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Transport Infrastructure Development Corporation

North West Rail Link Environmental Assessment

Flooding and surface water management

October 2006

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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1. Introduction

1.1 Purpose of this report

This report has been prepared as part of the environmental assessment of the proposed North West Rail Link (the proposal). The Transport Infrastructure Development Corporation is the proponent of the proposal, and the environmental assessment is being prepared by GHD, in accordance with the requirements of Part 3A of the *Environmental Planning and Assessment Act 1979*.

This report assesses the potential impacts of the proposal on flooding and surface water management.

It includes a description of the existing surface water environment of the study area, an assessment of potential impacts during construction and operation, and recommended measures to mitigate adverse impacts and enhance positive impacts.

It has been prepared to meet the Department of Planning Director-General's Requirements for the environmental assessment.

1.2 Project Outline

The proposed North West Rail Link would be the principal trunk public transport line in Sydney's North West. It would connect with the Northern Line between Beecroft and Cheltenham Stations and terminate at Rouse Hill Town Centre. The rail link would be twin track, approximately 23 km in length and would include:

- A 2.5 km surface quadruplication of the Northern Line between north of Epping Station and Beecroft Station (including works at Cheltenham Station);
- A 16 km section in tunnel from the Northern Line to north of Norwest Business Park, including four underground stations (Franklin Road Station, Castle Hill Station, Hills Centre Station and Norwest Station);
- A 4 km surface section from north of Norwest Business Park to Rouse Hill, including two underground stations (Burns Road Station and Rouse Hill Station)
- An interim train stabling facility at Rouse Hill;
- Ancillary tunnel support facilities such as tunnel ventilation, transformers and a water treatment plant(s); and
- Construction work sites, including a large site within the Balmoral Road Release Area.

The location of the proposal is shown in Figure 1.

1.3 Alignment (proposal)

The alignment of the proposal has been developed over a number of years and has been supported by a number of studies. This resulted in the release of the 2002 Alignment, which was taken through further study and stakeholder consultation. The

outcome resulted in a number of modifications, which formed the basis of the current alignment, documented in the Project Application and Preliminary Environmental Assessment report (SKM, April 2006). The current alignment is referred to as the proposal.

