

## **EXECUTIVE SUMMARY**

The United States Environmental Protection Agency (EPA) established the Drinking Water Source Assessment and Protection Program (DWSAP) in 1999 to assess the vulnerability of the drinking water supply to contamination. The program is Federally mandated, and regulated by the State of California Department of Health Services (DHS).

The drinking water supply for Soquel Creek Water District (SCWD) consists of water supply wells completed in the Purisima and Aromas Red Sands Formations. This report deals exclusively with the Purisima wells; a DWSAP report for the Aromas Red Sands wells was completed by Todd Engineers in April of 2002.

The DWSAP program for ground-water sources (wells) requires California drinking water purveyors to assess local hydrogeology, well construction and production, and land use in the vicinity of water supply wells. These components are then used to delineate Ground-Water Protection Zones for each well, which represent the area of ground water that may be drawn in by the well in two, five and ten years of pumping. Within these three protection zones, Possible Contaminating Activities (PCAs) – such as known contaminant plumes, leaking underground storage tanks, dry cleaners, gas stations, etc. – are identified and ranked according to their potential to contaminate the water supply well. The results of the DWSAP can then be used as a planning tool for land use development in the vicinity of water sources. The DWSAP should be updated every five years, or whenever existing water supply wells are modified or rehabilitated, or new wells are put into service.

### **BACKGROUND**

Soquel Creek Water District (SCWD) is located in Santa Cruz County and serves portions of the City of Capitola, and the unincorporated areas known as Soquel, Aptos, Rio Del Mar, La Selva Beach and Seascap. As of August 2002, SCWD maintained 13,682 regular service connections and 870 fire service connections, serving a population of approximately 42,000.

The drinking water for the SCWD water system is ground water pumped from sixteen active wells located within the District boundaries: ten wells completed in the Purisima Formation (Aptos Creek, Estates, Garnet, Ledyard, Madeline, Main Street, Monterey, Rosedale, Tannery Creek and T. Hopkins), and six wells completed in the Aromas Red Sands Formation (Altivo, Bonita, Country Club, San Andreas, Seascap and Sells). The wells included in this DWSAP are completed in the Purisima Formation, and are located in the Soquel Valley Ground-Water Basin, which has a surface area of approximately four square miles. All the information provided in this DWSAP for the Tannery Creek Well covers the existing well constructed in 1970 and not the new replacement Tannery Creek Well constructed in 2001. A separate

DWSAP for the new replacement Tannery Creek Well will be submitted to SCWD and DHS in January 2003 as part of the permit package to operate the new well. General land use is residential, commercial and municipal, with some rural and agricultural use. During the period from 1990 to 2000, SCWD pumped an average of 5,266 acre-feet of ground water per year, with an average of 65% of this production (or 3,423 acre-feet per year) coming from the Purisima Formation.

## **METHODOLOGY**

To complete the DWSAP for Soquel Creek Water District (SCWD), Luhdorff and Scalmanini, Consulting Engineers (LSCE) reviewed water supply well construction details, pump and discharge records, local hydrogeologic data and reports; conducted a field survey to identify land use within the capture zones for each water supply well; and reviewed local, State and Federal agency files on PCAs. These components were used as input for the TurboSWAP software program provided by the DHS. The TurboSWAP program (version 1.16) applies standard calculations, and produces the documents that make up the bulk of the DWSAP report.

### **Ground-Water Protection Zones**

The first step in the DWSAP program is the delineation of Ground-Water Protection Zones. The Ground-Water Protection Zones are nested circles that represent the areas of ground water that may be drawn into the well during two, five and ten years of pumping. The size of each protection zone is determined by the pumping rate of the well, the effective porosity of the formation that the well is completed in, the interval of pumping (two, five and ten years), and the screened interval of the well. For the Purisima wells, the maximum annual production of the last three calendar years (1999-2001) was used to calculate the protection zones. The Modified Calculated Fixed Radius method was used, and the direction of ground-water flow was determined for each well based on a contour map of ground-water elevation for Fall 1999, prepared by LSCE. The contour map is attached for reference. Each Ground-Water Protection Zone is assigned a point value. The two-year zone (Zone A) is assigned five points, the five-year zone (Zone B5) is assigned three points, and the ten-year zone (Zone B10) is assigned one point. The DHS requires a minimum radius for each protection zone: 600 feet for Zone A, 1,000 feet for Zone B5, and 1,500 feet for Zone B10. If the calculated radiuses of the protection zones are less than the DHS minimums, the minimum values are used instead.

