SoilFutures Consulting Pty Ltd

Review of Watermark Coal Project Environmental Impact Statement.

Soils, Rehabilitation Planning and Salinity

Prepared for
SOS Liverpool Plains and Caroona Coal Action Group

April 2013

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Executive Summary

This review has been prepared in response to a request from SOS Liverpool Plains and the Caroona Coal Action Group, two groups of concerned Landholders in the Breeza – Caroona district of the Liverpool Plains. The request was for an independent expert review of the soils, rehabilitation and salinity related issues addressed in the Watermark Coal Project Environmental Impact Statement (EIS). This review will form a part of their submission regarding the EIS.

The Watermark Coal Project Area occupies an area of the central Curlewis Hills physiographic region of the Liverpool Plains (Banks 1995) and consists of predominantly sandstone hills and rises with some basalt flow areas. The project area is bounded to the south, east and north by the highly fertile cropping lands of the Liverpool Plains. The area has significant high value cropping lands, predominantly on fertile Grey and Black Vertosols, which are used for dryland fallow based cereal growing, and irrigation agriculture.

The review shows that saline runoff from both the coal mine and seepages created through the rehabilitation process will substantially increase the annual salt loading of the Mooki River by at least 265% if waters are released within the space of one year (based on available 2011 figures presented in Mah and Timms (2012)). Salt loading is the physical amount of salts entering a stream, regardless of dilution and is the standard for water and salt budgeting both for environmental and irrigation flows within the Murray Darling Basin. This omission needs to be corrected.

It is apparent that the connection between soil and groundwater systems (particularly with the fate of seepage waters) has not been well made in the EIS. The hydrogeology section of the report is excellent, however the data have not been used to correctly predict the impacts on surface salinity, and salts in runoff on surrounding natural and farming systems although the location of salinity outbreaks and waterlogged patches has been well known and understood since at least 1998 (DLWC maps available on request to OEH).

Soil depths prescribed for the re-establishment are generally too shallow to create an engineered SCS Class III landscape post mining in the way prescribed. Excess soil in the soil balance should be considered for use in these areas to achieve at least 1.5 m rather than 0.7m. Current soil depth in the Class III lands within the disturbance area generally exceeds 2 – 3 m and this depth should be used as a guide to determine how the soil qualities of the soil materials in the planned rehabilitation will behave when re-formed.

Significant surface flow declines through Watermark Gully are noted in the EIS, followed by significant increases in flow following mine closure. Watermark Gully is a source of natural overland flow to adjacent farming systems, as well as ultimately being the source of waters for Curlewis Swamp, the only large wetland in the Liverpool Plains. The impacts of changed water flow both on farming systems and Curlewis Swamp during mining and following mining are not considered fully in the EIS.

Some of the proposed vegetation offsets for the project are of concern. Planted offset Area 6 will be predominantly on cleared Class III lands, and this will alienate this land from further

potential agricultural purposes. The out of catchment offset area near Mount Kaputar is of concern because it will be located in an area which is not connected to the delicate water balance which drives salinity in the sub catchment of the mine area of disturbance. In addition, this offset area has recently been independently audited by a qualified and experienced ecologist (Spark 2013). Spark (2013) found that the vegetation mapping done for this proposed offset is confounded and that vegetation communities mapped do not in fact qualify as Critically Endangered Ecological Communities (CEECs) as is required.

This review has been prepared by Robert Banks BSc Hons, Certified Professional Soil Scientist (CPSS), Dip Bus, and Adjunct Research Fellow of the University of Queensland. Robert Banks has worked in soil and groundwater research and soil survey in the Liverpool Plains for 14 years with the Soil Conservation Service of NSW and its successor organisations, and has been a practicing private soil consultant since 2004. His expertise lies in the fields of Geomorphology, Remote Sensing, plant ecology, soil and landscape description and analysis, soil and groundwater salinity studies; and has significant experience in connecting hydrogeological and surface processes.

This review starts with a stepwise, page by page review of relevant sections of the EIS, followed by a discussion and analysis of sections, which need to be considered in more detail.

1. Introduction

1.1 Background

This review has been prepared in response to a request from SOS Liverpool Plains and the Caroona Coal Action Group, groups of concerned Landholders in the Breeza – Caroona district of the Liverpool Plains, for an independent expert review of the soils, rehabilitation and salinity related issues addressed in the Watermark Coal Project Environmental Impact Statement (EIS) (2013).

This review covers an assessment of the validity of the information given in the EIS, and supplies supplemental information and science to aid in assessing the validity of some of the information provided in the EIS.

