Palm Lake Works Pty Ltd

Engineering Impact Assessment

Revision 4

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LIST OF FIGURES

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1. INTRODUCTION

Palm Lake Works Pty Ltd has instructed Opus International Consultants (previously blueLAND engineers) to assess the impacts of a proposed residential subdivision development at Creek Street, Hastings Point NSW.

The assessment addresses the following issues:

- Earthworks impacts including erosion control.
- Flooding Impacts.
- Traffic generation impacts.
- Stormwater drainage impacts.
- Stormwater quality impacts.
- Water demand and Wastewater generation impacts.
- Utility Services & Solid Waste Disposal

2. DEVELOPMENT LOCATION

The site is identified as Lot 156 DP 628026, Parish of Cudgen in the Shire of Tweed. The site is currently zoned partially 2(e) Residential Tourist and a small portion of the site adjacent to Cudgera Creek is zoned 7(a) Environmental Protection (Wetland & Littoral Rainforest). The site locality and zone boundary are given in Figure 1.0.

3. EXISTING FEATURES

The site is bounded by National Park to the west, Christies Creek to the south, Cudgera Creek to the east and Creek Street to the north. There are mangroves located below the mean high water mark and a pocket of dense mangroves and Casuarina in the western portion of the site. Above the mean high water mark, the surface is grassed with scattered shrubs and the site is relatively level, with the exception of scattered depressions and hollows. The soil has a sandy profile and some filling with sand has been previously carried out, presumably with material obtained from the inlet situated in the west of the property. The site is currently vacant. The existing features are shown in Figure 2.0.

4. DESCRIPTION OF PROPOSAL

The current proposal comprises of a residential subdivision providing 34 single residential allotments, 2 integrated housing allotments, 3 potential Dual occupancy allotments and 2 tourist allotments. The proposal will provide residential allotments of a 450 m^2 minimum size, and the provision of 9 300m^2 integrated housing lots. The tourist allotments cover a combined area of 3327 m^2, with an approximate unit area of 200 m^2 the site may provide for 20 units. The layout of the proposed development is shown in Figure 1.0.

5. EARTHWORKS AND EROSION CONTROL

5.1 EARTHWORKS

5.1.1 EXISTING SITE

The filling site is relatively level, generally cleared of trees, with grass cover and with a fringe of mangroves below the mean high water mark. Apart from some scattered mounds in the eastern portion of the site, the existing natural surface is RL 1.9m AHD approximately in the central and eastern portion of the site and approximately RL 1.0m AHD in the west.

5.1.2 PROPOSED EARTHWORKS

The proposed earthworks will comprise importation and placement of fill (from approved sources) to bring the existing levels up to above RL 2.40m AHD in accordance with the approved TSC Development Control Plan(DCP) 5: Development of Flood Liable Land. Figure 3.0 outlines the extent of the proposed filling works. Accordingly fill depths are generally of the order of 0.5 to 2 metres maximum (based on the existing natural surface). The average fill height will be RL 2.80m AHD. Any batters are proposed to have maximum slopes of 1V:3H. A SEPP 14 Coastal Wetland is located adjacent to the property to the south. The approximate SEPP 14 boundary is given in Figure 3.0. No works are proposed within the wetland. No on site excavation other than stripping topsoil and trenching for services is proposed under this development application.

The recently conducted 'Tweed-Byron Coastal Creeks Flood Study' details a flood level at the site of R.L 2.5. In accordance with the adopted DCP the design flood level would be the next contour being R.L 2.6. The finished floor level as stated in the DCP would be 500mm higher than the design level being R.L 3.1m. The average fill height of R.L 2.8m would meet the flood level required by the Council's recent flood study if adopted with the same principles. Finished floor levels would be to minimum R.L 3.1m.

The type of imported fill material will preferably be of a granular nature and will be required to comply with engineering criteria to limit sensitivity due to moisture such that any dwelling foundation can be designed for an "s" or "m" soil class. Furthermore the soil required for road subgrade construction will also be specified to have certain characteristics such that the depth of road base over the fill will be kept to a minimum. There are a range of soil types available which will meet the above criteria. The applicant has advised that this material will be obtained from a council approved external source. The location will be advised prior to construction.

5.1.3 IMPACT OF EARTHWORKS

Approximately 37,000 m^3 (solid volume) of fill is required to bring the site to above RL 2.40 plus a 1.0% minimum surface cross fall to prevent ponding. Accordingly, the impacts are localised to the filling area plus the external traffic impacts discussed in Section 7.0.

A Geotechnical assessment was conducted for the site by Soils Surveys. The report provides recommendations on treating the subgrade prior to general filling (i.e. strip topsoil and proof roll) and also recommends maximum batter slopes of 1V:3H. We conclude from the findings of the report that the subsurface can support the proposed fill. The report recommends compaction

criteria and short term constraints on excavation slopes. See Appendix G for the complete geotechnical report.

5.2 ACID SULFATE SOILS

On the Department of Land & Water Conservation Acid Sulphate Soils Risk Maps Edition II – Cudgen 9641-N3 the site is designated as "High Probability of acid sulphate soils at between 1 and 3m below the surface". This site warrants a field investigation for the occurrence of Acid Sulphate Soils. A Preliminary Acid Sulphate Soil Management Plan is provided in Appendix A. An Acid Sulphate Soils investigation by Soil Surveys Engineering Pty Ltd is appended in Appendix B.

