

Kings Forest

Stage 1 Project Application

No. MP08_0194

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

Date: August 2012
Rev. 05





DOCUMENT CONTROL

Revision	Date Issued	Reviewed by	Approved by	Date Approved	Revision Type
01	18 Feb 2011	KF	KF		Draft Issue
02	03 Mar 2011	KF	KF	3 Mar	Final
03	26 June 2011	KF	KF	26 June	Amended Final
04	October 2011	KF	KF	10 Oct	Amended Final (Stormwater)
05	September 2012	KF	KF	Sept 6	Final

DISTRIBUTION OF COPIES

Revision	Copy No	Quantity	Issued to
01	1	1.PDF	Project 28 Pty Ltd - Michael Geale
02	1	1.PDF	Project 28 Pty Ltd - Michael Geale
02	1	1.PDF	JBA
03	1	1.PDF	JBA
04	1	1.PDF	JBA
04	1	1.PDF	Project 28 Pty Ltd – Michael Geale
05	1	1.PDF	Project 28/DAC/Project Team

Author :	Kevin Fox
Project Manager	Kevin Fox
Name Of Organization	Mortons - Urban Solutions
Name Of Project	Kings Forest Development
Name of Document	Engineering Services Report
Document Version:	Rev 05
Project number	12301-ALL

The whole and every part of this document belongs to Mortons - Urban Solutions and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on media to any person without prior written consent of Mortons - Urban Solutions.



TABLE OF CONTENTS

1.0	LIST OF APPENDICES	3
2.0	INTRODUCTION.....	4
3.0	THE SITE AND ITS CONTEXT.....	6
3.1	PROPERTY LOCATION	6
4.0	SITE ANALYSIS & SURROUNDS	6
4.1	TOPOGRAPHY AND DRAINAGE	6
4.2	GEOTECHNICAL INVESTIGATION.....	6
4.3	FLOODING.....	7
4.4	EXISTING WATER SERVICES	7
4.5	EXISTING SEWER RETICULATION.....	8
4.6	EXISTING TRAFFIC AND ROADWORKS	8
5.0	PROPOSED DEVELOPMENT & ENGINEERING DESIGN	9
5.1	DESIGN BRIEF, INTENTS & QUALIFICATIONS	9
5.2	EARTHWORKS AND PROPOSED LEVELS	9
5.2.1	Sequencing of Earthworks and Construction.....	11
5.3	PROPOSED ACCESS POINTS.....	13
5.4	TRAFFIC	13
5.5	ROADWORKS	13
5.5.1	Tweed Coast Road and Entry Road Intersection	13
5.5.2	Rural Retail Development East of Tweed Coast Road	13
5.5.3	Kings Forest Parkway & Connection to Precincts 12, 13 & 14	14
5.5.4	Road Service Alignments	14
5.6	WATER RETICULATION.....	14
5.7	SEWER RETICULATION AND PUMP STATIONS	15
5.8	STORMWATER QUALITY MANAGEMENT	16
5.9	HYDRAULIC ANALYSIS / STORMWATER QUANTITY.....	16
6.0	CONSTRUCTION MANAGEMENT PLAN	18
7.0	CONCLUSIONS.....	19



1.0 LIST OF APPENDICES

- Appendix A Water & Sewerage Servicing Report, dated August 2012 prepared by
Mortons – Urban Solutions.
- Appendix B Cut Fill Areas Plan Drawing No. 12301-05-040 (Rev E) prepared by
Mortons – Urban Solutions
- Bulk Earthworks Sequencing Diagram No. 12301-ALL-041 to 50 (A)
prepared by Mortons - Urban Solutions
- Appendix C Extent of Stormwater Swale
Drawing Nos. 12301-SK-044(C)
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 Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised).

- Subdivision to create new lots for future development;
 - o Bulk earthworks across the site;
 - o Road works comprising:
 - construction of the entrance road into 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 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- The Plan of Development for Precinct 5.

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 and has been updated to cover the submissions following the advertising in January 2012.

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

Condition 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

- Condition 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.
- Condition 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.
- Condition 5.3** Demonstrate that the road crossings of waterways maintain existing fish passage.

Item 10: Earthworks

- Condition 10.1** Provide a detailed survey showing existing and proposed levels and quantities of fill required.
- Condition 10.2** Describe the methods for excavation, transportation and spreading of fill and determine whether fill will need to be imported to the site.
- Condition 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 Preliminary Flood assessment, Stage 1 Preferred Project Application, Kings Forest by Gilbert + Sutherland dated September 2012.

4.4 Existing Water Services

The Kings Forest development will be supplied by the Durambah 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 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

The current sewerage system consists of a 225mm diameter rising main which runs from Pump Station SPS 4025 along Tweed Coast Road to the vicinity of Pump Station SPS 4008 which is also connected to this main. At this point the 225mm diameter main is connected to an existing 375mm diameter rising main which runs to the manifold pit where all rising mains to Kingscliff Wastewater Treatment Plant (KWWTP) come together. The manifold pit is connected to the Kingscliff WWTP by twin 500mm diameter rising mains.

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 roundabout at this location.

Analysis of the proposed intersection is described in CRG's Traffic Assessment Report, dated August 2012 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 Stage 1-Application Site Analysis and overall concept plans 113691-PSP-4a 01-08 by RPS

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 Preliminary Flood assessment, Stage 1 Preferred Project Application, Kings Forest by Gilbert + Sutherland dated September 2012. 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 ongoing 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 Preliminary Flood assessment, Stage 1 Preferred Project



Application, Kings Forest dated September 2012. 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.

