Control of Rising Groundwater and Salinity in the Koojan Gillingarra Region

Final Report

Compiled by Bronwyn Fox – Project Manager

Project Funded and supported by:

nacc managing natural resources in WA's Mid West

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Background

Control of Rising Groundwater & Salinity in the Koojan Gillingarra Region was first approved for works in 2006 through the Northern Agricultural Catchments Council. An original budget of $237,500 was approved to carry out on ground works, planning and monitoring and evaluation to assist in mitigation of the rising groundwater levels in the Koojan Gillingarra Region just south of Moora (see Figure 1).

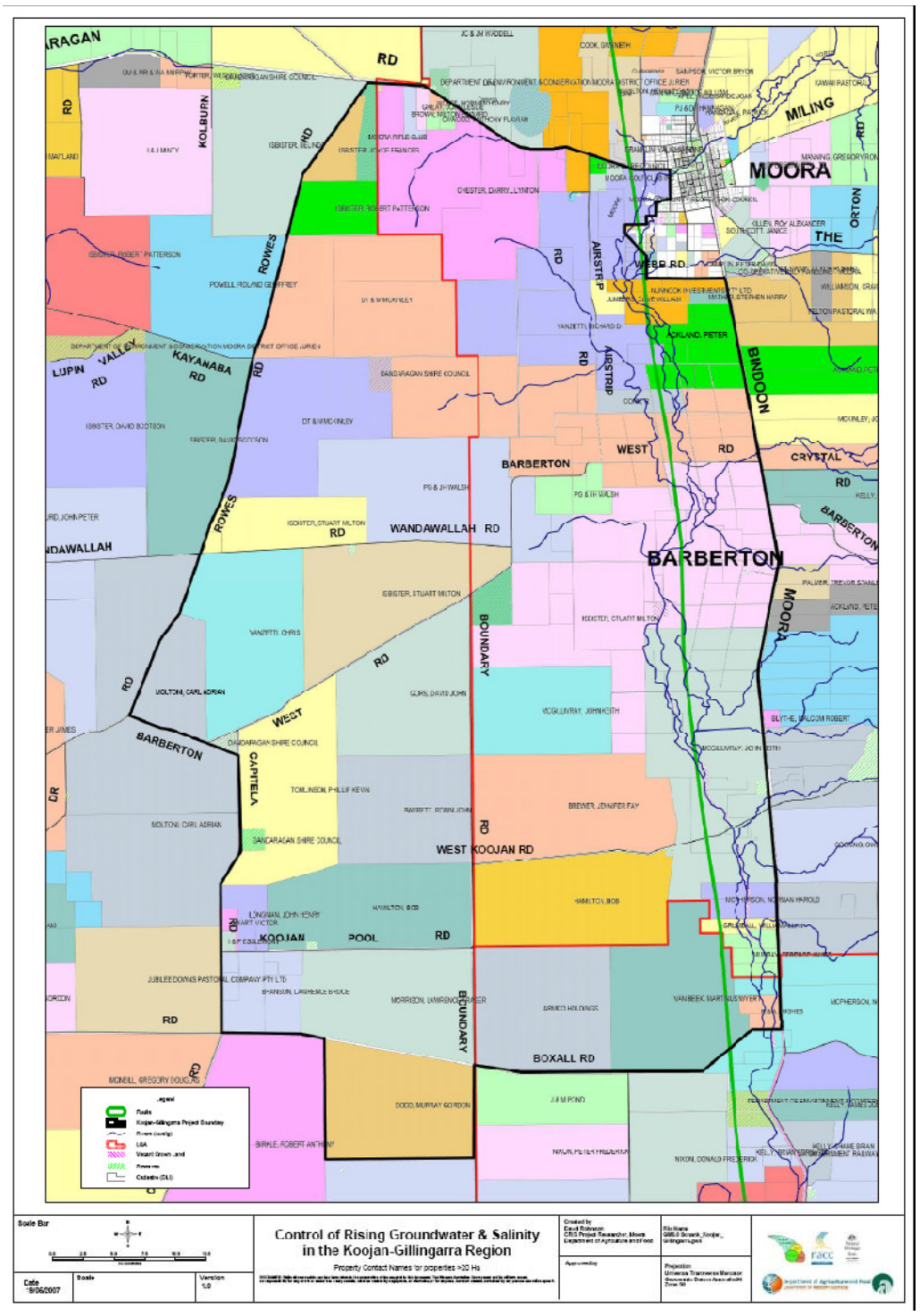


Figure 1 – Project Area: Control of Rising Groundwater & Salinity in the Koojan Gillingarra Region

The project was borne out of concern from local residents with water rising in previously productive landscapes and impacting production on those farms. The most notable example

is the Isbister's property on Wandawallah Road where approximately 24ha has become known to the local community as "Wandawallah Lake" (Figure 2).

Figure 2 – Wandawallah Lake, photo taken 25th Jan 2008

Since the project commenced another area has become inundated with water just to the North of the Koojan West Road at the Brewer property. This lake is now referred to as "Koojan West Lake"

Figure 3 – Koojan West Lake, photo taken 21st September 2007

Project Steering Committee

To guide the project and assist the project manager with advice and guidance, a steering committee was established with the following members.

- Project Manager – Bronwyn Fox
- Landowner – John Longman
- LCDC Representative – Bill Lullfitz
- NACC Representative – Christel Schrank

The steering committee must be thanked for their commitment and support that they provided to assist the direction of the project, they were always available for consultation and ensured the project achieved all milestones as outlined in the contract with NACC.

Project Activities

Local Area Plan

In the initial stages it was identified that the area needed some planning to assess the best way forward to try and mitigate the water rising. A "Local Area Plan" was decided as the best planning strategy and a call for tenders was carried out in mid 2007. Viv Read & Associates was the preferred tender for collating a Local Area Plan for the Moore Catchment Council.

