DEPARTMENT OF
PRIMARY INDUSTRIES




Mandatory Environmental Monitoring

Monitoring Manual for the Shepparton Irrigation Region.

Victoria
The Place To Be

Office of Regional Manager, DPI: Telephone (03) 5833 5222

Produced By: Greg Day, Environmental Management Program, DPI Tatura, 2003.

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Background

Statewide Salinity Monitoring Strategy

The Victorian Statewide Salinity Monitoring Strategy was created in 1992 to monitor the effectiveness of the salinity management plans in all areas of the state. The strategy was designed to ensure some level of consistency between different regions, allowing results to be reported statewide.

The aim of the strategy was to provide guidelines for tracking the effectiveness of the Victorian Salinity Program. The Mandatory Environmental Monitoring Program is part of the strategy.

Statewide Mandatory Environmental Monitoring Program

Objective of the program

The original objective was to determine if the Salinity program was having any impacts on wetlands and remnant vegetation, by assessing the condition of a selection of significant wetlands and remnant vegetation sites. Wetlands and remnant vegetation sites within each region were selected on the basis that they were:

- currently affected or potentially threatened by rising groundwater and/or
- currently affected or potentially influenced by salinity mitigation works.

The 'Mandatory' requirement for this monitoring was included in an attempt to try and protect this long-term program from regular budget cuts and other departmental changes that could have jeopardised funding. It was recognised that a dataset expanding over a very long time-span would be needed to even begin to see any environmental trends occurring (if any at all), thus the provision for long term commitment of funding was included.

Shepparton Irrigation Region Mandatory Environmental Monitoring

Environmental monitoring was identified to be an important component of the SIR Land and Water Salinity Management Plan and is referred to in the SIR Policy Document, revised November 1998, Section 2.5.1.
"Environmental monitoring will be carried out to determine whether degradation is occurring due to salinisation or salinity management programs."

Three wetland and **four** remnant vegetation sites were selected for environmental monitoring within the Shepparton Irrigation Region. The selection of these sites was determined following consideration of the following factors:

- sites of international, national or state significance,
- sites that could be affected by salinity or salinity works,
- sites 'representative' of the areas wetlands or remnant vegetation.

Details of each of the chosen sites are included in the 'Monitoring Site Information' section of this manual.

Monitoring Details

Parameters measured

A number of parameters were initially chosen as the most appropriate indicators of the effectiveness of the Salinity program. These parameters were to be measured at regular intervals throughout the year. Table 1 outlines the parameters, methodology and frequency for the wetland and remnant vegetation sites. A long history of data is required to identify long-term trends from seasonal or annual variations.

Table 1. Parameters measured at wetland and remnant vegetation sites

	Parameters	**Methodology**	**Actual Sample Frequency**	**Original sample frequency**
Water Quality	Nutrients	Field sampling and lab analysis	Seasonally	Seasonally
	Total Phosphorous			
	Reactive Phosphorous			
	Nitrate + Nitrite			
	Total Kjeldahl Nitrogen			
	Other parameters	Field sampling	Seasonally	Monthly
	Salinity (EC)			
	pH			
	Dissolved Oxygen			
	Temperature			
	Turbidity			
Biological Indicators	Invertebrates community composition	Field sample Rapid Bioassay Laboratory analysis	Yearly	Yearly
	Weed invasion and regeneration	Transects and quadrats species present	Seasonally	Yearly
	Vegetation Health	Photopoints	Seasonally	Seasonally
	Macrophytes	Transects	Seasonally	Yearly
Hydrology	Depth to groundwater	Bore hole at sites	Seasonally	Monthly

All parameters outlined in the statewide strategy (table 1) are monitored within the SIR. Monitoring commenced in the SIR in October 1995. Table 2 details the first time each of the parameters was measured in the SIR. The last column has been included to show how the actual monitoring frequency differs from the original intended monitoring frequency of each of the parameters. These differences are largely due to resource constraints, and the variable nature of the wetting/drying cycle in the wetlands. For this reason, some sites have large gaps in the data collected due to dry conditions.

Detailed methodology for monitoring of each parameter is included in the 'Wetland Monitoring', Remnant Vegetation Monitoring' and 'Groundwater Monitoring' sections of this manual.

Table 2. Initial monitoring times in the SIR

Parameter	1st sample time
Water Quality	Oct 1995
Macro Invertebrates	Spring 1997
Weed Invasion	Spring 1997
Vegetation Health	Oct 1995
Macrophytes	Spring 1997
Hydrology	Oct 1995

Evolution of Mandatory Environmental Monitoring since its inception

Since Mandatory Environmental Monitoring began, it has undergone quite a few evolutionary steps. For the purpose of recording some of these important changes, this section will attempt to explain what has happened and where mandatory environmental monitoring currently stands.

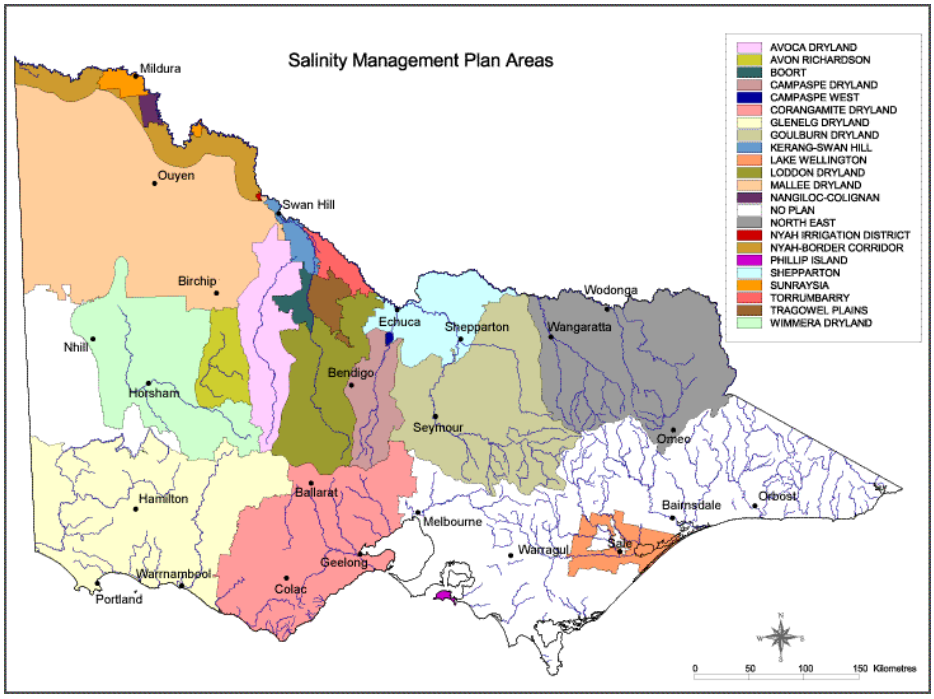
The mandatory environmental monitoring program began with a statewide co-ordinator, and monitoring in each of the regions was developed by monitoring officers guided by methodologies set out in the Victorian Statewide Salinity Monitoring Strategy document. The initial intention of the program was to have reasonably standard methodologies across the whole state so that the monitoring data could be collected and compared across the whole state. As monitoring in each region commenced, it appears that some aspects of the monitoring methodologies have varied from region to region, probably as an adaptation to the vastly different characteristics of the monitoring sites across the state. And maybe due to the different ways the people setting up the monitoring have interpreted the methodologies. These variations in methodology are also accompanied by a variety of different methods of data storage and even with data analysis and reporting. There has been little comprehensive documentation of how monitoring is actually undertaken, and why sites were originally chosen. Regions are only now working on monitoring manuals to assist with the equity of this program and to help with continuity during changes in staffing (hence the development of this manual).