Included within the Construction Management Plan appendices is a Haulage Management Plan which sets out the parameters that need to be considered should fill be required to be imported on site. In summary, it is envisaged that Duranbah Road will be used as the haulage route to avoid having loaded trucks traverse through recently completed stages of the development.

Prior to any import of material onto site, all applicable approvals are to be approved by the relevant authorities. A Traffic Management Plan is to be undertaken that considers quantity of import, 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 Preliminary Flood assessment, Stage 1 Preferred Project Application, Kings Forest dated September. This level also ensures that the sites can be graded in the interim until each individual stage is completed.

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-All-041 to 50) summarises the extent of the cut and fills on site and predicts the various movement of fills within the Kings Forest Development (Sequencing). We note the following with respect to spoil movement around the site:

- The northern Precincts 1, 2, 4 & 5 generally have a combined cut/fill balance with very little or no spoil site required within the western precincts (Precincts 6 to 11).
- The southern Precincts 12, 13 & 14 are predominately in cut with an estimated 414,000m³ 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 Erosion and Sediment Control Plan, July 2012.

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. All earthworks shall be carried out in accordance with As3798-2007, Guidelines on Earthworks for Commercial and Residential Developments.

5.2.1 Sequencing of Earthworks and Construction

The sequencing of earthworks will be dependent on the staging of construction on site. Mortons Urban Solutions Bulk Earthwork Management Plan (BEMP), contained as appendices of the Construction Management Plan, sets out the sequencing of earthworks and provides detail on the amount of earthworks cut/fill within each stage, the amount of spoil to be moved and the area required in the balanced Lot to be disturbed.

It is envisaged that initial works on site will consist of the Intersection on Tweed Coast Road and the Entry into the site, minor earthworks in Precinct 2 for the proposed transformer substation and the bulk earthworks for Precinct 5. The proposed large area of disturbance within Precinct 1 is a function of the various engineering parameters that need to be in place for the first Stage of Development. Components required include, the drainage swale along the east of Precinct 4, the Regional sewer pump station, the Tweed Coast Intersection works, and the Estate Major Access Works (Kings Forest Parkway). It is noted that the swale drain running the full length of Precinct 5 on the eastern edge is required to be constructed immediately as this acts as sediment erosion control device for this portion of the development. The earthworks in Sequence 1 is estimated to be a cut to fill balance. The total area was determined to be the most efficient method of opening areas, stabilising quickly and minimising or negating the need to haul fill over completed areas at a later date. Following the earthworks and stabilisation, the initial Stages of Precinct 5 will be constructed.

As shown on Mortons - Urban Solutions Bulk Earthworks Cut Fill Areas Plan 12301-ALL-040(E) and Bulk Earthworks Sequencing



Diagram 12301-ALL-041 to 50(A) these initial stages of construction have a general cut to fill balance. This negates the need to disturb the balance precincts (6-11) in the early stages as has been previously reported.

Earthworks within Precincts 12 - 14 would be constructed following with Precinct 5. This area will produce considerable spoil (approximately 414,000m³) and will be transferred to the Balance of Precinct 6 - 11. We note that prior to opening up any subsequent Stages all earthworks within the current stage of construction is required to be stabilised. Sequencing within the Gold Course area has ensured that areas contained within the environmental buffer has been reduced in size. No earthworks are to occur in heath regeneration areas with earthwork boundaries determined in coordination with JWA Pty Ltd, Environmentalist Consultants. All earthworks within the buffer areas will be strictly controlled and monitored by the environmental officer in regards to the Heath regeneration and relocation areas. Work within the revegetated/remediated areas will be coordinated between the earthworks sequencing plan and JWA staging of works as contained in their Stage 12-14 Vegetation Management Plan.

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 sequencing/staging plan is shown below in Table 1.

Table 1: Indicative Construction Sequencing & Staging Plan

Construction Stage	Precinct	Description
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
1	Tweed Coast Intersection	Bulk Earthworks/Civil Construction
2	Precinct 04/Road 10	Bulk Earthworks
3	Precincts 12 /road 23	Bulk Earthworks
4	Precinct 14(part)	Bulk Earthworks
5	Precinct 14/13(part) /road 9	Bulk Earthworks
6	Precinct 14(part)	Bulk Earthworks
7	Precinct 13(part)/road 9	Bulk earthworks
8	EMAW	Roadworks – Roads 27, 10, 9 & 23



9	Commence Balance Area	Bulk Earthworks
---	-----------------------	-----------------

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 August 2012 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 have been achieved with the additional, 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. Further discussions with Tweed shire Council is required to determine if a temporary smaller main should be installed to service Precinct 5 if the final alignment of the 450mm main is not suitable until Tweed Coast Road is widened to its ultimate alignment.



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 August 2012.

Located within the proposed Precincts 12, 13 and 14 (currently Lot 77 DP755701 & Lot 272 DP755201) is an existing 600mm diameter trunk water main. The developers surveyor has potholed the existing water main and surveyed the location and level of the obvert of pipe. Mortons Urban Solutions Bulk Earthwork Drawings No. 12301-GC has been updated to show cross sections indicating where cut/fill operations are occurring in the vicinity of the pipe. The cross sections show that adequate cover is maintained during and after construction activities.

The requirement of a Management Plan dealing with operations near the vicinity of the pipe will be required by Tweed Shire Council prior to the commencement of any construction activity within Precinct 12,13 & 14. This plan shall be completed by the successful tenderer for earthworks, reviewed by the supervising engineer and submitted for approval prior to the works commencing. A prestart meeting with Council representatives to review the components of the plan will be required.

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.

