

Proposed Kings Forest Project Application

Engineering Services Report

Address: Cudgen, New South Wales

Local Government: Tweed Shire Council

Prepared for: Project 28 Pty Ltd

Prepared by: MORTONS - URBAN SOLUTIONS
Level 2, 19 Short Street
(PO Box 2484)
Southport Qld 4215

T: (07) 5571 1099
F: (07) 5571 1088
E: mortons@urbansolutions.net.au

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Author:	Kevin Fox
Project Manager	Kevin Fox
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- Appendix B Cut Fill Areas Plan Drawing No. 12301-05-040 (Rev A)
prepared by Mortons – Urban Solutions
- Bulk Earthworks Transfer Diagram No. 12301-05-025 (Rev A)
prepared by Mortons - Urban Solutions
- Precinct 5 Sub-Staging Diagram 12301-SK-026 (Rev A)
Prepared by Mortons - Urban Solutions
- Appendix C Extent of Stormwater Swale
Drawing Nos. 12301-SK027(A), 028(A) & 029(A)
Prepared by Mortons – Urban Solutions



2.0 INTRODUCTION

Mortons - Urban Solutions have been commissioned by Project 28 Pty Ltd to provide civil engineering services for the proposed Kings Forest Stage 1 Project Application (08_0194) located in, Kings Forest, Kingscliff, New South Wales. The project is located within the Tweed Local Government Area.

The following report reviews the proposed earthworks and infrastructure to service the proposed development components of the Project Application, as set out in the Director-General's Environmental Assessment Requirements. These components include:

- Subdivision to create new lots for future development;
- Construction of the entrance road to the site and associated intersection works on Tweed Coast Road;
- Alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4/5 through to the western side of the site, as well as the alignment of the two proposed roads through SEPP14 areas to access the Southern (Cudgen Paddock) Area;
- Construction works for the first Stage (Precinct 5) of Urban Development; and
- Bulk earthworks across the balance of the site.

The report covers the requirements of the Director-General's Environmental Assessment Requirements (DGRs) dated September 2010 based on the approved Kings Forest Concept Plan (MP06_0138) for the site.

Requirements of Attachment 1, 2 and 3 of the approved DGRs include, but are not limited to, the following:

Key Issues – DGR Attachment 1

Item 4 Infrastructure Provision

- 4.1** Address existing capacity and requirements of the development for sewerage and water. Identify and describe staging, if any, of infrastructure works.

Item 5 Traffic and Access

- 5.1** Demonstrate that the alignment of the Kings Forest Parkway is designed to be continuous or 'through' alignment to enforce its priority route status as a major collector/distributor road.



- 5.2 Demonstrate that provision has been made to maintain safe passage of wildlife between habitat areas through specific road design, lighting and signage requirements.
- 5.3 Demonstrate that the road crossings of waterways maintain existing fish passage.

Item 10 Earthworks

- 10.1 Provide a detailed survey showing existing and proposed levels and quantities of fill required.
- 10.2 Describe the methods for excavation, transportation and spreading of fill and determine whether fill will need to be imported to the site.
- 10.3 Address potential dust impacts of earthworks during construction and appropriate mitigation measures.

Plans & Documents to Accompany the Application -
DGR Attachment 2

Item 5 Subdivision plans are to show the following:

- The location, boundary dimensions, site area and north point of the land, and names of roads fronting the land;
- Title showing the description of the land with lot and DP numbers;
- Existing and proposed subdivision pattern including all measurements and sites areas of existing and proposed allotments;
- Location and details of all proposed roads and footpaths;
- Location of all structures proposed and retained on site;
- Cross sections of roads, including gradients, widths, road names, footpaths etc;
- Existing and proposed finished levels in relation to roads, footpaths and structures;
- Location and details of access points to the subdivision;
- Existing vegetation on the land and vegetation to be retained;



- Location of services and infrastructure, and proposed methods of draining the land;
- Any easements, covenants or other restrictions either existing or proposed on the site; and
- Type of subdivision proposed (Torrens, strata and/or community title).

Item 8 Construction Management Plan

- A plan which outlines traffic and pedestrian management during construction and management of impacts on amenity of adjoining properties and appropriate mitigation measures including noise, dust and sediment and erosion controls.

This report has been prepared based upon information supplied by other specialists, site investigations, as constructed data and a combination of detailed and aerial survey.

3.0 THE SITE AND ITS CONTEXT

3.1 Property Location

The site is located on the northern coast of New South Wales within the Tweed Shire Council and comprises a total area of 882.4ha. The site sits approximately 4km south of Kingscliff and 5km north of Cabarita. The site sits to the east of Old Bogangar Road and is partially bound by Cudgen Lake. The site extends to the west from Old Bogangar Road to Duranbah Road.

4.0 SITE ANALYSIS & SURROUNDS

4.1 Topography and Drainage

The site is dominated by three extensive areas of open space with a linear multi-use open space corridor. The layout of the area is generally flat with low lying pastoral land. The site is partially bound to the south by Cudgen Lake and the proposed development involves a five metre deep lake which will be used as a drainage path.



4.2 Geotechnical Investigation

Preliminary Geotechnical Investigations dated October 2010 were undertaken by Cardno Bowler in preparation of the Project Application over the whole of the development.

In summary:

- The cut/fill levels are expected to be up to 1.5m in both instances. The site conditions generally consist of loose to very dense sand and indurated sand from surface to depth.
- The site should be stripped of all topsoil from the fill footprints and prepared in general in accordance with AS3798.2007 'Guidelines on Earthworks for Commercial and Residential Development'.
- Depending on structural loads both high and deep level footings may be appropriate to support the proposed development on the subject site. With the exception of the topsoil stratum, all materials encountered during the investigation are considered acceptable for structural fill.
- The clays on site are highly plastic and could be expected to result in stiff raft foundation types. These clays could also be used as a liner for the proposed lake.
- Any structural sand fill should be placed in loose layers not greater than 200mm thick.

Refer to Cardno Bowler 'Geotechnical Investigation - Proposed Residential Subdivision, Depot Road, Kings Forest - 9528gs.10, dated 7 October 2010

4.3 Flooding

The site ranges in elevation from approximately RL 0m Australian Height Datum (AHD) to RL 55m AHD. The site is subjected to flooding from both local catchment runoff and regionally under the influence of Cudgen Creek flooding.

Roads, major infrastructure and development pads have been designed to meet the flooding requirements as set out in the Project Applications Flooding and Flood Management Assessment Report by Gilbert + Sutherland dated February 2010.



4.4 Existing Water Services

The Kings Forest development will be supplied by the Duranbah Reservoir complex located south west of the development. There is currently a 5.0 ML and a 7.5 ML reservoir situated at the complex with allocation for a third 7.5ML reservoir.

A 600mm diameter trunk main from the reservoir crosses the Kings Forest Development in an east west direction through the Cudgen Paddock and connects to a 450mm diameter main that acts as a the major coastal distributor.

Kings Forest will be serviced by take offs from the 600mm Trunk Main and the 450mm diameter main that services the area. An ultimate loop will be created to ensure adequate flow and pressure.

For the construction of the initial stages a take off from the existing 450mm diameter main on Tweed Coast Road will be extended to the site entry and feed Precinct 5. As the Kings Forest Development grows the ultimate loop will be required.

For details on existing water service infrastructure refer to **Appendix A** of this report Mortons - Urban Solutions Water and Sewer Servicing Report dated December 2010.

4.5 Existing Sewer Reticulation

There currently exists a 250mm diameter rising main on Old Bogangar Road / Tweed Coast Road. This main currently pumps to a transfer station at Chinderah and then onto Kingscliff Sewerage Treatment plant. We understand that there is still capacity within this rising main to accommodate some flow from Kings Forest initial Stages. Tweed Shire Council will be required to advise what capacity is available prior to an upgrade of this main is required.

Sewer from the Kings Forest Development will enter a Regional Pump Station on the east side of Tweed Coast Road (constructed as part of the Kings Forest Development) and will contribute flow to the existing 250mm rising main. Tweed Shire will upgrade the 250mm existing main when flows exceed the capacity.

Refer Mortons - Urban Solutions Water and Sewer Servicing Report dated December 2010 (**Appendix A**).



4.6 Existing Traffic and Roadworks

The proposed Kings Forest Development is currently accessed off Old Bogangar Road to the East and Duranbah road to the west.

Old Bogangar Road provides access to the Tweed Coast Road and consists of an 8 metre pavement. Duranbah Road runs North South along the western extents of the property. It consists of a 6 metre predominately unmarked pavement.

The Kings Forest Development is to create an Entry off Tweed Coast Road; subsequently, creating a new Intersection at this location.

Analysis of the proposed intersection is described in CRG's Traffic Assessment Report, dated December 2010 as submitted as part of the Project Application.

Details of the intersection are shown on Mortons - Urban Solutions Preliminary Engineering Plans - Tweed Coast Road Intersection and Entry Road 12301-ER-001 to 203.

5.0 PROPOSED DEVELOPMENT & ENGINEERING DESIGN

The following sections are to provide details of Bulk Earthworks and Preliminary Civil Engineering Design outcomes for each component of the proposed development.

5.1 Design Brief, Intent & Qualifications

The Preliminary Civil Engineering designs are based on Kings Forest Subdivision Proposal Plan Precincts 1 to 14 by MPS Architects (Drawing Ref: MPS 2142 DA-04, dated February 2011).

Mortons – Urban Solutions design brief is to provide Bulk Earthworks Design for the whole of the Development, Preliminary Engineering Design for the Estate Major Access works which include Tweed Coast Road Intersection and the Entry Road, alignment and preliminary engineering for the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4/5 through to the western side of the site, as well as the alignment of the two proposed roads through SEPP 14 areas to access the southern Precincts 12, 13 & 14. Mortons – Urban Solutions are also to provide preliminary engineering and bulk earthworks for the rural retail development to the east of Tweed Coast Road along with



access arrangements and Preliminary Engineering and Bulk Earthworks for Precinct 5 Residential Development.

5.2 Earthworks and Proposed Levels

Mortons - Urban Solutions has undertaken a complete earthworks review of the Kings Forest Development in order to ascertain the cut and fill requirements of the site. This review has considered local and regional flood levels and the escape routes for the Probable Maximum Flood (PMF) as detailed in Gilbert + Sutherlands Flooding and Flood Management Assessment dated February 2010 and subsequent addendums. Geotechnical constraints as addressed in Cardno Bowlers Report of October 2010 and Flora Fauna considerations by James Warren & Associates has also had an influence on the earthworks design.

The earthworks design has also taken into account ground water issues raised by Gilbert + Sutherland, and addressed in their reports as part of this submission. We note that ground water monitoring of all Precincts is on-going and there is a potential for earthwork level changes and varying stormwater treatment design changes with respect to Ground Water Dependent Eco-systems, ground water tables and constructability of civil infrastructure.

Cut and Fill Operations on site envisages a shortfall of material in the order of 320,000m³. Transport of fill from off site will be required to ensure that the balanced earthwork site (Precincts 6 - 11) are constructed to a level that meets the requirement of the Q100 ARI flood level as set out in Gilbert + Sutherlands Flooding and Flood Management Assessment. The actual quantity of fill required will be dependent upon compaction factors of the material, spoil achieved from trench excavations and possible further burrow areas on site. We anticipate that 320,000m³ will be close to the maximum amount required.

Prior to any import of material onto site, all applicable approvals are to be approved by the relevant authorities. A Traffic Impact Assessment is to be undertaken that considers quantity of import, haulage routes, traffic volumes and any ameliorative measures to be undertaken.

The levels to be achieved in Precincts 6 - 11 are shown on the amended Mortons - Urban Solutions Bulk Earthworks Plans (Balance Precincts 6 - 11; No 12301-EWB). Levels range between R.L 4.5m to 5.0m. These levels ensure that the development pads will be immune to flood levels for the Q₁₀₀ ARI as set out in Gilbert + Sutherlands Flooding and Flood Management Assessment dated February 2010.

Levels for the other Precincts are shown on Mortons - Urban Solutions engineering drawings submitted and are contained in JBA Planning



Report Appendix H. Similar to Precincts 6 - 11 all residential areas are to be constructed to ensure immunity for the Q₁₀₀ ARI flood event.

The Drawings attached in **Appendix B** (MUS Dwg. No. 12301-05-040, 12301-SK025) summarises the extent of the cut and fills on site and predicts the various movement of fills within the Kings Forest Development. We note the following with respect to spoil movement around the site:

- The northern Precincts 2, 4 & 5 are generally in cut with an estimated 94,000m³ of excess spoil being transported to the western balance site (Precincts 6 to 11).
- The southern Precincts 12, 13 & 14 are predominately in cut with an estimated 477,600m³ of excess spoil being transported to the western balance site (Precincts 6 to 11).
- An estimated maximum of 320,000m³ of imported fill material from off site will be used within the western balance site (Precincts 6 to 11) to achieve levels for residential purposes at or above the Q₁₀₀ ARI level.

All fill transferred to the Balanced Precincts 6 - 11 is required to achieve the designated flood levels. Preliminary grading and levels within Precinct 6 - 11 are shown on Mortons - Urban Solutions Bulk Earthworks - Balance Precincts 06-11 (No. 12301-EWB).

Based on Cardno Bowlers Geotechnical Report of October 2010 the site generally consists of loose sands over dense sand and indurated sand. We would anticipate that earthmoving would be undertaken using scrapers for the majority of the works.

Stabilisation of disturbed earthworks areas are to occur immediately following completion of bulk earthwork areas. This includes topsoiling and seeding and placement of sediment erosion control and stormwater dissipation devices. This is described in Gilbert + Sutherlands Site Based Management Plan.

Construction restrictions including noise, dust and sediment erosion control are considered in Mortons - Urban Solutions Construction Management Plan and Gilbert + Sutherland Overall Site Based Management Plan and Erosion & Sediment Control Management Plan, provided under separate cover.

All earthworks would be constructed under Level 1 supervision by a suitably qualified professional and be certified upon completion.



5.2.1 Staging of Earthworks and Construction

The staging of earthworks will be dependent on the sequencing of construction on site. It is envisaged that initial works on site will consist of the Intersection on Tweed Coast Road and the Entry into the site. Initial Stages of Precinct 5 will be constructed during the construction of these external works.

Earthworks from the External Roadworks, Entry Road and Precincts 4 & 5 will be completed during these initial stages. As shown on Mortons - Urban Solutions Bulk Earthworks Cut Fill Areas Plan 12301-ALL-040(A) and Transfer Diagram 12301-SK025(A) approximately 94,000m³ of spoil will be transferred as fill throughout Precincts 6 - 11.

Earthworks within Precincts 12 - 14 would be constructed following or concurrently with Precinct 4 & 5. This area will produce considerable spoil (approximately 473,600m³) and will be transferred to the Balance of Precinct 6 - 11.

Following the completion of Precincts 2 - 14 is the point where the amount of offsite fill to complete the balance of Precincts 6 - 11 will be determined. It is calculated that a maximum amount of import of 320,000m³ will be required to complete the balanced Precincts 6 - 11 and is anticipated to be placed in the vicinity of Precincts 9 - 11. This imported material would be used to ensure that all residential precincts in the balance of the development are constructed to levels at or above the designated flood level.