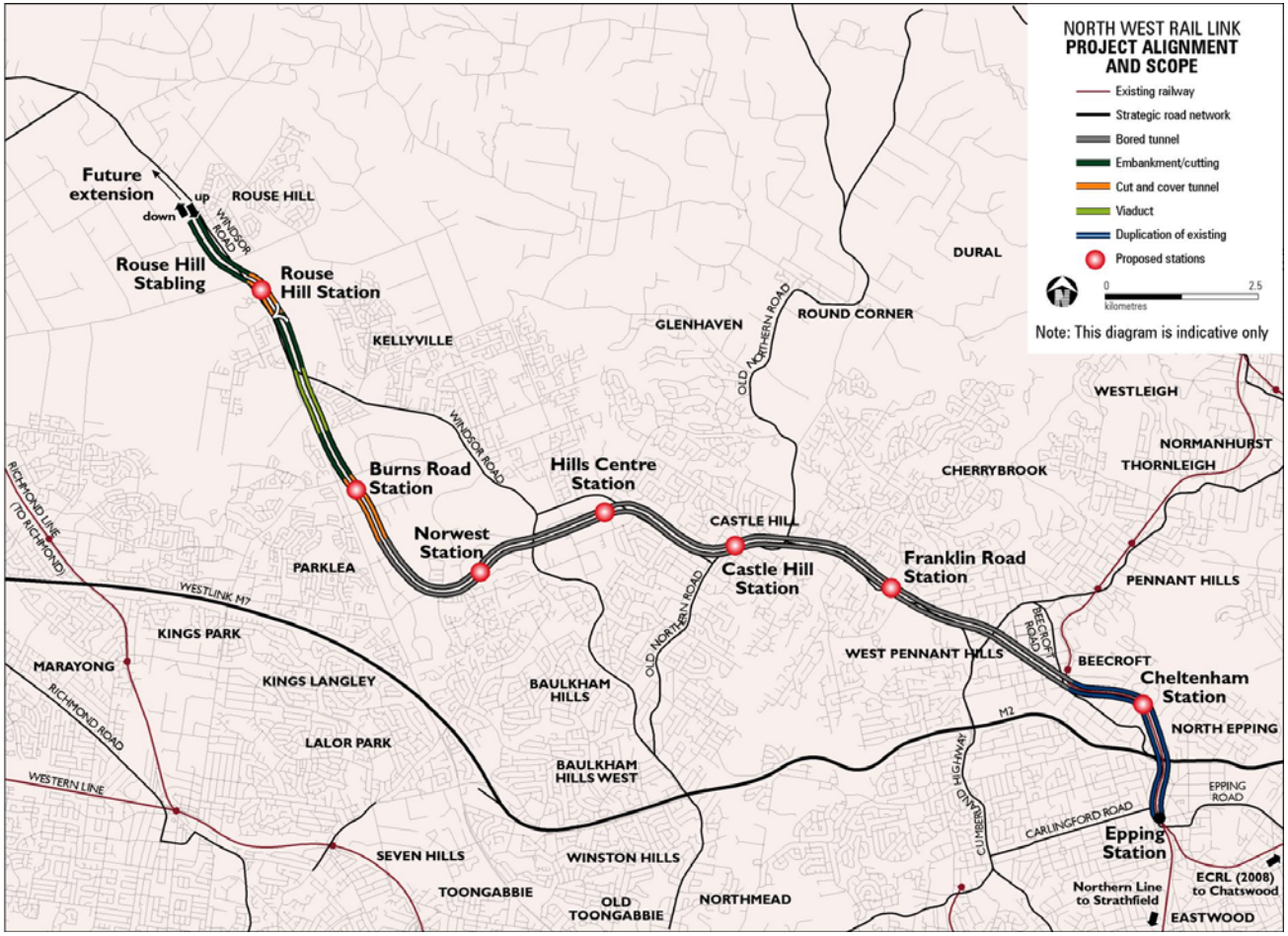

Figure 1 Location of the proposal

2. Methodology

2.1 General

The assessment of surface water and flooding impacts associated with the proposal has been based on available information. Most of this information was prepared for the 2002 Alignment, however given the nature of alignment modifications, the data was considered adequate for the present assessment.

2.2 Site Inspection

The proposal route alignment was inspected, and key sites were visited to obtain an overall understanding of the proposal interface with surface water. This provided background data to this assessment and an appreciation of the key issues.

2.3 Working Paper No 3

Working Paper No 3., Hydrology and Hydraulics Assessment, SKM, April 2003 provided an assessment on the 2002 Alignment. The modifications incorporated in the proposal respond to some of the issues raised in this report. Because the proposal is similar to the previous alignment for the above-ground sections, this Working Paper was used as a key background document to this assessment.

The Working Paper documents existing conditions, undertakes a detailed assessment at a number of sites and suggests mitigation measures. Information for the Working Paper included data provided by Rail Infrastructure Corporation, Rouse Hill Infrastructure Consortium RHIC, the RTA and various consultants.

Of particular relevance was information from RHIC, which was used to undertake flood modelling at key sites. The flood peak data and limited topographic data provided by RHIC was used to develop steady state hydraulic models, which were simulated for:

- Existing conditions; and
- Conditions with the proposal 2002 Alignment; and
- Conditions with the proposal 2002 Alignment with options for mitigation.

The Working Paper was reviewed and was found to be comprehensive. To this end it provided the primary source of data and information for the present study.

2.4 Stakeholder Liaison

Liaison is underway with key stakeholders, including Department of Natural Resources, Baulkham Hills Shire Council, Hornsby Shire Council, Blacktown City Council, and Sydney Water Corporation.

