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October 2018

Crawford Submission against the Vickery Extension Project

Vickery Extension Project
Environmental Impact Statement
Including Appendix C Flood Assessment

Introduction

This submission is to the Department of Planning and Environment and the Independent Planning Commission. This project is a 'State Significant Development' (SSD 7480) under the *Environmental Planning and Assessment Act 1979.* According to Section 4.41 of the same Act an SSD, with development consent, does not require a flood work approval under Section 90 of the *Water Management Act 2000.* The key words are, with development consent. The Vickery Extension Project should not be given 'development consent' because it doesn't comply with the basic principles of floodplain management.

The Vickery Extension Project is located in the headwaters of the Murray Darling Basin in the Upper Namoi Valley and the northern area of the Liverpool Plains. It has specific environmental risks to surface and groundwater that will attract the commonwealth water trigger. It is not so much as what is in the EIS but what is left out, For example, catchment-wide runoff considerations.

The case against the Vickery Extension Project EIS includes:

- location of the proposed railway loop infrastructure
- limitations of transient numerical modelling peculiar to this case study area
- failure to address extreme weather events and potential climate change in practice

- failure to address aquifer recharge implications, particularly in aquifer compaction and land subsidence
- failure to address the principles and implications of floodplain management for a relativity narrow and restricted floodplain

Methodology

In days to come, extreme weather events and climate change will pose a real threat to the environment of the northern part of the Liverpool Plains. This submission references the following papers that are an integral part of this submission.

- Crawford, K (2018) *Managing the impacts of climate change and infrastructure on the Namoi floodplain* Irrigation Australia Journal Autumn 2018

- Crawford, K (2018) *Managing the impacts of climate change and infrastructure on the Namoi floodplain;Part2* Irrigation Australia Journal Spring 2018

- Geoscience Australia(2015) *Seven Wonders of the Hydrogeological World (Australia) Gins Leap Gap NSW, Australia* Newsletter 120 May 2015

  Crawford, K., Ross, J. and Timms, W. (2004) *Implications of Aquifer Recharge for water sharing plans: a case study from the Upper Namoi Valley* Irrigation Australia Journal, vol. 19 no 2 pages 21-27

  Webb, McKeown & Associates (2005) *Draft for public exhibition Carroll-Boggabri; Floodplain Management Study.* DIPNR

The proposed railway location breaks all the principles of floodplain management. It will concentrate and divert the flow increasing velocity and depth of flow. The Vickery Extension Project should not be given development consent.

Deadmans Gully is a major flood-runner and ephemeral stream and as such must not be interfered with. The Namoi River and Gulligal Lagoon and associated floodways need to spread out and dissipate energy in times of flooding.

The limitations of transient numerical modelling are also discussed, and why it should not be relied upon in the assessment of major infrastructure location and design in this area.

It is important to note that the Draft Flood Management Plan for the Namoi (2016) has not been gazetted. It contains report cards for zones that offer guidelines only. The essential ‘ground truthing’ is not complete. There are errors in the case study area and should not be used as justification for any project. Instead the ‘*Water Management Act 2000’* is the final arbiter.

The Webb, McKeon and Associates 2005 study is a good reference for this sensitive part of the Namoi Floodplain and contains all the basic principles. The proposed railway location does not comply. It also crosses through the sensitive 'hotspots' in this area making the railway location untenable.

I would like to see a new balance of social, economic and environmental outcomes for sustainable agriculture and mining; an accord with lasting implications based on respect and understanding. The Gunnedah, Boggabri and Narrabri districts have a bright future if mining and agriculture work together. Both industries are making a valuable contribution to the community and Australia's economy.

Modelling

Transient numerical modelling has limitations. Assumptions have to be made where data is lacking and extrapolating to predict future extreme flooding events is unsatisfactory. Graham and Butts (2005) in their paper 'Flexible integrated watershed modelling with MIKE SHE' point out some of the problems with numerical modelling. They refer to a paper by Grayson and Bloschl (2000) '. The inherent heterogeneity of natural systems makes it difficult to represent those processes accurately'. The impacts of human induced changes due to agriculture, urban development, and water pollution are by no means understood. Furthermore, the growing focus on climate change has provoked increase research into understanding the complex feedback between the atmosphere and the terrestrial hydrological cycle, according to Graham and Butts.

The modelling in the Project EIS appears to ignore the complex, mixed characteristics of the extremely large watershed catchment. The Gins Leap Gap confines surface and groundwater. All the tributaries of the Namoi River including the Peel, Manilla, Macdonald, Mooki, Cox's Creek, Collygra Creek and Deadmans Gully are extremely difficult to model in the Catchment wide context. Transient numerical models are confounded by the characteristics of the extensive Upper Namoi Valley. If the flooding in Cox's Creek comes down first, flows into the Namoi river and doesn't get away, the community knows to be on guard, This is just one scenario that restricted boundary modelling does not address. Future extreme flooding is simply unpredictable.

