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Goodman International Limited

Oakdale Concept Plan

Water Sensitive Urban Design Strategy

May 2008

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

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1. Introduction

1.1 General

Goodman International Ltd (Goodman) is preparing a concept plan for the Oakdale development in accordance with the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979*.

For the purposes of the concept plan, the development site has been divided into the following 'precincts':

» Central Precinct – comprising Lot 2 DP 120673;

» South Precinct – comprising that part of Lot 82 DP 752041 east of Ropes Creek and Lot 87 DP 752041;

» West Precinct – comprising Lot 1 DP 120673 and that part of Lot 82 DP 752041 west of Ropes Creek; and

» East Precinct – comprising Lot 1 DP 843901, which is the site of an existing Austral Bricks quarry and brickmaking plant.

The location of the proposed development site is shown in Figure 1.

In terms of staging, it is likely that the Central Precinct would be developed first, and is therefore referred to in this report as 'Stage 1'. Indicative staging from Stage 1 would likely progress to the South Precinct ('Stage 2'), then the West Precinct ('Stage 3'), and finally the East Precinct ('Stage 4'). It is noted that the existing Austral quarry/brickmaking plant is planned to continue operating in accordance with existing approvals for the foreseeable future, and would only be developed following the cessation of quarrying/brickmaking and rehabilitation of the site.

The site forms part of the precinct known as the Western Sydney Employment Hub and is located within two local government areas being:

» Penrith City Council area; and

» Fairfield City Council.

1.2 Scope

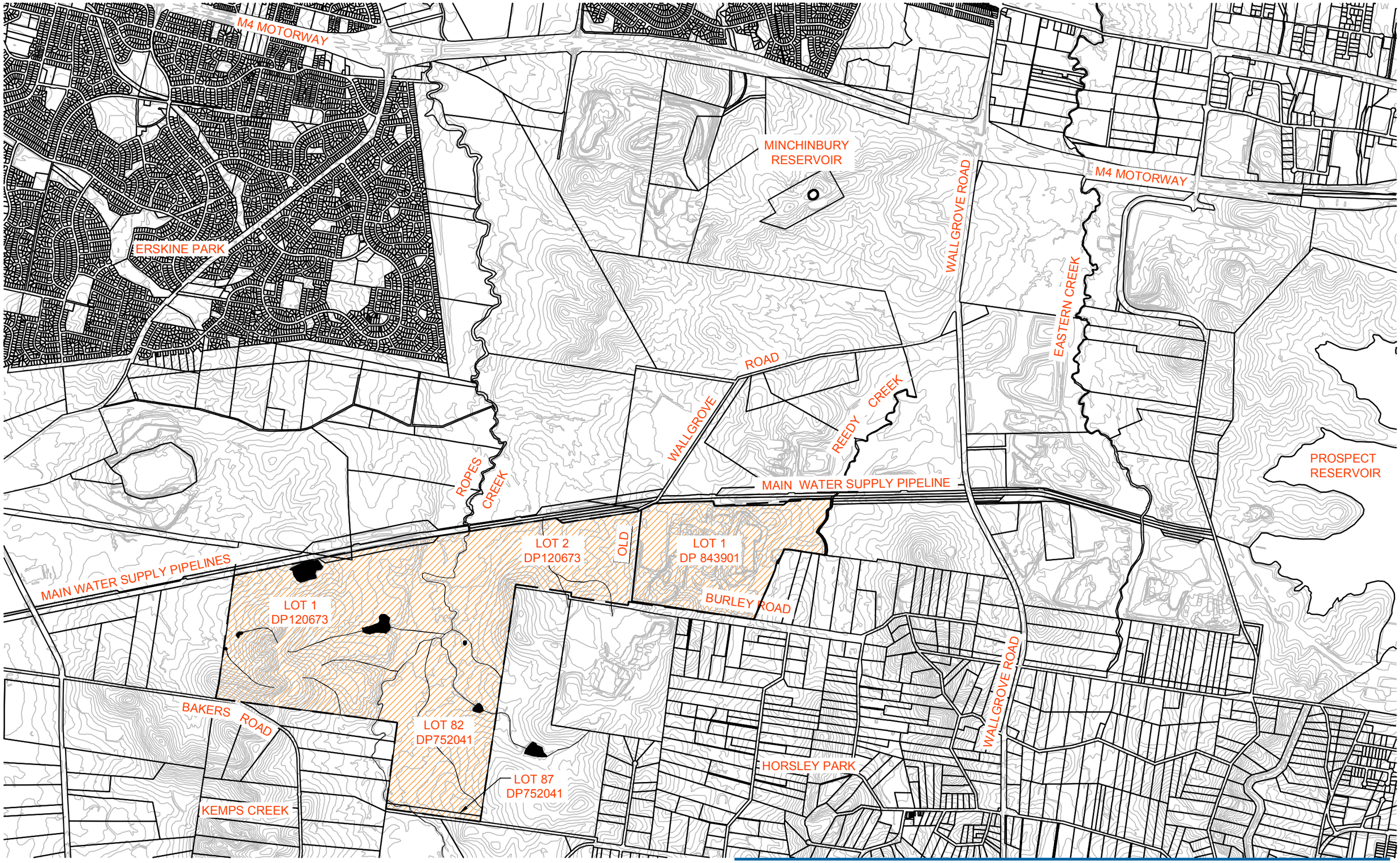
GHD has been engaged by Goodman to prepare a Water Sensitive Urban Design Strategy (WSUD) for Stages 1-3 of the proposed development site (herein know as "the site"). It should be noted that similar stormwater management principles developed for the Stage 1-3 area are proposed to be adopted for Stage 4.

This report assesses opportunities, constraints and principles for managing the surface water in terms of stormwater quantity and quality, flooding and the water cycle at the site. Specific topics addressed include:

» Statutory and authority requirements;

» The description of the existing hydrological environment;

- Potential impacts of the proposal with respect to stormwater quantity and quality and flooding;
- Proposals for mitigation of potential adverse impacts of the proposed development on surface water management; and
- Recommendations for ongoing maintenance of surface water management infrastructure at the site.



LEGEND

PROPOSED DEVELOPMENT SITE

PROPOSED DEVELOPMENT SITE BOUNDRY

N

0 250 500 750m

SCALE 1:25000 AT ORIGINAL SIZE

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GOODMAN INTERNATIONAL LTD
OAKDALE CONCEPT PLAN

SITE LOCALITY PLAN

job no. | 21-15101
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Figure 1

Level 6, 20 Smith St Parramatta NSW 1740 Australia PO Box 788 Parramatta NSW 2124 **T** 61 2 8898 8800 **F** 61 2 8898 8810 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Plot Date: 10 December, 2007 - 7:48 PM Cad File No: G:\21\15101\CADD\Drawings\21-15101-WSUD_FIG001.dwg

The detailed scope of work for the study was defined as follows:

» Compile a local hydrologic model (using RAFTS hydrologic modelling software) for the site, representing existing and developed conditions. This will allow the assessment of site discharges and formulation of a flood management strategy on account of increased impervious areas due to the development footprint;

» Compile an associated hydraulic model (TUFLOW hydraulic modelling software) in order to assess the existing flood extents on the site for the 5% and 1% Average Exceedance Probability (AEP) events and the Probable Maximum Flood (PMF) event. Flood peak input to the model would be provided by a second hydrologic model (using RAFTS hydrologic modelling software) for the Ropes Creek catchment upstream of the Sydney Water Main Water Supply Pipeline;

» Compile a stormwater quality model (MUSIC water quality modelling software) for the site representing existing and developed conditions. This will allow the assessment of pollutant loads and formulation/assessment of a water quality management strategy on account of the development; and

» Develop a concept Water Sensitive Urban Design Strategy for the site.

1.3 Water Sensitive Urban Design (WSUD)

WSUD encompasses all aspects of urban water cycle management, including water supply, wastewater and stormwater management. WSUD is a multi-disciplinary approach that promotes opportunities for linking water infrastructure, landscape design and the urban built form, to minimise the impacts of development upon the water cycle and achieve more sustainable forms of urban development.

1.4 Statutory and Authority Requirements

1.4.1 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is administered by the Department of Environment and Climate Change and is the primary legislative tool for regulating pollution control and waste disposal in NSW. The objectives of the POEO Act are:

» To protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development;

» To provide increased opportunities for public involvement and participation in environment protection;

» To ensure that the community has access to relevant and meaningful information about pollution;

» To reduce risks to human health and prevent the degradation of the environment;

» To rationalise, simplify and strengthen the regulatory framework for environment protection;

» To improve the efficiency of administration of the environment protection legislation; and

» To assist in the achievement of the objectives of the *Waste Avoidance and Resource Recovery Act 2001*.

In order to ensure that potential development impacts on surface water are managed in accordance with the objectives of the POEO Act, this report identifies mitigation measures that would need to be implemented during the construction and operational phases of the development.

1.4.2 Penrith and Fairfield City Council

Council's objectives for stormwater drainage for their cities are twofold:

» To provide an urban stormwater system which minimises possible inundation to the built environment; and

» To minimise the discharge of pollutants into receiving waters during the construction and operational phases of the project.

The following On-Site Detention (OSD) guidelines are specified by each of the Council's:

» Penrith City Council (PCC) – OSD storage of 280 m3/ha and a Permissible Site Discharge (PSD) of 120 L/s/ha. PCC indicated that site specific hydrologic modelling will be required to demonstrate how post-development flows are to be reduced to pre-development levels; and

» Fairfield City Council (FCC) – FCC defer to the requirements of the Upper Parramatta River Catchment Trust (UPRCT). That is OSD storage of 480 m3/ha and a PSD of 80 L/s/ha.

There are no specific requirements set out in the Penrith and Fairfield City Council design guidelines with respect to water quality targets and flood planning levels (FPL), however other councils in Western Sydney require the following:

» Water quality targets as outlined in 'Stormwater Flow and Quality, and the Effectiveness of Non-Proprietary Stormwater Treatment Measures – A review and Gap Analysis' (CRC 2004); and

» Flood planning levels of 1% AEP flood level with 300 mm freeboard for industrial and commercial areas.

2. Existing Conditions

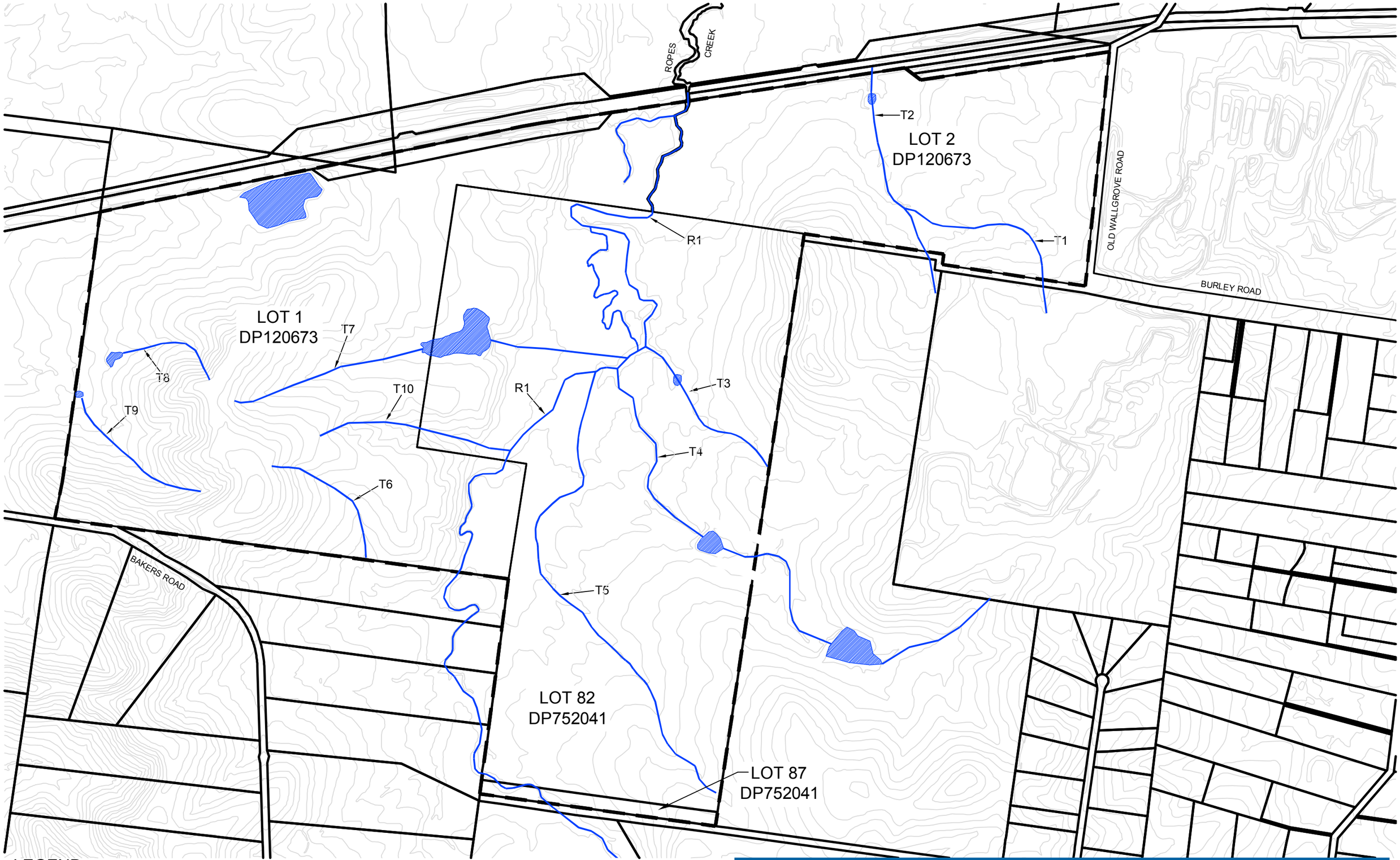
2.1 Topography and Existing Drainage

The Stage 1-3 area is presently undeveloped and comprises grazing land. It is predominantly pervious at present other than one existing house. The lowest area of the site is at Reduced Level (RL) 55m Australian Height Datum (AHD) and highest point at RL 94m AHD. The slope of the site varies between 1% and 25%. The eastern half of the site (predominantly Lot 2 of DP 120673 and Lot 82 of DP 752041) has the flattest with grades of 1-15%, while the western half of the site (predominantly within Lot 1 of DP 120673) has steeper natural surface grades that are in the range of 5-25%.

Ropes Creek drains the site on a north-south alignment. A number of tributaries confluences with Ropes Creek within the Stage 1-3 boundary. Some of these tributaries originate on the site while others convey stormwater run-off from areas upstream, through the site.

There are several other watercourses that originate on the site that drain westward through private property towards Kemps Creek.

Refer Figure 2 for the locations of the various watercourses on the site.



LEGEND

- EXISTING DAMS
- LOT BOUNDRY
- SITE BOUNDRY
- T5 EXISTING WATERCOURSE & LABEL

N

0 100 200 300m
SCALE 1:10000 AT ORIGINAL SIZE

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EXISTING DRAINAGE

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Figure 2

scale | 1:10000 for A3 date | DECEMBER 2007

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2.2 Climate and Rainfall

The site experiences Sydney's sub-tropical climate with rainfall predominantly occurring in summer and autumn. The nearest operational daily rainfall station is located at Horsley Park (BOM Stn 067119), which started recording data in 1997. A longer-term monitoring station exists at Badgerys Creek (BOM Stn 067068) with data from 1936 to 1996. The mean annual rainfall using the combination of data from the two stations is 779 mm for the period 1936 to date.

Figure 3 below shows the mean monthly rainfall and number of rain days recorded at the Badgerys Creek daily rainfall station, which is considered representative of conditions at the site. The figure shows elevated monthly rainfalls in the months of January to March, with the least rainfall being recorded in July to September. The mean number of rain days varies between approximately 4 and 9 days per month.

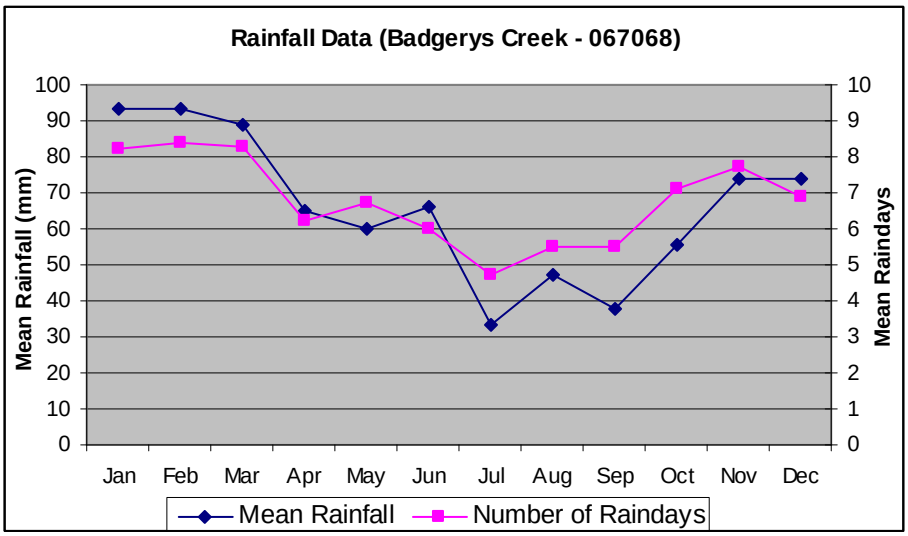


Figure 3 - Monthly Rainfall

The likelihood of rainfall occurring in any month throughout the year would support utilisation of WSUD vegetated systems such as swales, bio-retention and wetlands to manage stormwater. Furthermore, the mild seasonal variability would indicate that rainwater collection via rainwater tanks could be viable. A separate detailed water balance analysis has been conducted (GHD, December 2007) that investigates water reuse options.

3. Opportunities and Constraints

3.1 Topography

The topography is important when planning stormwater management facilities. Stormwater management facilities such as detention basins and quality management facilities should preferably be located in flatter areas to minimise the volume of earthworks, and maximise the treatment area.

Steeper slopes (greater than 5 to 10%) are generally not suitable for WSUD facilities such as bio-retention filtration and wetland systems. Flow attenuation via vegetated swales and bio-retention systems are less desirable in steeper areas due to excessive flow velocities, reduced detention times and potential scouring. In addition, detention basins are difficult to configure, particularly when located off-channel.

The eastern half of the Stage 1-3 development area (eastern side of Ropes Creek) comprises the flatter parts of the site and would be suitable for such stormwater management facilities as swales and precinct scale detention basins. Parts of the western half of the Stage 1-3 development area (western side of Ropes Creek) are considerably steeper and filtration systems are not considered practical.

3.2 Climate and Rainfall

The high likelihood of rainfall occurring in any month throughout the year would support utilisation of appropriate WSUD systems such as swales (at selected locations) and wetlands to manage stormwater quality. Furthermore water re-use via roof collection using rainwater tanks may be considered viable.

3.3 Riparian Corridors

The Department of Water and Energy (DWE) administers the *Water Management Act 2000 (WMA)* All waterways subject to approval under this act require a setback from the top of the banks, according to the category of creek. These setbacks form a constraint to the limits of development. A separate riparian assessment has been conducted (GHD December 2007) and a riparian strategy for the site developed. The stormwater management practices proposed for the site and as documented in this report are consistent with the proposed riparian strategy.

3.4 Stormwater

3.4.1 General

Development results in increased impermeable surfaces (roofs, driveways, roads, pavements etc.), which affect the hydrological cycle. This ‘hardening’ of the surfaces results in reduced infiltration of rainfall to the soil and more rainfall becoming runoff. If not managed effectively, key impacts could include:

» Impacts to the water balance, (including groundwater recharge);

» Stormwater pollution (by pollutant entrainment in runoff) discharged to receiving environments;

» Increased stormwater peak flows leading to increased flood risk and erosion (on-site and off-site); and

» Construction phase impacts, such as pollution, erosion and sedimentation.

3.4.2 Water Balance

If adequate water management strategies are not adopted in terms of the water balance, the proposed development could:

» Reduce rainfall infiltration to the soil resulting in decreased groundwater recharge;

» Increase stormwater runoff volumes, which could impact downstream sensitive habitats in terms of flushing regimes (frequency, volume and rate), water quality, and wetting cycles;

» Lead to increased recharge due to removal of vegetation, over-irrigation, and structural leakages; and

» Impact groundwater flow due to site compaction, fill, landform reshaping and underground structures.