3. Existing Environment

3.1 Project outline and environmental interfaces

From Epping Station to Beecroft the proposal is a quadruplication of the Northern Line. The proposal is a bored tunnel between Beecroft and north of Norwest Business Park. Near Burns Road station it becomes a cut and cover tunnel through to Sunnyholt Road. At Sunnyholt Road the alignment emerges and spans the Caddies Creek confluence, on a proposed viaduct. After crossing the Caddies Creek confluence it continues as a cut and cover tunnel beyond Rouse Hill Station and under Windsor Road. From this point it emerges into a siding before ending on the southeastern floodplain of Second Ponds Creek. Along the route the proposal traverses the floodplains of Caddies Creek and its tributaries. Caddies Creeks drains to Cattai Creek, a tributary of the Hawkesbury-Nepean River.

In the Caddies Creek catchment, the proposal interfaces with a number of tributaries draining to Caddies Creek, namely:

- Elizabeth Macarthur Creek,
- Seconds Pond Creek, and
- A number of smaller tributaries, namely Caddies Creek Tributaries 3, 4 and 5.

There are described below.

3.2 Existing Environment

3.2.1 Elizabeth Macarthur Creek (southeast of Burns Road Station)

There is no aboveground interface of the proposal with Elizabeth Macarthur Creek during the operational phase.

During the construction phase it is proposed to locate the worksite areas adjacent to Elizabeth Macarthur Creek, potentially within the edge of the floodplain. In addition, it is proposed to transition from bored tunnel to a cut and cover construction operation in this area.

Data inferred from the 2002 Alignment suggests that the catchment area draining to Elizabeth Macarthur Creek at this point comprises approximately 130 ha. 1% AEP flood peaks in the order of 30 m^3/s could be expected, with probable maximum flood (PMF) peaks of 180 m^3/s. The width of inundation is likely to be in the order of 50 m during a 1% AEP event and 120 m wide during a PMF event. These figures are indicative and should be confirmed during the detailed design stage.

3.2.2 Caddies Creek, Tributary 5 and Elizabeth Macarthur Creek Confluence

The Caddies Creek Confluence marks the confluence of Caddies Creek, Tributary 5 and Elizabeth Macarthur Creek. At this location the proposal emerges from cut and cover onto the Elizabeth Macarthur Creek floodplain. The alignment is located between

the creek and Old Windsor Road, with the North West Transitway located between Old Windsor Road and the proposal.

The proposal is located parallel to the Elizabeth Macarthur Creek centreline and traverses some 500 m of the 1% AEP floodplain. Significant development has occurred to the east of Elizabeth Macarthur Creek and flood mapping indicates that these properties are not inundated in a 1% AEP event. However it is documented that there is potentially limited freeboard. On this account, it is probable that the properties are flood affected during a PMF event. It has further been noted that this confluence of creeks acts as a wetland.

Caddies Creek flows pass under Old Windsor Road via Detention Basin 5, which attenuates flood peaks for both existing and future development conditions. Tributary 5 also passes beneath Old Windsor road and the transitway via a series of box culverts.

The catchment area upstream of this point is approximately 1,019 ha. Table 1 lists known key hydraulic parameters at this site.

Table 1 Caddies Creek Confluence Existing Environment

Event	Approximate Creek Invert (m AHD)	Approximate Rail Vertical Alignment at the crossing	Flood Level (m)	Flood Peak (m3/s)
1% AEP Event	43 (estimate)	viaduct	44.12	unknown
PMF			unknown	unknown

3.2.3 Tributary 4

At the position where the proposal crosses Tributary 4, the alignment is located in a cut and cover tunnel. There is no aboveground interface of the alignment with Tributary 4 during the operational phase.

Tributary 4 passes under Windsor Road via a series of culverts capable of conveying the 1% AEP event. The road is overtopped during a PMF event, the magnitude of which is presently unknown. The extent of inundation at the creek crossing is approximately 60m wide during a 1% AEP event. The information at hand indicates that no existing properties are inundated during a 1% AEP event.