At some stage since the program began, the statewide co-ordinator has moved to another job, and the position has never been refilled. At what point this actually occurred is not really known, although it was probably at some point prior to 1998. Central co-ordination ended here, though the funding has still flowed to each region due to the ‘mandatory’ requirement. So each of the regions continued with environmental monitoring and monitoring officers occasionally got together to discuss different issues regarding how monitoring was done, of which the last meeting occurred in 1998 before a gap of 4 years until recently (December 2002).

After central co-ordination ceased, none of the initial ambitions to store analyse and compare monitoring data on a statewide basis were ever undertaken, and most of the data is now kept at each region, and results of the monitoring reported locally (to CMA’s or Implementation Comittees’s etc). Most regions quickly discovered that it was difficult to keep up with monitoring because monitoring officers often worked on other projects, and monitoring became too time consuming to complete well. Many regions decided to contract out the actual

monitoring work, and the monitoring officer continued on with a local co-ordinating role. In the case of the Shepparton Irrigation Region, monitoring has always been undertaken by NRE staff, and has been given a lower priority than other tasks, and thus has suffered compared to some of the other regions that have had professional monitoring contractors undertaking monitoring runs and completing reports. There have been at least 5 staff members in charge of monitoring in the SIR since it began, which has impacted on the continuity of data collection.

Not all regions that started mandatory environmental monitoring have continued on with it. Corangamite dryland and Goulburn dryland (see below) have discontinued their monitoring. So with the lack of central co-ordination, the continuation of this program is now entirely up to the discretion of each region.



Other regions have expanded their monitoring to more sites than the minimum required for each region. Mandatory monitoring in the Mallee dryland, Nangiloc – Colignan & Nyah – Border corridor regions (all co-ordinated from Mildura) have expanded their monitoring (and discontinued sites that were not of any benefit), and their program has been very successful.

And in the Lake Wellington region, a quite different approach to environmental monitoring is being investigated. A partnership approach between various agencies that have a need for monitoring data (mostly for stream and groundwater monitoring, but can extend to other types of monitoring) gets all relevant groups together to identify between them what they are going to measure. This is more desirable than a segregated system where different agencies just deal with their own data collection requirements individually, which may lead to two separate groups collecting exactly the same information at the same site.

In early December 2002, a meeting was held in Melbourne with almost all of the monitoring officers, plus senior staff such as Stuart Minchin, Stuart Critchell, Paul Wilson, Paul Simpson & Jane Ryan from Catchment and Water division, and Phil Papas from Arthur Rylah Institute. The meeting was initiated by the monitoring officers, and we discovered that because central co-ordination had been lacking for quite a long time, the Mandatory Environmental Monitoring program had almost been completely forgotten by Catchment and Water senior

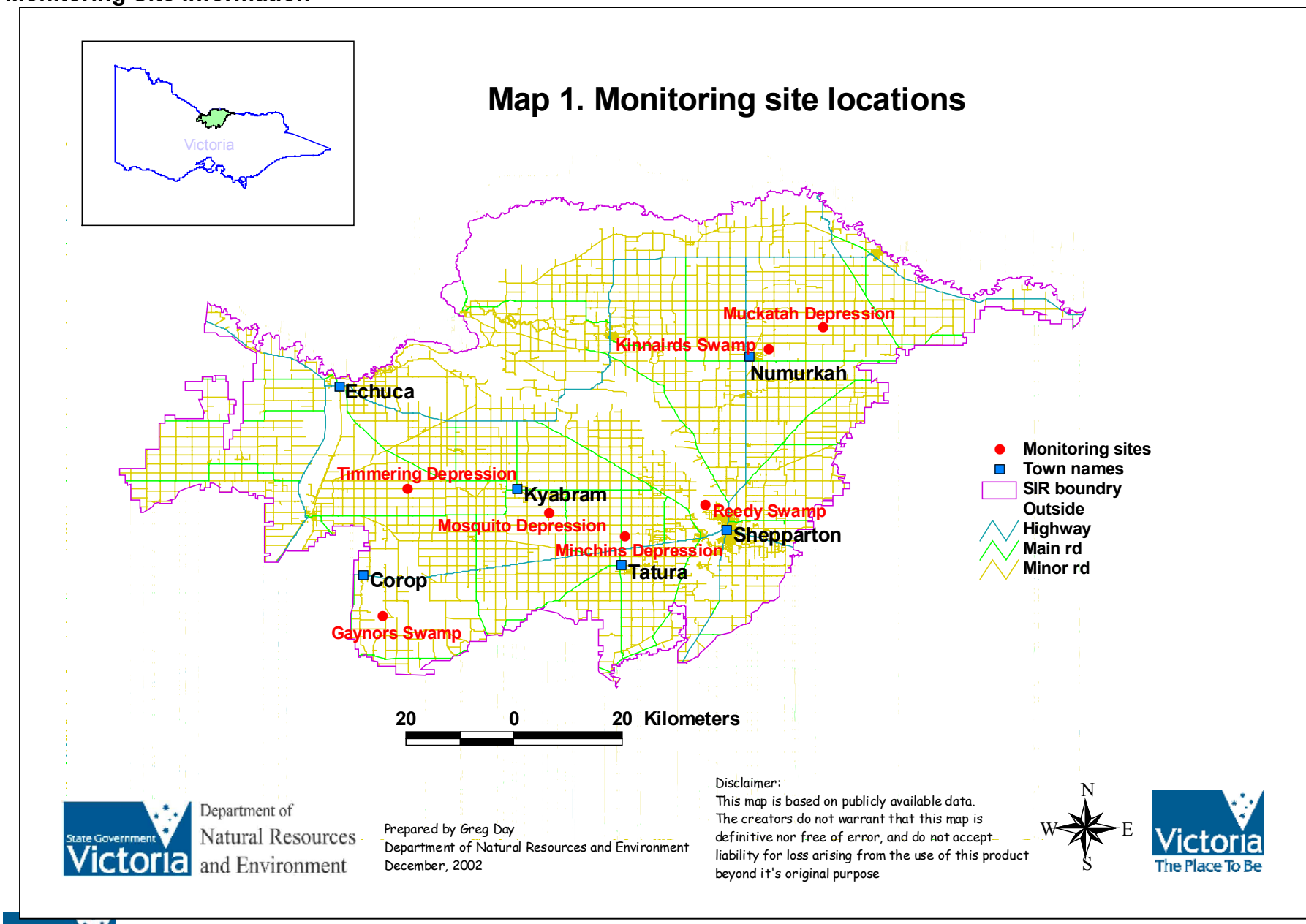
staff. Some staff from Arthur Rylah Institute knew through undertaking some of the macroinvertebrate work that this monitoring program existed but didn't quite understand what it was trying to achieve.
Most of the senior staff were astounded that the program had lasted so long, and recognised it as being very unique in the sense that it had been collecting information from wetlands and remnant vegetation for so long (there are very few environmental monitoring programs that have run for this long).

It was also recognised that although the monitoring was originally set up under the banner of the Salinity programs, the monitoring program is actually more 'environmental' monitoring than just 'salinity' monitoring. And in fact, it has become apparent that it is extremely difficult to separate the affects of salinity on the environment from other threatening processes such as drought, overgrazing etc, and is probably almost impossible with the current methodology being used.

In the Shepparton Irrigation Region, monitoring has been completed at the necessary times, but the data collected has not really been recorded into an adequate database to make analysis of the results easy. As a direct consequence of this, no annual reports have been completed to report back on what the monitoring might be detecting. The only reports available are the macro-invertebrate reports that have been completed at the Arthur Rylah Institute and sent back to report on the findings. This is not to say that the data collected isn't useful, but it needs to be properly handled, analysed and reported on regularly and effectively to be able to tell just how useful it is.

