

VicRoads - GIS Workflow Based Speed Sign Management System

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Abstract

VicRoads has developed a state-wide GIS speed sign management system that tracks the status of a request to install or replace a speed sign. The system allows the entry the proposed speed signs on the GIS map which are then forwarded for approval to the appropriate authority. If approved a Memorandum of Consent is automatically generated which textually describes the location of the signs in relation to the nearest side road, produces a schedule and map of those sign changes. This Consent is then forwarded via email to the Council for installation with an automatically generated Notification of Completion (NOC) form to be returned upon installation. The system audits the status of any approved signs that have not yet been received within a month and then alerts the responsible officer to confirm status. The signs can be viewed at various stages; proposed, approved, installed, removed and not approved.

Background and Overview

VicRoads is the responsible state authority for managing the 22,320km of arterial road network which includes implementing road safety strategies and providing registration and licensing services in the state of Victoria, Australia. Speed is the biggest road safety challenge facing Victoria today. Over the last few years, VicRoads has heavily focussed on introducing speed enforcement using speed signs, speed zones etc. to reduce speeding on the road network. The new speed sign application has been designed to facilitate the process for assessing, approving, issuing, recording and auditing of speed sign information.

VicRoads embarked a project in February 2004 to standardise the existing spreadsheets and word processor based practices of managing speed sign into an integrated workflow based management system. The key sponsorship for the project was provided by the road safety business area within VicRoads. From the beginning the project was envisaged as a multi user, multi region asset management enterprise system and single source for speed signs information in the state.

Function

The system utilises a GIS map to represent the location of speed signs on the road network at the various stages of the approval process; proposed, approved, installed, removed and not approved.

Users of the system need to enter speed sign details into the system to process an application for a Memorandum of Consent (MOC) and forward it to their Team Leader for approval. If an application for an MOC is approved an MOC is automatically generated together with an accompanying Notification of Completion (NOC) form. The MOC will also include an automatically generated schedule of signs and a map of the proposed sign locations.

Once an MOC is approved and forwarded to the applicant either by email or hardcopy, an NOC is to be returned to VicRoads within a month and entered into the system otherwise the application will trigger an email requiring the NOC to be provided to VicRoads or confirmation provided that the signs have been installed as per the MOC.

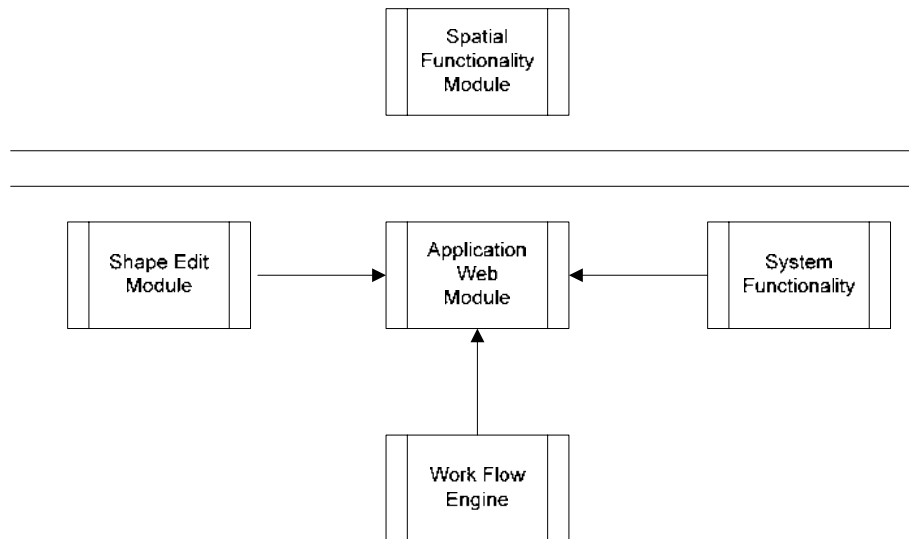
Details of the system functionality are attached in the appendix below.