During the construction phase of the cut and cover operation, careful management of Tributary 4 would be required. The catchment area of Tributary 4 upstream of the site is approximately 134 ha and Table 2 lists key hydraulic parameters at this site.

Table 2 Tributary 4 Existing Environment

Event	Approximate Creek Invert (m AHD)	Approximate Rail Vertical Alignment at the crossing	Flood Level (m)	Flood Peak (m3/s)
1% AEP Event	43 (estimate)	Cut and cover	43.60	36.5
PMF			unknown	unknown

3.2.4 Tributary 3

At the position where the proposal crosses Tributary 3, it is located in a cut and cover tunnel. Furthermore, it appears that the Rouse Hill Station at this location has been moved westward in the proposal, away from the creek centreline. Thus, it is unlikely that there would be an aboveground interface of the proposal with Tributary 3 during the operational phase.

Tributary 3 passes under Windsor Road via a series of culverts. The road is likely to be overtopped during a PMF event, the magnitude of which is presently unknown. The extent of inundation at the creek crossing is approximately 70m-100m wide during a 1% AEP event. The information at hand indicates that no existing properties are inundated during a 1% AEP event.

During the construction phase of the cut and cover operation and station construction, careful management of Tributary 3 would be required. The catchment area of Tributary 3 upstream of the proposed rail crossing is approximately 34 ha and Table 3 lists key hydraulic parameters at this site.

Table 3 Tributary 3 Existing Environment

Event	Approximate Creek Invert (m AHD)	Approximate Rail Vertical Alignment at the crossing	Flood Level (m)	Flood Peak (m3/s)
1% AEP Event	45.5	Cut and cover	47.11	6.9
PMF			unknown	unknown

3.2.5 Second Ponds Creek

The western end of the proposal and associated stabling yards are located on the eastern edge of the Second Ponds Creek floodplain. The proposal would be located in a cutting, emerging from the cut and cover tunnel. The surrounding land use in this location comprises semi-rural residential and commercial developments, bushland and open space. Redevelopment is expected in the future.

The catchment area of Second Ponds Creek upstream of the proposed rail crossing is approximately 625 ha and Table 4 lists key hydraulic parameters at this site. The PMF flood level is presently unknown. The width of Second Ponds Creek inundation at the

proposed stabling yards is approximately 180m during a 1% AEP Event and 350 to 400 m during a PMF.

Table 4 Second Ponds Creek Existing Environment

Event	Approximate Creek Invert (m AHD)	Approximate Rail Vertical Alignment at the crossing	Flood Level (m)	Flood Peak (m3/s)
1% AEP Event	40 (estimate)	54.5	43.82	56.6
PMF			unknown	635

3.2.6 Quadruplication of Main North Line

Where the route comprises quadruplication of the northern line, it is likely that a number of smaller drainage creek crossings exist. These include the crossing of Devline Creek at the intersection with the M2 Motorway.

4. Impact assessment (Construction and Operational)

4.1 General

Potential impacts associated with the proposal in terms of surface water and flooding include:

- Raised flood levels due to obstructions to the flood discharges in the form of insufficient waterway openings, or constriction due to facilities and buildings being located in the flood way. This could lead to increased flood risk;
- Reduced floodplain storage at the location of rail embankment or associated facilities in the floodplain;
- Impact on local drainage, due to facilities interfering with the conveyance of local runoff;
- Increased runoff due to increased impervious areas;
- Stormwater quality impacts associated with the construction phase and operational phase, such as dewatering of underground facilities;
- General construction phase impacts; and
- Flood water entering tunnels through the dives.

