READYMIX REGIONAL DISTRIBUTION CENTRE PROJECT
KELLOGG ROAD, ROOTY HILL

FLOOD STUDY

April 2005

Bewsher Consulting Pty Ltd

READYMIX REGIONAL DISTRIBUTION CENTRE
KELLOGG ROAD, ROOTY HILL

FLOOD STUDY

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Prepared by:

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1. INTRODUCTION

1.1 PROJECT DESCRIPTION

Readymix proposes to construct and operate a Regional Distribution Centre (RDC) at Kellogg Road, Rooty Hill ('the RDC Site'). The RDC will be a key component of the Readymix rail based strategy where construction materials would be transported to Rooty Hill from outlying quarries outside of the Sydney Basin.

The proposed RDC would be capable of handling up to 4 million tonnes of various sand and aggregate products each year with an initial operational capacity of approximately 2 to 2.5Mtpa. The materials would be blended as required to suit customer requirements, by equipment in the RDC and distributed by road to the Sydney market.

The RDC would consist of:

- a regional office building which incorporates a quarry materials and concrete testing laboratory;
- a rail siding with aggregate unloading facility;
- storage bin area and load out facilities;
- ground storage and reclaim facilities;
- blending plant;
- a conveyor system linking the unloading station to the storage and truck load out facilities;
- workshop, stores, and amenities facilities, truck washdown facilities, truck refuelling, weighbridges, truck and car parking;
- concrete batching plant;
- bridges at two locations over Angus Creek; and
- realignment of North Parade (to a location immediately north of the new rail siding).

1.2 POTENTIAL FLOODPLAIN ISSUES

The major portion of the Readymix property is elevated and slopes in a general south-easterly direction towards Angus Creek (which flows in an easterly direction through the southern portion of the property). Angus Creek crosses the RDC Site's eastern boundary and then passes through the Nurragingy Reserve which is where the creek joins the larger Eastern Creek. The One Steel Mini Mill is located immediately west of the site.

While much of the project infrastructure is proposed to be located on the elevated northern portion of the RDC Site, some elements – principally the rail siding, rail unloading station, the rail unloading transfer conveyor system (and related access road), the two bridges over Angus Creek and the realigned North Parade – will be within the Angus Creek 100 year ARI floodplain. Bewsher Consulting was commissioned to undertake a flood study in accordance with the Director General's requirements and in particular to assess the project's potential impact on the local Angus Creek flood regime.

In a report dated August 2003 and entitled *Readymix Concrete Batch Plant Development Flood and Drainage Assessment* (**Reference 1**), Bewsher Consulting had previously used Blacktown City Council flood study information which was prepared by Bewsher Consulting to document the 100 year average recurrence interval (ARI) flood regime through the RDC Site. However the scope of the proposed RDC works within the floodplain were such that a new and more detailed flood modelling approach needed to be adopted, as is described in this report for the proposed RDC.

This report principally focuses on the 100 year ARI flood event, but also includes a broad picture of an extreme or probable maximum flood (PMF) event.

2. AVAILABLE DATA

The flood modelling has made use of the following data:

- A RAFTS hydrologic model of the Angus Creek catchment which was used by Bewsher Consulting for the *Blacktown Floodplain Management Study* (**Reference 2**).

- Results from an Eastern Creek flood model also used by Bewsher Consulting for the *Blacktown Floodplain Management Study* (**Reference 3**).

- Detailed aerial mapping undertaken by Geospectrum Pty Ltd for the RDC project but specifically extended to better suit the requirements of the flood study.

- Field survey data of local area Angus Creek and Eastern Creek culverts and bridges by Hammond Smeallie (registered surveyors).

- Railway siding embankment details prepared by Watson Technology Pty Ltd.

- Project design ground levels along the northern fringe of the Angus Creek floodplain provided by the client.

3. METHODOLOGY

3.1 HYDROLOGIC MODELLING

The 1996 Blacktown study saw the refinement of an earlier RAFTS hydrologic model of Angus Creek. That 1996 model, as documented in **Reference 2**, was adopted for this study. The 1996 study had determined that the critical duration storm for the Angus Creek catchment was two hours and therefore the two hour storm output for the 100 year event was directly used (see **Appendix A**) and the 100 year flows were also factored to provide flows for the Probable Maximum Flood (PMF) flood modelling.

3.2 HYDRAULIC MODELLING

3.2.1 Choice of Model

Prior to this study, the definition of Angus Creek flood levels has been based on a 'one dimensional' (HEC-RAS) hydraulic model of Angus Creek which is described in **Reference 2**.

While the HEC-RAS model is generally appropriate for assessment of the current Angus Creek overall flood regime, a more refined model needed to be established in order to more accurately quantify the RDC flood-related impacts and the potential need for, and performance of, offsetting works.

It was subsequently determined that a two-dimensional (2D) model would achieve the necessary extra level of detail by:

- Providing a significantly better definition of the existing flood regime. In particular this would include;

  (a) the flood regime at the adjacent downstream confluence of Angus Creek and Eastern Creek; and

  (b) the flood regime south (or upstream) of the Main Western Railway line.

  Item (b) is significant because the 1996 Blacktown Flood Study modelling of the flood regime at that location identified that some flood flows would spill in an easterly direction along the southern (or upstream) side of the railway embankment and hence not actually pass through the RDC Site, but the assessment of that spill regime lacked sufficient detail. In addition, there has been sporting infrastructure works undertaken adjacent to that spill location since the 1996 study's modelling and hence the spill regime needed to be reviewed and refined.

- Allowing very refined testing of various development options (particularly the embankment of the proposed railway siding).

- Allowing detailed examination of the nature of compensating floodplain works which may be required to offset the impact of the project.

TUFLOW 2D modelling software (**Reference 4**) was adopted for the project modelling.

3.2.2 'Existing Conditions' 100 year TUFLOW Model Inputs

- The digital elevation model — which is required for the development of a TUFLOW model — utilised aerial mapping undertaken by Geospectrum. The 1D elements (which were used to model the various Angus Creek and Eastern Creek hydraulic structures and the Eastern Creek floodplain) were respectively based on culvert and bridge details provided by Hammond Smeallie and cross sections extracted from the 1996 study's flood model of Eastern Creek (**Reference 3**). Some limited interpolation of local area contours (based on available contour mapping) was also undertaken to extend the TUFLOW model at several model boundary locations.

- The relevant Angus Creek inflow hydrographs were extracted from the 1996 study's RAFTS model, while the Eastern Creek flow and stage hydrographs were extracted from the 1996 study's Eastern Creek hydraulic model results. (**Figure A1** in **Appendix A** defines the Angus Creek sub-catchments whose runoff hydrographs were directly imported to TUFLOW.) Since the 1996 study had determined (not surprisingly, given their different catchment sizes) that the Eastern Creek and Angus Creek catchments had differing critical storm durations, this study's TUFLOW model was set up such that the flood peaks from both catchments coincided at their confluence. That is, the resultant model provides an 'upper bound' definition of the local area flood regime.

- The model hydraulic roughness terms were based on a combination of the Mannings 'n' values used in the 1996 study's 1D modelling, site and local area inspections and review of high resolution aerial photography.

It is noted that the Angus Creek flood modelling in the 1996 Blacktown Flood Study— and the previous 1989 flood modelling (**Reference 5**) undertaken for the then proposed BHP Mini Mill project — was undertaken in the absence of any flood calibration or verification data. Most importantly this is also the situation for the study for the proposed RDC because there has been no significant flooding in the intervening years.

3.2.3 RDC Project TUFLOW Model Inputs

There are a number of RDC project elements which needed to be explicitly included in the TUFLOW model. They are:

- the definition of the 3 track railway siding parallel and north of the Main Western Railway line, which includes a new Angus Creek crossing (which is designated as Bridge No. 1) just north of the current alignment of North Parade: This would also see the relocation of North Parade to a new alignment just north of the new siding, while the remnant length of North Parade would be retained for maintenance access to the Main Western Railway line. While the railway siding will be elevated relative to existing ground levels (and hence constitute a potential obstruction to flood flows), the new North Parade roadway is to be constructed essentially to match existing ground levels and therefore that roadway did not require explicit definition in the TUFLOW model. (While it is noted that there will be noise barriers erected along substantial portions of the siding embankment, they would not be located within the 100 year floodplain. They therefore do not need to be included in the TUFLOW 100 year model. Since the noise barriers would not be expected to withstand any floods (much larger and rarer in occurrence than the 100 year event) that would overtop the siding embankment, the structures were also not included in the PMF model);

- the definition of the new Angus Creek access road/conveyor structure (which is designated Bridge No. 2) about six hundred metres downstream of the railway line: Similar to the relocated North Parade, this access road is intended to be built such that its finished levels essentially match the existing ground levels as it crosses the floodplain. However at the actual crossing of the creek channel, the bridge structure and its accompanying approaches would rise above the floodplain;

- the definition of where the ‘north-south aligned’ rail unloading transfer conveyor reaches and exceeds ground level just north of the unloading station: While the project plans show that a portion of the rising conveyor structure is elevated relative to ground level, the majority of the structure would represent a local floodplain obstruction. Therefore a slightly conservative approach was adopted in the flood model whereby the whole ‘north-south’ length of the structure which is at or above ground was regarded as potentially fully obstructing flood flows (i.e. no flow would be possible through the area occupied by the rising conveyor). (It is important to note that for the remainder of the conveyor route across the floodplain, the conveyor structure would be elevated relative to natural ground levels and therefore not represent an obstruction to 100 year flood flows.);

- the definition of project finished ground levels along the northern fringe of the 100 year ARI floodplain: The project finished ground levels in this area will be higher than existing conditions and so the project design contours were used to amend the TUFLOW model’s definition of the local topography.

In the course of the flood study, advice was sought from the Department of Infrastructure Planning and Natural Resources (DIPNR) regarding the creek/floodplain issues of those RDC elements located in the floodplain. During the associated on-site meeting, concept design details of the project floodplain works were shared with a DIPNR officer. Most of the discussion centred on the concept design of Bridge No. 2 and the officer recommended extending the overall length of the structure (which at that time was proposed to consist of a twenty metre long single span bridge) and the examination of ways to reduce the loss of daylight to the creek corridor which would be associated with the bridge's floodplain footprint. (As documented in **Section 3.2.4**, the Bridge No. 2 design was subsequently amended to consist of a structure having an overall forty metre length and was also raised relative to the initial concept design proposal.)

3.2.4 TUFLOW Testing of RDC Elements

A number of alternative openings for Bridge No. 1 to carry the siding embankment and the relocated North Parade across the Angus Creek channel were examined using the TUFLOW model before finalising the concept design. The proposed structure has a rectangular opening which has dimensions of twenty metres (width) by 2.05 metres (depth) relative to the local creek bed level of RL 32.8m. Transitioning works over a distance of approximately twenty metres downstream of the structure were also included in the model.

Since the initial TUFLOW modelling showed that the new siding embankment would be serving to 'trap' some Angus Creek floodwaters between it and the Main Western Railway embankment, works to relieve that 'channelling' pattern was tested by examining the performance of a range of pipes under the siding embankment. The proposed arrangement of siding embankment pipes consists of:

(a) two series of fifteen 600mm diameter pipes and one series of twenty-five 600mm diameter pipes located along the length of the siding embankment, and

(b) seven 900mm diameter pipes located at the eastern end of the siding.

All the pipes would have their invert levels matching natural ground levels.

Reference is made to the detailed project plans which show that Bridge No. 2 (crossing Angus Creek in the middle of the site) will consist of the following:

(i) a twenty metre wide central span (with a bridge structure depth of approximately 1.2m);

(ii) two ten metre spans (with bridge structure depths of approximately 0.9m); and

(iii) roadway levels varying between RL 34.25m at the northern abutment and RL 33.25m at the southern abutment.