Technology

An internal customised build option was preferred primarily because of heavy VicRoads specific functionality and the availability of good internet GIS skill sets within the organisation. The speed sign system makes use of ESRI technology, ArcIMS 9.0 with .Net link, MapObject 2.0, integrated with MS Access as the database. This application utilises the Spatial Functionality web services created by VicRoads for common GIS functionality.

The application comprises of four modules

1. Spatial functionality module
2. System functionality module
3. Application web Module
4. Work flow engine
5. Shape Edit module
6. Speed Signs placement Algorithm



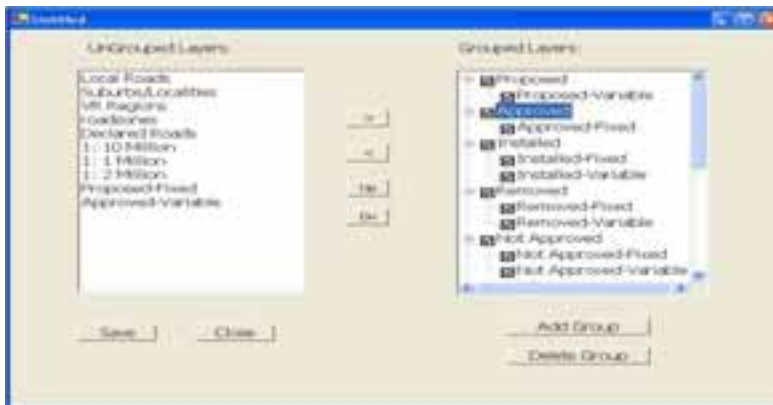
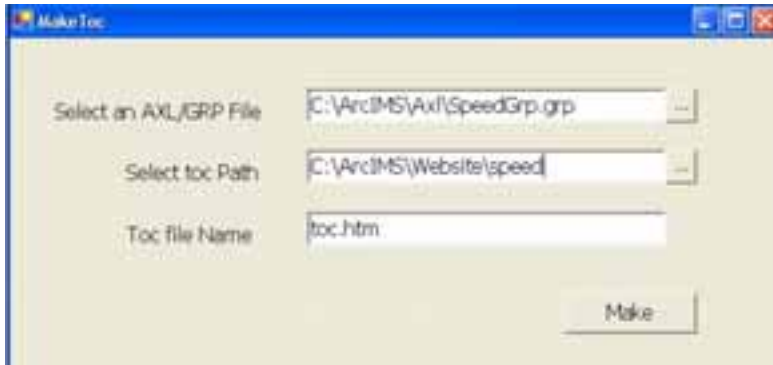
Spatial Functionality Module

This module comprises of standard GIS functionality like Pan, Zoom, info, print, highlight etc. The print functionality is specifically enhanced by using PDF technology. VicRoads has created a series of web services which provide the above functionality.

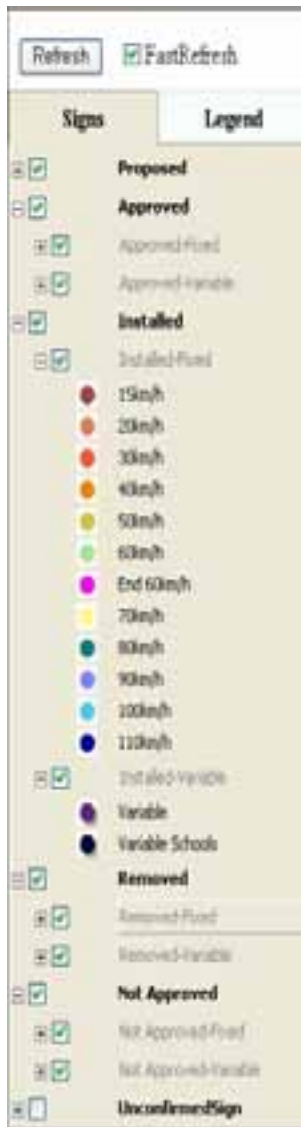


System Functionality Module

This module comprises of all the functionality to set the system framework. It includes an auto legend/Table of Contents creator, which is a .Net based application developed internally by VicRoads to create an enhanced Legend/TOC for ArcIMS based internet applications. This application takes ArcIMS AXL file as an input, allows the user to define the layers visibility, positioning etc. and then creates a legend/TOC. The legend/TOC can be expanded/collapsed or toggled and provide functionality like fast refresh, checkboxes to hide-show layers. It Stores the TOC/Legend configuration as a modifiable XML files which can be updated by the core application.



