

TO: Water Supply Advisory Committee

FROM: City Staff

DATE: August 22, 2014

SUBJECT: Vulnerability Report

BACKGROUND: At their July meeting the Water Supply Advisory Committee (Committee) asked for a summary of existing information regarding the vulnerability of the City's water system to natural hazards such as storms, earthquakes, and seawater intrusion. This memo summarizes information known to date highlighting information related to existing facilities including the City's wells, Beltz (Live Oak) and Tait, as well as other infrastructure (water mains, pump stations, treatment plants, etc.).

DISCUSSION: At the July meeting Stratus Consulting summarized several existing studies on climate change, vulnerability, and sea level rise that have been done for the Santa Cruz area. The three main studies are:

- Simulation of Climate Change in San Francisco Bay Basins, California: Case Studies in the Russian River Valley and Santa Cruz Mountains; USGS/Flint and Flint, 2012
- City of Santa Cruz City Climate Change Vulnerability Assessment; Griggs and Haddad, 2011
- The Impacts of Sea-Level Rise on the California Coast; Pacific Institute, 2009.

In general these studies indicate an increase in intensity, duration, and amount of rainfall in winter months that could increase flooding risk on the San Lorenzo River and other coastal streams. The Pacific Institute study also gives a generalized idea of impacts by adding sea level rise to existing 100 year flood elevations; however, it does not factor in location-specific features such as the location of levees and berms, and specific hydrology of the San Lorenzo River, all of which may have mitigating affects.

Other studies of note include:

- City of Santa Cruz Local Hazard Mitigation Plan 2012 – 2017; City of Santa Cruz, 2013
- City of Santa Cruz Climate Adaptation Plan; City of Santa Cruz, 2011
- Water Quality and System Improvement Study TM-2/Appendix A – The Potential for Natural Disasters to Damage the SCWD System; CDM, 2002.

According to the City's Local Hazard Mitigation Plan, and consistent with the Pacific Institute study, the Tait Wells and Coast Pump Station are located in the existing 100-year floodplain and could potentially experience an increased frequency of inundation during storm events in the future; however, site specific hydrology would need to be completed to accurately determine the nature of any increased risk. The City of Santa Cruz Climate Adaptation Plan identifies as an

action item a study of site specific hydrology to determine more accurate risks and potential flood control measures. The Tait Wells are not currently a large component of the water supply during winter storm events; historically, the percentage of total water supply derived from the Tait wells generally represents about 4 percent of the City's annual water supply. The City is currently studying different options for the Tait Wells and Coast Pump Station that could change the way these resources are used in the future during storm events; this study will include vulnerability to various potential hazards.

The abovementioned studies also identify a potential for increased risk of seawater intrusion into low lying wells due to sea level rise. In 1961 there was a period of high salinity in the Tait wells that required they be shut down. This high salinity period coincided with a period of low river flows, in a critically dry year when the Tait wells were fully utilized, and may have occurred due to the highest high tide (possibly a "king tide"). However, similar low flow, pumping rates, and high tide conditions existed in 1972 and no elevated salinity levels were found in the wells. This phenomenon has not occurred since. At this time it is inconclusive as to how or if elevated sea level rise could affect the Tait wells.

Seawater intrusion has been identified as a threat to the City's Live Oak wells. Seawater intrusion is currently not detected in any of the City's production wells. Historically, however, indicators of seawater intrusion (elevated levels of chloride and TDS) have been detected in monitoring wells near the Pleasure Point area. The City, along with the Soquel Creek Water District, have been monitoring and otherwise studying the potential for seawater intrusion in the Soquel-Aptos basin for many years now. Analysis of this data shows that there is a likely threat of seawater intrusion in the Pleasure Point, Soquel Point, and Moran Lake areas.

Sea level rise could potentially raise the seawater/freshwater interface over time and increase the risk of seawater intrusion to the Live Oak wells. Since the exact location of the seawater/freshwater interface is not currently known, it is difficult to determine exactly when and in what time frame seawater could impact one the City's production wells. Soquel Creek Water District, in conjunction with the City of Santa Cruz, Central Water District, Hydrometrics WRI and the USGS (US Geological Survey), are in the process of developing a groundwater model and studying the seawater/freshwater interface. This will allow further study of the potential impacts of sea level rise to seawater intrusion in the City production wells.