Viv visited the region on numerous occasions, working with the steering committee, project managers and landowners to ensure the local area plan was suitable for the desired outcomes. 2 field days were held where Viv Read presented and collected information relevant to the Local Area Plan.

The first field day was held on 7th February 2008, this event attracted hydrologists from Department of Water, Department of Agriculture & Food, Department Managers, Steering Committee Members and various Project Managers from around the region, see figure 4. The aim of this field day was to discuss the technical reasons for the rising groundwater in the region and to assist Viv Read in the collation of this data for use in the Local Area Plan. A meeting summary is attached in Appendix A.

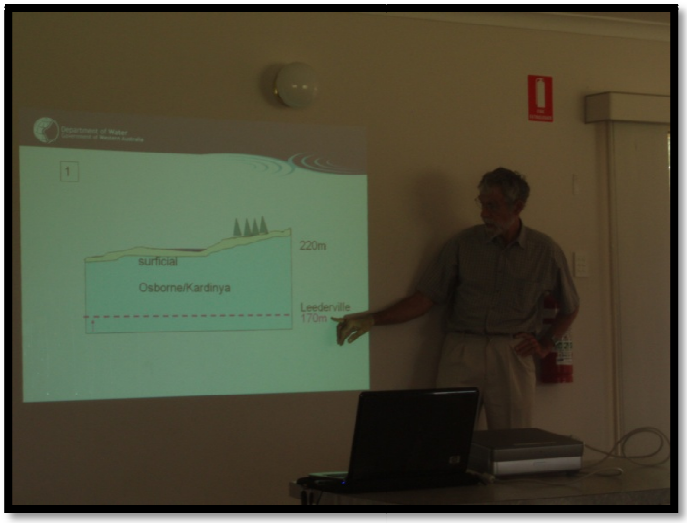


Figure 4 – Phil Commander, DoW presenting information about Wandawallah Lake 7th Feb 2008

A second field day was held on the 8th February 2008 to inform farmers of the technical results of the previous day and to discuss how land managers want to manage the issues into the future and how willing they were to adopt possible ideas to minimise the impact of rising groundwater.

Viv visited the area again during the period between February and delivery of the Local Area Plan on 30th June 2008, primarily to ground truth the region and assess impacts in areas that are affected by rising groundwater and to discuss with farmers their observations of the groundwater issues over time.

On the 25th July 2008, Viv presented his Local Area Plan to a small roll up of farmers, NACC representatives and Steering Committee at the Gillingarra Hall. Viv explained what he had found during his investigation into the area and outlined what he considered was the best way forward for the landowners in the project area to minimise the impact of groundwater on their production. Attached to this document is a copy of the "Local Area Plan for the Control of Rising Groundwater and Salinity in the Koojan-Gillingarra Region".

Bore Monitoring

An integral part of this project was the ongoing monitoring of ten bores drilled across the project area at the beginning of the project. Figure 5 indicates the location of various bores.

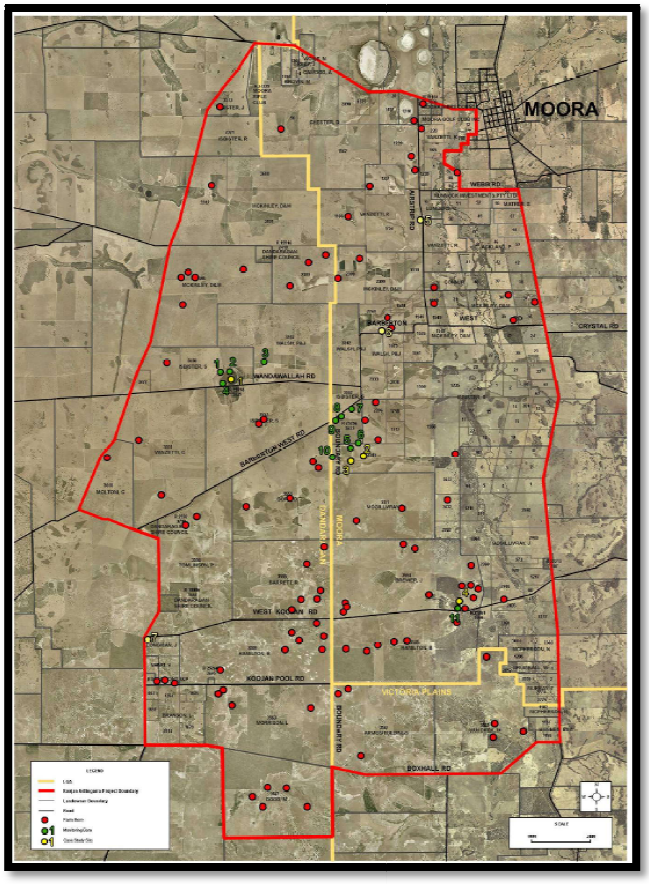


Figure 5 – location of bores in project area

Incentives Offered

Perennial Pasture Establishment

Perennial Pastures were considered to be an integral method to replace cleared woody perennial species with alternative perennial plants that also allow productivity to be maintained on farm. Tagasaste, lucerne, saltbush as well as various perennial pasture species were eligible for funding and the rates for incentive payments are detailed below:

- $1,500/km for fencing ($500/km for electric fencing)
- $85/ha for the establishment of perennial pastures
- Minimum establishment 20ha and maximum establishment 80ha per year.

Successful establishment was rewarded if more than 8 plants per square metre were recorded 3 months post sowing.

Farm Forestry

Farm Forestry was offered to replace the cleared land with woody perennials to increase the uptake of groundwater. Various species were included for this incentive including *Eucalyptus maculata* (Spotted Gum), *Eucalyptus cladocalyx* (Sugar Gum), *Santalum spicatum* (Sandalwood) and *Eucalyptus loxophleba* (Oil Mallees). The rates available for these species are detailed below:

- Eucalypts for sawlogs $600/ha
- Oil Mallee $1,050/ha
- Sandalwood $800/ha
- Weed control $120/ha
- Minimum 10ha establishment

Successful establishment was considered if there was more than 80% survival rate of species or in the case of sandalwood of host species.

