



BROAD SCALE REASSESSMENT for URBAN SALINITY ASSESSMENT.

**LOCAL GOVERNMENT
SALINITY INITIATIVE**

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Broad Scale Resources for Urban Salinity Assessment

This booklet outlines some useful information resources for beginning a salinity hazard investigation. They are divided into Stage One, Two and Three resources depending on the scale at which the data is collated. Not all resources will be available for all Local Government Areas. Also assistance with their application and interpretation may be required from specialists in various technical fields. Due to variation in their development the usefulness of these resources will also vary throughout the state.

Information on salinity hazard is valuable for the management of existing and future buildings and infrastructure. It helps to ensure costly problems are avoided and, in areas already affected, that valuable resources are carefully targeted. However, the initial collection and interpretation of this information can be very resource intensive and generally beyond the scope of most Local Governments. Therefore in an effort to minimise these costs the use of material already gathered for other purposes is necessary.

No one resource, whether developed to assess salinity or not, can provide all of the information required to determine salinity hazard. This is not only because of inadequacies within these resources, but also because hazard can change considerably over time, space, and land use. It is essential that the outputs of a number of resources are examined together before any assumptions and decisions are made.

Furthermore it is essential that adequate "ground truthing" is undertaken to verify conclusions made from the use of these resources and that problems of scale are considered. In urban areas, where there is a great deal of development in a relatively small area and ownership changes across very small distances, precise identification of individual house lots on broad scale maps is very difficult. Also much of the existing information is available at scales too small (greater than 1:100 000) for use in urban areas. Extrapolation of information from small scale (eg 1:100 000) to large scale (eg 1:1 000) can lead to misclassification or incorrect predictions.

However, despite these limitations the conclusions from broad scale resources can be used as tools to assist decision making and direct further investigation.



Stage One Resources

Whether or not salinity is an issue for an urban area can be determined through a variety of resources. In most cases these resources have not been developed to assess salinity, but other urban issues such as land use change, floodplain management and stormwater control. However they can provide background biophysical data that may identify a salinity problem. These resources are at a broad scale and therefore cannot accurately pinpoint sites, but they can provide an overview of the interacting factors that can lead to a salinity problem. They can also provide a picture of how the surrounding catchment impacts upon the town and vice versa. The interpretation of these resources requires a basic knowledge of landscape processes and the aid of an appropriately qualified person should be sought if one does not exist within council.

Geographic Information Systems

Geographic Information Systems (GIS), are computer systems that can collate, store, manipulate and display any attribute whose location can be mapped. This can include roads, vegetation, land use, topography, population, rainfall, geology, soils, saline sites and many others. Complex analyses of any number of these attributes can be performed through GIS, aiding the interpretation of relationships between them. For example mapping saline sites and geology may identify significant trends in the occurrence of salinity, thus assisting in further identification and investigation.

“FLAG” (Fuzzy Landscape Analysis Geographical Information Systems)

FLAG is a GIS analysis that has been applied to all of NSW except the Western Plains. It uses topography and elevation (DEM¹) to assess the landscape and “flags” where slope changes and wetness is likely to occur.

FLAG does not identify saline sites but highlights where they are likely to occur if other conditions make the landscape susceptible to the development of salinity. To a lesser degree it can identify sites that are at risk of becoming wet and or saline in the future. Currently it cannot be used in low relief areas.

FLAG has been applied to several urban sites. It has been suggested that urban areas are more suitable for FLAG, due to

the greater homogeneity in geology and hydrogeology in smaller areas. However at the same time, the changes to natural drainage and erosion processes within the built-up environments makes identification of sites more difficult.



FLAG makes a number of assumptions about the landscape and these can impact upon the accuracy of the data interpretation and must be considered when using FLAG. They include;

- Topography displays the impact on a site of all factors (including geology, soils, climate, vegetation and land use) over time.

This means that geological features that have not altered the surface topography, such as some dykes, may not be picked up even if they can create salinity problems. In addition if the DEM used does not incorporate human changes, such as roads or railways which can alter natural drainage patterns, then their impact on salinity will not be considered.

- The height of the watertable follows that of the topographic surface, except it's smoother and has less high/low variation than the ground surface.

This means that the modelled watertable is closer to the surface at low points in the landscape and further from the surface at high points. In reality this will not take into consideration perched watertables or watertables that are impeded by something that is not apparent in the topography.