Sewerage from the Kings Forest development will be pumped to the proposed Regional Pump Station 01 (SPS 4023 as previously allocated in Council's numbering system) which will be constructed by Project 28 Pty Ltd. Regional Pump Station 01 (SPS 4023) will be constructed on the east side of Tweed Coast Road and will receive the existing flow from SPS 4025. SPS 4023 will pump the combined flow via the existing 225mm and 375mm dia rising mains in Tweed Coast Road to the manifold and then on to Kingscliff Wastewater Treatment Plant. We understand the 225mm and 375mm dia rising mains have 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.

Mortons - Urban Solutions have undertaken a sewer servicing report and is attached in **Appendix A** (Water and Sewer Servicing Report dated August 2012).



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. Redesign of the system ensures that no drowned outlets are to be constructed..

To demonstrate the extent of stormwater swale located within the buffer adjacent Precinct 5, we attach Mortons - Urban Solutions revised Drawing 123-SK-044 (C) 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. The revised plan has removed the bio swale from the inner 30m zone.

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. It is envisaged that the entire swale system within Precinct 5 would be constructed in the first Stage. The planting of the batters would occur during the first Stage of Precinct 5; however, the base would have a sacrificial layer of grass that allows infiltration into the native sands but allows for removal of silt during the future stage construction. The base would be planted when a the majority of silt runoff from construction has ceased. This would be negotiated with Tweed Shire Council.

The constructed swale is an infiltration trench with no side slopes exceeding 1V:4H.

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 July 2012.



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:

- o 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. Incorporated into the the CMP is a detailed Bulk Earthwork Management Plan detailing the Sequencing of Earthworks, also included is a Haulage Management Plan which details the requirements should imported fill be required on site.



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

Kings Forest

Stage 1 Project Application

No. MP08_0194

Sewer & Water Report

Address: KINGSCLIFF, 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

Date: August 2012





TABLE OF CONTENTS

1.0	LIST OF APPENDICES	2
2.0	INTRODUCTION.....	3
2.1	Background.....	3
2.2	Scope.....	3
2.3	Site Location.....	4
3.0	SEWERAGE RETICULATION STRATEGY.....	5
3.1	Existing Sewerage System	5
3.2	Design Flows	5
3.3	Sewerage Reticulation Strategy	6
3.3.1	Regional Pump Station 01.....	6
3.3.2	Stage 1	6
3.3.3	Stage 2	7
3.3.4	Stage 3	8
3.4	Septicity Management.....	9
4.0	POTABLE WATER SUPPLY STRATEGY.....	10



1.0 LIST OF APPENDICES

Appendix A	Mortons Urban Solutions Engineering Drawing 123-01-SK530, 'Kings Forest' Sewer Schematic Plan
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 Project 28 Pty Ltd 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.

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised).

- Subdivision to create new lots for future development;
 - o Bulk earthworks across the site;
 - o Road works comprising:
 - construction of the entrance road into 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 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- The Plan of Development for Precinct 5

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 Duranbah 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 SPS 4025 along Tweed Coast Road to the vicinity of Pump Station SPS 4008 which is also connected to this main. At this point the 225mm diameter main is connected to an existing 375mm diameter rising main which runs to the manifold pit where all rising mains to Kingscliff Wastewater Treatment Plant (KWWTP) come together. The manifold pit is connected to the Kingscliff WWTP by twin 500mm diameter rising mains.

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	2.8
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	784
Prec 4	Commercial	-	8.1	607.5
Prec 5	Residential	442	30.8	1237.6
Prec 6	Residential	275	14	770
Prec 7	Residential	590	43	1652

Prec 8	Residential	592	43.4	1657.6
Prec 9	Residential	492	37.6	1377.6
Prec 10	Residential	422	28.9	1181.6
Prec 10	Commercial	-	1	75
Prec 11	Residential	820	66.9	2296
Prec 12	Residential	417	33.4	1167.6
Prec 12	Commercial	-	0.3	22.5
Prec 13	Residential	173	13.9	484.4
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 (SPS 4023 as previously allocated in Council's numbering system) which will be constructed by Leda Developments. Regional Pump Station 01 (SPS 4023) will be constructed on the east side of Tweed Coast Road and will receive the existing flow from SPS 4025. SPS 4023 will pump the combined flow via the existing 225mm and 375mm dia rising mains in Tweed Coast Road to the manifold and then on to Kingscliff Wastewater Treatment Plant. We understand the 225mm and 375mm dia rising mains have 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 375mm 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 375mm 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 525mm 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 225mm 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 225mm 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 225mm 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-Rev H
Kings Forest Sewer Schematic Plan



MAXIMUM RISING MAIN PIPE CAPACITIES (v=2.5M/S)

Ø 100 - 19.6 l/s
Ø 150 - 44.2 l/s
Ø 225 - 99.4 l/s
Ø 300 - 176.7 l/s
Ø 375 - 276.1 l/s
Ø 450 - 541.2 l/s

MINIMUM GRAVITY PIPE CAPACITIES

Ø 150 - 10.5 l/s @ 1 in 180
Ø 225 - 26.4 l/s @ 1 in 300
Ø 300 - 44.8 l/s @ 1 in 400
Ø 375 - 66.5 l/s @ 1 in 580
Ø 450 - 97.6 l/s @ 1 in 710
Ø 525 - 136.2 l/s @ 1 in 830
Ø 600 - 177.1 l/s @ 1 in 1000

CALCULATIONS

DESIGN FLOW = PDWF + GWI + IIF

PDWF = d x ADWF

ADWF = 0.0021 x EP

d = 0.01 (log A)⁴ - 0.19 (log A)³ + 1.4 (log A)² - 4.66 log A + 7.57

A = gross area of the developments catchment, in hectares.