Roadway levels will transition back to natural surface levels within approximately twenty five metres of the southern abutment and continue to rise to meet other project design ground levels beyond the northern bridge abutment.

4. 100 YEAR FLOOD AND PMF MODEL RESULTS AND IMPACTS

4.1 100 YEAR EVENT

The resultant TUFLOW model results are presented in **Figures 1** and **2. Figure 2** presents the contours and other information at an appropriate scale in the area where the siding crosses Angus Creek. The red contours represent the *'existing condition'* flood levels and the green contours represent the flood levels after inclusion of the various RDC project elements described in **Section 3.2**. The inundation regime shown in both figures relates to the 'post RDC' scenario.

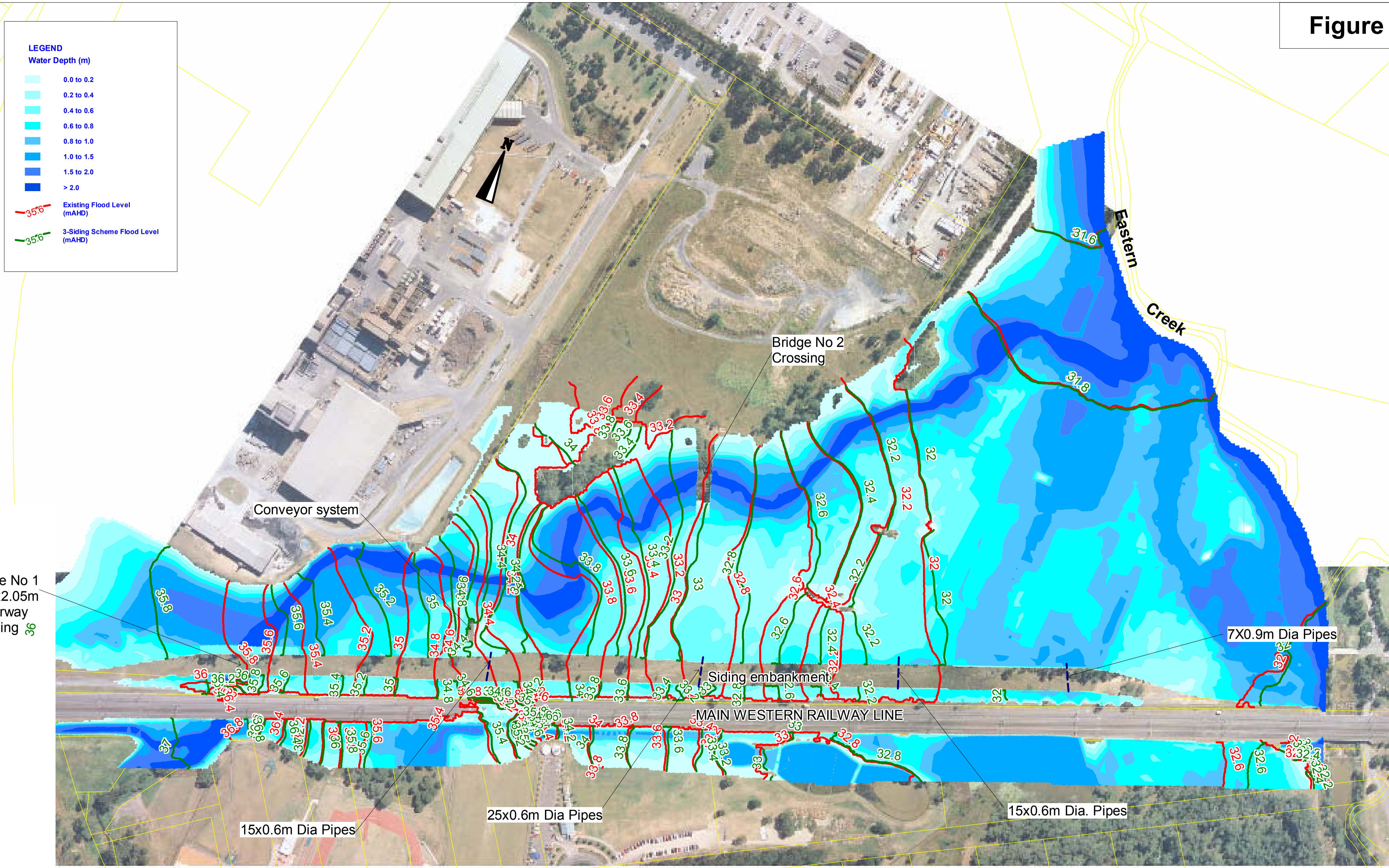
The *'existing condition'* flood levels have been compared with those derived as part of earlier flood studies (being the 1989 Mini Mill study and the 1996 Blacktown Study) and certain differences were discernible. The reasons for the differences are outlined below:

- the red TUFLOW contours in **Figures 1** and **2** were compared with the cross section alignments which were used for the earlier 1989 and 1996 1D hydraulic models. This comparison showed how the TUFLOW flood contours are often not parallel to those cross sections which indicate that the 1D cross sections were actually not positioned such that they are consistently perpendicular to the flood flows. (This is often a 'problem' with 1D modelling because the modeller has to estimate the cross section orientations before running the model. Any orientation errors then impact on the accuracy of the 1D results since the modelling software treats all the flow at each cross section as being conveyed perpendicular to the cross section alignment.) This difference was found to be particularly noticeable immediately downstream of both the railway and North Parade culverts;

- the TUFLOW Angus Creek flood level at the upstream side of the Main Western Railway line is about 400mm higher than that forecast in the 1996 modelling and this difference is mainly attributed to two factors. They are (a) a more realistic definition of floodwaters spilling out in an expanding fan shape downstream of the railway and North Parade which serves to elevate the flood level immediately downstream of the railway, and (b) the late 1990s placement of significant earthworks and an associated retaining wall structure at the Angus Creek overbank spill location which has a potentially substantial adverse impact on the amount of easterly spill which can occur upstream of the railway; and

- the TUFLOW flood levels adjacent to the BHP Mini Mill are significantly higher than that calculated in the 1989 flood study principally due to a substantial increase in the magnitude of 100 year flood flows compared with the flow which was adopted for the 1989 study. In particular it is noted that the 1989 study adopted the same 100 year event flood flow from upstream

Figure 1



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Following structures are included in the model:-
a) Relocated North Parade and three siding track embankment over 20mx2.05m rectangular waterway opening at Augus Creek;
b) Bridge structure approx. 600 metres d/s of main railway;
c) 7x0.9m dia pipes at eastern end of the siding track;
d) 2 sets of 15x0.6m dia. pipes and 1 set of 25x0.6m dia. pipes spaced along siding track;
e) Flow 'block out' for transfer conveyor system;
f) Project design contours north of Angus Creek.

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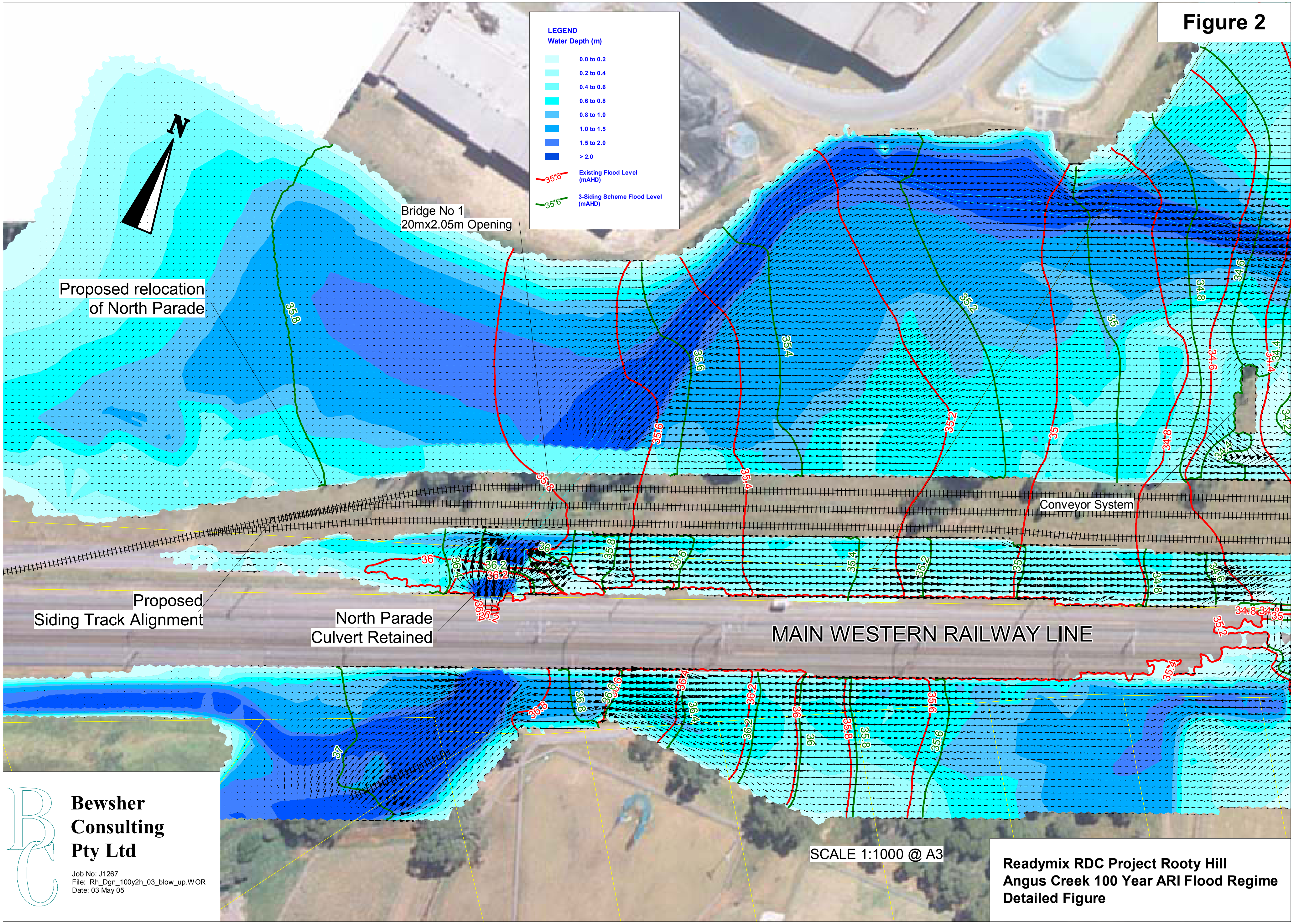
Job No: J1267
File: Rh_Dgn_100y2h_03.WOR
Date: 30 Mar 05

Readymix RDC Project Rooty Hill
Angus Creek 100 Year ARI Flood Regime

Figure 2



Bewsher Consulting Pty Ltd

Job No: J1267
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Date: 03 May 05

Readymix RDC Project Rooty Hill
Angus Creek 100 Year ARI Flood Regime
Detailed Figure

of the railway culvert through to the Angus Creek confluence with Eastern Creek and in so doing did not include any allowance for the substantial western sub-catchment flows which drain to Angus Creek downstream of the railway line. (These western sub-catchment flows were included in the 1996 study modelling and are also explicitly included in the TUFLOW model.)

It is recognised that all the models (being the TUFLOW model and the earlier 1989 and 1996 models) are uncalibrated and therefore the generated flood levels are from 'untested' models. However given both the reasons presented above and the ability of TUFLOW to explicitly model complex flow patterns, it is considered that the TUFLOW model represents a more accurate picture of the complex flood flow regime through and in the vicinity of the RDC Site. Therefore the results from the *'existing conditions'* TUFLOW model have been used as the 'base case' flood levels for comparison with the 'RDC conditions' model.