An indicative earthworks and construction sequencing/staging plan is shown below in Table 1.



Table 1
Indicative Construction Sequencing & Staging Plan

<i>Sequence Stage</i>	<i>Precinct</i>	<i>Description</i>
1	Precincts 01 & 02	Bulk Earthworks
1	Estate Major Access Work (EMAW)	Earthworks & Road Construction to Precinct 5 Entry
1	Precinct 05	Bulk Earthworks & Commence Residential Construction as per Precinct 5 Sub-Staging Diagram. Mortons – Urban Solutions Dwg 12301-SK026(A).
1	Precinct 04	Bulk Earthworks
2	Tweed Coast Intersection	Bulk Earthworks/Civil Construction
3	Precincts 12 – 14	Bulk Earthworks
4	EMAW	Roadworks – Roads 27, 10, 9 & 23
5	Precinct 13	Residential Construction
6	Precinct 12	Residential Construction
7	Precinct 14	Golf Course Construction
8	Precinct 04	Residential/Commercial Construction
9	Precinct 06	Residential Construction
10	Precinct 07	Residential Construction
11	Precinct 08	Residential Construction
12	Precinct 01	Commercial Construction
13	Precincts 02 & 03	Community Facilities
14	Precinct 09	Residential Construction
15	Precinct 10	Residential Construction
16	Precinct 11	Residential Construction

5.3 Proposed Access Points

The proposed access points to the development are off Tweed Coast Road with a potential future connection to Duranbah Road to the West and Cudgen Road to the North.

5.4 Traffic

Assessment of road requirements throughout the proposed development have been undertaken by CRG and are described in CRG's report of December 2010 submitted under separate cover.



5.5 Roadworks

5.5.1 Tweed Coast Road and Entry Road Intersection

The alignment, cross sections and geometry of the proposed Tweed Coast Intersection with The Entry Road are shown on Mortons - Urban Solutions Drawing Package for Estate Major Access Works (EMAW) Bulk Earthworks - Precincts 01 & 02 & Tweed Coast Road Intersection & Estate Major Access Works No. 12301-EMAW (enclosed). We note that design of these works has been undertaken based on CRG's traffic analysis.

We note that the Entry Road requirements of a Fauna Friendly crossing has been achieved with the additional of slow down points, signage and a fauna crossing consisting of a 1.8 x 2.4m culvert with openings for light. (Refer Mortons – Urban Solutions Dwg 12301-EWER-090).

5.5.2 Rural Retail Development East of Tweed Coast Road

The alignment, cross sections and geometry of the proposed access to the rural retail development is shown on Mortons - Urban Solutions Drawing Package Bulk Earthworks-Precincts 01 & 02 & Tweed Coast Road Intersection & Estate Major Access Works No 12301-EMAW (enclosed). We note that design of these works has been undertaken based on CRG's traffic analysis.

5.5.3 Kings Forest Parkway & Connection to Precincts 12, 13 & 14

The alignment, cross sections and geometry of the proposed Kings Forest Parkway is detailed on Mortons - Urban Solutions Drawing Package Bulk Earthworks - Precincts 01 & 02 & Tweed Coast Road Intersection & Estate Major Access Works No 12301-EMAW (enclosed). We note that design of these works has been undertaken based on CRG's Traffic Analysis.

We note that the design of Kings Forest Parkway has ensured that the alignment of the road through the site is continuous and enforces its priority route status as a major collector/distributor road

Crossing of the Sepp 14 areas and the main drain have minimised disturbance to these areas. A bridge or bebo arch structure is envisaged at the eastern crossing which shall not restrict water flow or fish passage. The crossing of the Sepp 14 area to the west



into Precincts 13,14 &15 will consist of a series of box culverts or similar (as modelled) in order to allow the flood waters to pass without upstream afflux issues. These culverts will also allow for safe fish passage as required by the DGR's. Final detailed design of both crossing will be submitted during the Construction Certificate phase of the development.

5.5.4 Road Service Alignments

Servicing of the development will consist of standard infrastructure including gravity sewer, potable water reticulation, stormwater reticulation, electrical and telecommunications. Where possible, Tweed Shire Standard layout configurations in relation to offset from boundaries will be adopted. Environmentally sensitive areas including the Sepp 14 may require consultation for revised servicing layouts should reduced verges be required to avoid contact with sensitive vegetation. Should deviations in servicing corridors be required Consultation with Tweed Shire Council will be sought.

5.6 Water Reticulation

Water reticulation for the whole of the development will be constructed in accordance with the Tweed Shire Council Guidelines.

For Precinct 5, the existing 450mm diameter water main is to be extended along Tweed Coast Road to The Entry of the site. This main will service the initial Precincts of the development. The ultimate water network will have the 450mm diameter connected via the Entry and to the existing 600mm trunk main further to the west so that a loop can be formed. Details of the preliminary layout for water reticulation is shown in Mortons - Urban Solutions Drawings - Bulk Earthworks - Precincts 03, 04 & 05 Preliminary - Precinct 05 (Dwg 12301- 05).

The detailed water network for the Kings Forest Development by MWH -Tweed Shire Council is provided in **Appendix A** contained within the Mortons - Urban Solutions Water and Sewer Servicing report dated February 2011.

5.7 Sewer Reticulation and Pump Stations

Sewer reticulation for the proposed Kings Forest Development is to be constructed using a conventional gravity system augmented with sewer pump and lift stations to overcome the relative flatness of the site. Vacuum and pressure systems were discussed with Tweed Shire Council; however, Officers expressed concern over these systems



based on previous experience in the area. Council advised that only conventional gravity systems would be accepted.

The requirement of the construction of a Regional Pump Station is necessary during the preliminary Stages of Construction of the Kings Forest Development. This pump station is to be located just south of the Rural Retail Site on the east side of Tweed Coast Road. This will be connected to the existing 225mm diameter rising main that will ultimately discharge to the Kingscliff Treatment Plant.

Mortons - Urban Solutions have undertaken a sewer servicing report and is attached in **Appendix A** (Water and Sewer Servicing Report dated February 2011).

5.8 Stormwater Quality Management

Design of the stormwater drainage shall be generally in accordance with Tweed Shire Council's Development Guidelines. Traditional stormwater drainage is proposed for the site, consisting of concrete pipes with gully pits to capture the road runoff. The stormwater is to be directed to bio-retention treatment areas to treat the prescribed quantity to ensure that post development runoff meets the guidelines as set in Gilbert + Sutherlands Site Based Management Plan.

The design of the proposed swales and treatment devices along with the corresponding outlets is configured to ensure that the 'first flush' of stormwater does not directly enter the Sepp 14 areas but is treated and then discharged to the main east-west drain. Thus, maintaining pre- development conditions within the Sepp 14 areas.

To demonstrate the extent of stormwater swale located within the buffer adjacent Precinct 5, we attach Mortons - Urban Solutions Drawings 123-SK027(A), 028(A) and 029(A) refer **Appendix C**. These plans show typical cross-sections along the swale east of Precinct 5 and the extent of stormwater infiltration swale within the outer 20m and inner 30m of the buffer. The plans show that the extent of works within the inner 30m is to accommodate the infiltration trench only, and does not incorporate any "hard" infrastructure or development pads.

The swale performs a number of functions including the treatment of stormwater runoff from the proposed development in Precinct 5, along with aiding in the protection of the native wetland to the east by maintaining the existing hydrological regime.

The constructed swale is an infiltration trench with no "hard" infrastructure (pipes and headwalls) located in the inner 30m with side slopes not exceeding 1V:4H. Following completion of earthworks the inner 30m would be fully rehabilitated with enhancement planting and



commencement of the regeneration of vegetation in areas untouched by earthwork would occur.

Preliminary engineering details of swale locations, sizes and quantity are shown on Mortons - Urban Solutions Drawings Bulk Earthworks - Precincts 03, 04 & 05 Preliminary - Precinct 05 (No. 12301-05) and Estate Major Access Works (No. 12301-EMAW).

5.9 Hydraulic Analysis / Stormwater Quantity

Gilbert + Sutherland have undertaken analysis of the proposed development with regards to Stormwater conveyance.

Gilbert + Sutherland's assessment has shown the majority of the proposed development is above current flooding influence and future climate change affected flooding. Design of earthworks is in accordance with Gilbert + Sutherland Flooding and Flood Management Assessment dated December 2010.

6.0 CONSTRUCTION MANAGEMENT PLAN

Item 8 of the DGR's (Appendix 2) requests that a Construction Management Plan be prepared to address the following issues:

- A plan which outlines traffic and pedestrian management during construction and management of impacts on amenity of adjoining properties and appropriate mitigation measures including noise, dust and sediment and erosion controls.

Mortons - Urban Solutions have prepared a Construction Management Plan.

7.0 CONCLUSIONS

Based on preliminary reporting from the associated consultants, Mortons - Urban Solutions Bulk Earthwork design drawings, the water network analysis, the sewer network analysis, and the preliminary civil engineering design drawings, we conclude the subject site is able to be developed in accordance with relevant Planning Scheme requirements and Codes and the appropriate solutions can be implemented to allow the development to proceed.

Appendix A

Water & Sewerage Servicing Report

Dated February 2011

Prepared by Mortons – Urban Solutions



MORTONS
urban**solutions**

Kings Forest

Sewer & Water Report

Address: KINGSCLIFF, NEW SOUTH WALES

Local Government: TWEED SHIRE COUNCIL

Prepared for: STOCKLAND DEVELOPMENT PTY LTD

Prepared by: MORTONS—URBAN SOLUTIONS
Level 2, 19 Short Street
(PO Box 2484)
Southport Qld 4215

T: (07) 5571 1099
F: (07) 5571 1088
E: mortons@urbansolutions.net.au

Date: February 2011





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Appendix B	Kings Forest Sewer Design Flows
Appendix C	MWH's Tweed Shire Council – Water Network Modelling, Kings Forest Water Supply Network Analysis, dated 27 March 2009



2.0 INTRODUCTION

2.1 Background

Mortons Urban Solutions has been engaged by Leda Developments Pty Ltd to undertake a sewerage and water infrastructure strategy report for the 'Kings Forest' development in Cudgen, New South Wales. The local government authority for this proposed development is the Tweed Shire Council.

The purpose of this report is to provide Tweed Shire Council a sewer and water infrastructure strategy to base future development approvals on.

2.2 Scope

This report covers the following civil engineering elements associated with the proposed development:

- Develop a sewerage reticulation strategy;
- Develop a potable water supply strategy;
- Prepare a septicity management plan.

2.3 Site Location

The 'Kings Forest' development is located on the northern coast of New South Wales, within the Tweed Shire Council. The site is approximately 4km south of Kingscliff and 5km north of Cabarita. The site is bound by Old Bogangar Road to the east and Durunbah Road to the west. The site extends to the west from Old Bogangar Road to Duranbah Road. The subject property in total is 882.4ha.



3.0 SEWERAGE RETICULATION STRATEGY

3.1 Existing Sewerage System

The current sewerage system consists of a 225mm diameter rising main which runs from Pump Station 4025 along Old Bogangar Road and Chinderah Road to Pump Station 4008. From Pump Station 4008 the flow is diverted into Council's existing 150mm diameter rising main which runs to the Kingscliff treatment plant. A standpipe has been installed at the high point near the intersection of Old Bogangar Road and Cudgen Road to reduce the flow rate in the pipe system under normal flow conditions, and prevent motor overload. Under wet weather conditions, the system has the capacity to pressurise (depending on the duration of the PWWF) over its entire length, and operates as a rising main. Under dry weather conditions, the system operates as a pumped rising main to the standpipe, and then as a gravity flow system to the treatment plant.

The overall capacity of the present system is primarily governed by the 150mm diameter rising main downstream of Pump Station 4008. With the development of the Salt site, it is proposed that a new rising main be constructed to replace the rising main downstream of Pump Station 4008 and to supplement the portion of rising main upstream of Pump Station 4008. Upon completion of this new main, both the existing 150mm diameter rising main and Pump Station 4008 will be disconnected from the Casuarina system, and will run standalone. It is noted that this returns this pump station and rising main to the same operational status as they had prior to the construction of the Casuarina main.

3.2 Design Flows

The sewer design flows to be applied will be in accordance with WSA 02-2002 guidelines and the population for each precinct has been taken from Leda's figures provided. From WSA 02-2002 guidelines the design flow is calculated as:

$$\text{Design Flow} = \text{PDWF} + \text{GWF} + \text{IIF}$$

PDWF = Peak dry weather flow

GWI = Groundwater (non-rainfall dependant) infiltration

IIF = Peak (rainfall dependant) inflow & infiltration

The design parameters used in generating these sewer flows are shown in table 3.1.

**Table 3.1 – Sewer Flow Design Parameters**

Design Parameters	
Description	Value
EP/ET	3.2
Portion _{wet}	0.15
Portion Impervious	0.9
Soil Aspect, S _{aspect}	0.3
Network defects and inflow aspect, N _{aspect}	0.4
Rainfall Intensity, I _{1,2}	52

Table 3.2 – Development Precinct Data

Precinct	Development	ET	Gross Area (ha)	EP
Prec 1	Commercial	-	1.5	112.5
Prec 2	Commercial	-	1.9	142.5
Prec 3	School	-	8.3	150
Prec 4	Residential	280	8.3	896
Prec 4	Commercial	-	8.1	607.5
Prec 5	Residential	442	30.8	1414.4
Prec 6	Residential	275	14	880
Prec 7	Residential	590	43	1888
Prec 8	Residential	592	43.4	1894.4
Prec 9	Residential	492	37.6	1574.4
Prec 10	Residential	422	28.9	1350.4
Prec 10	Commercial	-	1	75
Prec 11	Residential	820	66.9	2624
Prec 12	Residential	417	33.4	1334.4
Prec 12	Commercial	-	0.3	22.5
Prec 13	Residential	173	13.9	553.6
Prec 14	Golf Course	-	68.5	685
Prec 14	Golf Club	-	0.5	125

A copy of the sewer design flows has been included on Mortons Urban Solutions engineering drawing 123-01-SK530 which has been included in Appendix A and a table of the sewer design flows has been attached as Appendix B.

3.3 Sewerage Reticulation Strategy

The proposed sewerage reticulation strategy for the 'Kings Forest' development has been designed to take in to consideration the levels of the land, the proposed precinct populations and the proposed construction program. A copy of Mortons Urban Solutions engineering drawing 123-01-SK530 has been included within Appendix A and shows the proposed sewer main sizes and pump station locations within the proposed development.



The sewerage reticulation strategy for the 'Kings Forest' development has been broken up in to 3 stages based on the current proposed construction program. A summary of each of the sewerage reticulation strategy stages is provided below along with a summary of the proposed Regional Pump Station 01.

3.3.1 Regional Pump Station 01

Sewerage from the Kings Forest development will be pumped to the proposed Regional Pump Station 01 which will be constructed by Leda Developments. Regional Pump Station 01 will be constructed on the east side of Tweed Coast Road and will pump via the existing 225mm rising main in Old Bogangar Road to the transfer station at Chinderah and then on to Kinscliff Sewerage Treatment Plant. We understand the 225mm rising main has capacity for the first stage of Kings Forest, however, further information will be required by Tweed Shire Council to confirm at the time of construction.