75 EP/ha for local commercial

2.8 EP/lot for residential

0.25 EP/occupant for clubs

0.2 EP/student for educational institutions.

GWI = 0.025 x A x Portion_{wet}

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

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

A_{EFF} (Residential) = A x (Density/150)^{0.5} for Density < 150EP/ha

A_{EFF} (Residential) = A for Density > 150 EP/ha

A_{EFF} (Commercial) = A x (1 - 0.75) Portion_{impervious}

C = S_{ASPECT} + N_{ASPECT}

S_{ASPECT} & N_{ASPECT} are determined from Table B1 of WSA 02-2002-2.3

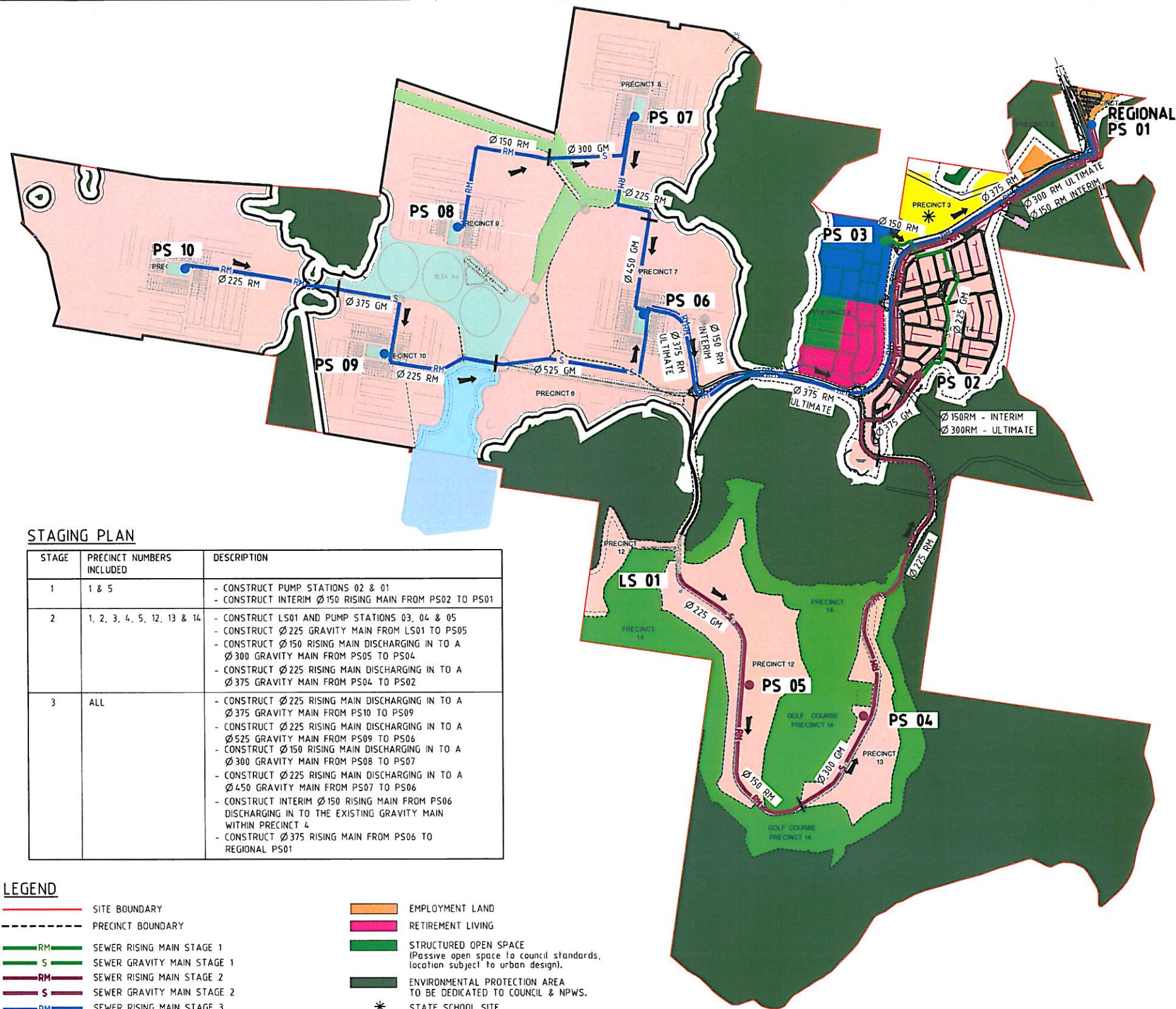
I = I_{1,2} x Factor_{size} x Factor_{containment}

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

Factor_{size} = (40/A)^{0.12}
Factor_{containment} = 0.77 x $\frac{10^{0.43x}}{10^{0.14x^2}}$

X = log₁₀ (ARI)

ARI is the specified containment frequency in years.



STAGING PLAN

STAGE	PRECINCT NUMBERS INCLUDED	DESCRIPTION
1	1 & 5	- CONSTRUCT PUMP STATIONS 02 & 01 - CONSTRUCT INTERIM Ø 150 RISING MAIN FROM PS02 TO PS01
2	1, 2, 3, 4, 5, 12, 13 & 14	- CONSTRUCT LS01 AND PUMP STATIONS 03, 04 & 05 - CONSTRUCT Ø 225 GRAVITY MAIN FROM LS01 TO PS05 - CONSTRUCT Ø 150 RISING MAIN DISCHARGING IN TO A Ø 300 GRAVITY MAIN FROM PS05 TO PS04 - CONSTRUCT Ø 225 RISING MAIN DISCHARGING IN TO A Ø 375 GRAVITY MAIN FROM PS04 TO PS02
3	ALL	- CONSTRUCT Ø 225 RISING MAIN DISCHARGING IN TO A Ø 375 GRAVITY MAIN FROM PS10 TO PS09 - CONSTRUCT Ø 225 RISING MAIN DISCHARGING IN TO A Ø 525 GRAVITY MAIN FROM PS09 TO PS06 - CONSTRUCT Ø 150 RISING MAIN DISCHARGING IN TO A Ø 300 GRAVITY MAIN FROM PS08 TO PS07 - CONSTRUCT Ø 225 RISING MAIN DISCHARGING IN TO A Ø 450 GRAVITY MAIN FROM PS07 TO PS06 - CONSTRUCT INTERIM Ø 150 RISING MAIN FROM PS06 DISCHARGING IN TO THE EXISTING GRAVITY MAIN WITHIN PRECINCT 4 - CONSTRUCT Ø 375 RISING MAIN FROM PS06 TO REGIONAL PS01

