

AQUA DATA: AUTOMATICALLY CAPTURING, MAPPING & SHARING LATEST WATER QUALITY DATA ON THE WEB

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Abstract

This year Shoalhaven City Council (SCC) received the Local Government Award for Excellence in Overall Environmental Management at the prestigious United Nations of Australia World Environment Day Awards. In part this was in recognition of the considerable amount of time and money SCC invests on monitoring and reporting Water Quality across its Drinking Water, Effluent Treatment, Waste Management and Environmental Services departments. The most laborious aspect of this work is the time each department currently spends on manually collating results, entering into databases, exporting to spreadsheets, statistically analysing, summarising and publishing on the web.

Yet despite the millions of dollars NSW organisations spend on all this monitoring and reporting of water quality, the vast majority is still rarely available within a time frame or at an appropriate level of detail necessary to assist management decisions outside the immediate needs of the custodian who collected it. And even then it usually requires the assistance of a database expert to access it. As a consequence the data is effectively inaccessible to other internal and external stakeholders, and thus the returns on investment from all this environmental monitoring are not being realised.

SCC has therefore established a public, user friendly, GIS searchable, water quality information portal called Aqua Data. Aqua Data automatically captures and shares water quality information from multiple custodians with internal and external customers, quickly and effectively, so they have the very latest water quality information presented in various useful ways.

SCC are now keen to work with other water quality custodians to expand both the number and geographical extent of the Aqua Data approach, so that the benefits of having a cost effective, one-stop, easily maintained and accessible water quality information service is shared and utilised by a growing audience.

Introduction

Although millions of dollars are spent on a wealth of environmental monitoring, and thus extensive data on water quality and catchment activities exists, it is rarely analysed or considered across organisational custodians or for interpretation towards informed management of each individual water body. As a consequence the data is effectively inaccessible by third parties outside the custodian organisation. Thus the returns on investment from environmental monitoring are not realised, with poor availability of cohesive information within each waterway. This pilot project covering the Shoalhaven LGA has establish a public accessible, user friendly, online water quality portal which demonstrates the benefits of collating information from multiple sources to facilitate informed decisions. The online public portal is targeted to the community audience, but it's value will extend to participants also representing catchment

managers (NRM, State and LGA), industries and researchers. This target audience can be served by a single, current and scalable spatial-information source that will provide the best tool for remedial action and adaptive responses at a LGA scale, while also proving the concept can be expanded to a State or National scale.

The Oyster Information Portal (OIP) prototype presented at the 2012 Coastal Conference successfully designed and integrated data from multiple stakeholders. However the developers of the OIP at the conclusion of the project recognised that to go from prototype to long term viability would need a coordinated approach using an accessible and heavily automated data management system. (Rubio et al, 2012)

Following on from the OIP project Shoalhaven City Council (SCC) and its water authority division Shoalhaven Water identified the need for both an internal and external water quality portal that was user friendly and was a one-stop shop for the latest water quality monitoring data across multiple departments. Therefore the Water Quality Portal had to service both internal business needs and the wider community.

Background

Shoalhaven City Council (SCC) is responsible for reporting summarised water quality information to meet both legislative and community expectations requirements for Environment Protection Licences (EPL) and State of the Environment (SOE) Reporting.

Environmental Protection Licences

The water quality information collected by Shoalhaven City Council to meet EPL requirements is published on two different web sites, in different formats by three different departments.

There was a need to co-ordinate all water quality information into one location to reduce workload and produce timely information to the public.

The historic approach to reporting of EPL across all three departments is illustrated in Figure 1 for Wastewater treatment plants, Figure 2 for Reticulated drinking water and Figure 3 for Licensed waste transfer facilities.

Figure 1 – Shoalhaven wastewater treatment EPL reporting site:
<http://shoalwater.nsw.gov.au/services/epa-monitoring.html>

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Customer Services

Environment Protection Authority (EPA) Pollution Monitoring Data - 2013 / 2014

Shoalhaven Water holds 8 Environment Protection Licences (EPL) issued by the Environment Protection Authority (EPA) to cover the operation of our 12 wastewater treatment plants. Pollution monitoring data is collected and recorded by Shoalhaven Water as required under these licences.

Shoalhaven Water has an obligation under the Protection of the Environment Legislation Amendment Act 2011 to publish monitoring data collected according to the EPL requirements. The Act requires the public display of monitoring data within 14 days of results being available.