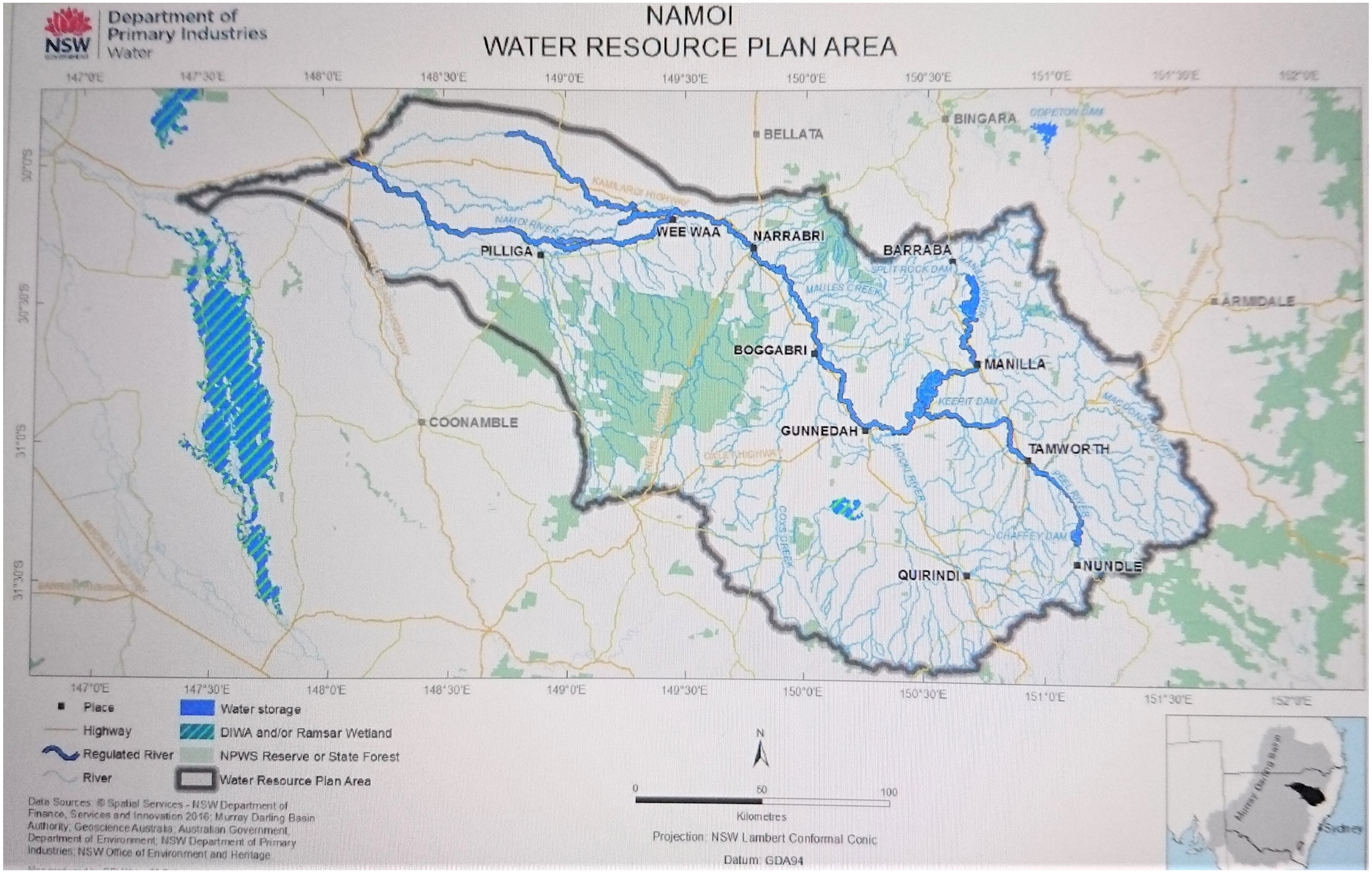
The methodology in the Crawford submission against the Project, necessarily engages a wider scope of works. Many aspects of floodplain management left out of the Project EIS are covered in this submission. The Project EIS uses restricted boundary modelling and has not addressed the broader issues of floodplain management in the real catchment of the Upper Namoi Valley. Catchment communities are well aware of these issues.

There are many knowledge gaps in our understanding of natural resource management in the real catchment. The Draft Terms of Reference presented to the Namoi Catchment Water

Study Working Group Tamworth NSW. 5th December 2008 is a strong foundation. Field investigations and observation in the real Upper Namoi Catchment is the way forward in our quest to understand the catchment. The Project EIS uses restricted boundary modelling where many assumptions are made. This is unsatisfactory.

Many valuable lessons can be gained by consulting local members of the community and generations of flood observations in this area. The Webb McKeon and Associates (2005) achieved this by having Flood Committees from within the local communities The Project EIS has not addressed the sensitive nature of the floodplain where they plan to cross and the many ‘hotspots’ delineated in the 2005 study. To ignore this is to do so at your own peril. I appeal to Whitehaven Coal, as a member of our community, to graciously withdraw the Vickery Extension Project EIS.