3.3.2 Stage 1

The first stage of the sewerage reticulation strategy will be for Precincts 1 & 5. Works required for Stage 1 are as detailed below:

- The construction of Pump Stations 02;
- The construction of a temporary 150mm dia rising main from Pump Station 02 to Regional Pump Station 01.

Precinct 1 will have a gravity sewer constructed directly to regional sewer pump station 01 and it is proposed that Pump Station 02 will ultimately service Precincts 2, 3, 4, 5, 12 & 13. As the first stage of construction is assumed to be Precincts 1 & 5 only, there will be septicity problems if the ultimate 375mm dia rising main is constructed from Pump Station 02 to Regional Pump Station 01 as part of the initial works. To avoid the septicity issues we propose to construct a temporary 150mm dia rising main from Pump Station 02 to Regional Pump Station 01 which will be utilised until capacity is reached. Once capacity of the 150mm dia rising main has been reached, a 305mm dia rising main will be required for the ultimate sewer network.

3.3.3 Stage 2

The second stage of the sewerage reticulation strategy will be for the addition of Precincts 2, 3, 4, 12, 13 & 14 to the Stage 1 sewerage reticulation strategy. Works required for Stage 2 are as detailed below:

- The construction of Lift Station 01;
- The construction of Pump Stations 03, 04 & 05;
- The construction of a 225mm dia gravity main from Lift Station 01 to Pump Station 05;
- The construction of a 150mm dia rising main discharging in to a 300mm dia gravity main from Pump Station 05 to Pump Station 04;



- The construction of a 225mm dia rising main discharging in to a 450mm dia gravity main from Pump Station 04 to Pump Station 02;
- The construction of a 150mm rising main discharging in to a 225mm dia gravity main from Pump Station 03 to Pump Station 02;
- The construction of a 300mm dia rising main from Pump Station 02 to Regional Pump Station 01;
- The decommissioning of the 150mm dia rising main from Pump Station 02 to Regional Pump Station 01;
- The upgrade of Pump Station 02.

It is anticipated that Lift Station 01 and Pump Station 05 will service Precinct 12, Pump Station 04 will service Precincts 13 & 14 and Pump Station 03 will service Precincts 2, 3 & 4. It is proposed that Lift Station 01 will service the western section of Precinct 12, and Pump Station 05 will service the entire Precinct 12. The western section sewer of Precinct 12 will be graded to Lift Station 01 and gravity sewered to Pump Station 05 via a 225mm dia gravity main. Precinct 12 will be pumped from Pump Station 05 to Pump Station 04 via the construction of a 150mm dia rising main discharging in to a 300mm dia gravity main. Sewer reticulation for Precincts 13 & 14 will grade to Pump Station 04 and will be pumped to Pump Station 02 via a 225mm dia rising main discharging in to a 450mm dia gravity main. Precincts 2, 3 and the northern half of Precinct 4 will be gravitated to Pump Station 03 and pumped to Pump Station 02 via a 150mm dia rising main discharging in to a 225mm dia gravity main.

With Precincts 2, 3, 4, 12 & 13 now being pumped to Pump Station 02, Pump Station 02 will need an upgrade to cater for the increase in flow. With the upgrade of Pump Station 03, a 375mm dia rising main will be constructed from Pump Station 02 to Regional Pump Station 01 and the existing 150mm dia rising main connecting Pump Stations 02 and Regional Pump Station 01 will be decommissioned.

3.3.4 Stage 3

The third stage of the sewerage reticulation strategy will be for the addition of Precincts 6, 7, 8, 9, 10 & 11 to the Stage 2 sewerage reticulation strategy. Works required for Stage 3 are as detailed below:

- The construction of Pump Stations 06, 07, 08, 09 & 10;
- The construction of a 225mm dia rising main discharging in to a 375mm dia gravity main from Pump Station 10 to Pump Station 09;
- The construction of a 225mm dia rising main discharging in to a 450mm gravity main from Pump Station 09 to Pump Station 06;
- The construction of a 150mm dia rising main discharging in to a 300mm dia gravity main from Pump Station 08 to Pump Station 07;
- The construction of a 300mm dia rising main discharging in to a 450mm dia gravity main from Pump Station 07 to Pump Station 06;
- The construction of an interim 150mm dia rising main discharging in to the existing gravity main within Precinct 4;



- The construction of a 375mm dia rising main from Pump Station 06 to Pump Station 01.

It is proposed that Pump Station 06 will ultimately service Precincts 6, 7, 8, 9 & 10 whilst Pump Station 09 will service Precinct 10, Pump Station 10 will service Precinct 11, Pump Station 07 will service Precinct 8 and Pump Station 08 will service Precinct 9. Precinct 7 will be the first Precinct of Stage 3 to be constructed and will require the construction of PS06. The sewer reticulation for Precinct 6 will be graded to PS06 and pumped to Regional PS01. As PS06 will also be catering for Precincts 7, 8, 9 & 10 and the construction of these precincts may be some time after the initial construction of PS06, there will be septicity problems if the ultimate 375mm dia rising main is constructed from Pump Station 06 to Regional Pump Station 01 as part of the initial works. To avoid the septicity issues we propose to construct a temporary 150mm dia rising main from Pump Station 06 to Precinct 4 which will be utilised until capacity is reached. Once capacity of the 150mm dia rising main has been reached, a 375mm dia rising main will be required for the ultimate sewer network.

The sewer associated with Precinct 8 will be graded to Pump Station 07 then pumped to Pump Station 06 via a 300mm dia rising main discharging in to a 450mm dia gravity main. Sewer within Precinct 9 will be graded to Pump Station 08 and will then be pumped to Pump Station 07 via a 150mm dia rising main discharging in to a 300mm dia gravity main. Sewerage reticulation for Precinct 10 will be graded to Pump Station 09 which will then pump to Pump Station 06 via a 225mm dia rising main discharging in to a 525mm dia gravity main. The Precinct 6 sewer will be serviced by the 525mm dia gravity main connecting PS 09 to PS 06. Sewer reticulation for Precinct 11 will grade to Pump Station 10 and will be pumped to Pump Station 09 via a 225mm dia rising main discharging in to a 375mm dia gravity main.

3.4 *Septicity management*

Septicity issues are a concern for the Kings Forest development by virtue of long lengths of rising main within the development and minor sewerage flows in the early stages of the development.

Initial development stages of Kings Forest will have small volumes of sewerage resulting in long detention times in the rising mains with consequent septicity issues.

Mortons Urban Solutions proposed the installation of a bore water pump adjacent to each of the pump stations within the development. The bore water will help ensure there is sufficient flow within the rising mains to avoid septicity within the rising mains.



4.0 POTABLE WATER SUPPLY STRATEGY

A potable water supply strategy for the Kings Forest development has been completed by MWH. A copy of MWH's Tweed Shire Council – Water Network Modelling, Kings Forest Water Supply Network Analysis, dated 27 March 2009, has been included in Appendix C.

Appendix A

Mortons Urban Solutions Engineering Drawing
123-01-SK530, Kings Forest Sewer Schematic
Plan, dated 4 January 2010



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MAXIMUM RISING MAIN		MINIMUM GRAVITY
PIPE CAPACITIES (V=2.5M/S)		PIPE CAPACITIES
Ø100	- 19.6 l/s	Ø150 - 9.6 l/s @ 1 in 180
Ø150	- 44.2 l/s	Ø225 - 22.0 l/s @ 1 in 300
Ø225	- 99.4 l/s	Ø300 - 41.0 l/s @ 1 in 400
Ø300	- 176.7 l/s	Ø375 - 61.7 l/s @ 1 in 580
Ø375	- 276.1 l/s	Ø450 - 90.7 l/s @ 1 in 710
Ø450	- 541.2 l/s	Ø525 - 126.5 l/s @ 1 in 830
Ø525	- 164.5 l/s @ 1 in 1000	
Ø600	- 164.5 l/s @ 1 in 1000	

CALCULATIONS

DESIGN FLOW = PDWF + GWF + IIF
PDWF = d x ADWF
d = 0.01 (log A)^{0.75} - 0.19 (log A)³ + 1.4 (log A)² - 4.66 log A + 7.57
A = gross area of the development's catchment, in hectares.

75 EP/ha for local commercial
3.2 EP/lot for residential
0.25 EP/occupant for clubs
0.2 EP/student for educational institutions.

GWF = 0.025 x A x Portion_{wei}

Portion_{wei} = Portion of planned pipe network estimated to have ground water table levels in excess of pipe inverts.

IIF = 0.028 x A_{EP} x C x I

A_{EP} (Residential) = A x (Density/150) as for Density < 150EP/ha
A_{EP} (Residential) = A for Density > 150 EP/ha
A_{EP} (Commercial) = A x (1 - 0.75) Portion_{upper wsa}

C = S_{Aspect} + N_{Aspect}
S_{Aspect} & N_{Aspect} are determined from Table B1 of WSA 02-2002-2.3

I = I_{1,2} x Factor_{use} x Factor_{containment}

I_{1,2} is determined from Table B2 of WSA 02-2002-2.3

Factor_{use} = (40/A) x 2

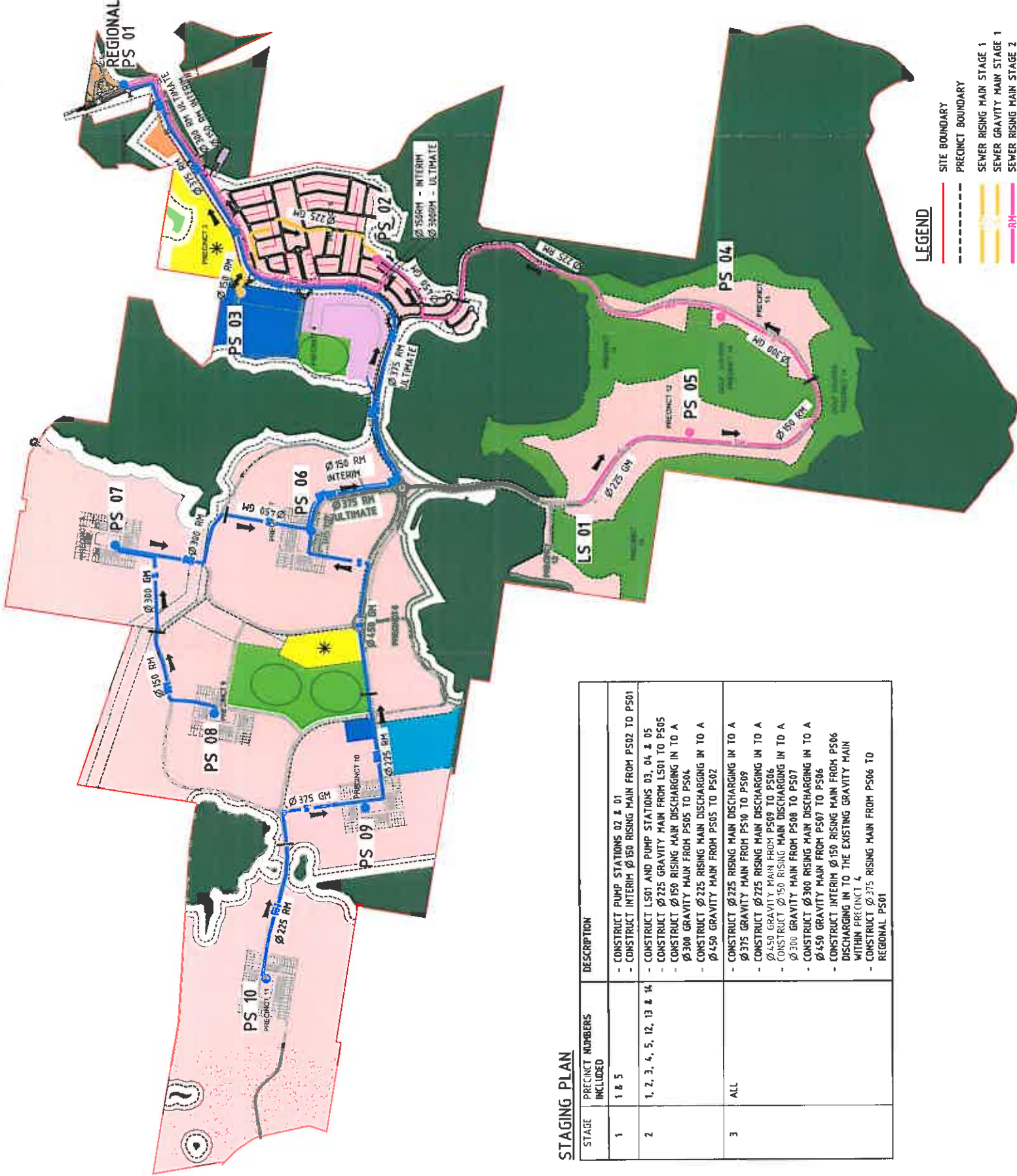
Factor_{containment} = 0.77 x 10^{4.25}

X = log₁₀ (ARI)

ARI is the specified containment frequency in years.

CATCHMENT TABLE

Stage	Precinct Number	Description	Lot#	Grass Area (ha)	EP	ADWF	d Precipitation	Focal	PDWF	Portion Wet (0.0-1.0)	Is the area Contaminated? (Y/N)	Perilous Imperviousness (0.0-1.0)	Soil Aspect (0.0-1.0)	Soil Aspect Deficiency (0.2-0.8)	Lection	Size Factor	Adj	Containment Factor	I	IF	Design Flow	Pump Station	
1	Prec 1	Commercial		1.5	102.5	0.236		6.792	1.605	0.1	0.004	Y	0.180	0.3	0.4	0.7	Gold Coast	52	185.667	1.095	2.716	PS01	
1	Prec 5	Residential	442	30.8	1616.4	2.970		3.558	0.380	0.1	0.077	N	0.142	0.3	0.4	0.7	Gold Coast	52	80.495	24.841	34.348	PS02	
2	Prec 2	Commercial		1.9	142.5	0.299		6.376	1.908	0.1	0.005	Y	0.180	0.3	0.4	0.7	Gold Coast	52	102.432	1.361	3.273	PS03	
2	Prec 3	School		8.3	150.0	0.395		4.329	1.344	0.1	0.021	Y	0.180	0.3	0.4	0.7	Gold Coast	52	1208	10	8.128	9.813	PS03
2	Prec 4	Residential	280	8.3	896.0	1.882		4.329	0.146	0.1	0.021	N	0.180	0.3	0.4	0.7	Gold Coast	52	94.200	13.000	21.867	PS02	
2	Prec 4	Commercial		8.1	697.5	1.276		4.356	5.558	0.1	0.020	Y	0.180	0.3	0.4	0.7	Gold Coast	52	94.476	4.875	10.452	PS03	
2	Prec 12	Residential	417	33.4	1334.4	2.882		3.402	6.691	0.1	0.004	N	0.180	0.3	0.4	0.7	Gold Coast	52	79.704	24.579	35.704	PS05	
2	Prec 13	Residential	773	13.9	553.6	1.183		3.806	4.425	0.1	0.035	N	0.180	0.3	0.4	0.7	Gold Coast	52	113.95	10	10.768	12.431	PS05
2	Prec 14	Golf Course		48.5	685.8	1.639		2.472	3.843	0.1	0.177	N	0.180	0.3	0.4	0.7	Gold Coast	52	113.95	10	10.768	12.431	PS05
2	Prec 15	Golf Club		0.5	125.0	0.243		9.905	2.390	0.1	0.001	Y	0.180	0.3	0.4	0.7	Gold Coast	52	88.548	12.431	16.898	16.898	PS04
3	Prec 6	Residential	775	14.9	880.8	1.848		3.799	7.021	0.1	0.035	N	0.180	0.3	0.4	0.7	Gold Coast	52	73.024	25.349	29.363	PS04	
3	Prec 7	Residential	519	43.0	1888.0	3.945		2.937	11.643	0.1	0.001	N	0.180	0.3	0.4	0.7	Gold Coast	52	13.967	0.428	2.602	PS04	
3	Prec 8	Residential	592	43.4	1894.6	3.918		2.937	11.660	0.1	0.001	N	0.180	0.3	0.4	0.7	Gold Coast	52	88.472	16.715	22.771	PS06	
3	Prec 9	Residential	492	37.6	1571.4	2.386		3.022	9.962	0.1	0.091	N	0.180	0.3	0.4	0.7	Gold Coast	52	77.324	35.259	47.018	PS06	
3	Prec 10	Residential	422	28.9	1258.4	2.836		3.203	9.084	0.1	0.072	N	0.180	0.3	0.4	0.7	Gold Coast	52	77.324	35.259	47.018	PS06	
3	Prec 11	Commercial		1.0	75.0	0.958		2.570	1.192	0.1	0.003	Y	0.180	0.3	0.4	0.7	Gold Coast	52	11.802	26.401	34.797	PS09	
3	Prec 11	Residential	829	66.9	2624.0	5.510		2.686	14.789	0.1	0.167	N	0.180	0.3	0.4	0.7	Gold Coast	52	73.332	43.010	64.120	PS10	