Legend/TOC:



Application web Module/Core Module

This module comprises of all the speed signs specific GIS functionality such as a list view of speed signs, search for an intersection, audit list etc. This functionality is created utilizing ArcIMS .Net connector and utilises Access as the database for managing the intersections information. It has a sophisticated reporting engine supporting both spatial and non-spatial queries, with a choice of output in either HTML or PDF formats. This provides the functionality to add, delete or update speed sign information and location. It provides the functionality to show images/photos as the background. This module also provides a front end to the workflow engine.

Ref. NO: SSA0000112
Proposed (NotExist)

Application Detail

File Reference NO:

Keywords:

Team Leader:

Concil:

Installing Authority:

Comment:

MOC Detail

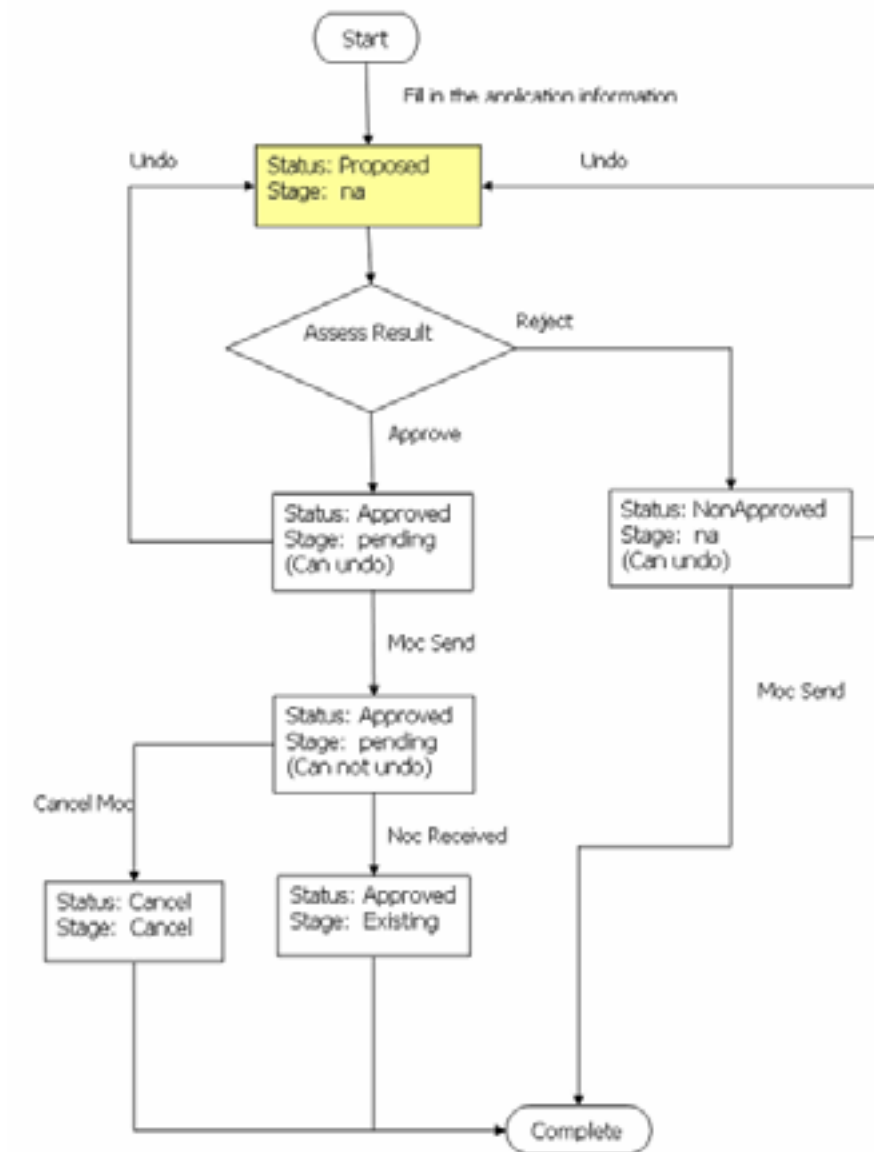
Other Details

Speed Signs

1: Installation
Road:
 BANOOL AVENUE
Intersecting Road:
 STUDLEY PARK ROAD
Sign Distance: 30