Namoi Water Resource Plan Area   NSW Department of Primary Industries Water



Understanding the potential rainfall and deep drainage of sub-catchments in a valley is essential in calibrating numerical models. In the study area the ephemeral streams of Collygra Creek and Deadmans Gully are often underestimated for groundwater recharge and potential runoff (Crawford et al 2004). Major structures across ephemeral streams with ill-defined catchments, steep slopes and extensive catchments create havoc under certain meteorological conditions. The total catchment to the Gins Leap Gap offers infinitely variable characteristics of soil type, vegetation, landuse and landslope. The area of catchment to Gunnedah is 17,000 square kilometers (Webb, McKeon and Associates 2005).

Extreme weather events and climate change

There is a new awareness of extreme climatic events and the potential impact of engineering structures on our valley. The area from Gunnedah to Gins Leap Gap is a sensitive vulnerable area of national and international significance. Indeed it is the Seventh Wonder of the Hydrogeological World in Australia (Geoscience Australia 2015).

Presently NSW is experiencing the worst drought since federation in Australia. Droughts and flooding rains have always been a feature of eastern Australia. Professor Anthony Kiem of Newcastle University and his team are studying these cyclical patterns. He warns of short term thinking in planning that may give a false sense of security. According to Professor Kiem (Foley 2018) addressing issues of climate change requires a long term view.

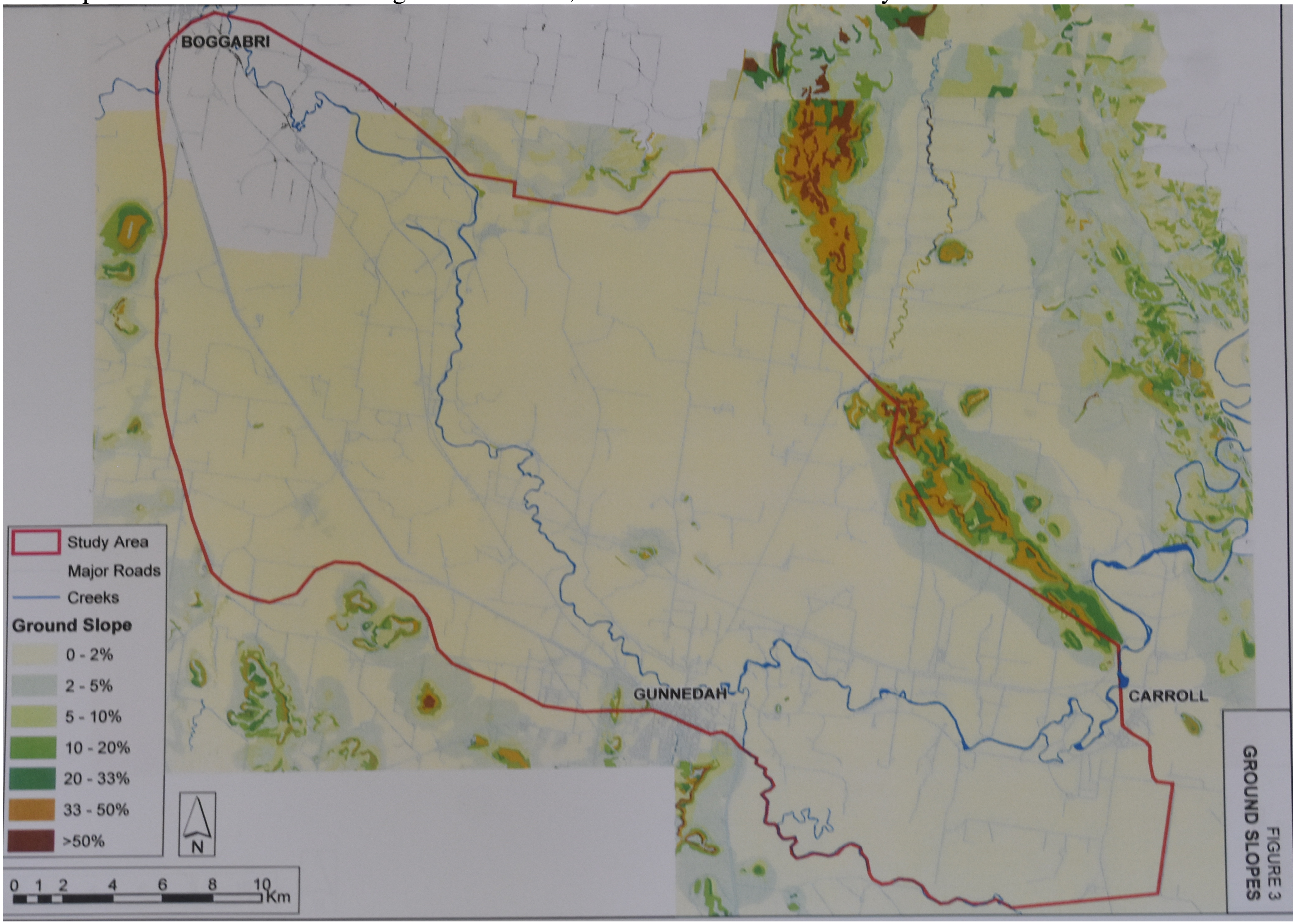
KLC Environmental has focused on physical hydrogeological investigations precisely for this reason. We do not understand the complex catchments characteristics including the infinitely variable soil landslope and roughness coefficients in the extremely large catchment where ephemeral streams prevail with ill defined catchments. As well as these unknowns are storm cells intensity and variability creating uncertainty in numerical modelling for the purpose of flood prediction.