- The area considered to contribute (through surface/sub-surface flow), to potential discharge at a point, is everything that is connected by a continuous uphill path.

¹ Elevation is the height of a point above sea level and it is held in a data set called DEM Digital elevation model

This means that topographical catchment boundaries can be crossed, (provided the subsequent points in the next catchment are higher). Hence areas outside the catchment can actually contribute water and salt to a particular site.

How to access FLAG information

1. Identify the coordinates for the area you want.
 2. Ensure you have access to ArcView software to be able to view the information.
 3. Contact the Manager, Resource Information Systems at DLWC Parramatta on ph: 02 9895 7963 and request 3 indices: Upness (r_up), Lowness (r_low) and r_lowup for the area you are interested in. The information will be supplied to you for free, in latitude and longitude, for use with cadastra information.
- Note that GIS expertise (ability to use ArcView and ArcInfo to run spatial analysis) is required if you want to develop a salinity hazard map. This allows other layers to be built in either as subjective layers of local knowledge or objective layers such as good soils mapping to weight a wetness index.
 - \$\$\$ Although the FLAG data can be supplied for free the analysis of the data and work required to develop a salinity hazard map can be expensive.
 - A user guide for FLAG is currently being developed by DLWC



Draft Salinity Hazard Map for Western Sydney

Case Study - Western Sydney

Western Sydney is one urban site that has used a GIS model to produce a 'Draft Salinity Hazard Map'. The first step involved choosing a suitable GIS analysis tool by comparing results from models to aerial photos, local knowledge on soils, geology and known salinity sites in the area.

The Draft Salinity Hazard Map for Western Sydney shows areas of known salinity and areas of high, moderate and very low potential salinity hazard. The salinity hazard map is not overlaid with cadastra information (roads, house blocks), due to limited scale of accuracy of the map (1:100 000). It's use is limited to general planning and identifying the hazard of localities. It does not substitute for site investigations.

When using modelling tools to generate salinity maps it is important to understand the limitations of generated data

Salinity Audit

An audit of NSW rivers within the Murray Darling Basin was undertaken in 1998 as part of a review of the Murray Darling Basin Commission's Salinity and Drainage Strategy.

The audit established detailed predictions for all major river valleys in the Basin for the next 20, 50 and 100 years. In particular it looked at future change in both salt load and salt concentration in these rivers. The predictions enable the monitoring of change in river salinity and prioritisation of investment and action.

More recently work by DLWC has been undertaken to apply this process to the coastal rivers. The Hunter Audit has been released in March 2002 and the Coastal Audit will be released by mid 2003. Changes to the methodology used means these newer audits can be used to develop salinity hazard maps. Salinity hazard maps can provide a first step in determining whether or not salinity is an issue in an area.

It is likely that a second review of Murray Darling Basin rivers will be undertaken some time in the future. If this new methodology is used further salinity hazard maps may be developed to assist councils with identifying salinity.

Soil Landscape Maps

Many factors are involved in determining when and where salinity will occur. These include land use, soils, geology, topography, vegetation and climate.

Soil Landscape maps integrate several of these factors (although notably excluding land use) into a single mapping unit called a "Soil Landscape Unit". All the land within a soil landscape unit has a similar set of land management constraints, including salinity.

Soil Landscape maps are available for most of the Coast and Tablelands at 1:100 000 scale and for the Central West at 1:250 000 scale.

Reconnaissance soil landscape mapping at 1:100 000 is also available for the Brigalow Belt South Bioregion in the state's north.

Land Systems mapping (similar to Soil Landscape maps) covers the Far West of NSW at a 1:250 000 scale. Different soil landscape groups are required in this region due to the unique landscape and soil types.

The maps at 1:250 000 scale are unlikely to identify individual salinity outbreaks. However, they are best used for providing a description of the broad features and assisting in understanding catchment processes. These maps are particularly beneficial where very little is known about an area's physical characteristics.

Specific derivative maps can be produced from Soil Landscape Maps for a particular issue such as salinity.

Salinity derivative maps can be prepared for areas covered by existing soil landscape mapping but are not currently available for all Local Government Areas. Work is currently being undertaken to prepare salinity derivative maps for the Murray Darling Basin at the scale of existing soil landscape maps.

Soil Landscape maps and map notes provide information on....