Figure 3 represents an 'afflux' map where various colour bands define the relative changes in flood levels between the *'existing conditions'* and 'RDC conditions' flood levels and the general trends shown in **Figure 3** are as follows:

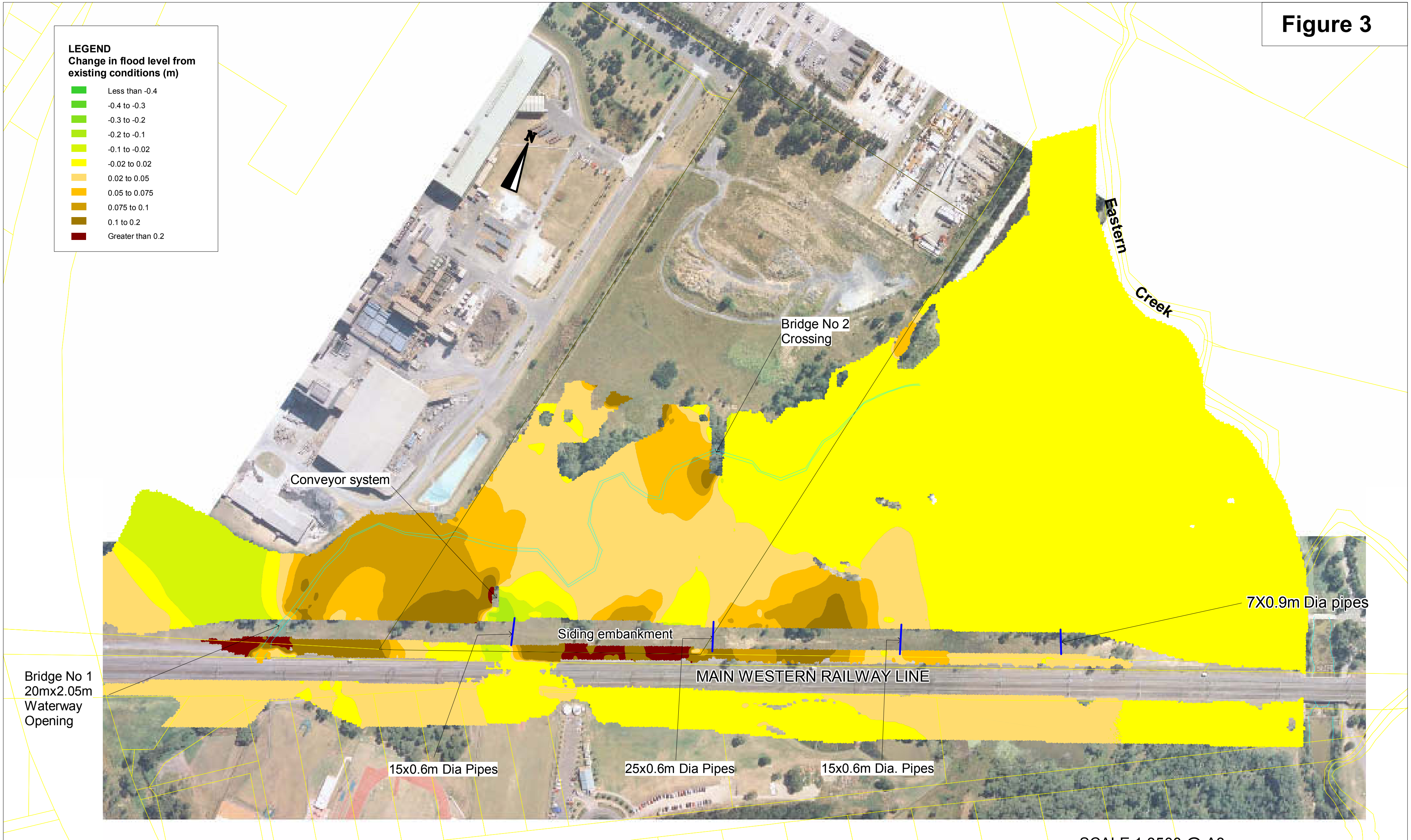
- there is a localised increase in flood levels near the siding just east of the Readymix eastern boundary. This is principally a function of an area of higher ground levels which includes a small area which is actually not inundated in the 100 year event. This area of higher ground levels naturally causes a localised redistribution of floodwaters and this affect is more noticeable following the inclusion of the nearby siding embankment into the flood model. The impact of the re-distribution is considered to be minor;

- there are several locations of increased flood levels within the site, principally associated with the Bridge No. 2 floodplain crossing in the middle of the site and re-distribution of flood flows adjacent to the siding in the south-western corner of the site. The increase at the former location is typically less than 75mm. While the latter impact zone extends west of the Readymix property, the increase in flood levels in that area is typically less than 100mm. With the inundation line corresponding to the embankment below the Mini Mill plant area, there are no existing or incremental flood damages in that minor impact zone;

- immediately upstream of the Main Western Railway line, the Angus Creek flood levels increase by less than 50mm. This is considered to be a nominal increase and again there are no incremental flood damages issues; and

- the potential impact of extra flows heading eastwards between the siding and main railway embankments has been addressed by the combined capacities of the four series of stormwater pipes under the siding

Figure 3



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Date: 30 Mar 05

Readymix RDC Project Rooty Hill
Impact of Project on
Angus Creek 100 Year ARI Flood Levels

embankment. Where there are increases in flood levels along this ‘corridor’ they are typically limited to 100mm to 200mm (with a maximum increase of 250mm). These correspond to only localised impacts and the figure shows that there is no adverse impact on how upper catchment floodwaters would potentially overtop the Main Western Railway line. Hence the project has no adverse impact on the Main Western Railway line.

Construction of new bridges across floodplains can lead to significant changes in flood-time flow velocities. Interrogation of the TUFLOW model’s flow calculations for the peak of the 100 year ARI flood at the Bridge No. 1 and No. 2 locations revealed that the average velocities at the Bridge No. 1 location would likely increase from about 1.0m/s to 1.8m/s with its construction while the corresponding values at the central span of Bridge No. 2 would be 0.7m/s and 0.9m/s. While the Bridge No. 2 velocity increase is not seen to be significant, the Bridge No. 1 concept design plan shows the placement of rock in the bed of the bridge waterway opening (and the adjacent bed of the transitional channel) will address potential scour issues.

It is concluded that none of the project’s flood impacts constitute a significant change to the 100 year flood regime, nor result in an increase in potential flood effects.

4.2 PMF EVENT

The following changes were made to the TUFLOW model to assess the Probable Maximum Flood (PMF) regime:

- The Angus Creek and Eastern Creek 100 year ARI flood flow hydrographs were increased to replicate the respective 1996 study’s PMF flows.

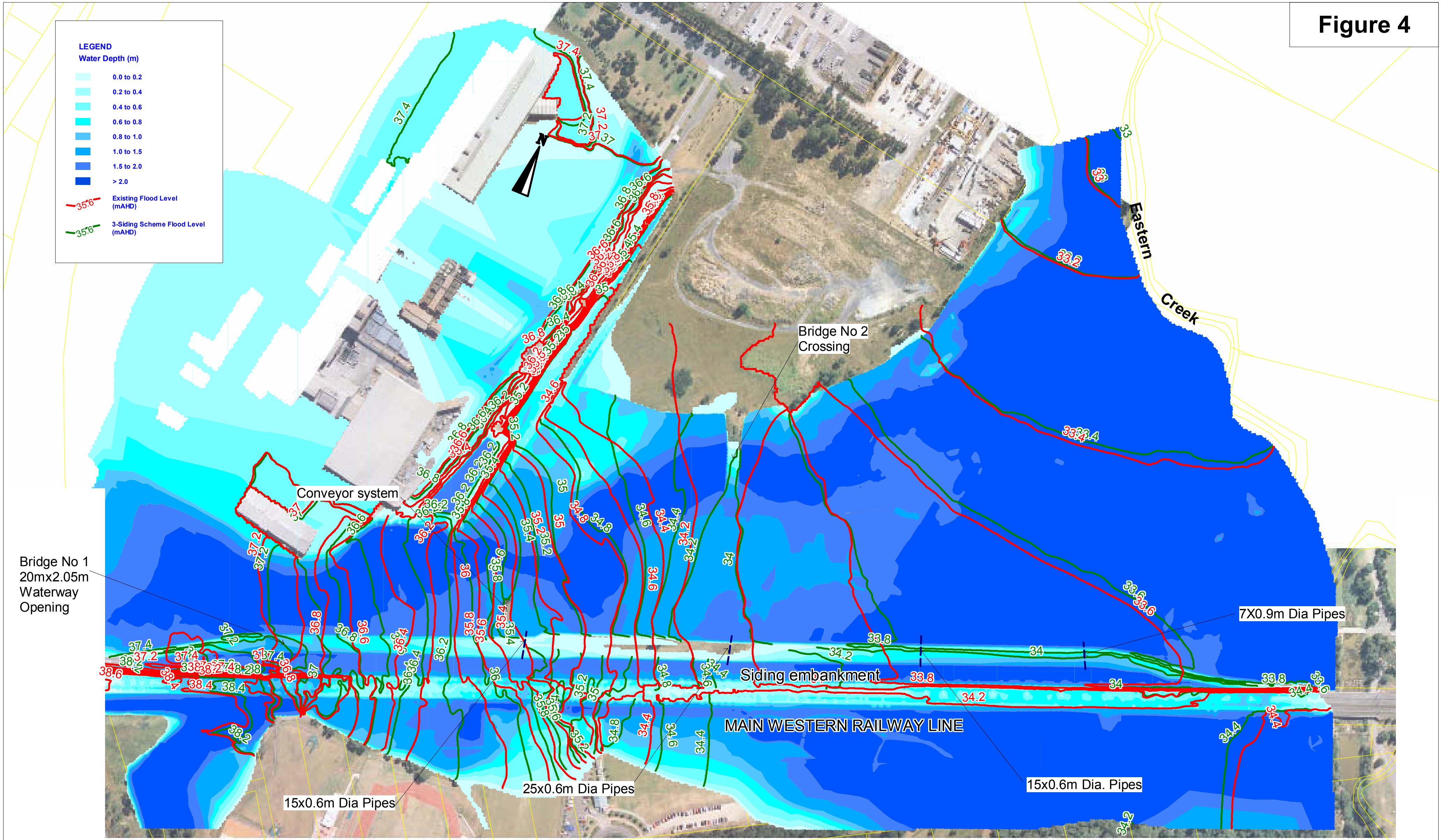
- An approximate Eastern Creek stage-discharge relationship was developed to provide a model boundary level which was similar to 1996 study’s peak flood level.

- The TUFLOW model’s floodplain boundaries were extended using as-available contour and spot level information to ensure that the resultant flood levels were not significantly constrained by the geographical limits of the digital elevation model north of the Main Western Railway.

Figure 4 shows the two sets of PMF flood levels where the red contours represent the ‘existing condition’ flood levels and the green contours represent the flood levels after inclusion of the various RDC project elements. The figure shows greater extents and depths of inundation than are predicted to occur in the 100 year event. Hence all of the Main Western Railway and almost all of the siding are overtopped.

The red and green contours are similar in location and where there are increases in flood level they are typically less than 200mm. There are flood level increases of the order of 400mm to 500mm in the area between the siding embankment and the Main

Figure 4



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Following structures are included in the model:-
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b) Bridge structure approx. 600 metres d/s of main railway;
c) 7x0.9m dia pipes at eastern end of the siding track;
d) 2 sets of 15x0.6m dia. pipes and 1 set of 25x0.6m dia. pipes spaced along siding track;
e) Flow 'block out' for transfer conveyor system;
f) Project design contours north of Angus Creek.

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Date: 31 Mar 05

Readymix RDC Project Rooty Hill
Angus Creek PMF Regime

Western Railway embankment but the increase is solely due to the siding itself being overtopped.