LEGEND

—	SITE BOUNDARY	■	EMPLOYMENT LAND
- - -	PRECINCT BOUNDARY	■	RETIREMENT LIVING
— RM —	SEWER RISING MAIN STAGE 1	■	STRUCTURED OPEN SPACE (Passive open space to council standards, location subject to urban design).
— S —	SEWER GRAVITY MAIN STAGE 1	■	ENVIRONMENTAL PROTECTION AREA TO BE DEDICATED TO COUNCIL & NPWS.
— RM —	SEWER RISING MAIN STAGE 2	★	STATE SCHOOL SITE
— S —	SEWER GRAVITY MAIN STAGE 2	■	PROPOSED ZONE SUBSTATION (Subject to County Energy final approval)
— RM —	SEWER RISING MAIN STAGE 3	■	PRIVATE OPEN SPACE
— S —	SEWER GRAVITY MAIN STAGE 3	■	GOLF COURSE AREA (Encapsulating ecological buffers where indicated)
■	TOWN CENTRE / NEIGHBOURHOOD CENTRE	■	PRIVATE OPEN SPACE
■	RESIDENTIAL SMALL LOT INTERGRATED / ATTACHED		
■	COMMUNITY FACILITIES / EDUCATION		

CATCHMENT TABLE

Stage	Precinct Number	Description	Lots	Gross Area (ha)	EP	ADWF	d (Peaking Factor)	PDWF	Portion Wet (0.0 - 1.0)	GWI	Is the area Commercial? (Y/N)	Portion Impervious (0.0 - 1.0)	A (eff) ha	Soil Aspect (0.2 - 0.8)	Network Deficiency Aspect (0.2 - 0.8)	C (0.4 - 1.6)	Location	I (1.2)	Size Factor	ARI	Containment Factor	I	IIF	Design Flow	Pump Station
1	Prec 1	Commercial	722	1.5	112.5	0.236	6.782	1.605	0.15	0.006	Y	0.9	0.488	0.3	0.4	0.7	Gold Coast	52	1.483	5 years	1.3	100.245	0.958	2.588	PS01
2	Prec 5 & 4	Residential	722	39.1	2021.6	4.245	2.997	12.723	0.15	0.147	N	0.9	22.956	0.3	0.4	0.7	Gold Coast	52	1.003	5 years	1.3	67.785	30.499	43.368	PS02
2	Prec 2, 3 & 4	Commercial	173	18.3	900	1.890	3.561	6.731	0.15	0.069	Y	0.9	5.948	0.3	0.4	0.7	Gold Coast	52	1.098	5 years	1.3	74.251	8.655	15.455	PS03
2	Prec 13	Residential	173	13.9	484.4	1.017	3.806	3.872	0.15	0.052	N	0.9	6.700	0.3	0.4	0.7	Gold Coast	52	1.135	5 years	1.3	78.742	10.077	14.001	PS04
2	Prec 14	Golf Club	417	0.5	125	0.263	9.105	2.390	0.15	0.002	Y	0.9	0.163	0.3	0.4	0.7	Gold Coast	52	1.692	5 years	1.3	114.371	0.364	2.756	PS04
2	Prec 12	Residential	417	33.4	1167.6	2.452	3.102	7.605	0.15	0.125	N	0.9	16.124	0.3	0.4	0.7	Gold Coast	52	1.022	5 years	1.3	69.079	21.831	29.561	PS05
2	Prec 12	Commercial		0.3	22.5	0.047	10.417	0.492	0.15	0.001	Y	0.9	0.098	0.3	0.4	0.7	Gold Coast	52	1.799	5 years	1.3	121.602	0.232	0.726	PS05
3	Prec 6 & 7	Residential	885	57	2422	5.086	2.770	14.091	0.15	0.214	N	0.9	30.337	0.3	0.4	0.7	Gold Coast	52	0.958	5 years	1.3	64.787	38.523	52.828	PS06
3	Prec 8	Residential	592	43.4	1657.6	3.481	2.931	10.202	0.15	0.163	N	0.9	21.900	0.3	0.4	0.7	Gold Coast	52	0.990	5 years	1.3	66.841	28.734	39.099	PS07
3	Prec 9	Residential	492	37.6	1377.6	2.893	3.022	8.743	0.15	0.141	N	0.9	18.583	0.3	0.4	0.7	Gold Coast	52	1.007	5 years	1.3	68.104	24.805	33.689	PS08
3	Prec 10	Residential	422	28.9	1161.6	2.481	3.203	7.948	0.15	0.108	N	0.9	15.088	0.3	0.4	0.7	Gold Coast	52	1.040	5 years	1.3	70.289	20.788	28.843	PS09
3	Prec 10	Commercial		1	75	0.158	7.570	1.192	0.15	0.004	Y	0.9	0.325	0.3	0.4	0.7	Gold Coast	52	1.557	5 years	1.3	105.243	0.670	1.866	PS09
3	Prec 11	Residential	820	66.9	2296	4.822	2.684	12.941	0.15	0.251	N	0.9	32.000	0.3	0.4	0.7	Gold Coast	52	0.940	5 years	1.3	83.554	39.861	53.053	PS10