## Physical Barrier Effectiveness

After the Ground-Water Protection Zones are established, the local hydrogeology and the construction of each well is evaluated – confined or unconfined aquifer, sanitary seal depth, proximity to improperly abandoned or destroyed wells, static water level conditions, etc. – to determine how effective the well may be in preventing potential contamination in ground water from entering the well. Each component of this Physical Barrier Effectiveness (PBE) survey is given a point value, with more points given to the options that more effectively protect the well from contamination. The resulting total point score is then categorized as the PBE of the well: low (0 to 35 points), moderate (36-69 points) or high (70-100 points). Each PBE category is assigned a point value. A PBE of low is assigned five points, medium is assigned three points, and high is assigned one point. Wells in unconfined aquifers can score a maximum of 70 PBE points, and wells completed in confined aquifers can score a maximum of 100 PBE points.

## Possible Contaminating Activities Inventory and Vulnerability Ranking

Within each Ground-Water Protection Zone, Possible Contaminating Activities (PCAs) are identified. The DHS provides a PCA Inventory, and assigns each PCA a risk ranking – VH (very high/seven points), H (high/five points), M (medium/three points), or L (low/one point) – based on the potential for that PCA to contaminate ground water. For instance, the DHS ranks gas stations as VH, and schools as L. Some PCAs have different risk rankings depending on which Ground-Water Protection Zone they are located in. For example, sewer collection systems are ranked H in Zone A, but only L in Zones B5 and B10.

A Vulnerability Score, ranging from three to seventeen, is calculated for each Possible Contaminating Activity:

$$\begin{aligned} & \text{(Possible Contaminating Activity Points – 7, 5, 3 or 1)} \\ + & \text{(Ground-Water Protection Zone Points – 5, 3 or 1)} \\ + & \text{(Physical Barrier Effectiveness Points – 5, 3 or 1)} \\ = & \text{Vulnerability Score} \end{aligned}$$

All of the PCAs within the Ground-Water Protection Zones are ranked by Vulnerability Score from highest to lowest – from the most likely to contaminate ground water to the least likely. For example, for a well with a PBE of M, a gas station (VH) located in Zone B5 would have a Vulnerability Score of thirteen:

$$\begin{aligned} & \text{PCA of VH} && 7 \text{ points} \\ + & \text{Zone B5} && 3 \text{ points} \\ + & \text{PBE of M} && 3 \text{ points} \\ = & \text{Vulnerability Score} && 13 \text{ points} \end{aligned}$$

Only those PCAs with Vulnerability Scores of nine and higher are included in the Vulnerability Ranking. The water supply wells are considered by DHS to be vulnerable to those PCAs with a score of nine or higher, and most vulnerable to those PCAs associated with ground-water contamination.

## DWSAP RESULTS

### Ground-Water Protection Zones

All but two of the Soquel Creek Water District (SCWD) Purisima wells were assigned the DHS minimum values for Ground-Water Protection Zone radius. The calculated radiuses for the Garnet and Main Street wells were larger than the minimum values, so the calculated values were used. The Ground-Water Protection Zone data for each well is shown below:

<i>Well</i>	<i>Pumping Capacity (ac-ft/yr)</i>	<i>Screened Interval (feet)</i>	<i>Direction of Ground-water Flow</i>	<i>Zone A Radius (feet)</i>	<i>Zone B5 Radius (feet)</i>	<i>Zone B10 Radius (feet)</i>
Aptos Creek	379	470	235°	600*	1000*	1500*
Estates	500	405	220°	600*	1000*	1500*
Garnet	427	113	65°	725	1145	1617
Ledyard	12	210	255°	600*	1000*	1500*
Madeline	109	160	235°	600*	1000*	1500*
Main Street	1067	266	105°	745	1178	1667
Monterey	263	151	75°	600*	1000*	1500*
Rosedale	548	222	90°	600*	1000*	1500*
Tannery Crk.	344	256	90°	600*	1000*	1500*
T. Hopkins	247	255	240°	600*	1000*	1500*

\* minimum radius used

### Physical Barrier Effectiveness

All of the SCWD Purisima wells are in confined aquifers, and on that basis can receive up to 100 PBE points. However, because there may be abandoned or improperly destroyed wells within the Ground-Water Protection Zones, and because the head in the confined Purisima aquifers is lower than or the same as the head in the overlying unconfined aquifer under static conditions, the SCWD Purisima wells can receive a maximum of only 70 points. Points can be deducted from this maximum for various reasons; the PBE points for each well are explained below:

<i>Well</i>	<i>Seal Depth (feet)</i>	<i>Total PBE Points</i>	<i>PBE Ranking</i>	<i>Comments</i>	<i>Points Deducted</i>
Aptos Creek	88	65	M	Located in 100-year flood zone Surface seal is 3' x 3' <sup>1</sup>	1 4
Estates	60	70	H		
Garnet	76	70	H		
Ledyard	60	65	M	Well not secure <sup>2</sup>	5
Madeline	60	65	M	Well not secure <sup>2</sup>	5
Main Street	60	70	H		
Monterey	Unknown <sup>3</sup>	56	M	No well construction records Surface Seal is 2' x 2' <sup>1</sup>	10 4
Rosedale	60	70	H		
Tannery Crk.	60	66	M	Surface Seal is 3' x 3' <sup>1</sup>	4
T. Hopkins	50	70	H		

<sup>1</sup> DHS considers any surface seal less than 4' by 4' to be improperly sealed, and deducts four points.