Eastern Australia's rainfall patterns are dominated by climate cycles across the Pacific Ocean that last approximately an average of thirty years. Evidence from ice core samples from the Law Dome in Antarctica reveal eastern Australia's long term climate cycle and its real drought and flood risk (Foley 2018). The ice contains compacted snow, laid down in layers by clouds formed over the Pacific Ocean. Oceanic storms whip up the sea which drives plumes of salt into the air and into the snow which is layered in the ice core. This leaves a signature of the prevailing weather conditions which brought it there. This means that the salt signature or lack of it, in Antarctic ice cores can tell us a lot about past droughts and flooding rains in eastern Australia.

The ice core evidence is correlated with growth rings in trees going back some 400 years. Ice cores can take us back a thousand years and more. Climate data from the last 100 years is good but doesn't give the full picture. Extreme floods and droughts have exceeded the last 100 years of data and will do so again.

Floodplain management

Figure 1 shows the extent of the Namoi floodplain between Carroll and Boggabri. Figure 1 Floodplain shown in red ie landslope less than 2%   Image credit: Webb, McKeown & Associates Pty Ltd 2005



Consider the Liverpool Plains before the black soil was cultivated. Floodwater spread out, slowed down, infiltrated the soil and recharged the alluvial aquifers. Valuable sediment containing nutrients, fungal and microbial elements recharged soil fertility. Soil structure was improved and the water holding capacity increased. Considering the extensive nature of the plains below 2% landslope, the soil became a vast storehouse of water and nutrients. There was no soil erosion (Gunnedah District Technical Manual, Soil Conservation Service of NSW).

History repeats. In my early days as a Soil Conservationist in Gunnedah, the Soil Conservation Service of NSW was encountering legal problems with earthworks on country below 2% landslope. Illegal diversions were being caused by poorly designed earthworks with ill-defined catchments. A technique was developed called strip cropping using vegetative means to spread and slow down flood waters (Breckwolt, 1988). This proved very successful in combating soil erosion and avoiding legal problems on the Liverpool Plains.

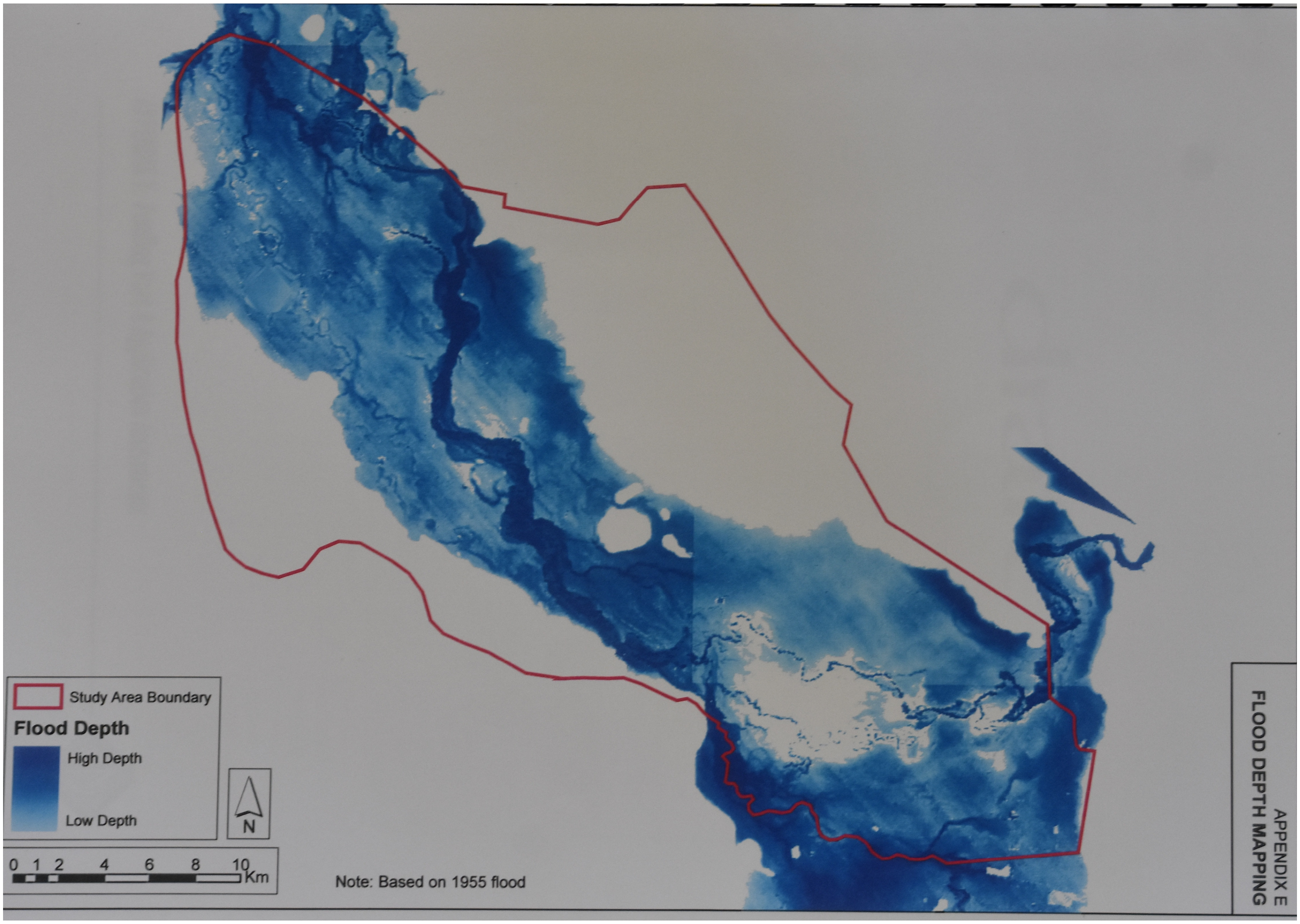
The Darling Downs in Queensland had similar problems on the low-slope black soil. Water spreading allowed Strip Cropping methods to combat soil erosion. This was the key to maximising agricultural productivity and minimising environmental impact. Maximum height restrictions on roads and other structures were introduced (Marshall, 1993).