Surface Water Management

Surface water management was offered to assist with the moving of stagnant water to minimise the impact of evaporation in causing salt scalds in the landscape. A rate of $800/km was offered to farmers who were having issues with such areas. Farmers who were interested in this incentive were visited with a drainage specialist from DAFWA to assess their eligibility to carry out surface water management on their farm. Two farmers expressed interest in this incentive but none followed through with on ground works.

Native Vegetation Management

The management of native vegetation to ensure ongoing use of groundwater was an important aspect of the project. Incentives were offered for farmers to revegetate or enhance already existing native vegetation within the project area. The details of the incentives are outlined below.

- $3,500/km for areas 20-50ha
- $4,000/km for areas over 50ha
- Revegetation $700/ha
- Enhancing $1,500/ha
- Weed control $100/ha/year were required for 5 years
- Pest control $20/km per year where required for 5 years
- Minimum site 20ha, minimum width 30m, minimum site assessment score of fair or better

Some farmers expressed an interest in this incentive but none followed through with on ground works.

Saline Land Management

This incentive was offered to provide farmers with the opportunity to minimise the spread of saline areas on farmland. One farmer was very interested in this and a management plan was developed but unfortunately due to illness was unable to complete the works required.

- Fencing $2,000/km
- $85/ha for establishment of salt tolerant perennial pastures
- $500/ha buffer of trees and shrubs

Strategic Revegetation

This is a very important incentive in relation to the project area particularly for wind breaks, sand blowouts and break of slope plantings, there wasn't a lot of interest shown in this incentive from landowners and the guidelines for this incentive were very under developed and as such no farmers were involved in this type of on ground works.

This type of incentive is important to include in future works in the project area as it targets strategic issues which are identified in the local area plan as important.

Monitoring and Evaluation

Monitoring and Evaluation were a large part of the day to day activities during this project. Bores were established in December 2006 and were monitored from March 2007 until the end of the project in November 2008.

The bores were monitored at 6 weekly intervals using monitoring equipment owned by the Moore Catchment Council. The project manager passed on the skills to continue monitoring past the end of the project to the local Natural Resource Management Officers to ensure the monitoring is ongoing.

From the bore results figure 6 shows the depth to water in the various monitoring bores. Figure 5 shows the location of the monitoring bores that are monitored in figure 6. Figure 7 shows the electrical conductivity of the water at each of the monitoring sites, this includes all of the bores as well as the Wandawallah and Koojan West Lakes.

From the graphed results in Figures 6 and 7 we can see that the depth to water is fairly constant with seasonal fluctuations evident. Further data analysis is required to determine of there is any further statistically relevant conclusions that can be drawn from the data but to the naked eye it appears that the depth to water is remaining constant.

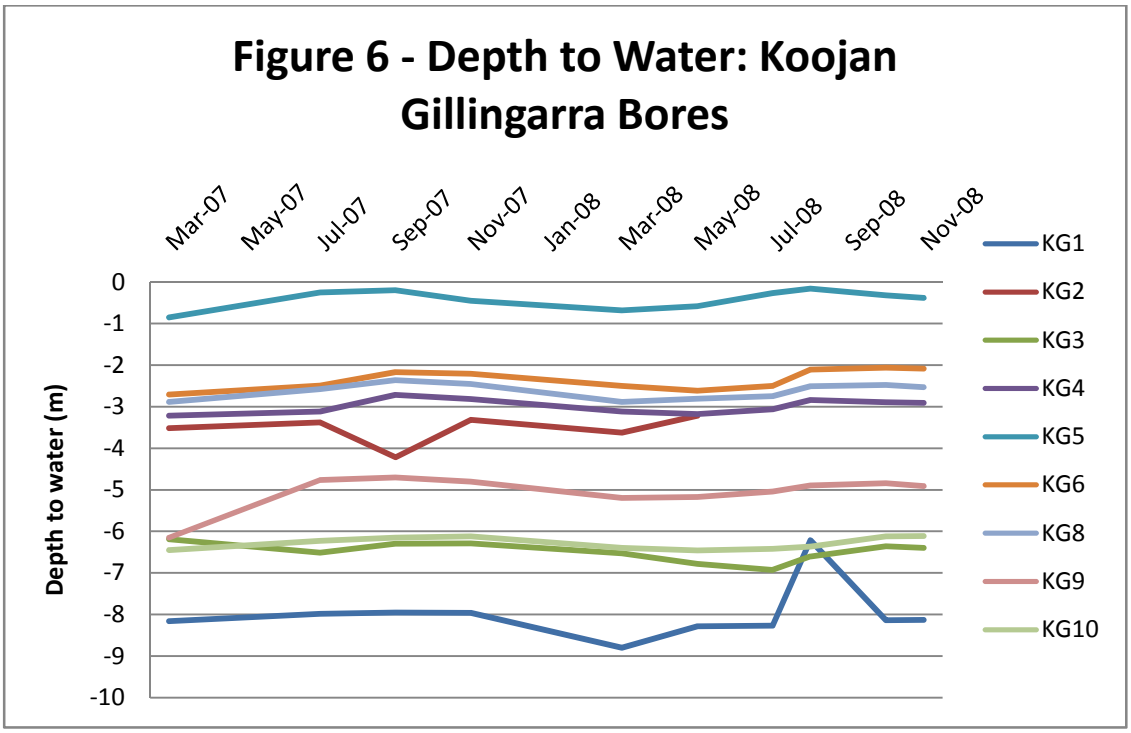
It is important to continue to monitor these bores to provide the relevant organisations with ongoing data over a long time period. It appears however that the bores are not rising as is the general understanding of landowners in the region. This may be due to the last 3 seasons being drier than usual or it may be that the water is finding equilibrium at this level. As mentioned before monitoring over a longer period is required to draw any real and relevant conclusions and the use of further statistical analysis is also important.