4.2 Flood Levels and Conveyance

4.2.1 Elizabeth Macarthur's Creek (southeast of Burns Road Station)

As the proposal adjacent to Elizabeth Macarthur Creek is located in a cut and cover tunnel, no major impact is expected during the operational phase provided the topography is reinstated. During the construction phase it is proposed to locate the work sites within the Elizabeth Macarthur Creek flood plain. Locating the works area within the creek is not considered favorable, and careful management of surface water would be required to divert flows around works areas preventing construction related pollution from discharging to the creek. In addition, a buffer (preferably 40m or more) should be provided between the works area and Elizabeth Macarthur Creek.

The cut and cover operation is located on the edge of the floodplain and it would be necessary to ensure that flood waters are adequately managed during the construction phase, to prevent inundation of the works areas. This could be achieved by the provision of bunding to an appropriate flood level which should be determined through a risk assessment.

4.2.2 Caddies Creek, Tributary 5 and Elizabeth Macarthur Creek Confluence

At this location the proposal would be located on a viaduct, with the vertical alignment 3 m to 4 m above existing ground surface. A viaduct length of 850 m is proposed. The viaduct is likely be located above the 1% AEP event, however may be subject to the PMF. The PMF information at this site is presently not available. The viaduct would

need to minimise flood level impacts to the residential area located east of Elizabeth Macarthur Creek and throughout the area of the Caddies Creek, Tributary 5 and Elizabeth Macarthur Creek Confluence confluence.

Potential impacts associated with the viaduct include loss of floodplain storage and disruption to the flow associated with piers and abutments. It would also be important to determine the PMF flood situation to ensure the viaduct does not impact on rare events.

A further impact is the potential for raised flow velocities associated with conveyance through the constriction and around piers of the proposed viaduct. This may lead to erosion and local scour and as a result the piers would need to be carefully designed.

4.2.3 Tributary 4

As the proposal at Tributary 4 is located in a cut and cover tunnel, no major impact is expected during the operational phase. During the construction phase the cut and cover operation is proposed across the creek line. It would be necessary to ensure that, during the construction phase, the creek and potential floodwaters are adequately managed to prevent inundation of the works.

Temporary works to manage Tributary 4 would need to minimise the flood level impact to surrounding lands as this could raise the flood risk to existing dwellings.

4.2.4 Tributary 3

At Tributary 3 the proposal is located in a cut and cover tunnel. No impact is expected during the operational phase. During the construction phase the cut and cover operation is proposed across the creek line. It would be necessary to ensure that the creek and potential floodwaters are adequately managed during the construction phase, to prevent inundation of the works.

Temporary works to manage Tributary 3 would need to minimise the flood level impact to surrounding lands as this could raise the flood risk to existing dwellings.

While Rouse Hill Centre Station has been moved westward, away from the creek centerline, it would be necessary to ensure that the station is outside the 1% AEP and PMF flood extents of Tributary 3, to prevent the risk of floodwater ingress to the station.

4.2.5 Second Ponds Creek

At Second Ponds Creek the alignment and stabling yards would be located in a cutting, emerging from the cut and cover tunnel. During the construction phase it is proposed to locate work site areas within the PMF and 1% AEP event flood plains. The works in these areas would need to minimise the flood level impact to surrounding lands as this could raise the flood risk to existing dwellings.

For the operational phase, the cutting is located on the edge of the floodplain, and it would be necessary to ensure that flood waters do not overflow to the cutting, and potentially ingress to the cut and cover tunnel.

4.2.6 Quadruplication of Northern Line

At creek crossings associated with the quadruplication of the Northern Line the risk exists that extension of culverts and fill embankments affects conveyance through existing structures and impacts local flood risk. In addition, where culverts may be replaced, the risk exists that flood conveyance through the structure may be altered resulting in a reduction an upstream flooding, with the transfer of flood risk downstream of the alignment.

4.3 Scour

The potential for raised flow velocities as flood flow passes through the constriction of any proposed waterway opening, leading to scour at the inlets and outlets, would need to be managed and designed for. In addition where piers and abutments are located within the flow path, the risk of erosion and scour impacts needs to be managed.