Throughout the whole year of 2002, I have been reviewing the mandatory monitoring and investigating the major factors that are preventing reporting of monitoring results. Some ways that the monitoring could be improved so that the findings are distributed to, and are useful for the various organisations that are working on improving / maintaining the environmental health of our wetlands and remnant vegetation have been presented to PISC. This review of the mandatory environmental monitoring in the Shepparton Irrigation Region was quite overdue, and regular evaluation into the future will be vital to getting this program back on track and keeping it their so that it provides some useful results into the future.

Monitoring Site Information



Map 1 (opposite) shows the general location of the selected monitoring sites in the Shepparton Irrigation Region, and table 3 below contains some additional information to assist with navigation to each of the sites.

Table 3: Site location details

Site	AMG Reference	Region 12 & 22 CFA map number
Wetland		
Gaynor Swamp		289
Bells Rd	59551-3059	
Structure	59558-3046	
Reedy Swamp	59765-3530	257
Kinnairds Swamp	60060-3620	222
Remnant Vegetation		
Mosquito Depression	59752-3285	255
Muckatah Depression	60101-3702	223
Timmering Depression	59788-3085	254
Minchins Depression	59708-3412	256

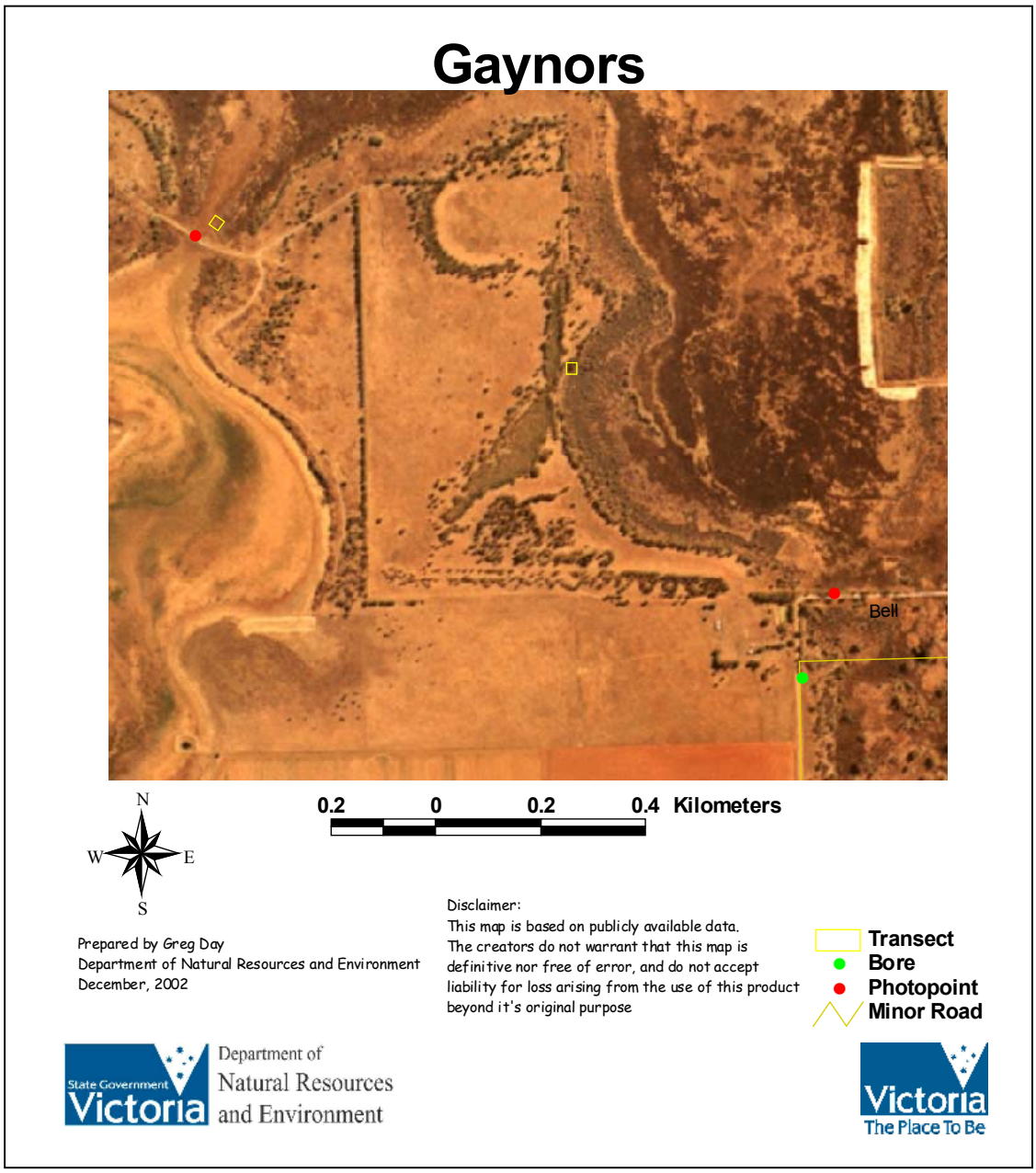
The following maps show each of the monitoring sites in more detail, with aerial photographs to assist with contexting where the monitoring points are in the landscape. At most sites, wooden or metal posts are present to show where transect, photopoints etc are positioned, however it has proven quite difficult to prevent some of these posts from being removed at various times, and these GIS maps may assist at sites where posts have gone missing.
To view the points at even higher resolution, an arcview project is set up on the following directory on the server at Tatura: **J:\regional_services\programs\gb-sialm\environment_program\ arcviewprojects\Mand_Monitoring\monitoringinfo.**

There is also additional information on this arcview project such as Pre 1750, and current Ecological Vegetation Class (EVC) layers, watertable contour layers for each year since 1995, remnant vegetation and wetland layers.

Wetland Sites

The wetland sites chosen are all areas of national significance and are threatened by high watertables and salinity. It should be noted that at the time of selection, all of the wetland sites were targeted for salinity mitigation works under the Shepparton Irrigation Region Land and Water Salinity Management Plan.