The review is not as comprehensive as it might have been due to the limited time frame given for comment on the EIS.

1.2 Brief for this report

The brief provided to SoilFutures Consulting for this report was to undertake the following work:

1. Critically review the EIS specifically with respect to soils, and soil related aspects of vegetation and water.

2. Provide some basic modeling to help critically assess some of the calculations provided in the EIS, and to address important issues which the EIS has failed either to address, or to address adequately in the EIS.

3. Summarise the issues that remain to be addressed with respect to soil, vegetation, and water by Hansen Bailey, and Shenhua.

1.3 Methodology

The review was carried out by reading relevant sections of the EIS and the relevant appendices of the EIS, which expand on conclusions drawn in the EIS's main document. Statements made within the EIS were compared with published literature and local knowledge of the area within and surrounding the Project Area.

In addition to examination of the document, some calculations were made using spatial data for the area surrounding the Project Area and a series of maps were produced to predict possible offsite changes to runoff, deep drainage and salinity inputs to surrounding land.

1.4 Preparation of datasets for analysis

Spatial data used in this review included the following:

- Soil Landscape data (Banks, 1995; NCMA 2009)
- Salinity outbreak mapping (DLWC, 2006)
- Disturbance area map provided by Hansen-Bailey
- EL boundary provided through the public NSW Mineral Resources website, *MinView*
- Hand digitised final mined and rehabilitation areas, and seepage outbreak locations – from the EIS

2. Stepwise Review of relevant sections of EIS

The following is a review by page number of the Main Report for the Watermark Coal Project EIS.

P xi. Paragraph 3. It is proposed that the mine will produce up to 65.7 tons of salt per day at year thirty. This equilibrates to 23,980 tons per year of salt output. Despite the proposed strategy of keeping the salt onsite in dams and being released in high rainfall periods to maintain appropriate salinity discharge levels, which will not damage plants etc, this amount of salt is still a significant salt loading of to surface water. Salt loading is the physical amount of salt passing a point in a stream in a period of time. When water flow is high, actual salinity of the water may be low, but the physical amount of salt can still be very high. The amount of salt being discharged in addition to natural salt levels due to mining operations will compromise the Namoi CMA end of valley targets for salinity based on salt loading. This is a serious issue as the Namoi River is already a main contributor to salinity in the Murray Darling Basin.

P 132. Paragraphs 3 – 5. The statement that there is no potential for the increase of salinity to surface water both during mining and post mining contradicts the findings in Groundwater Appendix T, and on P xi above which will be discussed in more detail below.

P 133 paragraph 12. Note that recharge is expected to be higher in the re-formed lands than pre-mining.

P139 Paragraph 9. Native Dog Gully is referred to here because of its salinity levels. It should be noted that the salt loading of Native Dog Gully is not referred to here, just the amount of salinity in the waters it contains.

Pp 145 – 147. Watermark Gully. It is interesting to note that the peak flows for Watermark Gully will be reduced during the life of the mine, and then increased after mine closure. Watermark Gully provides surface water to several farms along its course, and eventually feeds into Curlewis Swamp. Curlewis Swamp is an ephemeral wetland to the east of Curlewis, and contains Curlewis Common, a TSR and some grazing land. Alteration of the flows through the farmlands and water supply to this wetland may be of concern to the Namoi CMA. This offsite impact does not appear to have been considered in the EIS.

Also of note is the increase in salinity of waters (by 30%) delivered to Watermark Gully at year 30. This increase should be accounted for in respect of receiving lands such as the farmlands that the gully flows through and Curlewis Swamp.

The Final void estimates for salinity of water are of concern in terms of the potential for this water to enter the surrounding lands.

P 150. The geomorphology study title is incorrect – this is a short *Fluvial Geomorphology* section, not a full geomorphic study of the site and its surrounds. The title needs to be changed to reflect this.

P. 190. Offset Area 6 is of great concern in terms of the potential to alienate BSAL land from future agricultural production through replacement of farming lands with planted trees. This should be reconsidered so that the impact on BSAL land is lessened.

P 193 and Figure 45 on Page 199. The proposal to have an offsite offset area near Barraba is of concern for the following reasons.

