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Contemporary and Historical Hydrologic Analysis of the Ballona Creek Watershed

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EXECUTIVE SUMMARY

The current study investigates the partitioning of native and non-native water sources for the Ballona Creek Watershed—a highly urbanized system within the Los Angeles basin. The goal is to evaluate the impact of imported water on spatial and temporal hydrologic cycling and to develop conceptual models of the system as it has evolved from pre-development through the contemporary period. The conceptual model includes precipitation and imported water (outdoor use) as inputs and evapotranspiration, runoff, and groundwater recharge as outputs. The residual term from the water balance accounts for the aggregated uncertainties from model components as well as inputs or outputs that may be unaccounted (leaky pipes, wastewater return, etc.). Daily data were collected and aggregated to the basin-wide annual values for use in the long-term comparison. Components were then analyzed to identify trends and temporal variability. To determine runoff partitioning between native (rainfall) and non-native (imported water) sources, imported water and regional springs was analyzed.

Precipitation throughout the study period has a long-term annual average of 409 mm, with distinct seasonality. January and February are the wettest months, bringing in almost half of the total annual precipitation each year. Annual average runoff for the study period was 204 mm. Runoff ratios (runoff/precipitation ratio) more than doubled during the 73-year study period, increasing from .07 (pre-development) to around 1.0 (contemporary period). The amount of total imported water doubled and outdoor landscape tripled over the 73 year study period. Long-term outdoor water use was estimated at 246 mm. Average evapotranspiration rates were 393 mm during the study period. Annual evapotranspiration peaks during the summer and we hypothesize that the plants are not water limited and precipitation is playing less of a role in vegetation transpiration across the watershed. Water balance results indicate that the sum of recharge and the residual is +58 mm for the most recent period. More work on long-term groundwater table levels is necessary to refine our estimates and reduce the model residual.

For the pre-development period, precipitation was assumed to remain constant (409 mm). Annual runoff was estimated to be 29 mm based on historical irrigation reports, resulting in a runoff ratio of 0.07. Evapotranspiration estimates were based off a water limited scenario so the pre-development annual depth was estimated to be 164 mm. The pre-development water balance estimates the sum of recharge and residual is 216 mm, indicating greater groundwater recharge and potentially larger uncertainties associated with the early water budget estimates, particularly evapotranspiration.

Field measurements were also undertaken to measure sub-watershed runoff and spring flow contribution to runoff. Data was collected at several sites to develop a preliminary understanding of distributed flows in the watershed. Results indicate that sub-watershed area was a good predictor of the percentage flow contribution to the total runoff at the outlet. Extensive field investigations were performed to locate springs based on 41 mapped pre-development springs. The 29 springs which were identified covered approximately 20% of the total watershed area and had an aggregated flow rate of

0.00057 m^3/s during the dry season. This accounts for 2% of the dry season runoff implying that the remaining 98% was from non-native (imported water) sources.

Differences between the pre- and post-development water balance residuals highlight the anthropogenic impacts on watershed fluxes and the reduction of natural recharge across the basin. Land cover transition from pervious to impervious surfaces governed the water balance evolution and increased both dry and wet season runoff from pre-development to the contemporary period. We estimate the uncertainties associated with our model residual could be as high as 40%, with the largest uncertainty likely related to our evapotranspiration estimates.

Full Text

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/683_BallonaWaterBalance.pdf