Latest Monitoring Results Published 16th September 2014

Site Name	EPA Licence Number	Site Plan	Latest Monitoring Results
Berry	1738	View	View Results
Bomaderry	1735	View	View Results
Nowra	1734	View	View Results
Shoalhaven Heads	4128	View	View Results
REMS	2419	View	View Results
Sussex Inlet	3936	View	View Results
Conjola Scheme	12357	View	View Results
Ulladulla	446	View	View Results
Kangaroo Valley	20244	View	View Results

Our service commitment
 Information for developers
 Business customers
 Residential customers
 Effluent pump-out customers
 Our systems & operations
 Complaints & compliments
 Resolving complaints
 EPA Licensing
 Drinking Water Quality Monitoring

Figure 2 – Shoalhaven reticulated drinking water EPL reporting site:
<http://shoalwater.nsw.gov.au/services/reticulated-water-test-results.html>



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Monthly drinking water quality monitoring results

Shoalhaven Water provides safe and reliable drinking water to approximately 100,000 people in the Shoalhaven on a daily basis. The drinking water we supply is routinely tested throughout our water supply systems with analysis undertaken at independent NATA certified laboratories as per the 2011 Australian Drinking Water Guidelines (ADWG).

This detailed water quality monitoring forms part of Shoalhaven Water's framework for the management of drinking water quality. Results are based on samples representative of water supplied to customers' taps. Results for microbiological and key physical/chemical parameters are summarised in the following:

Test Results

Reticulated Test Results	Mar '13	View Results
Reticulated Test Results	April '13	View Results
Reticulated Test Results	May '13	View Results
Reticulated Test Results	June '13	View Results
Reticulated Test Results	July '13	View Results
Reticulated Test Results	Aug '13	View Results
Reticulated Test Results	Sept '13	View Results
Reticulated Test Results	Oct '13	View Results
Reticulated Test Results	Nov '13	View Results
Reticulated Test Results	Dec '13	View Results
Reticulated Test Results	Jan '14	View Results
Reticulated Test Results	Feb '14	View Results

Figure 3 – Waste services EPL reporting site:

<http://shoalhaven.nsw.gov.au/Environment/Wasteandrecycling/EnvironmentalMonitoringData.aspx>

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Home Discover Shoalhaven My Property My Community For Business My Council Environment Planning & Building

You are here: Environment » Waste and recycling » Environmental Monitoring Data

Environment

- Air quality
- Aqua Data
- BioBanking
- + Biodiversity
- + Bushcare
- + Bushfire management
- + Coastal Landscape
- + Coastline and waterways
- + Flood risk
- + Pest management
- + Pollution management
- Nowra Gas Works
- State of the environment
- + Sustainability
- Shoalhaven Tree Species List
- Waste and recycling
 - Environmental Monitoring Data**
 - Home Sustainability Workshops
 - Illegal dumping
 - Love Food Hate Waste
 - Recycling
 - + Special programs
 - Waste depots
 - Worms and compost
 - Christmas Waste
 - Bulky waste pickup
 - Garbage collection

Pollution Incident Response Management Plans (PIRMP) and Environmental Monitoring Data

Provides PIRMP and Environmental Monitoring Data for Council's licenced waste and transfer facilities, as required by the POEO Act 1997 and POEO (General) Regulation 2009.

Licensed Waste and Transfer Facilities

Council owns and operates ten (10) waste and transfer facilities throughout the local government area. Five (5) of these facilities operate under Environment Protection Licences (EPL). The five facilities are:

- [West Nowra Recycling and Waste Facility](#) (links to Google maps in a new window)
- [Huskisson Recycling and Waste Facility](#) (links to Google maps in a new window)
- [Sussex Inlet Recycling and Waste Facility](#) (links to Google maps in a new window)
- [Ulladulla Transfer Station](#) (links to Google maps in a new window)

North Nowra Closed Landfill

Publishing of Pollution Incident Response Management Plans

Some sections of the PIRMPs must be made publicly available after they have been prepared by placing the PIRMP in a prominent position on a publicly accessible website of the licence holder. The information to be made available to the public:

- must include the procedures for contacting the relevant authorities including the EPA, local council, NSW Ministry of Health, WorkCover NSW, and Fire and Rescue NSW,
- must include the procedures for communicating with the community, and
- may be exclusive of any personal information within the meaning of the Privacy and Personal Information Protection Act 1998.