- ◆ Geology/rock types
- ◆ Regolith
- ◆ Landforms and slopes
- ◆ Native vegetation distribution
- ◆ Current and historical land use
- ◆ Severity and types of land degradation
- ◆ Detailed soil descriptions and locations of typical soil sites
- ◆ Diagrams of soil occurrence patterns
- ◆ Soil and landscape properties which can affect development
- ◆ Soil fertility assessments and tables of soil test results and interpretations
- ◆ Soil erodibility and erosion hazards
- ◆ Urban and rural capability



Where to get Soil Landscape Maps....

Soil Landscape Maps are readily available both in hard copy and digitised.

1. Go to the DLWC website at <http://www.dlwc.nsw.gov.au>
2. Follow the links from "Caring for Our Natural Resources" – "Soil" – "Soil Landscape Map Program"
3. Go to "Soil Landscape Mapping Publication Status" where you can select the region and then the map you want.
4. Select the "place an order" button for details on how to order from the DLWC Information Centre by phone, fax or e-mail.

Derivative maps may be more difficult to obtain and salinity derivative maps have not yet been completed for most areas. For more information on them please contact your local DLWC Regional Office

Cost:

Soil Landscape Maps	\$16.50
Reports	\$22.00
Derivative Maps (first copy)	\$400.00
Subsequent map copies	\$16.50

Before using Soil Landscape Maps a number of limitations must be taken into account. Firstly, soil landscape units of less than 100ha (1:250 000 scale mapping) or 40ha (1:100 000 scale mapping) were generally not mapped unless they were considered to be locally significant.

Secondly, at times boundaries between different soil landscapes were difficult to identify. This is demonstrated with boundaries drawn as broken lines.

Finally, some areas exist where extensive disturbance and/or development have hampered identification of the original soil landscape. This is particularly the case for urban areas especially rubbish dumps, quarries, major commercial or industrial areas and areas of medium to high density housing with extensive paving, terracing or landscaping.

Geology Maps

Different rocks, their position, orientation and interactions, have different impacts upon the movement of groundwater and thus influence the movement of salt. The spatial distribution of these rocks can be identified using geological maps that cover NSW. However using geology maps to identify and investigate salinity requires specialist knowledge in hydrogeology².

Geological maps at the scale 1:250 000 have been published for the majority of NSW. Most are accompanied by explanatory notes and/or mine data notes where relevant. These maps can be used to give a broad assessment of geological formations occurring in an area, but are unlikely to be able to pinpoint specific sites. The amount of detail on these maps also depends on when they were produced.

Maps at a 1:100 000, 1:50 000 and 1:25 000 have been developed for some areas of special geological interest such as current or prospective mining operations. Whilst these are not available for all of NSW, their scale and detail makes them valuable for salinity investigation so check their availability.

The scale at which geological mapping is available is a critical feature in its usefulness for salinity investigation.

The smaller the scale e.g. 1:250 000 and above, the more difficult it is to accurately overlay cadastra information to identify specific sites.

Where to get Geology maps

1. Go to the Department of Mineral Resources web page at <http://www.minerals.nsw.gov.au>
2. From here go to Maps and Publications
3. Select the Geology and Metallogenic Map Catalogue button.

\$\$\$ Hard copy maps are between \$11.00 and \$55.00 each. Some digital information is also available.

²Hydrogeology is the science that deals with the nature and movement of subsurface waters, and with related geological aspects of surface water.

Urban Capability Mapping

Urban Capability maps assess the physical attributes (including geology, landform, soils and surface drainage) of an area and identify its ability to sustain a given use. This is called its "capability". Land is then classified according to the level of limitation that applies. For example a classification of 'Low' would include areas with limitations that are difficult to overcome and require detailed site investigation and engineering design.

Capability refers to the most intensive urban use an area can tolerate without the use leading to short or long term degradation eg. erosion, sedimentation and drainage problems. It must be noted that when assessing the capability, no account is taken of development costs, social implications, aesthetics or other factors relating to ecology and the environment.

Although urban capability maps and reports may provide valuable information on the physical attributes of an area, they are not always able to provide accurate information on salinity. In a few cases soil salinity may be identified as a limiting factor to development, however generally only where it may impact upon sediment and erosion control or plant growth.

What is generally not considered is the corrosive impact that salts can have on infrastructure, such as building foundations, roads and underground services. Recent examination of several maps for areas with salinity problems showed that salinity and/or waterlogging was either not recognised at all or the scale and its risk to development was understated.