Figure 6 outlines the depth to water of each bore over time. KG5 is the closes to the surface. This is no surprise as at the site there are dead pine trees in a low lying area and salt crystal can be seen on the surface as well as water lying on the surface after rain events.

There is an anomaly in the results for bore KG1 in around August 2008. This bore has returned different sounds when the monitoring equipment has been put down during

monitoring, it sounds as though the water is slushy and may indicate that there has been some sand interaction with the water table. The results for this bore are not considered consistent because of this noise and the drilling contractor will come back to assess the bores in 2009 and fix any errors that may be present if possible.

KG2 also indicates an anomaly in September 2007, by May 2008 the bore was not able to be monitored anymore as there was some plant material in the bottom of the bore. This again will be assessed by the drilling contractor in 2009.

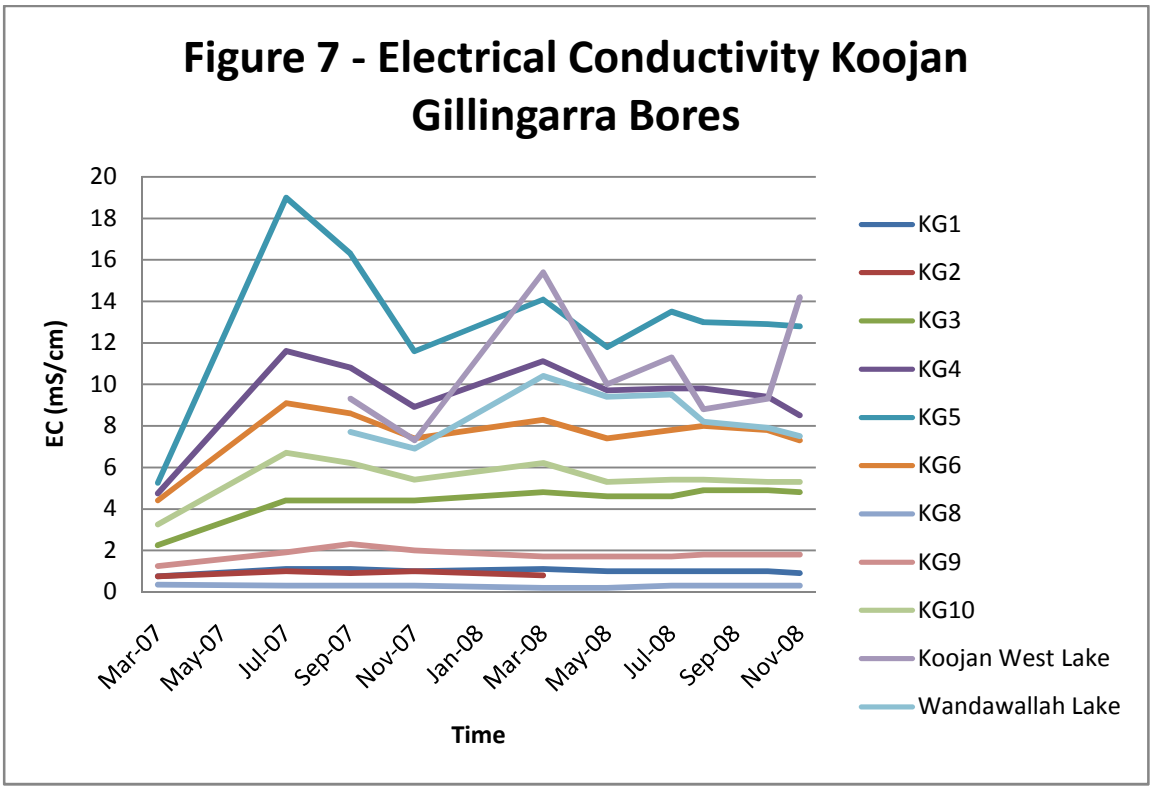


Three new bores were installed as part of this project across the southern half of the project area, the details of the drilling can be found in an accompanying document that has been developed by Russel Speed, Adele Kendle and Bill Gibbon from the Department of Agriculture and Food in Geraldton entitled “Capitela Valley Drilling Report”. Further drilling was carried out across transect near Wandawallah Lake, the results of which can be seen in the attached document “Summary of the Resource Condition Monitoring drilling in the Northern Perth Basin”.

The electrical conductivity (EC) results in figure 7 indicate the amount of salt content in the water under the surface. As expected the results from the 2 lakes monitored are more variable than most of the bore readings due to the impact of evaporation from the water being at the surface.

KG8, KG9 and KG10 are located within a nature reserve on the corner of Boundary Road and Barberton West Road, these bores indicate very low EC as expected indicating that under the native bush the results are less variable.

KG1, KG2, KG3 and KG4 are located around Wandawallah Lake, KG1-3 all have relatively low EC results as well as consistent readings. KG4 has a much more variable reading level, Phil Commnader from DoW presented on the 7th February that his department believes that Wandawallah Lake is a flow through lake, flowing from North East to South West and as such KG4 will reflect the movement of the lake water. This appears to be the case in looking at the data in figure 7, but as mentioned previously more monitoring of these bores over a longer period of time is required before any real conclusions can be drawn.



Photos

Following are a series of photos that have been taken during the project period.

Biodiversity

Drilling

Monitoring

Koojan West Lake

September 2007 March 2008

Pine plantation with dead pines in background, near KG5 bore.

Future project ideas

Coordinated Rabbit baiting program

Rabbits have been raised as a serious production impact in the project area. Some coordinated rabbit baiting is required with cooperation from Shires and the impact of rabbits nesting in the road verges must be addressed.

Bore monitoring

As identified throughout this report ongoing monitoring is crucial in the gathering of clear and concise data over long periods of time, the data collected during this project has been good but it needs to continue on an ongoing basis.

Photo monitoring

Photo monitoring has been carried out at the same time as bore monitoring, this should also continue for historical reference into the future.