5.3 SOIL CONTAMINATION

Soil contamination test results are given in the Soil Surveys Engineering report in Appendix B. A Preliminary Soil Contamination Report has been prepared by Opus International Consultants and is appended in Appendix C. This report concluded that the site is uncontaminated and suitable for residential use.

5.4 EROSION & SEDIMENT CONTROL

5.4.1 EXISTING SITE

The existing filling site has some grass cover and is buffered from stream flows by a fringe of mangroves. There is no evidence of any erosion problems.

5.4.2 PROPOSED EROSION CONTROL

The proximity of the adjacent SEPP 14 wetland area warrants that careful attention is given to erosion control. Minimisation of sediment transfer on the filling site itself plus also retention of any runoff within sediment ponds (temporary or permanent) is needed such that mixing with external "clean" runoff is avoided both during construction and after filling is completed.

The following proposed construction sequence is recommended to meet this objective.

1. Install silt fences around the filling perimeter.

2. Clear, grub and remove topsoil from 10 metre wide strip (stockpiling topsoil for reuse) before placing imported fill bund inside perimeter silt fences including installation of outlet pipe work to suit the post development pipe outlet locations.

3. Topsoil and turf external batter and crest of initial bund.

4. Remove existing vegetation (trees and ground cover) from balance of filling site progressively ahead of filling operations such that cleared areas area generally kept less than 2 Ha.

5. Strip topsoil from cleared areas and stockpile away from drainage paths.

6. Place imported fill starting from adjacent to the perimeter bund and progressing towards the central sediment pond. Maintain 0.5% grade to direct runoff towards central sediment pond.

7. Spread stockpiled topsoil with grass seed mix (appropriate to season). Water regularly to ensure early groundcover regeneration.

A strategy to place the filling inside of a perimeter bund will essentially mean the entire site will act as a sediment pond. This will enable the site runoff water entering the downstream drainage system be released in a controlled manner. Sediment basin sizing calculations (Refer appendix D) indicate that suitable area exists within the proposed bounded site to capture sediments from runoff until vegetation is re-established.

In addition the measures recommended in the Soil and Water Management Plan (Refer Appendix E) should be implemented.

6. FLOODING

6.1 DEVELOPMENT IMPACTS – 100 YEAR EVENT

An assessment was made to determine the impacts of filling the area indicated in Figure 3.0. The 1 in 100 year design flood specified in Tweed Shire Council DCP Section 3 Flood Liable Land is RL 2.40m AHD. It is proposed to fill to a minimum level of RL 2.40m with a 1% surface grade to prevent ponding of stormwater runoff. The water surface or backwater modelling program HEC-RAS by the US Army Corps of Engineers was initially used for the study.

The Hec-Ras model incorporated the topographical Christies Creek Catchment defined from 1 :25,000 maps. This analysis did not include the downstream influence of the bridge or the inflow associated with Cudgera Creek. The Hec- Ras results indicated an average change in flood level of approximately 20mm, which is less than the overall accuracy of the model. A public meeting was held in February 2007 regarding a number of aspects of the proposal. As a consequence of concerns raised by residents with respect to flooding a more detailed flood assessment was carried out. The increased detail calculations were performed using the Computer Programme XP-Storm incorporating a 2 dimensional calculation module “tuflow”.

The model used is technically described as a 1 dimensional / 2 dimensional analysis (1d/2d).
A 1 d model (such as HEC Ras) calculates water levels and velocities along the direction of the stream. Overbank flows are considered to be parallel to the main flow. A 2d model calculates water levels, flows and velocities parallel and at 90 degrees to the main channel. Calculations are carried out on a rectangular grid covering the area of interest. The combined model uses the 1 d calculations in the mainstream where the width of flow is smaller than the grid pattern adopted and for parts of the catchment which are outside the area of detailed interest.

The initial XP-Storm 1d / 2d model incorportated the Cudgera Creek catchment, the Christies Creek catchment and contributing catchments to the north of the site. The Christies Creek and Cugera Creek catchment was defined from topographical maps. Local ground levels used in the model were based on aerial laser survey as obtained by Tweed Shire for regional flood assessment. Flows were calculated by the computer programme using hydrograph methods (flow varies with time). The total calculated inflow from the contributing catchments for the 100 year ARI storm peak hydrograph inflows was 620 m^3/s

The model incorporated the existing bridge over Cudgera Creek which was not part of the HEC Ras model. The hydraulic capacity of the bridge was checked using an alternative computer programme (Culvertw) to XP-Storm. The Culvertw model indicated that the bridge has a capacity of approximately 300 m^3/s before overtopping and would produce an upstream headwater RL of 2.46m with a downstream tailwater of RL 1.0m. The 1d/2d model produced similar results.

The initial XP-Storm study was queried by Council as a result of the recently completed regional study conducted by BMT – WBM. The 'Tweed-Byron Coastal Creeks Flood Study' was prepared by BMT-WBM for the Tweed & Byron Shire Council. The study outlines the regional flood inundation and flow conditions for a number of catchments including Cudgen Creek, Christies Creek and Cugera Creek. The study includes various flood scenarios including a range of various Average Recurrence Interval(ARI) storms and storm surge combinations and the Probable Maximum Flood (PMF) event. The BMT-WBM study highlighted interactions between the Cudgen Creek and Christies Creek catchments. The upper reach of the Christies Creek catchment appears to be diverted at the Kanes Road directing flow into Cudgen Creek at this point. This affectively halves the catchment area and inflows previously adopted.