- The vegetation survey for this site is currently under investigation – as the map of the offsite offset appears to not match the vegetation found in the offset area (Spark 2013) (see Appendix 1 of this document), and the mapped vegetation does not meet the requirements for Critically Endangered Ecological Communities.
- The Liverpool Plains have been a focal catchment for salinity research in Australia over the past 20 plus years because of the high level of salinity in the area that became apparent in the late 1980's. Much of the agricultural derived salinity is now stable owing to significant Federal funding to achieve land management changes, such as crop-fallow management changes to maintain agricultural viability of this potentially very productive land into the future. This is not so of the so-called "red country" and the footslope-plain boundary salinity where "red soil" slopes meet the "black soil" plains, which have ongoing salinity issues. It is important that vegetation offsets are kept within the catchment of the Liverpool Plains for saline water balance considerations as much as biodiversity considerations.

P 209, Figure 46. Additional Aboriginal sites occur within the lease areas, which have not been mapped in Figure 46. Locations of these sites have been provided to Earth Systems Pty Ltd, another reviewing consultant.

P 244. The definition of the Alluvial Black Soil Boundary has wrong assumptions in it. It shows a confusion of "recent alluvium" or Alluvial Soils (as per Stace et al, 1968) with 'alluvial landscape containing Black Earths' (Stace et al, 1968) or Black Vertosols (Isbell 2002). If the sediment supply in a landscape is all very fine as for the clays of the Liverpool Plains and the Goran Basin Plains physiographic regions (Banks, 1995), then any resulting recent alluvium, immediate shrinks and swells and forms part of the older soil mass underneath. It is generally unstratified and indistinguishable from the Vertosols upon which the recent material is deposited.

P 245 – 248. It is pleasing to note that Hansen and Bailey and their subcontractors are now using Soil Landscape mapping as it was intended to be used, and that they have acknowledged the sources of information.

P 248 – 249. The soil mass balance appears to be well in order; however it would be useful to use any surplus materials to increase soil rooting depth in areas that are targeted to become constructed Class III or even Class II lands. The aim to restore 0.7 m depth of soil is generally accepted to be an absolute minimum soil depth for cropping in NW NSW. A depth of 1.5 m would be more robust, with established perennial pastures or annual crops providing 'drought insurance' through more available water holding capacity achieved through increasing soil depth. In addition, the existing soil depths of the proposed Class III reconstruction are generally in excess of 3 m (Banks 1995, Namoi CMA 2009)

P251 – 252. It is obvious from these maps that some Class II land will be taken up with disturbed lands post mining. This should be avoided if possible, or compensated for by the re-establishment of Class II capability lands.

P 253. It is interesting to note that there is a soil budget surplus. This should be invested in deepening soil profiles in proposed constructed Class III lands.

A draft land management plan listing soil erosion control measures and strategies should be provided at this stage, rather than simply mentioning that one will be in place, 'when the mine is operational'. How will the soil erosion management plan proceed?

Appendix T part 3 Appendix 6

P iii - iv The numbers given for daily seepage and salinity outputs in this section equilibrate to a range of salt output of 276 – 1117 tons per year of annual salt output from seepage sites following rehabilitation of mined areas over a total area of 283 Ha. This is of concern because of the additional salt loading that adjacent salinity outbreaks will incur, which are already mapped (OEH data). The comment that salts "will only be mobilised with significant prolonged rainfall events" is disturbing as it shows that the concept of salt loading as discussed above has not been considered in the EIS. Seepage salinity and the fate of seepage salts will be discussed below.

P 9. The map presented in Figure 4 here has been digitised for further consideration in the discussion below. Of note is that it shows saline seepages very close to surface water drainage as well as close to known and mapped salinity outbreaks.

Appendix T part 3 Appendix 9 – Peer Review

As a general comment, Dr Merrick is recognised as one of the best groundwater modellers in the world. However his brief for his review did not include the impact of salinity outputs from the mines or seepages. It is interesting to note that he agrees that the modelling in the groundwater section is good. In this instance, the reviewer finds that it is a good indication that the numbers given for salt outputs should be reliable. Salinity will be discussed further below.

Appendix Y - Soils

The soils appendix of the EIS is generally very good. The following are of a reasonably high standard and suitable for the purposes of the EIS:

- The method deployed is acceptable and defensible
- The BSAL land identification is good
- Soil types have been well identified
- The topsoil and subsoil balances are very good
- The pre and post land capability work is good (but can be better)

P 5. DGR requirements are that salinisation and contamination potential was addressed. The soil survey has not done this well. Salinity is noted as being normal for some soil types but what happens post mining is not discussed.

P6. DGR requirement of the definition of the Upper Namoi Alluvium has been done, but the results are not incorporated as a change in soil boundaries, making some of the area estimates for soil units incorrect in the document.

P12. Soil unit boundary definition is as given in Banks (1995) without further subdivision.

