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ENVS 144 – HW 8 Literature Review

­ The Clean Water Act, henceforth CWA, is a federal policy that aims at regulating the (surface) Waters of the United States (WOTUS). The first major U.S. law to address water pollution was the Federal Water Pollution Act of 1948 (P.L. 80-845), which provided "state and local governments with technical assistance funds to address water pollution problems, including research" (Copeland, 2016, pg. 2). Issues associated with the Federal Water Pollution Act of 1948 were commonly focused around the establishment, or lack thereof, of authority to regulate. Major amendments were established in 1972, with the Federal Water Pollution Control Act Amendments (P.L. 92-500) laying the groundwork for the present-day CWA. "Mounting frustration over the pace of pollution cleanup efforts… along with increased public interest in environmental protection, set the stage for the 1972 amendments" (Copeland, 2016, pg. 2). The 1972 amendments declared a clear objective related to water quality and water resource management: "restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters"… where goals of zero discharge of pollutants by 1985 and water quality in the U.S. that is to be both "fishable" and swimmable" by mid-1983 (Copeland, 2016, pg. 2).

The Environmental Protection Agency was outlined in the CWA as a regulator of this specific policy. As part of the CWA, the EPA's major regulation is the National Pollutant Discharge Elimination System program (NPDES). This NPDES program "controls water pollution by regulating point sources that discharge pollutants into the [WOTUS]" (SWRCB, National Pollutant…). As part of the NPDES permit, there is a NPDES MS4 (Municipal Separate Storm Sewer System) where permittees must implement a comprehensive Storm Water Management Plan (SMWP) (EPA, Municipal Separate Storm…), where in California, the State Water Resources Control Board (SWRCB) oversees the implementation. As part of the requirements of MS4/SWMP permits, the permitter must implement outreach to their constituents.

The City of Lodi's community-based monitoring (CBM) program, Storm Drain Detectives (SDD), was established to prevent a fine from the SWRCB. In 1998, the City of Lodi's wastewater facility was fined $20,000 for high chlorine levels in their discharge. The Public Works Director for the City of Lodi asked the SWRCB if "$10,000 of the fine [could] remain in Lodi to develop a water-quality education program" (Western City, 2017). As part of this agreement with the SWRCB, SDD was created in 2001. The SDD program now meets requirements for the Phase II MS4 General Permit of outreach.

CBM programs are a way to involve stakeholders and the community in environmental work. CBM "makes a valuable contribution to environmental management and construction of active societies for sustainable future" (Burgos et al., 2013). CBM has been shown that "the hands-on activities of environmental monitoring using simple equipment and techniques are a tremendous motivation for participation" (Deutsch et al., 2001, pg. 195). The SDD program follows this outline for CBM, where hands-on activities engage a broad audience, where middle and high-schoolers are involved in the monitoring. Not only is CBM beneficial for environmental management, but CBM has also been shown to be an important expression of governance for Indigenous populations (Wilson et al., 2018). Wilson et al. (2018) found that "data quality and credibility, trust and legitimacy and relevance to decision contexts are key to mobilizing CBM data in relevant decision-making processes" (Wilson et al., 2018). "Citizen-science" is frequently considered irrelevant science; however, researchers have shown that trust in CBM data is crucial to decision-making. SDD data was used when the City of Lodi began to plan out its Surface Water Treatment Plant located on Lodi Lake. Ultimately, the data was used to determine the water treatment plant's specifications (Western City, 2017). Therefore, trust in the data that has originated out of CBM is crucial.

As the SDD program monitors water quality in Lodi, CA, overall good water quality is paramount. The "degradation of water quality creates water scarcity and limits its availability for human use and ecosystem and thereby impacts the optimum management of water resources" (Rao and Mamatha, 2004, pg. 946). Water quality is an important environmental factor that needs to be ensured that it is in good standing. As Rao and Mamatha (2004) showed, water quality can significantly affect overall water levels and ecosystems. Parameters for water quality are essential to determine when looking at overall water quality. Gorde and Jadhav (2013) outlined lake water monitoring parameters that should be tested: pH, conductivity, alkalinity, phosphorus, nitrogen, light transmission, Dissolved Oxygen (D.O.), turbidity/transparency (Secchi Disk), plankton, and chlorophyll-a. As lake ecosystems vary widely, the SDD program monitors the majority of these outlined parameters.

The City of Lodi is located in the Lower Mokelumne River Watershed (LMR), which stretches from the base of the Camanche Dam to the confluence of the Consumes and Mokelumne Rivers (Lower Mokelumne River Stewardship Steering Committee, 2012). The SDD program monitors five sites around the City of Lodi (Image 1), with a comprehensive view of the City of Lodi's effects on overall water quality. The water quality parameters that the SDD program monitors are pH, D.O., turbidity, nitrates, bacteria, Electrical Conductivity (E.C.), and visual observations. Turbidity, the measure of relative clarity of a liquid, is measured based on the amount of light scattered by material in the water (USGS, Turbidity and Water). Turbidity can have significant effects on ecosystems, where aquatic life can be significantly affected.

Water quality trend analysis can be conducted in many different ways. Researchers convey that conducting a Kendall test is an effective way to conduct water quality trend analysis (Hirsch et al., 1982). The seasonal Kendall test has been conveyed that it is a "nonparametric test for trend applicable to data sets with seasonality, missing values, or values reported as 'less than'" (Hirsch et al., 1982). Researchers have also outlined additional ways to conduct water quality trends for watersheds: (1) quadratic trend models; (2) linear models; where "It was observed that for most of the sites and water uses quadratic trend models were a better fit than the linear models" (Khan, Husain, and Lumb, 2003). Khan et al. (2003) and Gorde and Jadhav (2013) outlined a Water Quality Index (WQI) as a test for overall water quality health. Other researchers convey that Systat 10.2, "which is a well-known program for performing a range of statistical analyses," was helpful when analyzing stormwater monitoring programs (Lee et al., 2007, pg. 4187).

**Images:**

**A picture containing chart

Description automatically generated**

**Image 1:** Site Locations for SDD program

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