The XP-Storm Model was recalculated to reflect the flood scenarios and outlet conditions outlined in the BMT –WBM study. The Christies Creek Catchment was reduced to reflect the diversion of the catchment at Kanes Road. The combined catchment peak outflow reduced to $257m^3/s$ for the Q100 (100 year ARI storm) event as a result of the diversion. The resulting XPSTORM peak flows were within 0% to +15% of the BMT WBM model for various storm duration comparisons. The flood scenarios modeled included; a Q100 flow in the catchments with a Q20 (20 year ARI storm) storm surge at the outlet; a Q10 (10 year ARI storm) flow in the catchments with a Q100 storm surge at the outlet; a PMF storm in the catchments with a Q100 storm surge at the outlet. The BMT WBM Storm surge profiles for the Q20 and Q100 cases were reproduced in the XPSTORM model with peaks of R.L 2.20m and R.L 2.60m respectively. XPstorm catchment peak flows were compared to the BMT WBM results to validate model output.

The sensitivity of the model to various sea levels downstream of the bridge was assessed against the storm surge scenarios. The range of sea levels modelled conform with range of suggested level increases outlined in the Department of Enviroment and Climate Change (DECC) document Flood Risk Management : Practical Consideration of Climate Change. This analysis takes into account the potential impacts associated with sea level rises as a consequence of Global Warming.

Flood modelling was conducted for existing and proposed cases. The Existing case consisted of a Digital Terrain Model (DTM) of the current ground levels and areas representing existing buildings. Building areas provide a physical block where flow cannot pass over even in high water level situations. The proposed case comprised of a DTM of the surface incorporating the proposed earthworks plus provision for buildings.

The results of the various 1d/2d model calculations are presented in Figures 5 – 11. . The figures provide calculated flood elevations, depths, hazard and flow vectors. The flow vectors show the direction of flow. The length of the flow arrow is proportional to the magnitude of the flow. The levels have a stated accuracy of +/- 0.15m.

The local residents expressed concern with flood waters from the north flowing down Creek St rather than flooding from the Christies Creek catchment. The 1d/2d model replicated the observations of the residents in that flows are shown within Creek St. in the various Figures.

When considering properties in the vicinity of the bridge and on the southern side of Creek Street the Q100 storm surge Q10 flows scenario produces levels comparable to the BMT-WBM study. Whereas the Q20 storm surge Q100 flow scenario produces levels comparable to the BMT-WBM study properties on northern side of Creek Street.

The recalculated XP-Storm model produced flood elevations which were within + 100mm of the BMT –WBM results for the Q100 & Q10 events and -150 mm for the PMF. The average difference between the XP-Storm results and BMT-WBM results for depths along the major channel was +3% for the Q100 event and -5% for the PMF event.

Our analysis and interpretation of the various calculated results reveal the following impacts.

- The proposed development and emergency access road for the Q100 storm surge Q10 flow scenario has reduced flood levels by - 20mm in Creek Street. Reduced inundation of Creek Street and the caravan park is evident as a result of the emergency access road blocking flow. There is a + 30mm increase in flood elevations on the northern side of the caravan park localised to the existing drainage channel.
- The Q20 storm surge Q100 flow scenario has increased flood elevations on the northern side of the caravan park by + 60mm and + 30mm on the north east side of the car park for the proposed case. Inundation is reduced on the eastern end of Creek Street due to the access road. There is a + 20mm increase on flood elevation on the north west end of Creek Street.
- The Q100 storm surge PMF flow scenario has produced no increase in flood elevation on the eastern end of Creek Street. There is a + 30mm increase on the north west end of Creek Street and the northern side of the caravan park with no level change through the caravan park
- The increase in flood levels to the north of the caravan park as a result of the PMF and Q100 storm flow scenarios in both cases is confined to the existing drainage channel.
- The emergency access road has reduced inundation onto Creek Street however there will still be flow from catchments on the northern side of the emergency access road. The culverts under the access road will require tide gates to be designed along with the pipe capacities at the detailed design stage to ensure that flows from Creek Street are able to flow to the creek and limit storm surge inundation.
- An examination of the flow direction and inundation area indicate that the filling has to some extent restricted the flow from Christies Creek into Creek Street without adversely affecting flood levels in the north eastern corner of the Tourist Park. There is an increase in flood levels of approximately + 30mm in the western end of Creek Street which is not zoned for development. This is not significant if the effects of natural erosion and sedimentation on the hydraulic conductivity of the bridge are taken into consideration. These factors will cause much greater variations in flood levels.
- There is a calculated increase in levels of up to + 30 mm in the main channel due to the development however the increase does not cause additional inundation to developed areas.

We conclude that the proposed development results in a reduction in water levels on the eastern end of Creek Street. It slightly increases levels in the main channel by + 20 mm to + 30 mm. It causes a minor increase in levels at the western end of Creek Street of + 20mm and the northern drainage channel + 20 to + 60mm.These increases are mathematically insignificant in the context of natural variation due to the hydraulic influence of the downstream bridge and the variability in estimating flood flows. We are of the opinion that the increase (and decrease) has no practical significance as the area is already inundated by up to 1.0m of water irrespective of the development and consequently the development is unlikely to result in a measurable increase in damage or nuisance to adjacent properties. The development reduces the impact of storm surges on the properties north of and adjacent to Creek Street.