Floodplain Geophysical Survey

The Local Area Plan identified that a floodplain geophysical survey would be useful for identifying the groundwater resource along the Moore River floodplain. Paul Findlater from

DAFWA Geraldton would be a useful contact for this type of work to be carried out as he has expressed interest in it happening and may have further contacts for the project to go ahead.

Water Management Demonstration Program

The Local Area Plan identified the need for a demonstration program over the coming 5 year period where demonstrations are established to assess the best methods for managing water in the project area, both at the surface and groundwater resource. Below are some ideas from the Local Area Plan about how to implement these as a coordinated program.

Demonstration A – Integrated Surface Water Control

Surface water is a high risk issue as it sits at the surface and can cause salinity due to the evaporation. This can be managed by establishing some well developed and researched sites that need surface water management to minimise the impact of salinity

Demonstration B – Groundwater Pumping and Siphons

Pumping groundwater and using siphons to move water to other areas such as the Moore River are possible options for demonstration program. Groundwater pumping may help to assist in mitigating the groundwater rise but it may be costly, as such a clear economic analysis would need to be carried out as part of any demonstration such as siphons and pumping.

Demonstration C – Spillway Sand Revegetation

In the Local Area Plan the spillway sands were identified as an area of high recharge for the project area, this is significant and revegetation of these area may help to assist with the minimisation of the groundwater resource rising.

Demonstration D – "Break of Slope" revegetation

Break of slope revegetation was also an area identified in the Local Area Plan as a high recharge zone and as such revegetating this was considered high priority. Some demonstration areas can be developed and with ongoing groundwater monitoring the impact can be assessed.

Demonstration E – Hill crest vegetation rehabilitation

The top of hills within the project area were identified as an area of particular interest, it was considered that these were high groundwater recharge areas as well and as such some rehabilitation and fencing of these areas is required as a demonstration site.

Demonstration F – long rotation saw log plantations

The project area has many long term pine plantations located within it. These are seen as a good thing by the Local Area Plan developer and the economics and environmental returns for such long rotation crops need to be quantified as well as the identification of optimal sowing rates, alternative crops to pine and other relevant information will also be developed as part of this program.

Finally

The project manager Bronwyn Fox would like to thank all involved with this project including:

- The Moore Catchment Council staff and volunteers
- Viv Read
- Russel Speed and the rest of the crew at the DAFWA Geraldton Office
- Project Steering Committee – John Longman, Bill Lullfitz and Christel Schrank

- NACC – including all staff and volunteers who have been involved or assisted with the project.

Appendices

Appendix A

Summary of Groundwater Workshop – Moora 7th February 2008

John Longman gave an initial summary of the past

- Area cleared in the early 60's and 70's
- Rising groundwater was first noticed late 80's and early 90's
- Bores observed to be rising at 0.5m per year
- Lupin Valley was observed to have risen 5m in 18 months in the early 90's
- Observed soil types are gravel on hill tops – sandy slopes – sand over clay valley floors
- Wandawallah Lake is a claypan swamp around 1993 permanent water appeared there
- 1998 meetings were held with Department of Water in Moora about the issue, from this Tanya Kay was engaged to do a PhD study in the area to investigate the rising groundwater.
- Now – Roland Powell's series of lakes have dried up, Wandawallah Lake is still there and Brewer's Lake has appeared 3 years ago

Phil Commander from Department of Water then presented his research into the 4 chosen sites, below are the diagrams presented on the 7th February 2008. Of the 4 sites, 2 and 3 were grouped together as it was believed that they were experiencing the same issues

SITE 1 – WANDAWALLAH LAKE

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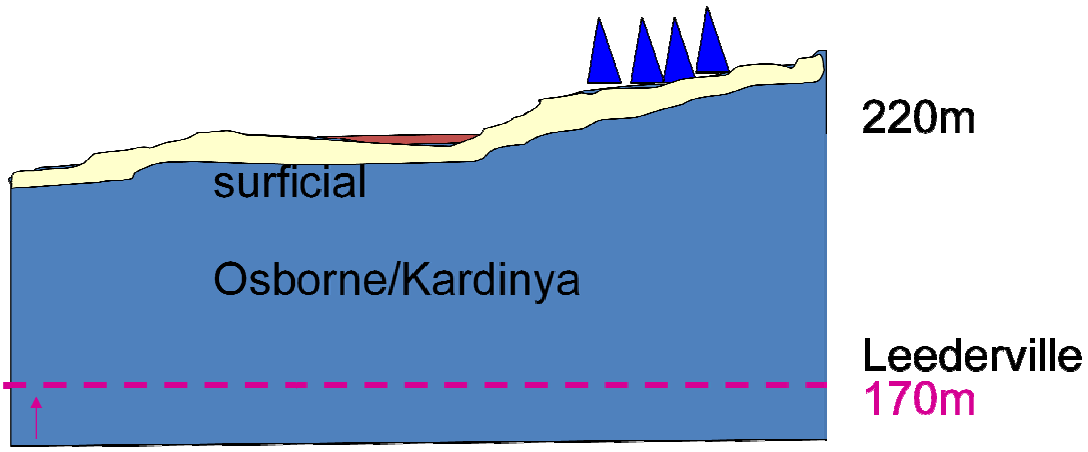
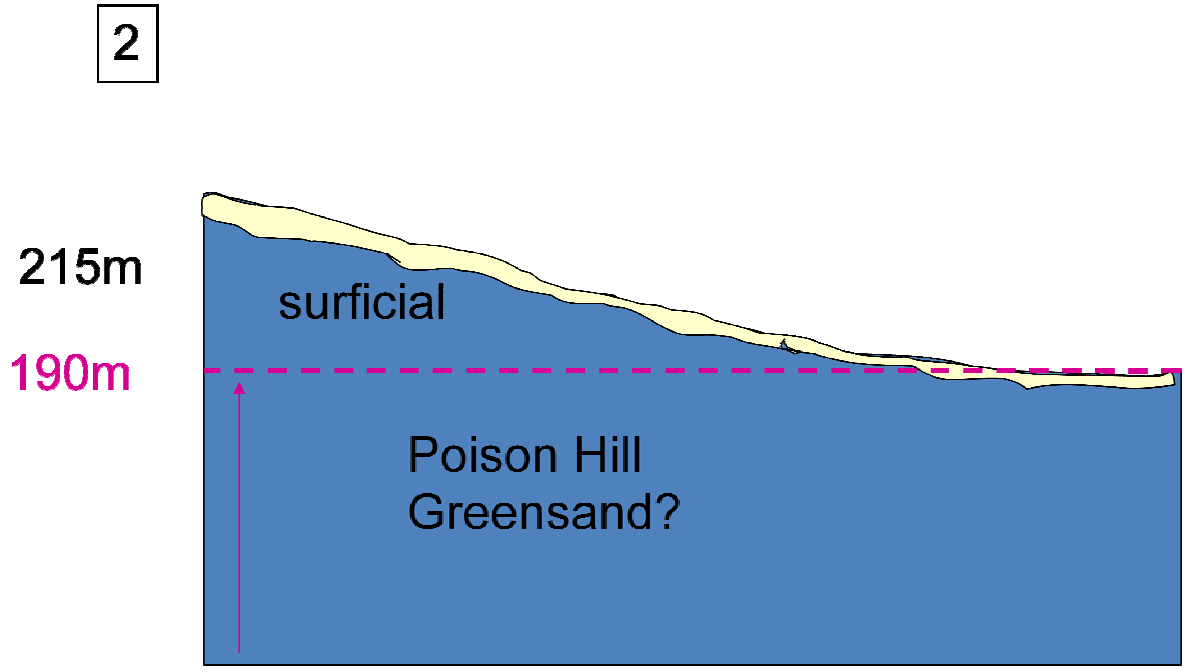


