

Utilizing Object-Based Classification to Quantify Lawn in High and Low Water Usage Areas in Hillsboro, Oregon



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Introduction

- ❖ Water consumption to sustain outdoor features, such as lawns, gardens and pools makes up a significant portion of municipal water budgets.
- ❖ In Australia, it is estimated that almost half of all urban water use is for gardens (Miller and Buys 2008) .
- ❖ During the summer in Phoenix, Arizona and Layton Utah, 50-75% of overall municipal water is used outdoors to maintain non-native, water intensive landscapes (Balling, Gober and Jones 2008; Endter-Wada et al. 2007).
- ❖ In Barcelona, Spain, houses with a high proportion of lawn exhibit higher water consumption (Domene and Sauri 2006).
- ❖ In Phoenix, Arizona, an increase in the percentage of mesic vegetation per census block is significantly correlated with an increase in overall water demand (Wentz and Gober 2007).

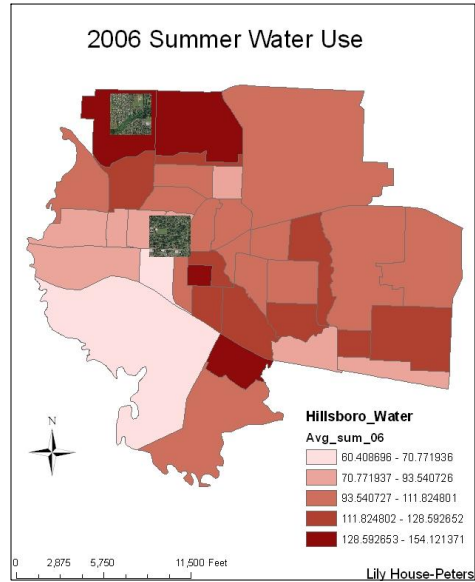
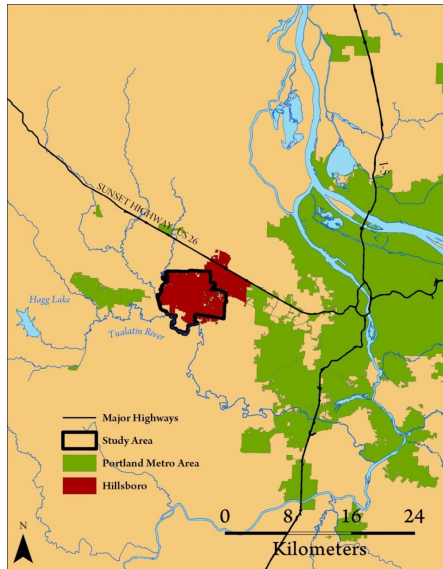
Introduction

- ❖ Object-based classification combines the tools of segmentation, the nearest neighbor classifier, and integration of expert knowledge, which can yield improved classification accuracy compared to the traditional pixel-based method (Jobin et al. 2008; Platt and Rapoza 2008).
- ❖ Through object-based classification, information needed for image analysis can be represented in meaningful image objects and their mutual relations (Baatz and Schape 2000; Rahmnan and Saha 2008).
- ❖ In comparison to pixel-based classification, Rahman and Saha (2008) found an increase in overall Kappa accuracy score from 83% to 90%.
- ❖ Zhou, Troy and Grove (2008) recommend the use of the object-based approach as a convenient and useful method of classifying fine-scale measurements of tax lot lawn area.
- ❖ For classification of land cover in urban areas, studies have shown that the integration of Light Detection and Ranging (LiDAR) data significantly improves overall accuracy (Huang et al. 2008; Chen et al. 2009)

Research Objectives

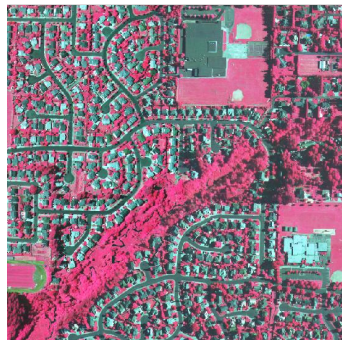
1. To classify land cover on single-family residential tax lots in high and low summertime water consumption neighborhoods, in Hillsboro, Oregon.
2. To quantify the average amount of lawn per tax lot in each neighborhood.
3. To compare the average amount of lawn per tax lot in each neighborhood.