3.4.3 Stormwater Quality

Stormwater quality discharging from the site would need to be adequately managed, to address:

» Increased runoff volume during regular rainfall events, which would more readily entrain and mobilise pollutants and increase pollutant loads to the receiving environments. The type of development and associated activities, may introduce differing pollutant profiles. For example vehicular traffic could increase hydrocarbon introduction. In general, typical pollutants include litter, sediment, suspended solids, nutrients, hydrocarbons and toxicants;

» Increased runoff flow rates could lead to erosion and sedimentation. If not adequately managed this material could discharge off site;

» Contamination from waste streams on the site, which may enter the drainage system and groundwater; and

» During construction there is a significant risk of increased stormwater pollution. Increased sedimentation on account of landform disturbances and accidental spills on unbunded areas of the site could discharge to the receiving environment. Clearing and earthmoving activities have the potential to impact on surface water quality in the vicinity of the site, 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:

  – 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; and
- Maintenance of plant and equipment.

3.5 Other Constraints

3.5.1 Site Soil Characteristics

Douglas Partners (May 2007) has conducted a preliminary geotechnical assessment of the site although no site-specific soil testing/test pitting has been conducted at this point in time. The soil landscape at the site is described below.

Bannerman and Hazelton (1990) describe three soil landscapes across the development site:

» **South Creek Soil Landscape** – a fluvial soil landscape developed in floodplains, valley flats (slopes <5% and local relief <10 m) and drainage depressions with incised channels. The South Creek soils within the site are developed on alluvium derived from Wianamatta Group shales and are often very deep-layered sediments over bedrock or relict soils. Landscape limitations include flood hazard, waterlogging (seasonal or localised), permanently high water tables (localised) and high erosion hazard.

» **Blacktown Soil Landscape** – a residual soil landscape developed on a landscape typically comprising gently undulating rises with local relief to 30 m and slopes usually less than 5% on Wianamatta Group shales and Hawkesbury shales. The Blacktown soils are shallow to moderately deep (<1 m), red and brown podsolic soils on crests, upper slopes and well-drained areas. Deep (1.5 m – 3 m) yellow podsolic soils are located on lower areas and in areas of poor drainage. These soils are derived from weathering of the underlying (typically shaly) bedrock and are highly plastic, moderately reactive, of low soil fertility, poor soil drainage, localized salinity or sodicity and moderate erodibility.

» **Luddenham Soil Landscape** – an erosional soil landscape developed on undulating to rolling hills with local relief of 50 m to 80 m and slopes of 10% to 20% on Wianamatta Group shales, often associated with resistant sandstone bands. The Luddenham soils are shallow (<1 m), dark podsolic soils or massive earthy clays on crests; moderately deep (0.7 m to 1.5 m) yellow podsolic soils and prairie soils on lower slopes and drainage lines. The soils have highly plastic subsoils of moderately reactivity and low to moderate shrink-swell potential, low to moderate soil fertility and moderate erodibility.

The majority of the site consists of the Blacktown Soil Landscape. The higher areas of the site in the west consist of the Luddenham Soil Landscape and Ropes Creek and the land immediately adjacent consists of the South Creek Soil Landscape.

3.5.2 Salinity

Douglas Partners report that very saline soils along poorly drained sections of Ropes Creek and tributary gullies is expected. Elsewhere, it is anticipated that most of the site will be classified as non or slightly saline with a scattering of moderately saline areas.

4. Analysis

4.1 Concept Plan

A Concept Plan showing a preliminary lot layout for the site including internal roads is provided in Appendix A. The Concept Plan also indicates the proposed first 3 Stages of development. Stage 4 is the area of land occupied by the existing Austral brickworks and quarry.

The analysis conducted as part of this study and outlined in the following sections is based on the Concept Plan.

4.2 Summary of Analysis Undertaken

Numerical modelling was carried out for the flood assessment and to assist in the development of the WSUD strategy. In particular, the modelling was carried out to determine:

» Existing condition flood peaks and flood levels for Ropes Creek within the Stage 1-3 development area for a range of design storm events (using RAFTS hydrologic model and TUFLOW hydraulic model);

» Appropriate volumes of stormwater detention throughout the precinct which reduced post development flood peaks to existing condition flood peak levels (using the RAFTS model);

» Simulated stormwater runoff quantity and quality for the developed scenario (using the MUSIC water quality model); and

» Appropriate strategies for stormwater quality management throughout the Stage 1-3 site area, which achieved the targeted pollution load export requirements (using MUSIC).

All modelling should be considered as preliminary and would need to be updated at later stages with more detailed studies, when more detailed information on landform, development footprints, and road configurations are known.

4.3 Ropes Creek Flooding

4.3.1 Past Relevant Studies

In February 1991, Willing & Partners completed “South Creek Floodplain Management Study” report for the then Department of Water Resources. The purpose of this report was to develop a floodplain management plan for the South Creek catchment in accordance with the NSW Government’s Floodplain Development Manual. As part of this study, flood simulation of a portion of Ropes Creek was carried out. However the extent of modelling did not cover the entire proposed Stage 1-3 site area. Although the Main Water Supply Lines are identified on the channel long sections it is not clear as to whether the pipelines were included in the hydraulic model to determine their effect on flood levels. The flood levels downstream of the Stage 1-3 development site have

been used to set the downstream boundary conditions for the modelling carried out by GHD as part of this study.

4.3.2 Flood Simulation

Peak flows for Ropes Creek were simulated using the RAFTS hydrological model.

Compilation of the model included:

» Catchment discretisation;

» Hydrological parameter determination;

» Intensity-Duration-Frequency determination for generating storm rainfall events; and

» The RAFTS model was simulated for a range of design storms (5% AEP, 1% AEP and PMF) and durations ranging from 45 minutes to 9 hours. Simulations were undertaken for the existing conditions.

Key parameters assumed in the RAFTS modelling are provided in Table 1, in accordance with the Australian Rainfall and Runoff (IEAust, 2000)

Table 1 Key RAFTS modelling parameters for Flood Assessment

	Pervious	Impervious
Initial loss (mm)	15	2
Continuing loss (mm/hr)	2.5	0

A digital terrain model was developed using Airborne Laser Scanning survey of the area provided by Penrith City Council. The accuracy of the survey cannot be confirmed at this stage, although the survey is not considered as accurate as a detailed field survey.

Hydraulic modelling was conducted using TUFLOW and the flood extents corresponding to each event modelled was mapped. Detail survey of the Sydney Water Main Water Supply Pipelines was conducted so that they could be incorporated into the model to determine their impact on flood levels.

The flood extent maps for existing conditions and detailed modelling results are presented in Appendix B. It is noted that the flood maps include the existing farm dams located on some of the Ropes Creek tributaries. It is proposed to remove these farm dams. The farm dams do not have dedicated spillways and as such, overflow discharges in an uncontrolled manner. It is noted that on the Ropes Creek tributary T4 (refer Figure 2) the flow path separates. This is due to the existing farm dam impeding flow and causing water to find an alternate flow path towards Ropes Creek rather then via the existing defined watercourse. When the farm dam is removed the flow path will follow the defined watercourse rather then take alternate flow paths. As such, the alternate flow path is unlikely to impose a restriction to development. This will need to be confirmed during the detail design phase when detailed flood modelling is

conducted using a detailed field topographical survey as the base digital terrain model, and the proposed earthworks in the affected area are included. Further hydraulic modelling should be conducted during the detail design phase utilising a detailed topographical survey as a digital terrain model and incorporating the final earthworks levels.

4.4 On-Site Flooding

Existing and developed flood peaks and stormwater detention requirements were simulated using the RAFTS hydrological model.

Compilation of the model included:

» Local catchment discretisation based on the Concept Plan;

» Hydrological parameter determination; and

» Configuration of storm rainfall events.

The RAFTS model was simulated for the 1% AEP event and durations ranging from 25 minutes to 9 hours. Simulations were undertaken for three scenarios, namely:

» Existing (undeveloped) conditions;

» Developed conditions based on the Concept Plan. For the developed condition individual allotments were modelled as between 60% and 85% impervious depending on the individual sub-catchment characteristics; and

» Developed conditions based on the Concept Plan with detention storage provided on a precinct scale, rather than on-lot OSD. It is noted that on-lot OSD could be provided in lieu of precinct style detention storage. The increase in impervious area on account of the development will increase runoff peaks from the site.

It is noted that roof run-off is proposed to be captured and re-used on the individual lots for non-potable water uses. Overflow from the roofwater collection tanks is proposed to be collected and utilised for the Regional Roofwater Harvesting Scheme whereby such run-off is directed to Prospect Reservoir. Although some detention benefit may be derived, this has not been included in the RAFTS modelling.

The stage discharge was modified until post-development flows match pre-development flows at the three site discharge locations. The resultant storage and PSD is as follows:

» OSD: 250 m^3/ha; and

» PSD: 140 l/s/ha.

The resultant peak flows are listed in Table 2. From Table 2 it is noted that:

» The post development flows are significantly higher due to the large areas of hardstand; and

» The increased flood peaks are effectively reduced to pre-developed conditions through the provision of stormwater detention (this is discussed further in Section 6.5).

Table 2 Stage 1-3 Peak Flows, 1% AEP event

Catchment	Existing Condition (m^3/s)	Post Condition with No Detention (m^3/s)	Post Condition with Detention (m^3/s)
A1	4.1	13.2	3.7
A3	2.6	8.8	2.4
A5	1.7	4.7	1.3
A6	3.9	8.8	2.3
A7a	2.1	4.1	1.1
A7b	2.3	4.2	1.1
A8	2.8	8.2	2.2
A9	3.4	9.1	2.4
A10	3.1	5.9	1.5
A11a	5.0	8.0	2.1
A11b	2.1	4.6	1.2
A12a	1.1	2.1	0.5
A12b	1.6	2.5	0.7
A13	1.3	2.1	0.6
A14a	1.6	4.4	1.2
A14b	1.0	1.6	0.5
A15 & A16	11.7	25.3	7.0
A17	1.1	1.7	0.5
Total site outlet	26.08	49.6	24.1

The detailed modelling results and catchment plan are presented in Appendix C.

It is noted that the required detention volume and PSD differs slightly to the PCC guidelines. The calculated detention storage volume and PSD is much lower than the FCC guidelines, which are the same as the UPRCT guidelines. The UPRCT guidelines are not considered relevant for a green fields site such as Oakdale as they were developed to address existing drainage system capacity constraints in the built out areas of the Parramatta River catchment.

4.5 Stormwater Quality Modelling

A MUSIC model was configured for the Stage 1-3 area incorporating the proposed water quality control facilities as outlined in Section 6 of this report and as shown in the WSUD strategy plan in Appendix E.

The model was analysed for two scenarios, with and without water quality control facilities included.

In undertaking the MUSIC modelling, the following key parameters were used:

» Pollution generation parameters and treatment efficiencies for stormwater management facilities as recommended in the MUSIC User Guide (April 2005) and the Western Sydney Growth Centres – Stormwater Guidance for Precinct Planning (DEC, Nov 2006);

» Simulations were undertaken using the Badgerys Creek (BOM Stn 067068) rainfall data for an average rainfall year; and

» Simulations were undertaken using the Badgerys Creek (Stn 67068) mean evaporation data for the available period, 1968 to 1984.

Roofwater runoff was not accounted for in the stormwater quality model. It is assumed that roofwater run-off is collected and either re-used on each lot or diverted to the Regional Roofwater Harvesting Scheme.

The results are shown in Table 3, Table 4 and Table 5. The results show a decrease in total suspended solids, phosphorous, nitrogen and gross pollutants at the three site discharge locations. Table 6 gives a summary of the entire site. The decrease in pollutant loads meet the stormwater quality objectives as outlined in the Western Sydney Growth Centres – Stormwater Guidance for Precinct Planning (DEC, Nov 2006), that is:

» Total suspended solids: 85% reduction;

» Total phosphorus: 65% reduction;

» Total nitrogen: 45% reduction; and

» Gross pollutants: 90% reduction.

The model network and inputs summary is presented in Appendix D.

Table 3 Pollutant Loads – Ropes Creek

	Source	Residual Load	% Reduction
Total SS (kg/yr)	69,800	3,070	95.6
Phosphorus (kg/yr)	110	27.7	74.9
Nitrogen (kg/yr)	867	466	46.3
Gross Pollutants (kg/yr)	12,100	0 (approx)	99.9% (approx)

Table 4 Pollutant Loads – Ropes Creek Tributary

	Source	Residual Load	% Reduction
Total SS (kg/yr)	19,600	775	96.0
Phosphorus (kg/yr)	34.5	7.31	78.8
Nitrogen (kg/yr)	238	104	56.2
Gross Pollutants (kg/yr)	3,880	0 (approx)	99.9% (approx)

Table 5 Pollutant Loads – Western Discharge Point

	Source	Residual Load	% Reduction
Total SS (kg/yr)	15,800	222	98.6
Phosphorus (kg/yr)	28.5	4.51	84.2
Nitrogen (kg/yr)	251	117	53.3
Gross Pollutants (kg/yr)	3,630	0 (approx)	99.9% (approx)

Table 6 Pollutant Loads – Entire Site

	Source	Residual Load	% Reduction
Total SS (kg/yr)	105,000	4,060	96.1
Phosphorus (kg/yr)	173	39.5	77.2
Nitrogen (kg/yr)	1,360	688	49.3
Gross Pollutants (kg/yr)	19,600	0 (approx)	99.9% (approx)

5. Principles for Management

5.1 General

A number of measures can be implemented to effectively manage and mitigate the impacts of development on stormwater as follows:

» Water balance impacts
  – Provision of stormwater retention on the site;
  – Rainwater harvesting;
  – Management and monitoring of onsite activities (irrigation) and infrastructure (leaks);
» Stormwater quality (contaminated runoff and pollution entering the stormwater system) impacts
  – Treatment of stormwater targeting pollutants using WSUD and treatment train approaches;
  – Construction Phases Impacts;
    - Soil and Water Management planning for construction activities;
    - Implementation of erosion and sediment control strategies;
    - Ongoing monitoring and maintenance of erosion and sediment control strategies
» Flooding and flood risk impacts
  – On-site or precinct level detention strategies;
  – Flood planning levels; and
  – Flood evacuation strategies.

5.2 Water Balance

The impacts on the water balance at the site can be mitigated and managed by:

» Provision of stormwater retention strategies. These can be provided in the form of swales (vegetated and/or bio-retention swales), rain gardens, retention water bodies and wetlands. Some devices may need to be lined to prevent percolation to groundwater or in areas of high salinity. Infiltration-based strategies may not be suitable in some areas due to high groundwater levels or potential groundwater contamination impacts and rock at shallow depths. This will need to be confirmed in the detail design phase when detailed land-capability and geotechnical field investigations have been completed;
» In general, water reuse by capturing roof rainwater is desirable. Roof water would require adequate first flush treatments and can be directed to a single or a number of holding tanks for re-use for toilet flushing, irrigation of landscaped areas or other on-lot non-potable water uses; and

5.3 Stormwater Quality

Stormwater quality and pollution can be effectively managed and mitigated by providing suitable WSUD strategies. These typically comprise both structural and procedural mitigation measures. Strategies should preferably aim at “source control”.

Structural measures have a direct, measurable effect on water quality, while procedural measures (for example improved maintenance) would play an important role in mitigation and would reduce the pollutant load on the structural mitigation measures. This would effectively manage water quality and reduce the maintenance requirements for the structural measures.

Specific strategies can include:

» Orientation of roads to traverse across contours, providing slopes with grades of 4% or less where possible, to promote the provision of treatment measures into the streetscape;

» Preserve and restore (where practicable) existing elements of the natural topography;

» Manage the quality and quantity of stormwater at or near the source; and

» Provide primary stormwater treatment measures, which target litter, gross pollutants and coarse sediments and secondary treatment measures, which target sediment, nutrients and bacteria.

Construction phase water quality impacts can be managed by implementation of a Construction Phase Soil and Water Management Plan detailing stormwater management strategies in accordance with Landcom Soil and Construction, Managing Urban Stormwater (Landcom, 2004). These would include amongst others:

» General site practices and responsibilities;

» Material management practices;

» Stockpile practices;

» Topsoil practices; and

» Erosion control practices (earth sediment basins, straw bales, sediment fences, turbidity barriers, stabilised site accesses, diversions and catch drains).

Monitoring should be undertaken to ensure that stormwater quality management measures are working effectively. Monitoring would rely primarily on visual inspections and targeted sampling. Visual inspections should be undertaken of sediment traps, pits, diversion, Gross Pollutant Traps (GPT), catch drains and all stormwater conveyance structures. A general indication of frequencies for inspections is provided in Table 7.

Table 7 Sample Monitoring Program

Sample location	Collection mechanism	Frequency first six months	Frequency normal operation
Sediment Traps	Visual Inspection	Every runoff event	First runoff event of any month
Inlet Pits	Visual Inspection	Every runoff event	First runoff event of any month
Trunk Drainage Channels	Visual Inspection	Every runoff event	First runoff event of any month
Overland Flow Paths	Visual Inspection	Every runoff event	First runoff event of any month
Trafficable Areas (during construction)	Visual Inspection	Every month	
Bunded areas (during construction)	Visual Inspection	Every runoff event	
Other works areas, potentially contaminating stormwater (during construction)	Visual Inspection and system operation testing	Every month	

Notes:

1. Runoff event must be sufficient;
2. Inspect after 24 hour retention period (ie 24 hrs after runoff event);
3. For every inspection, date, time and ambient weather conditions would be recorded.

5.4 Flooding and Flood Risk

Increased peak flows on account of increased impervious areas can be managed by providing stormwater detention on the site. As this proposed development is an industrial sub-division, the impervious areas are significantly more than for residential areas. Stormwater detention could be provided as either precinct style detention or On-Site Detention (OSD) as follows:

» Larger development scale basin; and/or

» Smaller on-lot detention systems such as above ground storage in carparks or in-ground tanks.

Development and land-use in flood prone areas should be in accordance with the NSW Floodplain Management Manual. In the context of the NSW Floodplain Development Manual (April 2005) all areas inundated during a PMF are termed “flood liable”. This

land would need to be assessed as part of a “merit approach” to development, for managing flood risk, after definition of flood hazard.

A key tool in the management of flood risk is the Flood Planning Levels (FPL), which ensure that development is located in areas where it would not have significant adverse impacts on flooding nor on personal safety (identified by the flood hazard). The FPL is often based on the 100-year ARI flood extent plus a freeboard (often 500mm). Thus development floor levels are located outside of the 100-year ARI flood extent and at an elevation above the 100-year ARI flood level plus a suitable freeboard. In addition, provision for flood evacuation for events up to and including the PMF must be provided.

6. Proposed Water Sensitive Urban Design Strategy

6.1 General

The proposed WSUD Strategy Plan is provided in Appendix E.

It is proposed to manage stormwater using a number of facilities based on WSUD principles and as outlined in general in Section 5. The facilities include:

» Provision of suitable riparian zones to maintain and enhance the ecological value of the existing watercourses;

» Provision of bio-retention swales at major overland flow routes and bio-retention basins or wetlands to remove pollutants from the stormwater run-off;

» Provision of on-lot stormwater treatment facilities including vegetated systems, infiltration systems and structural facilities (gross-pollution traps);

» Provision of either precinct style stormwater detention facilities or OSD provided for each precinct/lot before discharge to the receiving waters;

» Where possible separation of road and lot drainage systems until stormwater run-off from both areas have been treated;

» Roofwater run-off harvesting, and re-use for toilet flushing, irrigation purposes and other on-lot non-potable water uses to minimise potable water use on the site and to mitigate the potential increase in run-off volumes;

» Provision of blackwater treatment and recycling of treated water for non-potable water uses on each site. This will further reduce potable water demands and minimise the amount of effluent to be disposed of off-site;

» Connection of the site to the proposed Regional Roofwater Harvesting Scheme to return “clean” run-off to the potable water supply system;

» Flood risk management using Flood Planning Levels and provision of adequate flood evacuation routes; and

» Construction phase water management principles that would include Soil and Water Management planning for construction, implementation of erosion and sediment control strategies and ongoing monitoring and maintenance of erosion and sediment control strategies.

In general, the proposed WSUD strategy was developed in accordance with the Concept Plan. Any changes to the Concept Plan would inherently need to be reflected in the WSUD strategy.

6.2 Site Discharge Points

It is proposed that the site discharge points would be located at various places as shown on the strategy plan (Appendix E) corresponding to existing drainage lines. Stormwater quality measures are provided using a “treatment train” approach with control measures incorporated at the source and throughout the drainage path to the

discharge points. Existing peak flow conditions are maintained at all site discharge locations via the use of stormwater detention facilities.

6.3 Water Balance

It is proposed that all allotments will incorporate roofwater run-off collection tanks. The captured roofwater run-off is to be re-used on each allotment for non-potable water uses. Overflow from the tanks would go to the proposed Regional Roofwater Harvesting Scheme rather then to the site stormwater system. A separate detailed water balance analysis has been undertaken with a number of scenarios modelled including blackwater recycling. The reader is referred to the separate detailed water balance report for the results of the analysis (GHD, December 2007). A diagrammatic representation of the proposed scheme is included in Appendix E.