STAGING PLAN

STAGE	PRECINCT NUMBERS INCLUDED	DESCRIPTION
1	1 & 5	- CONSTRUCT PUMP STATIONS 02 & 01 - CONSTRUCT INTERIM Ø150 RISING MAIN FROM PS02 TO PS01
2	1, 2, 3, 4, 5, 12, 13 & 14	- CONSTRUCT LS01 AND PUMP STATIONS 03, 04 & 05 - CONSTRUCT Ø225 GRAVITY MAIN FROM LS01 TO PS05 - CONSTRUCT Ø150 RISING MAIN DISCHARGING IN TO A - Ø300 GRAVITY MAIN FROM PS05 TO PS04 - CONSTRUCT Ø225 RISING MAIN DISCHARGING IN TO A - Ø450 GRAVITY MAIN FROM PS05 TO PS02
3	ALL	- CONSTRUCT Ø225 RISING MAIN DISCHARGING IN TO A - Ø375 GRAVITY MAIN FROM PS10 TO PS09 - CONSTRUCT Ø225 RISING MAIN DISCHARGING IN TO A - Ø450 GRAVITY MAIN FROM PS09 TO PS06 - CONSTRUCT Ø150 RISING MAIN DISCHARGING IN TO A - Ø300 GRAVITY MAIN FROM PS08 TO PS07 - CONSTRUCT Ø300 RISING MAIN DISCHARGING IN TO A - Ø450 GRAVITY MAIN FROM PS07 TO PS06 - CONSTRUCT INTERIM Ø150 RISING MAIN FROM PS06 DISCHARGING IN TO THE EXISTING GRAVITY MAIN WITHIN PRECINCT 4 - CONSTRUCT Ø375 RISING MAIN FROM PS06 TO REGIONAL PS01

LEGEND

- SITE BOUNDARY
- PRECINCT BOUNDARY
- SEWER RISING MAIN STAGE 1
- SEWER RISING MAIN STAGE 2
- SEWER RISING MAIN STAGE 3
- SEWER GRAVITY MAIN STAGE 1
- SEWER GRAVITY MAIN STAGE 2
- SEWER GRAVITY MAIN STAGE 3
- TOWN CENTRE / NEIGHBOURHOOD CENTRE
- RESIDENTIAL SMALL LOT INTEGRATED / ATTACHED
- COMMUNITY FACILITIES / EDUCATION
- EMPLOYMENT LAND
- RETIREMENT LIVING
- STRUCTURED OPEN SPACE
- Passive open space to council standards, location subject to urban design.
- ENVIRONMENTAL PROTECTION AREA
- TO BE DEDICATED TO COUNCIL & NPWS.
- STATE SCHOOL SITE
- PROPOSED ZONE SUBSTATION
- (Subject to County Energy (no) approval)
- PRIVATE OPEN SPACE
- GOLF COURSE AREA
- Interconnecting ecological buffers where indicated
- PRIVATE OPEN SPACE

PROJECT NAME
KINGS FOREST

CONCEPT PLANNING

CLIENT
**PROJECT 28
PTY LTD**



Scale 1:10000 - A1 (120000 - A3)

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CONSTRUCTION	

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Appendix B

Kings Forest Sewer Design Flows
Prepared by Mortons-Urban Solutions
dated 21 February 2011



MORTONS
urban**solutions**

KINGS FOREST SEWER DESIGN FLOWS

Stage	Predict Number	Description	Lots	Gross Area (ha)	EP	ADWF	α (Peakling Factor)	PDWF	Portion Wet (0.0 - 1.0)	GWI	Is the area Commercial? (Y/N)	Portion Impervious (0.0 - 1.0)	A (m ² ha)	Sol Aspect (0.2 - 0.8)	Network Deficiency Aspect (0.2 - 0.8)	C (0.4 - 1.8)	Location	(L2)	Size Factor	AR	Containment Factor	I	IIF	Design Flow	Pump Station
1	Prec 1	Commercial		1.5	112.5	0.238	6.762	1.605	0.1	0.004		0.8	0.488	0.3	0.4	0.7	Gold Coast	52	1.483	10 years	1.5	115.697	1.105	2.714	PS01
1	Prec 5	Residential	442	30.8	1414.4	2.970	3.158	8.380	0.1	0.077	N		17.042	0.3	0.4	0.7	Gold Coast	52	1.052	10 years	1.5	86.465	28.884	36.340	PS02
2	Prec 2	Commercial		1.9	142.5	0.269	6.378	1.908	0.1	0.005	Y	0.9	0.818	0.3	0.4	0.7	Gold Coast	52	1.441	10 years	1.5	112.432	1.381	3.273	PS03
2	Prec 3	School		8.3	150	0.315	4.329	1.364	0.1	0.021	Y	0.8	4.595	0.3	0.4	0.7	Gold Coast	52	1.208	10 years	1.5	84.200	8.428	9.613	PS03
2	Prec 4	Residential	280		899	1.892	4.329	8.148	0.1	0.021	N		7.041	0.3	0.4	0.7	Gold Coast	52	1.208	10 years	1.5	84.200	13.000	21.187	PS02
2	Prec 4	Commercial		8.1	607.5	1.278	4.356	5.559	0.1	0.020	Y	0.9	2.633	0.3	0.4	0.7	Gold Coast	52	1.211	10 years	1.5	84.478	4.875	10.452	PS03
2	Prec 12	Residential	417	33.4	1334.4	2.802	3.102	8.991	0.1	0.084	N		17.237	0.3	0.4	0.7	Gold Coast	52	1.022	10 years	1.5	78.709	28.929	35.704	PS05
2	Prec 12	Commercial		0.3	22.5	0.047	19.417	0.492	0.1	0.001	Y	0.9	0.098	0.3	0.4	0.7	Gold Coast	52	1.789	10 years	1.5	140.310	0.268	0.781	PS05
2	Prec 13	Residential	173	13.9	553.8	1.163	3.809	4.425	0.1	0.035	N		7.182	0.3	0.4	0.7	Gold Coast	52	1.135	10 years	1.5	86.549	12.431	16.890	PS04
2	Prec 14	Golf Course		68.5	685	1.439	2.872	3.843	0.1	0.171	N		17.587	0.3	0.4	0.7	Gold Coast	52	0.937	10 years	1.5	73.124	25.349	29.383	PS04
3	Prec 6	Residential	275	0.5	125	0.263	8.105	2.380	0.1	0.001	Y	0.9	0.183	0.3	0.4	0.7	Gold Coast	52	1.892	10 years	1.5	131.897	0.420	2.812	PS04
3	Prec 7	Residential	590	14	880	1.848	3.789	7.021	0.1	0.035	N		9.063	0.3	0.4	0.7	Gold Coast	52	1.134	10 years	1.5	88.472	15.715	22.771	PS08
3	Prec 8	Residential	592	43	1880	3.045	2.937	11.643	0.1	0.108	N		23.264	0.3	0.4	0.7	Gold Coast	52	0.981	10 years	1.5	77.328	35.259	47.010	PS08
3	Prec 8	Residential	492	37.8	1894.4	3.878	2.931	11.690	0.1	0.109	N		23.412	0.3	0.4	0.7	Gold Coast	52	0.980	10 years	1.5	77.240	39.443	47.212	PS07
3	Prec 8	Residential		28.9	1350.4	3.308	3.022	9.992	0.1	0.094	N		19.868	0.3	0.4	0.7	Gold Coast	52	1.007	10 years	1.5	78.581	30.897	40.664	PS08
3	Prec 10	Residential	422		1350.4	2.838	3.203	9.084	0.1	0.072	N		16.130	0.3	0.4	0.7	Gold Coast	52	1.040	10 years	1.5	81.102	25.640	34.787	PS09
3	Prec 10	Commercial		1	75	0.158	7.570	1.182	0.1	0.003	Y	0.9	0.325	0.3	0.4	0.7	Gold Coast	52	1.557	10 years	1.5	121.434	0.774	1.898	PS09
3	Prec 11	Residential	820	68.8	2624	5.510	2.684	14.788	0.1	0.187	N		34.210	0.3	0.4	0.7	Gold Coast	52	0.840	10 years	1.5	73.332	48.770	64.128	PS10

Appendix C

Tweed Shire Council – Water Network Modelling,
Kings Forest Water Supply Network Analysis
dated 27 March 2009
Prepared by MWH



MORTONS
urban**solutions**



A BETTER WORLD



TWEED SHIRE COUNCIL - WATER NETWORK MODELLING

KINGS FOREST WATER SUPPLY NETWORK ANALYSIS

A1190100

27 MARCH 2009



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REVISION SCHEDULE

REV. NO.	DATE	DESCRIPTION	PREPARED BY	REVIEWED BY	APPROVED BY
1.0	4/3/2009	Draft v1	Roger Crozier	Dan Johnson	
2.0	27/3/2009	Final	Roger Crozier	Dan Johnson	Mark Hunting



TWEED SHIRE COUNCIL - WATER NETWORK MODELLING

KINGS FOREST WATER SUPPLY NETWORK ANALYSIS

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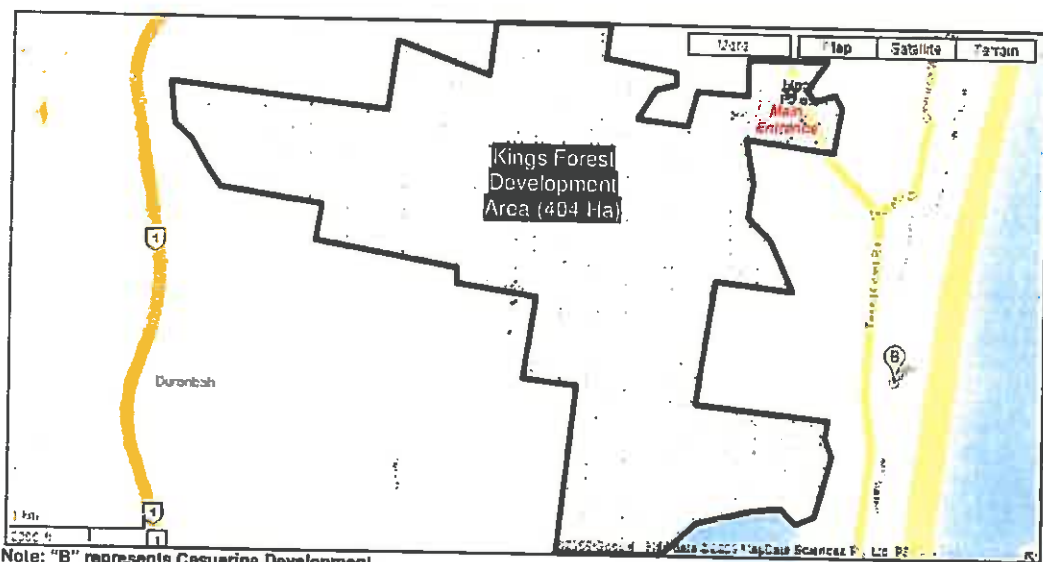
JUNCTION AND PIPE REPORTS



1. INTRODUCTION

Tweed Shire Council (TSC) commissioned MWH to undertake a Water Supply Network Analysis of the proposed Kings Forest Development in Tweed Shire.

The development has an ultimate planned population of 4,481 Equivalent Tenements (ET) and is located to the west of Casuarina on the Tweed Coast Road (see Figure 1-1). The main entrance to the development will be at the corner of Depot Road and Tweed Coast Road. It will extend as far as the Pacific Highway to the west and has a gross development area of 404 hectares (Ha).



Note: "B" represents Casuarina Development

Figure 1-1: Kings Forest Location

This report presents the results of the water supply network analysis for Kings Forest and subsequent impacts on the surrounding water network. The report includes:

- The Existing System Overview;
- The Standards of Service adopted;
- Kings Forest Development Demands;
- The Existing System Analysis;
- The Future Systems (Years 2021 and 2041) Analyses; And
- The proposed Kings Forest Water Reticulation Layout.



2. OVERVIEW

This section of the report includes an overview of the Kings Forest Concept Plan and associated Precinct populations as well as providing a description of the existing water supply system.

2.1 KINGS FOREST DEVELOPMENT

Concept Plan

The King Forest development consists of 5 release areas and within these areas there are 24 development precincts. Table 2-1 summarises the relationship between each release area and development precinct and their associated populations.

Table 2-1: Development Summary

RELEASE AREA	PRECINCT	LAND USE	AREA (HA)	POPULATION (DWELLINGS)
E	1	Business Park	1.1	22
E	2	Business Park	1.6	32
E	3	School	8.4	15
A	4	Residential	22.1	391
A	5	Residential	29.8	463
B	6	Residential	16.5	160
B	7	Residential	23.0	251
B	8	Residential/ Sporting/ School/ Neighbourhood Centre	43.7	743
B	9	Residential	25.0	286
B	10	Residential	24	221
B	11	Residential	14	106
B	12	Residential	26	288
C	17	Residential	3.5	101
C	18, 19, 20	Residential/ Neighbourhood Centre	37.3	743
C	22, 23, 24	Residential/ Golf Club	24.3	411
D	13	Residential	11	83
D	14	Residential	25.4	47
D	15	Residential	33.6	202
D	16	Residential	33.6	49
Total			404	4,614

The Release Area Plan and the Precinct Plan can be seen in Figure 2-1 and 2-2 respectively.



Figure 2-1: Kings Forest Release Area Plan



Figure 2-2: Kings Forest Precinct Plan



Development Growth Rate

TSC have adopted the Demand Management Strategy (DMS) Report written by MWH in 2008, on behalf of TSC. Table A1 from this report is summarised in Table 2-2, which provides the planned growth for Kings Forest. The following populations are in Equivalent Persons (EP).