6.2 DEVELOPMENT IMPACTS – PROBABLE MAXIMUM FLOOD EVENT

The Bureau of Meteorology's Generalised Short Duration Method (GSDM) was used to calculate the Probable Maximum Precipitation (PMP) for the Christies and Cudgera Creek Catchments. Tweed Shire Council's Flood Risk Management Policy requires a 100 year ARI (Q100) flood free access to land above the PMF for all new residential development. The applicant has incorporated a flood free access to the eastern end of Creek St. This is to be made available to the residential development in emergencies. The Flood assessment has included an analysis of the PMF and has demonstrated no additional inundation during PMF event as a result of the development. Figures 9 -10 demonstrate the PMF flood scenarios combined with a 100 year ARI Storm surge.

6.3 FLOOD HAZARD ASSESSMENT

The NSW Government Floodplain Development Manual (2005) categorises the hazard posed by the flow of floodwaters based on their depth and velocity. The degrees of flood hazard outlined in the manual are low (0 - 0.6) medium (0.6 - 0.8) and high (> 0.8) where the values given are depth multiplied by velocity. By their nature and the results of the Flood Model the site and surrounding areas are categorised as flood storage area for Q100 and PMF flood events. The results from the Flood Model were output as flood hazard maps to assess any variation between existing and post development scenarios as follows in Figures 5.2, 6.2, 7.2, 8.2, 9.2, 10.2 and 11.2.

From the figures it can be seen that the development does not change the flood hazard ratings for the developed areas surrounding the development. Developed areas and the proposed development are rated as low hazard. There is an increase in flood hazard area within the main stream however there is no additional risk to persons or properties due to the increase .

6.4 TIDAL INUNDATION

The highest astronomical tide for the site is RL 1.14m AHD. The proposed filling of the site is to a minimum level of RL 2.4m AHD and the site would not be affected by tidal inundation.

6.5 CUMULATIVE IMPACTS

The development site represents the practical extent of undeveloped zoned land in the catchment required to be filled for residential development. A large area of the site is unable to be filled due to environmental constraints. We would consider that the proposal has no cumulative impact on flooding.

6.6 FLOODING CONCLUSION

Filling of the site to the extents indicated in Figure 3.0 would result in a mathematically and practically insignificant variation in flood levels upstream of the site. We do not consider the impacts to be significant in terms of water surface elevation or change in inundated land area. The development would not result in an increased flood hazard, damage or nuisance.

7. TRAFFIC

7.1 EXISTING TRAFFIC ENVIRONMENT

Access to the site is currently from Creek Street. It is intended that this access arrangement continue for the proposed development.

7.1.1 ROAD NETWORK AND HIERARCHY

Creek Street is classified an Access Street as defined in Tweed Shire Council Design Specification D1: Road Design. It has a designated speed of 50 km/h.

Coast Road is classified as Main Road No. 450 – Wooyung – Chinderah in RTA Traffic Volume Data 2004: Hunter and Northern Regions. Tweed Shire Council officers (pers. comm.) have advised that the design speed on Coast Road in the vicinity of Creek Street is 65km/h.

7.1.2 EXISTING ROAD GEOMETRY

Creek Street is a two-way road of approximately 6m width that allows left and right turn movements into and out of Coast Road. Creek Street has no kerb and gutter and the seal terminates at the site boundary adjacent to Lot 34 DP 25777. It then becomes a gravel road for approximately 80m. It has a linear horizontal alignment and slopes gradually towards the west, away from Coast Road.

Coast Road is a two-way road of 11m kerb to kerb width. In the vicinity of Creek Street, Coast Road has a slightly grading vertical geometry and a linear horizontal geometry.

7.1.3 EXISTING TRAFFIC VOLUMES

An existing traffic volume on Creek Street has been determined using traffic generation rates from RTA's Guide to Traffic Generation (2002) and Annual Average Daily Traffic (AADT) for Coast Road was obtained from RTA Traffic Volume Data 2004: Hunter and Northern Regions and from Tweed Shire Council. These volumes are as follows:

Creek Street

Dwelling Type	Number of Dwellings	Generation Rate (trips/dwelling)	Traffic Generation (vpd)
Medium density residential flat	24	4	96
Duplex dwelling	8	4.5	36
Single dwelling house	27	9	243
		TOTAL	**375**

Coast Road

RTA AADT (2001) **= 11,915 vehicles per day**

(Norries Head – 1km N of post office)

RTA AADT (2004) **= 5,837 vehicles per day**

(Norries Head – 1km N of post office)

TSC AADT (2006) **= 5,687 vehicles per day**

(South of Creek Street)

7.1.4 EXISTING PUBLIC TRANSPORT

There are two bus routes along Coast Road. The Tweed Heads to Pottsville route runs half hourly on weekdays and hourly on weekends. The Pottsville and Bogangar Community Bus Service runs a limited service on weekdays between Kingscliff and Pottsville. There is a bus stop 50m north of the entrance to Creek Street however the closest major bus stop is Hastings Point Store, approximately 570m south of Creek Street.

7.1.5 EXISTING PEDESTRIAN ACCESS

Creek street is un-kerbed and has no formed pedestrian pathways. Coast Road contains concrete footpaths for pedestrian access, which runs north and south on the western side of the road.

7.1.6 EXISTING PARKING

On street parking along Creek street is on the verge.

7.2 PROPOSED TRAFFIC ENVIRONMENT

7.2.1 INTERNAL ROAD HIERACHY

The development is to be serviced by an internal road network consisting of two access roads forming a loop from Creek street, extensions of both access roads combine to form another loop providing access to lots in the south east end of the development. An access road joining the south east loop provides access to lots in the north east corner of the site.. An emergency exit for flood purposes is also provided. The road layout is illustrated in Figure 1.0. The proposed road geometry follows Tweed Shire Council Design Spec D1 as shown in Table 7.2.1.

