# VSIS an new system for Victorian soil data

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**Abstract**
The Victorian Soil Information System (VSIS) is a new information system for storing and accessing primary soil data. The system comprises soil profile data, which is fundamental to land use and biophysical modelling, and inference systems supporting management of the land resources. VSIS is sympathetic to the design of the existing national Australian Soil Resource Information System (ASRIS) but contains additional elements to support soil monitoring (time series), detailed metadata and Victoria's standards and classifications. Part of the VSIS development was to formulate and build linkages for future streamlined data exchange and interoperability between VSIS and ASRIS. VSIS contains approximately 3,000 soil profile sites that have been described and analysed according to national standards. VSIS is a web-based application that allows for data to be viewed and extracted using a SQL queries tool and through a Geographical Information System (GIS) mapping interface. The system supports the seamless integration of both spatial and aspatial queries to support efficient search and discovery of the data asset. Current VSIS can only be access via the Department of Primary Industries Victoria (DPI) intranet.

**Key Words**
Soil Profiles, On-line GIS.

**Introduction**
The first formal soil and land survey in Victoria occurred in 1928 near Swan Hill (VRO 2009). Since then hundreds of surveys and projects have assessed landscapes across Victoria and collected detailed soil and land data (VRO 2009). It is estimated that well in excess of 70 million dollars has been invested through the years in Victoria in collecting primary soil attribute data.Early precursors to the VSIS had their origin in a sequence of dBase3, Microsoft™ Access and eventually Microsoft™ SQLServer implementations all based on an evolving data model. The initiation of the Australian Soil Resource Information System (ASRIS) (McKenzie *et al.* 2005) saw the formation of a new data model based around a conceptual model for a soil profile. Large parts of this model were subsequently adopted and now form the core of the VSIS although extensions to support time-series data and metadata have been added. Primary functions of the VSIS are to aid data consolidation, ensure secure storage to prevent loss, provide a ready access point for this information and significant knowledge resource. This paper describes the current VSIS solution in what will be a continually evolving approach to storing, accessing and using soil- and land-based data and data products.

**Principles behind VSIS**
The key principles driving the development of the VSIS are:

- The need to create a primary consolidated database to store and secure soil data that becomes a single point of truth for Victorian soils data.
- The need to improve the accessibility and visibility of soils data.
- The need to improve the management and use of Victorian soils data.

The VSIS development combines these principles with the aim to create an environment whereby the State of Victoria and relevant stakeholders within it can derive the best value from soils data both now and into the future. Indeed the drivers behind the VSIS system are similar to those for the counterpart Soil And Land Information (SALI) system in Queensland (Brough *et al.* 2006) and the S-map system in New Zealand (Lilburn *et al.* 2004). To achieve the consolidated database required the development and deployment of a common data model that can accommodate a diversity of soil data. This is largely provided by the emerging national standard embodied within ASRIS. Additionally data entry tools were developed to facilitate entry of soil data currently held as hard copy records or field sheets. To improve accessibility new approaches to viewing, querying and assembly of the data were developed. This fulfils aspects of the whole data cycle by allowing soils data to be directly interrogated (Nichol *et al.* 2005; Nichol, 2006) and downloaded to desktop computers so that it could be integrated with research and modelling activities. Overall the system needed the capacity to cope with state-wide data and allow state-wide spatial viewing of soil site data. A key strategy is for the VSIS to become a focal point to store and access all available soils data and thereby guiding future collection programs and projects.

**VSIS system overview**

A simplified overview of the VSIS is shown in Figure 1. Broadly the system has three major components: a core backend database, the VSIS web application, and an associated data entry sub-system called the Victorian Soil data Entry System (VSES). At present the VSES is a Microsoft™ Access database application that integrates all the codes, code lists and naming conventions used in Victoria to describe soils, and matches the VSIS, ASRIS (McKenzie *et al.* 2005) and the "Australian Soil and Land Survey Field Handbook (NCST 2009). A supplemental business process within DPI reviews the data after entry to detect when valid values have been applied incorrectly (i.e. in the wrong context) or any other anomalies. Users of the VSIS can query, view and download to their desktop any of the data held within the system. The VSIS is currently hosted within the state government wide area network (WAN) hence current usage of the system is currently restricted to state government personal.