Table 2-2: Kings Forest Growth from DMS (EP)

2011	2021	2031	2041
0	5,000	5,000	11,500

Leading on from the DMS report, TSC commissioned MWH to develop and update the TSC H₂OMap Water Supply Trunk (Conveyancing) Model. With consultation with TSC the following growth in Table 2-3 was adopted within the Water Supply Model.

Table 2-3: Kings Forest Growth in Water Supply Model (EP)

2011	2021	2031	2041
500	5,000	10,000	11,500

Based on populations provided to TSC from the developer an ultimate population of 11,533 has been calculated using an occupancy ratio of 2.5 persons per dwelling. The ultimate population compares very well to the DMS estimation.

Table 2-4 summarises the Precinct growth rate in EP and Dwellings, adopted for this analysis based on the previous water supply model growth rate in Table 2-3. The development growth assumes that Release A will reach capacity before Release B becomes available to buyers. Release E is assumed to fully developed by 2021. Because the majority of Kings Forest will be developed by 2031, Release C and D are assumed to be available to buyers simultaneously. By 2041 the development is at 100 percent capacity.

Table 2-4: Kings Forest Precinct Population

RELEASE AREA	PRECINCT	EP				DWELLING			
		2011	2021	2031	2041	2011	2021	2031	2041
A	4	229	976	976	976	92	391	391	391
A	5	271	1,158	1,158	1,158	108	463	463	463
B	6		210	400	400		84	160	160
B	7		329	628	628		132	251	251
B	8		974	1,856	1,856		389	743	743
B	9		375	715	715		150	286	286
B	10		290	553	553		116	221	221
B	11		139	265	265		56	106	106
B	12		378	720	720		151	288	288
C	17			158	253			63	101
C	18			439	703			176	281
C	19			361	578			144	231
C	20			361	578			144	231
C	22			88	140			35	56
C	23			300	480			120	192



RELEASE AREA	PRECINCT	EP				DWELLING			
		2011	2021	2031	2041	2011	2021	2031	2041
C	24			255	408			102	163
D	13			130	208			52	83
D	14			73	118			29	47
D	15			316	505			126	202
D	16			77	123			31	49
E	1		55	55	55		22	22	22
E	2		80	80	80		32	32	32
E	3		38	38	38		15	15	15
Total		500	5,000	10,000	11,533	200	2,000	4,000	4,613

Table 2-5 summarises the populations in EP and ET for the 5 Release Areas. Release Area B accommodates approximately 45 percent of the total development population.

Table 2-5: Release Area Population

RELEASE AREA	EP	ET
A	2,306	923
B	5,136	2,055
C	1,980	792
D	2,110	844
E	135	54
Total	11,533	4,613

2.2 EXISTING WATER SUPPLY SYSTEM

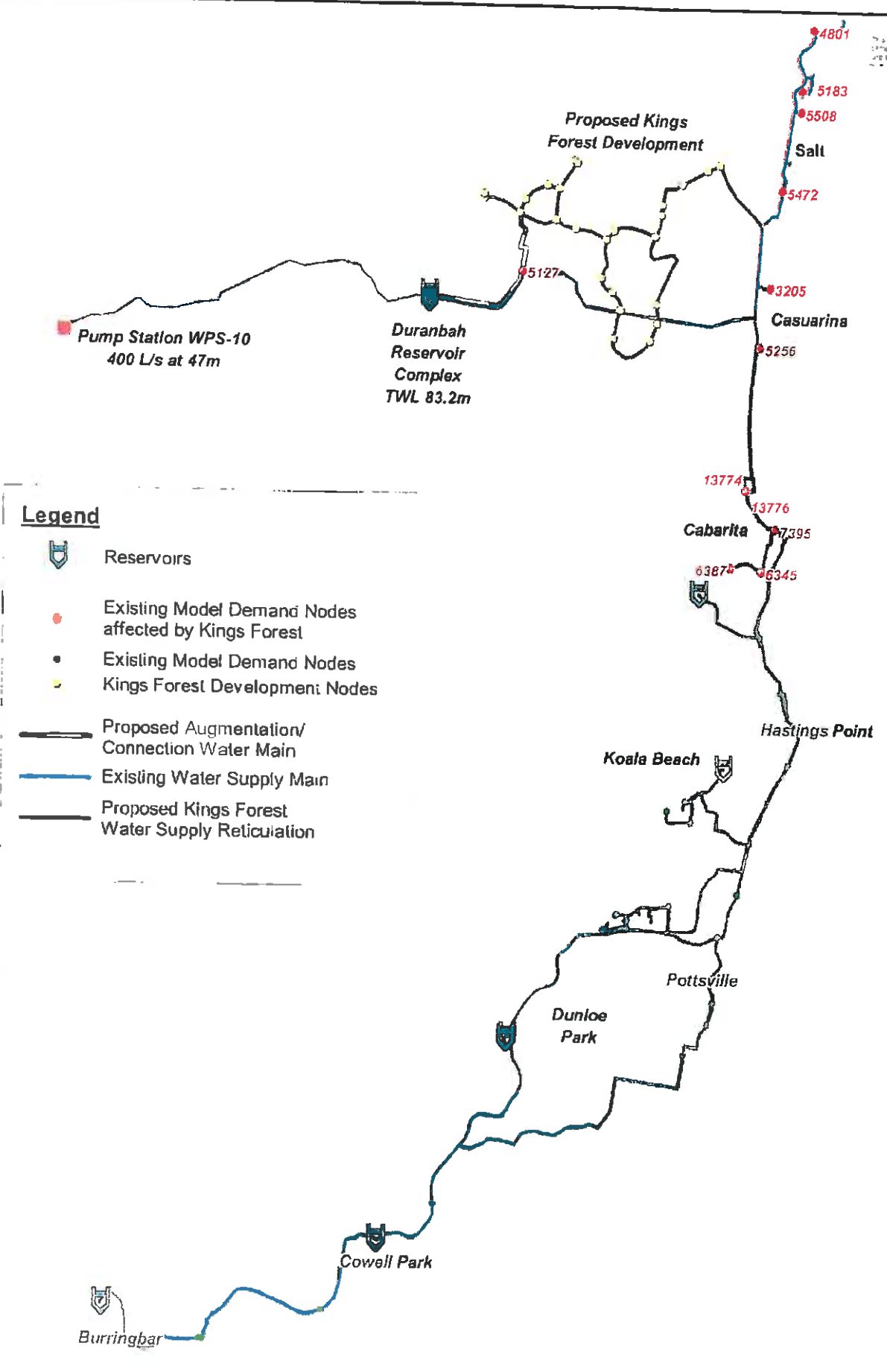
The Kings Forest development will be supplied by the Duranbah Reservoir complex located south west of the development. Currently there is a 5.0 ML and a 7.5 ML reservoir situated at the complex with allocation for a third 7.5 ML reservoir. The Top Water Level (TWL) is 83.2m AHD. The Duranbah Booster Pump Station (WPS-10) lifts water to the Duranbah Reservoir complex via a 600 mm diameter trunk main at an existing duty of 400 L/s at 47m head.

The Duranbah Reservoirs supply the south coast of the Tweed from the Salt Development in the north to Burringbar Township in the south. An existing 600mm diameter water main connects the Duranbah Reservoirs with a 450mm diameter water main that acts as the major coastal distribution main from Salt to Pottsville. Figure 2-3 shows the location of Kings Forest in relation to the South Tweed Water supply system.

Kings Forest, as it develops will hydraulically affect the surrounding areas of Salt, Casuarina and Cabarita. The network pressures of Hastings Point, Koala Beach, Pottsville, Cowell Park and Burringbar will not be affected by Kings Forest as they are controlled by their own localised reservoirs. Ultimately, the Round Mountain reservoir that serves Hastings Point may be de-commissioned with Hastings Point being served by the proposed high level Koala Beach reservoir.

This report presents the network results for the Kings Forest and existing model demand nodes that are immediately affected by the development. Figure 2-3 highlights the existing demand nodes and the ID annotations using the colour red.

THESE PLANS OR ANY PART THEREOF
 SHALL BE VALID ONLY WHEN USED IN
 CONJUNCTION WITH THE PROJECT
 AND THE DESIGN SPECIFICATIONS



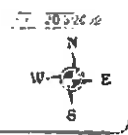
Legend

-  Reservoirs
-  Existing Model Demand Nodes affected by Kings Forest
-  Existing Model Demand Nodes
-  Kings Forest Development Nodes
-  Proposed Augmentation/ Connection Water Main
-  Existing Water Supply Main
-  Proposed Kings Forest Water Supply Reticulation



AS/D
 1:75000

Figure 2.3
 South Tweed
 Water Supply
 Overview Map





3. STANDARDS OF SERVICE

The water supply analysis was mainly based on the TSC Development Design Specification D11 for Water Supply version 1.2. Reductions to the standards of service included applying a Peak Hour (PH) demand of 0.075 L/s/ET instead of Peak Instantaneous demand (PID) of 0.1 L/s/ET. Other criterion was taken from the Water Supply Code of Australia Part 1: Planning and Design (WSA 03). Table 3-1 summarises the criteria used.

Table 3-1: Standards of Service

CLAUSE	DESCRIPTION	CRITERIA
D11.05 – 1.	Minimum Pressure	20 m at Peak Hour
Revision of D11.05 – 2.	Peak Hour (PH)	0.075 L/s/ ET
D11.05 – 4.	Maximum Pressure	780 kPa ($\approx$ 80 m)
D11.05 – 5.	Fire Fighting	11.8 m Residual Pressure at 11 L/s for residential, 15 L/s for commercial/ industrial buildings and 22 L/s for shopping complexes
D11.05 – 6.	Maximum Pipe Velocity	2.0 m/s (normal demand, excl. fire flow)
WSA 03 - 3.2.5.2	Maximum Pipe Head Losses	5 m/km for $\leq$ 150 mm 2 m/km for $\geq$ 200 mm This network analysis assumed a 5 m/km limit for all pipe sizes for PH
Revision of D11.05 – 7.	Trunk Mains	Designed for PH
D11.31 – 2.	Reservoir Sizing and Operations	One Day of Ultimate Peak Day Supply plus Emergency Storage (4 hours of Fire Demand at 22L/s), reservoir level > 20%
Revision of D11.23 – 9.	Pump Station Sizing	Transfer Peak Daily Flow in 22 hours. Peak Daily unit demand is 700 L/EP/day



4. WATER SUPPLY DEMANDS

Kings Forest and the surrounding water supply network were assigned PH in L/s at each demand node. Table 4-1 summarises the PH for each demand node. The location of the external demand nodes can be seen on Figure 2-3 and the location of the Kings Forest demand nodes are shown on Figure 6-1.

Table 4-1: PH Demand

DEMAND NODE ID	LOCALITY	PH (L/S)				
		2008	2011	2021	2031	2041
4801	Lot 490	0	7	14	14	14
5183	Salt	67	90	101	102	102
5508	Seaside City	0	14	55	55	55
5472	Casuarina North	29	38	42	42	43
3205	Casuarina Central	28	43	54	55	55
5127	Duranbah	1	1	1	1	1
5256	Casuarina South	9	14	18	18	19
13774	Tanglewood	4	4	33	33	33
13776	Cabarita	37	40	48	56	64
7395	Cabarita	24	25	30	36	41
6387	Cabarita	16	13	16	18	21
6345	Cabarita	16	17	21	24	28
KF_001	Kings Forest Precinct 1			1.3	1.3	1.3
KF_002	Kings Forest Precinct 2			1.9	1.9	1.9
KF_003	Kings Forest Precinct 3			4	4	4
KF_004	Kings Forest Precinct 4		9	44	44	44
KF_005	Kings Forest Precinct 5		8	36	36	36
KF_006	Kings Forest Precinct 6			7	12	12
KF_007	Kings Forest Precinct 7			10	19	19
KF_008	Kings Forest Precinct 8			34	61	61
KF_009	Kings Forest Precinct 9			12	22	22
KF_010	Kings Forest Precinct 10			9	17	17
KF_011	Kings Forest Precinct 11			4	8	8
KF_012	Kings Forest Precinct 12			12	22	22
KF_013	Kings Forest Precinct 13				5	8
KF_014	Kings Forest Precinct 14				14	22
KF_015	Kings Forest Precinct 15				11	18
KF_016	Kings Forest Precinct 16				11	18
KF_017	Kings Forest Precinct 17				3	4
KF_018	Kings Forest Precinct 18				10	15
KF_019	Kings Forest Precinct 19				8	13
KF_020	Kings Forest Precinct 20				5	7
KF_022	Kings Forest Precinct 22				3	4
KF_023	Kings Forest Precinct 23				10	16
KF_024	Kings Forest Precinct 24				3	4
Kings Forest PH			17	175	331	377
Total PH		232	324	608	788	856



Kings Forest contributes an ultimate PH demand of 380 L/s to the system directly supplied from the Duranbah Reservoirs and has the potential to significantly impact on the local network hydraulics.



5. NETWORK ANALYSIS

5.1 METHODOLOGY

The network analysis was performed using the TSC H₂OMap Water Supply Conveyancing Model. The Kings Forest development water reticulation network was created in the model using a spatially referenced Precinct Plan (refer Figure 2-2). The model was set-up with the following scenarios and applied to the 2011, 2021 and 2041 planning horizons:

1. PH demand without Kings Forest plus Fire Flow – steady state simulation in L/s;
2. PH demand with Kings Forest plus Fire Flow – steady state simulation in L/s;
3. Maximum Day (MD) demand without Kings Forest – 3 day simulation in EP; and
4. Maximum Day (MD) demand with Kings Forest – 3 day simulation in EP.

Scenarios 1 and 2 aided to size the trunk and water reticulation network of Kings Forest and to check the impact of the development on the surrounding network. Scenarios 1 and 2 were based on the Mid Water Level (MWL) of the Duranbah Reservoirs and with the pump station WPS-13 downstream of the reservoir in operation. This represents a worst case situation for Kings Forest and the surrounding network pressures.

Scenarios 3 and 4 were to look at the operation of the Duranbah Reservoirs over three Maximum Days and again check the impact the development has on the existing network.

This analysis also looks into the timing and sizing of a required trunk main augmentation from the Duranbah Reservoirs connecting into the trunk system of the Kings Forest Development (refer Figure 6-1). This augmentation will supplement the capacity of the existing 600mm diameter trunk main that connects to the existing 450mm diameter trunk main that is the major distribution main to the South Coast of the Tweed.

5.2 BULK INFRASTRUCTURE ASSESSMENT

5.2.1 RESERVOIR ASSESSMENT

An assessment of the Duranbah Reservoir complex was undertaken to work out the timing and capacity of the complex with the additional Kings Forest demand and future growth in the South Tweed Coast region. The existing combined storage capacity of Duranbah is 12.5 ML.

It is a requirement that the reservoir storage capacity hold one day of peak day demand plus an additional 4 hours of fire flow demand at 22 L/s. The storage was calculated using a MD unit demand of 700 L/EP/day. Table 5-1 summarises the storage necessary to supply the localised water supply zone area and the additional Kings Forest development up to ultimate.