Table 7.2.1– Subdivision Road Widths

ROAD TYPE	RESERVE WIDTH (m)	PAVEMENT WIDTH (m)
Access Road	13.0	6.0
Lane way	20.0*	6.0

* Existing Creek Street road reserve

7.2.2 ACCESS

Access to the subdivision is proposed from Creek Street via the road connections shown in Figure 1.0. The sight distances available at the intersection of Creek Street and Coast Road are presented in photo plates 1 and 2. Figure 14.0 shows a detail of the eastern access emergency driveway. The emergency access will be above the 100 year ARI flood level of R.L.2.4m, will provide a route to land above the PMF and will function as an emergency exit for all residents west of the low point of Creek Street. The emergency access will join Creek Street at the existing pump station access road. A portion of the access road is proposed to be reconstructed and a cul de sac constructed to separate access to the pump station and the proposed development. The Flood access provides for a 6m wide fire trail with a 4m wide clear trail and 2.5m wide cycle way. A passing bay is provided as required by NSW Rural Fire Service: Planning for bushfire protection 2001.This is the minimum requirement specified in Council's Flood Risk Management Policy section 1.4.2. Creek Street service vehicle access i.e. Refuse Truck circulation has been accounted for in the road design and truck turning paths are demonstrated in Figure 11.0 and 11.1.

Photo Plate 1 – Creek St Sight Distance – (North)

Photo Plate 2 – Creek St Sight Distance – Right (South)

The sight distances available at the intersection were assessed according to Austroads Guide to Traffic Engineering Practice Part 5: Intersections at Grade (2005) and are presented in Table 7.2.2(a).

Table 7.2.2(a) – Observed Intersection Sight Distances - Coast Rd/Creek St

Location	Safe Intersection Sight Distance (SISD) Left (m)	Safe Intersection Sight Distance (SISD) Right (m)
3m from Creek Street	149	200+
5m from Creek Street	131	200+

From Austroads Guide to Traffic Engineering Practice – Part 5 Intersections at Grade (2005) the minimum Safe Intersection Sight Distance for roads with a design speed of 65 km/hr is interpolated as 130m. The existing sight distances left and right are greater than that specified by the Austroads guide.

We conclude that the proposed development can provide suitable access for both the short and long term.

7.2.3 PARKING

Off street parking for the development can be provided within the proposed allotments, an additional 35 off street parks have been provided throughout the development. The tourist facility parking should be provided as per Tweed Shire Council DCP section A2 as detailed in Table 7.2.3 below. On Street Parking can be accommodated by the proposed road widths specified in Tweed Shire Council Design Specification D1 – Road Design.

Table 7.2.3 – Proposed Tourist Facility off Street Parking Requirements

Dwelling Type	Number of Units	Parking Required	Required Parking spaces
Tourist Facility	20	1/unit	**20**

7.2.4 PEDESTRIAN ACCESS

Pedestrian access is proposed along the Creek Street frontage and on the proposed internal access streets in accordance with Tweed Shire Council Design Specification D1 – Road Design. The proposed layout can provide for this requirement. It is also proposed to provide pedestrian access along the emergency access for residents west of the low point of Creek Street in the event of a 100 year ARI flood.

7.3 ROAD LAYOUT IMPACTS AND MITIGATING METHODS

The proposed extension of Creek Street should be designed in accordance with Tweed Shire Council Design Specification D1 – Road Design. The proposed road layout allows for vehicle circulation through the proposed subdivision. TRAFFIC GENERATION
The Road and Traffic Authority (RTA) provide data for traffic generation from residential development in their Guide to Traffic Generation (2002). The proposed traffic generation based on these rates was calculated for the development as shown in Table 7.3.1 below.

Table 7.3.1 – Proposed Traffic Generation

Dwelling Type	Number of Dwellings	Daily Trip Rate Per Dwelling	Estimated Daily Trips (vpd)
Single Dwelling	34	9	**306**
Integrated housing	9	4.5	**41**
Duplex Dwelling	3	18	**54**
Tourist Facility	20	4	**80**
		TOTAL	**481**

The proposed total design traffic generated by the development is 481 vehicles per day. Therefore the total proposed design traffic along Creek street combined with the existing traffic is 856 vpd.

7.4 CONSTRUCTION TRAFFIC

During the construction phase, heavy vehicle traffic could be expected. This would comprise of earthmoving equipment, construction plant and builder's vehicles. Importation of fill material is required for the proposed development. Based on the approximately 37,000m3 (solid volume) of fill material required to be imported, a bulking factor of 20% and a 20m3 capacity truck, approximately 4,440 vehicle trips (two-way) would be required. We estimate at maximum capacity approximately 1000m3 would be delivered /day over a 1- 2 month 6- 8 week period.

Impacts resulting from the traffic generated by construction would be mitigated by the location of the site in close proximity to the main road Coast Road. Contributions toward the impacts on pavement life as a result of importation of fill material would be levied from the proposed development under Section 94 plan no. 4 Tweed Road Contribution Plan.