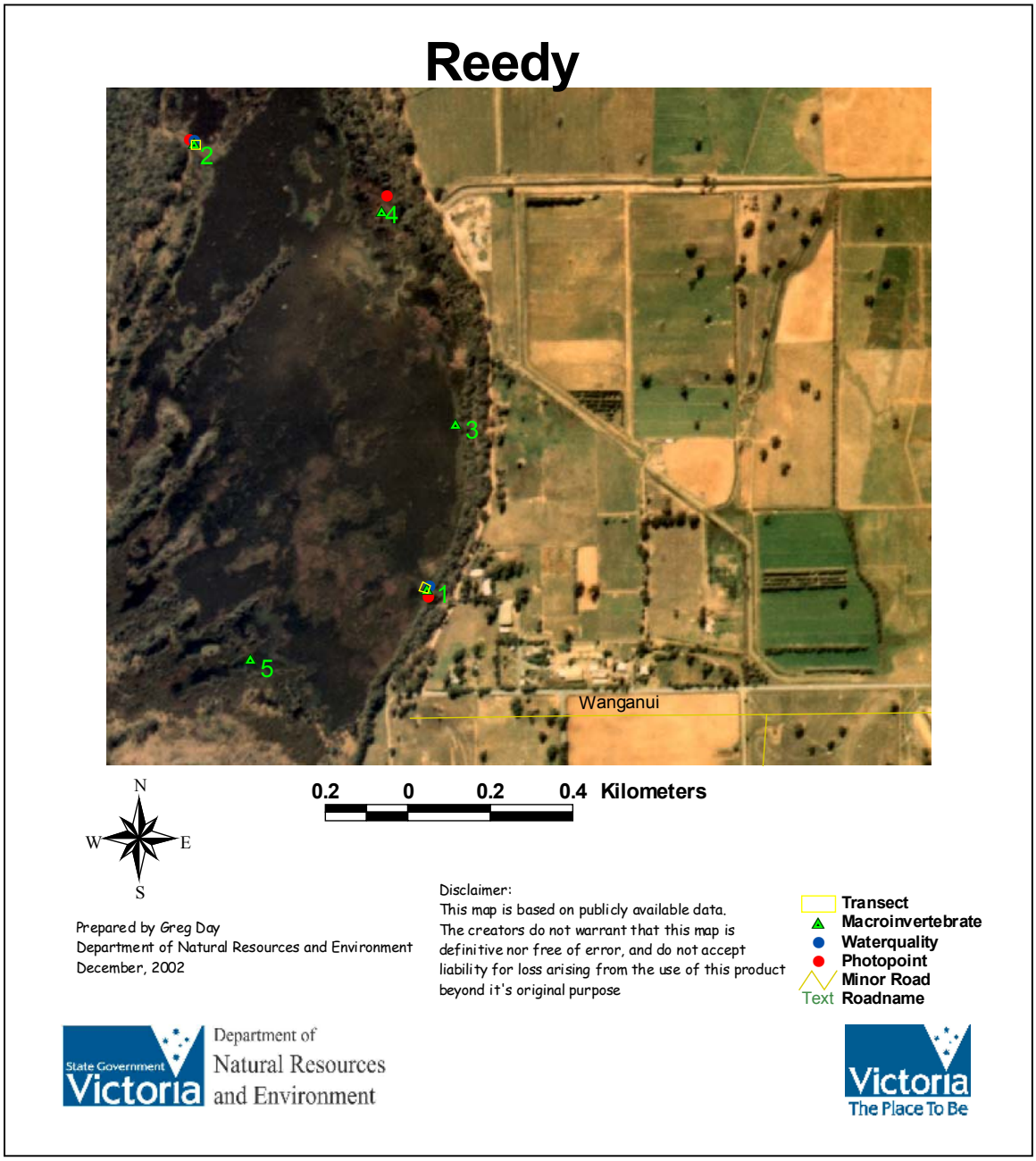
Gaynors Swamp



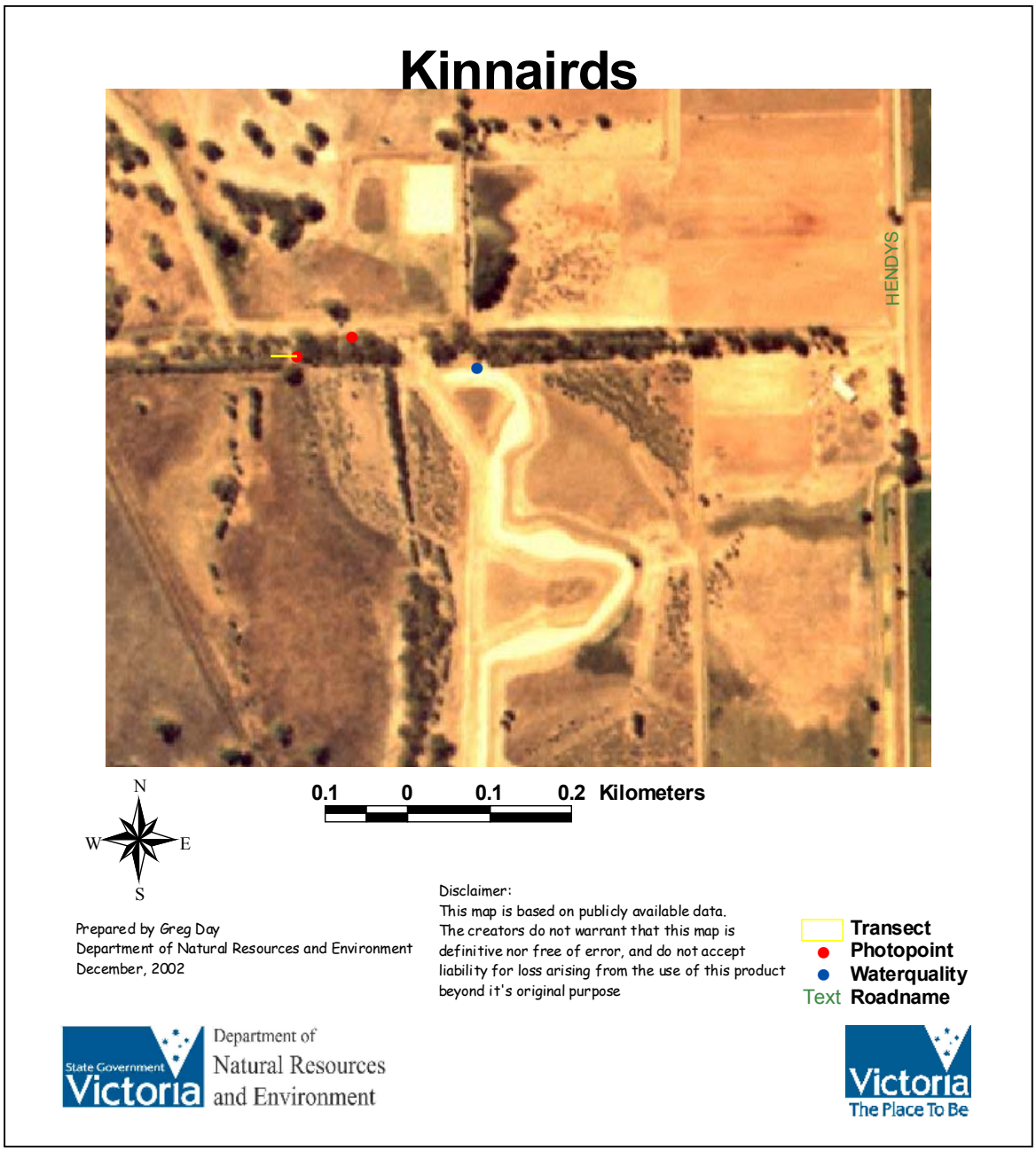
The monitoring site at Gaynors swamp is located off Bell road, and the different monitoring points are spread out slightly. Gaynor Swamp is part of the Wallenjoe wetlands which are of national significance. This area of public land has been impacted by altered flooding regimes, saline inflows, and a high, saline watertable. The Lake Cooper-Greens lake link channel also has a significant impact. As part of the salinity program works were carried out during 94/95 and 95/96 to allow flooding regimes and water quality to be managed almost independently of

Lake Cooper. These works were implemented to improve the water quality in Gaynors Swamp and to reduce the incidence of saline water entering Gaynors Swamp from Lake Cooper.

Reedy Swamp



Reedy swamp is situated to the north of Shepparton and can be accessed via Wanganui road. This wetland forms part of the Goulburn River floodplain, and as a consequence is of national significance (Kelly 1993). This area of public land has been affected by drain and channel outfalls in the past. In 92/93 and 93/94 works were carried out by GMW and the salinity program to divert drainage around the wetland. More recently in 2001/2002, the wetland has been dried out and re-flooded using an environmental water allocation to try and reinstate a more natural wetting and drying regime.