It is therefore considered that the project does not have any major adverse impacts on the passage of an extreme flood event.

5. CONCLUSIONS

As detailed in the report:

- The use of a two-dimensional flood model has produced a very detailed and accurate picture of the Angus Creek flood regime;

- The combined use of very detailed information about local area ground levels and structures spanning both Angus Creek and Eastern Creek and catchment runoff flows which are consistent with an earlier Council flood study has resulted in a comprehensive definition of the *'existing conditions'* 100 year ARI and probable maximum flood (PMF) flood regimes in and surrounding the area occupied by the RDC project;

- The inclusion of the RDC project elements into the flood model has shown that there would be only minor changes to — and no incremental increase in flood damages in — the 100 year ARI flood event. Similarly the modelling shows that the project does not have major adverse impacts on the passage of an extreme flood event.

6. REFERENCES

1. Bewsher Consulting (2003) Readymix Concrete Batch Plant Development Kellogg Road Rooty Hill Flood and Drainage Assessment. August. Commissioned by NECS on behalf of Readymix.

2. Bewsher Consulting (1996) Blacktown Floodplain Management Study Volume 4 (Working Paper No. 20 Angus Creek Flood Study and Mitigation Options). October. Commissioned by Blacktown City Council.

3. Bewsher Consulting (1996) Blacktown Floodplain Management Study Volume 3 (Working Paper No. 10 Additional Eastern Creek Modelling). October. Commissioned by Blacktown City Council.

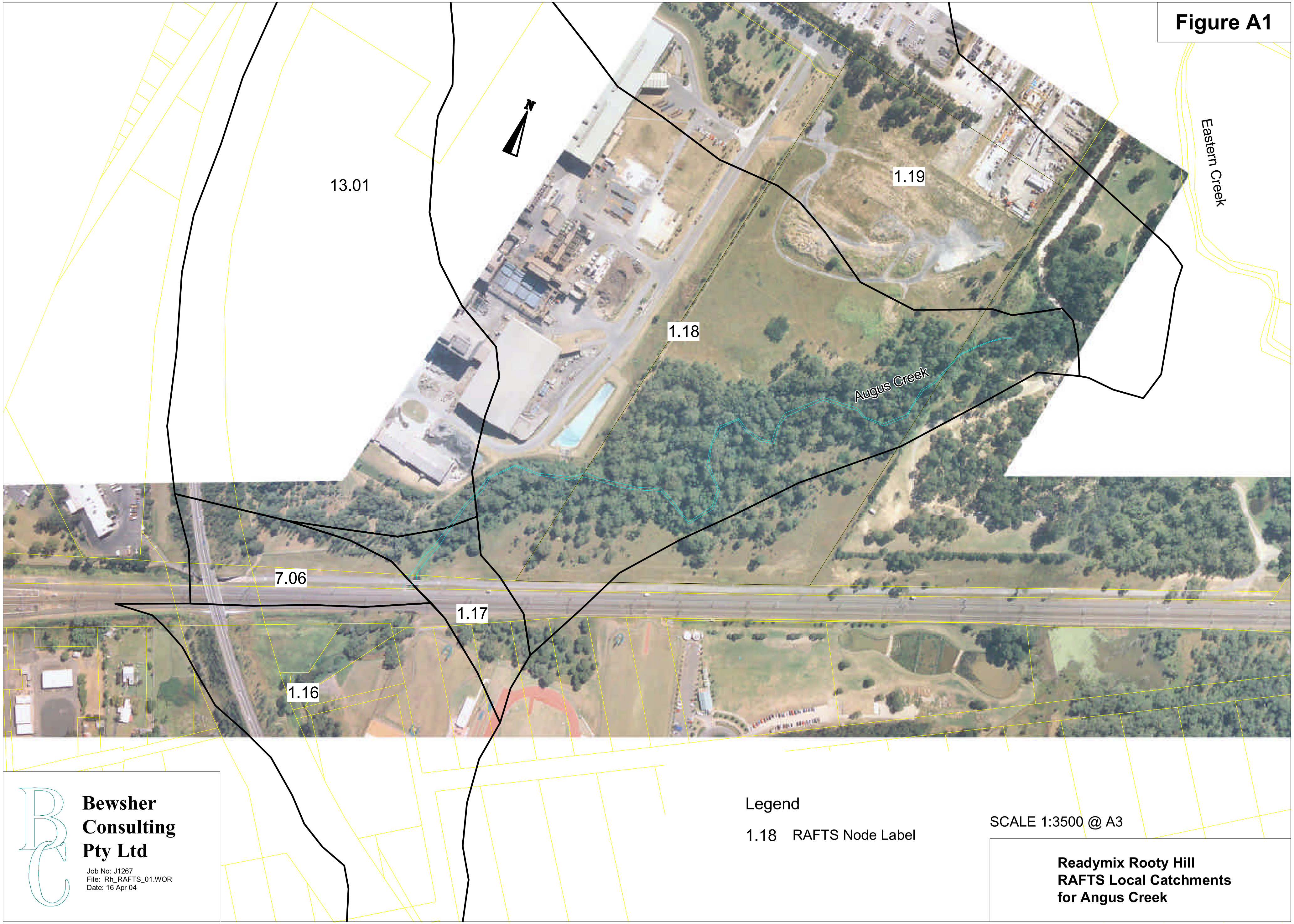
4. WBM Oceanics (2003), TUFLOW Version 2003-07-AG.

5. BHP Engineering Pty Ltd. (1989). Sydney Mini Mill Project Angus Creek Flood Study. July. Report No. 0780Z.

APPENDIX A

RAFTS SUB-CATCHMENT BOUNDARIES AND 100 YEAR ARI OUTPUT

Figure A1



Legend

1.18 RAFTS Node Label

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Readymix Rooty Hill
RAFTS Local Catchments
for Angus Creek