7.5 INTERSECTION ANALYSIS

Austroads Guide to Traffic Engineering Practice Part 2 – Roadway Capacity (1988) provides intersection volumes below which a capacity analysis is unnecessary. The post-development design traffic volume on Creek Street is below the threshold values and does not require a detailed intersection analysis. Nonetheless an analysis has been carried out using the computer programme aa sidra. The results of the analysis are appended at Appendix F. In summary the proposal will produce a queue not exceeding one vehicle with 95% probability for both right and left turns.

A conceptual intersection treatment is also appended to demonstrate that the existing intersection can be upgraded to provide for a dedicated right turn lane in Coast Road for traffic safety reasons rather than for traffic movement delay. The turn lane length need only meet minimum length requirements. The concept Plan incorporates provision for an existing pedestrian refuge.

7.6 TRAFFIC IMPACTS AND MITIGATING MEASURES

Creek Street is classified as a Local Street. The indicative maximum traffic volume of local streets from Design Spec D1 is 1,000 vehicles per day. The current traffic on Creek Street based on RTA generation rates is 375 vehicles/day. The expected impact of 481 additional vehicles per day on Creek Street is less than the indicative maximum traffic volume in Design Spec D1. Creek Street will comply with Design Specification D1.

The traffic environment on Coast road has demonstrated a decrease in AADT of 6,078 vehicles between 2001 and 2004 due to the construction of the Chinderah-Yelgun Bypass. A further decrease of 150 vpd has been measured between 2004 and 2006. The traffic generation attributable to the proposed development is offset by these decreases.

We conclude the road network has the design capacity to cater for the proposed subdivision. The intersection of Creek St and Coast Road can be upgraded to provide a protected right turn lane for safety reasons.

8. WATER CYCLE MANAGEMENT PLAN

8.1 STORMWATER DRAINAGE

8.1.1 EXISTING DRAINAGE

The site is vacant and grassed drainage patterns in this area are well defined with a general fall towards Christies Creek to the south of the site. A 2.5m wide grass lined table drain runs along the southern side of Creek Street for its frontage to the site draining along the west of the site to Christies Creek. All site runoff drains ultimately to Christies Creek which joins Cudgera Creek adjacent to the south eastern corner of the site

Due to the slightly grading topography there is only one external catchment affected by the development (catchment C). The areas utilized by the proposed development have been divided into three sub catchments A1, A2 & B. The stormwater catchments are shown in Figure 13.0.

8.1.2 PROPOSED DRAINAGE NETWORK

Excess runoff from driveways will flow across grass to the internal drainage network. Runoff from the public roads to the west (Catchment A1 & A2) will enter inlet pits flowing onto a treatment device before being discharged to Christies creek. Runoff from roads and lots to the east (Catchment B) will be treated separately to the Catchment A runoff before being discharged to Christies creek. Roof water from allotments will drain into inter-allotment drainage pits connecting into the stormwater drainage network where suitable.

Runoff from catchment C (existing dwellings) will be collected in the concrete swale drain to the north of the emergency access driveway and discharged beneath the driveway to Christies Creek. This piped system should by designed to accommodate Q100 flows as there is no overland flow path below the flood level for this catchment. Water sensitive design features such as infiltration of roof water and the use of swale drains can be readily incorporated into the proposal if a sand fill is used. The proposed drainage is detailed in Figure 13.0.

8.1.3 DRAINAGE IMPACT

Drainage calculations have been carried out using the Rational Method as recommended by Design Specification D5 Stormwater Drainage and described in Australian Rainfall & Runoff 1987. Analysis has been carried out for the existing undeveloped case and the proposed developed case.

The resultant discharge from the internal site catchments for various return period storms is summarized as follows in Tables 8.1.3(a) and 8.1.3(b). Developed catchment calculations were determined using recommended values for Impervious Fraction and Time of Concentration from the Queensland Urban Drainage Manual (QUDM 1992).

Table 8.1.3(a) Existing undeveloped catchments

Storm ARI.	Catchment	Area (ha)	t_c (min)	I_y (mm/hr)	C_y	Q (m^3/s)
5 yr	A1	0.688	26	100.59	0.665	0.128
	A2	2.336	26	100.59	0.665	0.434
	B	2.062	26	100.59	0.665	0.383
	C	0.89	10	154.43	0.760	0.290
100 yr	A1	0.688	26	160.47	0.840	0.258
	A2	2.336	26	160.47	0.840	0.875
	B	2.062	26	160.47	0.840	0.772
	C	0.89	10	241.07	0.960	0.572

Table 8.1.3(b) Proposed developed catchments

Storm ARI.	Catchment	Area (ha)	t_c (min)	I_y (mm/hr)	C_y	Q (m^3/s)
5 yr	A1	0.627	15	130.15	0.762	0.190
	A2	2.329	15	130.15	0.762	0.643
	B	1.803	15	130.15	0.764	0.569
100 yr	A1	0.627	15	204.92	0.962	0.377
	A2	2.329	15	204.92	0.962	1.280
	B	1.803	15	204.92	0.965	1.132

Note: Catchment C remains unchanged post development.

8.1.4 STORMWATER DRAINAGE SUMMARY

The proposed development impacts on stormwater runoff rates are given in Table 8.1.4(a).

Table 8.1.4(a) Development Impact on Flow Rates

Catchment	Minor ARI Increase (%)	Major ARI Increase (%)
A1	48	46
A2	48	46
B	49	47

It can be observed from the values above that the proposed residential subdivision will have an impact on the runoff rates for the site. Stormwater detention has not been provided to maintain existing flow rates as this may have an unwanted hydraulic affect. As the development is situated at the mouth of Christies Creek and close to the mouth of Cudgera Creek the peak flow from the development catchment would arrive much sooner than that of the two creeks respective catchments. This would mean the developed catchments peak flow would dissipate prior to the arrival of the larger catchments peak flow. If the peak flow from the developed catchment is detained this may add to the peak flows of the Christies & Cudgera Creek catchments.