4.4 Floodplain Storage

To date there exists no definitive information on impacts associate with flood plain storage loss. While loss of floodplain storage may be an issue for all the proposed crossings, the key areas where the impact may be significant include:

- Second Ponds Creek; and
- Caddies Creek Confluence

During the detail design phase, further studies should be undertaken to define flood peaks and levels for a full range of events. These should rely on two-dimensional modeling where potential floodplain storage impacts need to be defined.

4.5 Local Stormwater Management and Drainage

On-site stormwater runoff peak flow rates and volumes could be increased due to the increased impermeable surfaces associated with the works, particularly in areas such as the stabling yards or at the location of stations. During moderate rainfall events the resultant discharges can be highly erosive to stream bed banks and the receiving environment, thereby causing downstream degradation (for example of the aquatic habitat).

Increased peaks could raise on-site and off-site flood risk if not adequately managed. This could raise the flood risk (to life and property), compromise downstream infrastructure capacity and impact downstream environments leading to increased erosion and sedimentation.

Flood risk at the sites could also be impacted by local drainage channels that bisect or are located in close proximity to the alignment, and that convey runoff from larger upstream catchment areas either through or past the works. In areas of cuttings, local berms may be required to divert surface waters. Floodwaters captured within cuttings would need to be managed and disposed.

4.6 Stormwater Quality

Water quality impacts are expected to be associated primarily with dewatering of the underground infrastructure during the operational phase. Water intercepted through sub-surface drainage, would need to be pumped to the surface, treated and disposed of to local creeks, meeting relevant water quality standards.

For the construction phase, stormwater quality would need to be managed as further discussed in Section 4.7.

4.7 Construction Phase Impacts

During the construction phase, clearing and earthmoving activities have the potential to impact on surface water quality in the vicinity of the sites, especially during high rainfall events. The activities and aspects of the works that have potential to lead to erosion, sediment transport, siltation and contamination of natural waters include, amongst others:

- Earthworks undertaken immediately prior to rainfall periods;
- Work areas that have not been stabilised, and clearing of land in advance of construction works;
- Stripping of topsoil, particularly in advance of construction works;
- Bulk earthworks and construction of pavements;
- Washing of construction machinery;
- Works within drainage paths, including depressions;
- Stockpiling of excavated materials;
- Storage and transfer of oils, fuels, fertilisers and chemicals;
- Maintenance of plant and equipment; and
- Management of tunnel construction water.

4.8 Stakeholder Liaison

Concerns and comments provided by the stakeholders to date include:

- Impacts on existing flooding should not be exacerbated;
- Disturbances to the environment should be minimised and managed during construction and operational phases;
- Local drainage connections from the proposal will need provision of Gross Pollutant Traps;
- Standards for connections to Sydney Water Corporation assets needs to be followed and works should undertaken through a Water Service Co-ordinator;
- Cognisance needs to be given to known flooding problems on Tributary 4;
- Need to consider the upgrade of Windsor Road;
- The latest hydrology needs to be established at each site;

- Collaboration with Councils needs to occur in determining flood levels;
- Local tributaries need to be considered at the proposed siding site;
- In rural areas of Blacktown, it will be important to maintain existing conditions in terms of stormwater quantity;
- DNR riparian requirements will need to be considered;
- All ingress of surface water to tunnels portals and stations will need to be ensured up to the PMF flood event;
- Water quality policy for Blacktown City Council will need to be incorporated;
- Water Sensitive Urban Design approaches should be proactively pursued and water reuse should be maximized (for example train wash facilities);
- Construction phase impacts need to be managed using a risk based approach;
- Opportunities to upgrade water quality should be sought;
- Revegetation and stabilisation after construction will require careful consideration;
- DNR requirements and guidelines for water course crossing design, construction and stormwater outlet structures to streams and any other relevant documents/guidelines need to be incorporated in the designs;
- Viaduct piers should consider debris impact and hydraulic loading;
- Significant bank protection should be provided throughout the flood plain using appropriate soft engineered approaches;
- Salinity issues should be considered;
- Cross-drainage in the section of quadruplication should be designed not to exacerbate upstream and downstream flooding and flood risk; and
- Water quality treatment of tunnel seepage water will need careful design such that pollution targets are met, before discharge to surface water.