Pollution Incident Response Management Plans

The PIRMP for each of the licenced Facilities can be accessed by clicking on the links below:

- [West Nowra PIRMP](#) (PDF 4.57MB)
- [Huskisson PIRMP](#) (PDF 3.62MB)
- [Sussex Inlet PIRMP](#) (PDF 1.14MB)
- [Ulladulla PIRMP](#) (PDF 3.44MB)

Publishing of Environmental Monitoring Data for Licenced Facilities

Changes to the Protection of the Environment Operations (POEO) Act 1997, which commenced on 31 March 2012, require a licence holder (licensee) who:

- Undertakes environmental monitoring, as a result of a licence condition to publish or make available monitoring data within 14 days of obtaining the data and /or receiving a request in accordance with requirements issued in writing by the Environment

State of the Environment Reporting

A reduction in the reporting requirements for the SOE report means that instead of reporting the SOE every year it is now only reported every 4 years (once every term of Council). In the interim years the water quality data is being updated but not as easily accessible on Councils website as desired.

At present water quality data is collated from various sources and then manually entered into an Access database. The compiled data is then exported to an Excel spreadsheet where it is manipulated and summarised into water quality (WQ) graphs. This information is then manually edited into web format for display on the SCC web site. Due to the time consuming nature of the data analysis for 20 catchments this reporting is currently done every twelve months.

Figure 4 – State of the Environment Report Site:

<http://shoalhaven.nsw.gov.au/soe/Region/Indicator%20homes/Surfacewaterquality.htm>



Surface Water Quality

[Home](#) | [Water](#) | [Water Quality & Ecology](#) | Surface Water Quality

[Indicator description](#)

What data is available for Shoalhaven

Water quality index rating for a number of water bodies in the Shoalhaven LGA

Dissolved oxygen, mean faecal coliform and nutrient levels for a number of water bodies in the Shoalhaven LGA

Ecosystem Report Cards have been produced for some catchments based on the State Government's Monitoring, Evaluation and Reporting (MER) protocols using indicators such as chlorophyll -A & turbidity for water quality but also considering estuarine vegetation such as seagrasses, mangroves and saltmarshes in determining a rating for the waterway.

General Details of Monitoring

[2004](#) | [2005](#) | [2006](#) | [2007](#) | [2008](#) | [2009](#) | [2010](#) | [2011](#)

[Beachwatch Monitoring 2012](#)

Surface water monitoring carried out in Shoalhaven

Bomaderry Creek		Lake Wollumboola	(New) Estuary Health Report
Broughton Creek		Meroo Lake	
Burrill Lake	(New) Estuary Health Report Card	Millard Creek	
Crookhaven River/Curleys Bay		Narrawallee Inlet	(New) Estuary Health Report Card
Clyde River		Racecourse Creek	
Currarong Creek		St Georges Basin	(New) Estuary Health Report Card
Jervis Bay		Shoalhaven River	(New) Estuary Health Report Card
Kangaroo River		Swan Lake/Berrara Creek	
Lake Conjola	(New) Estuary Health Report Card	Termeil Lake	
Lake Tabourie	(New) Estuary Health Report Card	Willinga Lake	

[Home](#) | [Water](#) | [Water Quality & Ecology](#) | Surface Water Quality

Shoalhaven City Council water quality web portal project

Aim and objectives

Aim: To have a more effective, efficient and engaging way of delivering water quality information to internal and external users.

Objective: To develop an automated WQ information process, from data collation and processing to an interactive geographical online display that disseminates WQ information within days rather than months of monitoring. This SCC Water Quality Portal will thereby address the current issues and implications as well as provide the opportunity of enhanced functionality (via additional Phases of work) to both internal and external users.

Because the project had initial funding of \$30,000 the objectives below were broken down into product delivery Phases to ensure a working product at the end of Phase 1 that could be value added as further resources become available. The delivery of each Phase must take into account the functional needs of subsequent Phases to prevent having to go back and amend previous work.

Project phase

Automate, as much as possible, the current WQ information collation, analysis, and dissemination procedures to more quickly report WQ information via a geographical based public online WQ Web Portal.

Project deliverables

- Automated system to upload collected raw data and associated metadata with minimal manual intervention.
- Automated system which summarises the WQ data to at least that currently represented on the SCC website.
- Automated system to display this WQ information online.

Questions during planning Phase 1

- What are the current SCC stages of information transfer from field to WQ database entry?
- What is the most time and cost effective stage at which the automated uploading system can intervene?
- What online functionality is required to satisfy:
 - SOE reporting requirements
 - Licensing requirements
 - Public enquiries
- What scope is there to add further functionality
- How easily can a change/new source of WQ data collection be incorporated into the automated processes?