Work Flow Engine

The work flow engine is designed for business rule changes. The speed sign application follows a lifecycle approach for speed signs, in which a number of activities can be performed on a speed sign. This module comprises the sequence definition of workflow activities. For a particular sign category, a flow id is defined based on the different steps that can be created regarding approval, delegation and email policy. The flow steps and relative activities are defined in the database. Once the business rule(work process of speed sign application) changes, there's no need to change the source code of the system, the only requirement is to redefine the flow steps and relative activities in the database, the system will follow the new process to handle the speed sign applications.



Add/Edit Signs or Forward for Approval → Approve or Reject the Application → Forward Consent to LGA → Confirm Installation → Audit

Shape Edit Module

This module comprises of the creating, deleting, updating speed sign spatial information on the web using ArcIMS and Mapobjects. This module provides a sophisticated locking mechanism built into the application, which allows the user to edit or add a speed sign without locking the shape file for all the users.

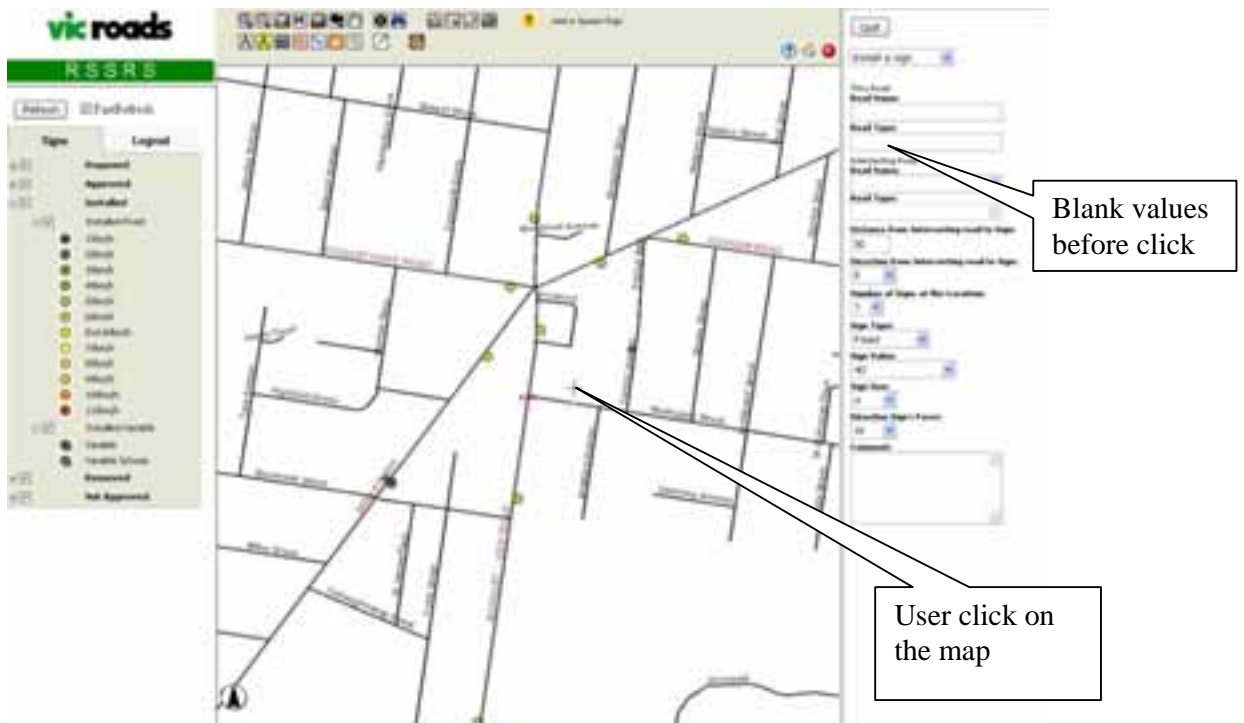
Speed Signs Placement Algorithm

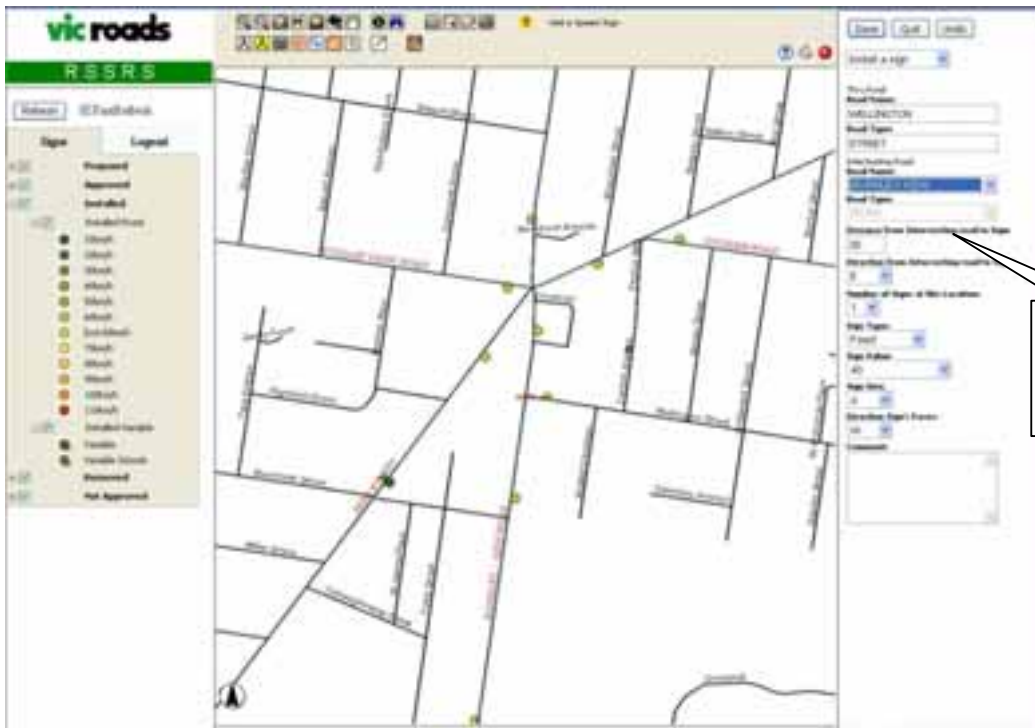
The system utilises a complex algorithm for the placement of speed signs. The speed sign is defined in terms of location by the four elements.

- Road name on which the sign is to be referenced against

- Side of the road the sign is on
- Nearest intersection of roads, roads start or road end
- Distance from the nearest intersection of roads, road start or road end
- Direction of the sign and the direction of the traffic

