Research Project: SHA/MSU/4-3
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RESEARCH SUMMARY

Highway Runoff Stormwater Management Potential Site Characterization Using NASA Public Domain Imagery

Problem

There is an urgent need for non-invasive techniques to evaluate and characterize highway runoff stormwater management potential (HRSMP) sites in order to reduce their impact on properties, save lives and operational cost. Reduction of Total Maximum Daily Loads (TMDL), an important initiative of the SHA, could be achieved through the development and use of geospatial technologies (GST) which takes advantage of NASA public domain imagery such as Landsat, at no cost to SHA, and has demonstrated its cost-effectiveness across many professional fields.

Objective

The objectives of this research were to develop and utilize GST methodologies including remote sensing, to characterize and determine the level of performance of stormwater management (SWM) facilities (BMPs), resulting in the reduction of highway projects delivery time and compliance with the required TMDLs set by the Environmental Protection Agency/Maryland Department of the Environment.

Description

Comprehensive field observations of representative sites of the four SHA rated BMP facilities were conducted using Trimble's handheld DGPS, in order to examine the facilities and get a better understanding of the geospatial features existing at the sites. Landsat TM images from the United State Geological Survey (USGS) were acquired, evaluated and assessed for image quality. Based on the outcome of the image assessment, 5 Landsat TM and 1 Landsat OLI_TIRS images which span 1990 – 2015 were selected, processed and analyzed using the Environment for Visualizing Images (ENVI) software. All image processing and analyses were done using HP PC workstations. Land use/land cover (LULC) and normalized difference vegetation index (NDVI) images were created and further analyzed to determine the relationships with BMP performance ratings. By using ENVI's image processing tools and procedure including Link Displays and Pixel Locator, the exact NDVI indices and LULC class type were extracted for the different BMP rated sites (see Figure 1). This process was fast and straightforward.

RESEARCH SUMMARY

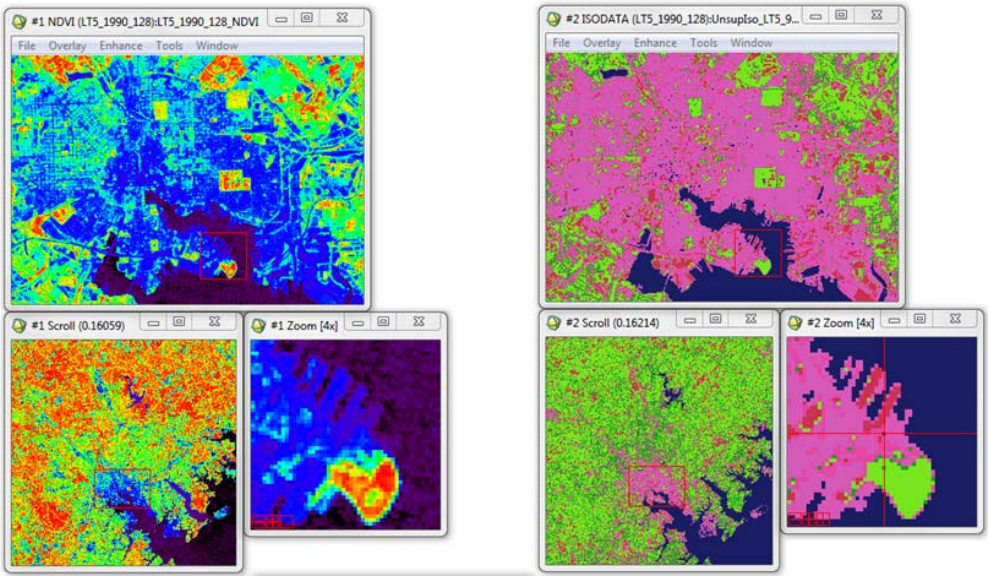

Figure 1. Extracting NDVI (left images) and LULC (right images) for Selected BMP Sites.

Results

The results obtained from the LULC analyses suggested that vegetation was a major factor affecting the performance of the BMP facilities. Most of poor and failed sites showed excessive overgrowth of vegetation such as high brush and trees; the vegetation at some of the sites were thick that it was inaccessible. Some that performed as originally intended, had less vegetation cover (mostly low cut grass) and were located in close proximity to streams. Analysis of the NDVI however, did not show definitive trends as it relates to both temporal and spatial patterns. For example, some BMPs that were ranked Failed, showed increase in NDVI values, while others that performed well (Good) also showed increase in NDVI values. The ambiguity in getting definitive results from the NDVI values could be due to the relatively low spatial resolution of the TM images (30 m by 30 m). Using higher spatial resolution such as IKONOS multispectral images with a 4-meter spatial resolution may resolve these inconsistencies.

Report Information

Dr. Frederick K. Wilson, PI
Morgan State University
Baltimore, MD 21251
443-885-4200
Frederick.wilson@morgan.edu

Link to Final Report

http://www.roads.maryland.gov/OPR_Research/MD-16-SHA-MSU-4-3_Highway-Runoff-Stormwater-Management_Final%20Report.pdf