

DYNAMIC GENERATION OF INTERACTIVE ECOSYSTEM REPORT CARDS USING SILVERLIGHT AND VIRTUAL EARTH

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INTRODUCTION

The Health-e-Waterways Project is a three way collaboration between the University of Queensland, Microsoft Research and the Healthy Waterways Partnership (HWP) (over 60 local government, state agency, universities, community and environmental organizations). The project is developing an innovative framework and set of services to enable streamlined access to an integrated collection of real-time, near-real-time and static datasets acquired through ecosystem monitoring programs in South East Queensland. Using a novel combination of semantic web technologies, scientific data servers, web services, GIS visualization interfaces and data processing workflows, we are enabling the sharing and integration of high quality data and models, through a combined integrated water information management system and Web portal.

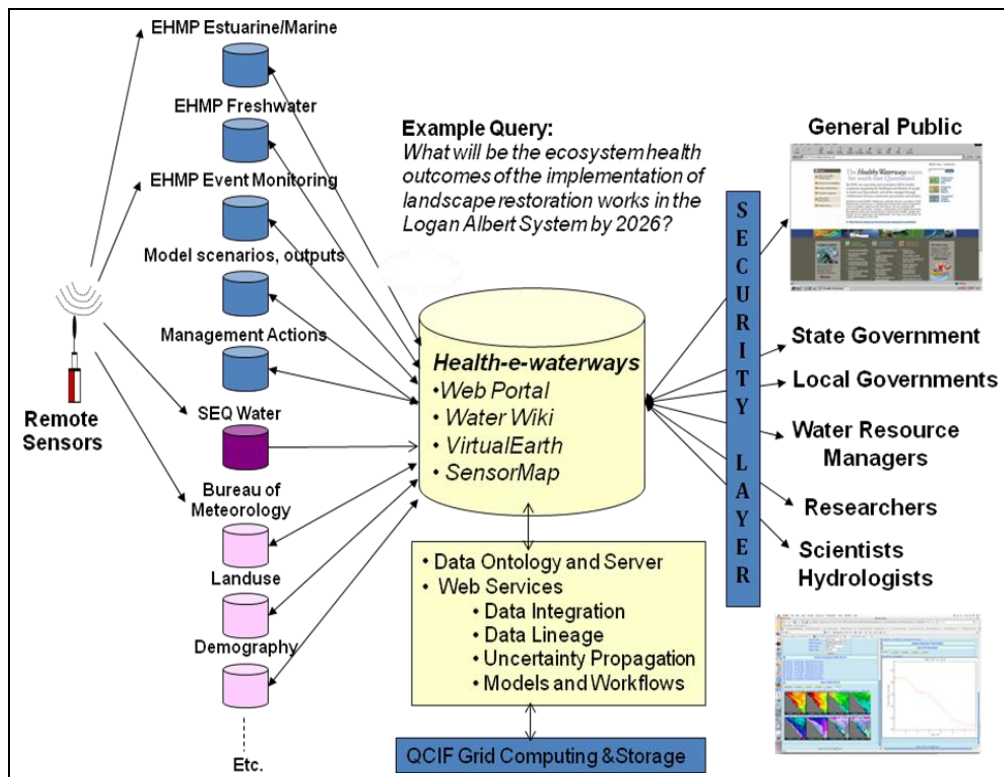


Figure 1: Overview of the Health-e-Waterways System

¹ <http://www.healthywaterways.org/>

The primary aim of the project is to improve the speed, reliability and adaptability of the water management decisions being made within South East Queensland - by providing scientists and planners with fast, Web-based access to the disparate and heterogeneous datasets and models describing: climate, water flows, water quality, land use, vegetation, fish distributions, population growth, urban development, water consumption and water management policies. Figure 1 provides a high level overview of the components and architecture of the system.

DYNAMICALLY GENERATED AND INTERACTIVE ECOSYSTEM HEALTH REPORT CARDS

Healthy Waterways Partnership (HWP) is responsible for the Ecosystem Health Monitoring Program (EHMP)² in South East Queensland. This involves sampling 30 freshwater indicators at 100 sites twice a year and 250 estuarine/marine sites every month. The number of sampling sites and size of the datasets is expected to rapidly expand in the near future, with the planned installation of sensor networks in Moreton Bay.

The EHMP data sets are statistically aggregated and standardized to produce ecosystem health grades that are published annually in hard copy EHMP Report Cards. Politicians and planners from 20 different agencies (including the EPA), 4 universities, 18 local councils and CSIRO, use the report cards to make decisions with respect to land use, water quality, allocations and investments in water recycling plants etc. The report cards provide a standardized method for understanding and comparing the health of catchments between regions and over time.