Bewsher Consulting Pty Ltd

Job No: J1267
File: Rh_RAFTS_01.WOR
Date: 16 Apr 04

RAFTS MODEL OUTPUT FOR 2 HOUR 100 YEAR STORM

```
################################################################################
Catchment 14 - Angus Creek

Results for period from  0: 0.0  1/ 1/1990
                     to  5: 0.0  1/ 1/1990
################################################################################
```

```
                              ROUTING INCREMENT (MINS) =       1.00
                              STORM DURATION (MINS)    =       120.
                              RETURN PERIOD (YRS)      =       100.
                              BX                       =     1.0000
                              TOTAL OF FIRST SUB-AREAS  (km2) =     282.20
                              TOTAL OF SECOND SUB-AREAS (km2) =     401.46
                              TOTAL OF ALL SUB-AREAS (km2)    =     683.66
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2	Slope #1 (%)	Slope #2	% Impervious #1 (%)	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	0.0100	25.030	2.240	2.240	100.0	8.000	.025	.025	.0002	.0662	1.000
2.00	2.000	16.700	2.630	2.630	100.0	8.000	.025	.025	.0026	.0495	2.000
2.01	3.160	9.000	2.540	2.540	100.0	8.000	.025	.025	.0034	.0365	2.001
2.02	0.4500	5.200	2.040	2.040	100.0	8.000	.025	.025	.0014	.0306	2.002
1.01	0.0100	16.710	2.590	2.590	100.0	8.000	.025	.025	.0002	.0499	1.001
1.21	1.000	5.000	4.420	4.420	100.0	8.000	.025	.025	.0014	.0204	1.002
1.02	10.390	9.470	3.610	3.610	100.0	8.000	.025	.025	.0053	.0315	1.003
1.03	12.110	18.720	1.260	1.260	100.0	8.000	.025	.025	.0097	.0758	1.004
1.04	8.140	14.000	1.840	1.840	100.0	8.000	.025	.025	.0065	.0540	1.005
1.05	7.360	9.760	1.870	1.870	100.0	8.000	.025	.025	.0062	.0444	1.006
1.06	8.220	13.220	2.230	2.230	100.0	8.000	.025	.025	.0060	.0476	1.007
1.07	13.430	25.320	1.660	1.660	100.0	8.000	.025	.025	.0089	.0773	1.008
1.08	8.350	12.320	1.530	1.530	100.0	8.000	.025	.025	.0073	.0554	1.009
12.00	1.870	2.300	2.030	2.030	100.0	8.000	.025	.025	.0029	.0201	3.000
1.09	2.850	4.380	1.630	1.630	100.0	8.000	.025	.025	.0040	.0313	1.010
3.00	5.410	6.620	3.870	3.870	100.0	8.000	.025	.025	.0036	.0252	4.000
3.01	11.000	10.850	3.250	3.250	100.0	8.000	.025	.025	.0058	.0356	4.001
3.02	11.190	21.000	1.610	1.610	100.0	8.000	.025	.025	.0082	.0712	4.002
3.03	6.520	9.800	1.810	1.810	100.0	8.000	.025	.025	.0059	.0452	4.003
1.10	0.1900	0.1800	2.400	2.400	100.0	8.000	.025	.025	.0008	.0049	1.011
4.00	4.000	7.380	2.570	2.570	100.0	8.000	.025	.025	.0038	.0327	5.000
9.00	3.110	6.310	2.080	2.080	100.0	8.000	.025	.025	.0037	.0335	6.000
4.01	0.0100	0.0100	1.000	1.000	100.0	8.000	.025	.025	.0003	.0017	5.001
4.02	3.000	4.200	2.020	2.020	100.0	8.000	.025	.025	.0037	.0275	5.002
10.00	12.420	6.600	1.740	1.740	100.0	8.000	.025	.025	.0084	.0375	7.000
10.01	0.4300	1.300	2.250	2.250	100.0	8.000	.025	.025	.0013	.0142	7.001
4.03	0.0100	0.0100	1.000	1.000	100.0	8.000	.025	.025	.0003	.0017	5.003
4.04	2.430	3.760	1.830	1.830	100.0	8.000	.025	.025	.0035	.0273	5.004
4.05	2.720	3.330	1.200	1.200	100.0	8.000	.025	.025	.0046	.0317	5.005
1.11	0.1900	0.1800	1.300	1.300	100.0	8.000	.025	.025	.0011	.0067	1.012
5.00	5.250	6.400	4.700	4.700	100.0	8.000	.025	.025	.0033	.0225	8.000
5.01	3.330	8.000	2.260	2.260	100.0	8.000	.025	.025	.0037	.0364	8.001
1.12	6.000	14.260	1.470	1.470	100.0	8.000	.025	.025	.0062	.0609	1.013
6.00	5.760	14.000	2.710	2.710	100.0	8.000	.025	.025	.0045	.0445	9.000
6.01	4.080	6.000	2.420	2.420	100.0	8.000	.025	.025	.0040	.0303	9.001
1.13	0.9000	2.270	1.180	1.180	100.0	8.000	.025	.025	.0026	.0262	1.014
1.14	7.180	8.800	2.170	2.170	100.0	8.000	.025	.025	.0056	.0390	1.015
1.15	7.600	8.540	2.940	2.940	100.0	8.000	.025	.025	.0050	.0330	1.016
13.00	4.790	5.850	2.360	2.360	100.0	8.000	.025	.025	.0044	.0303	10.00
7.00	3.500	8.160	2.500	2.500	100.0	8.000	.025	.025	.0036	.0350	11.00
7.01	3.330	6.800	1.540	1.540	100.0	8.000	.025	.025	.0045	.0405	11.00
7.02	0.8600	1.000	1.280	1.280	100.0	8.000	.025	.025	.0024	.0164	11.00

11.00	5.460	6.670	2.750	2.750	100.0	8.000	.025	.025	.0043	.0300	12.00
11.01	6.380	5.100	1.820	1.820	100.0	8.000	.025	.025	.0058	.0321	12.00
7.03	0.0100	0.0100	1.000	1.000	100.0	8.000	.025	.025	.0003	.0017	11.00
7.04	3.570	0.8000	.9100	.9100	100.0	8.000	.025	.025	.0061	.0173	11.00
8.00	4.000	6.430	2.840	2.840	100.0	8.000	.025	.025	.0036	.0290	13.00
8.01	7.030	7.030	1.440	1.440	100.0	8.000	.025	.025	.0068	.0426	13.00
7.05	0.0100	0.0100	1.000	1.000	100.0	8.000	.025	.025	.0003	.0017	10.00
7.06	1.400	0.2500	1.060	1.060	100.0	8.000	.025	.025	.0034	.0088	10.00
1.16	3.490	2.300	1.360	1.360	100.0	8.000	.025	.025	.0049	.0245	1.017
13.01	13.710	1.520	1.150	1.150	100.0	8.000	.025	.025	.0108	.0215	14.00
1.17	0.8200	0.6000	1.630	1.630	100.0	8.000	.025	.025	.0021	.0111	1.018
1.18	23.930	7.000	.7400	.7400	100.0	8.000	.025	.025	.0180	.0593	1.019
1.19	17.830	5.000	1.280	1.280	100.0	8.000	.025	.025	.0118	.0379	1.020

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	6.584	42.00	4.000
2.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	5.660	40.00	3.000
2.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	8.946	41.00	3.000
2.02	43.700	1.000	10.00	0.000	2.500	86.400	73.025	10.538	43.00	1.000
1.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	21.616	45.00	1.000
1.21	43.700	1.000	10.00	0.000	2.500	86.400	73.025	23.009	45.00	3.000
1.02	43.700	1.000	10.00	0.000	2.500	86.400	73.025	26.212	47.00	5.000
1.03	43.700	1.000	10.00	0.000	2.500	86.400	73.025	31.249	51.00	2.000
1.04	43.700	1.000	10.00	0.000	2.500	86.400	73.025	34.833	52.00	4.000
1.05	43.700	1.000	10.00	0.000	2.500	86.400	73.025	13.826	99.00	5.000
1.06	43.700	1.000	10.00	0.000	2.500	86.400	73.025	17.751	40.00	3.000
1.07	43.700	1.000	10.00	0.000	2.500	86.400	73.025	26.428	43.00	4.000
1.08	43.700	1.000	10.00	0.000	2.500	86.400	73.025	30.627	45.00	1.000
12.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	1.574	35.00	.5000
1.09	43.700	1.000	10.00	0.000	2.500	86.400	73.025	33.097	46.00	.5000
3.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	4.641	35.00	1.000
3.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	12.650	35.00	6.000
3.02	43.700	1.000	10.00	0.000	2.500	86.400	73.025	14.969	41.00	5.000
3.03	43.700	1.000	10.00	0.000	2.500	86.400	73.025	18.493	46.00	.5000
1.10	43.700	1.000	10.00	0.000	2.500	86.400	73.025	51.642	47.00	1.000
4.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	3.866	35.00	0.000
9.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	3.100	40.00	0.000
4.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	5.551	40.00	3.000
4.02	43.700	1.000	10.00	0.000	2.500	86.400	73.025	7.693	39.00	0.000
10.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	7.510	35.00	2.000
10.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	2.978	40.00	0.000
4.03	43.700	1.000	10.00	0.000	2.500	86.400	73.025	10.660	40.00	2.000