<sup>2</sup> If the well is not adequately fenced to prevent humans or animals from accessing the wellhead, it is considered 'not secure', and five points are deducted.

<sup>3</sup> If no information about surface seal is available, the assumption is that there is no seal, and ten points are deducted.

### **Possible Contaminating Activities Inventory and Vulnerability Ranking**

There have been no primary contaminants detected in concentrations exceeding drinking water standards or evidence of seawater intrusion detected in the SCWD Purisima water supply wells. The Garnet and Monterey water supply wells are the closest Purisima wells to the Pacific Ocean. Monitoring wells up to 2,500 feet closer to the ocean (and outside the Zone B10 radiuses for the wells) have not detected the elevated chloride levels typically associated with seawater intrusion. Once results from SCWD's semi-annual sampling event conducted in December 2002 are available, LSCE will prepare an updated Technical Memorandum on Ground-Water Conditions within the District. The SCWD has conducted water quality sampling of all production wells for MTBE since 2001 and has not found detectable concentrations in any well. The PCAs that each well is considered most vulnerable to are shown below:

<i>Well</i>	<i>Zone</i>	<i>Activity</i>	<i>Vulnerability Score</i>
Aptos Creek	A	Dry Cleaners	15
	A	Historic Gas Stations	15
Estates	A	Sewer collection systems	11
Garnet	A	Sewer collection systems	11
Ledyard	B5	Known Contaminant Plume	13

<i>Well</i>	<i>Zone</i>	<i>Activity</i>	<i>Vulnerability Score</i>
Madeline	A	Gas Station	15
	A	Home Manufacturing (Building)	13
	A	Photo Processing/Printing	13
Main Street	A	Sewer collection systems	13
	B10	Known Contaminant Plumes	9
Monterey	A	Gas Stations	13
	A	Home Manufacturing (Building)	13
Rosedale	A	Sewer Collection Systems	13
	A	Utility Stations – Maintenance Areas	13
	B10	Known Contaminant Plumes	9
Tannery	A	Sewer collection Systems	11
	B10	Known Contaminant Plume	11
T. Hopkins	A	Sewer collection Systems	13
	A	Sewer collection systems	11
	B5	Dry Cleaners	11
	B5	Historic Gas Stations	11

The Ledyard, Main Street, Rosedale, and Tannery Creek Wells are considered potentially vulnerable to known contaminant plumes from current and former gas station sites. These contaminant plumes have affected soil and shallow ground water in the immediate vicinity of the gas station sites.

The Ledyard Well is considered vulnerable to a known contaminant plume in the five-year capture zone (Zone B5), caused by leaked gasoline beneath the dispenser island of a gas station at 18 Rancho Del Mar, located approximately 600 feet south of the well. Soil and ground water have tested positive for contamination by total petroleum hydrocarbons as gasoline (TPH-G), benzene, methyl tertiary butyl ether (MTBE) and tert-butyl alcohol (TBA). The extent of contamination at this site has been partially characterized. Contamination of ground water with TBA has occurred to a depth of at least 142 feet below ground surface (bgs). Additional deeper monitoring wells are being installed to determine the full extent of contamination. Remediation with ground-water extraction has been successful in reducing contaminant concentrations, and a soil-vapor extraction system is planned. The ground-water flow direction in the area of the Ledyard well is to the southwest, therefore this contaminant plume is located in a cross-gradient to down gradient direction. It is not likely that the existing discharge from the Ledyard well (12 acre feet per year) will impact the ground-water flow direction and cause the contaminant concentrations to migrate to the well.