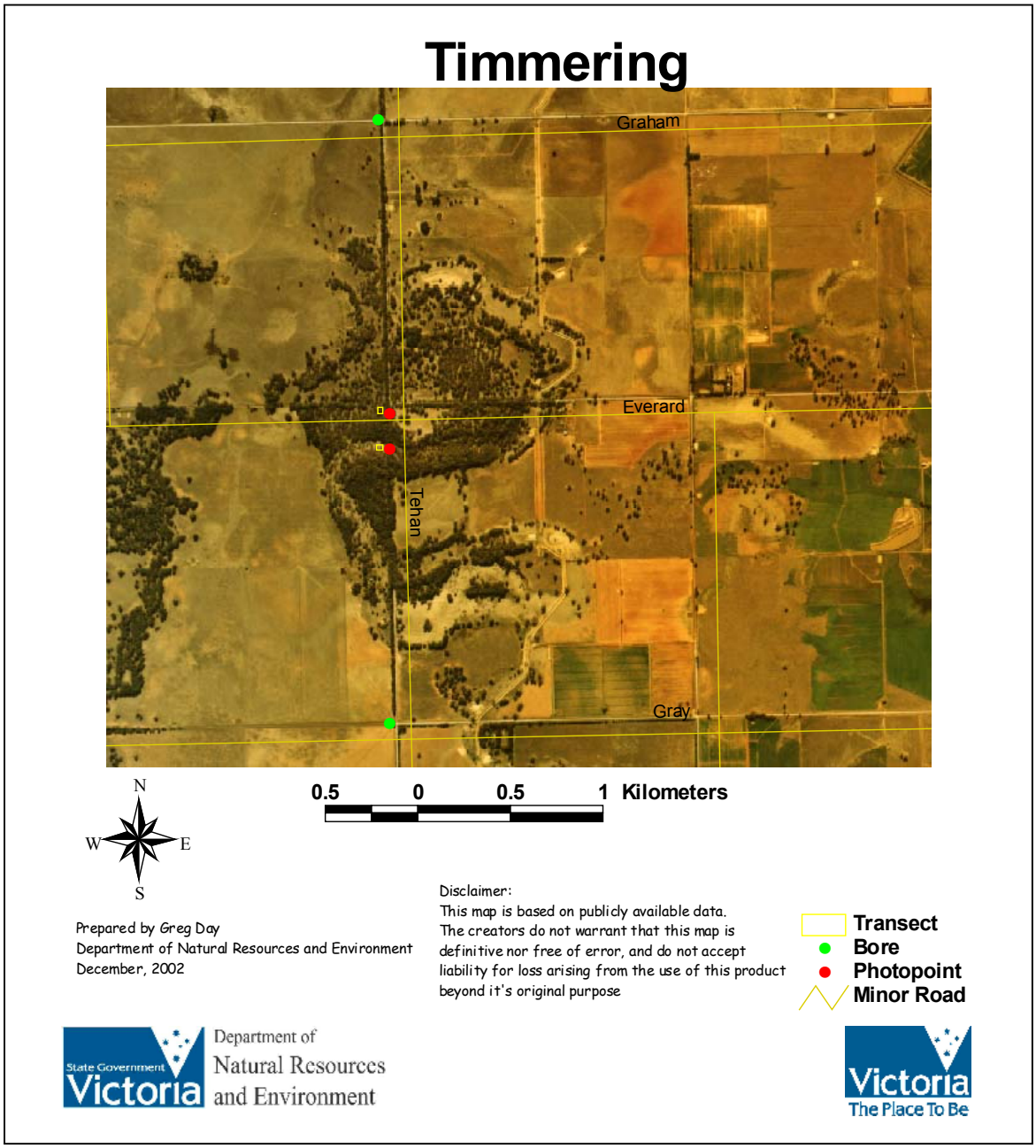


Kinnairds Swamp is situated off Hendys Road, north-east of the Numurkah Township. The wetland is located at the terminal end of the Muckatah Depression, which is a wetland depression of national significance. This wetland will be managed as a retardation basin as part of the management of the Muckatah Arterial Drainage Scheme. High drain flows following heavy winter spring rainfall events will be directed into the wetland to minimise flooding pressure in the Broken Creek.

Remnant Vegetation Sites

Four remnant vegetation sites were selected for environmental monitoring within the SIR. All of these sites are threatened by high watertables and salinity and their immediate area has been targeted for salinity mitigation works.

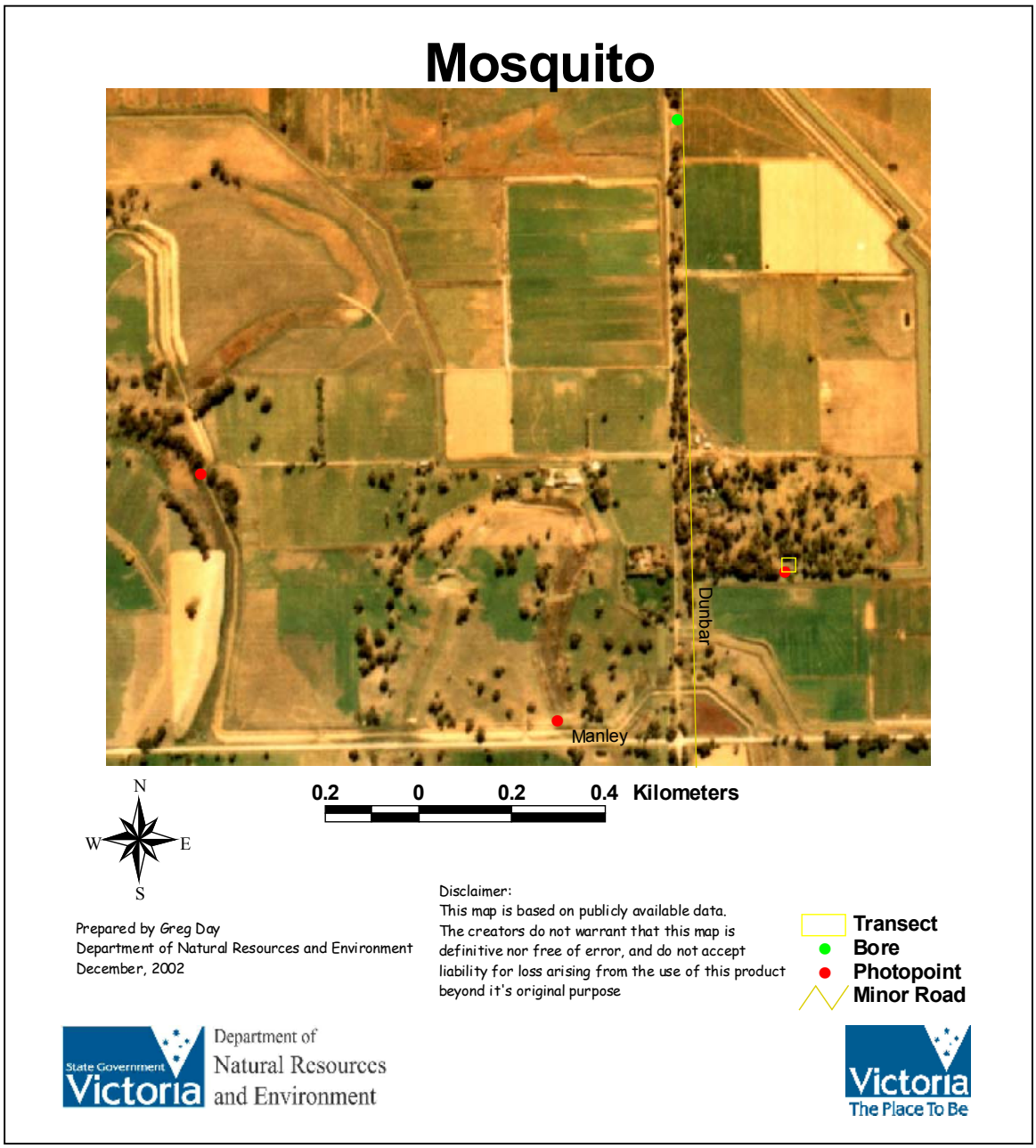
Timmering Depression



This site is located along Tehan Road, Timmering. The Timmering depression is an area of regional significance in terms of wetland habitat. It is an example of the Plains Grassy Wetland and Drainage Line Complex Ecological Vegetation Classes, and is dominated by River redgum overstorey. A surface drain is proposed along much of the depression to provide drainage and salinity protection to adjacent irrigated farmland and remnant