4.04	43.700	1.000	10.00	0.000	2.500	86.400	73.025	6.169	65.00	3.000
4.05	43.700	1.000	10.00	0.000	2.500	86.400	73.025	6.878	45.00	3.000
1.11	43.700	1.000	10.00	0.000	2.500	86.400	73.025	58.574	48.00	5.000
5.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	4.594	35.00	5.000
5.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	8.259	40.00	1.500
1.12	43.700	1.000	10.00	0.000	2.500	86.400	73.025	66.650	48.00	2.000
6.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	6.257	40.00	4.000
6.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	9.426	40.00	4.000
1.13	43.700	1.000	10.00	0.000	2.500	86.400	73.025	75.007	49.00	3.000
1.14	43.700	1.000	10.00	0.000	2.500	86.400	73.025	77.309	52.00	3.000
1.15	43.700	1.000	10.00	0.000	2.500	86.400	73.025	79.268	55.00	4.000
13.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	3.831	35.00	4.000
7.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	3.835	40.00	4.000
7.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	6.866	40.00	1.000
7.02	43.700	1.000	10.00	0.000	2.500	86.400	73.025	7.458	41.00	0.000
11.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	4.459	35.00	4.000
11.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	8.216	40.00	0.000
7.03	43.700	1.000	10.00	0.000	2.500	86.400	73.025	15.617	40.00	3.000
7.04	43.700	1.000	10.00	0.000	2.500	86.400	73.025	16.588	43.00	0.000

8.00	43.700	1.000	10.00	0.000	2.500	86.400	73.025	3.713	35.00	7.000
8.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	7.723	40.00	0.000
7.05	43.700	1.000	10.00	0.000	2.500	86.400	73.025	27.523	41.00	2.000
7.06	43.700	1.000	10.00	0.000	2.500	86.400	73.025	27.857	43.00	1.000
1.16	43.700	1.000	10.00	0.000	2.500	86.400	73.025	93.237	59.00	.5000
13.01	43.700	1.000	10.00	0.000	2.500	86.400	73.025	6.892	35.00	0.000
1.17	43.700	1.000	10.00	0.000	2.500	86.400	73.025	95.260	60.00	9.000
1.18	43.700	1.000	10.00	0.000	2.500	86.400	73.025	98.516	69.00	12.00
1.19	43.700	1.000	10.00	0.000	2.500	86.400	73.025	100.60	81.00	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
1.04	52.00	34.83	90.00	12.95	119634.	0.0000	53911.2	3.3643
3.01	35.00	12.65	44.00	7.860	26924.3	0.0000	3596.9	2.7592
9.00	40.00	3.100	47.00	1.861	7293.3	0.0000	1027.4	1.6020
10.00	35.00	7.509	50.00	2.607	15538.9	0.0000	4160.9	2.5117
4.03	40.00	10.66	75.00	5.555	38596.4	0.0000	12895.7	3.3176

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
1.04	3.0		.8999	0.000	34.200	0.5000
3.01	2.0		1.050	0.000	24.400	0.9300
9.00	1.0	1.000		0.000	40.000	1.000
10.00	1.0	1.000		0.000	40.000	1.000
4.03	2.0	1.000		0.000	22.000	0.5000

Run completed at: 24th December 2003 10:33:13

READYMIX REGIONAL DISTRIBUTION CENTRE
KELLOGG ROAD, ROOTY HILL

STORMWATER DRAINAGE AND
PAVEMENT DESIGN

Prepared by:

GW Engineers

Services & Solutions

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Gardiner Willis & Associates Pty Ltd ABN 58 087 249 814

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TABLE OF CONTENTS

1.0 INTRODUCTION

Readymix is proposing the construction of a Regional Distribution Centre on their property at Rooty Hill.

The property is elevated and slopes in the south-easterly direction towards Angus Creek. Angus Creek crosses the site and divides it into a northern and southern part. The One Steel Mini Mill is located immediately west of the site, and the Humes Factory immediately north of the site. The Nurragingy Reserve is located east of the site.

GW Engineers were commissioned to develop the stormwater drainage concept plan for the northern part of the site, design internal roads pavements, develop site lay-out, design site finished levels and contours, estimate volume of the earthworks and prepare a Construction Program for Civil Works.

2.0 AVAILABLE DATA

Readymix provided GW Engineers with the concept site lay-out drawings, a survey of the site, the Flood Study report prepared by Bewsher Consulting Pty Ltd, information about existing services in the vicinity of the site, and a geotechnical investigation report.

A site inspection has been carried out and a number of photographs of the site have been taken. The proposed stormwater drainage lay-out and site levels have been discussed with Mr Richard Savage of Readymix.

3.0 STORMWATER DRAINAGE

3.1 Water Quantity

The property slopes in the south-easterly direction towards Angus Creek. The proposed site drainage system follows the fall of the ground and runs towards Angus Creek. The site has been divided into four main catchments with drainage systems consisting of surface flow paths and underground stormwater drainage lines. The underground drainage system has been designed to accommodate and convey the stormwater flows resulting from a 1 in 20 years ARI rainfall event (see stormwater drainage calculations - Appendix A) The surface flows paths and the underground drainage system will together accommodate and convey stormwater flows resulting from a 1 in 100 years ARI rainfall event.

The stormwater drainage systems for each catchment will discharge into dispersal basins located at the lowest points of the catchments. The basins are designed to accommodate the total runoff resulting from a 1 in 3 months ARI rainfall event. The average depth of the basins will be 0.3m. The banks along Angus Creek will be constructed at a constant level to allow stormwater, after filling the basins, to overflow to Angus Creek as a sheet flow.

Stormwater collected from the roofs of buildings and roofs over storage bins will be stored in rainwater tanks and re-used on site. The Concrete Plant will collect and recycle as much rainwater as possible.

External stormwater flows (see catchment plan – Appendix B), will be captured in cut-off drains and diverted around the site. The cut-off drains and associated drainage lines will be designed to accommodate and convey flows resulting from a 1 in 100 years ARI rainfall event.

3.0 STORMWATER DRAINAGE (CONT'D)

3.1 Water Quality (Cont'd)

All storage and loading areas will be provided with sediment/gravel traps.

Stormwater discharging into the dispersal basins will run through Humeceptors. The Humeceptors are 'hydrodynamic source control devices for the capture and retention of a range of contaminants from stormwater runoff' (see Appendix C for Humeceptor information).

Stormwater runoff resulting from up to a 1 in 3 months ARI rainfall event will be captured in the dispersal basins and infiltrate the ground or evaporate.

Stormwater collected within the truck refuelling area and truck wash areas will be separated and processed by the local treatment facilities.

The peak flow, volumes and time of concentration (t_c) for the nominated return periods for pre and post development are given in the table below.

	Pre Development (50% impervious)			**Post Development (85% impervious)**		
	Peak Flow	Volume	t_c	Peak Flow	Volume	t_c
