2. RESEARCH OBJECTIVES

Despite the modularity of pervious pavement systems, our understanding of the associated runoff dynamics at large spatial scales over variable land use and land cover layers significantly the scalability of the technology. Subsequently, the primary research objective is to quantify the net effect of pervious pavement systems on runoff dynamics at a catchment scale, accounting for variable traffic load and land use patterns.

3. METHODS

LAND USE AND COVER (LUC) CLASSIFICATION: Identified Pierce catchment as an area of mixed-use zoning (Fig 2); predominantly residential, detached single-family home subdivision and light industrial, bordering Indian Bend Wash (IBW) in south Scottsdale, Arizona (Fig 3). LUC classification was carried out in ArcMap 9.3 (ESRI, 2011) according to land cover material and land use type for future analysis of traffic load and ensuing runoff potential (Fig 2). LUC data was used for Identifying Total Impervious Area (Fig 3), to which sidewalks, main roads, and alleys contributed 12.04, 15.16, and 38.93%, respectively. Additionally, LUC parameterization contributed to TRI breakdowns (Fig 6), and for MANAGER input file calculations (primarily in rainfall-runoff factors, ksat, flow routing, and vegetation cover data) to simulate runoff conditions.

DIGITAL ELEVATION MODEL (DEM): of Pierce was originally extracted from the City of Scottsdale DEM. at a resolution of 10 m × 10 m, the DEM was too coarse to accurately render elevation profiles for Pierce (91,168.5 m²) and subsequently, the city of Phoenix established 3x3 m DEMs. The modified DEM (Fig 6) was converted to a raster (Fig 12). Through stormwater routing, flow, and accumulation analysis, the derived DEM resulted in new catchment boundary delineation (Fig 8).

HYDROLOGIC RESPONSE MODELING: was carried out using MAHNER (Model for Assessing Hillslope-Landscape Erosion, Runoff and Nutrients), a spatially explicit, event-based model, parameterized at a spatial resolution of 0.25 m × 0.25 m. MAHNER’s process representation of runoff dynamics relies on inputs of spatially explicit DEM and pavement coverage percent, final infiltration rates (ksat), soil thickness (effective depth to wetting front), friction factors, wetting front position, drainage parameters, and initial and saturated soil moisture content in addition to a land cover material and land use type for future analysis of traffic load and ensuing runoff potential. MAHNER's parameterization contributed to TRI breakdowns (Fig 6), and for MANAGER input file calculations (primarily in rainfall-runoff factors, ksat, flow routing, and vegetation cover data) to simulate runoff conditions.

5. SUMMARY & NEXT STEPS

SUMMARY: To date, final DEM raster accurately renders both local and catchment wide topography-driven patterns; channeling flow down streets and alleys, following south-bound flow across catchments. Model-driven contributing area matches up with flow (runoff) contribution area, and matches field-observed topographical properties. The CAP monitoring station located in the SW corner of the catchment both displays the highest flow accumulation, and effectively intercepts the majority of the runoff from the north residential zones. This is consistent with field observations, previous assumptions, and reveals that modeled flow is being routed correctly. Several zones of elevated hydraulic significance have been identified; the multi-use alleyway and multi-house residential parking area, the N/S corridor in the SW corner of the catchment, and the SW arterial along Fulling Mill Road, each contribute to a central roadway depression. The SW arterial along Fulling Mill Road, each contributes to a central roadway depression, and its subsequently prone to flooding.

NEXT STEPS involve refining parameterization of soil properties and assigning a significant level of confidence in model parameterization for CAP monitored events as well as for field-observed topographical properties. The CAP monitoring station located in the SW corner of the catchment both displays the highest flow accumulation, and effectively intercepts the majority of the runoff from the north residential zones. This is consistent with field observations, previous assumptions, and reveals that modeled flow is being routed correctly. Several zones of elevated hydraulic significance have been identified; the multi-use alleyway and multi-house residential parking area, the N/S corridor in the SW corner of the catchment, and the SW arterial along Fulling Mill Road, each contribute to a central roadway depression, and its subsequently prone to flooding.

REFERENCES