6.4 Stormwater Quality Management

It is proposed to manage stormwater quality by:

- Provision of GPT's and other structural measures, for example bunding and oil/ water separation systems before discharge to any OSD systems or site drainage infrastructure;
- Provision of rainwater tanks on each site;
- Provision of bio-retention swales where appropriate;
- Provision of bio-retention basins (to be lined in areas of high salinity potential); and
- Provision of GPT's, oil/water separation systems and/or bio-retention systems at road drainage system discharge points;
- Where it is considered impractical to treat water on a precinct basis, for example lots that are immediately adjacent to existing watercourses, then on-lot treatment measures will be incorporated such as bio-retention basins.

The areas that are to be set aside for water quality treatment facilities on the site are sufficient in size to accommodate the necessary stormwater quality control features.

Construction phase water quality impacts would be managed by implementation of a Construction Phase Sediment and Erosion Control Plan detailing stormwater management strategies in accordance with Landcom Soil and Construction, Managing Urban Stormwater (Landcom, 2004). Strategies would include amongst others general site practices and responsibilities, material management practices, stockpile practices, topsoil practices and erosion control strategies such as earth sediment basins, straw bales, sediment fences, turbidity barriers, stabilised site accesses, diversions and catch drains.

6.5 Stormwater Quantity Management

It is proposed that all on-lot stormwater be routed to either the individual OSD systems or to precinct style detention systems, depending on the local topography of the sub-catchment (refer WSUD Strategy Plan in Appendix E). The precinct style detention

systems would be combined with the proposed bio-retention basins. Such precinct style water quantity and quality controls are proposed to be “off-line” of any Category 1 or 2 watercourses.

Post-development site discharge would be limited to the pre-development site discharge for a range of storm events.

The required detention storages are provided in Section 4.4 and the results indicate how the provision of detention storage will limit post-development flows to pre-development levels.

6.6 On- Site Flooding and Flood Risk

Flood levels for Ropes Creek and its tributaries have been determined and the associated flood extents maps are included in Appendix B. All building floor levels would be located above the 1% AEP flood level plus a freeboard of 300mm. For flooding associated with discharges on internal roads, it is proposed to limit the overland flows and associated flow velocities and depths. This would be achieved through a detailed design of the subsurface stormwater infrastructure in order to contain overland flow in the roadway. For areas of the Stage 1-3 area below the PMF level a flood evacuation strategy will be developed. Elevated areas on either side of Ropes Creek would provide suitable evacuation muster areas.

It is proposed to relocate tributary T1 as shown on Figure 2 to the southern boundary of the Stage 1 area. This tributary has a small natural catchment originating upstream of the site boundaries. Preliminary hydrologic modelling of the 1% AEP event peak flows has been conducted for the associated catchment. A preliminary trapezoidal channel size has been determined that will convey the 1% AEP peak flows and allow for a suitable freeboard. The preliminary channel dimensions are 12m wide, 1m deep with 1v:4h side slopes. Detailed hydraulic modelling will need to be conducted as part of the Stage 1 detailed design process to confirm the channel size.

6.7 Ongoing Monitoring

Monitoring will be undertaken to ensure that stormwater quality management measures are working effectively. Monitoring would rely primarily on visual inspections and targeted water sampling. Visual inspections should be undertaken of sediment traps, pits, diversion, GPTs, catch drains and all stormwater conveyance structures. A sample monitoring program is provided in Table 7 (Refer Section 5.3).

7. Conclusion

A WSUD strategy has been developed that mitigates the potential impacts of the development of the Oakdale such as:

» Impacts to the water balance;

» Stormwater quality impacts;

» Increased stormwater peak flows and flood risk; and

» Construction phases impacts;

The proposed WSUD strategy incorporates the following measures to manage and mitigate the impacts of the proposed development;

» Stormwater treatment facilities such as GPT's, bio-retention swales and bio-retention basins;

» Either precinct style stormwater detention or OSD systems;

» Roofwater run-off collection and re-use for non-potable water uses;

» Blackwater recycling;

» Flood risk management using flood planning levels and flood evacuation; and

» Construction phase management provisions which include implementation of erosion and sediment control strategies.

Numerical modelling was undertaken to support the proposed WSUD strategy plan. The results of the simulations show that the stormwater management strategy would effectively mitigate the impacts of development at the site and the stormwater quality and quantity targets can be met.

8. References

- Penrith and Fairfield City Council standards
- DNR&DE, 1998: Stormwater Quality Control Guidelines for Local Government, Department of Natural Resources and Department of Environment, February 1998;
- AR&R, 2000: The Institute of Engineers in Australia, Australian Rainfall and Runoff;
- Landcom, 2004: Soil and Construction, Managing Urban Stormwater (formerly the "Blue Book");
- Douglas Partners (May 2007), "Report on Preliminary Geotechnical Assessment, Proposed Ropes Creek "Southpipe" Development, Eastern Creek and Erskine Park"
- GHD Pty Ltd (December 2007), "Oakdale Concept Plan, Riparian Assessment"
- GHD Pty Ltd (December 2007), "Oakdale Concept Plan, Water Balance Report – Part 1"
- CRC for Catchment Hydrology, Music Model User Guide, April 2005
- CRC for Catchment Hydrology, Stormwater Flow and Quality, and the Effectiveness of Non-Proprietary Stormwater Treatment Measures – A Review and Gap Analysis, Technical Report 04/8, December 2004.
- Department of Environment and Conservation, Sydney Growth Centres – Stormwater Guidance for Precinct Planning, November 2006
- Department of Water Resources, South Creek Floodplain Management Study, February 1991.
- XP Software, XP-RAFTS User's Manual, Version 6.11
- NSW Government, Floodplain Development Manual, 2005.

Appendix A

Oakdale Concept Plan

Site Area Schedule

	Total	Central/ South/ West	EAST
Total Land Area	421.3 ha	333.0 ha	88.3 ha
Less: Restricted Areas	(95.3 ha)	(89.4 ha)	(6.2 ha)
DEVELOPMENT Area	325.7 ha	243.6 ha	82.1 ha
Less: Regional infrastructure Regional Roads	(21.6 ha)	(21.6 ha)	(00.0 ha)
Gross ESTATE Land Area	304.1 ha	222.0 ha	82.1 ha
Less: Estate Allocations	(43.2 ha)	(38.7 ha)	(4.5 ha)
NETT DEVELOPMENT LOTS	260.9 ha	183.3 ha	77.6 ha

Breakdown of Central/ South/ West Precinct		
Central	South	West
61.2 ha	111.2 ha	160.6 ha
(9.0 ha)	(30.3 ha)	(50.1 ha)
52.2 ha	80.9 ha	110.5 ha
(5.5 ha)	(5.2 ha)	(10.9 ha)
46.7 ha	75.7 ha	99.6 ha
(6.7 ha)	(16.2 ha)	(15.8 ha)
40.0 ha	59.5 ha	83.8 ha

Regional Roads	Length (km)	New/extra Width
OAKDALE		
Old Wallgrove Road (S-W)	1.0	20.0
"Oakdale" new road - (incl. B1, B2, B3, B4 + B5)	4.0	40.0
Bakers Lane upgrade - (incl intersection)	1.1	20.0
Total	6.1	
N-S Connection - (incl. B6)	1.3	40.0
Note: M7 Hub		
Old Wallgrove Road (M7 Hub)	1.5	20.0

Goodman

M7 Hub

B1

B2

CENTRAL

EAST

Jokona Pty Ltd

WEST

B6

B3

Jacfin Land

CSR (PGH)

B4

B5

SOUTH

HORSLEY PARK

Legend

- Riparian Zone
- 1 in 100 Flood Zone
- Detention Basin Area
- Estate Park/ Amenities
- Service Station/ Convenience
- Infrastructure Service Zone
- Substation
- Electrical Easements
- Future Road Links

design+

Oakdale

Eastern Creek

Design Masterplan - Link Rd Option 1

0 200 1000

1:10000 @ A1
1:20000 @ A3

05 Nov 07 AL

SP SK36 (I)

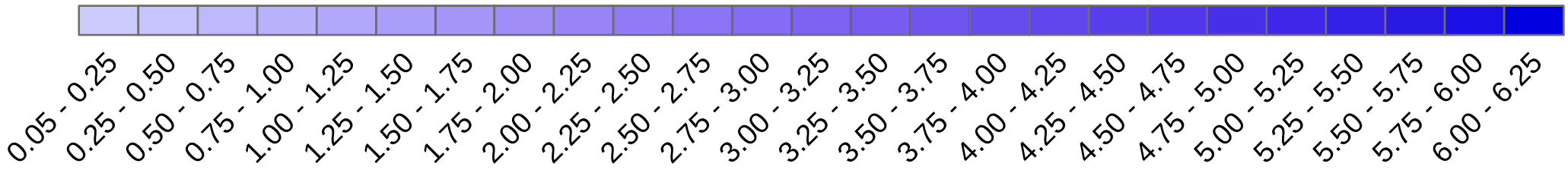
Appendix B

Ropes Creek Flood Modelling Results

Rafts output files

Flood extent mapping

Flood Depths (m)



Oakdale Site

1:14,000 for A3

0 55 110 220 330 440

Metres

GDA_1994_MGA_Zone_56

O

GHD CLIENTS | PEOPLE | PERFORMANCE

GOODMAN INTERNATIONAL
OAKDALE

20-year ARI Event Flood Map

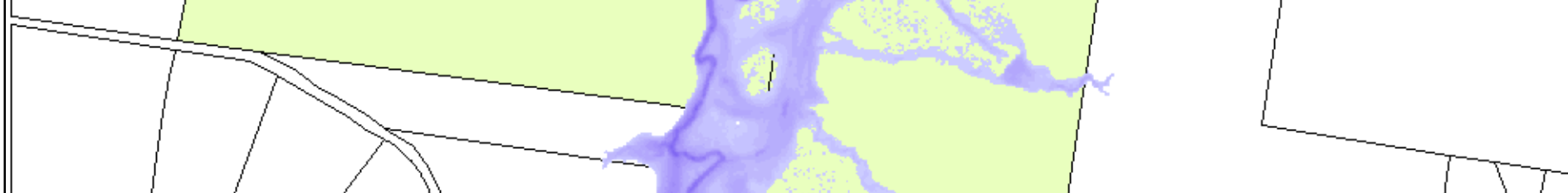
job no. | 21-15101
rev no. | REVA

date | June 2007

Gis File No: G:\Projects\21\15101\CADD\GIS\ArcMap\20yr_FloodExtents.mxd

10 Bond Street Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7190 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Flood Depths (m)



Oakdale Site

1:14,000 for A3

0 55 110 220 330 440

Metres

GDA_1994_MGA_Zone_56

O

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GOODMAN INTERNATIONAL
OAKDALE

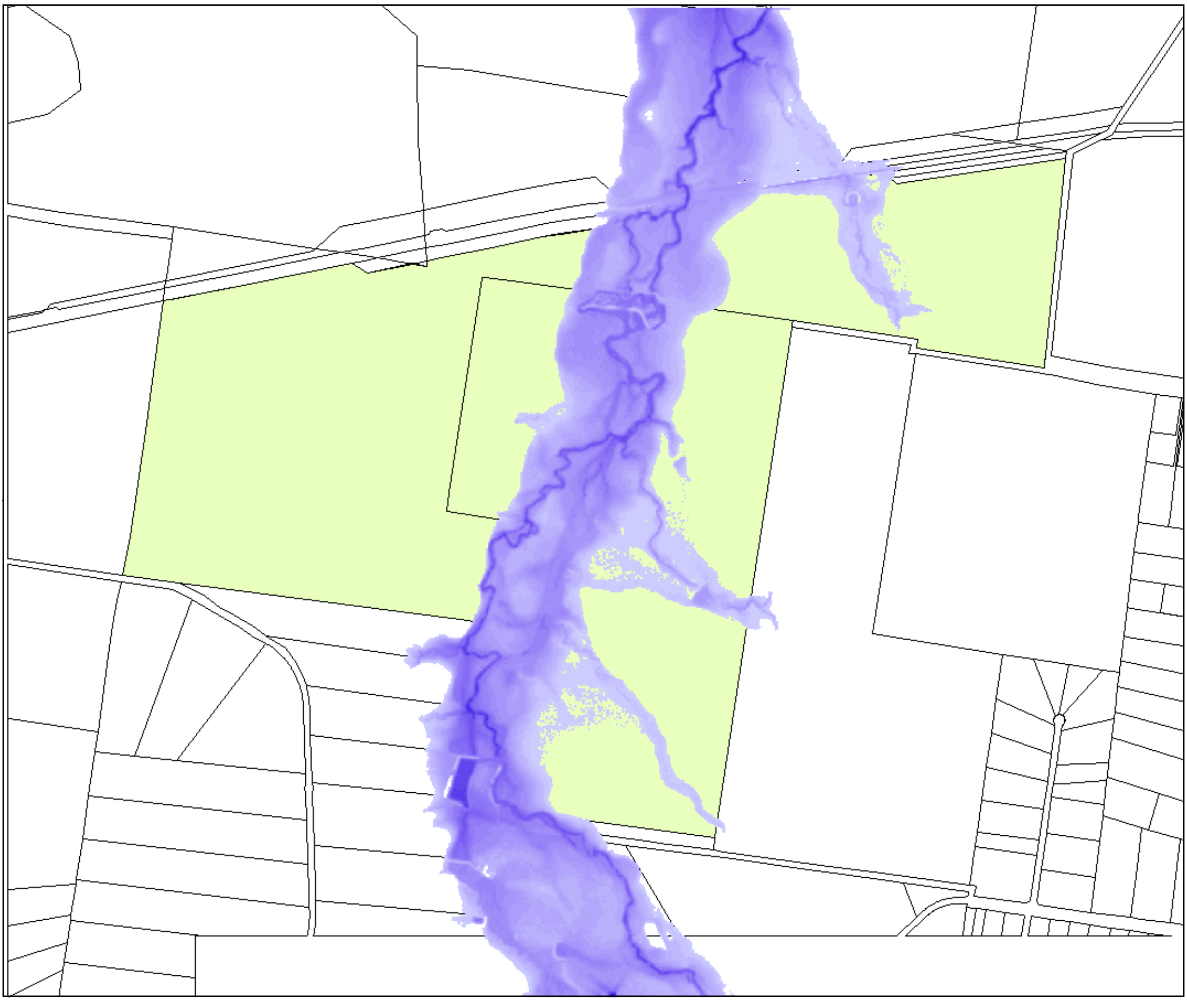
100-year ARI Event Flood Map

job no. | 21-15101
rev no. | REVA

date | June 2007

Gis File No: G:\Projects\21\15101\CADD\GIS\ArcMap\100yr_FloodExtents.mxd

10 Bond Street Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7190 **E** sydmail@ghd.com.au **W** www.ghd.com.au



Flood Depths (m)

0.05 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.00
1.00 - 1.25
1.25 - 1.50
1.50 - 1.75
1.75 - 2.00
2.00 - 2.25
2.25 - 2.50
2.50 - 2.75
2.75 - 3.00
3.00 - 3.25
3.25 - 3.50
3.50 - 3.75
3.75 - 4.00
4.00 - 4.25
4.25 - 4.50
4.50 - 4.75
4.75 - 5.00
5.00 - 5.25
5.25 - 5.50
5.50 - 5.75
5.75 - 6.00
6.00 - 6.25

Oakdale Site

1:14,000 for A3

0 55 110 220 330 440

Metres

GDA_1994_MGA_Zone_56

O

GHD CLIENTS | PEOPLE | PERFORMANCE

GOODMAN INTERNATIONAL
OAKDALE

PMF Flood Map

job no. | 21-15101
rev no. | REVA

date | June 2007

Gis File No: G:\Projects\21\15101\CADD\GIS\ArcMap\PMF_FloodExtents.mxd

10 Bond Street Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7190 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Appendix C

On-site Hydrological Modelling Results

Rafts output files

Catchment Plan

Hydrology Modelling - RAFTS MODEL

RAFTS-2000 model is used to simulate runoff hydrographs at defined points in the catchment. This model is suitable for application on catchments ranging from rural to fully urbanised. The model is capable of analysing catchments comprising natural waterways, formalised channels, pipes, retarding basins and combinations of these.

The existing catchments are rural (0% impervious) and will be urbanised (approximately 60 -85% impervious). The catchment was divided into sub-catchments, determined by topography, landuse and creek configuration. A split catchment option was utilized in the modeling. The first sub-catchment portion was taken as pervious and the second impervious (100% impervious).

Sub-catchment link flow lag times were calculated using standard hydraulic formula (velocity in the creek) applicable to open channel and/or closed conduit system. Correct runoff simulation is highly dependent on an accurate estimate of impervious area percentages for each sub-catchment.

The Initial/Continuing loss rate approach to estimate excess rainfall for the catchment was adopted. In the absence of historical flood flows, conservative model parameters were assumed.

The adopted conservative values were;

	Pervious	**Impervious**
Initial loss(mm)	**15.0**	**2.5**
Continuing loss(mm/hr)	**2.0**	**0**

Durations of 25 minutes to 9 hours were used for various ARIs of 2, 5, 10, 20 and 100 years and PMF. Details of sub-catchment input data is given in the attached Table. Historical flood flows were not available to calibrate the RAFTS model. The model was run for the following scenarios:

» Existing - All sub-catchments within Oakdale Industrial Estate were assumed as 100 % pervious
» Proposed - Assumed impervious area percentages is around 65% to 85%.
» Proposed with OSD - In order to maintain the existing flow conditions, trial and error approach was used to estimate the maximum Permissible Site Discharge (PSD) and minimum storage requirements for retarding basins.

A list of the model input data files and the extracted summary output for the existing, proposed and proposed with OSD follow. For details of the model, refer to the RAFTS User Manual.

Table C1

Oakdale Industrial Estate - Subcatchment Details for Rafts Model

Subcatch. Node Label	Total Area (ha)	Percentage of Imperviou Area	Pervious Area (ha)	Impervious Area (ha)	Slope (%)	Lag (mins)	100 ARI Flow Existing m^3/s	Critical Duration	100 ARI Flow Proposed	Critical Duratio n	100 ARI Flow With OSD OSD- 250 m^3/ha PSD = 140 l/s/ha	Critical Duratio n
A1	29.12	85	4.37	24.75	1.96%	2	4.1	2hr	13.2	1.5 hr	3.7	4.5 hr
A3	19.37	85	2.91	16.46	2.15%	2	2.6	2hr	8.8	90 min	2.4	4.5 hr
A5	10.05	85	1.51	8.54	2.20%	1	1.7	2hr	4.7	25 min	1.3	4.5 hr
A6	18.09	85	2.71	15.38	4.76%	1	3.9	2hr	8.8	25 min	2.3	4.5 hr
A7a	8.43	85	1.26	7.17	4.35%	1	2.1	2hr	4.1	25 min	1.1	4.5 hr
A7b	8.37	85	1.26	7.11	5.83%	1	2.3	2hr	4.2	25 min	1.1	2 hr
A8	17.67	85	2.65	15.02	2.39%	1	2.8	2hr	8.2	90 min	2.2	4.5 hr
A9	19.07	85	2.86	16.21	3.26%	1	3.4	2hr	9.1	25 min	2.4	4.5 hr
A10	11.81	85	1.77	10.04	6.15%	1	3.1	2hr	5.9	25 min	1.5	2 hr
A11a	15.83	85	2.37	13.46	11.52%	1	5	2hr	8	25 min	2.1	2 hr
A11b	9.48	85	1.42	8.06	3.72%	1	2.1	2hr	4.6	25 min	1.2	2 hr
A12a	4.09	85	0.61	3.48	4.17%	1	1.1	2hr	2.1	25 min	0.5	2 hr
A12b	5.65	60	2.26	3.39	5.00%	1	1.6	2hr	2.5	1.5 hr	0.7	2 hr
A13	5.03	60	2.01	3.02	3.64%	1	1.3	2hr	2.1	1.5 hr	0.6	4.5 hr
A14a	9.21	85	1.38	7.83	2.42%	1	1.6	2hr	4.4	25 min	1.2	4.5 hr
A14b	3.61	60	1.44	2.17	4.09%	1	1	2hr	1.6	1.5 hr	0.5	2 hr
A15	51.21	85	7.68	43.53	7.18%	1	10.9	2hr	24.1	25 min	-	
A16	3.77	0	3.77	0.00	2.58%	1000	11.7	2 hr	25.3	25 min	7	4.5 hr
A17	3.56	85	0.53	3.03	8.10%	0						
Outlet	-	-	-	-	-	-	33.8	2hr	49.6	1.5 hr	24.1	2 hr
Total Area	**253.42**		**44.79**	**208.63**								

Subcatchment divisions and equivalent slopes are based on contour survey.