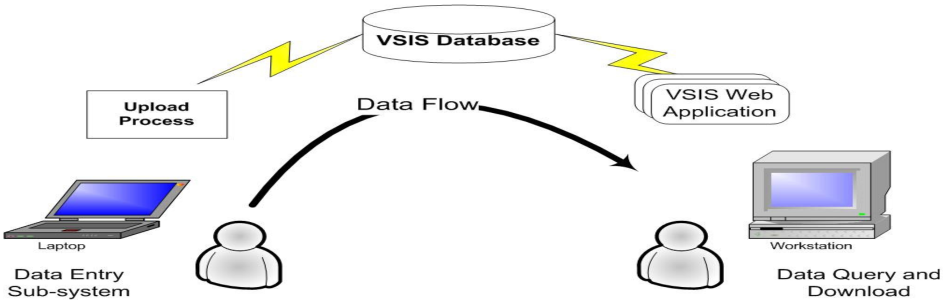


**Figure 1. Highly simplified VSIS system model.**

**Data model/database**

A pictorial and conceptual version of the VSIS data model is shown in Figure 2. The main entities within the model are *agencies* which commission soil survey *projects* that examine or assess soil *features* (i.e., pits, cuttings and soil cores etc) from which *samples* are taken or identified. Finally measurements or *observations* are made against the samples or profile sections. Each successive entity inherits the key fields from parent entities and as the data model is interrogated these form a combined key to uniquely identify records. Functional within the data model *agency* provides an institutional context and *project* often provides details regarding the people and purpose associated with the data collection. Spatial location (x,y or latitude, longitude) is defined at the *feature* level and the time of collection and depth information (z) is associated with a *sample*. In this way the data model provides a multi-dimensional contextual framework for soil data. The association of dates with *samples* enables the VSIS to be used to record soil monitoring data.

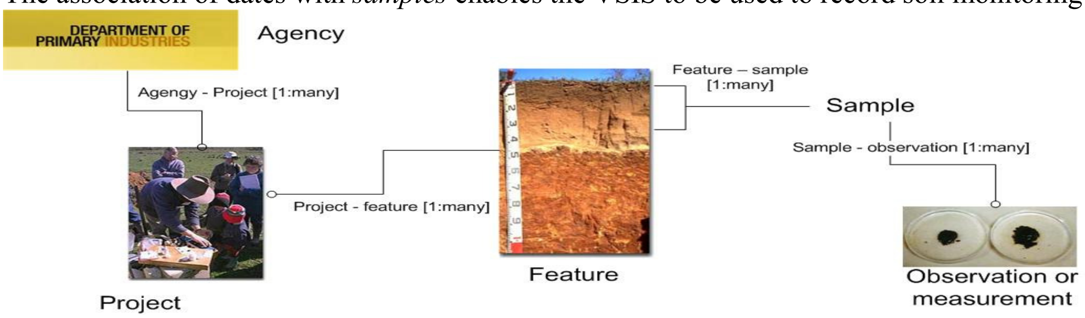


**Figure 2. Pictorial and simplified version of the VSIS data model.**

**VSIS web application and interface design**

The VSIS web application is designed according to the functional business model that was generated after business and user consultations. The current web application interface has been broken into six major components: Home, Map View, Soil Query, Administration, Support and VSIS Feedback. The visualisation/mapping, search and delivery functions are well developed in the current version of the VSIS; further work is required to expand the administrative functions within information management and to automate more of the data processing functions. The 'Map View' (Figure 3) screen is divided into a mapping pane that displays spatial information such as the location of soil pits and auger holes and a range of polygonal datasets that can all be turned on and off in the view as the user desires. Selecting the 'Query' icon activates a concise but powerful query tool in the pane below the map view. This enables users to build a query to select soil features based on soil properties and other criteria. The results can be view spatially and textually as well as downloaded to the desktop either directly into applications such as Microsoft™ Excel, or as an ESRI shape-file with an associated table for linkage of attributes.