ARI 5	874 l/s	944 m3	18 min	1467 l/s	1056 m3	12 min
ARI 20	1268 l/s	1370 m3	18 min	2166 l/s	1559 m3	12 min
ARI 100	1903 l/s	2055 m3	18 min	2978 l/s	2144 m3	12 min

4.0 PAVEMENT DESIGN

It is proposed to construct two types of pavement within the site. Truck loading areas, truck parking areas and the main internal roads will be constructed using reinforced concrete pavement. Car parking areas and the secondary internal roads will be constructed using flexible pavement (see pavement design – Appendix D)

Roads within the Concrete Plant areas and around Storage Bays will be constructed using reinforced concrete pavement. The Storage Bins area will be constructed using concrete pavement.

5.0 PRELIMINARY CONSTRUCTION PROGRAM

The preliminary construction program envisages the completion of the site establishment and preliminary works involving sediment control and environmental monitoring stations prior to commencing bulk earthworks. Emphasis will be placed on ensuring that noise, air and water quality issues are properly managed through the adoption of procedures that will include:

- Minimising area to be disturbed.
- Maintaining earthworks stockpiles in a condition that minimises wind blown dust.
- Progressively rehabilitate disturbed areas as soon as possible.
- Restrict vehicle movements to specified routes.
- Ensure vehicles adhere to speed limits.
- Dust suppression.
- Commence landscaping as soon as practicable.
- Maintain all machinery and equipment in good order.
- Orient equipment so that noise emissions are directed away from noise sensitive areas.
- Noise barriers would be constructed as soon as possible during the construction phase.

As a consequence of the above procedures, the construction of the works will be undertaken in stages that will allow the works to be constructed efficiently while safeguarding environmental considerations. It is envisaged that the construction time frame will be approximately twenty-four (24) months.

APPENDIX A - STORMWATER DRAINAGE CALCULATIONS

Readymix Regional Distribution Centre Kellogg Road, Rooty Hill

Stormwater Drainage:

Piped Drainage to be designed to 20 year ARI (Blacktown City Council Engineering Development Guide)
$t_c \approx 12$ min $i_{20} = 122.3$ mm/h $C_{20} = 0.95$

Estimation of stormwater flows: (see stormwater drainage concept plan)

Point 'A' Catchment area: 1.67ha

$Q_{20} = \frac{0.95 \times 1.67 \times 122.3}{0.36} = 539\ ^{L}/_{S}$ 600 RCP

Point 'B' Catchment area: 0.95ha
$Q_{20} = \frac{0.95 \times 0.95 \times 122.3}{0.36} = 307\ ^{L}/_{S}$ 450 RCP

Point 'C' Catchment area: 1.54ha
$Q_{20} = \frac{0.95 \times 1.54 \times 122.3}{0.36} = 497\ ^{L}/_{S}$ 525 RCP

Point 'D' Catchment area: 1.17ha
$Q_{20} = \frac{0.95 \times 1.17 \times 122.3}{0.36} = 378\ ^{L}/_{S}$ 450 RCP

Point 'E' Catchment area: 2.25ha
$Q_{20} = \frac{0.95 \times 2.25 \times 122.3}{0.36} = 726\ ^{L}/_{S}$ 600 RCP

Stormwater drainage system will discharge into dispersal basins. Stormwater will fill the basins and overflow to Angus Creek as a sheet flow. The basins are designed to capture the 3 monthly ARI event.

APPENDIX A - STORMWATER DRAINAGE CALCULATIONS (CONT'D)

Basin 1

Catchment area: 1.67ha + 0.69ha (concrete plant)
t_c = 12min, i_1 = 55.4 mm/hr, C_1 = 0.72

$$Q1 = \frac{0.72 \times 2.36 \times 55.4}{0.36} = 261\ ^{L}/_{S}$$

Basin 2

Catchment area: 0.56ha

Q1 = 62 $^{L}/_{S}$ $Q_{3\ months}$ = ~ 21 $^{L}/_{S}$

Volume: 15.1 m^3

Basin area: 50m^2 approx
Basin depth: 0.3m approx

Basin 3

Catchment area: 1.54ha

Q_1 = 171 $^{L}/_{S}$ $Q_{3\ months}$ = ~ 57 $^{L}/_{S}$

Volume of runoff: 41m^3

Basin area: 137 m^2 approx
Basin depth: 0.3 m approx

Basin 4

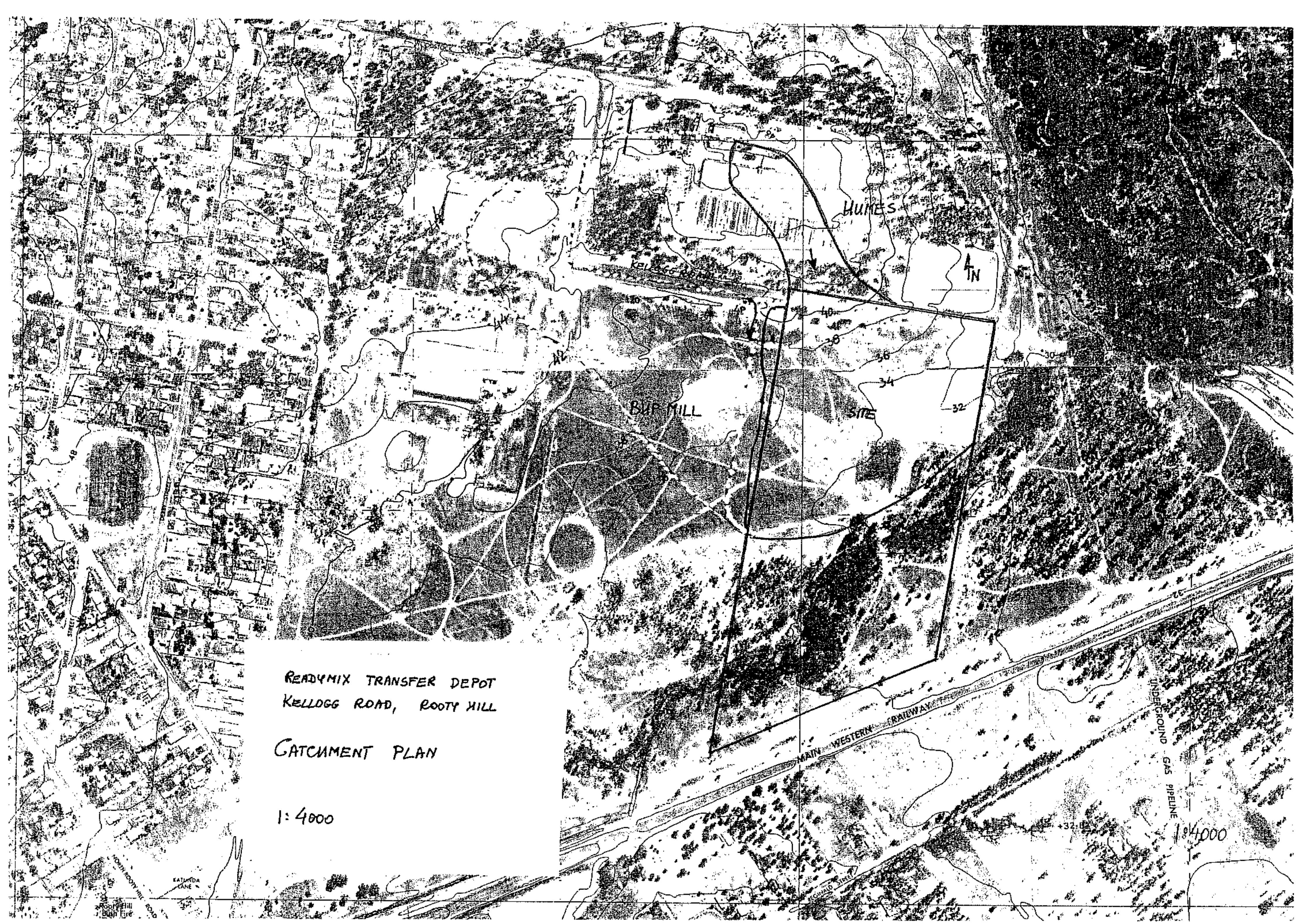
Catchment area: 2.25ha

Q_1 = 243 $^{L}/_{S}$ $Q_{3\ months}$ = ~ 83 $^{L}/_{S}$

Volume: 60 m^3

Basin area: 230 m^2 approx
Basin depth: 0.3 m approx

APPENDIX B – EXTERNAL CATCHMENT PLAN



READYMIX TRANSFER DEPOT
KELLOGG ROAD, ROOTY HILL

CATCHMENT PLAN

1: 4000

APPENDIX C - HUMECEPTOR INFORMATION

Humes™

- Product Range
- Applications
- Field Data
- Support and Resources

Humeceptor™

Hume*ceptor*™ is a hydrodynamic source control device for the capture and retention of a range of contaminants from stormwater runoff generated from impervious surfaces as car parks, industrial and commercial sites, roads and highways, marinas, airport facilities, sea port facilities, petrol stations, defence establishments, high/medium density residential developments and similar impervious/hardstand surfaces. These containments include free and floating oils, grease, hydrocarbon and petroleum products, fine suspended solids, including the fine fraction between 10 - 100µm that typically dominate the total suspended solids load and a range of sorbed contaminants that are transported by the fine suspended solids such as heavy metals, hydrocarbon and petroleum products. **Hume***ceptor*™ is a unique product, since it provides careful control of flow rates and operational velocities to prevent the resuspension and loss of fine suspended solids material and emulsification of collected hydrocarbons during infrequent high flow rates.

Hume*ceptor*™ is generally designed using a calibrated continuous rainfall and pollutant export simulation based on actual rainfall data to remove 70% - 95% of the total suspended solids load. The design is focussed on delivering a water quality outcome.

The performance of the **Hume***ceptor*™ product to deliver a water quality outcome has been extensively verified by independent third party regulatory authorities under field conditions. These conditions implicitly take into consideration the varying hydrologic, hydraulic and pollutant export conditions that exist in the real world. **Humes**, consultants, local authorities and customers can therefore proceed with development proposals with a high degree of confidence regarding the water quality outcomes from specifying and using the **Hume***ceptor*™ product.

Humeceptor Brochure

Top

Humes™

PRODUCTS

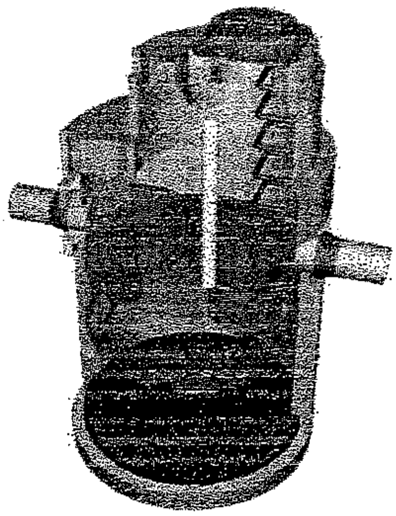
- **Inline Hume*ceptor*™**
- **Inlet Hume*ceptor*™**
- **Series Hume*ceptor*™**
- **Submerged Hume*ceptor*™**

In-Line Humeceptor™

The most commonly installed unit is the In-Line **Hume***ceptor*™. It is designed with single or multiple inlets and a single outlet, and is available in eight different unit sizes, ranging from 3,000 to 27,000 litre storage capacities. Each unit is constructed from precast concrete components and a patented fibreglass insert that separates the upper (by-pass) and lower (separation/holding) chambers. In areas where oil or hydrocarbon/petroleum spills accumulate in substantial volume between cleaning, the fibreglass insert provides dual wall containment to ensure trapped hydrocarbons are safely stored inside the treatment center.