Table 5-1: Reservoir Storage Volume

	2011	2021	2031	2041
Population (EP)	11,563	20,131	25,979	37,314
Operating Volume (ML)	8.1	14.1	17.8	23.1
Emergency Storage (ML)	0.32	0.32	0.32	0.32
Total Res Volume (ML)	8.4	14.4	18.1	23.4



The additional storage volume required to serve Kings Forest at ultimate is 8.0 ML. The total ultimate storage necessary to supply the localised zone area and Kings Forest is 23.4 ML which also includes an additional 4,300 EP from the Kings Forest West development area. This will require an additional two storages to be constructed to supplement the existing 12.5 ML storage capacity. Based on growth rates assumed and linear interpolation, the first 7.5 ML storage will be required at 2018 and the second 5.0 ML will be required between the 2031 and 2041 planning horizons.

The suggested sizing and timing of the additional reservoirs are only indicative and a cost analysis should be undertaken to find the optimal size. That is, constructing one 12.5 ML reservoir or building two reservoirs in a staged approach.

5.2.2 PUMP STATION ASSESSMENT

An assessment of the Duranbah Booster Pump Station (WPS-10) capacity was completed. The previous TSC Master Planning report (GHD, 1999) flagged a WPS-10 to be upgraded in 2031 with a duty of 525 L/s at 56 m head. It is a requirement that the pump station capacity be able to provide 22 hours peak daily flow.

Table 5-2 summarises the peak daily flow required with the additional Kings Forest development.

Table 5-2: WPS-10 Peak Daily Flow

	2011	2021	2031	2041
Peak Daily Flow in 22 hours (L/s)	167	317	394	486

The peak daily flow has been calculated using a peak daily unit demand of 700 L/EP/day over 22 hours in a day. The assessment found WPS-10 requires upgrading between 2031 and 2041 and will have an ultimate design duty of 550 L/s at 74m head.

The future peak daily flow of WPS-10 is calculated on the total reservoir capacity of the South Tweed Coast of 43.0 ML. The velocity in the 600 mm diameter trunk main is operating at 1.95 m/s, which is within standards of service limits, however this option should be re-visited by TSC in the future to find out the optimal solution to the upgrade based on the pumping head and trunk main sizing.

The ultimate pump duty head of 74m is high so it may be beneficial to lower the pump head to reduce operating costs and greenhouse gas emissions by augmenting the 600 mm diameter trunk main.

5.3 EXISTING SYSTEM ANALYSIS (2011)

The 2011 Planning Horizon was considered as the Existing System as Kings Forest will start development around the Year 2011. Two scenarios have been considered in the 2011 analysis:

- Current System
- Current System with Kings Forest

5.3.1 RESERVOIR OPERATION

The Duranbah reservoir operation under three consecutive MD demand conditions was assessed with and without the proposed Kings Forest Development.



Figure 5-1 shows that Kings Forest does not significantly impact on the 2011 reservoir operation. The blue line represents the reservoir level with the additional Kings Forest demand. WPS-10 was controlled to operate between 8.00PM to 6.30AM during the night and 2.30PM to 5.00PM in the afternoon.

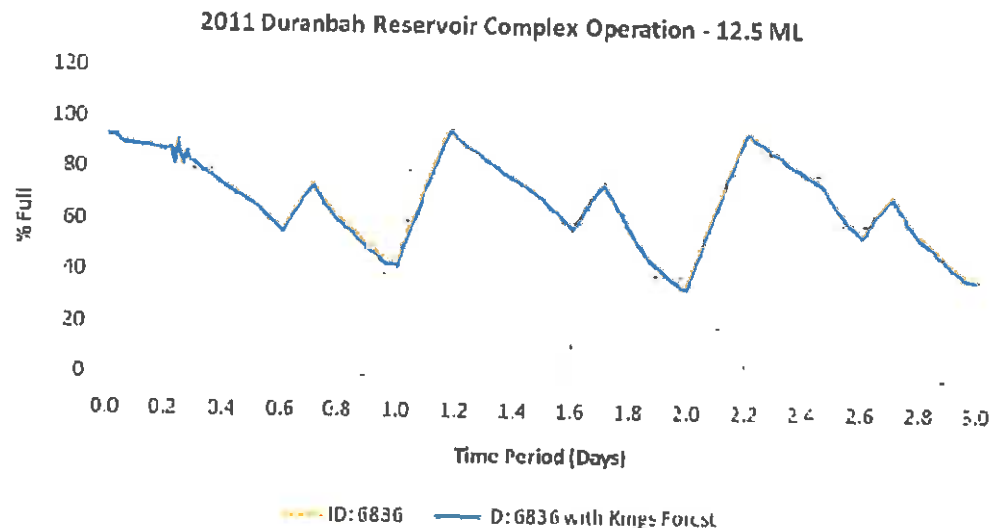


Figure 5-1: 2011 Duranbah Reservoir Operation

5.3.2 HYDRAULIC PERFORMANCE

The 2011 network was assessed for PH. Network pressures were obtained using the demand nodes from the TSC H₂OMap Conveyancing Model.

Table A1 and A2 in Appendix A provides a full junction report under 2011 PH and fire flow conditions. The location of the external demand nodes can be seen on Figure 2-3 and the location of the Kings Forest demand nodes are shown on Figure 6-1.

Node 6345 is the critical node and is well above the minimum pressure requirement before Kings Forest is developed. Kings Forest reduces the PH localised by a maximum 2m pressure and the fire flow residual pressure by a maximum of 3m. This is not a significant impact.

Table 5-3 details the critical node under PH and fire flow before and after the addition of the Kings Forest development.

Table 5-3: Critical Nodes – 2011 PH and Fire Flow

SCENARIO	NODE ID	PH DEMAND (L/S)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)
i. 2011 PH and Fire Flow	6345	17	34	11	33
ii. 2011 PH and Fire Flow with Kings Forest Development	6345	17	34	11	32



A pipe report of the 2011 Kings Forest water mains is available in Table A3, Appendix A.

5.4 INTERMEDIATE SYSTEM ANALYSIS (2021)

The 2021 Planning Horizon is an intermediate horizon to assess the timing of the trunk augmentation/ connection main from Duranbah Reservoir Complex to the Kings Forest Development. Three scenarios have been considered in the 2021 analysis:

- 2021 System without trunk augmentation/ connection mains;
- 2021 System with Kings Forest, **without** trunk augmentation/ connection mains; and
- 2021 System with Kings Forest, **with** trunk augmentation/ connection main and additional Duranbah 7.5 ML reservoir.

5.4.1 RESERVOIR OPERATION

The Duranbah reservoir operation under three consecutive MD demand conditions was assessed with and without the proposed Kings Forest Development and the required 7.5 ML storage. Figure 5-2 shows that Kings Forest does not significantly impact on the 2021 reservoir operation, however with the existing 12.5 ML storage capacity for both cases falls below the minimum 20% level requirement at the third MD.

WPS-10 was controlled to operate between 8.00PM to 6.30AM during the night and 9.00AM to 5.00PM in the daytime. With the additional 7.5 ML reservoir the minimum level increases to 40% which satisfies the minimum level requirement over 3 maximum days. The light blue line represents the reservoir level with the additional Kings Forest demand and the new 7.5 ML reservoir.

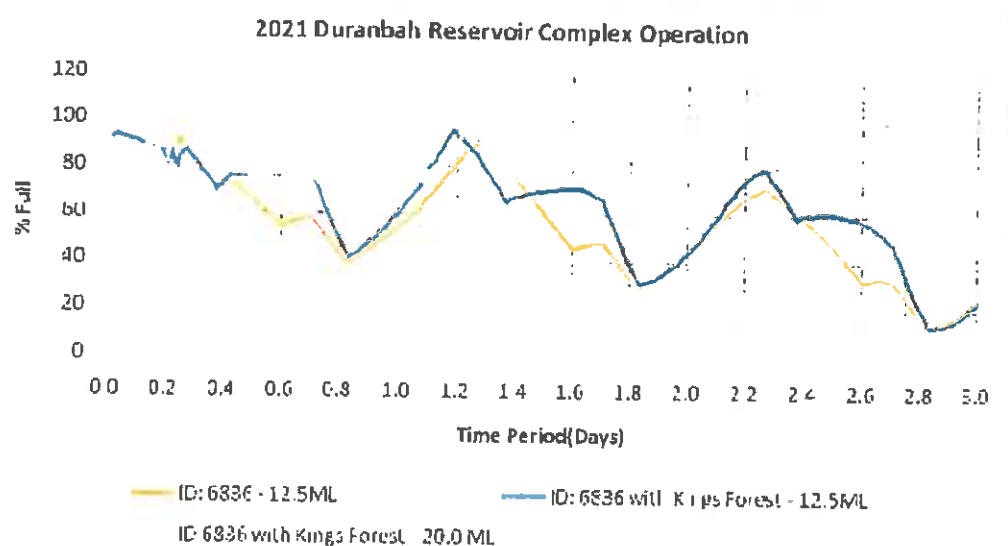


Figure 5-2: 2021 Duranbah Reservoir Operation



5.4.2 HYDRAULIC PERFORMANCE

The 2021 network was assessed for PH. Network pressures were obtained using the demand nodes from the TSC H₂OMap Conveyancing Model. Tables A4, A5 and A6 in Appendix A provide a full junction report under 2021 PH and fire flow conditions for each scenario. The location of the external demand nodes can be seen on Figure 2-3 and the location of the Kings Forest demand nodes are shown on Figure 6-1.

Table 5-4 details the nodes that do not meet the minimum pressure requirements under PH and fire flow.

Table 5-4: Critical Nodes – 2021 PH and Fire Flow

SCENARIO	NODE ID	PH DEMAND (L/S)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)
i. 2021 PH and Fire Flow, without trunk augmentation/connection mains					
ii. 2021 PH and Fire Flow with Kings Forest Development, without trunk augmentation/connection mains	4801	14	12.9	11	10.3
	5183	101	6.1	22	0.0
	5508	55	10.3	11	7.8
	5472	42	10.9	15	7.1
	KF_001	1	11.6	22	7.2
	KF_002	2	11.0	22	6.5
	KF_003	4	9.8	15	6.6
	KF_004	44	8.5	11	5.9
	KF_005	36	8.3	11	5.7
	KF_006	7	12.2	11	9.4
	KF_007	10	7.5	11	4.7
	KF_008	34	7.2	15	3.2
	KF_009	12	10.7	11	6.9
	KF_010	9	5.5	11	1.2
	KF_011	4	5.4	11	1.1
	KF_012	12	-30.4	11	-34.4
	KF_014	0	7.2	11	4.3
iii. 2021 PH and Fire Flow with Kings Forest Development, with trunk augmentation/connection mains					



Table 5-4 clearly shows that the Kings Forest significantly impacts on the hydraulic network without the trunk augmentation/ connection main from Duranbah Reservoir to the Kings Forest development. The local network falls under PH and fire flow conditions. The trunk augmentation/ connection main is required when precinct 6 commences construction. This equates to a population of approximately 2,300 persons or 920 dwellings. With the trunk augmentation/ connection main it significantly improves the system under PH and fire flow conditions.

The trunk augmentation/ connection main has been sized for ultimate PH and the sizing can be seen on Figure 6-1. The pipe reports of the 2021 Kings Forest water mains with and without the trunk augmentation/ connection main are available in Table A7 and A8 of Appendix A.

5.5 ULTIMATE SYSTEM ANALYSIS (2041)

The 2041 Planning Horizon is the ultimate horizon. Two scenarios have been considered in the 2041 analysis:

- 2041 System with second additional 5.0 ML Duranbah reservoir and upgraded pump station (WPS-10); and
- 2041 System with second additional 5.0 ML reservoir, upgraded pump station (WPS-10) and Kings Forest.

5.5.1 RESERVOIR OPERATION

The Duranbah reservoir operation under three consecutive MD demand conditions was assessed with and without the proposed Kings Forest Development. The ultimate 25.0 ML storage capacity along with the pump station upgrade to WPS-10 was included for both ultimate scenarios. WPS-10 was controlled to operate between 8.00PM to 6.30AM during the night and 9.00AM to 5.00PM in the daytime.

Figure 5-3 shows that Kings Forest impacts on the 2041 reservoir operation, however is still above the 20% minimum level criteria. The blue line represents the reservoir level with the additional Kings Forest demand.

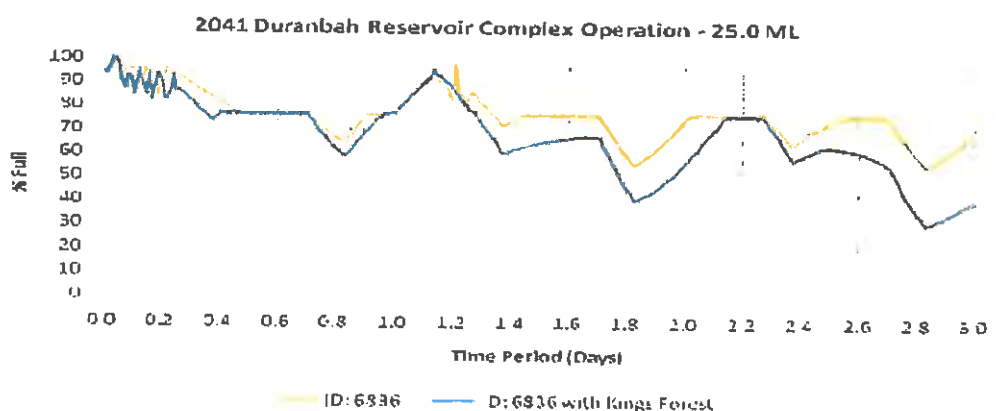


Figure 5-3: 2041 Duranbah Reservoir Operation



5.5.2 HYDRAULIC PERFORMANCE

The 2041 network was assessed for PH. Network pressures were obtained using the demand nodes from the TSC H₂OMap Water Conveyancing Model. Tables A9 and A10 in Appendix A provide a full junction report for 2041 PH and fire flow conditions for each scenario. The location of the external demand nodes can be seen on Figure 2-3 and the location of the Kings Forest demand nodes are shown on Figure 6-1.

Table 5-5 details the critical nodes under PH and fire flow before and after the addition of the Kings Forest development.

Table 5-5: Critical Nodes – 2041 PH and Fire Flow

SCENARIO	NODE ID	PH DEMAND (L/S)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)
i. 2041 PH and Fire Flow	6345	28	33.4	11	32.0
	6387	21	34.1	11	30.6
ii. 2041 PH and Fire Flow with Kings Forest Development	KF_012	22	23.2	11	22.0

The Kings Forest development reduces PH and fire flow residual pressure in the localised zone by a maximum of 8m, however all pressures will exceed the minimum pressure requirement of 20m. This includes junction KF_012 in the Kings Forest Development which is at a maximum elevation of 45m.



6. WATER RETICULATION LAYOUT

The Kings Forest water reticulation has been sized based on ultimate PH and fire flow conditions. The proposed layout can be seen on Figure 6-1. The proposed sizing and timing of the water infrastructure is detailed in Table 6-1.