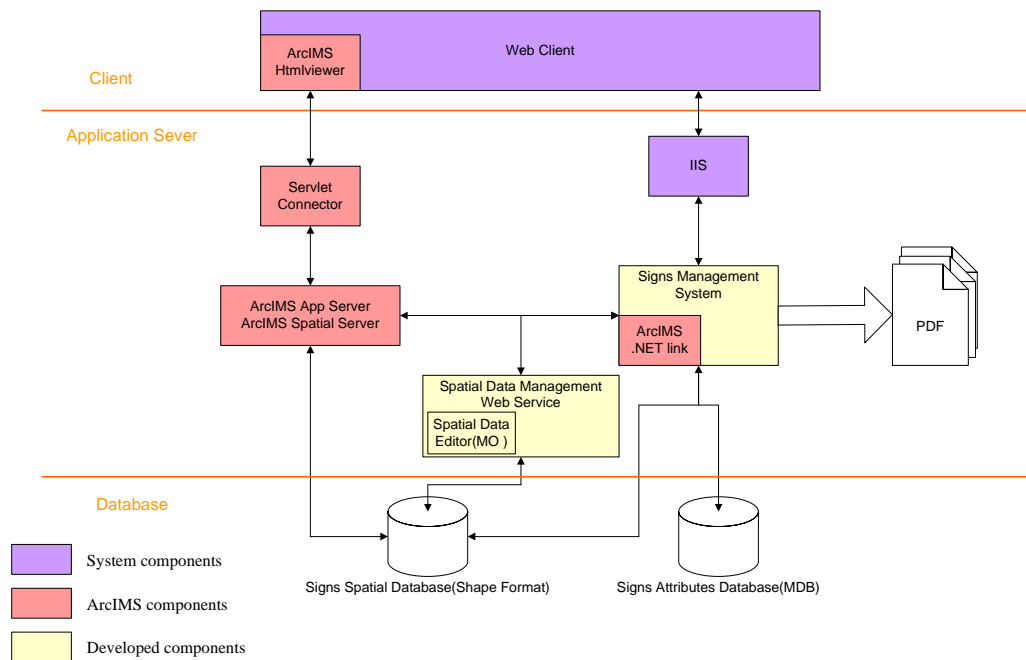
It's a complicated and time consuming exercise for the users to enter all this information manually and accurately. There was a tendency for the data to become inconsistent because of wrong names etc. The users of the system were also not professional GIS operators and would need to be trained to understand functionalities like snap, buffer etc. A one click algorithm has been developed to decrease the complexity of these operations. The user only needs to provide the distance from the nearest intersection etc. and click on the map. The system automatically calculates the other parameters like road name, direction etc. and show these to the user.





Software architecture

Software Architecture



The application is based on multitiered architecture and is developed using Microsoft .Net technology. Typically the user requests information over the intranet server using a browser. The server then processes the request, interacts with the database and sends the information back to the client viewer.

Client Side components

The applications client is based on ArcIMS HTML viewer. The standard functionality of the HTML viewer was enhanced by using webservices to provide the application specific functionality. The client also used the VicRoads in-built tool for advance legend/TOC.

Server Side Components

The client makes a request to the signs management system, dll's written in Microsoft .net. The system interacts with the database and retrieves the parameters required for the request. Based on these parameters an ArcIMS ArcXML request is created by the system and sent to the ArcIMS server using the ESRI ArcIMS .net Link. The System then handles the ArcXML response based on information returned from ArcIMS and appropriate client response is created. The spatial data management utility which is a wrapper dll built around ESRI mapobjects product is used to manage edits to the underlying shape file. The wrapper dll is written in Microsoft .net technology and also supports advance request management functionality so that the shape file doesn't get locked during editing. After the edits have been confirmed a request is sent to the ArcIMS via the system to refresh the map. The map is refreshed and the final map is shown to user with the changes, without the need to restart the ArcIMS services. Currently the system doesn't support simultaneous edits.

Database components

The database component consists of ESRI shapefiles and signs attribute MS Access database. The database is specifically designed to provide fast zoom/pan functionality for the speed signs application. The MS Access database stores all business information of the system , while the shape files only store the rendering information. Since various databases are used, an extra mechanism is developed to guarantee the data consistency between Access database and DBF database.

Summary and future works

Speed Signs management system was successfully rolled out in VicRoads in March 2006. The application team learnt many invaluable lessons during the system development specifically around webservices and component software development. The underlying architecture used in the speed sign application has also been adopted for some of the VicRoads internet application, using the same mechanism to edit data on the web. Continuous work is being carried out on improving the speed of the system. The team is also exploring the opportunities to allow multiple edits on the shapefile.

Acknowledgements

Many a thanks to GIS spatial services team in VicRoads with special mention to Richard Zhou ,Qinglin Song and Sameer Babbar for their enormous support.