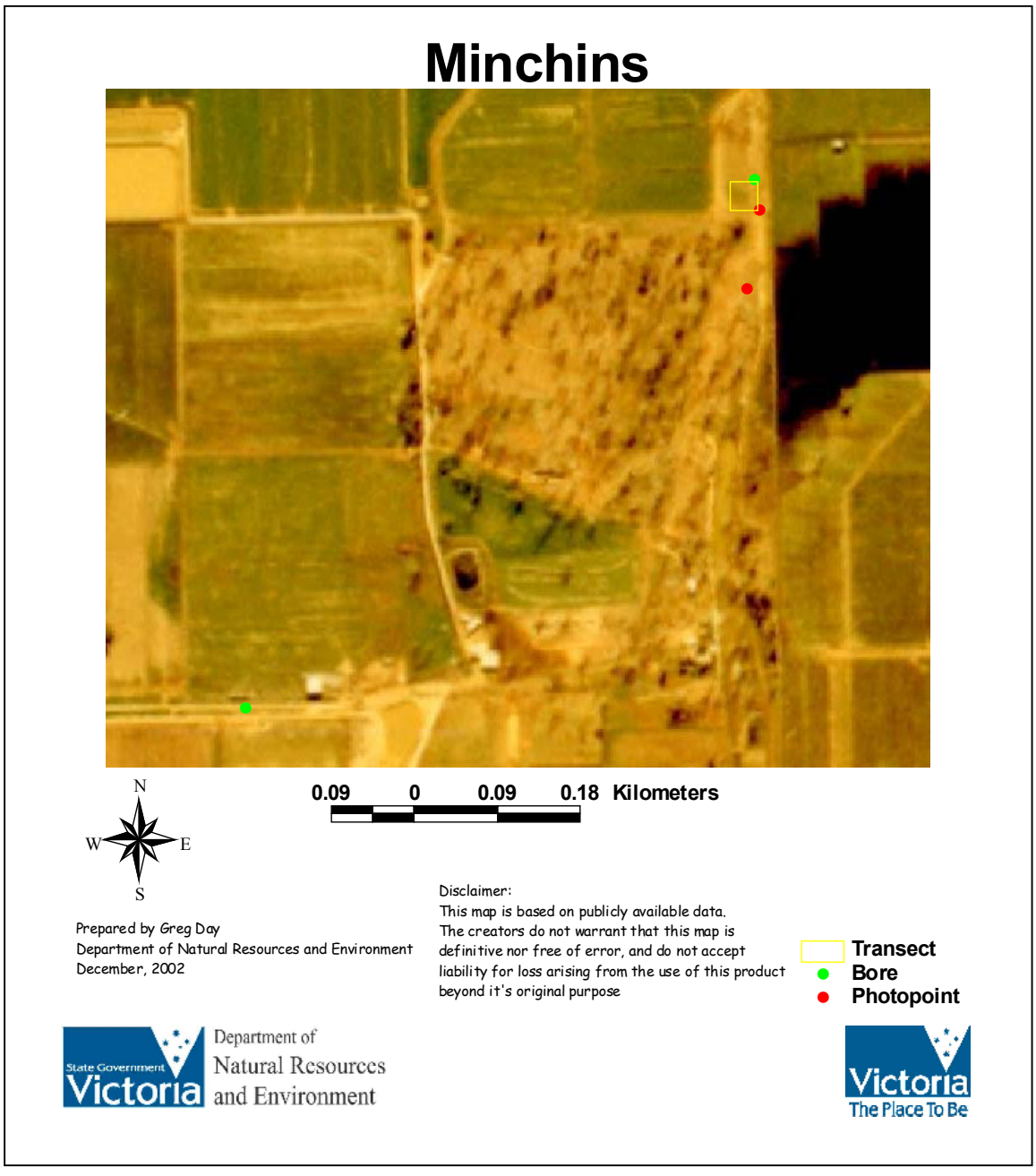
vegetation. Monitoring so far has attempted to assess the success of salinity mitigation works on this patch of remnant vegetation.

Mosquito Depression



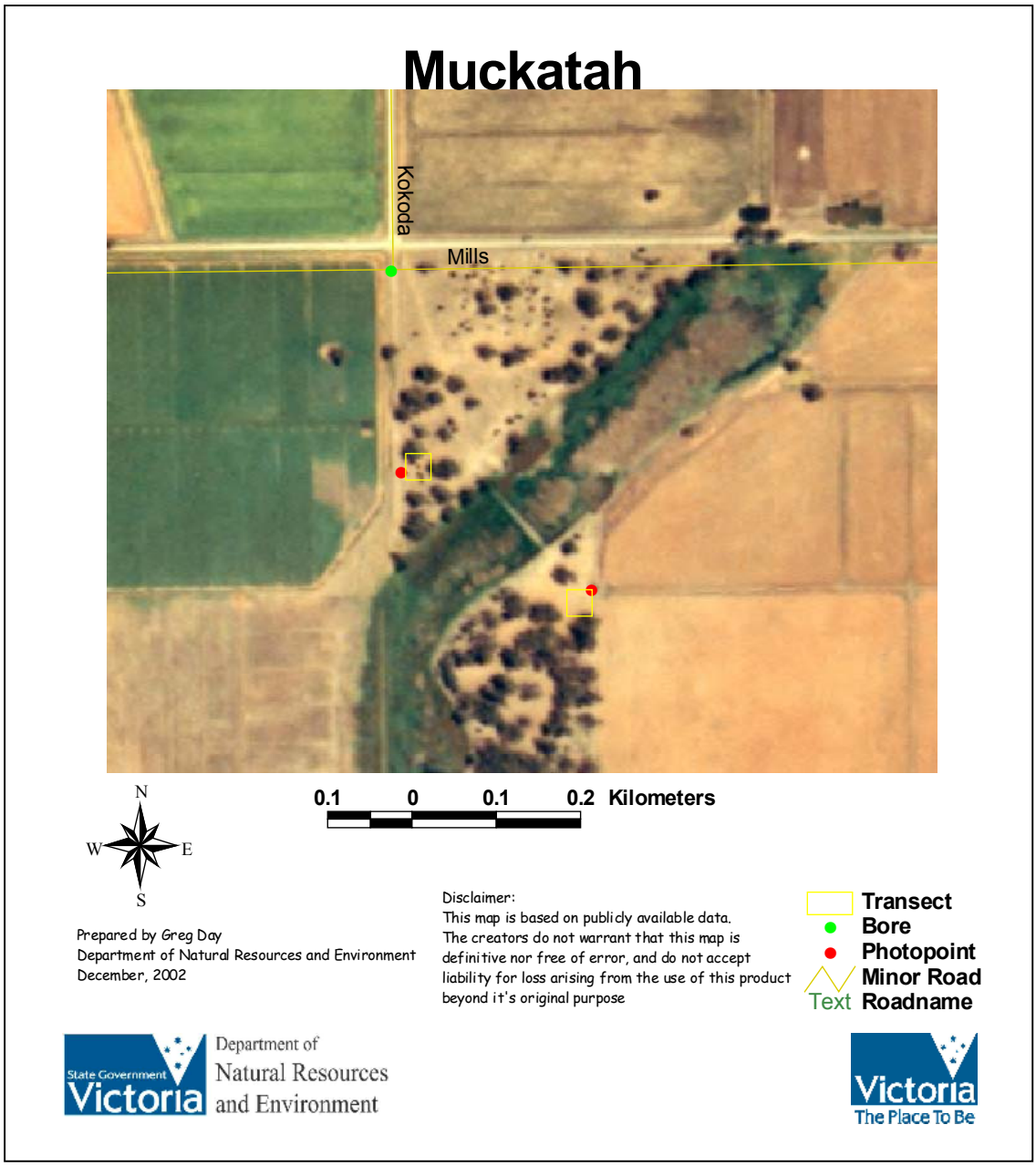
The monitoring sites at the mosquito depression are also slightly spread out, but are generally along either Dunbar road or off Manley road. Mosquito Depression is an area of regional significance. This site is an example of both sand ridge woodland and pine box woodland/ Riverina plains grassy woodland mosaic Ecological Vegetation Classes, which is dominated by Murray pine, grey box, yellow box and white box. A surface drain has been constructed along much of the depression to provide drainage relief and salinity protection for adjacent irrigated farmland and remnant vegetation. Monitoring so far has attempted to assess the success of salinity mitigation works on remnant vegetation adjacent to the depression and drain.