The process of urban capability assessment is evolving with time. Also new technology and design solutions, together with changing community expectations influence some of the subjective assessments. Therefore new urban capability studies may be of benefit to salinity management.

The scale at which urban capability investigation is undertaken depends on the planning or development requirements applicable and the size of the area to be studied.

Regional (1:25 000 to 1:50 000) - Used in conjunction with other data to identify development and land use possibilities within a region.

Semi-detailed investigations or Reconnaissance Surveys (1:8 000 to 1:25 000) - Uses major landform units and general soil patterns to broadly define land use for parcels of land. May be undertaken as a first step in the study of a pre-determined urban locality.

Detailed investigations

(1:2 000 to 1:8 000) – For small parcels of land not exceeding 1000 hectares. Information used for subdivision planning with roads and house lots identified.

Where to get Urban Capability Maps

1. Urban capability maps and reports were originally developed by DLWC (formerly the Soil Conservation Service) and given to local government. Therefore copies may exist within council or local DLWC offices.
2. More recently the private sector and a business unit within DLWC have undertaken the work for specific development applications or for councils on a fee for service basis. Again copies may still be available within records department or internal libraries of the councils involved.



Stage Two Resources

If salinity is identified as a problem in an area, more detailed information can be sought using some of the Stage Two resources. They can be used to identify specific information about salinity in the town such as location of the problem, its severity and history. This information can assist in identifying the scale of the problem as well as begin to identify more precisely its cause. Whilst this information can be quite easily gathered care must be taken to ensure it is accurate and interpretation may require some expert technical assistance.

Initial investigation of the salinity problem can help determine if site specific investigation or the input of more resources are required. The information can also be used to develop a framework for a local action plan for salinity.

Local Knowledge

Local Knowledge can include written material or anecdotal evidence from community members. However, evidence particularly anecdotal, must be treated with care where those providing information are not suitably qualified.

Location of Saline Sites

The size and severity of saline sites are seasonally and time dependent. This can impact on the accuracy of salinity surveys undertaken by either over or under estimating the problem. In addition, employing an expert to survey an urban area for salinity is time consuming and expensive and it is unlikely that they will be able to identify all sites on private land.

These problems can be partly overcome by accessing the community's knowledge of the location of saline sites. The community can be encouraged to map known saline sites through coordinated media attention, the use of local interest groups or a public meeting. Information from tradespeople including builders, plumbers, pest inspectors and the public housing authority would be particularly valuable. The sites that have been identified by the community can then be verified in the field (ground truthed) to ensure they are saline.

In some cases community education and awareness raising maybe needed in the first instance. Often indicators of salinity are not recognised by the community as indicators of salinity, other explanations



are accepted as the cause of the problem. For example a road that is continually being patched maybe thought to poorly constructed not a victim of high salt or water levels.

Care must be taken using these indicators to determine the source of the problem. In some cases, damage may not be due to a rising watertable, but may be a result of leaky underground pipes, sandblasting, the impact of spray from propelled sprinklers or another factor.

Advantages

- May assist in targeting further surveying.
- May identify sites on private land that would not otherwise be visible or accessible.
- May enable identification of sites at an earlier stage.
- Can provide an indication of the level of community understanding on salinity.
- Raises community awareness and understanding of the problem.
- The greater coverage of information (on both private and public land) will help to better understand the problem.

Disadvantages

- Requires some level of community knowledge of salinity.
- Coordination difficult for large areas.
- Ground truthing is essential and can be expensive.
- Incorrect use may have social and/or legal implications.

History of Saline Sites

Details related to the development of saline sites, and how they change over time, assist in identifying their cause and determining the most appropriate solution. Sites change over time and can develop in response to variation in rainfall, surface drainage, ground level, irrigation rates and land use change. A site history can be obtained from local people and/or historical records and can provide a valuable benchmark from which to monitor future change.

Advantages

- Establishes a benchmark.
- Identifies factors influencing the site.

Disadvantages

- Care must be taken with inaccurate recollections.
- Sites may not be saline because of a rising watertable but due to other causes e.g. leaking pipes.

Soil Types

Detailed information on the location and characteristics of soils within the area may be obtained from local soil experts. This can provide much more site specific information on soil type, structure and distribution, than would otherwise be available through broader mapping programs.