P 15. Although the Field Survey Methodology states that base mapping scales were between 1:25 000 and 1:50 000, it should be noted that Banks (1995) used a consistent scale of 1:25 000 in his base maps. Although the consultant quotes McKenzie et al (2008) saying that the mapping scale is suitable for planning, this is not exactly correct. P33 of McKenzie et al (2008) tables scales and uses for soil mapping or soil landscape mapping. Certainly the scale used by the consultant is sufficient at a broad planning level, but if the mine is approved then intensive mapping at 1:10 000 or greater needs to be done to ensure depths and volumes of soil materials available for rehabilitation are consistent with earlier estimates.

P 19 Map. The map provided is directly from Banks (1995). This map should have taken into account the boundary changes, which were done during the Alluvial soil mapping, so that subsequent area estimates would be correct.

PP 20 – 46. The soil unit and soil profile description section is good and presented clearly to the reviewer.

Pp 47 – 48. The purpose of this study is unclear and certainly the definition of alluvial soil used is incorrect as discussed above. The reviewer agrees with the revised alluvial boundary, however, the new boundary has not been incorporated into the soil mapping. Therefore areas for some soil landscapes given in the report are incorrect.

PP 53 – 58. The Land Capability section is well presented and appears to be well done.

P 59. There is an error in Table 36. Following mining, 100% of the land will be Disturbed Terrain according to the NSW Soil Survey Definition given in Banks (1995), and which is still used today.

P 69. This map should be removed from offset consideration throughout the report as it has been shown to be not an appropriate offset area by Spark (2013) as shown in Appendix 1 of this document.

Appendix AA Rehabilitation and Closure

P 21. As noted above. This offsite vegetation offset is currently under investigation as the mapped vegetation units do not meet the requirements for CEEC offsets. This site needs to be removed from the plan and offsets in the appropriate Liverpool Plains sub catchment need to be identified and incorporated into the offset strategic plan.

3. Discussion of points raised in the review

3.1 Salinity, salt loading and surface waters

The EIS states that the mine will be producing 23,980 tons per year at year 30 of the mining operation, and an additional 276 – 1117 tons per year of salt output from seepage sites in rehabilitated areas. Although this water may be released to surface waters via runoff during and after heavy rain periods without significantly increasing the salinity of surface waters, the concept of salt loading of surface waters has not been discussed.

While EC readings are one way to assess water salinity of streams, they do not take into account the physical quantity of salts being transported by the river or the *salt load*.

Mah and Timms, (2012) reported that the salt load of the Mooki River was 14700 tons/year in 2011 and that Native Dog Gully is the only large surface drainage salinity hotspot in the Mooki Catchment. Given that at some stage, salts produced by the mining operations will have to be released to the surface water environment, this presents a serious issue for downstream water users in the Murray Darling Basin.

If the total salt production from seepages (taking the lower figure of 276 tons/year) and the rest of the mine water for one year were to be released by overland flow in one event or within the period of one year, this would be equivalent to a 38 956 ton salt loading of the Mooki River system. This represents a 265% increase in the salt load of the Mooki River as at 2011. Conserving salts on site for several years prior to a release would no doubt increase this figure substantially.

Although the waters in such a high flow event may not be saline due to dilution factors, the physical amount of salt entering the Murray Darling Basin, through the Mooki River (and consequentially the Namoi River) would be much larger than pre mining. These salts will concentrate by evaporation as they flow down the river system as well as when the water is used in irrigation. This potential impact has not been considered as a long term offsite impact of the mine.

3.2 Consideration of Seepages

As Dr Merrick points out, the groundwater modeling section of the EIS is quite good. However, taken in the context of the whole EIS, the seepage predictions have not considered mining induced offsite impacts on stream salinity as pointed out above, in addition to the impacts on existing (or natural) seepages. The Department of Land and Water Conservation had an intensive salinity mapping program, which shows saline outbreaks and waterlogging points in the natural landscape of the Liverpool Plains, largely based on intensive field traverse of sites mapped using aerial photograph interpretation (DLWC 1998). The predicted seepage points induced by mining lie directly adjacent to known salinity outbreaks as shown below in Figure 1.