Additional phases

Phase 1 objectives needed to be completed first, but enhanced functionality can be delivered through following Phases of development. The objectives for Phases 2 and Phases 3 outlined below can be expanded on as the need arises.

Phase 2 suggested project deliverables

- Site photographs.
- Importing rainfall data from Bureau of Meteorology to correspond with WQ results
- Additional interpretation and explanation pages can be added.
- On-line form for users to raise comments/queries for SCC staff with links to Q&A pages with answers to common questions.
- Other functionality determined by the project's steering group to provide compelling evidence that explains environmental cause and effect from the monitoring data.

Phase 3 suggested project deliverables

Expansion of the system to do Phase 1 functionality for external geographical data sets covering the:

- SCC boundary for other Government departments such as Bureau of Meteorology, Local Land Services, NSW Food Authority, NSW Office of Water etc.
- Outside the SCC boundary for other Government departments including other NSW Local Authorities, Sydney Catchment Authority, Office of Environment and Heritage etc.

This phased approach ensures that the project delivers its primary objectives in each phase before attempting to deliver enhanced services.

Non-goal items

Items not addressed by this project:

- The management of the monitoring scheme
- The provision of training to users (the system should be intuitive enough for users without the need for training or user guide).
- Field data collection and analysis methods

Project justification

The following corporate and community drivers have been identified:

- Enhanced customer service.
- Cost and resource savings.
- Meet legislative requirements.
- Improving community perception as to the efficiency and effectiveness of the Council's response to water quality problems.

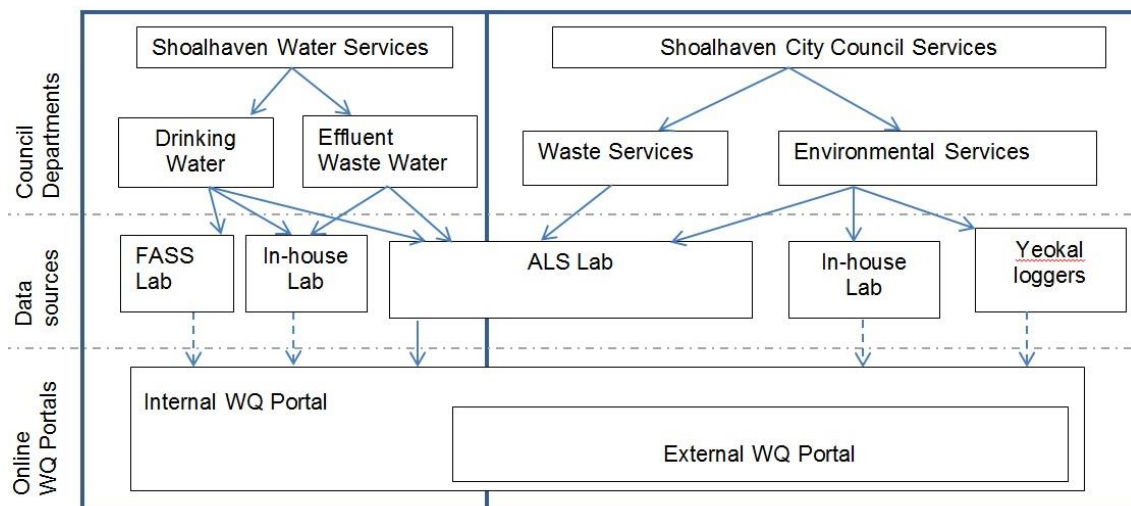
- Timeliness of information to inform licensing, strategic planning and development decisions.
- Provision of timely water quality information online to the public, achieving the public's expectation that up to date and current information will be supplied in a consistent and easily understandable format.

Methodology

Historically, laboratories support clients by providing analytical results as an e-mail with attachments (usually in pdf or excel format), with the client checking and transferring the information manually. This 'traditional' approach can now be eliminated with the development of software that automatically uploads results into a user friendly on-line client data management system (Water Quality Portal) without error, reducing administrative workload on the client side and speeding up the availability of results significantly to end users.

The following schematic diagram shows the Shoalhaven City Council departments and data sources that need to be collated by the online water quality portal.