Given the threat of seawater intrusion and lowered groundwater levels, actions have been taken to reduce pumping at production wells and move pumping inland so as to eliminate impacts and restore the basin. The City has reduced its pumping over the last several years by almost 50% to respond to lowered groundwater levels and groundwater management planning efforts in the region. And, the City and District are developing new production wells inland from the existing Live Oak wells in an attempt to control groundwater levels, protect the basin, while maintaining water service. The City is in the process of developing Beltz Well No. 12. The purpose of Beltz Well No. 12 is to increase the City's water production during dry years by supplementing the

production of the Live Oak Wells. (Note that the Live Oak wells are used every year during the peak season; Beltz Well 12 would be used to supplement peak season demand during dry years.) The addition of Beltz Well 12 will improve the Live Oak Well system's reliability and flexibility by reducing localized pumping but will not restore groundwater capacity to prior volumes.

It should be noted that for water supply planning purposes, the City has run water supply modeling scenarios with and without the production of the Live Oak wells to be able to consider impacts in the event of seawater intrusion. The water supply information the Committee saw at its June meeting are scenarios that include full production from the Live Oak wells and Beltz Well 12). Scenarios with lost production from the Live Oak wells, while available, was not included at the time for simplicity.

In 2007 the City completed the Water Quality & System Improvement Study; TM2/Appendix A The Potential for Natural Disasters to Damage the SCWD System is part of that study. The purpose of Appendix A was to develop a management plan that would enable the City to continue to provide drinking water that is safe, reliable and meets or exceeds current and anticipated water quality standards and regulatory requirements. CDM conducted a review of available information on potential natural disasters which could impact the system. That study concluded that the hazards of greatest importance to the Santa Cruz area are earthquakes, floods, landslides, and fire. CDM recommended that the City undertake site-specific hazard vulnerability assessments of key facilities including diversions, specific Graham Hill Water Treatment Plant (GHWTP) basins and buildings, and treated water reservoirs.

Prior to and following the CDM study the City has taken on much of the vulnerability assessment work. Several projects/studies were done specifically to address hazard issues while other facilities are evaluated as they come in to turn for capital improvements. The following list broadly summarizes this work.

- During the 1982 floods, the water system had one generator at the GHWTP; today, all essential facilities have either stationary or mobile back up power.
- During the construction of the Bay Street Tanks, a reconnection was made available between the Coast Raw Water System and the tanks. Should the GHWTP be offline for an extended period of time, water, albeit raw, would be available.
- The Newell Creek Dam (NCD) is monitored monthly and following seismic and increased rainfall events. Results are reviewed annually by the Division of Safety of Dams.
- The pipeline from NCD to the GHWTP crosses a landslide (Brackney slide). Infrastructure has been installed on either side of the slide to allow a workaround should a landslide eliminate this critical pipeline.
- The Water Department maintains a larger parts inventory than historically. The manufacturing industry has moved to a schedule of "we build it when you order it" which can create a lag of up to 9 months for some parts. Most recently, the Water Department

ordered a pump for the drought to ensure that the Coast Pump Station can stay functional at very low flows.

- Standby pumps are available at each pump station for redundancy and/or fire protection.
- The Department has started a study of the various concrete tanks in the system to evaluate their structural integrity. Results from the study may recommend upgrades and/or replacement due to vulnerabilities.

One area that continues to receive attention is treatment redundancy. The City operates two treatment plants with over 90% of its water being treated at the GHWTP. While the facility is evaluated and maintained to withstand hazards, a redundant facility would improve reliability and redundancy and meet emergency flows, at a minimum, should the GHWTP be out of service for an extended period of time. A membrane plant was evaluated as part of the Water Quality & System Improvement Study titled Membrane Plant Feasibility Study (CDM, 2007). Issues that reduced the feasibility of this include lack of ample land space in the vicinity of the sources including land already in City ownership; hydraulics; and reduced flows related to fisheries issues. However, redundant treatment facilities remains an important consideration in terms of the City water system's vulnerability assessment.