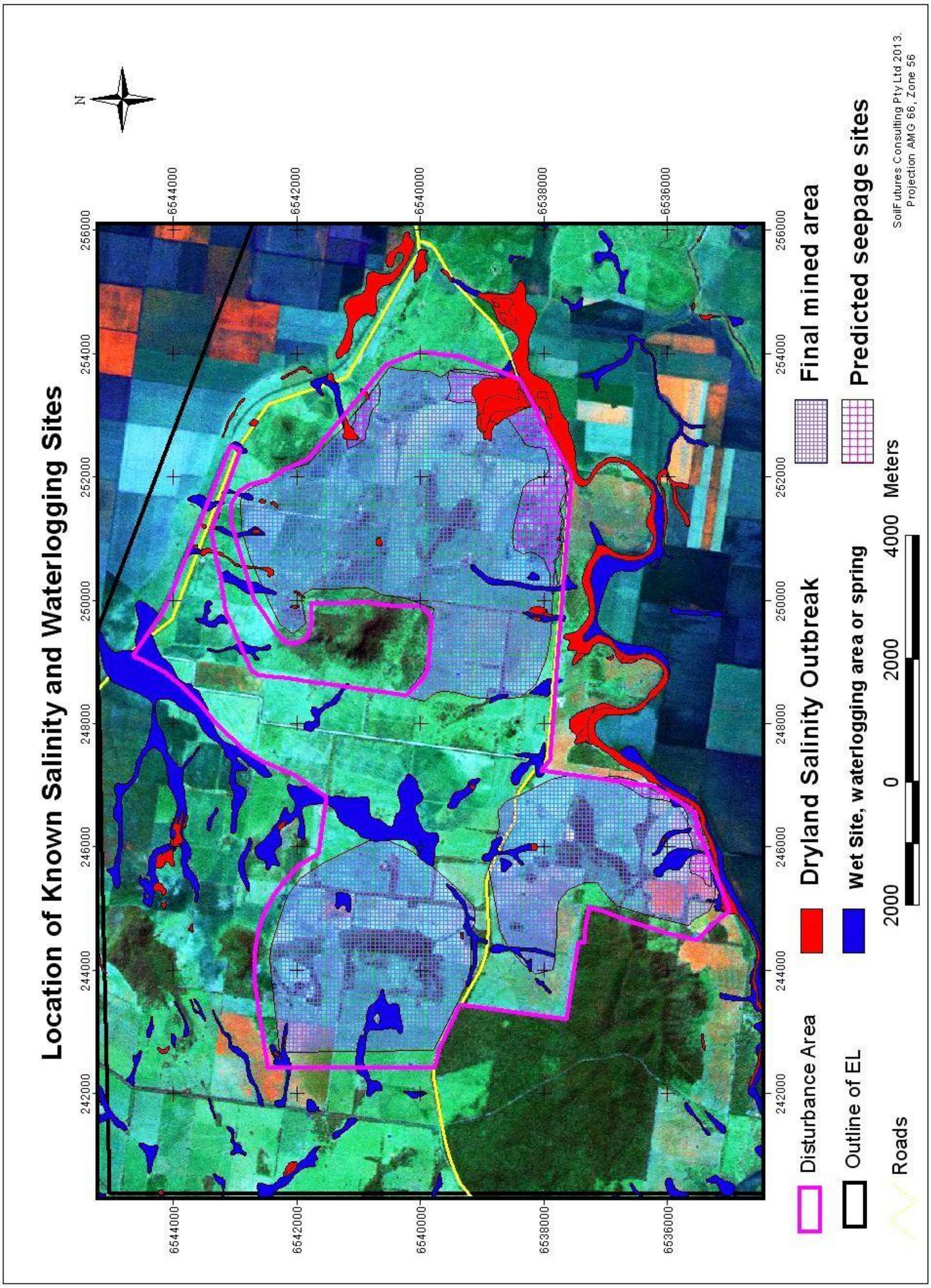

Figure 1: Location of Predicted Seepage sites with respect to existing dryland salinity and waterlogging

Native Dog Gully is noted by Mah and Timms (2012) as one of the largest saline seepage "hotspots" in the Namoi Valley. The consequences of additional salt entering the soil and surface runoff systems at these already saline sites is unknown, and no serious discussion about this is presented in the EIS. As pointed out above, the Namoi Catchment is a major contributor to salt loads in the Murray Darling Basin and has a serious responsibility to reduce salt loads into the system to sustain downstream communities (MDBC, 2005). Consideration needs to be given to existing saline outbreaks with regard to the placement of potential saline seepages. The proximity of Native Dog Gully to the western mining area seepages will ensure that salts enter surface waters during high flow events, exacerbating salt loading of the Mooki River as discussed above.