KINGS FOREST SEWER DESIGN FLOWS

PROJECT NAME **KINGS FOREST**

CONCEPT PLANNING

CLIENT
**PROJECT 28
PTY LTD**



0 100 200 300 400 500m
Scale 1:10000 - A1 (1:20000 - A3)

ISSUES	DATE
TENDER	
COUNCIL	07-11-07
CONSTRUCTION	

H	DATE	DESCRIPTION
17-08-12		NEW SEWER ALIGNMENT
24-07-12		TABLE UPDATED
07-12-11		UPDATE CATCHMENT TABLE
07-02-11		UPDATED PRECINCT BOUNDARIES
15-12-10		TABLES AMENDED
23-11-10		UPDATED TABLES AND NOTES
01-02-10		COUNCIL COMMENTS ADDRESSED
04-01-10		ISSUE FOR INFORMATION

PRE	DATE	AMENDMENT

COPYRIGHT IS VESTED IN MORTONS URBAN SOLUTIONS AND WRITTEN CONSENT IS REQUIRED PRIOR TO REPRODUCTION. COPYRIGHT MORTONS URBAN SOLUTIONS 2008. DO NOT SCALE FROM THIS DRAWING.

ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH 001-NOTES AND 002-LEGEND

ASSOCIATED CONSULTANTS

DRAWING TITLE

SEWER SCHEMATIC
PLAN

MORTONS
urbansolutions
Urban & Regional Planning
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065
mortons@urbansolutions.net.au
www.urbansolutions.net.au
Tel 07 5571 1099
Fax 07 5571 1088

Postal Address:
PO Box 2484
Southport QLD 4215
Gold Coast Office
Suite 9, 19 Short St
Southport QLD 4215

DESIGNED JLS DRAWN BL
APPROVED DATE 04-01-10
DRAWING NUMBER 123-01-SK530 AMEND. H

ATTACHMENT 4

Appendix B

Kings Forest Sewer Design Flows
Prepared by Mortons-Urban Solutions
dated August 2012

KINGS FOREST SEWER DESIGN FLOWS

Stage	Precinct Number	Description	Lots	Gross Area (ha)	EP	ADWF	d (Peaking Factor)	PDWF	Portion Wet (0.0 - 1.0)	GIW	Is the area Commercial? (Y/N)	Portion Impervious (0.0 - 1.0)	A (eff) ha	Soil Aspect (0.2 - 0.8)	Network Deficiency Aspect (0.2 - 0.8)	C (0.4 - 1.6)	Location	I(1,2)	Size Factor	ARI	Containment Factor	I	IIF	Design Flow	Pump Station
1	Prec 1	Commercial		15	112.5	0.236	6.792	1.605	0.15	0.006	Y	0.9	0.488	0.3	0.4	0.7	Gold Coast	52	1.483	5 years	1.3	100.245	0.958	2.568	PS01
	Prec 5 & 4	Residential	722	39.1	2021.6	4.245	2.997	12.723	0.15	0.147	N		22.956	0.3	0.4	0.7	Gold Coast	52	1.003	5 years	1.3	67.785	30.499	43.368	PS02
2	Prec 2, 3 & 4	Commercial		18.3	900	1.890	3.561	6.731	0.15	0.069	Y	0.9	5.948	0.3	0.4	0.7	Gold Coast	52	1.098	5 years	1.3	74.251	8.655	15.455	PS03
2	Prec 13	Residential	173	13.9	484.4	1.017	3.806	3.872	0.15	0.052	N		6.700	0.3	0.4	0.7	Gold Coast	52	1.135	5 years	1.3	76.742	10.077	14.001	PS04
2	Prec 14	Golf Club		0.5	125	0.263	9.105	2.390	0.15	0.002	Y	0.9	0.163	0.3	0.4	0.7	Gold Coast	52	1.692	5 years	1.3	114.371	0.364	2.756	PS04
2	Prec 12	Residential	417	33.4	1167.6	2.452	3.102	7.605	0.15	0.125	N		16.124	0.3	0.4	0.7	Gold Coast	52	1.022	5 years	1.3	69.079	21.831	29.561	PS05
2	Prec 12	Commercial		0.3	22.5	0.047	10.417	0.492	0.15	0.001	Y	0.9	0.098	0.3	0.4	0.7	Gold Coast	52	1.799	5 years	1.3	121.602	0.232	0.726	PS05
3	Prec 6 & 7	Residential	865	57	2422	5.086	2.770	14.091	0.15	0.214	N		30.337	0.3	0.4	0.7	Gold Coast	52	0.958	5 years	1.3	64.787	38.523	52.828	PS06
3	Prec 8	Residential	592	43.4	1657.6	3.481	2.931	10.202	0.15	0.163	N		21.900	0.3	0.4	0.7	Gold Coast	52	0.990	5 years	1.3	66.941	28.734	39.099	PS07
3	Prec 9	Residential	492	37.6	1377.6	2.893	3.022	8.743	0.15	0.141	N		18.583	0.3	0.4	0.7	Gold Coast	52	1.007	5 years	1.3	68.104	24.805	33.689	PS08
3	Prec 10	Residential	422	28.9	1181.6	2.481	3.203	7.948	0.15	0.108	N		15.088	0.3	0.4	0.7	Gold Coast	52	1.040	5 years	1.3	70.289	20.786	28.843	PS09
3	Prec 10	Commercial		1	75	0.158	7.570	1.192	0.15	0.004	Y	0.9	0.325	0.3	0.4	0.7	Gold Coast	52	1.557	5 years	1.3	105.243	0.670	1.866	PS09
3	Prec 11	Residential	820	66.9	2296	4.822	2.684	12.941	0.15	0.251	N		32.000	0.3	0.4	0.7	Gold Coast	52	0.940	5 years	1.3	63.554	39.861	53.053	PS10

Appendix C

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





WWF

A BETTER WORLD

TWEED SHIRE COUNCIL - WATER NETWORK MODELLING

KINGS FOREST WATER SUPPLY NETWORK ANALYSIS

A1190100

27 MARCH 2009



This document has been prepared specifically for Tweed Shire Council in relation to this project and should not be relied upon by other parties nor used for any other purpose without the specific permission of MWH.