- Phil mentioned that this site is related to the Barberton section in Tanya Kay's PhD report
- There is a lack of bore data in the entire region from Department of Water bores because their lines transect along the Dandaragan-Moora Road and west of Mogumber so there is a big gap of information and understanding of groundwater in this area.

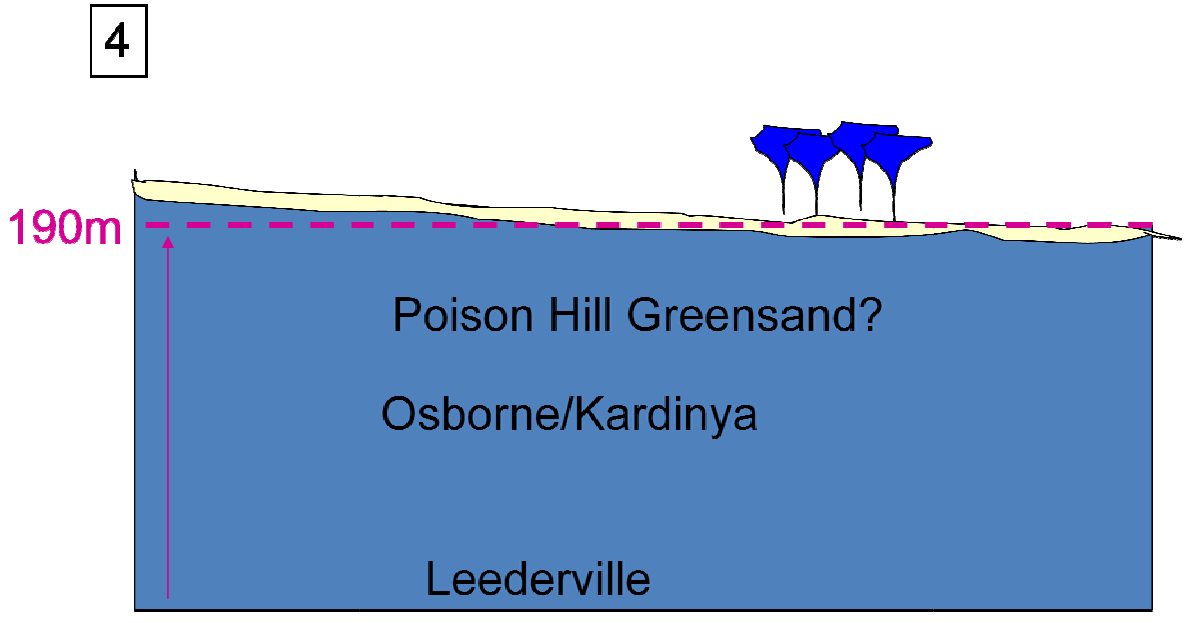
- Phil mentioned that in the Wandawallah situation that the amount of pines planted in the catchment for the lake area is not enough to use up all of the water in the underground catchment area and therefore has not reached equilibrium yet

SITE 2 and 3 – REMNANT VEGETATION AND PINE PLANTATION



- Site 2 and 3 was explained by Phil as being water ponding in an area where water has never been seen before.
- Phil believes it is not related to groundwater rise but runoff at the surface that is building up and not freely draining away