In the case that Stormwater detention is required the average storage requirement calculated for each allotment is $8m^3$. Calculations were carried out using the Volumetric Procedure for Determining Storages and Pump Rates (AR&R 1987) on the basis of maintaining the existing runoff rates following development. t should be noted that these per lot storage requirements could be further reduced by provision of detention structures within the public road reserve. The storage capacity required per lot for Catchments A1, A2&B is within the capacity of pre-fabricated residential rainwater tanks

Council officers (pers. comm.) have indicated that Christies Creek would be considered the lawful point of discharge for the development.

8.2 WATER QUALITY

8.2.1 EXISTING WATER QUALITY

The site is predominately undeveloped and no stormwater pollution was evident during site visits by Opus International Consultants in 2006.

8.2.2 WATER QUALITY IMPACTS

Development of the site is expected to increase the concentrations of suspended solids, nitrogen and phosphorous in stormwater runoff compared to the existing undeveloped catchment if untreated. Pollutants from residential areas generally comprise of gross pollutants (trash and sediments) biological pollutants (decaying vegetable matter and animal excreta) and nutrients (nitrogen and phosphorus). Road areas typically collect oil products and sediments from vehicles and drain rapidly to the stormwater system. As such, runoff from road areas should be treated prior to discharge from the site.

8.2.3 CONSTRUCTION PHASE GROUNDWATER

Due to the low lying nature of the existing surface of the site it is likely that groundwater will be encountered during the excavation of services trenches. The presence of Acid Sulfate Soils (Appendix B) also indicates that the ground water (and any stormwater) removed from open trenches will require treatment prior to discharge from site. The discharged water must satisfy Tweed Shire Council requirements as detailed in the Soil and Water Management Plan in Appendix E.

8.2.4 PROPOSED TREATMENT MEASURES

Roof water from allotments is to drain into Inter-Allotment Drainage (IAD) pits. IAD pits will connect directly into the stormwater drainage network as it is considered by TSC to be relatively clean water.

The runoff from driveways and paved areas on the proposed allotments is to flow across grassed areas following the drainage path to the IAD pits. Alternatively driveway runoff can flow back onto the road stormwater system. Road runoff would be collected and treated by proprietary Gross Pollutant Traps, such as a Humeceptor. Infiltration and swale drains are also reasonable alternative solutions.

The 'deemed to comply' requirements from Tweed Shire Council Design Specification D7 – Stormwater Quality are an 11m3 storage volume per impervious hectare for a proprietary device such as a Humeceptor or equivalent. The 11m3 consists of 9m3 storage for sediments and 2m3 storage for oil and grease per impervious hectare. The required proprietary device sizings are given in Table 8.2.3.

Table 8.2.3 Proprietary Treatment Device Sizing

Catchment	Impervious Area (Ha)	Sediment Storage Requirement (m^3)	Oil Storage Requirement (m^3)	Suitable Humeceptor Model
A1	0.275	2.48	0.55	STC 5
A2	0.934	8.41	1.87	STC 14
B	0.825	7.43	1.65	STC 14

We note that the size of treatment device could be reduced by providing smaller devices on separate outlets rather than a single treatment unit for each catchment. The storm water treatment measures are specified in accordance with Design Specification D7. The performance of the devices would achieve the performance criteria set by Tweed Shire Council, specified in the Tweed Urban Stormwater Quality Management Plan (2000).

8.2.5 TWEED COAST ESTUARIES MANAGEMENT PLAN 2004-2008 FOR CUDGEN, CUDGERA AND MOOBALL CREEKS

Due to the substantial productivity and biodiversity values of estuaries of Cudgen, Cudgera and Mooball Creeks, the Tweed Coast Estuaries management plan was developed. The plan proposes the adoption of the Tweed River Water Quality Objectives for all three estuaries. The recommended Water Quality Objectives for Cudgen creek and Cudgen estuary in the Management Plan are presented in Section 4.2 of the plan. The plan recommends use of the criteria adopted by Tweed Shire Council for the Tweed River, which were adopted in the Tweed Urban Stormwater Quality Management Plan (2000).

The stormwater runoff from the site is to be treated with measures in Tweed Shire Council Design Specification D7 – Stormwater Quality (2004) are deemed to comply with the water quality objectives of the Tweed Urban Stormwater Management Plan (2000). The Estuaries Management Plan was published after the Tweed Urban Stormwater Management plan and D-7 Design Spec. We consider the proposed measures are in accordance with the objectives of the Tweed Coast Estuaries Management Plan 2004-2008.

8.2.6 WATER QUALITY CONCLUSION

In conclusion, implementing pollution control structures will mitigate the potential increase in pollution attributable to development of this site. A number of measures are available.

9. WATER RETICULATION

9.1 PROPOSED WATER DEMANDS

An existing 100mm diameter water main runs along the Northern side of Creek Street. Proposed water reticulation is shown in Figure 13.0. It is not proposed to stage the water reticulation works. The proposed subdivision will result in the following demands presented in Table 9.1 below (refer Design Specification D11 – Water Supply).