Figure 5 – Data sources for online portal



There are effectively two online WQ Portals accessing a single set of water quality data management system. Having two portals facilitates internal and external accessibility. The internal portal requires a login and password. The external portal and can be accessed with or without the need for a login and password. Both portals can be set different levels of data accessibility ensuring that users access the most appropriate water quality data.

The internal WQ Portal software is called ESdat online and the Shoalhaven City Council's version of the external WQ Portal is called Aqua Data. The following sets out what each water quality portal provides.

ESdat online – internal water quality portal

ESdat portal provides easy to use, low-cost, accurate and efficient analysis of laboratory analytical data, and has the potential to be expanded to include other sources of analytical data. (EScIS, 2014)

Figure 6 – ESdat online workflow: streamline your analytical data management
(EScIS, 2014)



Laboratory reports

ESdat Online offers interactive functionality that facilitates managing, analysing and reporting of laboratory data. If managing Laboratory Reports is your main need then ESdat Online (Hosted or SaaS) is the perfect solution. (EScIS, 2014)

Field results

Field results can be uploaded directly from using a separate Tablet application known as PLog.

Logger data can also be automatically uploaded (requires ESdat Data Services to be installed on the server where your logger data is consolidated.)

If ESdat Online is installed onsite, these results can be displayed to others online through an internal login and password system or externally through the Aqua Data public portal.

A mechanism to view and manage and field results through ESdat Online is coming soon. (EScIS, 2014)

Automatic upload of laboratory reports for rapid review

- Laboratory reports are available in ESdat Online the moment they are released from the laboratory.
- Conduct QA validation reviews of laboratory reports: users can reject reports for re-issue, or accept reports for tabulation
- Export laboratory reports to Excel.

(EScIS, 2014)

Compare results against published standards

- From with ESdat Online users can select suitable Standards/Criteria/Guidelines to compare against results
- Display multiple criteria on the one table
- Apply variable formatting (colour, bold etc) to highlight exceedances

(EScIS, 2014)

Consolidate multiple laboratory reports or monitoring rounds

- Select multiple laboratory reports across different projects or sites
- View all selected laboratory reports on a single Chemistry Table and export to Excel.

(EScIS, 2014)

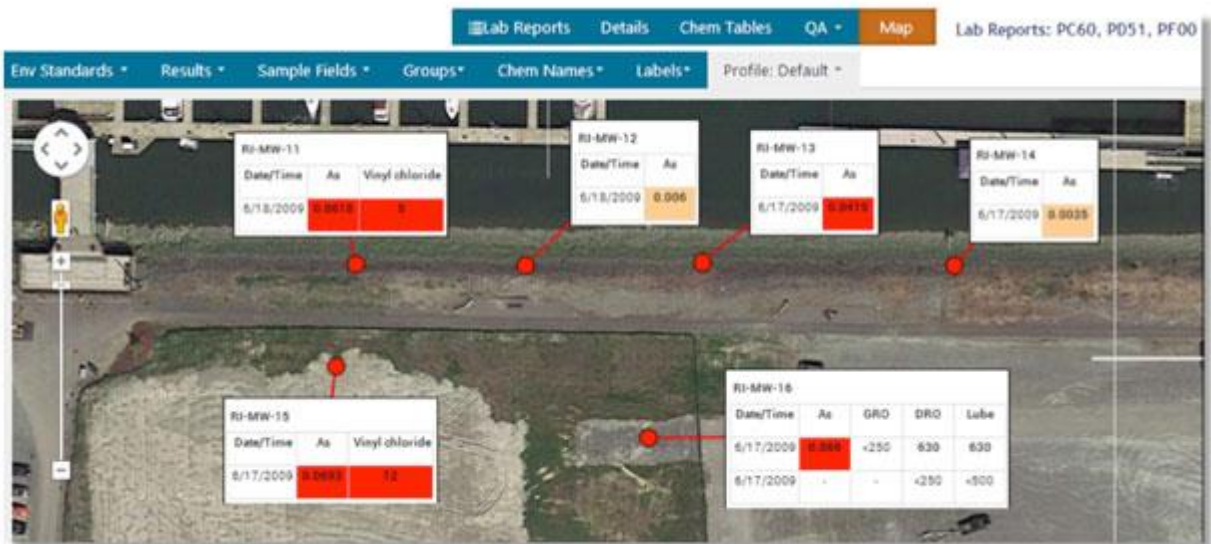
Figure 7 - Example of chemistry table prepared using ESdat Online viewed within a web browser (EScis, 2014)