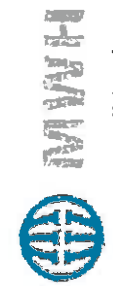
Table 6-1: Kings Forest Water Reticulation

PIPE ID	LENGTH (M)	DIAMETER (MM)	PLANNING HORIZON	PIPE ID	LENGTH (M)	DIAMETER (MM)	PLANNING HORIZON
KFM_001	1023	450	2011	KFM_015	95	250	2021
KFM_002	198	450	2011	KFM_016	177	250	2021
KFM_003	424	450	2011	KFM_017	390	250	2031
KFM_004	502	450	2011	KFM_018	199	250	2031
KFM_005	139	450	2011	KFM_019	568	250	2031
KFM_006	334	450	2021	KFM_020	75	250	2031
KFM_007	641	450	2021	KFM_021	570	250	2031
KFM_008	170	450	2021	KFM_022	285	250	2031
KFM_009	480	525	2021	KFM_023	295	250	2031
KFM_010	320	525	2021	KFM_024	421	200	2031
KFM_011	568	600	2021	KFM_025	806	150	2031
KFM_012*	955	600	2021	KFM_026	273	150	2031
P-793*	1644	600	2021	KFM_027	275	200	2031
KFM_013	447	250	2021	KFM_028	1437	200	2031
KFM_014	449	250	2021				

* Augmentation/ Connection Main from Durambah Reservoirs to Kings Forest Development

The proposed planning horizon timing of the Kings Forest water reticulation is only indicative and the actual timings will be determined by the growth realised in the development.

Figure 6-2 is an additional figure that shows the proposed sizing of Kings Forest using Peak Instantaneous Demand (PID) criteria of 0.1 L/s/ET. The reduction in design demand criteria to 0.075 L/s/ET has allowed pipe KFM_012 to be downsized to a 600mm diameter main and pipes KFM_025 and KFM_026 to become 150 mm in diameter (refer Figure 6-1).



**Figure 6-1
Kings Forest Water Supply
Reticulation Layout
PH Demands**





7. SUMMARY

A water supply network analysis has been undertaken on the proposed Kings Forest development. The outcomes of the analysis are summarised below:

- A 7.5 ML Reservoir is required at Durambah Reservoir Complex at 2018 to supplement the Kings Forest and growth within the localised South Tweed Coast;
- An additional 5.0 ML Reservoir is required at Durambah Reservoir Complex between 2031 and 2041 to supplement the Kings Forest and growth within the localised South Tweed Coast;
- Pump Station WPS-10 will require upgrading to 555 L/s at 74 m head between 2031 and 2041 when the additional 5.0 ML Reservoir is built;
- Kings Forest does not significantly impact on the current (2011) water supply system;
- The proposed augmentation/ connection main from Durambah Reservoirs to Kings Forest Development is required when Kings Forest development reaches a population of 2,300 persons or 920 dwellings. The proposed sizing is available in Table 6-1 and proposed route is shown on Figure 6-1;
- Kings Forest significantly impacts on the 2021 water supply system. With the addition of the augmentation/ connection main the hydraulic performance improves significantly;
- Kings Forest does not impact significantly on the 2041 water supply system;
- The proposed water reticulation layout for Kings Forest is shown on Figure 6-1 and detailed in Table 6-1; And
- Appendix A provides all junction and pipe reports for the analysis undertaken.



APPENDIX A

JUNCTION AND PIPE REPORTS





Table A1 – 2011 Junction Report

ID	PH DEMAND (L/S)	ELEVATION (M)	PH HEAD (M)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)	COMMENTS
4801	7	5	56	51	11	49	Satisfactory
5183	90	10	54	44	22	40	Satisfactory
5508	14	8	56	48	11	47	Satisfactory
5472	38	10	57	47	11	45	Satisfactory
3205	43	6	59	54	15	52	Satisfactory
5127	1	4	74	70	11	70	Satisfactory
5256	14	9	60	51	11	50	Satisfactory
13774	4	3	47	45	11	43	Satisfactory
13776	40	3	47	45	11	43	Satisfactory
7395	25	6	43	37	11	36	Satisfactory
6387	13	5	41	36	11	33	Satisfactory
6345	17	7	41	34	11	33	Satisfactory

Table A2 – 2011 Junction Report with Kings Forest Development

ID	PH DEMAND (L/S)	ELEVATION (M)	PH HEAD (M)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)	COMMENTS
4801	7	5	53	49	11	47	Satisfactory
5183	90	10	52	42	22	38	Satisfactory
5508	14	8	54	46	11	44	Satisfactory
5472	38	10	54	45	15	42	Satisfactory
3205	43	6	58	52	15	50	Satisfactory
5127	1	4	74	70	11	70	Satisfactory
5256	14	9	58	49	11	48	Satisfactory
13774	4	3	47	44	11	42	Satisfactory
13776	40	3	47	44	11	43	Satisfactory
7395	25	6	43	37	11	35	Satisfactory
6387	13	5	40	36	11	33	Satisfactory
6345	17	7	41	34	11	32	Satisfactory
KF_004	9	9	56	47	11	46	Satisfactory
KF_005	8	9	56	47	11	46	Satisfactory



Table A3 – 2011 Kings Forest Pipe Report

ID	LENGTH (M)	DIAMETER (MM)	ROUGHNESS (C)	FLOW (L/S)	PH VELOCITY (M/S)	MAX PH HL/KM	MAX MD HL/KM
KFM_001	1023	450	120	21.4	0.14	0.1	0.01
KFM_002	198	450	120	21.4	0.14	0.1	0.01
KFM_003	424	450	120	21.4	0.14	0.1	0.01
KFM_004	502	450	120	17.4	0.11	0.0	0.01
KFM_005	139	450	120	8.4	0.05	0.0	0.00

Table A4 – 2021 Junction Report

ID	PH DEMAND (L/S)	ELEVATION (M)	PH HEAD (M)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)	COMMENTS
4801	14	5	42.6	37.8	11	35.7	Satisfactory
5183	101	10	40.7	31.0	22	25.9	Satisfactory
5508	55	8	43.0	35.3	11	33.2	Satisfactory
5472	42	10	45.8	35.9	11	33.6	Satisfactory
3205	54	6	50.8	45.1	15	42.9	Satisfactory
5127	1	4	72.3	68.5	11	68.2	Satisfactory
5256	18	9	52.4	43.5	11	42.5	Satisfactory
13774	33	3	34.3	31.6	11	28.2	Satisfactory
13776	48	3	36.5	34.0	11	32.2	Satisfactory
7395	30	6	34.4	28.4	11	26.5	Satisfactory
6387	16	5	32.2	27.5	11	23.2	Satisfactory
6345	21	7	33.2	26.2	11	23.5	Satisfactory



Table A5 – 2021 Junction Report with Kings Forest Development, no Augmentation/
Connection Main

ID	PH DEMAND (L/S)	ELEVATION (M)	PH HEAD (M)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)	COMMENTS
4801	14	5	17.6	12.9	11	10.3	Unsatisfactory
5183	101	10	15.8	6.1	22	0.0	Unsatisfactory
5508	55	8	18.1	10.3	11	7.8	Unsatisfactory
5472	42	10	20.9	10.9	15	7.1	Unsatisfactory
3205	54	6	33.3	27.5	15	25.0	Satisfactory
5127	1	4	68.1	64.4	11	64.0	Satisfactory
5256	18	9	39.9	31.0	11	29.9	Satisfactory
13774	33	3	26.4	23.6	11	20.2	Satisfactory
13776	48	3	28.6	26.1	11	24.2	Satisfactory
7395	30	6	28.1	22.1	11	20.0	Satisfactory
6387	16	5	26.4	21.7	11	17.3	Satisfactory
6345	21	7	27.4	20.4	11	17.6	Satisfactory
KF_001	1	9	20.6	11.6	22	7.2	Unsatisfactory
KF_002	2	9	20.0	11.0	22	6.5	Unsatisfactory
KF_003	4	9	18.8	9.8	15	6.6	Unsatisfactory
KF_004	44	9	17.5	8.5	11	5.9	Unsatisfactory
KF_005	36	9	17.3	8.3	11	5.7	Unsatisfactory
KF_006	7	4	16.2	12.2	11	9.4	Unsatisfactory
KF_007	10	9	16.5	7.5	11	4.7	Unsatisfactory
KF_008	34	9	16.2	7.2	15	3.2	Unsatisfactory
KF_009	12	4	14.7	10.7	11	6.9	Unsatisfactory
KF_010	9	9	14.5	5.5	11	1.2	Unsatisfactory
KF_011	4	9	14.4	5.4	11	1.1	Unsatisfactory
KF_012	12	45	14.6	-30.4	11	-34.4	Unsatisfactory
KF_014	0	9	16.2	7.2	11	4.3	Unsatisfactory



Table A6 – 2021 Junction Report with Kings Forest Development, with Augmentation/
Connection Main

ID	PH DEMAND (L/S)	ELEVATION (M)	PH HEAD (M)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)	COMMENTS
4801	14	5	56.4	51.6	11	50.2	Satisfactory
5183	101	10	54.6	44.8	22	41.2	Satisfactory
5508	55	8	56.8	49.1	11	47.8	Satisfactory
5472	42	10	59.6	49.7	15	47.5	Satisfactory
3205	54	6	61.7	55.9	15	54.3	Satisfactory
5127	1	4	75.7	71.9	11	71.8	Satisfactory
5256	18	9	60.8	51.8	11	51.1	Satisfactory
13774	33	3	39.4	36.6	11	33.3	Satisfactory
13776	48	3	41.6	39.1	11	37.3	Satisfactory
7395	30	6	37.8	31.8	11	29.9	Satisfactory
6387	16	5	35.1	30.5	11	26.3	Satisfactory
6345	21	7	36.1	29.1	11	26.6	Satisfactory
KF_001	1	9	64.0	55.0	22	53.6	Satisfactory
KF_002	2	9	64.3	55.3	22	53.9	Satisfactory
KF_003	4	9	65.0	56.0	15	55.1	Satisfactory
KF_004	44	9	65.8	56.8	11	56.2	Satisfactory
KF_005	36	9	66.2	57.2	11	56.6	Satisfactory
KF_006	7	4	72.0	68.0	11	67.7	Satisfactory
KF_007	10	9	70.2	61.2	11	60.8	Satisfactory
KF_008	34	9	72.7	63.7	15	63.3	Satisfactory
KF_009	12	4	71.2	67.2	11	66.0	Satisfactory
KF_010	9	9	71.0	62.0	11	60.3	Satisfactory
KF_011	4	9	71.0	62.0	11	60.3	Satisfactory
KF_012	12	45	71.2	26.2	11	24.8	Satisfactory
KF_014	0	9	73.8	64.8	11	64.6	Satisfactory



Table A7 – 2021 Kings Forest Pipe Report, no Augmentation/ Connection Main

ID	LENGTH (M)	DIAMETER (MM)	ROUGHNESS (C)	FLOW (L/S)	PH VELOCITY (M/S)	MAX PH HL/KM	MAX MD HL/KM
KFM_001	1023	450	120	174.4	1.1	2.9	0.5
KFM_002	198	450	120	173.1	1.1	2.9	0.5
KFM_003	424	450	120	171.2	1.1	2.8	0.5
KFM_004	502	450	120	167.2	1.1	2.7	0.5
KFM_005	139	450	120	123.2	0.8	1.5	0.3
KFM_006	334	450	120	87.3	0.5	0.8	0.2
KFM_007	641	450	120	87.3	0.5	0.8	0.2
KFM_008	170	450	120	77.1	0.5	0.6	0.1
KFM_009	480	525	120	77.1	0.4	0.3	0.1
KFM_010	320	525	120	70.6	0.3	0.3	0.0
KFM_011	568	600	120	0.0	0.0	0.0	0.0
KFM_013	447	250	110	36.6	0.7	3.3	0.7
KFM_014	449	250	110	13.3	0.3	0.5	0.1
KFM_015	95	250	110	4.3	0.1	0.1	0.0
KFM_016	177	250	110	11.7	0.2	0.4	0.1

Table A8 – 2021 Kings Forest Pipe Report, with Augmentation/ Connection Main

ID	LENGTH (M)	DIAMETER (MM)	ROUGHNESS (C)	FLOW (L/S)	PH VELOCITY (M/S)	MAX PH HL/KM	MAX MD HL/KM
KFM_001	1023	450	120	-123.6	0.8	1.5	0.9
KFM_002	198	450	120	-124.9	0.8	1.6	0.9
KFM_003	424	450	120	-126.8	0.8	1.6	1.0
KFM_004	502	450	120	-130.8	0.8	1.7	1.0
KFM_005	139	450	120	-174.8	1.1	2.9	1.2
KFM_006	334	450	120	-210.7	1.3	4.1	1.6
KFM_007	641	450	120	-210.7	1.3	4.1	1.6
KFM_008	170	450	120	-220.9	1.4	4.5	1.7
KFM_009	480	525	120	-220.9	1.0	2.1	0.8
KFM_010	320	525	120	-227.4	1.1	2.2	0.8
KFM_011	568	600	120	-298.0	1.1	1.9	0.6
KFM_013	447	250	110	36.6	0.7	3.3	0.7
KFM_014	449	250	110	13.3	0.3	0.5	0.1
KFM_015	95	250	110	4.3	0.1	0.1	0.0
KFM_016	177	250	110	11.7	0.2	0.4	0.1
KFM_001	1023	450	120	-123.6	0.8	1.5	0.9



Table A9 – 2041 Junction Report

ID	PH DEMAND (L/S)	ELEVATION (M)	PH HEAD (M)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)	COMMENTS
4801	14	5	59.3	54.5	11	53.2	Satisfactory
5183	102	10	57.4	47.7	22	44.3	Satisfactory
5508	55	8	59.8	52.0	11	50.8	Satisfactory
5472	43	10	62.6	52.7	11	51.2	Satisfactory
3205	55	6	64.1	58.3	15	56.8	Satisfactory
5127	1	4	77.8	74.0	11	73.9	Satisfactory
5256	19	9	61.5	52.5	11	51.8	Satisfactory
13774	33	3	39.1	36.3	11	33.4	Satisfactory
13776	65	3	41.3	38.8	11	37.4	Satisfactory
7395	41	6	40.9	34.9	11	33.5	Satisfactory
6387	21	5	38.7	34.1	11	30.6	Satisfactory
6345	28	7	40.4	33.4	11	31.9	Satisfactory