5. Proposed Mitigation Measures

5.1 Flood Conveyance and Levels

Flood conveyance for each of the locations discussed in Section 4.2 is best mitigated on a case-by-case basis. At each site the objective would be to minimise increases in flood levels upstream of the structure and maintain or reduce the existing flood risk. At the design phase, it would be necessary to undertake detailed investigation of the hydrology and hydraulics at each site. This may require development of two dimensional hydraulic models to assess the impacts of floodplain storage loss where appropriate.

5.1.1 Elizabeth Macarthur Creek (southeast of Burns Road Station)

At Elizabeth Macarthur Creek, it would be preferable to locate the works areas outside the creek and associated floodplain. All works areas should be subject to an environmental management plan, which would include an erosion and soil management plan and considers flood risk. The erosion and soil management plan should be prepared in accordance with Landcom's Soils and Construction, Managing Urban Stormwater (March 2004).

During the construction phase of the cut and cover tunnel it would be necessary to ensure floodwaters do not overflow to the works areas. This may require local creek diversions with local bunding, with consideration given to local flood risk impacts. Bunding should occur to an appropriate flood level, which should be determined through a risk assessment. A buffer (preferably 40m or more) should be provided between the works area and Elizabeth Macarthur's Creek

5.1.2 Caddies Creek, Tributary 5 and Elizabeth Macarthur Creek Confluence

The proposed viaduct at this location is considered to be the best solution to minimise flood storage loss and interference with the conveyance of flood events. The proposed viaduct length of 850m is expected to provide the least interference with the 1% AEP event. While this mitigation option appears viable, the suggestion that a two dimensional model be used during the design stage is supported. This would facilitate:

- A better understanding of the discharges at the confluence of the creeks;
- The advantages of replacing a part of the viaduct with a bridge section at the confluence of Caddies Creek and Elizabeth Macarthur Creek and Tributary 5 and Caddies Creek;
- Definition of the PMF flood passage and assessment of the likely impacts;
- Better definition of flood plain storage loss impacts; and
- Opportunities for reducing viaduct lengths.

5.1.3 Tributary 4

The key issue to be mitigated at this site is the management of the creek during the construction phase to allow construction of the cut and cover tunnel. This may require a temporary diversion of the creek together with bunding of the works areas. Any such work should make provision for flood events to prevent overflow to the cut and cover operation and minimise upstream flood risk.

5.1.4 Tributary 3

As with Tributary 4 the key issue to be mitigated at this site is the management of the creek during the construction phase to allow construction of the cut and cover tunnel and Rouse Hill Station. This may require a temporary diversion together with bunding of the works areas. Any such work should make provision for flood events, to prevent overflow to the cut and cover operation and minimise upstream flood risk.

In terms of Rouse Hill Station it would be necessary to locate the station outside the Tributary 3 flood plain and make provision through local bunding to prevent floodwaters from entering the station for events up to the PMF.

5.1.5 Second Ponds Creek

At this site it would be preferable to locate the works areas outside the creek and associated floodplain during the construction phase. For the operational phase, it would be important to prevent ingress of flood waters to the siding area and potentially the cut and cover tunnel. This could be achieved by locating the western extent of the siding outside the floodplain or providing local bunding in this area.

For the area within the cutting, local surface water would need to be managed, such that discharges are diverted away from the cutting. Furthermore runoff entering the cutting area would need provision of adequate drainage including pump stations together with water quality treatment before discharge to the environment.

