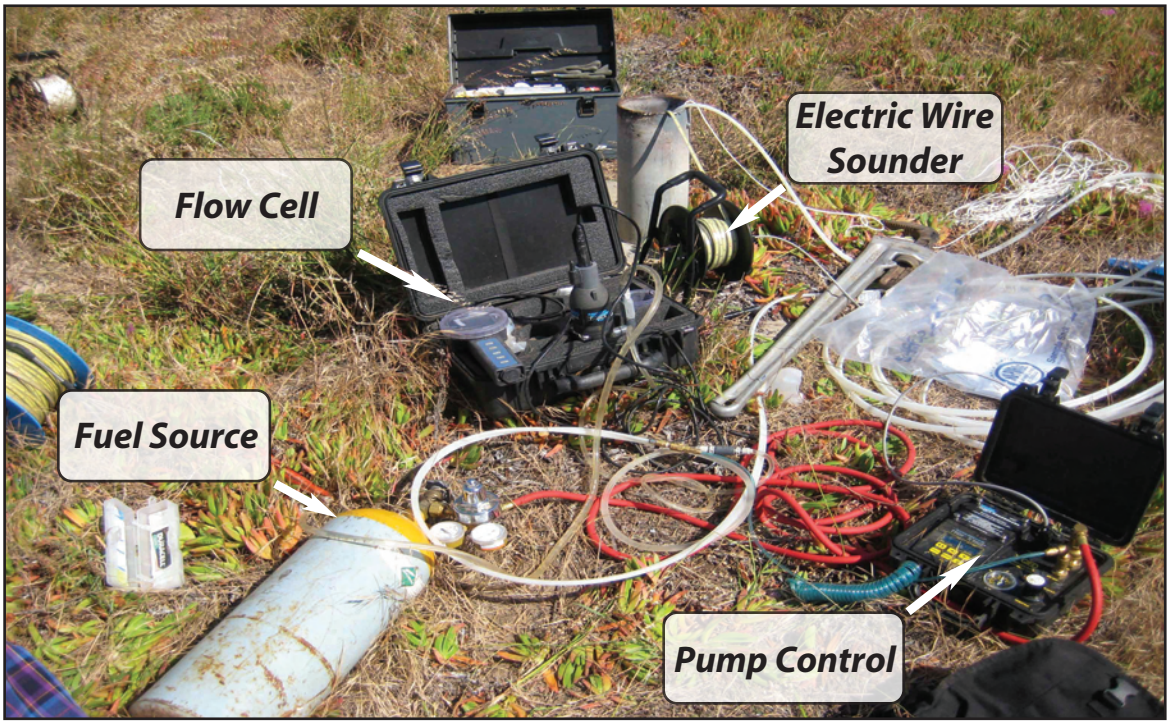


Figure 2. Low Flow Groundwater Sampling System Presented in Cartoon and Photograph

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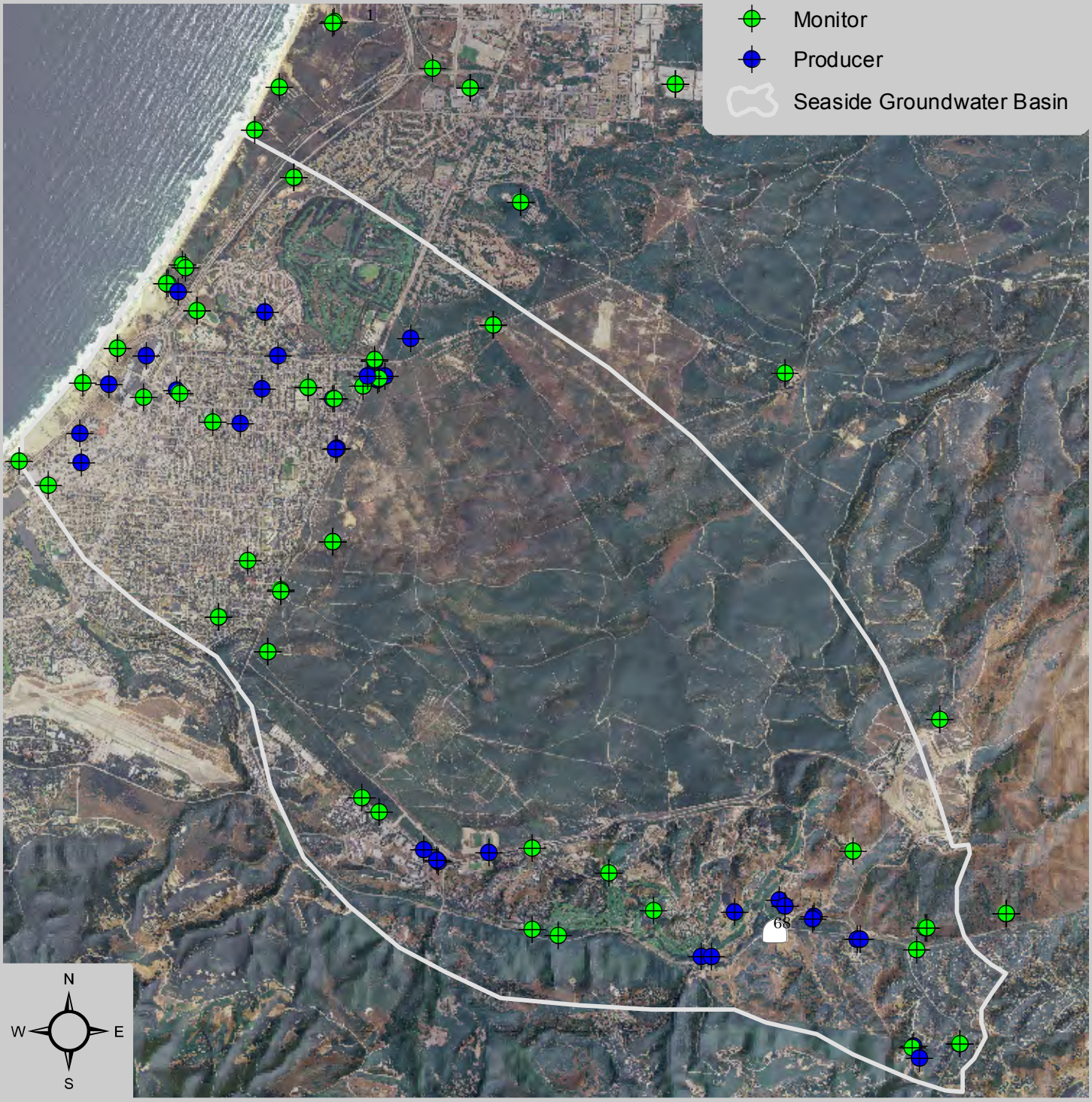

Figure 6. Seaside Groundwater Basin Watermaster Wells by Category, Seaside, CA

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Locations are approximate based on MPWMD files.