3.3 Soil Survey Information

As stated above, the soil survey section of the report is very good with respect to soil budgeting for rehabilitation. The alluvial soil survey map is good, correcting the errors, which are apparent in Banks (1995). However some of the assumptions regarding alluvium are not correct. In addition to this, the new alluvial boundary was not used to amend the maps of Banks (1995) and present a more accurate view of both Conadilly and Yarraman Soil Landscapes. This means that calculations for both soil landscapes for land capability areas, (which are based predominantly on soil landscapes) are inaccurate. If the new boundaries were included in the map of soil landscapes and Land Capability there would be substantially more areas of Class II land.

The soil material budget for rehabilitation shows a significant excess of topsoil and subsoil materials available for the Project. The proposed rehabilitation of Class III land should include as much of this excess as possible, so that soil depths approaching the system the rehabilitation replaces is achieved.

Although salinity is measured for individual profiles in the soil survey, there is no discussion of saline outbreaks, which occur along the footslope-plain junction, and how the rehabilitation process may affect these saline areas.

The scale of mapping provided in the soils section is no finer than the base scale used for Banks (1995), which was 1:25 000. Whilst this scale is useful at a strategic planning and gross soil budgeting level, finer scale mapping will be required if the project is approved.

3.4 Use of Soil Information for Checking Models

Ringrose-Voase et al (2003) and others were involved in a research project in the Liverpool Plains in the 1990's which spent in excess of five million dollars of public funding studying the Liverpool Plains soil types as part of the focal catchment for salinity studies conducted in three eastern catchments of Australia by CSIRO. Soil landscape and soil type runoff and deep drainage (recharge) values were measured at this time.

The measurements of Ringrose-Voase et al (2003) can be directly joined with the soil landscape data from Banks (1995) resulting in reasonable estimates of deep drainage through soils and runoff from soils, for the project area. This has not been done in the EIS and should be considered as a check or adjunct to the Hydrogeology and Soils sections, showing that an understanding of the junction of the soil and hydrogeological information has been achieved. Following the information provided in Ringrose-Voase et al (2003) for the soil landscapes and soil types within the proposed mining and rehabilitation areas, estimates for runoff which will change as a result of mining, and deep drainage, or recharge directly through soils to groundwater are given in Figure 2 and Figure 3 below respectively.