SITE 4 – BREWER'S LAKE

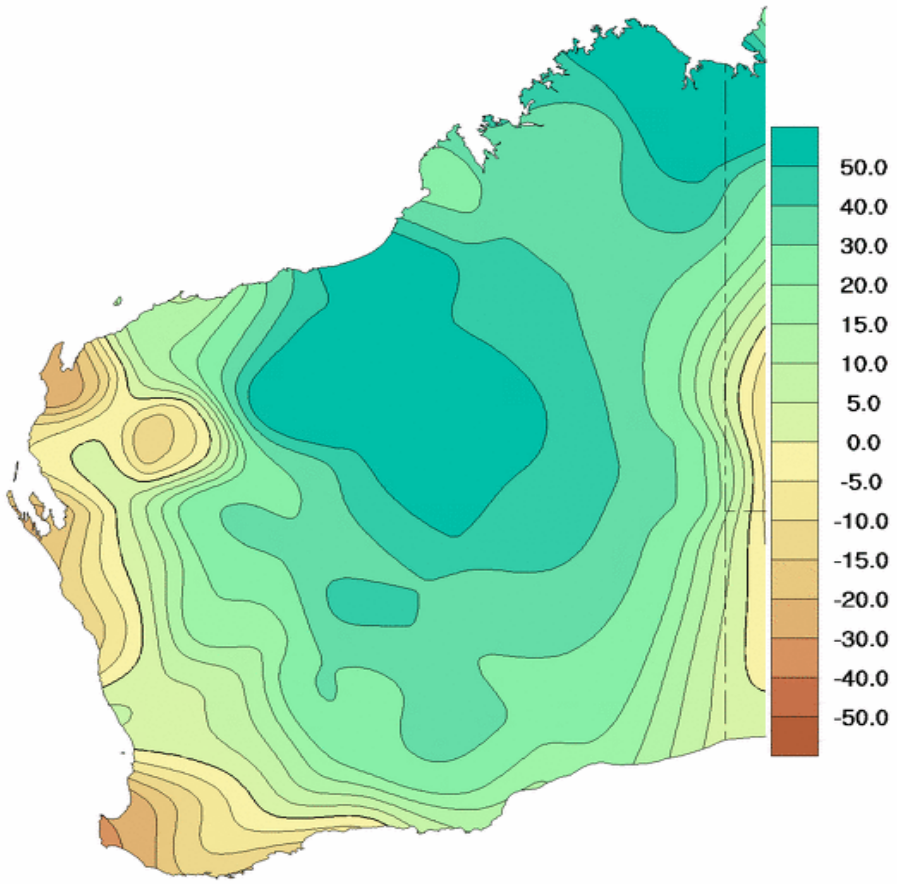


- Site 4 was a little more complex than the other sites
- Unusual to have Wandoos in this area
- Believed to be a clay deposit which indicates that it used to be a lake in past history
- There is no potential for downward drainage in this area because of the height of the Leederville aquifer in this location (i.e. near the surface)
- This site is a potential site where leakage from the Leederville aquifer is possible but not sure if it is being fed by surface or groundwater.
- There are highly erodible soils higher in the catchment area

General Feedback on climate and Leederville Aquifer trends by Phil Commander

- There has been no change in amount of rainfall over the past 40 years, this is supported by evidence from the Bureau of Meteorology and Department of Water rainfall figures
- Leederville aquifer is rising at ~ 0.3m/yr from their bore observations across WA
- The Leederville aquifer may be reaching equilibrium at the moment, aquifers generally take ~ 40 years to reach equilibrium after clearing.
- The faults that occur randomly in the project area do affect the Leederville and Parmelia aquifers but they don't affect at the surface because of the large amount of weathered material overlaying the groundwater aquifers
- Below are some diagrams presented about rainfall and climate.

Trend in Annual Total Rainfall 1970-2007 (mm/10yrs)



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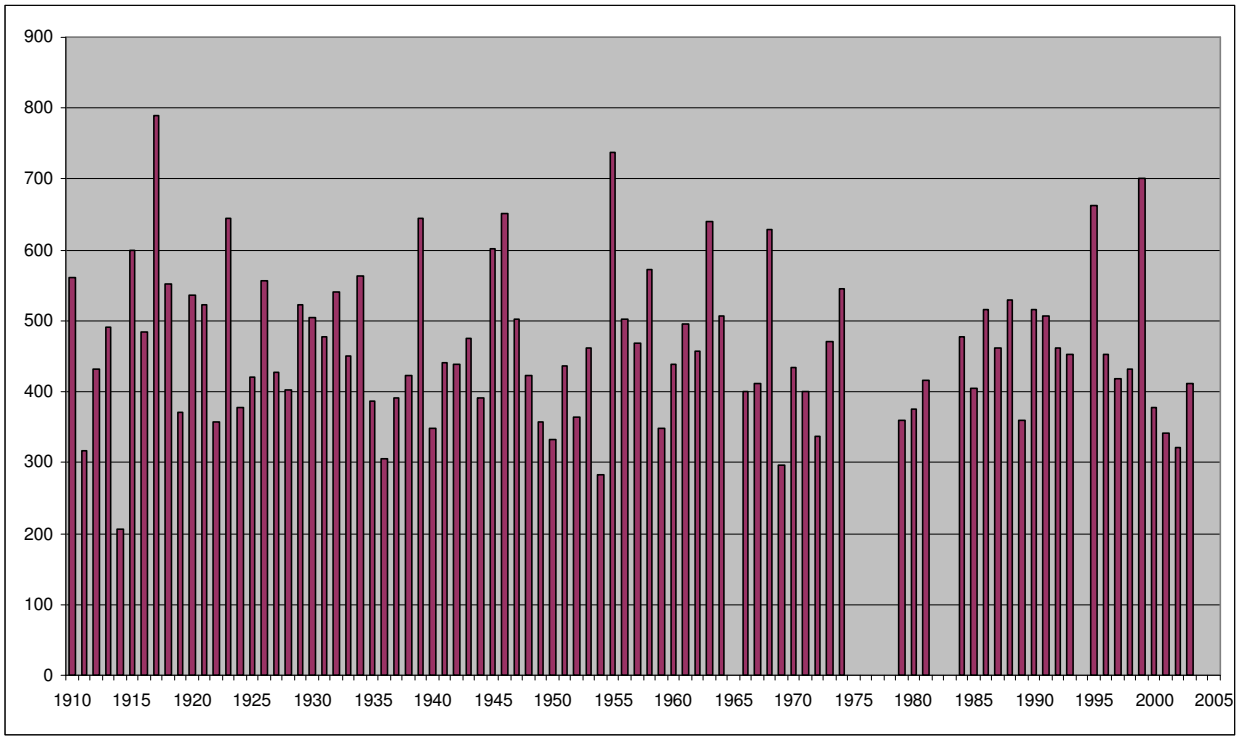