Table A10 – 2041 Junction Report with Kings Forest Development

ID	PH DEMAND (L/S)	ELEVATION (M)	PH HEAD (M)	PH PRESSURE (M)	FIRE FLOW DEMAND (L/S)	RESIDUAL PRESSURE (M)	COMMENTS
4801	14	5	51.0	46.2	11	45	Satisfactory
5183	102	10	49.1	39.4	22	36	Satisfactory
5508	55	8	51.4	43.7	11	42	Satisfactory
5472	43	10	54.3	44.3	15	42	Satisfactory
3205	55	6	56.7	50.9	15	49	Satisfactory
5127	1	4	73.5	69.7	11	70	Satisfactory
5256	19	9	55.5	46.5	11	46	Satisfactory
13774	33	3	35.7	32.9	11	30	Satisfactory
13776	65	3	37.9	35.4	11	34	Satisfactory
7395	41	6	37.8	31.8	11	30	Satisfactory
6387	21	5	36.2	31.5	11	28	Satisfactory
6345	28	7	37.9	30.9	11	29	Satisfactory
KF_001	1	9	58.2	49.2	22	48	Satisfactory
KF_002	2	9	58.5	49.5	22	48	Satisfactory
KF_003	4	9	59.0	50.0	15	49	Satisfactory
KF_004	44	9	59.6	50.6	11	50	Satisfactory
KF_005	36	9	60.0	51.0	11	50	Satisfactory
KF_006	12	4	66.1	62.1	11	62	Satisfactory
KF_007	19	9	63.7	54.7	11	54	Satisfactory
KF_008	61	9	67.2	58.2	15	58	Satisfactory
KF_009	22	4	66.2	62.2	11	61	Satisfactory
KF_010	17	9	65.4	56.4	11	55	Satisfactory
KF_011	8	9	65.4	56.4	11	55	Satisfactory
KF_012	22	45	66.3	21.3	11	20	Satisfactory
KF_013	8	4	67.9	63.9	11	63	Satisfactory
KF_014	22	9	68.9	59.9	11	60	Satisfactory
KF_015	18	45	67.1	22.1	11	21	Satisfactory
KF_016	18	35	67.1	32.1	11	30	Satisfactory
KF_017	4	10	61.4	51.4	11	50	Satisfactory
KF_018	15	9	60.1	51.1	11	49	Satisfactory
KF_019	13	9	59.5	50.5	11	48	Satisfactory
KF_020	7	9	58.7	49.7	11	46	Satisfactory
KF_022	4	9	57.4	48.4	15	42	Satisfactory
KF_023	16	9	56.5	47.5	11	42	Satisfactory
KF_024	4	9	57.7	48.7	11	45	Satisfactory



Table A11 – 2041 Kings Forest Pipe Report

ID	LENGTH (M)	DIAMETER (MM)	ROUGHNESS (C)	FLOW (L/S)	PH VELOCITY (M/S)	MAX PH HL/KM	MAX MD HL/KM
KFM_001	1023	450	120	-105.4	0.7	1.1	0.5
KFM_002	198	450	120	-106.7	0.7	1.2	1.6
KFM_003	424	450	120	-108.6	0.7	1.2	1.6
KFM_004	502	450	120	-112.6	0.7	1.3	1.7
KFM_005	139	450	120	-156.6	1.0	2.4	2.0
KFM_006	334	450	120	-192.5	1.2	3.5	2.4
KFM_007	641	450	120	-209.5	1.3	4.1	2.5
KFM_008	170	450	120	-228.9	1.4	4.8	2.7
KFM_009	480	525	120	-276.9	1.3	3.2	1.6
KFM_010	320	525	120	-289.3	1.3	3.5	1.7
KFM_011	568	600	120	-380.6	1.3	3.0	1.2
KFM_012	955	600	120	-485.9	1.7	4.8	0.9
KFM_013	447	250	110	30.0	0.6	2.3	0.4
KFM_014	449	250	110	25.4	0.5	1.7	0.3
KFM_015	95	250	110	8.2	0.2	0.2	0.0
KFM_016	177	250	110	-17.6	0.4	0.8	0.3

Appendix B

Bulk Earthworks Cut Fill Areas

Dwg No. 12301-05-040(A)

Prepared by Mortons – Urban Solutions

Bulk Earthworks Transfer Diagram

Dwg No. 12301-SK025(A)

Prepared by Mortons-Urban Solutions

Precinct 5 Sub-Staging Diagram

Dwg No. 12301-SK 026 A)

Prepared by Mortons-Urban Solutions



MORTONS
urbansolutions

PROJECT NAME
**KINGS
FOREST**

**BULK EARTHWORKS PRECINCTS
01 & 02, TWEED COAST RD.
INTERSECTION & ESTATE MAJOR
ACCESS WORKS**

REAL PROPERTY DESCRIPTION
 Lot 7 on DP875447, Part of Lot 8 on DP875446,
 Part of Lot 1 on DP781633, Part of Lot 40 on DP7482
 & Part of Lot 2 on DP819015
 PARISH OF CUDJEN
 COUNTY OF ROUS

PROJECT 28
PTY LTD



0 750 1500 2250 3000 3750m
Scale 1:75000 - A1 (1:150000 - A3)

[illegible]

ASSOCIATED CONSULTANTS

ASSOCIATED CONSULTANTS
LANDSURV Pty. Ltd.
14 END BL.,
TWEED HEADS NSW 2405
Ph. (07) 5557055

GILBERT+SUTHERLAND
agricultural and environmental scientists

DRAWING TITLE

BULK EARTHWORKS CUT FILL AREAS AND TRANSFER DIAGRAM



**Civil Engineering
Project Coordination**

Py Ltd T/As
non-urban Settlements
+ 39 18 375 045
tenc@urbanisulien.net.au
urbanisulien@urbanisulien.net.au

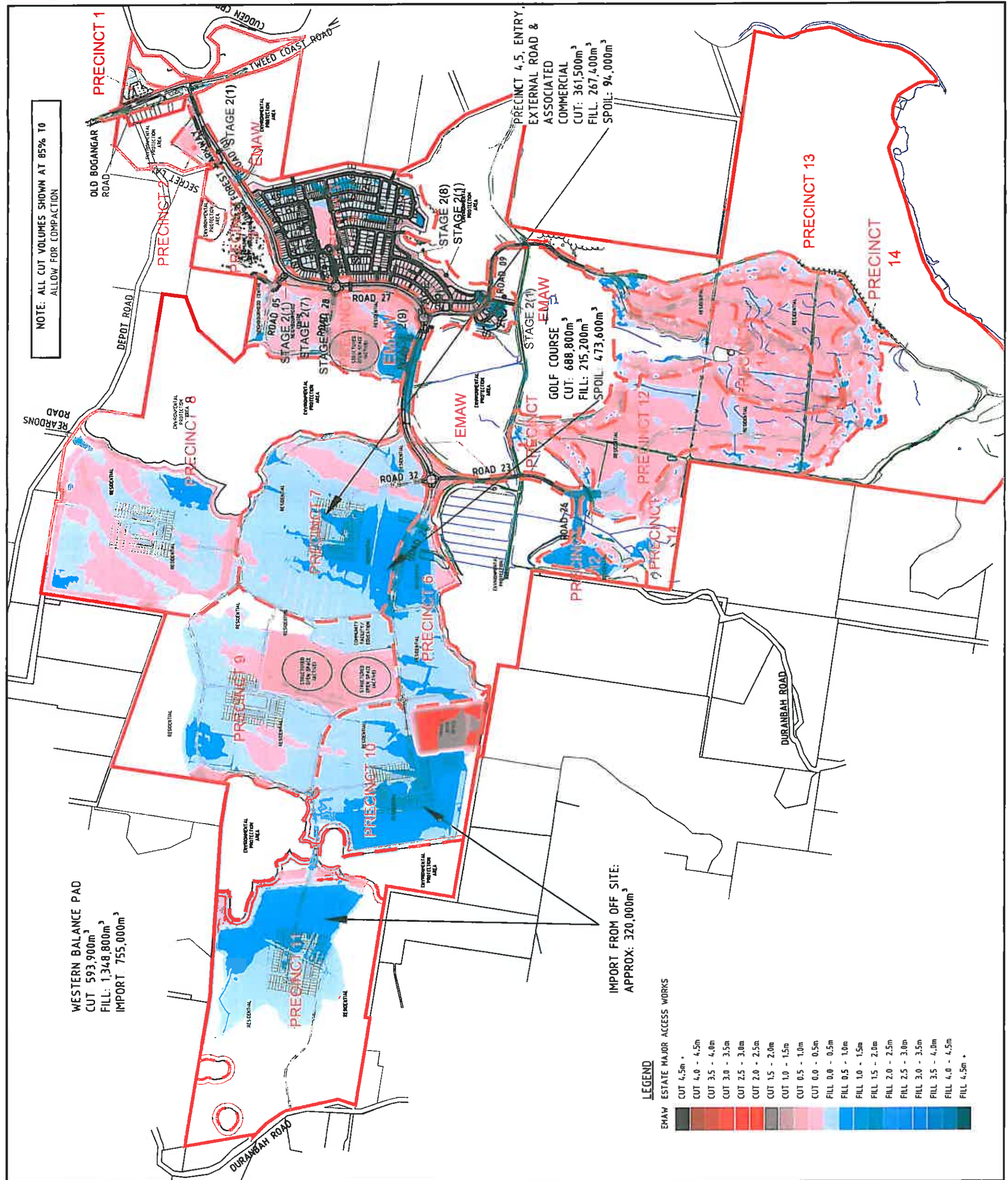
Postal Address
PO Box 7484
Seoulport QLD 4215

Gold Coast Office
Suite 9, 19 Shore! St
Seoulport QLD 4215

07 5571 1080
07 5571 1099

DESIGNED BY	BRAND	BL
PROVED		DATE 20-11-10
DRAWING NUMBER		ANIMA
12301-ALL-040		B

NOTE: ALL CUT VOLUMES SHOWN AT 85% TO ALLOW FOR COMPACTION



IMPORT FROM OFF SITE:
APPROX: 320,000m³

LEGEND

CUT 4.5m *	CUT 4.0 - 4.5m	CUT 3.5 - 4.0m	CUT 3.0 - 3.5m	CUT 2.5 - 3.0m	CUT 2.0 - 2.5m	CUT 1.5 - 2.0m	CUT 1.0 - 1.5m	CUT 0.5 - 1.0m	CUT 0.0 - 0.5m	FILL 0.0 - 0.5m	FILL 0.5 - 1.0m	FILL 1.0 - 1.5m	FILL 1.5 - 2.0m	FILL 2.0 - 2.5m	FILL 2.5 - 3.0m	FILL 3.0 - 3.5m	FILL 3.5 - 4.0m	FILL 4.0 - 4.5m	FILL 4.5m *
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PROJECT NAME
**KINGS
FOREST**

**BULK EARTHWORKS PRECINCTS
01 & 02, TWEED COAST RD.
INTERSECTION & ESTATE MAJOR
ACCESS WORKS**

REAL PROPERTY DESCRIPTION
Lot 7 on DP875446, Part of Lot 6 on DP875446,
Part of Lot 1 on DP87633, Part of Lot 4 on DP7482
& Part of Lot 2 on DP818015
**PARISH OF CUDGEN
COUNTY OF ROLDS**

PROJECT 28
PTY LTD

[illegible]

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WITH 001-NOTES AND 002-LEGEND

ASSOCIATED CONSULTANTS

LANDSURV Pty. Ltd.
14 END SL.,
TWEED HEADS NSW 2465
Ph. (07) 56387055

GILBERT+SUTHERLAND
agricultural and environmental scientists

D R A W I N G T I T L E

BULK EARTHWORKS TRANSFER DIAGRAM



MUS Ply Ltd T/A
Mertens-Urbia Solutions
ABN 39 116 375 645
murlons@urbiansolutions.net.au
www.urbiansolutions.net.au

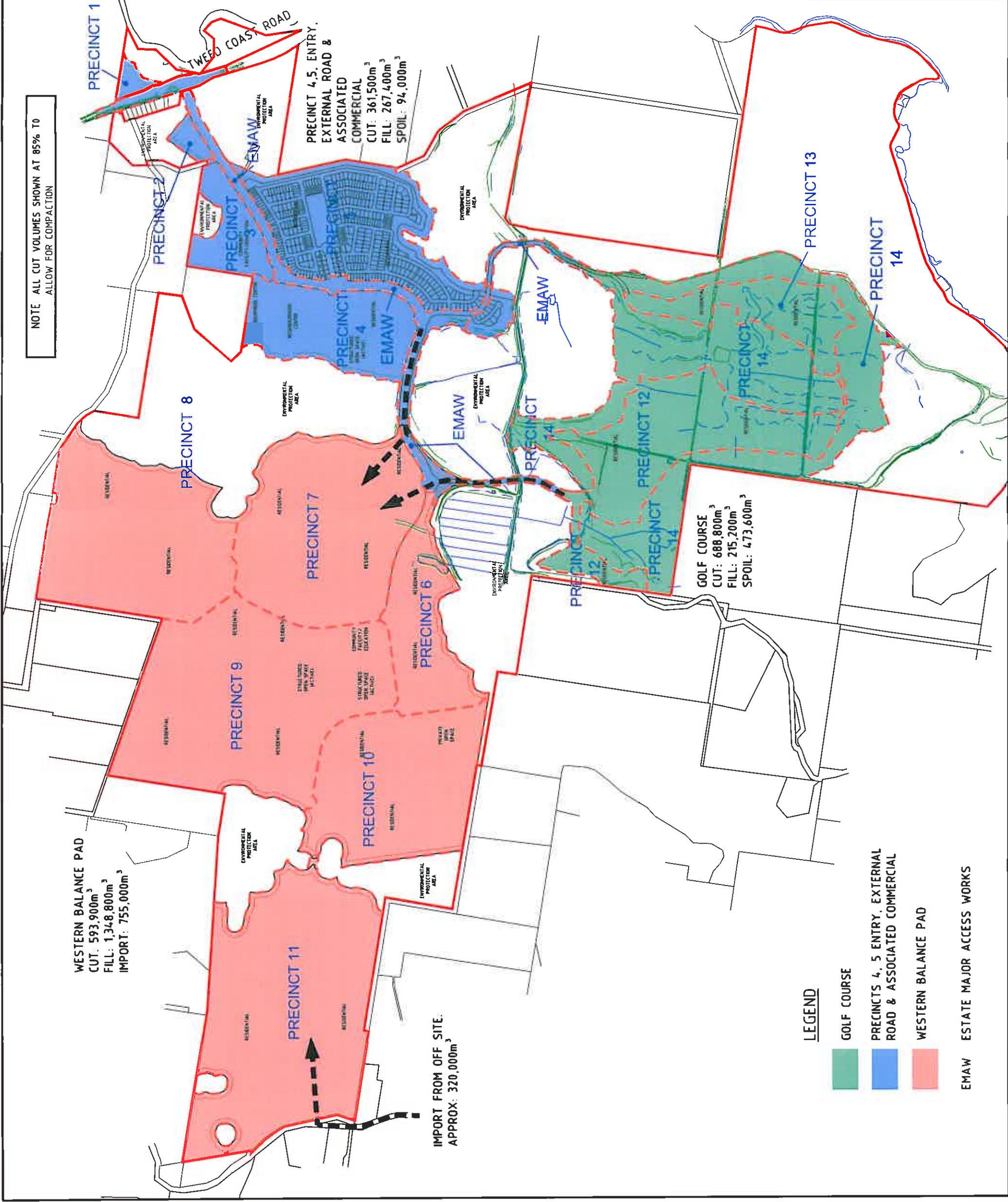
Postal Address:
PO Box 2440
Southport QLD 4215

Gold Coast Office:
Suite 9, 19 Sheri St
Southport QLD 4215

Tel 07 5571 1099
Fax 07 5571 1080

DESIGNED BY	DRYAN	BL
APPROVED		DATE 27.06.11
DRAWING NUMBER		AMEND.
12301-SK 025		A

NOTE ALL CUT VOLUMES SHOWN AT 85% TO ALLOW FOR COMPACTION



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Appendix C

Extent of Stormwater Swale
Dwg Nos. 12301-SK027(A), 028(A) & 029(A)
Prepared by Mortons-Urban Solutions



MORTONS
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