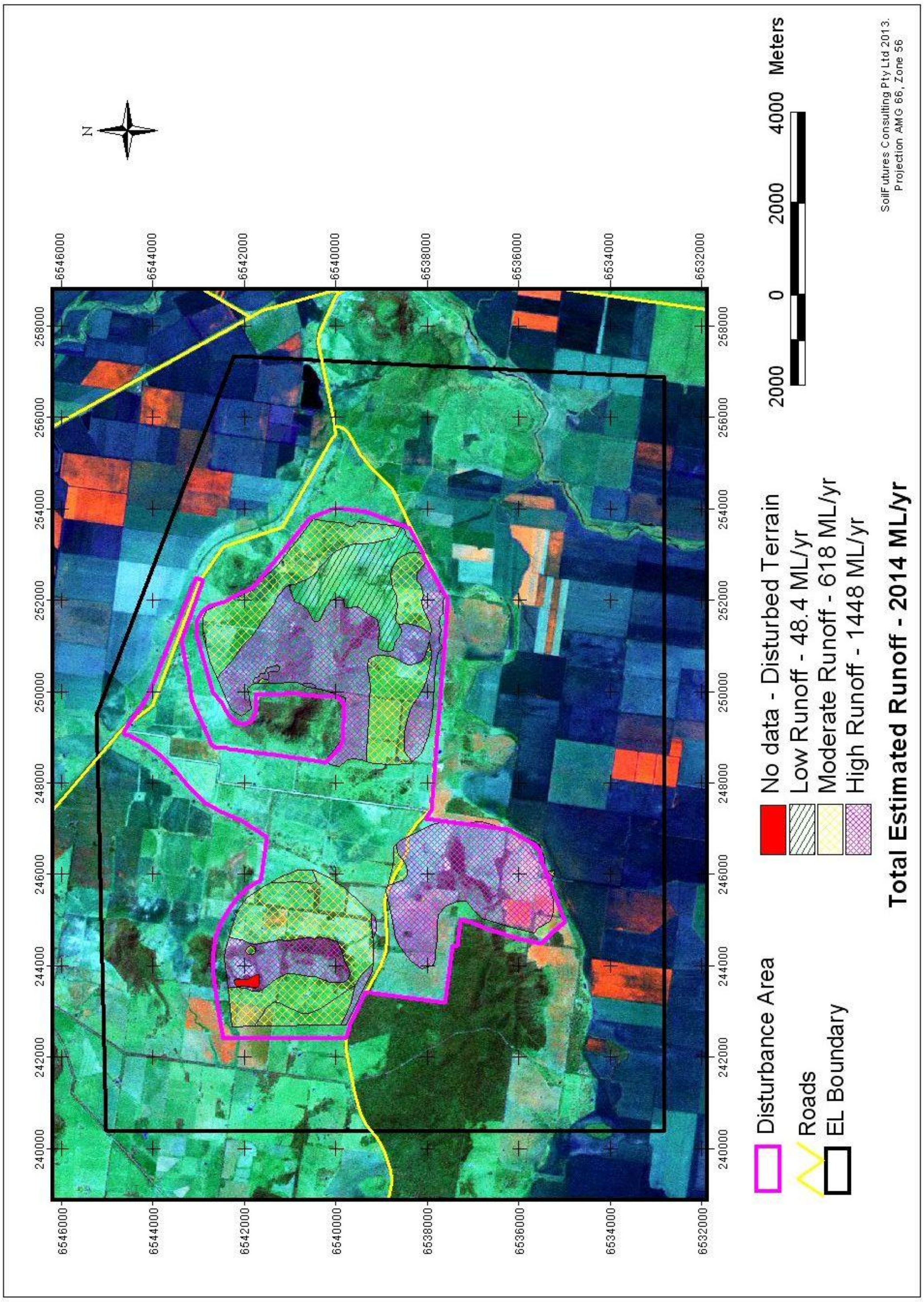

Figure 2: Estimated runoff from lands to be mined, pre mining

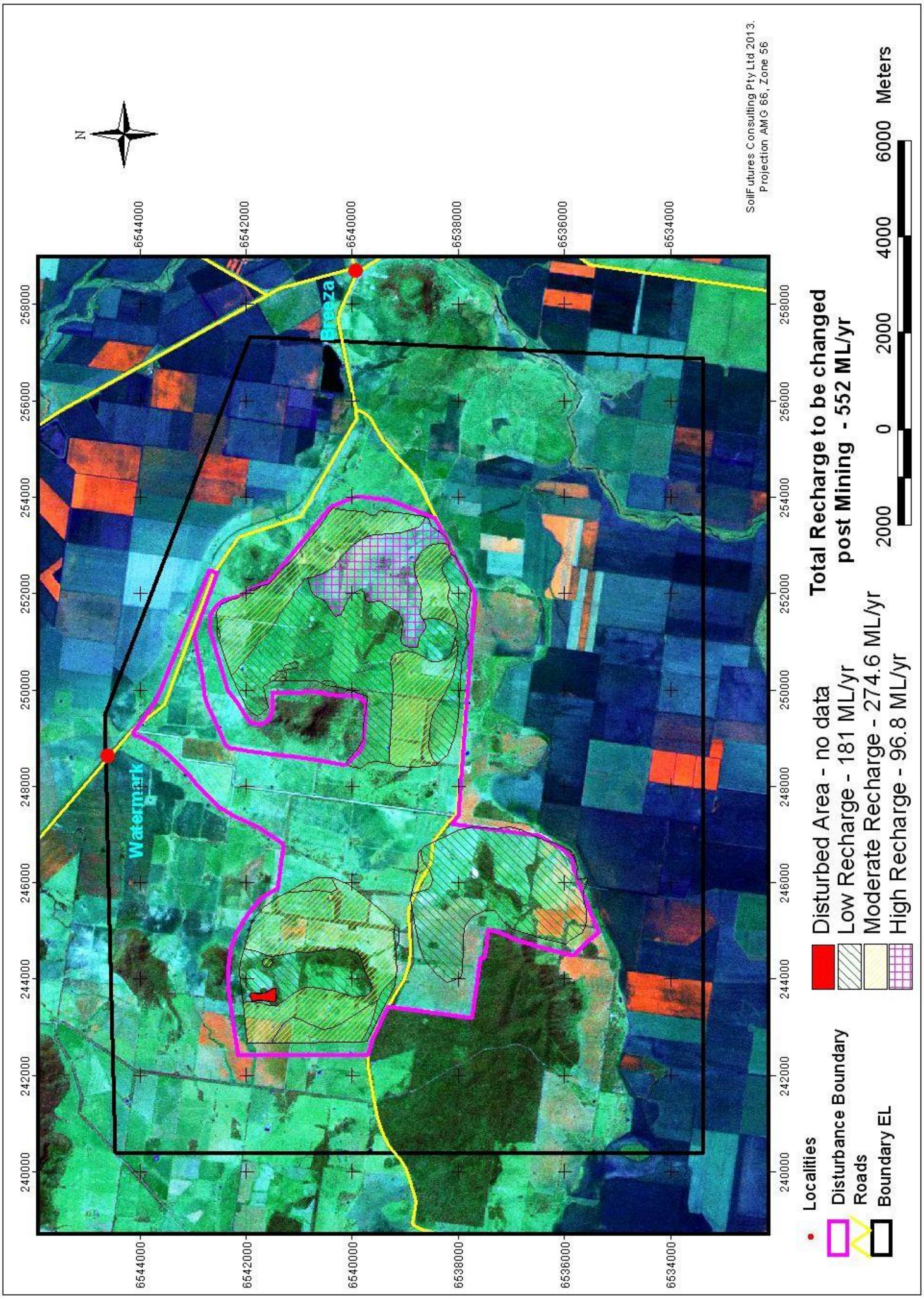

Figure 3: Estimated recharge through deep drainage from lands to be mined, pre mining

Figure 2 shows an estimated change in natural runoff of 2014ML per year, post mining. No attempt has been made to use the soil information provided in the Soils section of the EIS to use this value as a check on other calculations made for the Project. Figure 3 shows an estimated removal of 552ML natural deep drainage from groundwater systems of the project area post mining. Recharge rates will be higher in the rehabilitated areas as proposed in the EIS, and the fate of these waters appears to be in the form of seepages and input to the final void.

3.5 Consideration of Flow Changes to Watermark Gully

Significant surface flow declines through Watermark Gully are noted in the EIS during mining, followed by significant increases in flow following mine closure. Watermark Gully is a source of natural overland flow to farming systems through which it runs, as well as ultimately being the source of waters for Curlewis Swamp, the only large wetland in the Liverpool Plains. The impacts of changed water flow both on farming systems and Curlewis Swamp during mining and following mining are not considered fully in the EIS.

4. Concluding Remarks

Although the EIS for the Watermark Project is extensive, and has some very high quality science in it, there remains the following to be addressed:

- Salt load concepts have not been applied in the delivery of salts from mining to surface waters. The potential increase of annual salt loading of the Mooki River system of 265%, has significant potential impacts on agriculture, ecosystems and the socio-economic fabric of the Murray Darling Basin and the communities that rely on these resources
- Salts from predicted saline seepages in rehabilitation areas will impact on existing salinity outbreaks in the Project Area. This may well exacerbate delivery of salts to surface waters. The fact that the seepages are only a hundred or so metres from Native Dog Gully, which is already the most significant contributor of salt to the Mooki River, will probably increase salt loading of the Gully further in high flow events.