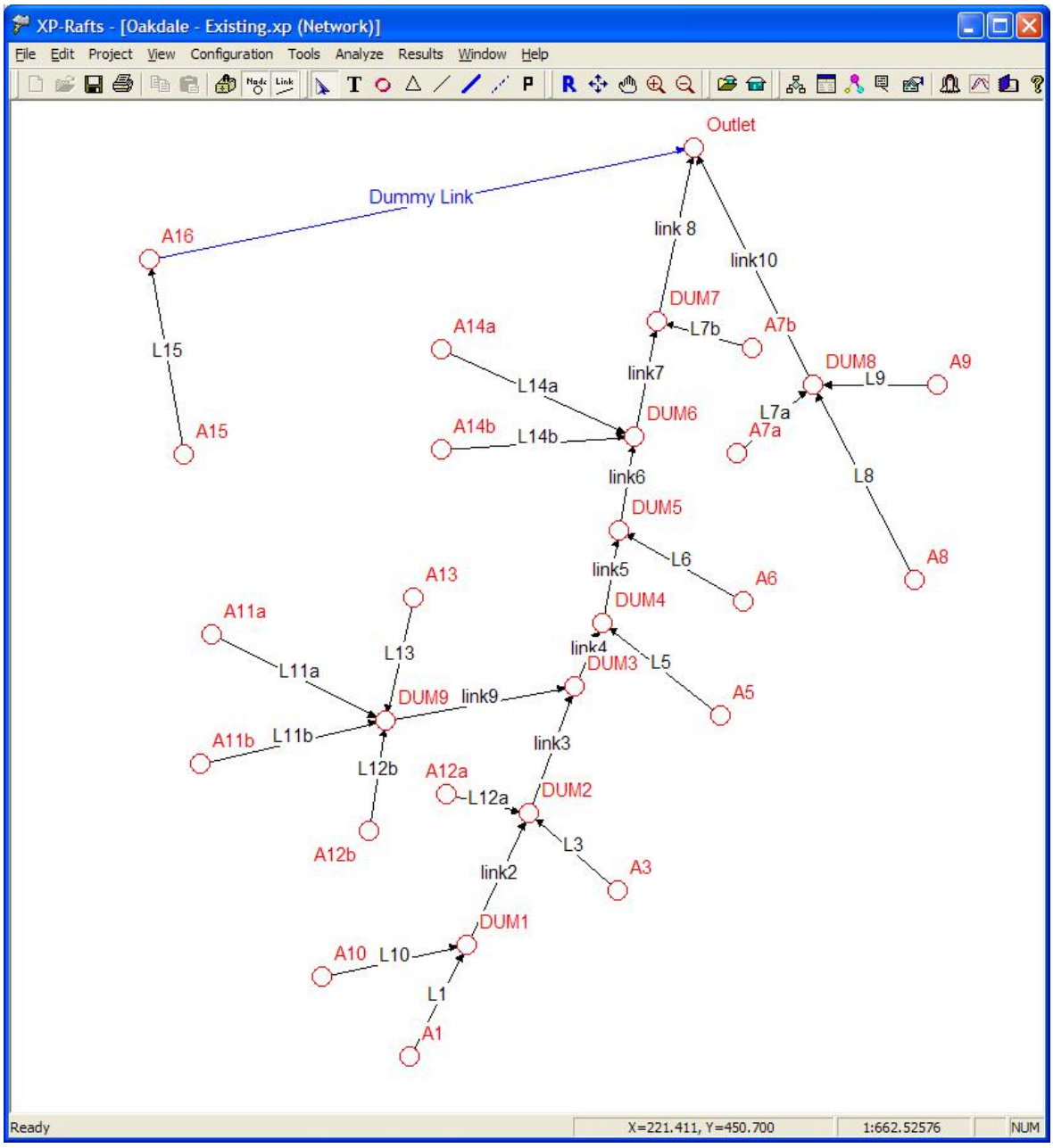
Lag time = length of connecting channel (node to node) / Flow velocity (say 1 to 2 m/s)

Table C2

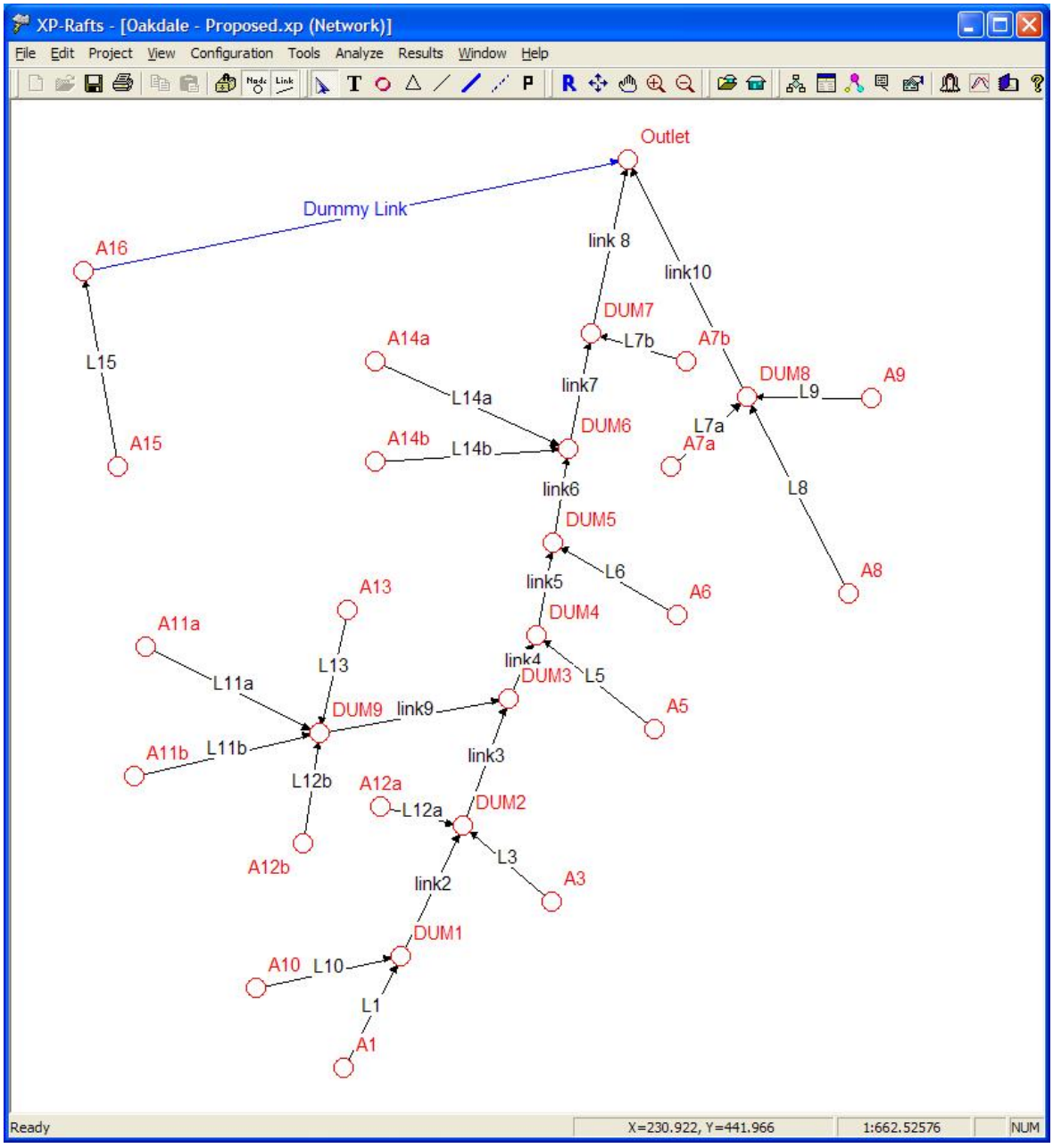
Oakdale Industrial Estate - OSD calculation for Rafts Model

OSD	**280**	**m^3/ha**	**250**			
PSD	**120**	**l/s/ha**	**140**			
Subcatch. Node Label	**Total Area**	**Retading/ Wetland Nodes**	**OSD 280**	**PSD 120**	**OSD 250**	**PSD 140**
	(ha)		**(m^3)**	**(m^3/s)**	**(m^3)**	**(m^3/s)**
A1	29.12		8154	3.494	7280	4.077
A3	19.37		5424	2.324	4843	2.712
A5	10.05		2814	1.206	2513	1.407
A6	18.09		5065	2.171	4523	2.533
A7a	8.43		2360	1.012	2108	1.180
A7b	8.37		2344	1.004	2093	1.172
A8	17.67		4948	2.120	4418	2.474
A9	19.07		5340	2.288	4768	2.670
A10	11.81		3307	1.417	2953	1.653
A11a	15.83		4432	1.900	3958	2.216
A11b	9.48		2654	1.138	2370	1.327
A12a	4.09		1145	0.491	1023	0.573
A12b	5.65		1582	0.678	1413	0.791
A13	5.03		1408	0.604	1258	0.704
A14a	9.21		2579	1.105	2303	1.289
A14b	3.61		1011	0.433	903	0.505
A15	51.21		14339	6.145	12803	7.169
A16	3.77		1056	0.452	943	0.528
A17	3.56		997	0.427	890	0.498
	253.42		**70958**	**30.410**	**63355**	**35.479**

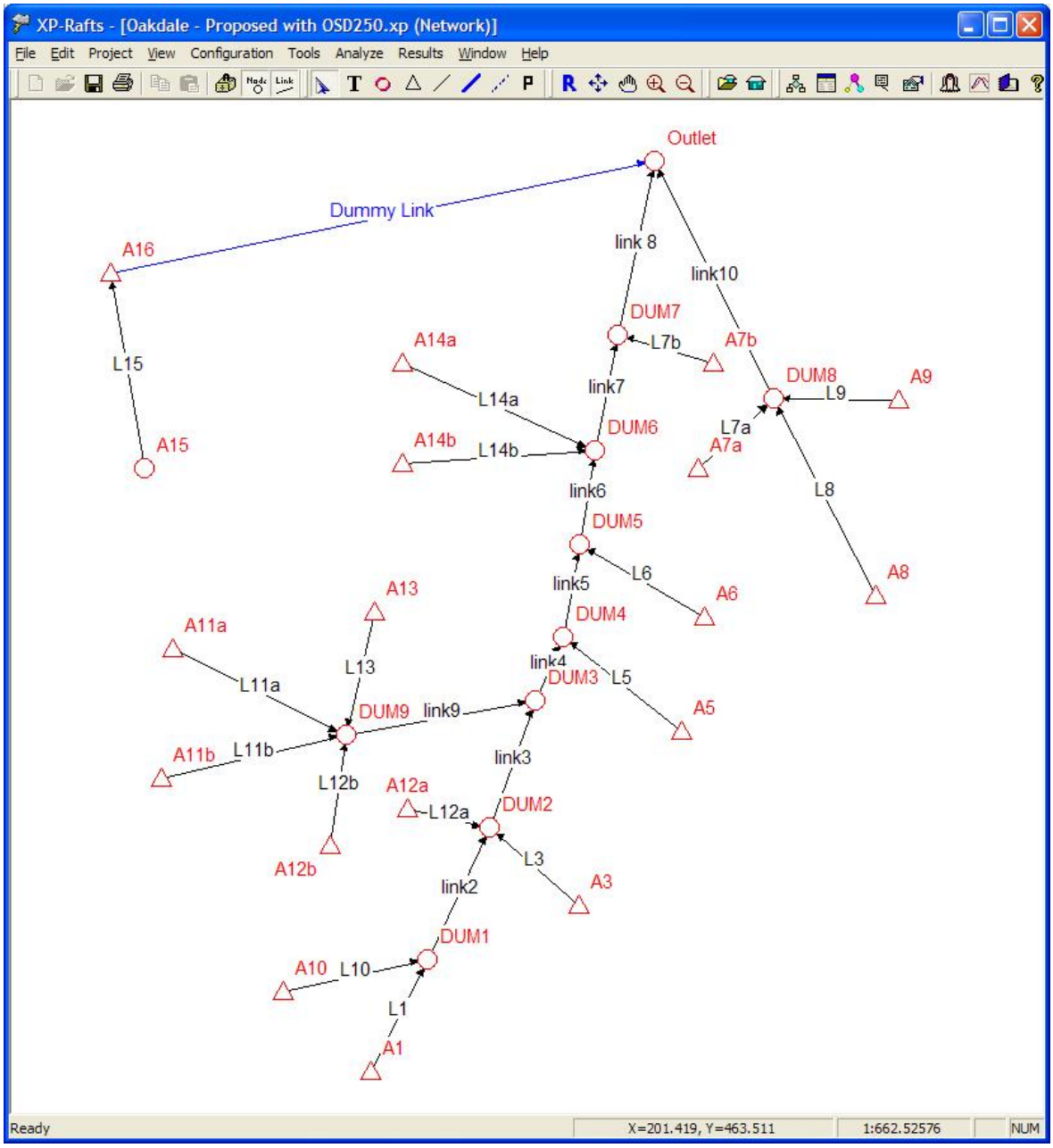
RAFTS Model Network for the Existing Conditions



RAFTS Model Network for the Proposed Conditions



RAFTS Model Network for the Proposed Conditions with OSD



##

Oakdale Site - Existing

##

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 25.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 249.86
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 249.86