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



CONTENTS



TWEED SHIRE COUNCIL - WATER NETWORK MODELLING KINGS FOREST WATER SUPPLY NETWORK ANALYSIS

1.	INTRODUCTION	1
2.	OVERVIEW	2
2.1	KINGS FOREST DEVELOPMENT	2
2.2	EXISTING WATER SUPPLY SYSTEM	5
3.	STANDARDS OF SERVICE	7
4.	WATER SUPPLY DEMANDS	8
5.	NETWORK ANALYSIS	10
5.1	METHODOLOGY	10
5.2	BULK INFRASTRUCTURE ASSESSMENT	10
5.3	EXISTING SYSTEM ANALYSIS (2011)	11
5.4	INTERMEDIATE SYSTEM ANALYSIS (2021)	13
5.5	ULTIMATE SYSTEM ANALYSIS (2041)	15
6.	WATER RETICULATION LAYOUT	17
7.	SUMMARY	20



FIGURES

Figure 1-1: Kings Forest Location	1
Figure 2-1: Kings Forest Release Area Plan	3
Figure 2-2: Kings Forest Precinct Plan	3
Figure 2-3: South Tweed Water Supply System Overview	6
Figure 5-1: 2011 Duranbah Reservoir Operation	12
Figure 5-2: 2021 Duranbah Reservoir Operation	13
Figure 5-3: 2041 Duranbah Reservoir Operation	15
Figure 6-1: Kings Forest Water Supply Reticulation Layout – PH and Fire Flow	18
Figure 6-2: Kings Forest Water Supply Reticulation Layout – PID and Fire Flow	19

TABLES

Table 2-1: Development Summary	2
Table 2-2: Kings Forest Growth from DMS (EP)	4
Table 2-3: Kings Forest Growth in Water Supply Model (EP)	4
Table 2-4: Kings Forest Precinct Population	4
Table 2-5: Release Area Population	5
Table 3-1: Standards of Service	7
Table 4-1: PH Demand	8
Table 5-1: Reservoir Storage Volume	10
Table 5-2: WPS-10 Peak Daily Flow	11
Table 5-3: Critical Nodes – 2011 PH and Fire Flow	12
Table 5-4: Critical Nodes – 2021 PH and Fire Flow	14
Table 5-5: Critical Nodes – 2041 PH and Fire Flow	16
Table 6-1: Kings Forest Water Reticulation	17

APPENDICES

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).