Normal Operating Conditions

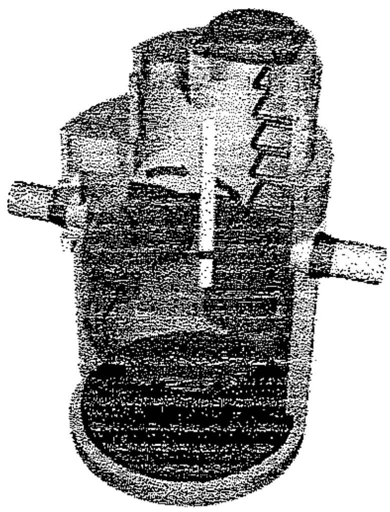
Under normal (frequent) operating conditions (more than 85% of all storm events), stormwater flows into the upper by-pass chamber and is diverted by a semi circular weir, down into the separation/holding chamber. Flow entering the lower chamber is carefully controlled by an orifice plate to prevent excessive operational velocities, and maximise capture and retention of hydrocarbons and suspended solids. This downward flow is directed, by right-angle outlets, tangentially around the circular walls of the chamber to maximise the flow path and detention time. Flow continues around the circumference of the unit, exits the lower chamber through the riser pipe and rejoins the piped drainage system. Fine and coarse suspended solids settle to the floor of the chamber, under very low velocity quiescent conditions, while the petroleum products rise and become trapped beneath the fibreglass insert.



Normal Flow Conditions

By-Pass Operating Conditions

During infrequent high flow events (less than 15% of all storm events), peak stormwater flows will pass over the diverting weir and continue through the by-pass chamber into the downstream stormwater system. This by-pass activity creates pressure equalization across the by-pass chamber, between the inlet and outlet, causing a slight throttling of the flow entering the lower treatment chamber which guarantees retention of fine material previously deposited. A portion of incoming suspended solids continues to be diverted by the weir into the lower chamber where it is stored, along with previously collected solids and hydrocarbons. **Hume**_ceptor_™ is unique in the market place since it is the only product which places emphasis on carefully controlling flow rates and operational velocities during all hydrologic conditions, thus preventing scouring, resuspension and ultimate loss of suspended solids during high flows.



High Flow Conditions

The In-Line **Hume**_ceptor_™ has been proven in full scale laboratory and field validation tests to capture and retain:

Over 80% of total suspended solids, including the fine fraction classified as material having a particle size less than 60µm, which has been shown to comprise the majority of the total mass load.

Over 97% of free and floating oils, grease, hydrocarbons and petroleum products under both dry weather, emergency spill situations and during wet weather rainfall periods.

A range of contaminants sorbed or attached to the fine suspended solids, material including hydrocarbons, petroleum products and heavy metals.

Top

APPENDIX D – PAVEMENT DESIGN

Reinforced concrete pavement:

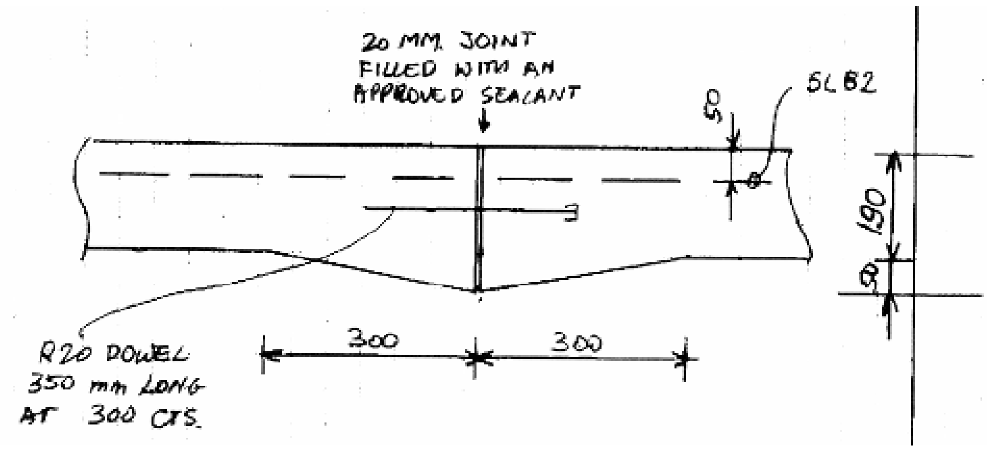
Adopted: CBR 3%   30+ daily axle repetitions

Pavement thickness: 190 mm
Concrete 32 MPa (AS3600 – vehicles > 3T mass)
Reinforcement 5L82 minimum

Sub-base thickness: 150 mm
CBR 3%   DGB 20 or DGS 20

"Jointed Reinforced concrete pavements"

Joints spacings   10 – 15m
Hand placing Paving lanes 5m wide



Flexible Pavement
Adopt: CBR 3%   Carpark/Access street

Pavement Thickness: 390mm

35 mm AC14
150 mm DGB20   Base
240mm DGS40   Sub-base

APPENDIX E - PAVEMENT CONSTRUCTION INFORMATION

Reinforced Concrete Pavement:

Area: 56,207m^2 approx.

Volume of concrete: 8,800m^3 (Tm^3 truck)

Reinforcement: 185t (4kg/m^2 – SL82)

Volume of sub-base: 7,000m^3 (15,400t)

Truck Deliveries:

1,258 Concrete trucks (7m3 each)

10 Steel reinforcement (20t each)

770 Road Base (gravel) (20t each)

Construction – Reinforced Concrete Slab:

Hand Placing – Paving Lanes 5m wide

Crew of 7 could construct ~ 100m^2 a day

46,207m^2/100m^2 = 462 days

4 crews ~400m^2 a day

46,207m^2/400m^2 = 116 days /20 days per month = 5.8 months (construction program – 8 months)

Flexible Pavement:

Area: 2,813m^2 approx

Volume of aggregate: 1,100m^3 (2,420t)

(base and sub-base)

Truck Deliveries:

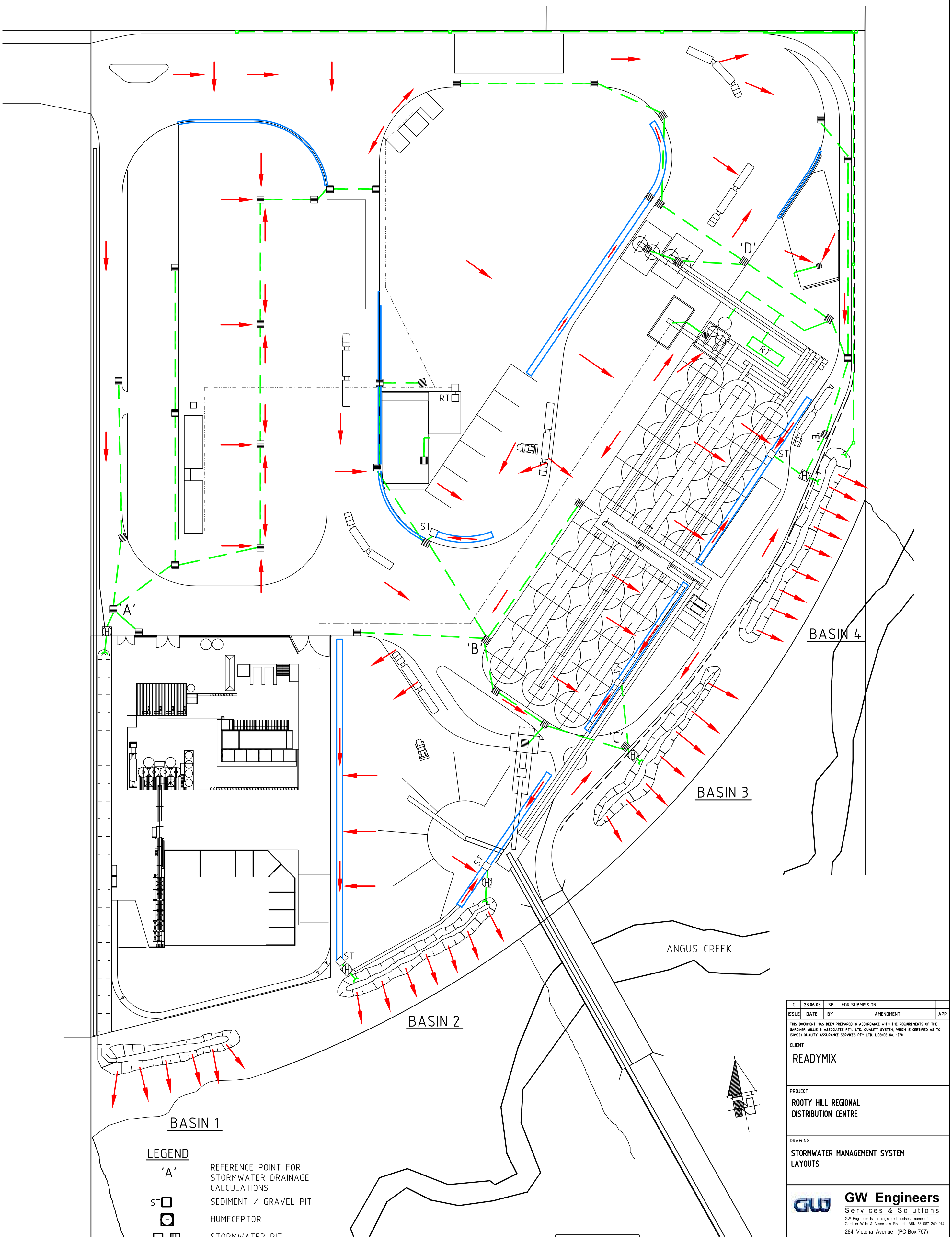
121 Road base and sub-base (20t each)

13 Bitumen (AC)

Construction:

Crew of 7 ~ 20 days

APPENDIX F – SITE DRAWINGS



CONCEPT

SITE PLAN

LEGEND

'A'	REFERENCE POINT FOR STORMWATER DRAINAGE CALCULATIONS
ST □	SEDIMENT / GRAVEL PIT
(H)	HUMECEPTOR
□ ▥	STORMWATER PIT
(green dashed line)	STORMWATER PIPE
RT	RAINWATER TANK
(green headwall symbol)	HEADWALL
(dash-dot line)	RISING MAIN
(light dash-dot line)	ROOF DRAINAGE
(red arrow)	FALL

ISSUE	DATE	BY	AMENDMENT	APP
C	23.06.05	SB	FOR SUBMISSION	

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CLIENT
READYMIX

PROJECT
ROOTY HILL REGIONAL DISTRIBUTION CENTRE

DRAWING
STORMWATER MANAGEMENT SYSTEM LAYOUTS

GW Engineers
Services & Solutions
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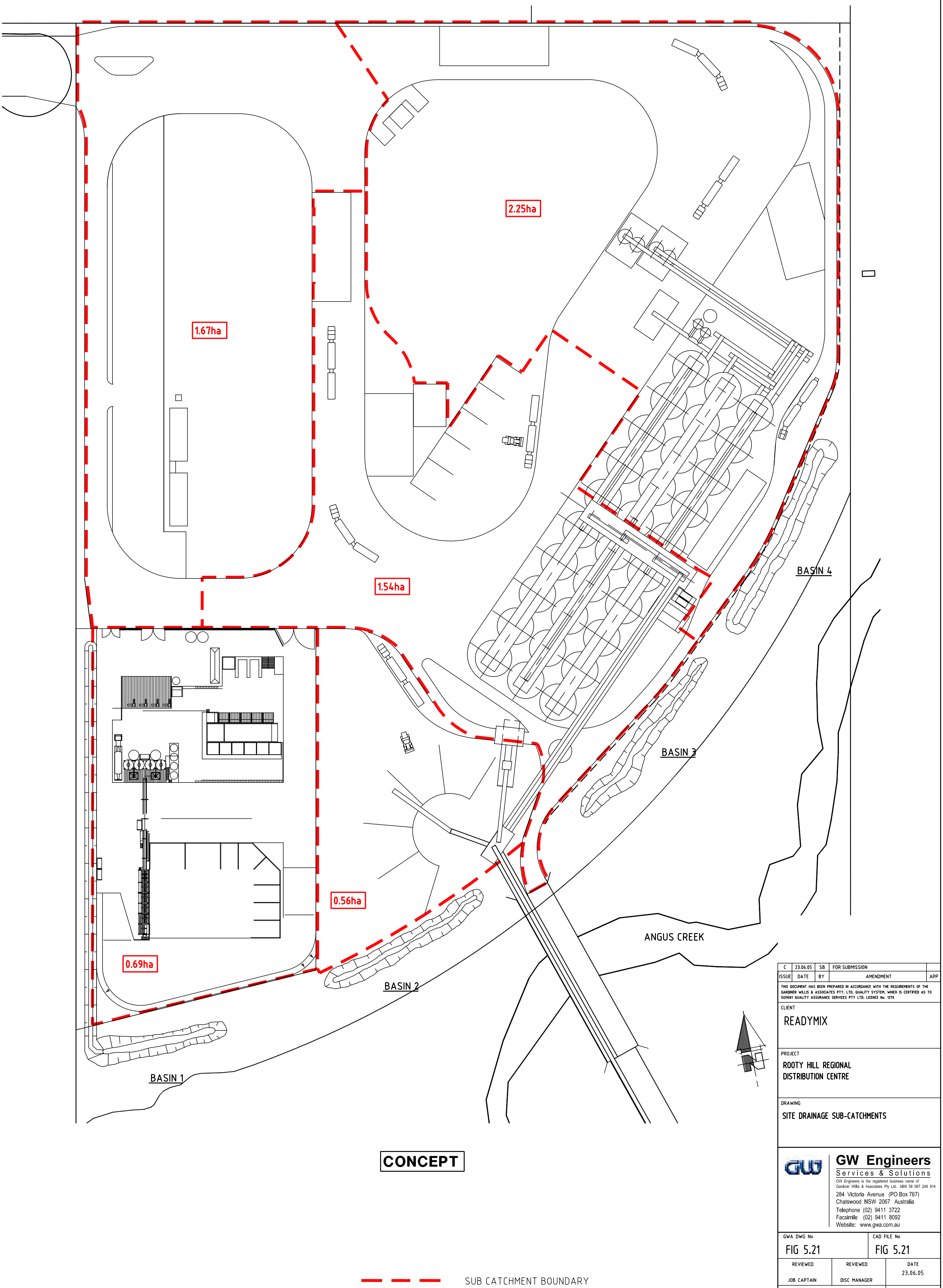
284 Victoria Avenue (PO Box 767)
Chatswood NSW 2067 Australia
Telephone (02) 9411 3722
Facsimile (02) 9411 8092
Website: www.gwa.com.au

GWA DWG No	CAD FILE No
FIG 5.20	FIG 5.20

REVIEWED	REVIEWED	DATE
JOB CAPTAIN	DISC MANAGER	23.06.05

DESIGNED & CHECKED	SCALE
DESIGN ENGINEER	

DRAWN & CHECKED	CHECKED	DWG No	REV
	CHECKER	FIG 5.20	A



CONCEPT

C	23.06.05	SB	FOR SUBMISSION	
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PROJECT
ROOTY HILL REGIONAL DISTRIBUTION CENTRE

DRAWING
SITE DRAINAGE SUB-CATCHMENTS

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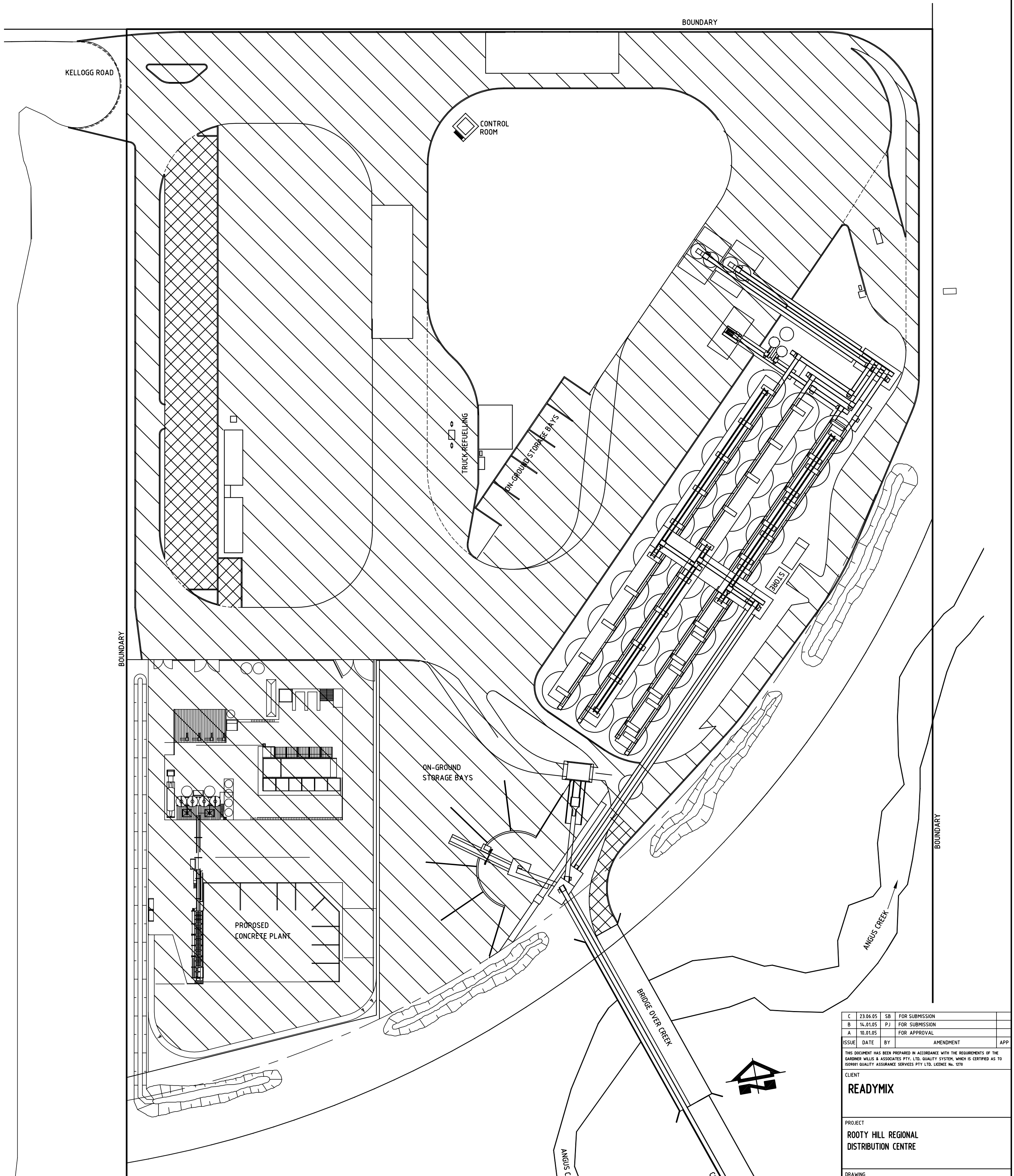
GWA DWG No	CAD FILE No
FIG 5.21	FIG 5.21

REVIEWED / JOB CAPTAIN	REVIEWED / DISC MANAGER	DATE 23.06.05
DESIGNED & CHECKED / DESIGN ENGINEER		SCALE

DRAWN & CHECKED	CHECKED / CHECKER	DWG No	REV
		FIG 5.21	A



LEGEND

FLEXIBLE PAVEMENT
2813 sq. m

REINFORCED CONCRETE PAVEMENT
46207 sq. m

PAVEMENT PLAN
SCALE 1:500

CONCEPT

ISSUE	DATE	BY	AMENDMENT	APP
C	23.06.05	SB	FOR SUBMISSION	
B	14.01.05	PJ	FOR SUBMISSION	
A	10.01.05		FOR APPROVAL	

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PROJECT
ROOTY HILL REGIONAL DISTRIBUTION CENTRE

DRAWING
PAVEMENT PLAN

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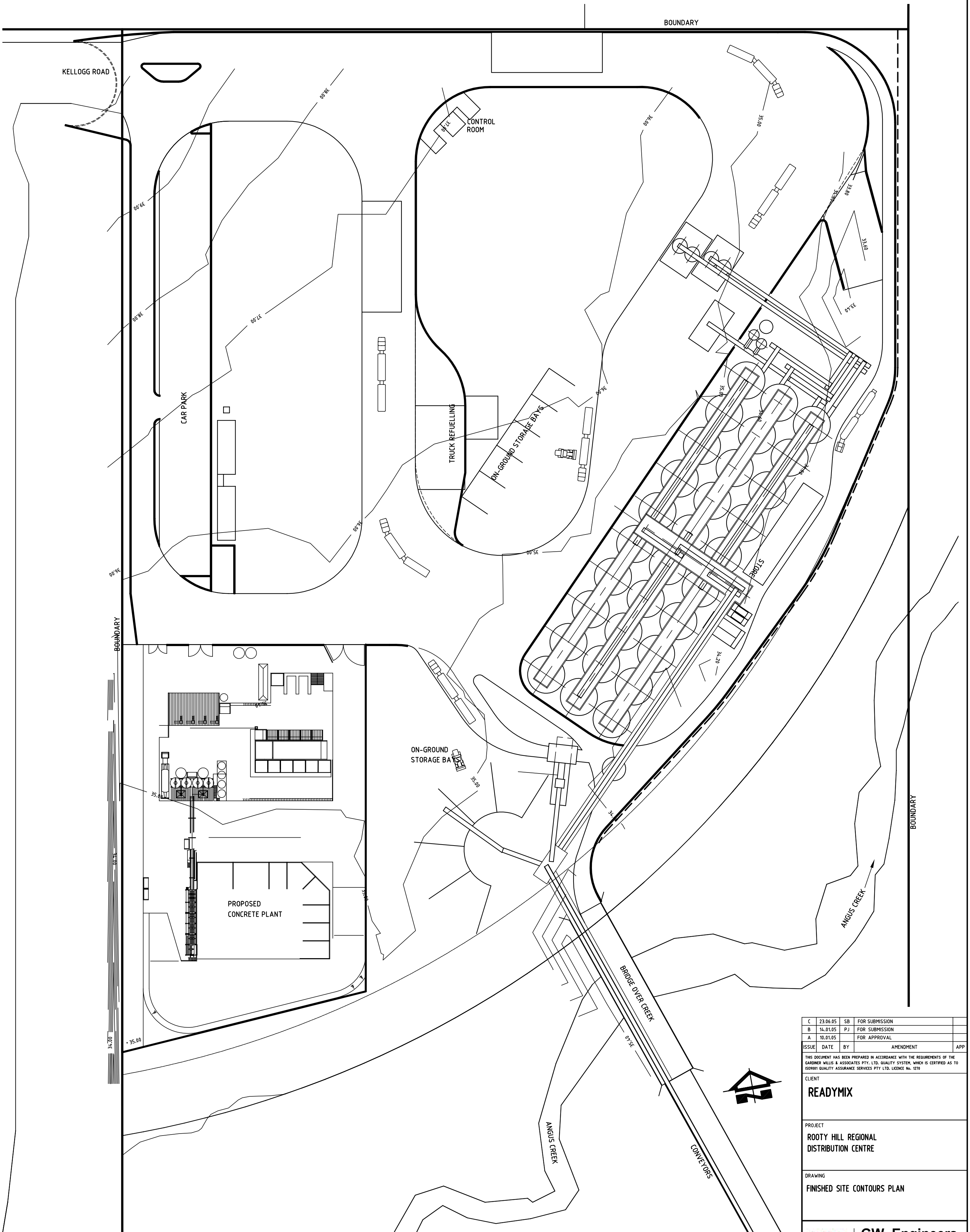
GWA DWG No	CAD FILE No
G284-C0004	G284-C0004

REVIEWED	REVIEWED	DATE
JOB CAPTAIN	DISC MANAGER	23.06.05

DESIGNED & CHECKED	SCALE
DESIGN ENGINEER	1:500

DRAWN & CHECKED	CHECKED	DWG No	REV
	CHECKER	G284-C0004	C



ISSUE	DATE	BY	AMENDMENT	APP
C	23.06.05	SB	FOR SUBMISSION	
B	14.01.05	PJ	FOR SUBMISSION	
A	10.01.05		FOR APPROVAL	

CLIENT
READYMIX

PROJECT
ROOTY HILL REGIONAL DISTRIBUTION CENTRE

DRAWING
FINISHED SITE CONTOURS PLAN

GW Engineers
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GWA DWG No	CAD FILE No
G248-C0006	G248-C0006

REVIEWED	REVIEWED	DATE
JOB CAPTAIN	DISC MANAGER	23.06.05

DESIGNED & CHECKED	SCALE
DESIGN ENGINEER	1:500

DRAWN & CHECKED	CHECKED	DWG No	REV
	CHECKER	G248-C0006	C

CONCEPT

NOTES:

1. ESTIMATED TOTAL CUT = 54472 cu. m
   ESTIMATED TOTAL FILL = 37998 cu. m
   BALANCE = 16474 cu. m