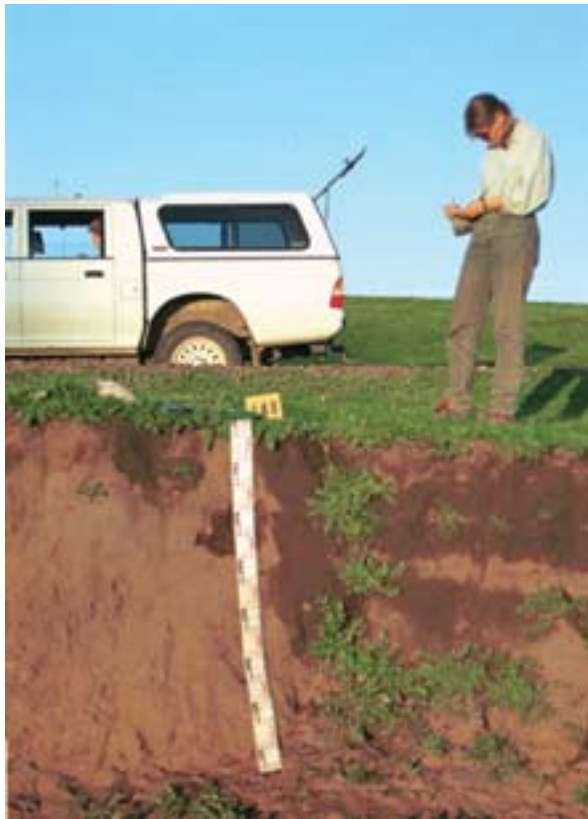
This information could be sought from local interest groups and/or DLWC. In addition earthworks undertaken for construction may provide information and/or sites to observe soil profiles and geology.

Advantages

- Provide greater detail than would otherwise be available.
- Reduce costs necessary to investigate the role of local soils in salinity.

Disadvantages

- May not have people suitably qualified or experienced.
- Must ensure that the information provided is accurate.



Groundwater Information

Groundwater information is extremely valuable for understanding salinity but can be quite expensive to obtain. However the local community may already have information on the groundwater situation that can be utilised. In particular this can include information from piezometers or testwells, old and disused bores and wells, observations of groundwater movement in cellars, mine shafts, quarries, dams or records from nearby bores.

Piezometers are deep bores (usually more than 3 metres in depth) carefully constructed to measure groundwater pressure at selected depths but usually not water quality. Testwells on the other hand are more common (because they cost less to construct), are usually less than 3 metres and are more responsive to seasonal influences as unconfined groundwater system responsiveness to climate usually decreases with depth. The term 'monitoring bore' is used to describe bores installed for water quality monitoring. Some monitoring bores are in excess of 100 metres deep.

Often these three terms are used interchangeably. For example it is common practise in many parts of the state to call shallow monitoring bores piezometers.

A large number of piezometers, testwells, and monitoring bores have been installed throughout NSW as part of investigations, or education and awareness programs. These may have been regularly monitored and will provide valuable water level information. Many have been very beneficial in raising the profile of salinity in towns, however very few were ever registered in the DLWC database and over time they have been lost from the system.

Groundwater monitoring can be undertaken from existing water extraction bores and wells, provided they are in a safe condition to do so. They may also provide valuable historical information. For example it may be recorded that they were unused because they became too salty, or were continually deepened to access good quality water. These bores and wells may be located in town or the nearby rural area. They could be identified following a public notice, review of DLWC bore records and/or review of older town maps. Speak with retired and active private drillers, windmill repairers and the local water delivery authority.

Local organisations that are involved in managing cellars, quarries and other below surface structures could also provide

valuable anecdotal evidence of groundwater movement and watertable rise.



Advantages

- Able to use existing infrastructure to sample groundwater and monitor watertable.
- If there is sufficient information available, a preliminary salinity hazard map may be developed.
- May provide valuable historical data on watertable levels and groundwater movement.
- Gets the community involved in monitoring groundwater

Disadvantages

- Piezometer height above sea level will need to be surveyed to determine flow directions or map the groundwater surface.
- Care must be taken with inaccurate recollections.
- Care must be taken to ensure testwells are still in useable condition. The life of the bore will depend on construction techniques, the type of aquifer and how the bore is developed.