Minchins Depression



Minchins is situated just off the Tatura – Undera Road. This is an area of regional significance, and the monitoring site is located on private land. Ponding of irrigation drainage and saline groundwater has caused the degradation of a large remnant yellow/grey box stand from the plains grassy woodland Ecological Vegetation Class. The construction of a Community Surface Drain, Rodney 2/6P, has aided drainage in this area. Monitoring so far has attempted to assess the success of salinity mitigation works on this patch of remnant vegetation.

Muckatah Depression



This site can be found on Kokoda Road (off Mills rd), north of Numurkah. The Muckatah Depression is an area of national significance. Along the depression are areas of high value remnant vegetation from the plains grassy woodland Ecological Vegetation Class. This particular site is dominated by a grey box overstorey. An arterial surface drain is proposed along much of the depression. Monitoring so far has attempted to assess the success of salinity mitigation works on remnant vegetation adjacent to the depression and drain.

Wetland monitoring

Water Quality

Nutrients

Equipment	- 6 x 250ml acid-washed polypropylene bottles - Waterproof marking pen - Esky and ice

Method

- Collect samples from about half way down the water column in open areas of clear water away from plant matter. NB. It is important not to disturb water before you take samples.
- Fill 2 bottles at each site. (rinse each bottle twice before collecting sample)
- Label bottles with : Date, Time, Location, Site Name.
- Store samples on ice.
- Send to accredited laboratory for analysis overnight.
- When results have been returned from the laboratory, these should be recorded on the appropriate Environmental Monitoring Data sheet.

Salinity

Equipment	- EC meter

Method

- Calibrate instrument with KCl standard before each sample is tested.
- Measure in open water by moving probe of EC meter gently through the water.
- Record salinity reading and temperature

Turbidity

Equipment	- WaterWatch Turbidity Tube

Method

- Measured as Nephelometric Turbidity Units (N.T.U.'s), degree of light scattering.
- Collect sample from area of open water.
- Pour into tube until squiggly lines on bottom can only just be seen (do this in the shade)
- Record number from side

Dissolved Oxygen

Equipment	- Dissolved Oxygen meter (Keith Ward has one available)

Method

- Calibrate meter in air
- Place probe in open water
- Allow to equilibrate
- Record measurement

pH

Equipment	- pH meter (Keith Ward has one available)

Method

- Calibrate pH meter using buffer solutions.
- Measure in open water by gently moving probe through the water.
- Record result on Environmental Monitoring Data sheet.

Temperature

Equipment	- Thermometer

Method

- Measure in open water, about half way down the water column.

Macroinvertebrates

Equipment	- Sweep net with mesh size 200-500um - Sample jars (500ml or 1-2 litre plastic jars with secure lids) - Waterproof labels detailing wetland name, site number, date and collectors name. - Data entry form for recording site conditions. - Ethanol for preserving samples (90% strength). - Sorting tray.

Method

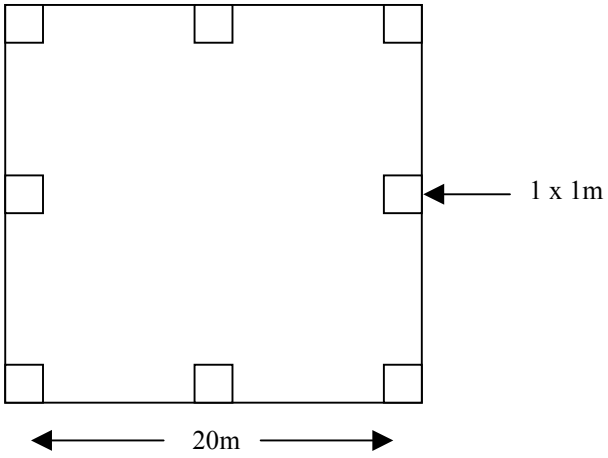
- Check with laboratory for their requirements for sample size, labelling and transport.
- Samples should be collected from the same sites at the same time each year.
- Most macroinvertebrates inhabit areas of diverse shallow water characterised by macrophytes, root masses, logs, leaf litter, and other organic debris. These areas would be most appropriate for permanent macroinvertebrate sampling sites.
- Minimum of five permanent sampling sites chosen randomly within the wetland. See diagrams in the monitoring site information section of this manual.
- Each sampling site should cover an area of approximately 400m^2 (eg 20m x 20m square, or 40m x 10m rectangle etc.)
- Five individual sweep samples, from an area of 1m x 1m (referred to as 'collection points'), are collected from each of the five sampling sites. Make sure that each collection point is free from disturbance from the previous collection point. It is best to work sequentially through the randomly selected collection points so as to minimise disturbance.
- Sweep sampling, using a net, should be conducted for approximately 30 seconds. It is important to keep this standard amount of time as this designates the 'sampling effort' and allows samples to be compared between years and wetlands.
- To collect a sample, sweep the net horizontally through any emergent or submerged organic debris. Sweep backwards and forwards, then sideways, keeping the opening of the net at the front of the sweep. Sample the collection point in two halves, each for 15 seconds.
- If the water level is higher than the height of the net, sweep the top strata first and then the deeper strata. Be careful not to dredge muddy bottoms, sweep about 20cm above.
- The size of the mesh in the sampling net will influence the size of the macroinvertebrates collected. Recommended mesh size is 200-500µm. The net that has been used had a mesh size of 500µm and it is important to keep the mesh size consistent throughout the life of the program.
- The samples from all five collection points should be collected in the same net.
- Remove and discard any large material such as twigs, whole plants etc. and rinse well in a sorting tray full of water.
- Continue to remove and rinse material until the sample will fit into the sample jar.
- Pour the tray full of water, fine organic material and macroinvertebrates back into the net.
- If the sample still contains a large amount of mud, pour water through the net to wash out some of the fines before removing the contents.
- Drain water from the sample by holding the net up and out of the water.
- Mark the outside of the jar with the wetland name, site number, date and collectors name using a permanent felt tip pen and gently empty the sample inside.
- Fill jar with 70% ethanol and secure the lid.
- Forward samples firstly to Paula Ward (See Keith Ward for assistance) for preliminary sorting, then to Phil Papas at Arthur Rylah Institute for species

Macrophytes

Equipment – Tape measure
Species Identification books
Sample bags
Waders

Vegetation at wetland sites should be surveyed when the water level has lowered, water temperature has risen and plants are flowering (usually late spring/early summer: November-December). To ensure consistency, vegetation surveys at each site should be undertaken at approximately the same stage of reproductive development each year (rather than the same calender date). This enables seasonal variations to be taken into consideration when undertaking surveys.