Study Area



Data

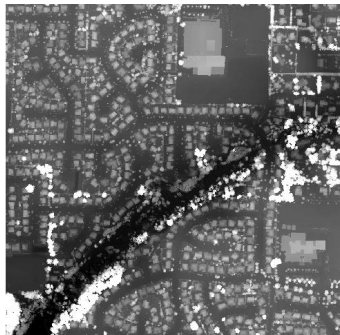
| Data Type | Spatial Resolution | Spectral Resolution | Date | Source |
|----------------------|------------------------------|-----------------------|----------------|--------------------|
| 2 Aerial photographs | 6 inch | False-color composite | June 2006 | Metro/ RLIS |
| 2 Aerial photographs | 6 inch | True- color | June 2006 | Metro/ RLIS |
| 2 LiDAR images | 3 foot | | March-May 2007 | Watershed Sciences |
| Tax lot shapefile | Clipped to aerial photo size | | 2008 | Metro/ RLIS |



**High Summer
Water Usage**



True-color aerial photo



LiDAR



Tax lot
shapefile



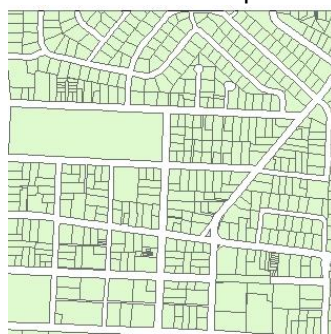