Appendix

Details of the system functionality are including in the appendix “Speed Sign System Functionality”:

References

1-www.vicroads.vic.gov.au

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Appendix: Speed Sign System Functionality

Speed Sign Management System



1. PURPOSE
2. FUNCTIONS
3. WORKFLOW
4. DEFINITIONS
5. METHOD
 - 5.1 ACCESS SYSTEM
 - 5.2 ENTER SPEED SIGNS
 - 5.3 REMOVING, MAINTAINING OR REPLACING SIGNS
 - 5.4 FORWARD FOR APPROVAL
 - 5.5 TEAM LEADER APPROVAL
 - 5.6. SENDING THE MEMORANDUM OF CONSENT BY EMAIL
 - 5.7. CONFIRMING IMPLEMENTATION
 - 5.8. AUDIT



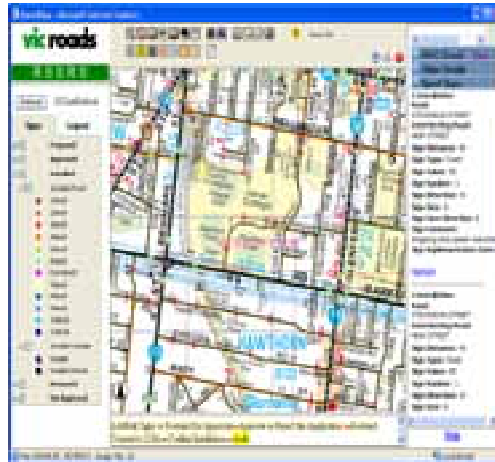
Speed sign management system



Functions

Applications requesting consent to install or remove speed signs are displayed on a GIS map at the following stages of the process:

- Proposed
- Approved
- Installed
- Removed
- Not Approved

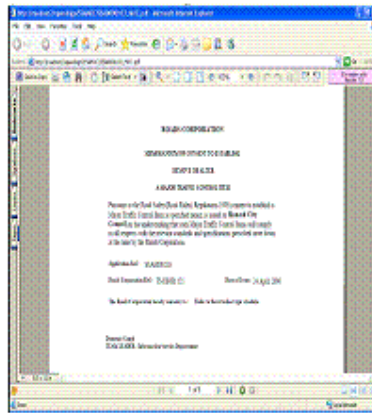


Speed sign management system



Functions

A memorandum of consent, a sign schedule, a map of the signs and a notification of completion form is automatically created once the speed signs are entered on the GIS map.



Speed sign management system



Sign Schedule:

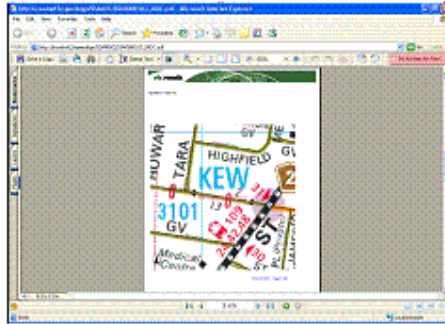
SIGN	DATE COMPLETED	DATE OF SIGN	DATE OF SIGN	COMMENTS
100/100/100/100	1/1/10	1/1/10	1/1/10	100/100/100/100
100/100/100/100	1/1/10	1/1/10	1/1/10	100/100/100/100
100/100/100/100	1/1/10	1/1/10	1/1/10	100/100/100/100
100/100/100/100	1/1/10	1/1/10	1/1/10	100/100/100/100



Speed sign management system



Map of speed sign locations:



Speed sign management system



Approve

If the Team Leader approves of the proposed application the Confirm button in the MDC view is clicked and the status of the application moves to Forward Consent to Local Government Area (LGA). An email of the application can be sent to the applicant by clicking the send button.



Speed sign management system



View Application

To view the application click on the view link button and a map showing the location of the proposed signs appears.



Speed sign management system



Replacing Signs

Signs are replaced using the same method as for removing a sign except that the either or both the value or the size of the sign can be changed.



Speed sign management system



Removing, Replacing or Retaining Signs

Signs can be selected for removal or retention by selecting the action from the droplet and then choosing the sign type; fixed or variable. The "select sign" button as shown below is the clicked to select the sign to be removed or retained.