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	#2	Slope #1 (%)	#2	% Impervious #1 (%)	#2	Pern #1	#2	B #1	#2	Link No.
A1	29.120	0.000	1.960	0.000	5.000	0.000	.045	0.00	.1323	0.000	1.000
A10	11.810	0.000	6.150	0.000	5.000	0.000	.045	0.00	.0468	0.000	2.000
DUM1	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.001
A3	19.370	0.000	1.910	0.000	2.150	0.000	.045	0.00	.1224	0.000	3.000
A12a	4.090	0.000	4.170	0.000	5.000	0.000	.045	0.00	.0327	0.000	4.000
DUM2	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.002
A11b	9.480	0.000	3.720	0.000	5.000	0.000	.045	0.00	.0536	0.000	5.000
A12b	5.650	0.000	5.000	0.000	5.000	0.000	.045	0.00	.0353	0.000	6.000
A13	5.030	0.000	3.640	0.000	5.000	0.000	.045	0.00	.0390	0.000	7.000
A11a	15.830	0.000	11.52	0.000	5.000	0.000	.045	0.00	.0398	0.000	8.000
DUM9	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	5.001
DUM3	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.003
A5	10.050	0.000	2.200	0.000	5.000	0.000	.045	0.00	.0718	0.000	9.000
DUM4	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.004
A6	18.090	0.000	4.760	0.000	5.000	0.000	.045	0.00	.0663	0.000	10.00
DUM5	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.005
A14b	3.610	0.000	4.090	0.000	5.000	0.000	.045	0.00	.0309	0.000	11.00
A14a	9.210	0.000	2.420	0.000	5.000	0.000	.045	0.00	.0654	0.000	12.00
DUM6	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.006
A7b	8.370	0.000	5.830	0.000	5.000	0.000	.045	0.00	.0402	0.000	13.00
DUM7	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.007
A8	17.670	0.000	2.390	0.000	5.000	0.000	.045	0.00	.0924	0.000	14.00
A9	19.070	0.000	3.260	0.000	5.000	0.000	.045	0.00	.0823	0.000	15.00
A7a	8.430	0.000	4.350	0.000	5.000	0.000	.045	0.00	.0466	0.000	16.00
DUM8	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	14.00
A15	51.210	0.000	7.180	0.000	5.000	0.000	.045	0.00	.0928	0.000	17.00
A16	3.770	0.000	2.530	0.000	5.000	0.000	.045	0.00	.0402	0.000	17.00
Outlet	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	106.91	15.00	0.000	2.000	0.000	28.980	0.000	2.123	26.00	2.000
A10	106.91	15.00	0.000	2.000	0.000	28.980	0.000	2.247	25.00	1.000
DUM1	106.91	15.00	0.000	2.000	0.000	28.980	0.000	4.294	27.00	6.000
A3	106.91	15.00	0.000	2.000	0.000	28.980	0.000	1.315	26.00	2.000
A12a	106.91	15.00	0.000	2.000	0.000	28.980	0.000	0.7936	25.00	1.000
DUM2	106.91	15.00	0.000	2.000	0.000	28.980	0.000	6.120	32.00	4.000
A11b	106.91	15.00	0.000	2.000	0.000	28.980	0.000	1.474	26.00	1.000
A12b	106.91	15.00	0.000	2.000	0.000	28.980	0.000	1.128	25.00	1.000
A13	106.91	15.00	0.000	2.000	0.000	28.980	0.000	0.8881	25.00	1.000
A11a	106.91	15.00	0.000	2.000	0.000	28.980	0.000	3.585	22.00	1.000
DUM9	106.91	15.00	0.000	2.000	0.000	28.980	0.000	6.916	25.00	5.000
DUM3	106.91	15.00	0.000	2.000	0.000	28.980	0.000	12.495	31.00	1.000
A5	106.91	15.00	0.000	2.000	0.000	28.980	0.000	1.107	26.00	1.000
DUM4	106.91	15.00	0.000	2.000	0.000	28.980	0.000	13.573	32.00	1.000
A6	106.91	15.00	0.000	2.000	0.000	28.980	0.000	2.731	26.00	1.000
DUM5	106.91	15.00	0.000	2.000	0.000	28.980	0.000	15.947	33.00	2.000
A14b	106.91	15.00	0.000	2.000	0.000	28.980	0.000	0.7162	25.00	1.000
A14a	106.91	15.00	0.000	2.000	0.000	28.980	0.000	1.111	26.00	1.000
DUM6	106.91	15.00	0.000	2.000	0.000	28.980	0.000	17.298	35.00	2.000
A7b	106.91	15.00	0.000	2.000	0.000	28.980	0.000	1.657	25.00	1.000
DUM7	106.91	15.00	0.000	2.000	0.000	28.980	0.000	18.040	37.00	8.000
A8	106.91	15.00	0.000	2.000	0.000	28.980	0.000	1.727	26.00	1.000
A9	106.91	15.00	0.000	2.000	0.000	28.980	0.000	2.236	26.00	1.000
A7a	106.91	15.00	0.000	2.000	0.000	28.980	0.000	1.464	25.00	1.000
DUM8	106.91	15.00	0.000	2.000	0.000	28.980	0.000	5.422	27.00	6.000
A15	106.91	15.00	0.000	2.000	0.000	28.980	0.000	7.463	26.00	1.000
A16	106.91	15.00	0.000	2.000	0.000	28.980	0.000	8.055	27.00	1000.
Outlet	106.91	15.00	0.000	2.000	0.000	28.980	0.000	22.357	42.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 45.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 249.86
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	77.485	15.00	0.000	2.000	0.000	41.981	0.000	3.303	46.00	2.000
A10	77.485	15.00	0.000	2.000	0.000	41.981	0.000	2.480	31.00	1.000
DUM1	77.485	15.00	0.000	2.000	0.000	41.981	0.000	5.141	41.00	6.000
A3	77.485	15.00	0.000	2.000	0.000	41.981	0.000	2.175	46.00	2.000
A12a	77.485	15.00	0.000	2.000	0.000	41.981	0.000	0.8839	31.00	1.000
DUM2	77.485	15.00	0.000	2.000	0.000	41.981	0.000	7.874	44.00	4.000
A11b	77.485	15.00	0.000	2.000	0.000	41.981	0.000	1.776	35.00	1.000
A12b	77.485	15.00	0.000	2.000	0.000	41.981	0.000	1.232	31.00	1.000
A13	77.485	15.00	0.000	2.000	0.000	41.981	0.000	1.019	32.00	1.000
A11a	77.485	15.00	0.000	2.000	0.000	41.981	0.000	3.676	29.00	1.000
DUM9	77.485	15.00	0.000	2.000	0.000	41.981	0.000	7.558	32.00	5.000
DUM3	77.485	15.00	0.000	2.000	0.000	41.981	0.000	14.400	42.00	1.000
A5	77.485	15.00	0.000	2.000	0.000	41.981	0.000	1.536	41.00	1.000
DUM4	77.485	15.00	0.000	2.000	0.000	41.981	0.000	15.926	43.00	1.000
A6	77.485	15.00	0.000	2.000	0.000	41.981	0.000	3.283	36.00	1.000
DUM5	77.485	15.00	0.000	2.000	0.000	41.981	0.000	18.966	43.00	2.000
A14b	77.485	15.00	0.000	2.000	0.000	41.981	0.000	0.7869	31.00	1.000
A14a	77.485	15.00	0.000	2.000	0.000	41.981	0.000	1.486	40.00	1.000
DUM6	77.485	15.00	0.000	2.000	0.000	41.981	0.000	20.917	44.00	2.000
A7b	77.485	15.00	0.000	2.000	0.000	41.981	0.000	1.822	31.00	1.000
DUM7	77.485	15.00	0.000	2.000	0.000	41.981	0.000	22.090	46.00	8.000
A8	77.485	15.00	0.000	2.000	0.000	41.981	0.000	2.532	42.00	1.000
A9	77.485	15.00	0.000	2.000	0.000	41.981	0.000	3.043	40.00	1.000
A7a	77.485	15.00	0.000	2.000	0.000	41.981	0.000	1.675	33.00	1.000
DUM8	77.485	15.00	0.000	2.000	0.000	41.981	0.000	7.064	41.00	6.000
A15	77.485	15.00	0.000	2.000	0.000	41.981	0.000	9.230	36.00	1.000
A16	77.485	15.00	0.000	2.000	0.000	41.981	0.000	9.930	37.00	1000.
Outlet	77.485	15.00	0.000	2.000	0.000	41.981	0.000	28.695	51.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 60.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 249.86
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	65.606	15.00	0.000	2.000	0.000	49.040	0.000	3.708	51.00	2.000
A10	65.606	15.00	0.000	2.000	0.000	49.040	0.000	2.834	35.00	1.000
DUM1	65.606	15.00	0.000	2.000	0.000	49.040	0.000	5.684	40.00	6.000
A3	65.606	15.00	0.000	2.000	0.000	49.040	0.000	2.414	53.00	2.000
A12a	65.606	15.00	0.000	2.000	0.000	49.040	0.000	1.012	33.00	1.000
DUM2	65.606	15.00	0.000	2.000	0.000	49.040	0.000	8.659	46.00	4.000
A11b	65.606	15.00	0.000	2.000	0.000	49.040	0.000	2.012	36.00	1.000
A12b	65.606	15.00	0.000	2.000	0.000	49.040	0.000	1.406	33.00	1.000
A13	65.606	15.00	0.000	2.000	0.000	49.040	0.000	1.162	35.00	1.000
A11a	65.606	15.00	0.000	2.000	0.000	49.040	0.000	4.343	31.00	1.000
DUM9	65.606	15.00	0.000	2.000	0.000	49.040	0.000	8.635	34.00	5.000
DUM3	65.606	15.00	0.000	2.000	0.000	49.040	0.000	16.237	42.00	1.000
A5	65.606	15.00	0.000	2.000	0.000	49.040	0.000	1.689	44.00	1.000
DUM4	65.606	15.00	0.000	2.000	0.000	49.040	0.000	17.920	43.00	1.000
A6	65.606	15.00	0.000	2.000	0.000	49.040	0.000	3.679	38.00	1.000
DUM5	65.606	15.00	0.000	2.000	0.000	49.040	0.000	21.400	44.00	2.000
A14b	65.606	15.00	0.000	2.000	0.000	49.040	0.000	0.9015	33.00	1.000
A14a	65.606	15.00	0.000	2.000	0.000	49.040	0.000	1.632	41.00	1.000
DUM6	65.606	15.00	0.000	2.000	0.000	49.040	0.000	23.624	45.00	2.000
A7b	65.606	15.00	0.000	2.000	0.000	49.040	0.000	2.071	33.00	1.000
DUM7	65.606	15.00	0.000	2.000	0.000	49.040	0.000	24.980	47.00	8.000
A8	65.606	15.00	0.000	2.000	0.000	49.040	0.000	2.759	46.00	1.000
A9	65.606	15.00	0.000	2.000	0.000	49.040	0.000	3.317	43.00	1.000
A7a	65.606	15.00	0.000	2.000	0.000	49.040	0.000	1.925	35.00	1.000
DUM8	65.606	15.00	0.000	2.000	0.000	49.040	0.000	7.664	42.00	6.000
A15	65.606	15.00	0.000	2.000	0.000	49.040	0.000	10.238	38.00	1.000
A16	65.606	15.00	0.000	2.000	0.000	49.040	0.000	11.023	39.00	1000.
Outlet	65.606	15.00	0.000	2.000	0.000	49.040	0.000	32.231	54.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 90.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 249.86
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	51.341	15.00	0.000	2.000	0.000	59.445	0.000	3.850	58.00	2.000
A10	51.341	15.00	0.000	2.000	0.000	59.445	0.000	2.881	35.00	1.000
DUM1	51.341	15.00	0.000	2.000	0.000	59.445	0.000	5.683	41.00	6.000
A3	51.341	15.00	0.000	2.000	0.000	59.445	0.000	2.498	59.00	2.000
A12a	51.341	15.00	0.000	2.000	0.000	59.445	0.000	1.048	33.00	1.000
DUM2	51.341	15.00	0.000	2.000	0.000	59.445	0.000	8.610	47.00	4.000
A11b	51.341	15.00	0.000	2.000	0.000	59.445	0.000	1.990	38.00	1.000
A12b	51.341	15.00	0.000	2.000	0.000	59.445	0.000	1.452	33.00	1.000
A13	51.341	15.00	0.000	2.000	0.000	59.445	0.000	1.170	36.00	1.000
A11a	51.341	15.00	0.000	2.000	0.000	59.445	0.000	4.780	31.00	1.000
DUM9	51.341	15.00	0.000	2.000	0.000	59.445	0.000	9.076	33.00	5.000
DUM3	51.341	15.00	0.000	2.000	0.000	59.445	0.000	16.530	43.00	1.000
A5	51.341	15.00	0.000	2.000	0.000	59.445	0.000	1.696	45.00	1.000
DUM4	51.341	15.00	0.000	2.000	0.000	59.445	0.000	18.213	44.00	1.000
A6	51.341	15.00	0.000	2.000	0.000	59.445	0.000	3.679	40.00	1.000
DUM5	51.341	15.00	0.000	2.000	0.000	59.445	0.000	21.738	45.00	2.000
A14b	51.341	15.00	0.000	2.000	0.000	59.445	0.000	0.9425	33.00	1.000
A14a	51.341	15.00	0.000	2.000	0.000	59.445	0.000	1.638	43.00	1.000
DUM6	51.341	15.00	0.000	2.000	0.000	59.445	0.000	23.978	46.00	2.000
A7b	51.341	15.00	0.000	2.000	0.000	59.445	0.000	2.158	33.00	1.000
DUM7	51.341	15.00	0.000	2.000	0.000	59.445	0.000	25.350	48.00	8.000
A8	51.341	15.00	0.000	2.000	0.000	59.445	0.000	2.749	47.00	1.000
A9	51.341	15.00	0.000	2.000	0.000	59.445	0.000	3.310	45.00	1.000
A7a	51.341	15.00	0.000	2.000	0.000	59.445	0.000	1.916	36.00	1.000
DUM8	51.341	15.00	0.000	2.000	0.000	59.445	0.000	7.659	44.00	6.000
A15	51.341	15.00	0.000	2.000	0.000	59.445	0.000	10.247	40.00	1.000
A16	51.341	15.00	0.000	2.000	0.000	59.445	0.000	11.032	41.00	1000.
Outlet	51.341	15.00	0.000	2.000	0.000	59.445	0.000	32.632	56.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 120.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 249.86
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	42.988	15.00	0.000	2.000	0.000	67.644	0.000	4.072	65.00	2.000
A10	42.988	15.00	0.000	2.000	0.000	67.644	0.000	3.088	43.00	1.000
DUM1	42.988	15.00	0.000	2.000	0.000	67.644	0.000	6.083	47.00	6.000
A3	42.988	15.00	0.000	2.000	0.000	67.644	0.000	2.631	66.00	2.000
A12a	42.988	15.00	0.000	2.000	0.000	67.644	0.000	1.125	41.00	1.000
DUM2	42.988	15.00	0.000	2.000	0.000	67.644	0.000	9.093	53.00	4.000
A11b	42.988	15.00	0.000	2.000	0.000	67.644	0.000	2.141	45.00	1.000
A12b	42.988	15.00	0.000	2.000	0.000	67.644	0.000	1.576	41.00	1.000
A13	42.988	15.00	0.000	2.000	0.000	67.644	0.000	1.253	44.00	1.000
A11a	42.988	15.00	0.000	2.000	0.000	67.644	0.000	5.003	41.00	1.000
DUM9	42.988	15.00	0.000	2.000	0.000	67.644	0.000	9.837	42.00	5.000
DUM3	42.988	15.00	0.000	2.000	0.000	67.644	0.000	17.582	52.00	1.000
A5	42.988	15.00	0.000	2.000	0.000	67.644	0.000	1.723	51.00	1.000
DUM4	42.988	15.00	0.000	2.000	0.000	67.644	0.000	19.304	52.00	1.000
A6	42.988	15.00	0.000	2.000	0.000	67.644	0.000	3.910	46.00	1.000
DUM5	42.988	15.00	0.000	2.000	0.000	67.644	0.000	22.865	53.00	2.000
A14b	42.988	15.00	0.000	2.000	0.000	67.644	0.000	1.015	41.00	1.000
A14a	42.988	15.00	0.000	2.000	0.000	67.644	0.000	1.684	49.00	1.000
DUM6	42.988	15.00	0.000	2.000	0.000	67.644	0.000	25.086	55.00	2.000
A7b	42.988	15.00	0.000	2.000	0.000	67.644	0.000	2.317	41.00	1.000
DUM7	42.988	15.00	0.000	2.000	0.000	67.644	0.000	26.372	57.00	8.000
A8	42.988	15.00	0.000	2.000	0.000	67.644	0.000	2.814	58.00	1.000
A9	42.988	15.00	0.000	2.000	0.000	67.644	0.000	3.404	50.00	1.000
A7a	42.988	15.00	0.000	2.000	0.000	67.644	0.000	2.073	44.00	1.000
DUM8	42.988	15.00	0.000	2.000	0.000	67.644	0.000	7.946	48.00	6.000
A15	42.988	15.00	0.000	2.000	0.000	67.644	0.000	10.878	46.00	1.000
A16	42.988	15.00	0.000	2.000	0.000	67.644	0.000	11.718	47.00	1000.
Outlet	42.988	15.00	0.000	2.000	0.000	67.644	0.000	33.808	63.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 180.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 249.86
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	33.376	15.00	0.000	2.000	0.000	79.895	0.000	3.601	76.00	2.000
A10	33.376	15.00	0.000	2.000	0.000	79.895	0.000	2.416	46.00	1.000
DUM1	33.376	15.00	0.000	2.000	0.000	79.895	0.000	4.998	77.00	6.000
A3	33.376	15.00	0.000	2.000	0.000	79.895	0.000	2.359	76.00	2.000
A12a	33.376	15.00	0.000	2.000	0.000	79.895	0.000	0.8634	46.00	1.000
DUM2	33.376	15.00	0.000	2.000	0.000	79.895	0.000	7.756	82.00	4.000
A11b	33.376	15.00	0.000	2.000	0.000	79.895	0.000	1.617	49.00	1.000
A12b	33.376	15.00	0.000	2.000	0.000	79.895	0.000	1.205	46.00	1.000
A13	33.376	15.00	0.000	2.000	0.000	79.895	0.000	0.9703	46.00	1.000
A11a	33.376	15.00	0.000	2.000	0.000	79.895	0.000	3.686	45.00	1.000
DUM9	33.376	15.00	0.000	2.000	0.000	79.895	0.000	7.431	47.00	5.000
DUM3	33.376	15.00	0.000	2.000	0.000	79.895	0.000	13.462	56.00	1.000
A5	33.376	15.00	0.000	2.000	0.000	79.895	0.000	1.374	58.00	1.000
DUM4	33.376	15.00	0.000	2.000	0.000	79.895	0.000	14.830	57.00	1.000
A6	33.376	15.00	0.000	2.000	0.000	79.895	0.000	2.996	50.00	1.000
DUM5	33.376	15.00	0.000	2.000	0.000	79.895	0.000	17.647	58.00	2.000
A14b	33.376	15.00	0.000	2.000	0.000	79.895	0.000	0.7690	46.00	1.000
A14a	33.376	15.00	0.000	2.000	0.000	79.895	0.000	1.325	56.00	1.000
DUM6	33.376	15.00	0.000	2.000	0.000	79.895	0.000	19.423	60.00	2.000
A7b	33.376	15.00	0.000	2.000	0.000	79.895	0.000	1.776	46.00	1.000
DUM7	33.376	15.00	0.000	2.000	0.000	79.895	0.000	20.505	61.00	8.000
A8	33.376	15.00	0.000	2.000	0.000	79.895	0.000	2.336	68.00	1.000
A9	33.376	15.00	0.000	2.000	0.000	79.895	0.000	2.705	57.00	1.000
A7a	33.376	15.00	0.000	2.000	0.000	79.895	0.000	1.580	46.00	1.000
DUM8	33.376	15.00	0.000	2.000	0.000	79.895	0.000	6.284	55.00	6.000
A15	33.376	15.00	0.000	2.000	0.000	79.895	0.000	8.312	50.00	1.000
A16	33.376	15.00	0.000	2.000	0.000	79.895	0.000	8.961	51.00	1000.
Outlet	33.376	15.00	0.000	2.000	0.000	79.895	0.000	26.600	69.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 270.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 249.86
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	25.882	15.00	0.000	2.000	0.000	93.769	0.000	3.833	91.00	2.000
A10	25.882	15.00	0.000	2.000	0.000	93.769	0.000	2.241	79.00	1.000
DUM1	25.882	15.00	0.000	2.000	0.000	93.769	0.000	5.811	92.00	6.000
A3	25.882	15.00	0.000	2.000	0.000	93.769	0.000	2.478	93.00	2.000
A12a	25.882	15.00	0.000	2.000	0.000	93.769	0.000	0.7856	79.00	1.000
DUM2	25.882	15.00	0.000	2.000	0.000	93.769	0.000	8.796	97.00	4.000
A11b	25.882	15.00	0.000	2.000	0.000	93.769	0.000	1.697	85.00	1.000
A12b	25.882	15.00	0.000	2.000	0.000	93.769	0.000	1.094	78.00	1.000
A13	25.882	15.00	0.000	2.000	0.000	93.769	0.000	0.9339	81.00	1.000
A11a	25.882	15.00	0.000	2.000	0.000	93.769	0.000	3.223	76.00	1.000
DUM9	25.882	15.00	0.000	2.000	0.000	93.769	0.000	6.831	79.00	5.000
DUM3	25.882	15.00	0.000	2.000	0.000	93.769	0.000	14.840	96.00	1.000
A5	25.882	15.00	0.000	2.000	0.000	93.769	0.000	1.662	90.00	1.000
DUM4	25.882	15.00	0.000	2.000	0.000	93.769	0.000	16.326	97.00	1.000
A6	25.882	15.00	0.000	2.000	0.000	93.769	0.000	3.209	87.00	1.000
DUM5	25.882	15.00	0.000	2.000	0.000	93.769	0.000	19.271	92.00	2.000
A14b	25.882	15.00	0.000	2.000	0.000	93.769	0.000	0.6964	78.00	1.000
A14a	25.882	15.00	0.000	2.000	0.000	93.769	0.000	1.563	90.00	1.000
DUM6	25.882	15.00	0.000	2.000	0.000	93.769	0.000	21.324	93.00	2.000
A7b	25.882	15.00	0.000	2.000	0.000	93.769	0.000	1.610	78.00	1.000
DUM7	25.882	15.00	0.000	2.000	0.000	93.769	0.000	22.584	94.00	8.000
A8	25.882	15.00	0.000	2.000	0.000	93.769	0.000	2.770	90.00	1.000
A9	25.882	15.00	0.000	2.000	0.000	93.769	0.000	3.201	90.00	1.000
A7a	25.882	15.00	0.000	2.000	0.000	93.769	0.000	1.551	82.00	1.000
DUM8	25.882	15.00	0.000	2.000	0.000	93.769	0.000	7.462	91.00	6.000
A15	25.882	15.00	0.000	2.000	0.000	93.769	0.000	9.022	87.00	1.000
A16	25.882	15.00	0.000	2.000	0.000	93.769	0.000	9.691	88.00	1000.
Outlet	25.882	15.00	0.000	2.000	0.000	93.769	0.000	29.481	101.0	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 360.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 249.86
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	21.614	15.00	0.000	2.000	0.000	104.62	0.000	3.595	138.0	2.000
A10	21.614	15.00	0.000	2.000	0.000	104.62	0.000	1.888	120.0	1.000
DUM1	21.614	15.00	0.000	2.000	0.000	104.62	0.000	5.124	123.0	6.000
A3	21.614	15.00	0.000	2.000	0.000	104.62	0.000	2.365	138.0	2.000
A12a	21.614	15.00	0.000	2.000	0.000	104.62	0.000	0.6552	120.0	1.000
DUM2	21.614	15.00	0.000	2.000	0.000	104.62	0.000	7.968	129.0	4.000
A11b	21.614	15.00	0.000	2.000	0.000	104.62	0.000	1.465	120.0	1.000
A12b	21.614	15.00	0.000	2.000	0.000	104.62	0.000	0.9080	120.0	1.000
A13	21.614	15.00	0.000	2.000	0.000	104.62	0.000	0.7963	120.0	1.000
A11a	21.614	15.00	0.000	2.000	0.000	104.62	0.000	2.561	120.0	1.000
DUM9	21.614	15.00	0.000	2.000	0.000	104.62	0.000	5.730	121.0	5.000
DUM3	21.614	15.00	0.000	2.000	0.000	104.62	0.000	13.186	127.0	1.000
A5	21.614	15.00	0.000	2.000	0.000	104.62	0.000	1.418	121.0	1.000
DUM4	21.614	15.00	0.000	2.000	0.000	104.62	0.000	14.581	128.0	1.000
A6	21.614	15.00	0.000	2.000	0.000	104.62	0.000	2.768	121.0	1.000
DUM5	21.614	15.00	0.000	2.000	0.000	104.62	0.000	17.150	129.0	2.000
A14b	21.614	15.00	0.000	2.000	0.000	104.62	0.000	0.5794	120.0	1.000
A14a	21.614	15.00	0.000	2.000	0.000	104.62	0.000	1.337	121.0	1.000
DUM6	21.614	15.00	0.000	2.000	0.000	104.62	0.000	18.885	131.0	2.000
A7b	21.614	15.00	0.000	2.000	0.000	104.62	0.000	1.342	120.0	1.000
DUM7	21.614	15.00	0.000	2.000	0.000	104.62	0.000	19.959	132.0	8.000
A8	21.614	15.00	0.000	2.000	0.000	104.62	0.000	2.401	125.0	1.000
A9	21.614	15.00	0.000	2.000	0.000	104.62	0.000	2.739	121.0	1.000
A7a	21.614	15.00	0.000	2.000	0.000	104.62	0.000	1.329	120.0	1.000
DUM8	21.614	15.00	0.000	2.000	0.000	104.62	0.000	6.447	122.0	6.000
A15	21.614	15.00	0.000	2.000	0.000	104.62	0.000	7.815	120.0	1.000
A16	21.614	15.00	0.000	2.000	0.000	104.62	0.000	8.399	121.0	1000.
Outlet	21.614	15.00	0.000	2.000	0.000	104.62	0.000	25.951	140.0	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 540.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 249.86
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	16.780	15.00	0.000	2.000	0.000	120.28	0.000	3.294	324.0	2.000
A10	16.780	15.00	0.000	2.000	0.000	120.28	0.000	1.642	300.0	1.000
DUM1	16.780	15.00	0.000	2.000	0.000	120.28	0.000	4.624	311.0	6.000
A3	16.780	15.00	0.000	2.000	0.000	120.28	0.000	2.179	324.0	2.000
A12a	16.780	15.00	0.000	2.000	0.000	120.28	0.000	0.5707	300.0	1.000
DUM2	16.780	15.00	0.000	2.000	0.000	120.28	0.000	7.240	319.0	4.000
A11b	16.780	15.00	0.000	2.000	0.000	120.28	0.000	1.265	301.0	1.000
A12b	16.780	15.00	0.000	2.000	0.000	120.28	0.000	0.7902	300.0	1.000
A13	16.780	15.00	0.000	2.000	0.000	120.28	0.000	0.6902	300.0	1.000
A11a	16.780	15.00	0.000	2.000	0.000	120.28	0.000	2.240	300.0	1.000
DUM9	16.780	15.00	0.000	2.000	0.000	120.28	0.000	4.982	301.0	5.000
DUM3	16.780	15.00	0.000	2.000	0.000	120.28	0.000	11.815	309.0	1.000
A5	16.780	15.00	0.000	2.000	0.000	120.28	0.000	1.232	307.0	1.000
DUM4	16.780	15.00	0.000	2.000	0.000	120.28	0.000	13.044	310.0	1.000
A6	16.780	15.00	0.000	2.000	0.000	120.28	0.000	2.399	301.0	1.000
DUM5	16.780	15.00	0.000	2.000	0.000	120.28	0.000	15.337	309.0	2.000
A14b	16.780	15.00	0.000	2.000	0.000	120.28	0.000	0.5057	300.0	1.000
A14a	16.780	15.00	0.000	2.000	0.000	120.28	0.000	1.153	304.0	1.000
DUM6	16.780	15.00	0.000	2.000	0.000	120.28	0.000	16.914	311.0	2.000
A7b	16.780	15.00	0.000	2.000	0.000	120.28	0.000	1.169	300.0	1.000
DUM7	16.780	15.00	0.000	2.000	0.000	120.28	0.000	17.917	313.0	8.000
A8	16.780	15.00	0.000	2.000	0.000	120.28	0.000	2.113	309.0	1.000
A9	16.780	15.00	0.000	2.000	0.000	120.28	0.000	2.377	305.0	1.000
A7a	16.780	15.00	0.000	2.000	0.000	120.28	0.000	1.151	300.0	1.000
DUM8	16.780	15.00	0.000	2.000	0.000	120.28	0.000	5.598	304.0	6.000
A15	16.780	15.00	0.000	2.000	0.000	120.28	0.000	6.721	301.0	1.000
A16	16.780	15.00	0.000	2.000	0.000	120.28	0.000	7.225	302.0	1000.
Outlet	16.780	15.00	0.000	2.000	0.000	120.28	0.000	23.336	321.0	0.000