- Offsite impacts of changed overland flow from Watermark Gully on receiving farm land and Curlewis Swamp, the Namoi Valley's largest natural wetland, have not been seriously considered in the EIS.
- Whilst it is good to see attempts being made to restore much of the appearance of the landscape and the land capability classes to pre-mining values in the soils and rehabilitation planning sections of the EIS, it seems that much of the constructed "Class III" land will have soils, which are marginal for agricultural production. The rehabilitation plan should consider attaining soil depths of at least 1.5 m in these areas.

- It seems that the soils section and the hydrogeology section of the EIS have little crossover, which is disappointing when one considers the volume of information available regarding soils of the Liverpool Plains as a source of deep drainage and therefore groundwater recharge to the groundwater systems of the project area.
- Although the alluvial soil boundary was remapped for the project area in the Soils section of the EIS, this new alluvial boundary was not incorporated into available soil landscape mapping. This means that area measurements of soil landscapes, and land capabilities along the footslope – plain junction in the south of the project area are incorrect.
- The EIS does not appear to have comprehensive erosion mitigation plans for areas to be disturbed and rehabilitated.
- The offsite vegetation offset near Barraba is in an area that has already been independently audited to check if it meets the criteria for CEEC vegetation offsets. This area has been shown not to meet the standard for meeting CEEC community offset status and additionally, mapping provided by Hansen Bailey in the EIS, is incorrect (as per Appendix1 of this review).
- The proposal to have planted vegetation offsets on Class III lands to the north of the mining areas will result in the permanent removal of this land from agricultural production. This needs to be re-considered.

5. References

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6. Appendices

Appendix 1: Extract from Maules Creek Community Council Submission to Tony Bourke's Office. By Mr Phil Spark of Northwest Environmental Services Pty Ltd – attached.