Land Use History

Information on landscape characteristics and land use within an area, pre and post European settlement will be valuable when investigating the cause of the problem. Changes overtime could include: the construction of roads, lakes or dams; change to surface drainage or ground level (including filling drainage lines); flooding; vegetation clearance or tree establishment. Failure of crops or trees in particular areas may be the first signs of an emerging salinity problem. Alternatively an area may appear well vegetated but this is the result of tree planting that followed many years of no trees or is more than what was naturally present in the area. These changes overtime may have impacted on the salt and water processes in the landscape.



This information could be obtained from interviews with community members or examination of town planning and historical records.

Advantages

- Can identify human influences on the salinity problem.
- Can provide information on what was the previous land use of the area, which may assist with identifying solutions.

Disadvantages

- May be difficult to accurately attribute land use change to salinity.
- Care is required with inconsistent records, particularly in the area of vegetation cover which can be both over and underestimated.

Surface Water Surveys

Understanding the movement of water and changes in its quality around an urban area, can assist in identifying sites contributing large salt loads through runoff and any areas where water is ponding unnecessarily. Water quality data can also provide a benchmark for total salt exported from the area.

This information may be gathered by taking measurements strategically around the town (Rapid Catchment Assessment) and/or by measuring the quality of stormwater. Further information may be obtained from council's own Stormwater Management Plan or Flood Maps and any routine sampling or Streamwatch activity.



Details of any Streamwatch or Salt Snapshot activities can be obtained from local schools or Landcare groups/coordinators that may have participated. In addition the local DLWC office may provide valuable contacts. Obviously because much of this information has been obtained at only one point in time (rather than regularly over a number of years), care must be taken with its use.

Advantages

- Establishing a benchmark assists in monitoring the effects of salinity management on downstream users.
- Identifying the source of salt (in runoff) allows salinity work to be prioritised.
- Identifying any areas of unnecessary ponding allows these to be addressed, minimising any chance for recharge.

Disadvantages

- In some cases care must be taken with the accuracy of results.
- Sufficient water quality data to pinpoint the source of salts may not be available.

Local Geology Knowledge

Detailed geological information may be available for the local area and would be beneficial for salinity investigation. This may be found within geological maps prepared for mining or other investigatory purposes, information on the routes of old mine shafts and historical records of geological surveys and mining activities.

Advantages

- Can provide geology information at the appropriate scale.
- May provide information on historical level of watertable and groundwater movement.
- May identify disused mine shafts through which groundwater is moving.

Disadvantages

- May be difficult to find and interpret historical information particularly given lack of landmarks.

Aerial Photography

Aerial photography can be used to identify saline sites on vacant or undeveloped land, parks and gardens. Its use enables rapid identification and a convenient way of investigating site history and monitoring any future change in these areas. This is restricted to open spaces because at the available scale, buildings and their shadows will obscure other sites and the deterioration of buildings and infrastructure can not be detected. In a rural area changes in the quality of vegetation can be used as an indicator of salinity. In urban areas this vegetation is not always present in sufficient quantities to be easily compared, is highly modified or frequently replaced.



The identification of saline sites using aerial photos is limited to those sites expressing symptoms at the soil surface. Aerial photos will not identify cases where salinity is affecting below ground structures or where

the watertable has risen rapidly but is not yet widely evident as wet patches or sick vegetation.

All NSW Rural Towns have been photographed at a 1:16 000 scale. This does not include Sydney, Newcastle, Wollongong and Central Coast area. These larger areas have been photographed at 1:25 000 or 1:50 000 scale, making urban salinity identification difficult. Photos of specific sites may have been taken at a larger scale. Photos may be sought through Land and Property Information NSW.

Specialist skills are required to interpret

Where to get your Aerial Photographs

- Visit the Land and Property Information website <http://www.lpi.nsw.gov.au>
- Or contact them on (02) 6332 8200
- Follow the prompts from Maps and Aerial Photographs – Aerial Photographs

\$\$\$ A hard copy of an Aerial Photo costs between \$55.00 - \$200.00 depending on the size required.

aerial photos and identify saline sites. In particular, skills with a stereoscope³ are required for interpretation. Individuals may be experienced in one or the other of these skills, however both are required for accurate identification of salinity.

Ground truthing of all sites identified through Air Photo Interpretation (API) is essential. The site must be checked to ensure it has been accurately identified, as well as to note any changes that have occurred since the photo was taken.

If councils do not wish to interpret photos themselves or do not have the necessary skills, they can purchase the photos and seek advice from DLWC or assistance with interpretation from private companies.