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Oakdale Site - Proposed

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ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 25.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area (ha) #1	#2	Slope (%) #1	#2	% Impervious (%) #1	#2	Pern #1	#2	B #1	#2	Link No.
A1	4.370	24.750	1.960	1.960	5.000	100.0	.035	.025	.0408	.0113	1.000
A10	1.770	10.040	6.150	6.150	5.000	100.0	.035	.025	.0144	.0040	2.000
DUM1	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.001
A3	2.910	16.460	1.910	2.150	2.150	100.0	.035	.025	.0377	.0087	3.000
A12a	0.6100	3.480	4.170	4.170	5.000	100.0	.035	.025	.0100	.0028	4.000
DUM2	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.002
A11b	1.420	8.060	3.720	3.720	5.000	100.0	.035	.025	.0165	.0046	5.000
A12b	2.260	3.390	5.000	5.000	5.000	100.0	.035	.025	.0181	.0025	6.000
A13	2.010	3.020	3.640	3.640	5.000	100.0	.035	.025	.0200	.0028	7.000
A11a	2.370	13.460	11.52	11.52	5.000	100.0	.035	.025	.0123	.0034	8.000
DUM9	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	5.001
DUM3	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.003
A5	1.510	8.540	2.200	2.200	5.000	100.0	.035	.025	.0221	.0061	9.000
DUM4	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.004
A6	2.710	15.380	4.760	4.760	5.000	100.0	.035	.025	.0204	.0057	10.00
DUM5	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.005
A14b	1.440	2.170	4.090	4.090	5.000	100.0	.035	.025	.0159	.0022	11.00
A14a	1.380	7.830	2.420	2.420	5.000	100.0	.035	.025	.0201	.0056	12.00
DUM6	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.006
A7b	1.260	7.110	5.830	5.830	5.000	100.0	.035	.025	.0124	.0034	13.00
DUM7	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.007
A8	2.650	15.020	2.390	2.390	5.000	100.0	.035	.025	.0285	.0079	14.00
A9	2.860	16.210	3.260	3.260	5.000	100.0	.035	.025	.0254	.0070	15.00
A7a	1.260	7.170	4.350	4.350	5.000	100.0	.035	.025	.0143	.0040	16.00
DUM8	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	14.00
A15	7.680	43.530	7.180	7.180	5.000	100.0	.035	.025	.0286	.0079	17.00
A16	3.770	0.000	2.530	0.000	5.000	0.000	.035	0.00	.0332	0.000	17.00
Outlet	.00001	0.000	1.000	0.000	0.000	0.000	.060	0.00	.0001	0.000	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	106.91	15.00	22.00	2.000	0.000	28.980	22.547	12.095	15.00	2.000
A10	106.91	15.00	22.00	2.000	0.000	28.980	22.547	5.904	14.00	1.000
DUM1	106.91	15.00	0.000	2.000	0.000	28.980	0.000	16.479	17.00	6.000
A3	106.91	15.00	22.00	2.000	0.000	28.980	22.547	8.677	15.00	2.000
A12a	106.91	15.00	22.00	2.000	0.000	28.980	22.547	2.071	14.00	1.000
DUM2	106.91	15.00	0.000	2.000	0.000	28.980	0.000	20.153	23.00	4.000
A11b	106.91	15.00	22.00	2.000	0.000	28.980	22.547	4.564	15.00	1.000
A12b	106.91	15.00	22.00	2.000	0.000	28.980	22.547	2.220	14.00	1.000
A13	106.91	15.00	22.00	2.000	0.000	28.980	22.547	1.947	14.00	1.000
A11a	106.91	15.00	22.00	2.000	0.000	28.980	22.547	8.030	14.00	1.000
DUM9	106.91	15.00	0.000	2.000	0.000	28.980	0.000	16.682	15.00	5.000
DUM3	106.91	15.00	0.000	2.000	0.000	28.980	0.000	26.666	21.00	1.000
A5	106.91	15.00	22.00	2.000	0.000	28.980	22.547	4.727	15.00	1.000
DUM4	106.91	15.00	0.000	2.000	0.000	28.980	0.000	28.323	22.00	1.000
A6	106.91	15.00	22.00	2.000	0.000	28.980	22.547	8.760	15.00	1.000
DUM5	106.91	15.00	0.000	2.000	0.000	28.980	0.000	31.347	23.00	2.000
A14b	106.91	15.00	22.00	2.000	0.000	28.980	22.547	1.435	14.00	1.000
A14a	106.91	15.00	22.00	2.000	0.000	28.980	22.547	4.378	15.00	1.000
DUM6	106.91	15.00	0.000	2.000	0.000	28.980	0.000	33.457	25.00	2.000
A7b	106.91	15.00	22.00	2.000	0.000	28.980	22.547	4.195	14.00	1.000
DUM7	106.91	15.00	0.000	2.000	0.000	28.980	0.000	34.433	27.00	8.000
A8	106.91	15.00	22.00	2.000	0.000	28.980	22.547	8.194	15.00	1.000
A9	106.91	15.00	22.00	2.000	0.000	28.980	22.547	9.109	15.00	1.000
A7a	106.91	15.00	22.00	2.000	0.000	28.980	22.547	4.107	14.00	1.000
DUM8	106.91	15.00	0.000	2.000	0.000	28.980	0.000	21.366	16.00	6.000
A15	106.91	15.00	22.00	2.000	0.000	28.980	22.547	24.752	15.00	1.000
A16	106.91	15.00	0.000	2.000	0.000	28.980	0.000	25.268	16.00	1000.
Outlet	106.91	15.00	0.000	2.000	0.000	28.980	0.000	37.915	34.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 45.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	77.485	15.00	22.00	2.000	0.000	41.981	36.114	8.969	20.00	2.000
A10	77.485	15.00	22.00	2.000	0.000	41.981	36.114	4.044	17.00	1.000
DUM1	77.485	15.00	0.000	2.000	0.000	41.981	0.000	12.607	21.00	6.000
A3	77.485	15.00	22.00	2.000	0.000	41.981	36.114	5.948	19.00	2.000
A12a	77.485	15.00	22.00	2.000	0.000	41.981	36.114	1.437	17.00	1.000
DUM2	77.485	15.00	0.000	2.000	0.000	41.981	0.000	16.987	27.00	4.000
A11b	77.485	15.00	22.00	2.000	0.000	41.981	36.114	3.137	18.00	1.000
A12b	77.485	15.00	22.00	2.000	0.000	41.981	36.114	1.688	20.00	1.000
A13	77.485	15.00	22.00	2.000	0.000	41.981	36.114	1.406	20.00	1.000
A11a	77.485	15.00	22.00	2.000	0.000	41.981	36.114	5.697	17.00	1.000
DUM9	77.485	15.00	0.000	2.000	0.000	41.981	0.000	11.596	18.00	5.000
DUM3	77.485	15.00	0.000	2.000	0.000	41.981	0.000	24.472	32.00	1.000
A5	77.485	15.00	22.00	2.000	0.000	41.981	36.114	3.168	19.00	1.000
DUM4	77.485	15.00	0.000	2.000	0.000	41.981	0.000	26.379	33.00	1.000
A6	77.485	15.00	22.00	2.000	0.000	41.981	36.114	5.899	18.00	1.000
DUM5	77.485	15.00	0.000	2.000	0.000	41.981	0.000	29.710	33.00	2.000
A14b	77.485	15.00	22.00	2.000	0.000	41.981	36.114	1.047	20.00	1.000
A14a	77.485	15.00	22.00	2.000	0.000	41.981	36.114	2.943	18.00	1.000
DUM6	77.485	15.00	0.000	2.000	0.000	41.981	0.000	31.829	35.00	2.000
A7b	77.485	15.00	22.00	2.000	0.000	41.981	36.114	2.887	17.00	1.000
DUM7	77.485	15.00	0.000	2.000	0.000	41.981	0.000	33.085	37.00	8.000
A8	77.485	15.00	22.00	2.000	0.000	41.981	36.114	5.540	19.00	1.000
A9	77.485	15.00	22.00	2.000	0.000	41.981	36.114	6.037	19.00	1.000
A7a	77.485	15.00	22.00	2.000	0.000	41.981	36.114	2.789	18.00	1.000
DUM8	77.485	15.00	0.000	2.000	0.000	41.981	0.000	14.217	20.00	6.000
A15	77.485	15.00	22.00	2.000	0.000	41.981	36.114	16.723	18.00	1.000
A16	77.485	15.00	0.000	2.000	0.000	41.981	0.000	17.087	19.00	1000.
Outlet	77.485	15.00	0.000	2.000	0.000	41.981	0.000	39.311	45.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 60.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	65.606	15.00	22.00	2.000	0.000	49.040	43.606	12.280	25.00	2.000
A10	65.606	15.00	22.00	2.000	0.000	49.040	43.606	5.332	24.00	1.000
DUM1	65.606	15.00	0.000	2.000	0.000	49.040	0.000	17.202	26.00	6.000
A3	65.606	15.00	22.00	2.000	0.000	49.040	43.606	8.174	25.00	2.000
A12a	65.606	15.00	22.00	2.000	0.000	49.040	43.606	1.849	25.00	1.000
DUM2	65.606	15.00	0.000	2.000	0.000	49.040	0.000	22.287	32.00	4.000
A11b	65.606	15.00	22.00	2.000	0.000	49.040	43.606	4.185	25.00	1.000
A12b	65.606	15.00	22.00	2.000	0.000	49.040	43.606	2.256	25.00	1.000
A13	65.606	15.00	22.00	2.000	0.000	49.040	43.606	1.939	25.00	1.000
A11a	65.606	15.00	22.00	2.000	0.000	49.040	43.606	7.309	25.00	1.000
DUM9	65.606	15.00	0.000	2.000	0.000	49.040	0.000	15.689	26.00	5.000
DUM3	65.606	15.00	0.000	2.000	0.000	49.040	0.000	30.837	36.00	1.000
A5	65.606	15.00	22.00	2.000	0.000	49.040	43.606	4.340	25.00	1.000
DUM4	65.606	15.00	0.000	2.000	0.000	49.040	0.000	32.770	37.00	1.000
A6	65.606	15.00	22.00	2.000	0.000	49.040	43.606	8.018	25.00	1.000
DUM5	65.606	15.00	0.000	2.000	0.000	49.040	0.000	35.746	38.00	2.000
A14b	65.606	15.00	22.00	2.000	0.000	49.040	43.606	1.425	25.00	1.000
A14a	65.606	15.00	22.00	2.000	0.000	49.040	43.606	3.999	25.00	1.000
DUM6	65.606	15.00	0.000	2.000	0.000	49.040	0.000	37.649	40.00	2.000
A7b	65.606	15.00	22.00	2.000	0.000	49.040	43.606	3.783	25.00	1.000
DUM7	65.606	15.00	0.000	2.000	0.000	49.040	0.000	38.983	37.00	8.000
A8	65.606	15.00	22.00	2.000	0.000	49.040	43.606	7.624	25.00	1.000
A9	65.606	15.00	22.00	2.000	0.000	49.040	43.606	8.326	25.00	1.000
A7a	65.606	15.00	22.00	2.000	0.000	49.040	43.606	3.756	25.00	1.000
DUM8	65.606	15.00	0.000	2.000	0.000	49.040	0.000	19.706	26.00	6.000
A15	65.606	15.00	22.00	2.000	0.000	49.040	43.606	22.683	25.00	1.000
A16	65.606	15.00	0.000	2.000	0.000	49.040	0.000	23.370	26.00	1000.
Outlet	65.606	15.00	0.000	2.000	0.000	49.040	0.000	45.972	45.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 90.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	51.341	15.00	22.00	2.000	0.000	59.445	55.011	13.181	30.00	2.000
A10	51.341	15.00	22.00	2.000	0.000	59.445	55.011	5.693	28.00	1.000
DUM1	51.341	15.00	0.000	2.000	0.000	59.445	0.000	18.319	31.00	6.000
A3	51.341	15.00	22.00	2.000	0.000	59.445	55.011	8.779	30.00	2.000
A12a	51.341	15.00	22.00	2.000	0.000	59.445	55.011	1.978	28.00	1.000
DUM2	51.341	15.00	0.000	2.000	0.000	59.445	0.000	22.019	37.00	4.000
A11b	51.341	15.00	22.00	2.000	0.000	59.445	55.011	4.512	29.00	1.000
A12b	51.341	15.00	22.00	2.000	0.000	59.445	55.011	2.467	30.00	1.000
A13	51.341	15.00	22.00	2.000	0.000	59.445	55.011	2.136	30.00	1.000
A11a	51.341	15.00	22.00	2.000	0.000	59.445	55.011	7.741	28.00	1.000
DUM9	51.341	15.00	0.000	2.000	0.000	59.445	0.000	16.826	31.00	5.000
DUM3	51.341	15.00	0.000	2.000	0.000	59.445	0.000	36.202	36.00	1.000
A5	51.341	15.00	22.00	2.000	0.000	59.445	55.011	4.671	30.00	1.000
DUM4	51.341	15.00	0.000	2.000	0.000	59.445	0.000	37.770	37.00	1.000
A6	51.341	15.00	22.00	2.000	0.000	59.445	55.011	8.583	30.00	1.000
DUM5	51.341	15.00	0.000	2.000	0.000	59.445	0.000	40.589	38.00	2.000
A14b	51.341	15.00	22.00	2.000	0.000	59.445	55.011	1.582	30.00	1.000
A14a	51.341	15.00	22.00	2.000	0.000	59.445	55.011	4.298	30.00	1.000
DUM6	51.341	15.00	0.000	2.000	0.000	59.445	0.000	42.608	40.00	2.000
A7b	51.341	15.00	22.00	2.000	0.000	59.445	55.011	4.043	28.00	1.000
DUM7	51.341	15.00	0.000	2.000	0.000	59.445	0.000	43.757	42.00	8.000
A8	51.341	15.00	22.00	2.000	0.000	59.445	55.011	8.200	30.00	1.000
A9	51.341	15.00	22.00	2.000	0.000	59.445	55.011	8.936	30.00	1.000
A7a	51.341	15.00	22.00	2.000	0.000	59.445	55.011	4.024	29.00	1.000
DUM8	51.341	15.00	0.000	2.000	0.000	59.445	0.000	21.145	31.00	6.000
A15	51.341	15.00	22.00	2.000	0.000	59.445	55.011	24.288	29.00	1.000
A16	51.341	15.00	0.000	2.000	0.000	59.445	0.000	25.132	30.00	1000.
Outlet	51.341	15.00	0.000	2.000	0.000	59.445	0.000	49.598	50.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 120.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	42.988	15.00	22.00	2.000	0.000	67.644	63.977	12.359	35.00	2.000
A10	42.988	15.00	22.00	2.000	0.000	67.644	63.977	5.405	33.00	1.000
DUM1	42.988	15.00	0.000	2.000	0.000	67.644	0.000	17.273	37.00	6.000
A3	42.988	15.00	22.00	2.000	0.000	67.644	63.977	8.274	35.00	2.000
A12a	42.988	15.00	22.00	2.000	0.000	67.644	63.977	1.884	33.00	1.000
DUM2	42.988	15.00	0.000	2.000	0.000	67.644	0.000	24.304	42.00	4.000
A11b	42.988	15.00	22.00	2.000	0.000	67.644	63.977	4.218	34.00	1.000
A12b	42.988	15.00	22.00	2.000	0.000	67.644	63.977	2.236	35.00	1.000
A13	42.988	15.00	22.00	2.000	0.000	67.644	63.977	1.918	35.00	1.000
A11a	42.988	15.00	22.00	2.000	0.000	67.644	63.977	7.316	33.00	1.000
DUM9	42.988	15.00	0.000	2.000	0.000	67.644	0.000	15.620	36.00	5.000
DUM3	42.988	15.00	0.000	2.000	0.000	67.644	0.000	36.673	46.00	1.000
A5	42.988	15.00	22.00	2.000	0.000	67.644	63.977	4.396	35.00	1.000
DUM4	42.988	15.00	0.000	2.000	0.000	67.644	0.000	38.257	47.00	1.000
A6	42.988	15.00	22.00	2.000	0.000	67.644	63.977	8.095	34.00	1.000
DUM5	42.988	15.00	0.000	2.000	0.000	67.644	0.000	40.631	48.00	2.000
A14b	42.988	15.00	22.00	2.000	0.000	67.644	63.977	1.411	35.00	1.000
A14a	42.988	15.00	22.00	2.000	0.000	67.644	63.977	4.048	35.00	1.000
DUM6	42.988	15.00	0.000	2.000	0.000	67.644	0.000	42.173	50.00	2.000
A7b	42.988	15.00	22.00	2.000	0.000	67.644	63.977	3.823	33.00	1.000
DUM7	42.988	15.00	0.000	2.000	0.000	67.644	0.000	43.028	52.00	8.000
A8	42.988	15.00	22.00	2.000	0.000	67.644	63.977	7.694	35.00	1.000
A9	42.988	15.00	22.00	2.000	0.000	67.644	63.977	8.402	35.00	1.000
A7a	42.988	15.00	22.00	2.000	0.000	67.644	63.977	3.768	34.00	1.000
DUM8	42.988	15.00	0.000	2.000	0.000	67.644	0.000	19.859	36.00	6.000
A15	42.988	15.00	22.00	2.000	0.000	67.644	63.977	22.866	34.00	1.000
A16	42.988	15.00	0.000	2.000	0.000	67.644	0.000	23.480	35.00	1000.
Outlet	42.988	15.00	0.000	2.000	0.000	67.644	0.000	47.784	60.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 180.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	33.376	15.00	22.00	2.000	0.000	79.895	78.128	7.181	45.00	2.000
A10	33.376	15.00	22.00	2.000	0.000	79.895	78.128	3.061	45.00	1.000
DUM1	33.376	15.00	0.000	2.000	0.000	79.895	0.000	10.197	46.00	6.000
A3	33.376	15.00	22.00	2.000	0.000	79.895	78.128	4.756	45.00	2.000
A12a	33.376	15.00	22.00	2.000	0.000	79.895	78.128	1.060	45.00	1.000
DUM2	33.376	15.00	0.000	2.000	0.000	79.895	0.000	15.625	46.00	4.000
A11b	33.376	15.00	22.00	2.000	0.000	79.895	78.128	2.447	45.00	1.000
A12b	33.376	15.00	22.00	2.000	0.000	79.895	78.128	1.446	45.00	1.000
A13	33.376	15.00	22.00	2.000	0.000	79.895	78.128	1.278	45.00	1.000
A11a	33.376	15.00	22.00	2.000	0.000	79.895	78.128	4.106	44.00	1.000
DUM9	33.376	15.00	0.000	2.000	0.000	79.895	0.000	9.277	46.00	5.000
DUM3	33.376	15.00	0.000	2.000	0.000	79.895	0.000	24.884	50.00	1.000
A5	33.376	15.00	22.00	2.000	0.000	79.895	78.128	2.551	45.00	1.000
DUM4	33.376	15.00	0.000	2.000	0.000	79.895	0.000	26.044	49.00	1.000
A6	33.376	15.00	22.00	2.000	0.000	79.895	78.128	4.670	45.00	1.000
DUM5	33.376	15.00	0.000	2.000	0.000	79.895	0.000	28.243	48.00	2.000
A14b	33.376	15.00	22.00	2.000	0.000	79.895	78.128	0.9218	45.00	1.000
A14a	33.376	15.00	22.00	2.000	0.000	79.895	78.128	2.351	45.00	1.000
DUM6	33.376	15.00	0.000	2.000	0.000	79.895	0.000	29.820	50.00	2.000
A7b	33.376	15.00	22.00	2.000	0.000	79.895	78.128	2.169	45.00	1.000
DUM7	33.376	15.00	0.000	2.000	0.000	79.895	0.000	30.721	52.00	8.000
A8	33.376	15.00	22.00	2.000	0.000	79.895	78.128	4.471	45.00	1.000
A9	33.376	15.00	22.00	2.000	0.000	79.895	78.128	4.875	45.00	1.000
A7a	33.376	15.00	22.00	2.000	0.000	79.895	78.128	2.181	45.00	1.000
DUM8	33.376	15.00	0.000	2.000	0.000	79.895	0.000	11.527	46.00	6.000
A15	33.376	15.00	22.00	2.000	0.000	79.895	78.128	13.216	45.00	1.000
A16	33.376	15.00	0.000	2.000	0.000	79.895	0.000	13.985	46.00	1000.
Outlet	33.376	15.00	0.000	2.000	0.000	79.895	0.000	35.525	60.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 270.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	25.882	15.00	22.00	2.000	0.000	93.769	94.471	6.425	75.00	2.000
A10	25.882	15.00	22.00	2.000	0.000	93.769	94.471	2.702	75.00	1.000
DUM1	25.882	15.00	0.000	2.000	0.000	93.769	0.000	9.099	76.00	6.000
A3	25.882	15.00	22.00	2.000	0.000	93.769	94.471	4.261	75.00	2.000
A12a	25.882	15.00	22.00	2.000	0.000	93.769	94.471	0.9370	75.00	1.000
DUM2	25.882	15.00	0.000	2.000	0.000	93.769	0.000	14.038	76.00	4.000
A11b	25.882	15.00	22.00	2.000	0.000	93.769	94.471	2.157	75.00	1.000
A12b	25.882	15.00	22.00	2.000	0.000	93.769	94.471	1.272	75.00	1.000
A13	25.882	15.00	22.00	2.000	0.000	93.769	94.471	1.115	75.00	1.000
A11a	25.882	15.00	22.00	2.000	0.000	93.769	94.471	3.631	75.00	1.000
DUM9	25.882	15.00	0.000	2.000	0.000	93.769	0.000	8.175	76.00	5.000
DUM3	25.882	15.00	0.000	2.000	0.000	93.769	0.000	22.209	81.00	1.000
A5	25.882	15.00	22.00	2.000	0.000	93.769	94.471	2.258	75.00	1.000
DUM4	25.882	15.00	0.000	2.000	0.000	93.769	0.000	23.923	82.00	1.000
A6	25.882	15.00	22.00	2.000	0.000	93.769	94.471	4.120	75.00	1.000
DUM5	25.882	15.00	0.000	2.000	0.000	93.769	0.000	26.997	83.00	2.000
A14b	25.882	15.00	22.00	2.000	0.000	93.769	94.471	0.8075	75.00	1.000
A14a	25.882	15.00	22.00	2.000	0.000	93.769	94.471	2.076	75.00	1.000
DUM6	25.882	15.00	0.000	2.000	0.000	93.769	0.000	29.192	84.00	2.000
A7b	25.882	15.00	22.00	2.000	0.000	93.769	94.471	1.916	75.00	1.000
DUM7	25.882	15.00	0.000	2.000	0.000	93.769	0.000	30.596	86.00	8.000
A8	25.882	15.00	22.00	2.000	0.000	93.769	94.471	3.965	75.00	1.000
A9	25.882	15.00	22.00	2.000	0.000	93.769	94.471	4.307	75.00	1.000
A7a	25.882	15.00	22.00	2.000	0.000	93.769	94.471	1.924	75.00	1.000
DUM8	25.882	15.00	0.000	2.000	0.000	93.769	0.000	10.196	76.00	6.000
A15	25.882	15.00	22.00	2.000	0.000	93.769	94.471	11.648	75.00	1.000
A16	25.882	15.00	0.000	2.000	0.000	93.769	0.000	12.352	76.00	1000.
Outlet	25.882	15.00	0.000	2.000	0.000	93.769	0.000	38.198	94.00	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 360.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	21.614	15.00	22.00	2.000	0.000	104.62	107.69	4.835	120.0	2.000
A10	21.614	15.00	22.00	2.000	0.000	104.62	107.69	1.972	120.0	1.000
DUM1	21.614	15.00	0.000	2.000	0.000	104.62	0.000	6.803	121.0	6.000
A3	21.614	15.00	22.00	2.000	0.000	104.62	107.69	3.214	120.0	2.000
A12a	21.614	15.00	22.00	2.000	0.000	104.62	107.69	0.6830	120.0	1.000
DUM2	21.614	15.00	0.000	2.000	0.000	104.62	0.000	10.653	121.0	4.000
A11b	21.614	15.00	22.00	2.000	0.000	104.62	107.69	1.583	120.0	1.000
A12b	21.614	15.00	22.00	2.000	0.000	104.62	107.69	0.9355	120.0	1.000
A13	21.614	15.00	22.00	2.000	0.000	104.62	107.69	0.8325	120.0	1.000
A11a	21.614	15.00	22.00	2.000	0.000	104.62	107.69	2.643	114.0	1.000
DUM9	21.614	15.00	0.000	2.000	0.000	104.62	0.000	5.994	121.0	5.000
DUM3	21.614	15.00	0.000	2.000	0.000	104.62	0.000	16.647	125.0	1.000
A5	21.614	15.00	22.00	2.000	0.000	104.62	107.69	1.676	120.0	1.000
DUM4	21.614	15.00	0.000	2.000	0.000	104.62	0.000	18.231	121.0	1.000
A6	21.614	15.00	22.00	2.000	0.000	104.62	107.69	3.021	120.0	1.000
DUM5	21.614	15.00	0.000	2.000	0.000	104.62	0.000	21.227	121.0	2.000
A14b	21.614	15.00	22.00	2.000	0.000	104.62	107.69	0.5977	120.0	1.000
A14a	21.614	15.00	22.00	2.000	0.000	104.62	107.69	1.537	120.0	1.000
DUM6	21.614	15.00	0.000	2.000	0.000	104.62	0.000	23.304	121.0	2.000
A7b	21.614	15.00	22.00	2.000	0.000	104.62	107.69	1.398	120.0	1.000
DUM7	21.614	15.00	0.000	2.000	0.000	104.62	0.000	24.631	121.0	8.000
A8	21.614	15.00	22.00	2.000	0.000	104.62	107.69	2.945	120.0	1.000
A9	21.614	15.00	22.00	2.000	0.000	104.62	107.69	3.183	120.0	1.000
A7a	21.614	15.00	22.00	2.000	0.000	104.62	107.69	1.408	120.0	1.000
DUM8	21.614	15.00	0.000	2.000	0.000	104.62	0.000	7.536	121.0	6.000
A15	21.614	15.00	22.00	2.000	0.000	104.62	107.69	8.551	120.0	1.000
A16	21.614	15.00	0.000	2.000	0.000	104.62	0.000	9.153	120.0	1000.
Outlet	21.614	15.00	0.000	2.000	0.000	104.62	0.000	32.069	127.0	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 540.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
A1	16.780	15.00	22.00	2.000	0.000	120.28	129.02	4.243	300.0	2.000
A10	16.780	15.00	22.00	2.000	0.000	120.28	129.02	1.734	300.0	1.000
DUM1	16.780	15.00	0.000	2.000	0.000	120.28	0.000	5.971	301.0	6.000
A3	16.780	15.00	22.00	2.000	0.000	120.28	129.02	2.815	300.0	2.000
A12a	16.780	15.00	22.00	2.000	0.000	120.28	129.02	0.6004	300.0	1.000
DUM2	16.780	15.00	0.000	2.000	0.000	120.28	0.000	9.341	301.0	4.000
A11b	16.780	15.00	22.00	2.000	0.000	120.28	129.02	1.391	300.0	1.000
A12b	16.780	15.00	22.00	2.000	0.000	120.28	129.02	0.8213	300.0	1.000
A13	16.780	15.00	22.00	2.000	0.000	120.28	129.02	0.7304	300.0	1.000
A11a	16.780	15.00	22.00	2.000	0.000	120.28	129.02	2.324	298.0	1.000
DUM9	16.780	15.00	0.000	2.000	0.000	120.28	0.000	5.267	301.0	5.000
DUM3	16.780	15.00	0.000	2.000	0.000	120.28	0.000	14.607	305.0	1.000
A5	16.780	15.00	22.00	2.000	0.000	120.28	129.02	1.472	300.0	1.000
DUM4	16.780	15.00	0.000	2.000	0.000	120.28	0.000	15.989	301.0	1.000
A6	16.780	15.00	22.00	2.000	0.000	120.28	129.02	2.655	300.0	1.000
DUM5	16.780	15.00	0.000	2.000	0.000	120.28	0.000	18.616	301.0	2.000
A14b	16.780	15.00	22.00	2.000	0.000	120.28	129.02	0.5247	300.0	1.000
A14a	16.780	15.00	22.00	2.000	0.000	120.28	129.02	1.350	300.0	1.000
DUM6	16.780	15.00	0.000	2.000	0.000	120.28	0.000	20.430	301.0	2.000
A7b	16.780	15.00	22.00	2.000	0.000	120.28	129.02	1.229	300.0	1.000
DUM7	16.780	15.00	0.000	2.000	0.000	120.28	0.000	21.584	301.0	8.000
A8	16.780	15.00	22.00	2.000	0.000	120.28	129.02	2.586	300.0	1.000
A9	16.780	15.00	22.00	2.000	0.000	120.28	129.02	2.796	300.0	1.000
A7a	16.780	15.00	22.00	2.000	0.000	120.28	129.02	1.237	300.0	1.000
DUM8	16.780	15.00	0.000	2.000	0.000	120.28	0.000	6.619	301.0	6.000
A15	16.780	15.00	22.00	2.000	0.000	120.28	129.02	7.516	300.0	1.000
A16	16.780	15.00	0.000	2.000	0.000	120.28	0.000	8.040	300.0	1000.
Outlet	16.780	15.00	0.000	2.000	0.000	120.28	0.000	28.116	307.0	0.000