According to John Marshall in his booklet on Floodplain Management, published by the Queensland Government, cooperation is the key (Marshall 1993). He concludes by stating that 'It cannot be overstressed, however, that the main ingredient of successful floodplain management is cooperation. All land users must accept that each property has artificial boundaries and therefore cannot be managed in isolation. Poor management by one landholder in a catchment will affect others adversely, while good management and cooperation will work to everyone's advantage. Concentrated, fast moving flood water can spell disaster, both in crop losses and soil erosion, while a well spread, slow moving flow is a free irrigation for everyone'.

Coming back to the study area, we know from eye witness accounts that the floodway covers most of the floodplain in this area. This is confirmed by the Airborne Laser Survey (ALS) with 'draped over' hydraulic model representation of flood water depth (Webb, McKeown & Associates, 2005). see Figure 2

The locality and regional drainage characteristics map Fig 1.3 page 4 of the EIS Appendix C Flood Assessment can be superimposed over the floodplain maps in this submission. Using Gulligal Lagoon as a locating feature and the Namoi River on the eastern ridge side and Collygra Creek on the western ridge side makes orientation simple. Gulligal Lagoon is the crescent shaped feature coming off the Namoi River. Deadmans Gully is also a distinctive feature with it's sinuous nature and extensive flat floodplain.

Figure 2 Airborne Laser Survey (ALS) representing depth of flooding: from Carroll-Boggabri Floodplain Management Study
Image credit: Webb, McKeown & Associates 2005



According to Webb, McKeown & Associates (2005),' The Airborne Laser Survey (ALS) was also utilized as part of this study. The flood level results obtained from the hydraulic model were "draped" over the digital terrain model produced by the survey data to obtain a representation of the depth of flooding across the study area'. See Figure 2.

The implications of engineering structures across the floodplain include: potential erosive flooding causing soil erosion and reducing groundwater recharge, increasing stream bank erosion and ecological disconnection between river and floodplain.

Major flooding is an important groundwater recharge source (Timms 2011). Thinking of rivers as ecological systems that are integral with their floodplains, gives a better understanding of the whole catchment and adds meaning to a holistic, multidisciplined approach to floodplain management. Major flooding, as a recharge source, was also a finding of the Namoi CMA Gins Leap Gap Project (KLC Environmental 2010).

Major Floods

Consider the Australian writers classic, 'The Red Chief, as told by the last of his tribe', by Ion Idriess. This is an historical reference text for our area. Idriess records in the appendix of his book on page 245 an account of the 1750 flood, (Idriess 1979). I quote directly, 'So far as could be ascertained, the Red Chief lived in the late seventeenth and early eighteenth centuries. Bungaree told of a great flood that apparently occurred about 1750, changing the course of the Namoi and Mooki Rivers. The Red Chief appears to have died about twenty years before this flood.' Bungaree, who gave the account, was the last of his tribe.

The second biggest flood was the 1864 which destroyed the township of Gulligal (personal comm. McIlveen, P.) Boggabri then became the main town centre.

The following flood height recordings of Major floods at the Gunnedah Gauge (419001) are as follows: *Gauge Zero = 254.885 mAHD* Table 1 (DLWC, 1996). A major flood is classified by the SES for the Namoi River at Gunnedah as having a gauge height of 7.9 metres (m).