Lab Reports: PC60, P051, PF00

Env Standards * Results * Sample Fields * Groups * Chem Names * Excel Export * Profile: Default *

Action Level Source	Chlorinated ...	Metals		TPH		
	Vinyl chloride	Arsenic	Copper	Gasoline Range Organics	Diesel Range Organics	Leak Oil
	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L
EQL	0.02	0.0003	0.0005	250	250	500
Region 3,6,9 Tapwater THQ<1.0	0.015	4.5E-05	0.62			
MR HCLs	3	0.01	1.3			
Date/Time	Field ID					
6/12/2009	RI-MW-1					
		0.006	0.003	<250	<250	<500
6/12/2009	RI-MW-10					
		0.0025		<250	<250	<500
6/12/2009	RI-MW-17					
		0.0027				
6/12/2009	RI-MW-18					
		0.0009				
6/12/2009	RI-MW-2					
		0.001	0.0022	<250	<250	<500
6/12/2009	RI-MW-9					
		0.0079		<250	<250	<500
6/12/2009	RI-MW-1					
		0.0008	0.003			

Figure 8 - Example of map showing analytical results viewed within a web browser (EScis, 2014)



AQUA DATA – external water quality portal

Shoalhaven City Council recognises the need for extensive water quality monitoring of its waterways, drinking water, waste water treatment and waste recycling facilities to fully assess and manage its services and protect the environment.

Council has been developing a new online public water quality web site it calls Aqua Data which has been designed to improve the communication of monitoring results to the community as well as assist consideration of water quality data within the catchment planning and catchment management decision making process.

Aqua Data displays water quality testing results within just a couple of days of the completed laboratory analysis. Users are able to navigate to any site using an interactive map, view result tables and graphs and even download or print pre-formatted reports for any date range.

Figure 9 – example showing Shoalhaven City Council Aqua Data home page

The screenshot shows the Aqua Data home page. At the top, there is the Shoalhaven City Council logo and a search bar. Below the logo, the text 'Aqua data Shoalhaven water quality information' is displayed. A navigation menu includes links for Home, Discover Shoalhaven, My Property, My Community, For Business, My Council, Environment, and Planning & Building. The 'Environment' menu is expanded, showing a list of categories including Air quality, Aqua Data, BioBanking, Biodiversity, Bushcare, Bushfire management, Coastal Landscape, Coastline and waterways, Flood risk, Pest management, Pollution management, Nowra Gas Works, State of the environment, Sustainability, Shoalhaven Tree Species List, Waste and recycling, Water and sewerage, and Weed management. The main content area is titled 'AQUA DATA – Shoalhaven water quality information on the web' and contains the following text:

Shoalhaven City Council recognises the need for extensive water quality monitoring of its waterways, drinking water, waste water treatment and waste recycling facilities to fully assess and manage its services and protect the environment.