**Low Summer
Water Usage**



True-color aerial photo



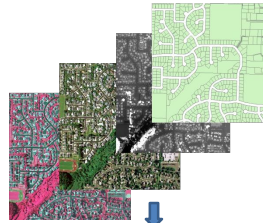
LiDAR



Tax lot
shapefile

Methods

High Water Use Neighborhood



Definiens Developer 7

Chessboard Segmentation

Multi-Resolution Segmentation

Land Cover Classification

Calculate % Lawn per Tax Lot

Low Water Use Neighborhood



Definiens Developer 7

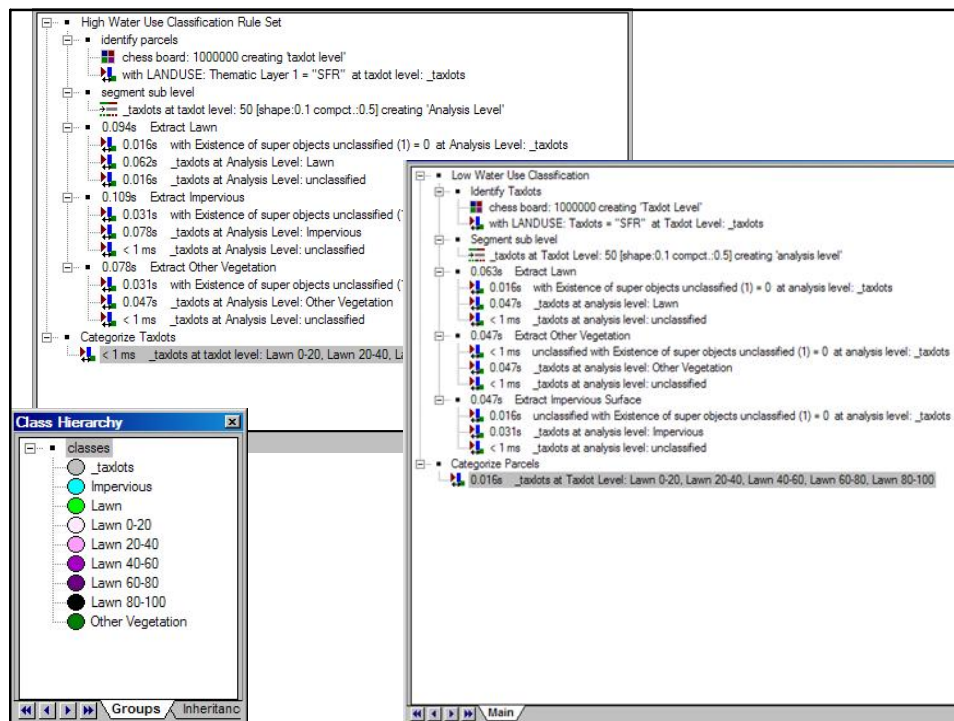
Chessboard Segmentation

Multi-Resolution Segmentation

Land Cover Classification

Calculate % Lawn per Tax Lot

Compare % Lawn per Tax Lot in each Neighborhood



Chessboard Segmentation



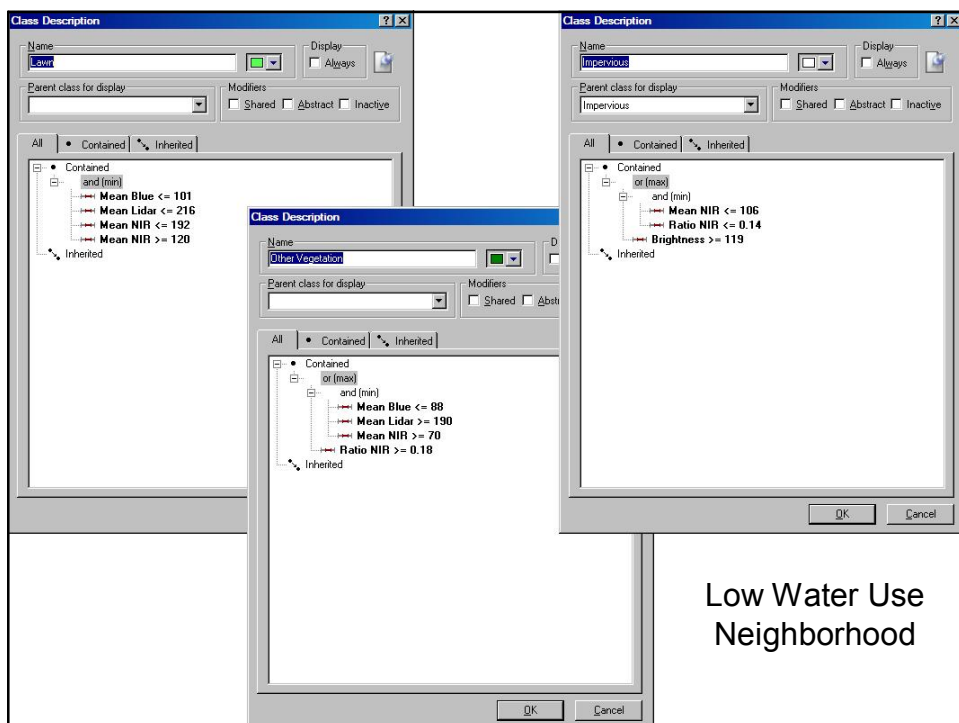
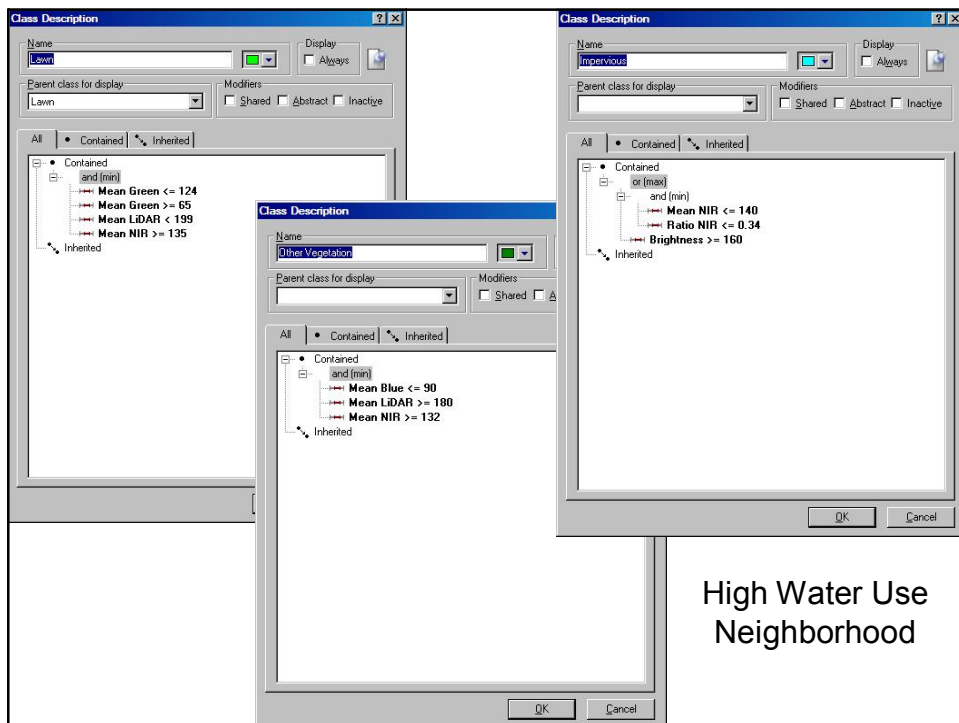
High Water Use
Neighborhood