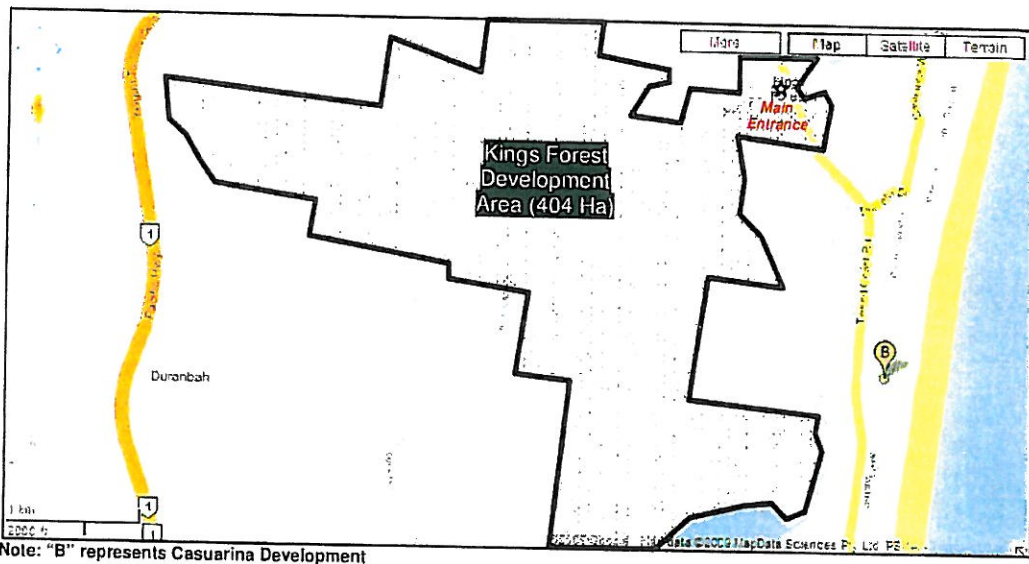


Figure 1-1: Kings Forest Location

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

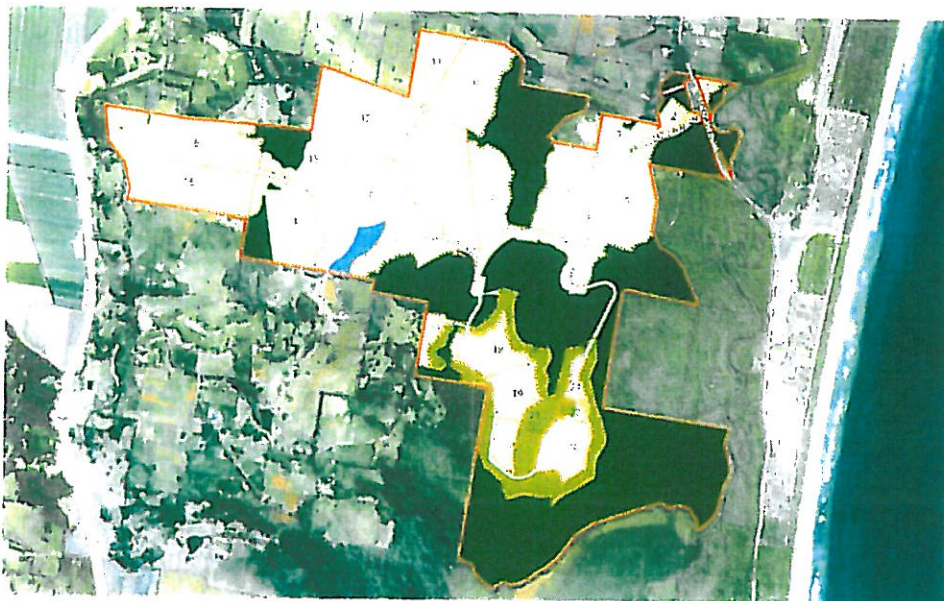


Figure 2-2: Kings Forest Precinct Plan



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

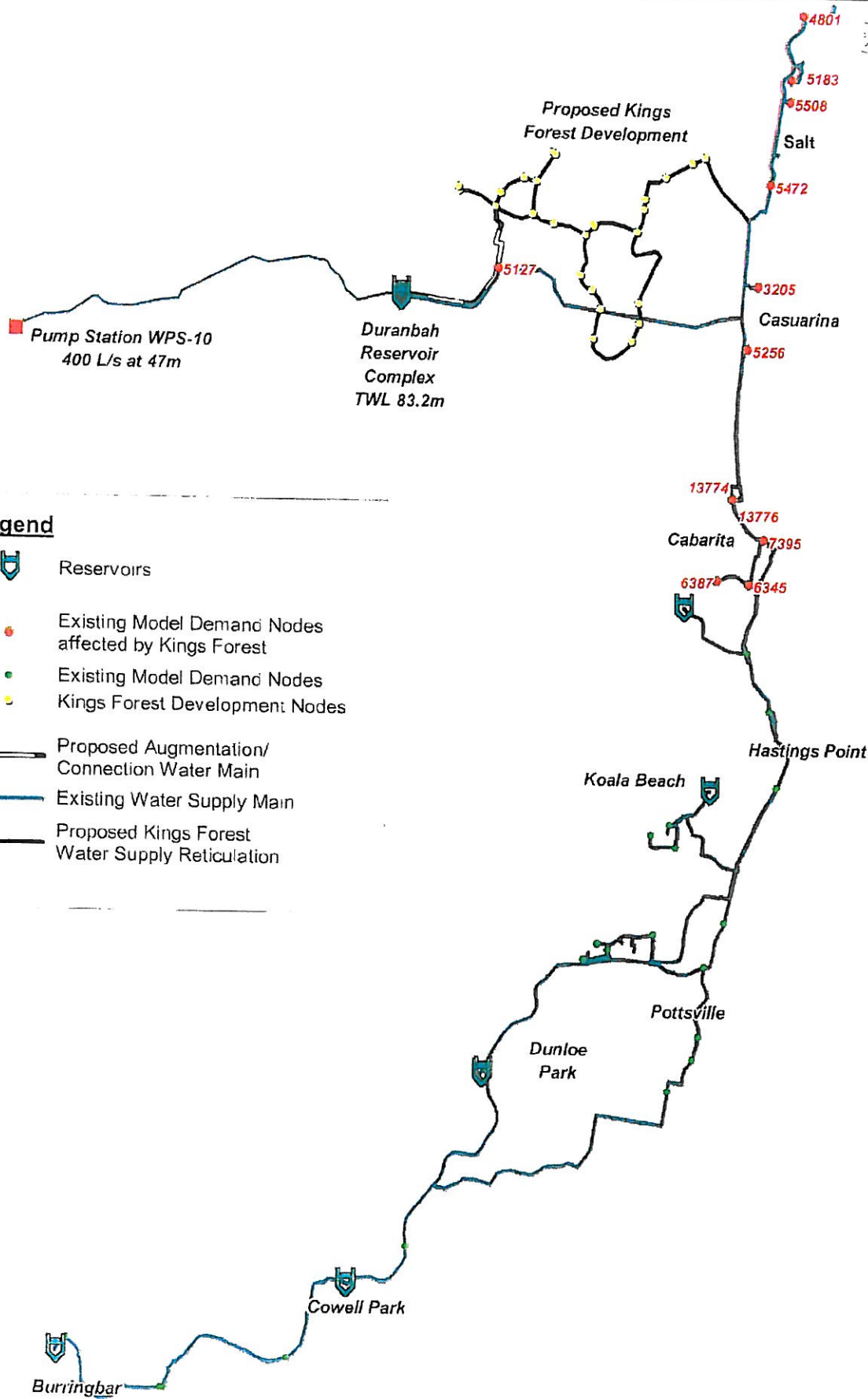
2.2 EXISTING WATER SUPPLY SYSTEM

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 decommissioned 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.



South Tweed
Water Supply
Authority

A1/D

A 190100

1:75,000

Figure 2.3
South Tweed
Water Supply
Overview Map



20/3/2009





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	25,379	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 maybe 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.