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Oakdale Site – Proposed OSD

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ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 25.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

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	Basin Vol. Used	Basin Stage Used
A1	15.00	12.09	28.00	2.393	6828.4	0.0000	4274.1	0.5871
A10	14.00	5.903	27.00	1.069	2767.2	0.0000	1910.7	0.6470
A3	15.00	8.676	27.00	1.587	4545.2	0.0000	2834.2	0.5852
A12a	14.00	2.070	26.00	.3724	961.60	0.0000	664.78	0.6498
A11b	15.00	4.564	27.00	.8471	2229.1	0.0000	1512.9	0.6383
A12b	14.00	2.219	27.00	.5026	1410.0	0.0000	897.83	0.6354
A13	14.00	1.946	28.00	.4375	1266.4	0.0000	781.87	0.6215
A11a	14.00	8.030	26.00	1.462	3719.1	0.0000	2611.6	0.6598
A5	15.00	4.727	27.00	.8663	2366.3	0.0000	1547.2	0.6157
A6	15.00	8.759	27.00	1.612	4247.1	0.0000	2878.3	0.6364
A14b	14.00	1.435	27.00	.3249	909.73	0.0000	580.96	0.6434
A14a	15.00	4.377	27.00	.8022	2168.4	0.0000	1433.3	0.6224
A7b	14.00	4.194	26.00	.7641	1966.9	0.0000	1364.5	0.6520
A8	15.00	8.193	27.00	1.503	4153.6	0.0000	2685.3	0.6078
A9	15.00	9.108	27.00	1.655	4470.5	0.0000	2956.1	0.6200
A7a	14.00	4.107	27.00	.7609	1982.0	0.0000	1359.4	0.6449
A16	16.00	25.27	28.00	4.799	13115.7	0.0000	8572.0	0.6236

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 45.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

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	Basin Vol. Used	Basin Stage Used
A1	20.00	8.969	43.00	3.202	10756.4	0.0000	5717.5	0.7854
A10	17.00	4.044	41.00	1.359	4364.6	0.0000	2428.8	0.8225
A3	19.00	5.948	42.00	2.120	7149.0	0.0000	3787.4	0.7820
A12a	17.00	1.437	41.00	.4700	1512.3	0.0000	839.12	0.8203
A11b	18.00	3.136	41.00	1.083	3500.0	0.0000	1934.4	0.8162
A12b	20.00	1.687	42.00	.6503	2172.0	0.0000	1161.7	0.8222
A13	20.00	1.406	42.00	.5739	1938.4	0.0000	1025.6	0.8153
A11a	17.00	5.696	41.00	1.832	5850.4	0.0000	3272.3	0.8268
A5	19.00	3.167	42.00	1.130	3710.0	0.0000	2019.3	0.8035
A6	18.00	5.899	41.00	2.061	6676.5	0.0000	3681.8	0.8140
A14b	20.00	1.047	42.00	.4166	1386.8	0.0000	745.02	0.8250
A14a	18.00	2.943	42.00	1.040	3399.7	0.0000	1859.1	0.8073
A7b	17.00	2.887	41.00	.9661	3096.1	0.0000	1725.3	0.8243
A8	19.00	5.540	42.00	1.973	6517.9	0.0000	3524.5	0.7978
A9	19.00	6.037	42.00	2.154	7049.4	0.0000	3847.3	0.8069
A7a	18.00	2.788	41.00	.9669	3111.9	0.0000	1727.3	0.8194
A16	19.00	17.09	43.00	6.223	20475.3	0.0000	11114.5	0.8086

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 60.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

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	Basin Vol. Used	Basin Stage Used
A1	25.00	12.28	46.00	3.459	12911.1	0.0000	6177.7	0.8486
A10	24.00	5.332	42.00	1.467	5245.2	0.0000	2622.1	0.8880
A3	25.00	8.174	46.00	2.294	8592.5	0.0000	4096.7	0.8459
A12a	25.00	1.849	42.00	.5077	1816.0	0.0000	906.40	0.8860
A11b	25.00	4.185	43.00	1.169	4208.1	0.0000	2089.2	0.8815
A12b	25.00	2.256	45.00	.7040	2589.0	0.0000	1257.5	0.8900
A13	25.00	1.938	46.00	.6205	2304.6	0.0000	1108.7	0.8813
A11a	25.00	7.308	41.00	1.977	7025.7	0.0000	3532.0	0.8924
A5	25.00	4.339	45.00	1.223	4465.0	0.0000	2184.5	0.8693
A6	25.00	8.018	43.00	2.228	8031.1	0.0000	3979.8	0.8799
A14b	25.00	1.424	45.00	.4515	1655.0	0.0000	807.35	0.8941
A14a	25.00	3.999	44.00	1.125	4091.9	0.0000	2010.7	0.8731
A7b	25.00	3.783	42.00	1.042	3715.9	0.0000	1861.5	0.8894
A8	25.00	7.623	45.00	2.136	7846.9	0.0000	3815.0	0.8635
A9	25.00	8.325	44.00	2.327	8466.5	0.0000	4155.4	0.8715
A7a	25.00	3.756	42.00	1.044	3742.2	0.0000	1866.1	0.8853
A16	26.00	23.37	46.00	6.732	24590.5	0.0000	12022.9	0.8746

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 90.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

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	Basin Vol. Used	Basin Stage Used
A1	30.00	13.18	47.00	3.452	16202.0	0.0000	6165.3	0.8469
A10	28.00	5.692	43.00	1.467	6571.3	0.0000	2621.1	0.8876
A3	30.00	8.778	47.00	2.283	10762.8	0.0000	4077.6	0.8420
A12a	28.00	1.978	42.00	.5081	2276.6	0.0000	907.11	0.8867
A11b	29.00	4.511	44.00	1.168	5271.9	0.0000	2086.6	0.8804
A12b	30.00	2.467	45.00	.7034	3207.7	0.0000	1256.5	0.8892
A13	30.00	2.135	46.00	.6193	2855.6	0.0000	1106.6	0.8796
A11a	28.00	7.741	42.00	1.980	8809.9	0.0000	3537.1	0.8937
A5	30.00	4.671	46.00	1.220	5594.5	0.0000	2180.0	0.8675
A6	30.00	8.583	43.00	2.229	10071.8	0.0000	3981.5	0.8803
A14b	30.00	1.581	46.00	.4510	2050.5	0.0000	806.38	0.8930
A14a	30.00	4.297	45.00	1.123	5126.5	0.0000	2007.1	0.8715
A7b	28.00	4.043	42.00	1.042	4657.4	0.0000	1862.0	0.8897
A8	30.00	8.199	46.00	2.131	9829.8	0.0000	3806.6	0.8616
A9	30.00	8.936	45.00	2.325	10615.8	0.0000	4153.4	0.8711
A7a	29.00	4.024	43.00	1.043	4687.4	0.0000	1864.5	0.8845
A16	30.00	25.13	46.00	6.725	30737.7	0.0000	12010.8	0.8738

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 120.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

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	Basin Vol. Used	Basin Stage Used
A1	35.00	12.36	49.00	3.563	18780.7	0.0000	6362.1	0.8739
A10	33.00	5.405	47.00	1.545	7619.8	0.0000	2760.8	0.9349
A3	35.00	8.273	49.00	2.362	12494.1	0.0000	4218.6	0.8711
A12a	33.00	1.883	47.00	.5365	2638.1	0.0000	957.77	0.9362
A11b	34.00	4.218	47.00	1.225	6116.8	0.0000	2188.2	0.9233
A12b	35.00	2.235	49.00	.7277	3698.2	0.0000	1300.0	0.9200
A13	35.00	1.918	51.00	.6360	3292.9	0.0000	1136.4	0.9033
A11a	33.00	7.315	46.00	2.093	10205.9	0.0000	3738.3	0.9445
A5	35.00	4.395	48.00	1.268	6485.7	0.0000	2265.7	0.9016
A6	34.00	8.094	47.00	2.337	11665.5	0.0000	4173.7	0.9228
A14b	35.00	1.410	50.00	.4652	2363.7	0.0000	831.75	0.9211
A14a	35.00	4.048	48.00	1.169	5943.6	0.0000	2090.0	0.9075
A7b	33.00	3.823	47.00	1.098	5401.2	0.0000	1961.9	0.9374
A8	35.00	7.694	48.00	2.215	11399.7	0.0000	3956.4	0.8955
A9	35.00	8.401	48.00	2.425	12303.4	0.0000	4330.8	0.9083
A7a	34.00	3.768	47.00	1.097	5439.6	0.0000	1960.4	0.9300
A16	35.00	23.48	49.00	6.983	35578.7	0.0000	12472.2	0.9073

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 180.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

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	Basin Vol. Used	Basin Stage Used
A1	45.00	7.181	78.00	3.214	22811.7	0.0000	5739.5	0.7884
A10	45.00	3.061	76.00	1.324	9254.6	0.0000	2366.9	0.8015
A3	45.00	4.755	77.00	2.139	15175.6	0.0000	3819.9	0.7888
A12a	45.00	1.060	76.00	.4582	3205.0	0.0000	818.06	0.7997
A11b	45.00	2.447	77.00	1.061	7430.1	0.0000	1895.2	0.7997
A12b	45.00	1.446	77.00	.6305	4453.7	0.0000	1126.3	0.7971
A13	45.00	1.278	77.00	.5604	3967.4	0.0000	1001.4	0.7960
A11a	44.00	4.106	76.00	1.781	12406.5	0.0000	3181.3	0.8038
A5	45.00	2.550	77.00	1.120	7879.9	0.0000	2001.0	0.7962
A6	45.00	4.669	77.00	2.022	14177.3	0.0000	3611.8	0.7985
A14b	45.00	.9218	77.00	.4035	2845.6	0.0000	721.47	0.7990
A14a	45.00	2.350	77.00	1.027	7220.9	0.0000	1836.2	0.7973
A7b	45.00	2.169	76.00	.9401	6560.0	0.0000	1678.8	0.8021
A8	45.00	4.470	77.00	1.964	13850.1	0.0000	3507.4	0.7939
A9	45.00	4.874	77.00	2.125	14943.3	0.0000	3795.1	0.7960
A7a	45.00	2.181	77.00	.9447	6606.6	0.0000	1687.6	0.8006
A16	46.00	13.98	78.00	6.129	43144.2	0.0000	10946.3	0.7963