Wetland macrophyte composition and abundance are monitored using square transects of a standard size. The transect size is **20 x 20m**. Eight **1 x 1m** quadrats are located around these square transects (see below).



Photopoints

Equipment - Camera & film
Photo folders

Visual changes in vegetation health are monitored using permanent photopoints at each site. At most sites, a treated pine post will be present to mark the exact location of the photopoint. A few photopoints have unfortunately not had posts positioned to indicate where the point lies. In these cases, the maps in the monitoring site information section of this manual, along with the photos taken at each site previously will assist in locating the photo point. Locating the exact place of the photopoint is perhaps not as important as making sure that the more distant features of each photo match reasonably well with previous photos that have been taken.

Incidental Observations

Any additional comments that can be added about the environment surrounding the monitoring sites is extremely valuable for making sense of trends in monitoring data. For instance, the red gums have been quite badly affected by leaf-skeletoniser insects in recent times, and if this observation is not recorded, it would be difficult to tell from photos alone what the cause of the defoliation might be.

Noting down any potential threatening processes to the monitoring site, plus any sightings of uncommon or rare fauna or flora species in the general vicinity is very useful to note down. An observation logbook has not been used so far and observations are noted on the bottom of data entry sheets usually, but this would be a good idea to employ in the future to keep all observations together to make analysis easier.

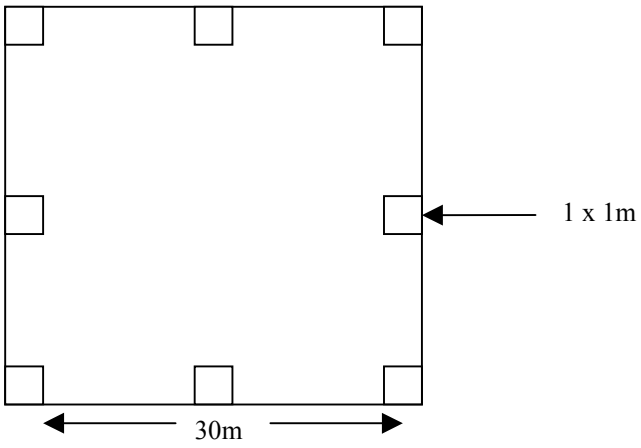
Remnant Vegetation monitoring

Vegetation Surveys

Equipment – 1 x 1m metal quadrat marker
Tape measure
Species Identification books
Sample bags

Vegetation health and changes in community composition are to be monitored at each site. Unfortunately, vegetation health has only been monitored through permanent photopoints, and through some extra qualitative comments added to data sheets. And while these are still very useful, they would be more informative with additional complimentary vegetation health data. A health scoring system for the remnant vegetation sites is one option that is being used in other regions.

Community composition and abundance are monitored using square transects of a standard size. For remnant vegetation sites, the transect size is **30 x 30m**. Eight **1 x 1m** quadrats are located around these square transects (see below).



At most sites, there are two transects. The detailed maps in the Monitoring site information section show approximately where the transects are located and their orientation as yellow squares.

Each quadrat is assessed for presence/absence of species, and then recorded using a percentage cover-rating, with the Braun-Blanquet scale.

Table 4. Modified Braun-Blanquet scale of cover abundance (Kent and Coker 1992).

Symbol	Cover
+	sparsely or very sparsely present, foliage cover less than 5%
1	plentiful, foliage cover less than 5%
2	5 - 25% foliage cover
3	25 - 50% foliage cover
4	50 - 75% foliage cover
5	75 - 100% foliage cover

Both botanical and common names are to be provided. The presence and status of rare or threatened species (VROT and AROT) is to be determined either on site or in the office. Exotic (introduced) species are to be marked with an asterix and salt indicator plants with "S". Salt indicator plants are those plants described by Matters and Bozon (1989) as being salt tolerant.
Extra comments about other obvious changes in vegetation outside of the quadrats are often very useful as the quadrats may not necessarily pick up some important changes in vegetation that simple observation of the general area can detect, especially with regards to weed infestations (see incidental observations below also).

Photopoints

Equipment - Camera & film
Photo folders

Visual changes in vegetation health are monitored using permanent photopoints at each site. At most sites, a treated pine post will be present to mark the exact location of the photopoint. A few photopoints have unfortunately not had posts positioned to indicate where the point lies. In these cases, the maps in the monitoring site information section of this manual, along with the photos taken at each site previously will assist in locating the photo point. Locating the exact place of the photopoint is perhaps not as important as making sure that the more distant features of each photo match reasonably well with previous photos that have been taken.

Incidental Observations

Any additional comments that can be added about the environment surrounding the monitoring sites is extremely valuable for making sense of trends in monitoring data. For instance, the red gums have been quite badly affected by leaf-skeletoniser insects in recent

times, and if this observation is not recorded, it would be difficult to tell from photos alone what the cause of the defoliation might be.
Noting down any potential threatening processes to the monitoring site, plus any sightings of uncommon or rare fauna or flora species in the general vicinity is very useful to note down. An observation logbook has not been used so far and observations are noted on the bottom of data entry sheets usually, but this would be a good idea to employ in the future to keep all observations together to make analysis easier.

Groundwater monitoring

Equipment -	Fox whistle Water collecting tube Bucket EC meter

The groundwater bores with the closest proximity to the monitoring sites were selected for mandatory monitoring. Details shown in table below and on the maps in monitoring site information section of this manual.

Table 5. Bore numbers at each location

Monitoring location	**Bore ID number**
Gaynors Swamp	4908
Kinnairds Swamp	No bore monitored
Reedy Swamp	No bore monitored
Timmering Depression	4857
	4858
Mosquito Depression	3382
Minchins Depression	Fenceline (no number)
	Driveway (no number)
Muckatah Depression	1033

To date, the bores in the table above have been measured on each monitoring run, however there are gaps in the data collected as some of the shallow bores have dried out, and there are some erroneous errors with miss-read EC values. The methodology used so far involved first using the fox whistle to measure the depth to the groundwater. The fox whistle is lowered into the bore until it hits the groundwater, and will give a characteristic whistle as it is gently moved up and down in the zone where it just touches the water. The depth can then be read from the measuring tape (depth is not read to the top of the pipe protruding from the ground but from the actual level of the ground surface).

The water collecting tube is then used to extract some water from the bore into the bucket so that the EC level can be measured with the EC meter. The newest EC meters correct the reading automatically to give the result in either mS/cm or µS/cm at the standard temperature of 25˚C (temperature differences can affect EC readings quite substantially). When reading the EC level off the meter, utmost care should be taken to observe whether the reading is given in mS/cm or µS/cm. The difference between the two is a factor of 1000 (ie 1 mS/cm = 1000 µS/cm). EC units are always given in µS/cm, so if an EC meter reading is given in mS/cm, it must be multiplied by 1000 to give the reading in EC. Some of the new meters are not able to measure very high EC levels, which is a problem when reading the bore at Gaynors swamp because it is usually slightly greater than 20000 EC (and this value is too high for the newer meters to register).

Because the bore data collected since monitoring began has a number of large gaps in some cases, and occasional data entry errors that are quite obvious and wildly incorrect (and impossible to check/correct). An investigation discovered that bore information from these bores has also been collected regularly by Sinclair Knight Mertz and stored on the statewide groundwater monitoring database, and provision can be made to obtain these bore reading from them. A comparison of the two data sets indicated that the SKM data was much better quality, and even extends a lot further back in time than data collected by mandatory monitoring. The only bores that they could not supply data for was the ones at Minchins depression which were installed specifically for the Mandatory monitoring project and aren't included on the statewide database. For the ones that are collected regularly by SKM, provision should be made to obtain this data in the future.

Data entry

Yet to be determined

Data analysis

See Monitoring Report

Reporting

See Monitoring Report