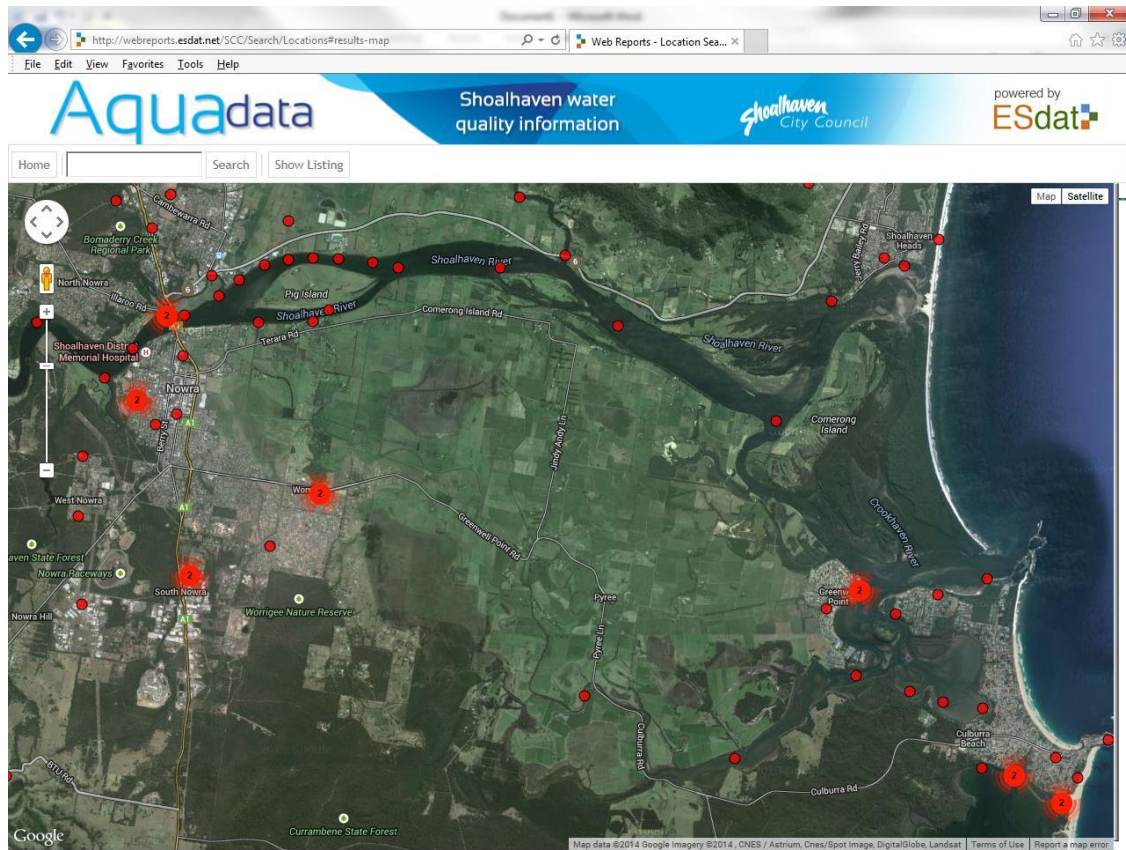
Council has been developing a new online web site it calls Aqua Data which has been designed to improve the communication of monitoring results to the community as well as assist consideration of water quality data within the catchment planning and catchment management decision making process.

Aqua Data will display water quality test results within just a couple of days of the completed laboratory analysis. Users will be able to navigate to any site using an interactive map, view result tables and graphs on-screen and even download or print reports showing results from the present to several years ago.

Below the text, there is a link to 'Visit the Aqua Data website' and a screenshot of the Aqua Data interface. The interface shows a map of waterways with red dots indicating monitoring sites. To the right of the map, there is a data table and two line graphs showing water quality results over time.

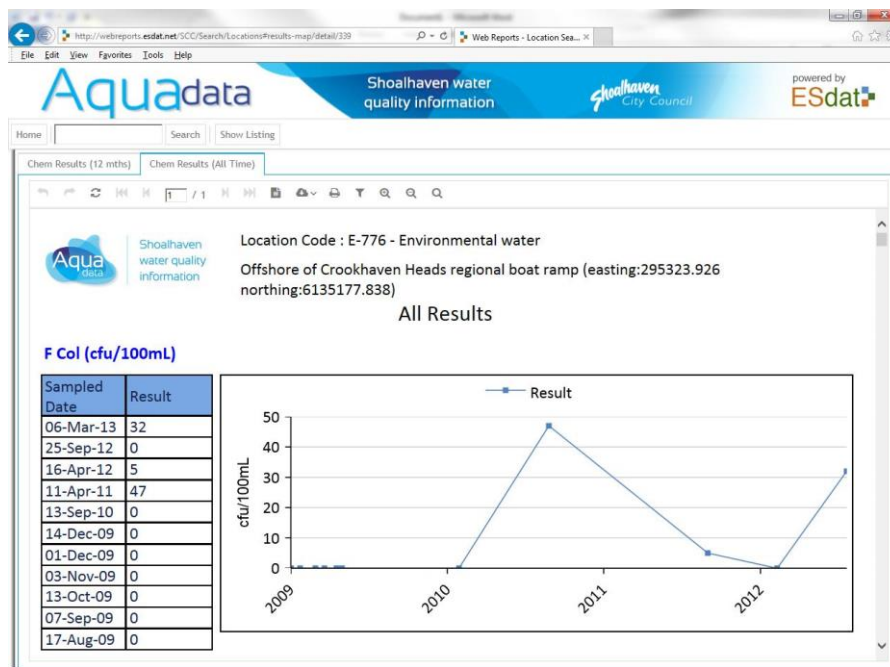
Aqua Data displays water quality monitoring sites via the full Google Map interface including satellite and street view.