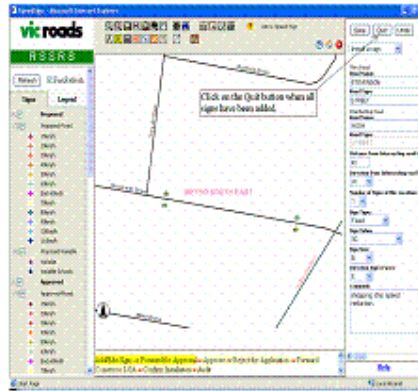


Speed sign management system



Map Speed Signs

Continue to install signs or replace, remove or retain signs as required as per the application and once complete click the Quit button.



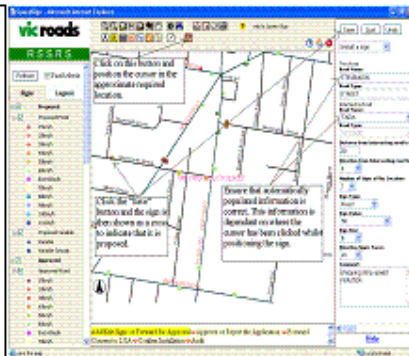
Speed sign management system



Map Speed Signs

Click on the install sign button and then position the cursor in the approximate location required.

Check that the thru and nearest intersection roads are populated as required, if not click the undo button and repeat the process with the cursor positioned closer to the required road.



Speed sign management system



Enter Speed Sign Details

Click on the Start button and enter the details of the sign to be installed, replaced, removed or retained.

Enter the speed sign details in the fields indicated only; the Thru Road Name, Intersection Road and Road Type fields are automatically populated when the sign is placed near the road.



Speed sign management system



Create New Application

The street directory background can be removed by clicking on the legend tab on the left of the screen and deselecting the checkbox.

The Create new application link is clicked to enter general application information

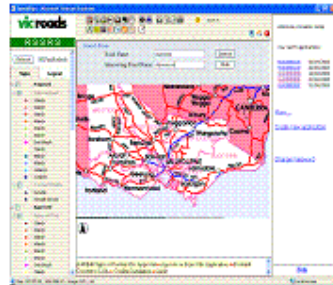


Speed sign management system



Find Location

To locate where the signs will be located click on the search intersection button and enter the nearest intersection to the sign location.



Speed sign management system



Method:

- Locate the road/s where the signs are to be installed or from which signs are to be removed, replaced or retained.
- Enter the details of the sign; speed limit, distance from the nearest side road, direction the sign faces, size of the sign and any comments.
- Click near the road and on the side of the road on which the sign is to be installed and the sign will automatically be placed at the distance previously specified from the nearest side road.
- Check that the signs details are correct and then continue to enter new signs.



Speed sign management system



Workflow:

- Application is submitted by a Council to State Road Authority (VicRoads).
- VicRoads
- Engineer enters speed sign location and sign values into GIS map and forwards the application to the Team Leader (signs can be viewed as proposed).
- Team Leader receives an email requesting approval of proposed signs.
- Team Leader assesses proposal and either approves or rejects the proposal (signs can be viewed in approved or not approved layer).
- Once approved/not approved the application can be emailed or printed and mailed to applicant.
- If approved, the applicant is to return the Notification of Completion form and the signs can then be confirmed as installed on the system with the date of installation entered for each sign (signs can be viewed in the installed layer).
- An audit list shows all applications which have not been confirmed as installed after 30 days have passed since the Memorandum of Consent was issued.



Speed sign management system



Audit

The system allows for the review of any applications which have not yet been installed. Clicking the view audit list button will show all signs which have been approved but are pending the notification of completion for the entry of implementation dates after 30 days have elapsed.



Speed sign management system



Enter Implementation Dates

The implementation date is entered in the fields shown below for each sign. Once the implementation dates are entered the application is confirmed as installed.



21



Speed sign management system



Confirm Installation

Once the application has been sent the stage moves to the confirm installation and awaiting the return of the Notification of Completion for the installation dates to be entered to confirm installation.



20