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 270.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

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	Basin Vol. Used	Basin Stage Used
A1	75.00	6.424	92.00	3.656	27476.4	0.0000	6528.5	0.8968
A10	75.00	2.702	91.00	1.533	11140.1	0.0000	2739.7	0.9278
A3	75.00	4.261	92.00	2.430	18274.7	0.0000	4340.9	0.8963
A12a	75.00	.9370	91.00	.5313	3859.0	0.0000	948.62	0.9273
A11b	75.00	2.156	91.00	1.224	8943.4	0.0000	2187.6	0.9230
A12b	75.00	1.272	91.00	.7226	5320.3	0.0000	1290.8	0.9135
A13	75.00	1.114	92.00	.6388	4738.8	0.0000	1141.5	0.9074
A11a	75.00	3.631	91.00	2.065	14935.6	0.0000	3689.7	0.9322
A5	75.00	2.257	92.00	1.285	9483.5	0.0000	2295.5	0.9135
A6	75.00	4.119	91.00	2.334	17063.6	0.0000	4168.4	0.9216
A14b	75.00	.8075	92.00	.4627	3400.3	0.0000	827.35	0.9162
A14a	75.00	2.076	92.00	1.181	8690.3	0.0000	2110.5	0.9164
A7b	75.00	1.915	91.00	1.089	7896.4	0.0000	1944.9	0.9293
A8	75.00	3.965	92.00	2.249	16673.0	0.0000	4016.5	0.9091
A9	75.00	4.306	92.00	2.443	17990.7	0.0000	4363.9	0.9152
A7a	75.00	1.923	91.00	1.092	7953.4	0.0000	1952.4	0.9262
A16	76.00	12.35	93.00	7.038	51846.6	0.0000	12569.1	0.9144

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 360.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

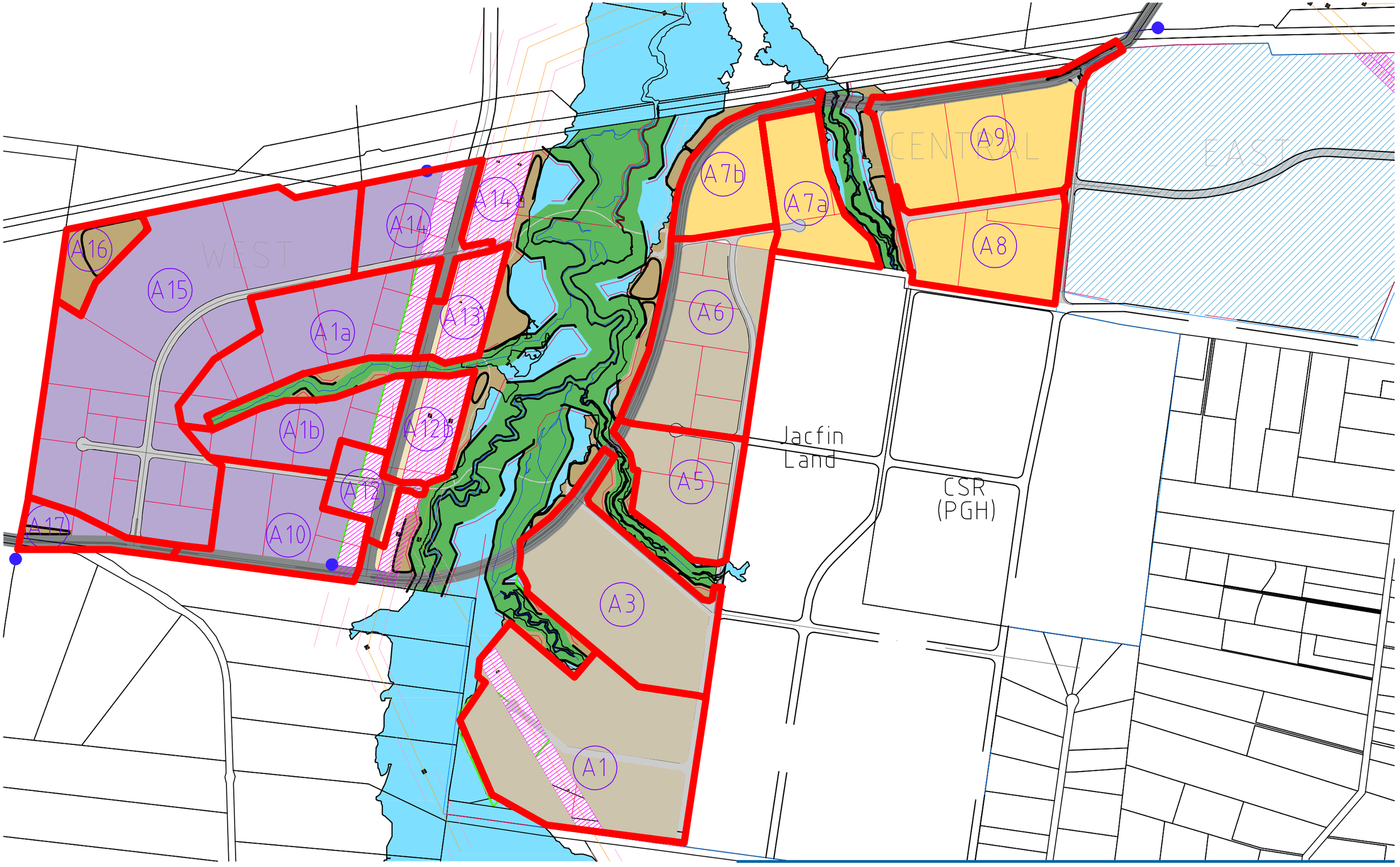
SUMMARY OF BASIN RESULTS

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	Basin Vol. Used	Basin Stage Used
A1	120.0	4.835	129.0	3.332	31220.5	0.0000	5950.9	0.8174
A10	120.0	1.972	123.0	1.383	12661.2	0.0000	2472.2	0.8372
A3	120.0	3.213	130.0	2.208	20768.0	0.0000	3943.6	0.8143
A12a	120.0	.6830	123.0	.4790	4384.2	0.0000	855.17	0.8359
A11b	120.0	1.582	124.0	1.106	10163.1	0.0000	1975.7	0.8336
A12b	120.0	.9355	130.0	.6533	6014.7	0.0000	1166.9	0.8259
A13	120.0	.8325	132.0	.5791	5354.5	0.0000	1034.9	0.8226
A11a	114.0	2.643	123.0	1.861	16968.6	0.0000	3325.5	0.8402
A5	120.0	1.676	126.0	1.162	10773.4	0.0000	2076.9	0.8265
A6	120.0	3.020	124.0	2.108	19393.9	0.0000	3764.8	0.8324
A14b	120.0	.5977	130.0	.4182	3843.2	0.0000	747.79	0.8281
A14a	120.0	1.536	125.0	1.068	9872.9	0.0000	1908.1	0.8285
A7b	120.0	1.397	123.0	.9823	8973.0	0.0000	1754.2	0.8381
A8	120.0	2.945	126.0	2.036	18945.2	0.0000	3636.3	0.8231
A9	120.0	3.182	125.0	2.209	20443.0	0.0000	3945.4	0.8275
A7a	120.0	1.407	124.0	.9862	9038.0	0.0000	1761.7	0.8357
A16	120.0	9.153	128.0	6.357	58836.5	0.0000	11353.0	0.8259

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 540.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 44.24
TOTAL OF SECOND SUB-AREAS (ha) = 205.62
TOTAL OF ALL SUB-AREAS (ha) = 249.86

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	Basin Vol. Used	Basin Stage Used
A1	300.0	4.242	320.0	3.210	37181.7	0.0000	5733.5	0.7876
A10	300.0	1.733	307.0	1.316	15078.7	0.0000	2351.9	0.7964
A3	300.0	2.814	325.0	2.133	24726.4	0.0000	3809.5	0.7866
A12a	300.0	.6004	307.0	.4550	5222.1	0.0000	812.34	0.7941
A11b	300.0	1.391	309.0	1.054	12103.3	0.0000	1883.8	0.7948
A12b	300.0	.8213	316.0	.6189	7090.6	0.0000	1105.6	0.7825
A13	300.0	.7304	318.0	.5504	6312.9	0.0000	983.52	0.7818
A11a	298.0	2.323	306.0	1.767	20209.4	0.0000	3156.5	0.7975
A5	300.0	1.472	314.0	1.114	12831.2	0.0000	1990.0	0.7919
A6	300.0	2.654	310.0	2.010	23097.2	0.0000	3589.1	0.7935
A14b	300.0	.5247	314.0	.3959	4530.7	0.0000	707.91	0.7840
A14a	300.0	1.350	312.0	1.021	11759.4	0.0000	1825.9	0.7928
A7b	300.0	1.228	306.0	.9336	10686.0	0.0000	1667.2	0.7965
A8	300.0	2.586	317.0	1.954	22558.4	0.0000	3489.8	0.7899
A9	300.0	2.796	314.0	2.112	24348.8	0.0000	3773.2	0.7914
A7a	300.0	1.237	308.0	.9389	10763.2	0.0000	1677.2	0.7957
A16	300.0	8.039	315.0	6.069	69914.2	0.0000	10840.1	0.7886



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GOODMAN INTERNATIONAL LTD
OAKDALE CONCEPT PLAN
CATCHMENT AREA PLAN
scale | 1:10000 for A3 date | DEC. 2007

job no. | 21-15101
rev no. | A

Figure 100

10 Bond Street, Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

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Appendix D

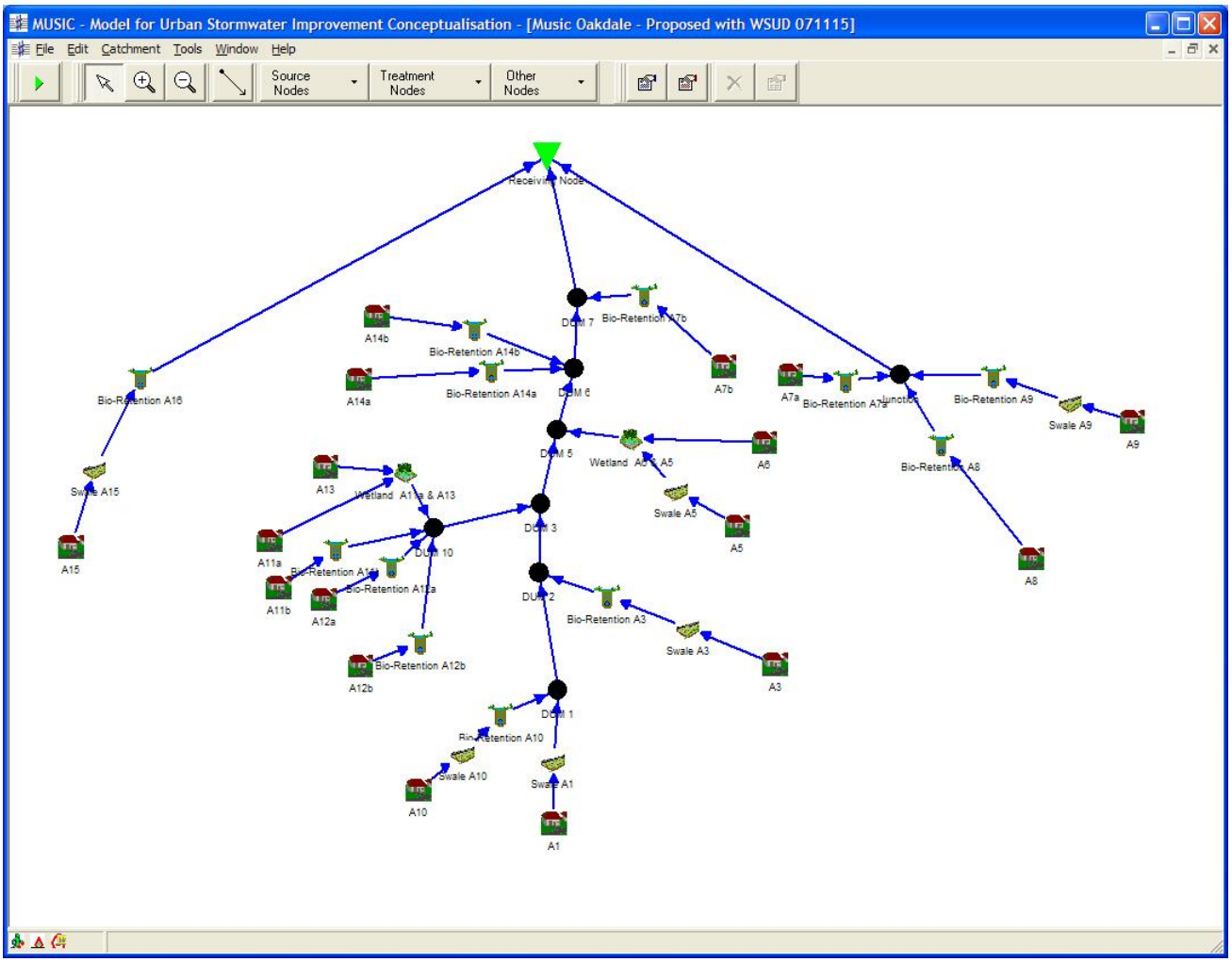
MUSIC Modelling Inputs and Model Network

Table
Oakdale Industrial Estate

Refer Figures for node,sub-catchment area, impervious area and catchment slope details

Subcatch. Node Label	Total Area (ha)	Lot Area (ha)	Roof Area (ha)	MUSIC Model Catch Area (ha)	% of Impervious	Bio-Retention Surface area 0.02 m^2	Bio-Retention Filter area 0.017 m^2	Wetland Area 0.05 m^2	Required Storage Volume m^3	Land Area Required m^2	Vegetated Swale Length m
A1	29.12	26.8	16.08	13.04	60				7280		600
A3	19.37	15.88	9.528	9.842	70	1968	1673		4843	**8400**	450
A5	10.05	8.71	5.226	4.824	70	965	820	2412	2513	**5800**	60
A6	18.09	13.77	8.262	9.828	70	1966	1671	4914	4523	**10000**	
A7a	8.43	5.89	3.534	4.896	70	979	832		2108	**6200**	
A7b	8.37	8.14	4.884	3.486	70	697	593		2093	**4000**	
A8	17.67	13.54	8.124	9.546	70	1909	1623		4418	**7500**	400
A9	19.07	15.51	9.306	9.764	70	1953	1660		4768	**7200**	
A10	11.81	10.14	6.084	5.726	70	1145	973		2953	**5100**	50
A11a	15.83	15.83	9.498	6.332	70			3166	3958	**8100**	
A11b	9.48	9.48	5.688	3.792	70	758	645		2370	**4800**	
A12a	4.09	2.5	1.5	2.59	70	518	440		1023	**2800**	
A12b	5.65	0	0	5.65	50	1130	961		1413	**3900**	
A13	5.03	0	0	5.03	50			2515	1258	**2800**	
A14a	9.21	6.57	3.942	5.268	70	1054	896		2303	**4200**	320
A14b	3.61	0	0	3.61	50	722	614		903	**1700**	
A15	51.21	47.57	28.542	22.668	70	4534	3854	11334	12803	**17000**	100
A16	3.77	3.77			0						
A17	3.56	1.44	0.864	2.696	70	539	458		890	**3000**	
Total Area	**253.42**	**205.54**	**121.06**	**128.59**		**20837**	**17712**	**24341**		**102500**	**1980**

MUSIC Model Configuration - Proposed with WSUD



Appendix E

WSUD Strategy Plan

Water Sensitive Urban Design Strategy Plan

Integrated Water Cycle Management Diagram

M7 Hub

M7 MOTORWAY

Mamre Road

HORSLEY PARK

Structure Plan Area

Oakdale Site Boundary

Bio-Retention Swale

Bio-Retention Basin

Pipe System

Site Based Bio-Retention and OSD

Channel

0 200 1000

design+

Oakdale

Eastern Creek

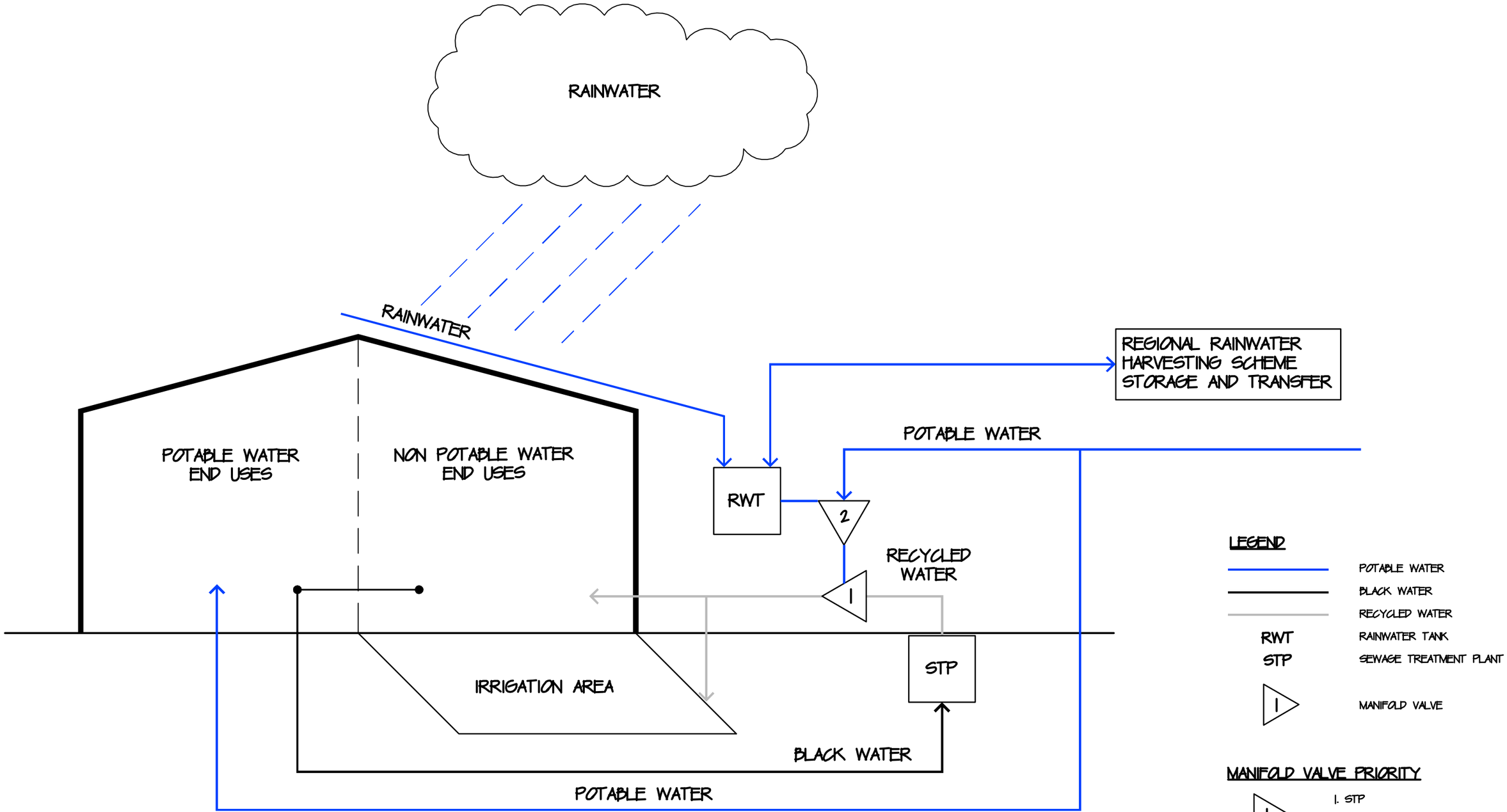
Design Masterplan

0 200 1000

1:10000 @ A1
1:20000 @ A3

4 Sep 07 AL

SP SK36 (D)



LEGEND

- POTABLE WATER
- BLACK WATER
- RECYCLED WATER
- RWT — RAINWATER TANK
- STP — SEWAGE TREATMENT PLANT
- 1 — MANIFOLD VALVE

MANIFOLD VALVE PRIORITY

1
1. STP
2. RWT

2
2. RWT
3. POTABLE WATER

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scale | NTS for A3 date | DECEMBER 2007

job no. | 21-15101
rev no. | B

Figure 03

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Working Draft 1	C McDougall					14/6/07
Working Draft 2	C McDougall	R Berg	On File	C McDougall	On file	10/07/07
Working Draft 3	C McDougall	R Berg	On File	C McDougall	On file	19/07/07
Rev 0	C McDougall	R Berg	On File	C McDougall	On File	10/12/07
Rev 1	C McDougall	C. McDougall		C McDougall		8/5/08