Figure 10 – example showing Aqua Data site selection tool using the Google satellite map



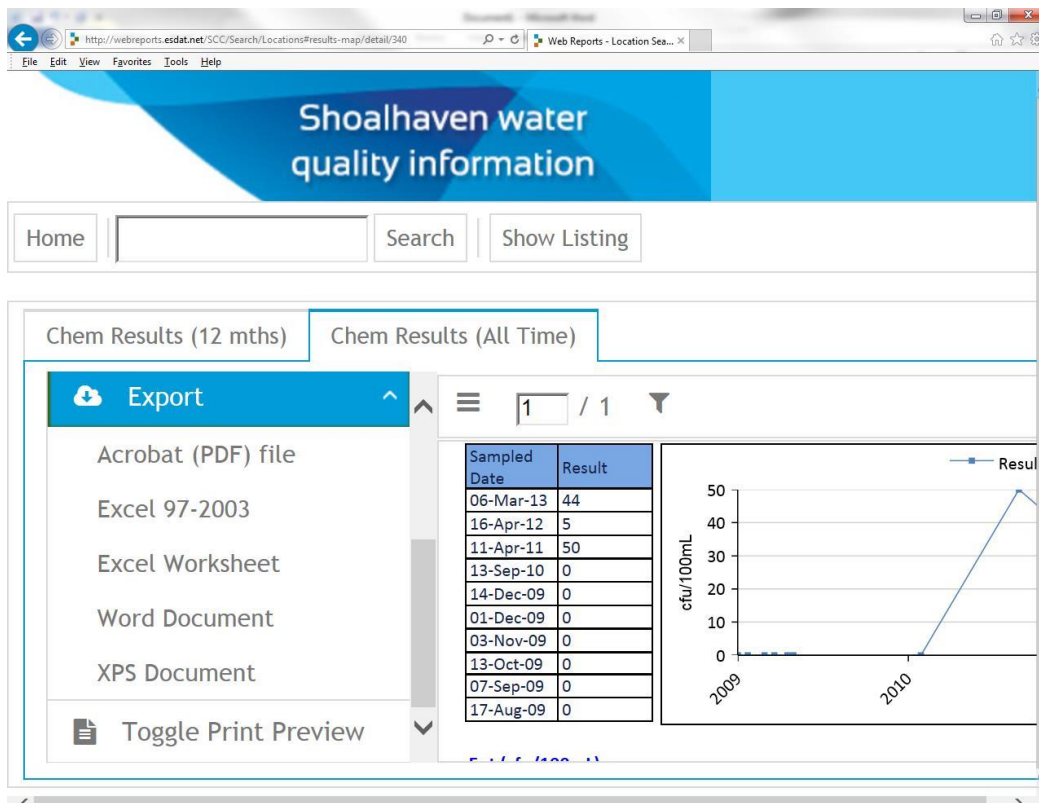
Once the user has clicked on a monitoring point, a chemical report is automatically produced showing tables and graphs for each chemical tested. The user can also filter results to a particular time range.

Figure 11 – example showing Aqua Data chemical report preview



The user can then export or print the chemical report in different formats including PDF, Excel and Word.

Figure 12 – example showing Aqua Data export menu options



Conclusion

While the current Water Quality Web Portal project has focused on achieving Phase 1 delivery of ESdat Online and Aqua Data portals, the system has been developed with future Phases of expansion and functionality in mind.

Therefore Shoalhaven City Council is looking to facilitate the expansion of this WQ Portal functionality and the inclusion of monitoring data from other organisations across the Shoalhaven area.

Shoalhaven City Council is also looking to champion the expansion geographically through wide spread adoption by other LGAs, Region and State organisations.

Shoalhaven City Council are now keen to work with other water quality custodians to expand both the number and geographical extent of the ESdat Online and Aqua Data approach, so that the benefits of having a cost effective, one-stop, easily maintained and accessible water quality information service is shared and utilised by a growing audience.

Acknowledgements

The project has been jointly funded by the Waste & Sustainability Improvement Payment programme and Shoalhaven Water. The portal was developed by Earth Science Information Systems (ESciS). Kind support and data was provided by several departments within Shoalhaven City Council: Environmental Services, Wastewater Treatment, Reticulated Drinking Water and Landfill & Recycled Waste Facilities.

References

ESciS (2014). ESdat Online - easy to use, low-cost, accurate and efficient analysis of your laboratory analytical data.

<http://www.esdat.com.au/ESdatOnlineHostedorSaaS.aspx>

Rubio, A, Winberg, P and Kirkendale, L. (2012) Oyster information portal: a user-group focused 'Coastal Google' for the future. 2012 NSW Coastal Conference, Kiama, NSW, Australia