MAUKA TO MAKAI: FROM THE MOUNTAINS TO THE SEA
Reducing Stormwater Runoff Pollution in Maunala Bay, O‘ahu, Hawai‘i
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Background
Urbanization
Urban development has severely altered the natural hydrology of many watersheds globally. A topic of contemporary interest in watershed management is reducing the amount of polluted stormwater runoff that enters streams and oceans. This phenomenon is worsened in watersheds with short and steep drainage basins and flashy precipitation, such as those in the Hawaiian Islands.

Coastal Ecosystem Impacts
Sediments such as polluted stormwater runoff have negatively impacted the ecosystems of Maunala Bay [3] (Figure 1). Fine sediments are particularly damaging to coral reefs [4] as they are carried with high peak flows of stormwater from erosion of the upper watershed [3, 4].

Project Objective
Develop a model using the Environmental Protection Agency’s Storm Water Management Model (SWMM) [5] to facilitate identification of “hotspot” areas that contribute higher stormwater pollution relative to surrounding areas in the Maunala Bay Region.

Approach

Characterize data availability and limitations for each of the 10 watersheds in the region

Delimit a representative watershed into areas called subcatchments using the heterogeneity of the natural and built environment

Use a hydrologic model, SWMM 5.1, to obtain a baseline estimate of runoff pollutant loading in the chosen watershed

Identify hotspot subcatchments that contribute higher total flow volume or peak flow relative to other subcatchments.

Main Findings

1. Model Results: Simulated vs. Observed Discharge
   Our model is useful to identify spatial distributions of runoff and the associated hotspot locations. Figure 1 shows the time series of observed and simulated discharge.

2. Stormwater Volume and Peak Flow Identified Hotspots
   Top 20 hotspots subcatchments were determined by overlaying subcatchments with high runoff ratios (0.64 - 0.80) for both storm events (Figure 2). The top 20 hotspot subcatchments for peak flow were determined by overlaying subcatchments with high peak flows (0.5) for both storm events (Figure 3).

3. Relationship Between Urbanization and Runoff
   Figure 4 shows that higher percent of impervious surfaces from urban environments generates more runoff.

Recommendations

Stormwater Volume (Runoff):
Explore green infrastructure placement to increase infiltration of stormwater and pollutants to natural soils [7].

Peak Flow (Sediment):
Reduce sources of sediment with erosion control measures of mass wasting areas in upper watershed, and prioritize green and gray infrastructure that provides sediment controls in the lower watershed [8].

Regional Strategy:
Use the model as part of a regional strategy to prioritize hotspot subcatchments for the remaining watersheds with viable data in the bay. Involve the community and other stakeholders in an informed decision making process based on results from the model, tools, and ground truthing.

Example Hotspot Areas
Highly urbanized areas (both urban and riparian areas, top) and the Maunala Watershed (bottom). Examples of heavy sediment erosion, called main wasting areas in the upper watershed (both images, Alex Waterhouse).

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References

Figure 1. Diagram of ecologic impact of stormwater pollutants.