Table 1

Gauge Heights (419001) for Major Historical Floods in Gunnedah
(*Gauge zero = 254.885 mAHD*)

Year	Date	Height (m)	Year	Date	Height (m)
1864	-	9.85	1964	15/1	8.69
1900	25/7	8.96	1971	2/2	8.98
1908	18/3	9.65	1974	9/1	8.59
1910	16/1	9.40	1976	25/1	8.78
1920	30/6	7.93	1977	17/5	8.00
1921	3/7	8.23	1984	31/1	8.84
1942	12/7	7.93		29/7	8.00
1950	24/7	8.38	1998	22/7	8.84
	23/11	8.10		29/7	8.55
1955	26/2	9.60		9/8	7.98
	26/10	8.47		7 Sept	8.50
1956	11/2	8.84	2000	22/11	8.87
1962	14/1	8.05			

The above flood records demonstrate that we must remain aware of what has happened in the past. We should also not rule out more extreme events in the future. In our relatively narrow floodway, with constricting ridges both sides, in extreme floods there is nowhere else for the water to go but to increase in depth and velocity. The safer strategy is to choose alternative access routes and keep off the floodplain.

Results

Keeping in mind the basic principles of floodplain management and groundwater recharge in the case study area we move onto the key environmental risks of newly built infrastructure.

Meetings with Whitehaven Coal have been open and friendly but agreement on the railway proposal location could not be reached. I appeal to the Independent Planning Commission **not** to give development consent to this project. The Vickery Extension Project EIS provides no specifications as to the hydraulic capacity and design of infrastructure. Floodplain management demands that infrastructure proposals incorporate location and design (Crawford 2018).

Alternative access is already provided at Gins Leap Gap over the railway viaduct bridge and also along the current coal haul road along the Blue Vale road. This is the shortest route and leads to the Whitehaven Coal Loader. An upgrade of the road and Kamilaroi Highway overpass would provide a solution with the least impact on the communities of Gulligal and Emerald Hill as well as the floodplain environment. This location crosses the paleochannel in the underground landscape at another constriction which is the best place to cross (Crawford 2018).

Keeping in mind the basic principles of floodplain management, it is proposed to investigate specific environmental risks to the floodplain posed by built infrastructure (Crawford 2018).

These risks include:

- built infrastructure location
- built infrastructure engineering design
- built infrastructure risks to groundwater recharge

Plate 1 shows part of the northern area of the famous Liverpool Plains between Gunnedah and Boggabri.

Plate 1 Northern area of the Liverpool Plains. Namoi River in the foreground. Deadmans Gully carrying the main body of water in the centre. Mount Binalong in the background with its ridge running north south for photo orientation. Photo credit Keith Harris

Built infrastructure location

Built infrastructure, such as major roads and railways, pose a high environmental risk to the floodplain with poorly understood implications. Infrastructure proposals should be assessed together with all the risks. Location should not stand alone as the first step but be integrated with engineering structural design and hydraulic flood capacity. Sustainable floodplain management must include social, economic and environmental aspects. Therefore the assessment process must be a holistic, integrated and multidisciplined approach. The Vickery Extension Project EIS fails this test.

Shortcomings in location design often become obvious only after the complete proposal is considered and worse still after construction is complete. By then it may be too late. Railways and roads running with the flow have the least impact whilst those cutting across pose the greatest risk. Structures having diagonal sections and corners are problematic. An anomaly to this general observation is the existing Gins Leap Gap railway viaduct bridge. Crossing at this narrow section of the valley with adequate hydraulic capacity in design Plate 2

Plate 2: Gins Leap Gap railway viaduct bridge in the Boggabri area. Crossing at the major constriction in the Upper Namoi Valley on bedrock high is the safest place to cross. Ken Crawford 2016

The Vickery Extension Project spur rail location does not comply with community expectations and surface and groundwater considerations. It will divert floodwaters because of its alignment and cross many ‘hotspots’ in the case study area. These ‘hotspots’ are covered in the Webb McKeon & Associates floodplain study (2005).

Built infrastructure engineering design

As alluded to earlier, engineering structural design should be assessed together with location. They cannot be separated. The Vickery Extension Project fails to present design specifications of the railway-loop structure other than to say, ‘The final vertical alignment of the rail and sizing of the openings (bridges and culverts) will be determined during the detailed design stage’. I have quoted Part 6 Flood impact assessment Appendix C of the EIS under 6.2.2 Project rail spur. A failure to provide specifications for such major infrastructure means that ‘development consent’ should not be given.

Figure 6.1 shows the alignment or location of the rail spur. Again I quote 'The Project rail spur openings will be designed to satisfy the conditions of the draft FMP'. The draft FMP has not been gazetted and should not be used in any design modelling. It has not been 'ground truthed' properly as there are errors in the case study area.

I notice that in the Secretaries Environmental Requirements page 7 that NSW OEH states 'The EIS must map the following features as described in the Floodplain Development Manual (2005)' to which the EIS responds 'Flood planning area' and 'hydraulic categorisation' was not required to be mapped for the purposes of this impact assessment as the area is managed under the Draft FMP. Again the Draft FMP has not been gazetted and leaves the way open to legal challenge if 'development consent' is given.

The Vickery Extension Project EIS fails to address the specific questions as it does with climate change which as an amendment to the Act 2017 must be addressed. The specific statement on page 8 by the secretary is 'The EIS must model the effect of the proposed Vickery Extension Project (including fill) on the flood behaviour under the following scenarios:
Current flood behaviour for a range of design events as identified in 8 above. The 1 in 200 and 1 in 500 year flood events as proxies for assessing sensitivity to an increase in rainfall intensity and flood producing rainfall events due to climate change'.