5.1.6 Quadruplication of Main North Line

At creek crossings associated with the quadruplication of the Northern Line care should be taken to maintain the existing local flood risk. If culvert extensions are required, these should be designed not to increase upstream flooding. Should existing culverts be replaced, flood risk should not be transferred downstream of the alignment by providing increased conveyance.

5.2 Scour

Erosion and scour can be managed by careful design of transitions at structure inlets and outlets. This would require adequate land upstream and downstream of structures to locate transitions. Erosion control using ‘soft’ engineered solutions should be used in preference to hard engineered structures.

5.3 Floodplain Storage

Floodplain storage impacts have not been defined to date and key sites of concern have been noted in Section 4.4. If a viaduct is used it is expected that there would be minimal impact upon floodplain storage volumes. These impacts are best managed using the proposed viaduct and reducing the footprint within the floodplain. It would be important to further define the flood plain storage impacts during the detailed design stage, potentially through the use of two dimensional modeling.

5.4 Local Stormwater Management and Drainage

Changes in local stormwater runoff, such as runoff volume and runoff peak magnitude and response can best be managed using on-site detention facilities, according to local Council requirements. This would be particularly relevant to areas such as stations and the sidings, which have larger development and hardstand footprints.

5.5 Stormwater Quality

Water quality associated with dewatering operations can be treated above ground, using package or other treatment facilities before disposal to local creeks. Construction phase water quality can be managed as discussed in Section 5.6 below.

5.6 Construction Phase

Construction phase impacts can be managed by implementation of a construction phase soil and water management plan detailing stormwater management strategies in accordance with the guideline ‘Soils and Construction, Managing Urban Stormwater’ (Landcom, 2004). These would include amongst others:

- General site practices and responsibilities;
- Material management practices;
- Stockpile practices;
- Water treatment plant for tunnel construction water;
- Topsoil practices; and
- Erosion control practices (earth sediment basins, straw bales, sediment fences, turbidity barriers, stabilised site accesses, diversions and catch drains).

6. Summary and Conclusions

This report has been prepared as part of the environmental assessment of the proposed North West Rail Link. It assesses the potential impacts of the proposal proposal on flooding and surface water management. This report responds to the alignment documented in the Project Application and Preliminary Environmental Assessment, SKM, April 2006.

The assessment has been undertaken based on available information, comprising previous studies, which were supported by preliminary flood modelling. In addition a site inspection and stakeholder liaisons have been undertaken.

Up to approximately Sunnyholt Road, the proposal is located within a bored tunnel or comprises a cut and cover tunnel. At Caddies Creek confluence a viaduct is proposed. The proposed viaduct at this location is considered to be the best solution to minimise flood storage loss and interference with the conveyance of flood events. Along the remainder of the route the proposal traverses the floodplains of Caddies Creek and its tributaries. Caddies Creek ultimately drains to Cattai Creek, which is located in the Hawkesbury-Nepean catchment.

The existing environment is described at the interface points of the proposal and creeks. Where information is available, flood extent, level and peaks are provided for the 1% AEP event and the PMF.

The impact assessment lists potential impacts at a number of sites, as determined through this assessment and through stakeholder liaison. Impacts include:

- Management and ingress of floodwaters during the operational and construction phases to stations, works areas and cut and cover sections. In particular ingress at tunnel portals and at stations should be provided up to the PMF event;
- Management of flood levels and local flood risk at creek crossings;
- Construction phase impacts;
- Loss of floodplain storage;
- Local stormwater management; and
- Provision of erosion and scour protection.

Measures have been proposed to mitigate the above impacts.

In conclusion, from a flooding and surface water management perspective, it is likely that the impacts identified can adequately be addressed during the detailed design stage. This would require further detailed hydrological and hydraulic investigations at a number of sites, to provide a better understanding of likely surface water conditions allowing the design to proceed.

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Document Status

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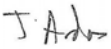
		Name	Signature	Name	Signature	Date
	R Berg	A Raleigh	19/10/06	J Ardas		19/10/06