STONE ENVIRONMENTAL INC

Risk Assessment of Decentralized Wastewater Treatment Systems in High-Priority Areas, City of Malibu, California

Background

The City of Malibu, located northwest of Los Angeles, California, relies on onsite wastewater treatment systems for protection of valuable water resources. A team of consultants and City staff led by Stone Environmental, Inc. conducted a three-year risk assessment/risk management study in a high-priority area of the city. Many stakeholders, including residents, regulators and environmental advocacy groups, were involved throughout and were essential to the study's successful outcomes. The study area included all zones that recharge groundwater in the alluvial aquifers around Malibu Creek and Lagoon, Winter Canyon, and the surfzone of the Pacific Ocean near Surfrider Beach. The team focused on the water table groundwater aquifer, since it receives treated effluent from onsite systems and transmits groundwater to local surface waters.

This satellite image illustrates the study area for the project (outlined in red). Malibu Creek runs from north to south near the center of the image.

Process and Methods

The study team combined available data, a network of new and pre-existing monitoring wells, and the results of a 12-month groundwater quality monitoring program into a centralized, web-based information management system. Using this information, they developed a three-dimensional groundwater model. The team used this model to evaluate impacts of onsite systems on groundwater quality and to determine the directions and rates of groundwater flow within the study area. The risk assessment approach in this study included a 6-step process:

- Define receiving waters and water quality objectives for key water quality constituents (pathogens and nitrogen for Malibu Creek and Lagoon, and pathogens for the surfzone).
- Identify, locate, and quantify contamination contributed by onsite systems.
- Evaluate hydrogeologic conditions to determine groundwater flow directions and geographic areas that contribute flow either to Malibu Creek and Lagoon or the surfzone, and determine travel times from discharge sources to receiving water bodies.
- Estimate the assimilative capacity of unsaturated and saturated zones to account for the reduction or assimilation of pathogens and nitrogen during transport within the groundwater.
- Delineate specific areas with conditions posing risks to the receiving waters relative to pathogens and nitrogen. The highest risk from pathogens appears to be posed by onsite systems that do not provide the combination of unsaturated soil and groundwater

travel time needed for pathogens to die off before reaching the Creek and Lagoon or the surfzone. Nitrate-nitrogen risks are a function of the collective contribution from all onsite systems and were evaluated by modeling the cumulative effects from all areas contributing flow to the nitrogen-impaired Creek and Lagoon.

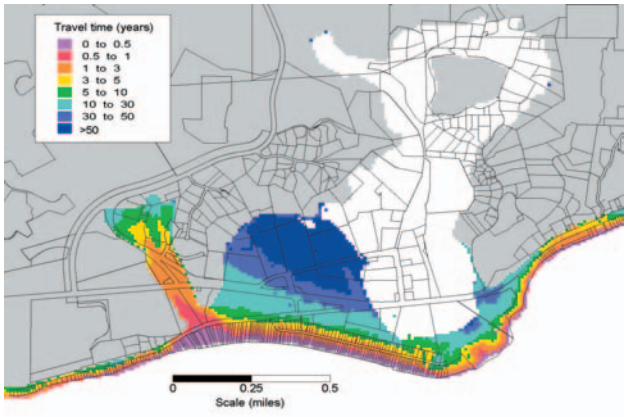
- Identify and evaluate corrective strategies to reduce risks to acceptable levels, including strategies to reduce pathogen and nitrogen contributions from onsite systems. Determine which strategies most effectively reduce risks and achieve water quality objectives.

Major Findings

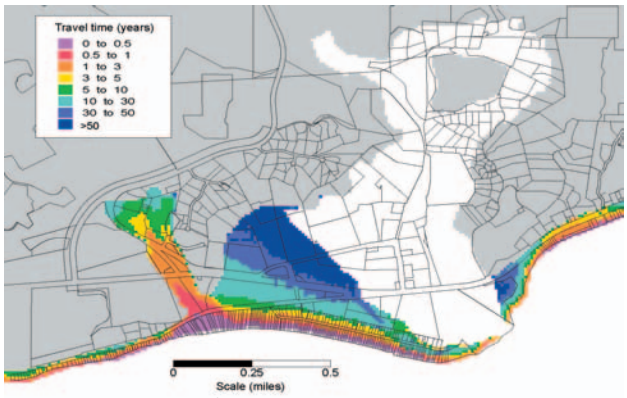
The study team determined that, depending on the location of onsite systems, portions of the study area may contribute pathogens and/or nitrogen to either Malibu Creek and Lagoon or the surfzone. They modeled groundwater movement to estimate the time of travel for pathogens and nitrogen to Malibu Creek and Lagoon and the surfzone, and found that times of travel for groundwater ranged from as short as six months to 50 years or more. The at-risk area identified in the pathogen risk assessment was a six-month time of travel zone around Malibu Creek and Lagoon and along the surfzone. The at-risk area identified in the nitrogen risk assessment included the part of the alluvial aquifer that contributed groundwater flow to Malibu Creek and Lagoon, and overlapped in some areas with the pathogen risk assessment area.

Recommended Actions

Action items focused on the desired water quality outcomes—specifically, meeting Total Maximum Daily Loads (TMDLs) for pathogens in Malibu Creek, Malibu Lagoon, and the surfzone; and meeting TMDLs for nitrogen in Malibu Creek and Lagoon. Recommended actions included initiating point-of-sale inspections; requiring inspection for any onsite system in a zone with time of travel of six months or less; evaluating a clustered wastewater collection, treatment, and dispersal system; requiring disinfection and/or nitrogen removal for systems in the contributing areas; or a combination of these and other action items. The City of Malibu is incorporating the study's action items into its Wastewater Management Plan.



The three-dimensional groundwater model showed that when the Lagoon outlet is blocked by sand, groundwater levels increase several hundred feet inland.



Once increased streamflow breaches the sand barrier, the local water table drops. In part of the study area, groundwater flows toward the Lagoon under breached conditions and towards the Ocean under flooded conditions.

Acknowledgements and Contact Information

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