The EIS responds by stating that the effects of climate change are addressed in Section 6. The numerical modelling carried out by extrapolation of past flood events in a restricted boundary model is inadequate. I see no mention of the 1 in 200 or 1 in 500 extreme flood event as requested. The is evidence of past real flood events from ice core sampling correlated with growth rings in tree studies that make us aware that the last 100 years of recorded data is not sufficient when assessing major infrastructure on floodplains.

Page 16 under 4.2.3 Extreme flood and 4.3 Namoi River Tributaries Design Discharges
Both sections here do not give confidence in the modelling because of lack of data and questionable discharge estimates. 5.2.3 Surface roughness Manning's 'n' values are always a problem for large and infinitely variable catchments like the Upper Namoi Valley. I sympathise with the modelers; arriving at reasonable outcomes in catchment wide studies is difficult. However, is the modelling undertaken truly catchment wide?

5.2.4 Inflow and outflow boundaries

The EIS has answered my question. They are not. There is also an assumption that Collygra Creek flooding would not be likely to coincide with Namoi flooding. That is exactly what happened in 1998. And it all has to get through the Gins Leap Gap. If Cox's Creek can't get away first the case study area is in trouble. Has the modelling taken this into account?

5.3 Hydraulic Model Calibration and Verification

The EIS states on page 27 ‘The model does not predict the flood extent along the western side of Deadmans Gully. It appears that the flooding in this area (1998) was due to Collygra Creek, which has not been modeled’. The catchment community knows very well how the Collygra Creek’s 32,000 ha can cause flooding. It is no surprise. Other parts of the 17,000 square kilometers of catchments contribute to flooding under different scenarios.

Leaving modelling for a moment and getting back to field investigations and observations. There is the very real risk of aquifer compaction and land subsidence with the location of the spur rail. Here the alluvial sediments are much deeper and the high yielding irrigation bores that exist are at risk. The laser scraped, constant grade cotton fields may also be impacted on this highly productive sustainable agricultural land. The EIS fails to address this issue.

The Vickery Extension Project EIS railway location is directly across the main body of the floodplain over the deepest unconsolidated sediments of the alluvial aquifer. An understanding of sedimentology would rule out this railway loop because of poor location. The EIS fails to address this issue.

Compaction and subsidence results from, not only the initial pile driving of piers, but the long term continual vibration of heavy coal trains on the structure. The unconsolidated sediments of the alluvial aquifers in this area consist of the Narrabri Formation and the Gunnedah Formation. Gravels, sands and clay aquitards containing precious groundwater exist in this hidden valley Figure 1: Geological cross-section Emerald Hill to Namoi River.