³ A stereoscope is a device for viewing a pair of photographs taken at slightly different positions. Looking at each with one eye, the combined images give an impression of depth and solidity

Soil Surveys

An increasing number of surveys of soil profiles are held in the Soil and Land Information System, (SALIS) database managed by the DLWC.

Currently this database contains more than 50 000 soil profiles. Their location can be identified using the Soil Profile Attribute Data Environment (SPADE) which is attached to the SALIS database.

Approximately 4% of these have been described as having urban land use on the site or within 300m. However this does not include those profiles for which land use has not been described. A further 4% of sites identified in urban areas have been noted as having evident or strongly evident signs of salinity. This is based on a visual assessment of the site and doesn't necessarily rely on laboratory testing.

Soil profiles can provide a detailed analysis of the soil at depth. Those that have undergone laboratory testing provide information on the level and chemical composition of any salts present. This information can be of assistance when selecting appropriate species for revegetation, identifying any subsurface salinity that may need to be managed and selecting suitable building materials.

SALIS contains profiles gathered for a range of purposes, from normal land assessment surveys through to specific topsoil chemical test results.

Because of this there is variation in the level of detail held for each sample and not all have undergone laboratory testing. In all cases however, the information provided identifies the soil type, describes the site and soil layers (to a depth of 4m in some cases). A qualified soils expert may be necessary to satisfactorily interpret this data.



How to access SALIS....

1. Go to the DLWC website at <http://www.dlwc.nsw.gov.au>
2. Follow the links from "Caring for Our Natural Resources" – "Soil" – "Soil Profile Data Environment (SPADE)"
3. Click on "Use SPADE to access soil information in NSW online"
4. Follow the instructions to check if there are any soil profiles for your town

Those undertaking soil investigation are encouraged to send their data to SALIS to be stored for future use. By early 2003 soils landscape data will also be available through SALIS.

\$\$\$ Soil profiles can be downloaded free for small sites and non-commercial users.

Stage Three Resources

Stage Three resources are site specific and can be used to investigate a site in more detail. These resources are more costly to access and implement and require specialist staff and equipment. Due to these issues access can be somewhat limited. These resources have been included in this booklet because where available, the information they provide can further enhance the understanding of salinity in the surrounding area.

Geophysics

There are a number of geophysical tools that are relevant to salinity and may be used in an urban environment. Currently the most commonly used include Electro-Magnetic Induction (EMI), Resistivity Soundings and Magnetics. All of these tools have advantages and limitations with their main limitation being the ambiguity of their results. This ambiguity can only be resolved with comprehensive ground truthing and sufficient geological and geophysical knowledge and experience, held by both the person operating the equipment and the interpreter of the output data.

Currently these geophysical tools and those capable of interpreting their outputs are not widely available and thus access is limited. More information on these tools can be gained from DLWC, a qualified hydrogeologist or university with a geophysics department. EMI is the most widely available and thus has been more frequently used in urban areas.

Electro-Magnetic Induction (EMI) EMI (commonly shortened to EM) surveying has been widely used in agricultural areas within Australia for a number of years. More recently it has been moving into urban areas for use in pre-development assessment, green space management and infrastructure design. The application and interpretation of EMI in existing urban areas is made difficult by the presence of metal fences, underground pipes and telecommunication cables which distort the readings. It is critical that care is taken to ensure the work is undertaken correctly.

Obviously this tool is of greatest value prior to development, however there are many situations where it may assist in salinity identification and management.

Examples of EMI use in Urban areas

- Identification of recharge areas on golf courses and in subdivisions, **guiding landscape design** to enable strategic plantings in these areas.
- Leaky dams on golf courses, leaking garbage tips and the presence of prior streams in green spaces have been identified enabling **prioritisation of repair work** and the **correct siting of piezometers**.
- EMI surveying has been used as **part of the development application process**, in some cases by councils to assist their decision making but in others by developers in their application.
- Assessment to ensure that any **earthworks or engineering structures** are appropriately **located to ensure minimal disturbance of inherent salt and damage to works**. For example the re-alignment and design (in this case depth) of stormwater channels has been adjusted following identification of the location and depth of salinity through EMI survey.
- **Management of parks and gardens** has been assessed through the use of EMI surveys detecting any over or underwatering and ensuring the appropriate regime is selected.
- Soil suitability survey for **recycling of effluent and serial biological concentration systems**.

Costs vary depending on the detail required in the survey, size of the area, level of validation and degree of interpretation of the result.





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