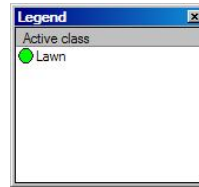
Low Water Use
Neighborhood

Multi-Resolution Segmentation





Classifying Lawn



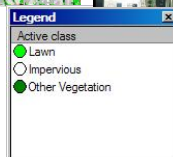
Classification Results



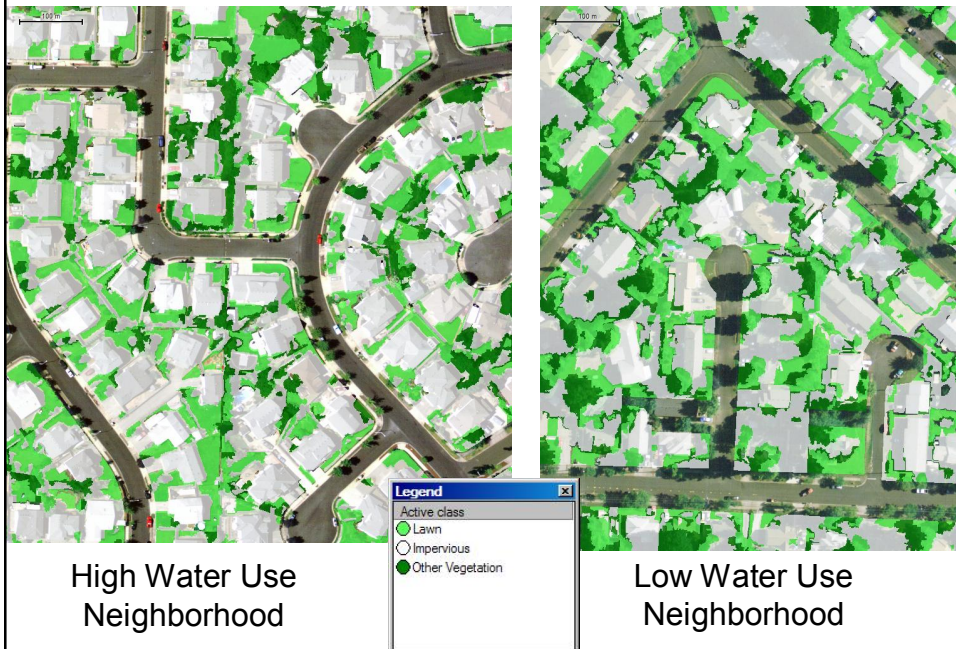
High Water Use
Neighborhood



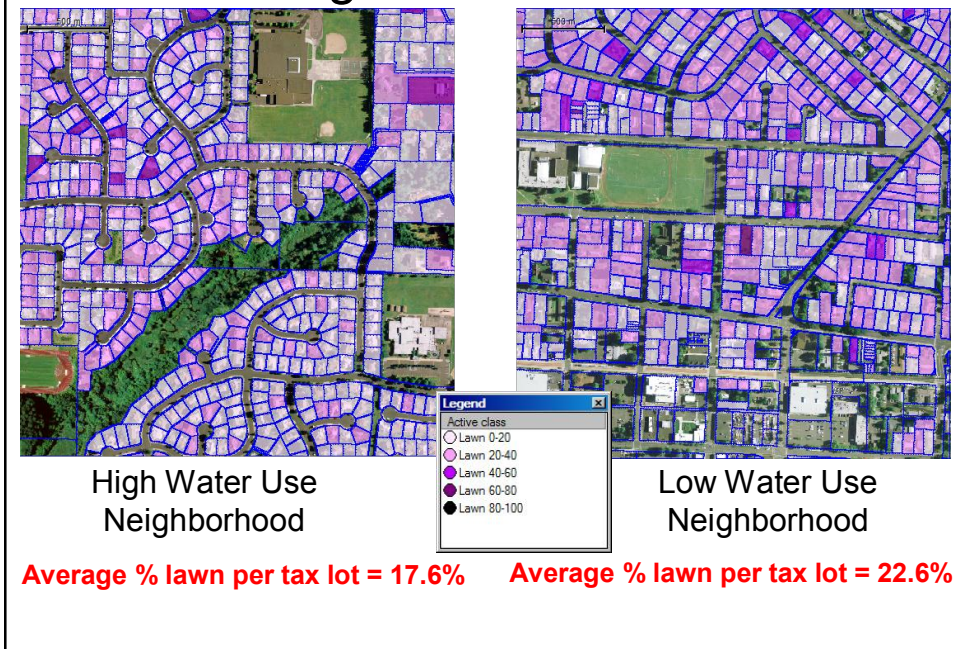
Low Water Use
Neighborhood



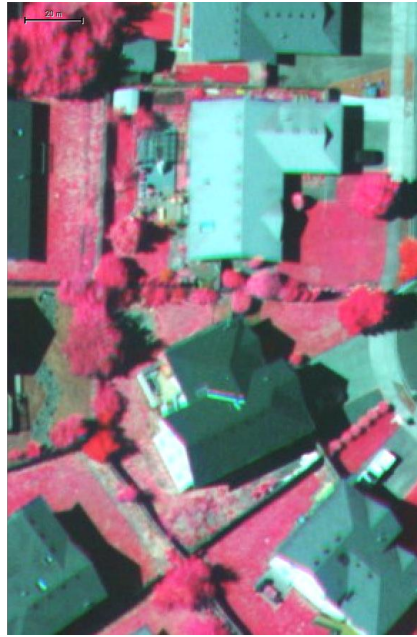
Classification Results



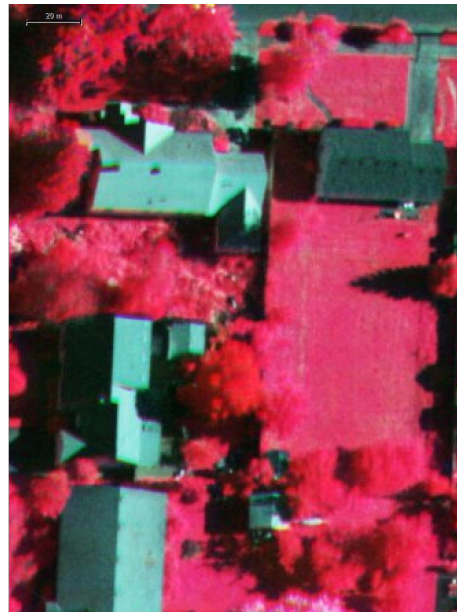
Categorization Results



Accuracy Assessment



Accuracy Assessment



Conclusions

Limitations:

- ❖ Only leaf-on images available
- ❖ Problems classifying areas of shadow
- ❖ Dead grass was often mis-classified as impervious
- ❖ Pools were not classified
- ❖ Unable to separate the spectral characteristics of different vegetation species

Future Analysis:

- ❖ Integrate more available features, such as shape and texture into the classification
- ❖ Optimize the segmentation process and rule set
- ❖ Create TTA mask in ERDAS to calculate a quantitative accuracy assessment
- ❖ Combine lawn classification information with the rest of my household level water use data using GIS

Sources

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