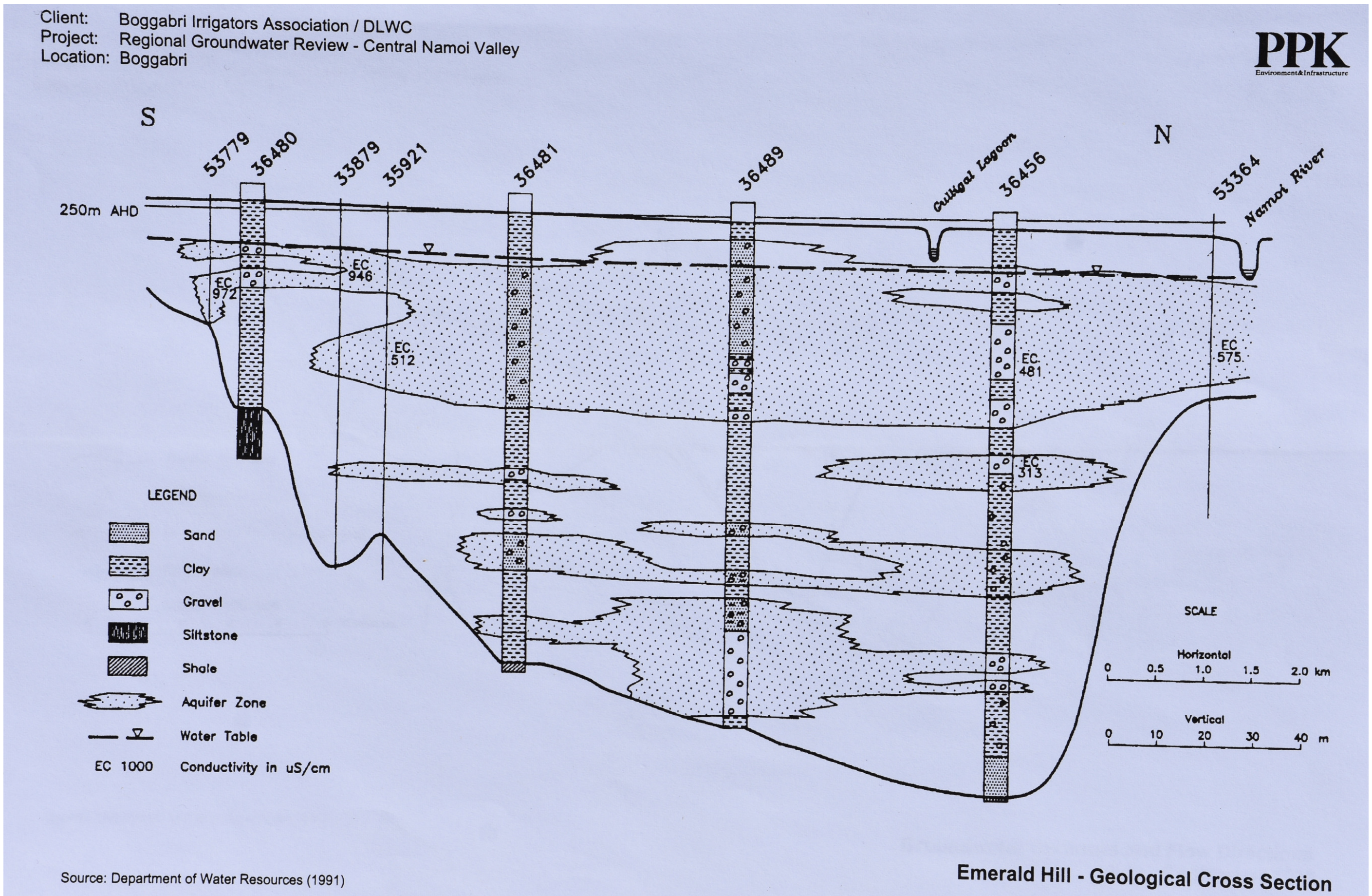


Figure 1 Emerald Hill geological cross section Boggabri Irrigators Association/DLWC Regional Groundwater Review- Central Namoi Valley PPK Source of diagram Department of Water Resources (1991)

The pore space containing the precious groundwater varies from approximately 60-65% by volume in the Gunnedah formation. These aquifers can be interfered with by way of reducing recharge and reducing the storage capacity of the pore space in the unconsolidated alluvial sediments. It happens imperceptibly over time. The continual vibration causes a ‘preferred orientation’ of the sediments. They take up less space meaning that aquifers may not refill to the same extent. Aquifer storage capacity is reduced. This a high risk to GW Zone 4 west which the proposed railway-loop divides in two.

Built infrastructure risks to groundwater recharge

Major flooding and Sideslope catchment are the two dominant sources of recharge in this area (Namoi CMA Gap Project 2010). One of the consequences of diversion of flow caused by poorly located large infrastructure projects is interference with aquifer recharge.
This happens because hillslope catchment runoff and deep drainage can be diverted away from intake beds on the floodplain.

The sideslope catchment of Collygra Creek has an area of 32,000 ha. Over 20 soil landscape slope and soil types and infinitely variable meteorological scenarios. Unpredictable summer storm cells in this area and complex soil landscape classifications make numerical modelling problematic (Crawford et al 2004). Storm cells over part or all of the catchment produce unbelievable runoff events. Eyewitness accounts of flooding over generations confirm that we should not be complacent. The limitations of transient numerical models must be acknowledged and the possibility of more extreme events in the future accepted. The runoff is usually underestimated (Pigram 2006).

Conclusions

The Namoi catchment area to Gunnedah is 17,000 square kilometers (Web, McKeon and Associates 2005). The case study area is acknowledged as being a sensitive part of the floodplain. There is no consistent pattern of flooding. This is due to the large catchment and variability of storm cell location and the many sources of floodwaters. Changes in flood behaviour have also been observed from flood to flood as the course of the river bed is altered and changes occur to floodplain development.

Storm intensity and duration together with ill-defined catchments, for example Deadmans Gully and Collygra Creek, mean that transient numerical modelling has limitations. Cropping patterns and soil landscapes have to be considered. This makes prediction of future flood heights through modelling unreliable. Modelling past floods can be helpful however; catchment communities are interested in planning for the future and preservation of their livelihoods. Extrapolating from previous flood models is unacceptable and irrelevant in infrastructure location approval.

Climate change issues have not been addressed in the Project EIS. An amendment to the Act in 2017 requires that major projects do this. Recent investigations by Professor Kiem and his team at Newcastle University give us a new sense of awareness of what may happen in future flooding and drought. His work is not to alarm us but to help us prepare fore extreme weather events. There is good correlation with studies in tree growth rings going back 300 to 400 years.

So how does Whitehaven Coal accommodate the transport needs of Vickery Project? Whitehaven Coal has access already approved in 2014 so there is no need to cross the floodplain. In this way the Biophysically Strategic Agricultural Land of the Liverpool Plains is protected. Extreme weather events and flooding is unpredictable so work and plan with nature and do not fight it.

Keep off the plains and let them behave as naturally as possible. Try to mimic the early plains and benefit from their natural sequencing and pond development. Keep away from the Namoi

River and Gulligal Lagoon. Do not interfere with the natural flood - distribution system of Deadmans Gully in the vicinity of Emerald Hill.

The planning and assessment process should proceed with caution being aware of possible unintended consequences after structures are built. The safest option is to keep large infrastructure off the floodplain. Existing works should remain, however no new 'development consent' for major infrastructure, such as the Vickery railway loop, should be given.

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