Annual Rainfall Moora – source Department of Water

Comments from Russel Speed, hydrologist at the Department of Agriculture, Geraldton about the project area

- Russel began by explaining about Roland Powell's property where there is a large mix of species where his lakes are located. The area has many different types of species in one place, as the groundwater rises this biodiversity is being lost as some species die out and other survive.
- There have been changes in vegetation over the last 5 years in this area due to the changes in the groundwater regime
- Russel explained about some of the observations he has made with the drilling that has been carried out around this area and the groundwater rise that has been observes. The deeper piezometers have flattened since 2005 in observations and previous to this time there was a rising trend.
- Russel also suggested that rising groundwater in neighbouring catchments could be related with through geology but different perched aquifers
- From Russel's groundwater observations zone 222 in the soil zone mapping was the only zone that exhibited consistently rising trends of groundwater
- 4 holes will be drilled across the project area in conjunction with Forest Products Commission (FPC) which will give some insight into the geology of the area and maybe provide more answers to the questions about why the groundwater is rising

Scenario discussions

Scenario 1 – Yarra Yarra Paleochannel drainage impacting Koojan Gillingarra area

- Not related except maybe at site 4 – more related to cycle of flooding in Moore River not the issues that we are seeing in project area
- Paleochannel is there and does exist but it is full and it can't get fuller than full
- Difference in water quality between Dandy and Koojan Gillingarra area can't be explained if this scenario is in fact correct, therefore it is not likely to be impacting the project area

Scenario 2 – Delayed affect of 1999 Moora Floods

- Not affecting this area, agreed by all attendees

Scenario 3 –Leederville Aquifer Discharge

- It is not likely that this is the cause of the groundwater appearing at the surface in most of the cases except maybe in Site 4 – Brewer's Lake, where it is thought that it may be a combination of Leederville Aquifer and surface water discharge

Scenario 4 – Surficial Aquifer Rise

- This is most likely to be the cause of the majority of the groundwater rise issues in the project area
- Porous soils enable higher movement rates through the soil and therefore it is happening quicker than in the eastern wheatbelt areas

MANAGEMENT OPTIONS

Each project manager /officer from projects in the similar area were asked to provide feedback about what sort of things the farmers and land managers in their project area would like to get involved in if we were

Farming Systems Project – Jill Wilson

- No farmers thing that they have a rising groundwater problem, rather the issue creates opportunities for them
- There is a lot of interest in perennial pastures because there are some good examples where people have already established good areas
- Farmers generally have no confidence in the hydrology and how it works, hard to understand
- Need a hydrologist to give one on one advice on farm about the groundwater issues and how they are affecting each farm adn best management options for this
- Adoption of new technology is driven by the production gains that can be achieved from implementation
- Farmers need good information and something in it for them to get involved in on ground works to manage groundwater rise

- Generally unwilling to plant woody perennial even tagasaste because of management and loss of land from production

Koojan Gillingarra CDI – Mark Weston

- Explained that farmers need runs on the board to implement new ideas, similar to farmers in Farming System project area
- There are limitations to adoption through lack of education
- Mike Clarke's project to give one on one advice to farmers in relation to managing salinity was very well received particularly with sceptical farmers
- Extra effort should be given where there is a willingness (on the farmers behalf) to change and try new things
- Once the momentum builds within the group willingness to change increase as well.

Targeted Investment Program – Christel Schrank

- Support farmers who are already planning something on their farm
- 62 agreements have been signed since September 2007
- The project in the future is looking to employ a speacialist for each incetive offered, i.e. surface water specialist, perennial pasture specialist, biodiversity specialist etc.

Revegetation of Creeklines in the East Moore Catchment – Lana Kelly

Lana got feedback from farmers asking "What are farmers in East Moore willing to do to combat rising groundwater?"

Farmer 1.

- Has been actively involved in landcare. Tree's, Saltbush (I think),
- "There is more remnant vegetation he could fence off'
- "It would depend on the size of the groundwater surfacing as to whether he would take action. If he was going to lose really good cropping land to trees or other works he would not want that."
- "Has done surface water drainage. Deep drainage so expensive and you don't get any money back. Would consider more deep drainage if cost was not so much of an issue."

Farmer 2.

- This farmer's uncle and father did a lot of deep drainage 20 years ago. Mostly redefining the creeks and other patches of concern. Due to this he feels they don't really have much of a problem with rising groundwater on their property at present.
- "If big issue arose then deep drainage would be first consideration then tree plantings. Also well aware of the benefits of Lucerne and Perennials, Tagasaste."

Farmer 3.

- Peter Kelly's Comments- at present is definitely not happy to replace front cropping paddock with trees.
- Reasons…
    - *"Thinks trees are too much work especially long term. If you are trying to drove stock and much more of a fire risk."*
    - *"If you are harvesting trees you end up with 1000's of stumps. You're left with ugly, unusable land that is a hazard for vehicles."*
    - *"Is relying on lease income from the paddock versus nil income while trees grow."*

    - *“He and his whole family spent a lot of time clearing the paddock of trees 40 years ago and it was a lot of sweat and hard work.”*
- Peter does believe if the paddock was planted with trees it would definitely help with the waterlogging and the salinity in the valley below. Also realises there are options to reduce fire hazard such as block plantings.

Farmer 4

- Farmer 4 has been actively involved in land care for many years and has already fenced off most of the creek line running through his property and the remnant vegetation.
- “Thinks clearing trees is the main reason for the rising groundwater.
- “There is too much money spent on experts and not enough $ on the gound.”
- “Where I used drainage on the farm 2 out if 4 sites had dolerite dykes going across the natural drainage lines. The drains broke them up and let the water flow through.”

Some discussion was had as a group about management options and how effective these measures would be, see attached document for a full summary