To date, these report cards have been largely produced manually, via the following process:

1. Values for each of the 5 indicators (physical, chemical, nutrients, ecosystem processes, aquatic macroinvertebrates and fish) are calculated from the 16 indices recorded for each site and for two seasons (spring and autumn);
2. Index values are compared against Ecosystem Health Guideline values to derive standardised scores that range from 0 (unhealthy) to 1 (healthy);
3. Standardised scores are averaged across combinations of indices, sites and seasons to provide intelligible summaries for catchments and seasons;
4. Graphical summaries of results are produced to enable the comparison of indices and indicators across reporting areas and between seasons: box and whisker plots, horizontal bar charts, and Ecosystem Health plots (EcoH plots).
5. Summarisation of the EHMP results culminate in a report card grade from A to F.

Currently the production of the EHMP Report Cards process takes about 5 months, with the most time-consuming step being the manual generation of the graphs and EcoH plots using Photoshop Illustrator. The results for July-June of each year, are published in the following November.

For the past 6 months, we have been working with the SEQ-HWP staff who are responsible for generating the annual ecosystem report cards. We have been developing software services that will enable the report cards to be generated dynamically via a Web-based Map interface that overlays a database containing the spatio-temporal monitoring data. Figure 2 shows the results of our collaboration – the Web-based user interface on the left hand side and the architectural components of the system on the right hand side.

² <http://www.ehmp.org/>

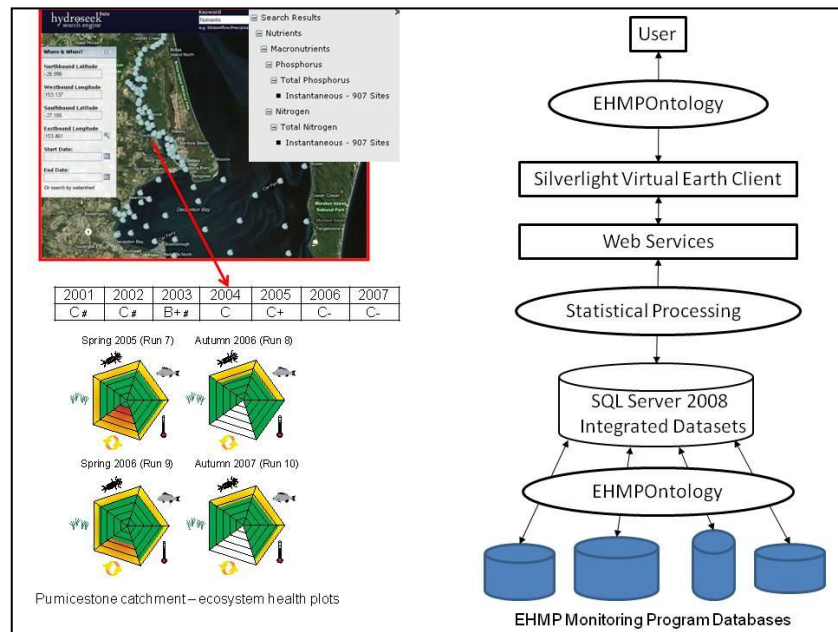


Figure 2: User Interface and System Architecture

The GUI enables users to specify:

- Spatial regions of interest (e.g., particular catchments or sites) through the Microsoft VirtualEarth interface.
- Concepts or indicators of interest through the EHMPOntology (a localized and extended version of the ODM ontology developed by CUAHSI HIS).
- Seasons or years of interest through a timeline.

A Report Card Grade is generated for the specified catchment and period. Clicking on a grade, displays the corresponding EcoH plots, dynamically generated from the 5 indicators in the underlying SQL Server database. Clicking on an EcoH plot, displays the actual raw data (16 indices) used to generate the indicators and plots. The combined use of Silverlight and SQL Server enables very fast aggregation of datasets and the dynamic generation of graphical mashups.

CONCLUSIONS

Numerous state, national and international agencies are advocating the need for standardized frameworks and procedures for environmental accounting. The Health-e-Waterways project provides an ideal model for delivering a standardized approach to the aggregation of ecosystem health monitoring data and the generation of dynamic, interactive reports (that incorporate links back to the raw data sets). The system we have described here will not only save agencies significant time and money in generating environmental accounts, but it can be used to guide regional, state and national environmental policy development, based on high quality evidential data.