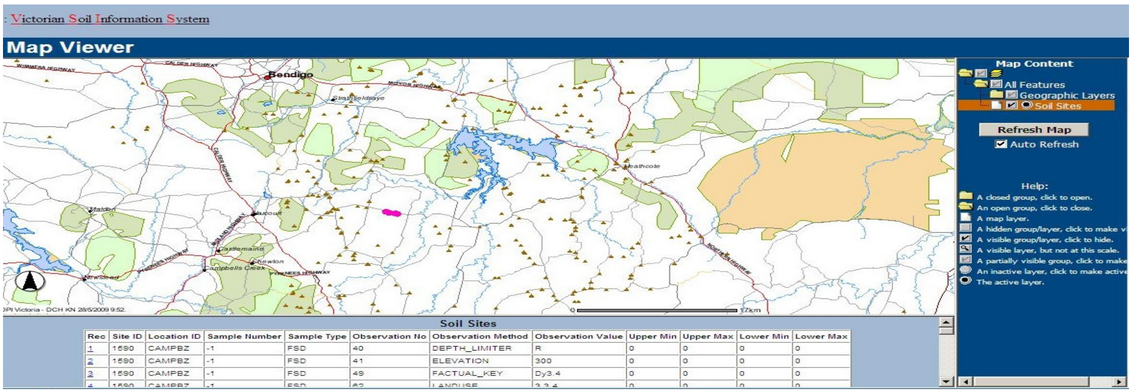


**Figure 3. The VSIS 'Map View' screen.**

The 'Soil Query' tool (Figure 4) provides an extremely powerful and flexible mechanism for querying the VSIS database in a user friendly environment. Any table or field within a single or multiple tables can be used to construct a complex query. The queries can also be saved as a file on the desktop and re-loaded for execution at a later date thus allowing users to store and exchange queries. Once a query is executed the results can be downloaded to a file on the desktop to be used as an input for modelling software or used for a pedotransfer function.

## Conclusion

While the current version of the VSIS addresses the core functions required to improve soils data reticulation in support of research and landscape modelling (Nichol 2006; Nichol *et al.* 2005), the future development of VSIS will need to begin to address the integration of the data required for soils inference modelling in a more systematic fashion. This will require moving away from the historical digital soil mapping that is currently stored in the system towards an approach that stores the inference model and processing rules, thereby enabling consistent and repeatable production, storage and delivery of soil parameter surfaces or three-dimensional models. This aligns with the directions that the SALIS system (Brough *et al.* 2006) and S-map system (Lilburn *et al.* 2004) have taken. It is likely that some of these models may not be stored in the VSIS itself but rather in the model information and knowledge environment system. Further work will need to be done to develop an underlying data service so that the soils data can be integrated with other data to support online services and modelling. The development of a community-based XML schema (SoilSciXML) to support the exchange of soil data will aid the above endeavours and additionally improve the potential for interoperability between state and federal systems. The integration of data from the Laboratory Information Management system (LIMS) and the soil sample archive database into VSIS will enable a consolidated single point of truth for soil information in Victoria.

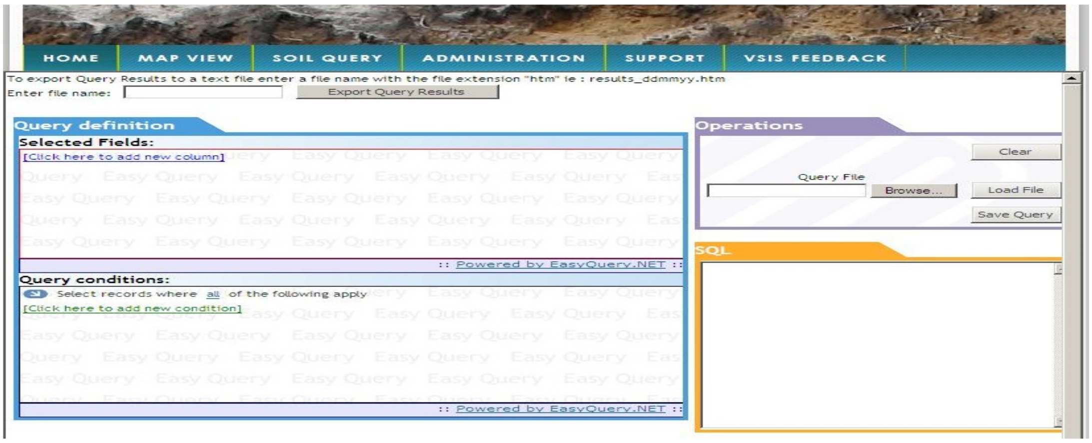

**Figure 4. The VSIS 'Soil Query' screen.**

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