The Main Street and Rosedale Wells are considered most vulnerable to two known contaminant plumes in the ten-year capture zone (Zone B10). The first site is a former gas station located at 4901 Soquel Drive, approximately 1000 feet south of the Main Street Well

and 1600 feet west-northwest of the Rosedale Well. Soil and ground water have tested positive for contamination by TPH-G, benzene, MTBE and TBA. The extent of contamination has been characterized as limited to the site. Contamination of ground water is limited to a maximum depth of 50 feet bgs. Remediation is underway with an air sparge well, extraction wells, and a vapor extraction system. The second site is a gas station located at 4860 Soquel Drive, approximately 1200 feet south of the Main Street Well and 1700 feet west-northwest of the Rosedale Well. Soil and ground water have tested positive for contamination by TPH-G and MTBE. The extent of contamination has been characterized as confined to the site. Contamination is limited to a maximum depth of 45 feet bgs. Remediation with underground storage tank pit overexcavation and vapor extraction has been successful in reducing contaminant concentrations, and ground-water monitoring and sampling continue at the site. The ground-water flow direction in the area of the Main Street and Rosedale wells is primarily to the east. The Main Street Well is located in a cross-gradient direction to the two gas station sites, while the Rosedale Well is located in a down gradient direction.

The Tannery Creek Well is considered most vulnerable to a known contaminant plume located in the ten-year capture zone (Zone B10), caused by leaked gasoline from underground storage tanks at a gas station at 5505 Soquel Drive, located approximately 1600 feet west of the Tannery Creek Well. The lateral extent of contamination has partially characterized and additional monitoring is planned to define the vertical extent. Soil and ground water have detectable concentrations of MTBE and tert-amyl methyl ether (TAME). Contamination was previously detected in Nobel Creek, and in ground water as far south as the middle of Soquel Drive. Contaminant concentrations in Nobel Creek appear to fluctuate on a seasonal basis with current concentrations being non-detectable (October 1, 2002). Contamination of ground water has occurred to a depth of at least 30 feet bgs. Full-time remediation with soil-vapor extraction and ground-water extraction has occurred since May/June 2002 and the system's ability in reducing contaminant concentrations will be evaluated in 2003. The ground-water flow direction in the area of the Tannery Creek Well is primarily to the east. The gas station site is located in an upgradient direction of the Tannery Creek Well.

The remaining Purisima wells are considered most vulnerable to activities that are not known to have contaminated soil or ground water, but have the potential to do so. The wells are considered most vulnerable to the following activities: Aptos Creek Well – dry cleaners and historic gas stations; Estates Well – sewer collection systems and historic gas stations; Garnet Well – sewer collection systems; Madeline Well – home manufacturing, photo processing/printing and sewer collection systems; Monterey Well – home manufacturing, sewer collection systems and utility stations/maintenance areas; T. Hopkins Well – sewer collection systems, dry cleaners and historic gas stations.

## CONCLUSIONS

The sole water supply for Soquel Creek Water District is ground water pumped from the Purisima and Aromas Red Sands Formations. The vulnerability rankings calculated for the SCWD Purisima water supply wells are reflective of the Possible Contaminating Activities found in nearly all urban settings. All of the Purisima wells have a moderate or high Physical Barrier Effectiveness ranking; of those with a moderate ranking, all but one (Monterey) have sanitary seals to at least 50 feet below ground surface.

The water supply pumped from the Ledyard, Main Street, Rosedale, and Tannery Creek Wells is not considered to be vulnerable to the contaminant plumes located within their delineation zones due to the limited extent of the plumes, the remediation that is underway at each site, and the pumping capacity. With the exception of the Rosedale and Tannery Creek wells, the location of Ledyard and Main Street Wells are either in a cross gradient or up gradient direction from each plume which minimizes the potential for contaminated ground water to migrate to the wells. The Ledyard Well is producing at a very low rate which minimizes the potential for the cone of depression formed by the well to cause contaminants to migrate toward the well. In the case of the Rosedale Well, the two contaminant plumes are confined within each gas stations property boundaries and are not likely to impact the Rosedale Well located over a quarter mile down gradient. The contaminant plume upgradient from the Tannery Creek Well is undergoing remediation and downgradient monitoring at Noble Creek and private wells currently has non-detectable concentrations of contaminants.

Soquel Creek Water District is committed to providing safe drinking water, and operates its network of wells to ensure that the drinking water it delivers meets all State and Federal drinking water standards. SCWD has acted to reduce the vulnerability of the drinking water supply to contamination by: incorporating well construction features that provide additional protection against contamination into all new wells; working with the Central Coast Regional Water Quality Control Board and Santa Cruz County Environmental Health to ensure that identified contaminant sites within the Ground-Water Protection Zones are managed to minimize the potential for contamination of the drinking water supply; decreasing pumping at some wells to prevent drawing contaminated ground water or seawater toward the wells; implementing a ground-water management plan to protect the water supply; maintaining a database of ground-water levels and quality, and monitoring the status of the ground-water basin to ensure that any changes can be promptly addressed. In addition, SCWD is planning on implementing a program to identify and properly destroy abandoned wells within the district's boundaries.