Table 9.1- Water Supply Demands

No. & type of dwelling	Instantaneous Rate	Instantaneous Demand	Daily Rate	Daily Demand
34 Single	0.15 L/s	5.10 L/s	2720 L/d	92.48 kL/d
9 Integrated	0.15 L/s	1.35 L/s	2720 L/d	24.48 kL/d
2 Duplex	0.30 L/s	0.60 L/s	5440 L/d	10.88 kL/d
20 Units	0.1125 L/s	2.25 L/s	2040 L/d	40.80 kL/d
Total	---------	**9.30 L/s**	---------	**168.64 kL/d**

Council officers (pers. comm.) have advised that the existing 100mm diameter main in Creek Street would not be able to provide for the above demands. They advised however that there are 250mm and 450mm mains on the eastern side of Coast Road, near the Peninsular Street and Creek Street intersection that would be adequate to cater for the proposed development demands.

9.2 WATER CONSERVATION MEASURES

The site is relatively low lying and the sandy soil has a high water table. The ability to treat and dispose of stormwater drainage by infiltration depends on the type of material used to fill the site to its design level. If a permeable material such as sand fill is imported, allotments may be able to discharge excess roof water into an infiltration trench rather than into the piped stormwater network.

With the introduction of the BASIX model by the Department of Infrastructure, Planning and Natural Resources in July 2005, all single dwellings are required to meet particular water sensitive and energy efficient design criteria. A number of design measures are required to achieve criteria including the following:

- Eaves and shading to windows
- Native vegetation
- Wall, ceiling and floor insulation
- Gas appliances
- 3A rated toilet and showerhead

- Gas boosted solar hot water system
- Light coloured roof
- Rainwater tank connected to toilet and garden irrigation
- Grey water recycling

The BASIX model aims to achieve a 40% reduction in mains potable water consumption across the state. Dwellings constructed on the proposed allotments will be required to meet the BASIX criteria and water sensitive design measures will be incorporated. Adequate allotment sizes are proposed that allow for construction of a dwelling with sufficient area to provide a rainwater tank. The provision of this tank and other water sensitive urban design practices would be required to be implemented at the dwelling construction stage. Figures 13.1 & 13.2 show a water cycle management plan and details incorporating BASIX criteria and other water sensitive urban design features.

10. WASTEWATER

10.1 PROPOSED WASTEWATER GENERATION

The proposed sewerage reticulation is given in Figure 14.0. Design Specification D12 Sewer System and Tweed Shire Council Fees and Charges 2006-2007 contain design generation rates for assessing developments in the Tweed Shire. These generation rates have been used with the methods given in NSW Department of Public Works Manual of Practice – Sewer Design (1984). The proposed residential subdivision is estimated to create the following total wastewater demands presented in Table 10.1 (based on 3.2 persons per tenement).

Table 10.1 Proposed Development Demands

Dwelling Type	No. of Dwellings	Equivalent Tenements (TSC)	Equivalent Tenements (PWD)
Single Dwelling	34	34	27.2
Integrated Dwelling	9	7.2	5.76
Duplex Dwelling	2	6	4.8
Tourist Units	20	20	16
Total	**65**	**67.2**	**53.76**
Flow Generation (L/s)			
Average Dry Weather Flow			0.530
Peak Dry Weather Flow			1.956
Peak Wet Weather Flow			5.577

10.2 WASTEWATER IMPACTS AND MITIGATING MEASURES

The whole development can be provided with gravity sewer if the finished surface level of proposed lots numbered 1 to 17 is approximately RL 3.0 -3.6. Alternatively a lift station can be constructed. Filling is the best option economically on a capital cost and running cost option. The wastewater generated by the proposed development is to be serviced by the existing pump station adjacent to the site. It is not proposed to stage the sewerage infrastructure works. Council officers (pers. comm.) have advised that the pump station is of sufficient capacity to cater for the proposed development and connection can be made to the existing gravity reticulation on the site.

11. PUBLIC SERVICES AND INFRASTRUCTURE

11.1 ELECTRICAL AND TELECOMMUNICATIONS

Electrical and telecommunications services are available from existing cables in the Creek Street reserve. It is intended that these services be extended to provide service to the proposed allotments.

11.2 SOLID WASTE DISPOSAL

The proposed roads within the development conform to the horizontal and vertical geometric requirements of Tweed Shire Council's Design Specification D1 – Road Design. The proposed roads are suitable for manoeuvring of a garbage truck for solid waste collection. Solid waste collection services would be provided by Tweed Shire Council's solid waste contractor. Details are provided on figure 11.0 & 11.1.

11.3 PUBLIC SERVICES AND INFRASTRUCTURE CONCLUSION

We conclude that existing services are available for electrical and telecommunications. The relevant authorities will advise on the scope of works required to supply the proposed development at the construction certificate stage.

12. CONCLUSIONS

The following conclusions are made.

a) The development will have a minor impact on local and regional traffic movements. The existing local road system would require upgrading to cater for the development.

b) The proposed filling of the site will not have any measurable impact on the potential for flood damage, nuisance or hazard of adjacent properties. Flood free (100 Year ARI) access is available.

c) The development will not have any measurable impact on downstream stormwater capacity due to the on-site storage of stormwater runoff.

d) The potential increase in stormwater pollutants attributable to the proposed development will be reduced by introduction of treatment devices and water sensitive design strategies.

e) Water demand will increase under the proposed development. This additional demand is to be supplied by the existing water reticulation network and will have minor impact on the network. BASIX certificate requirements will reduce the demand by 40% for future dwellings.

f) The wastewater generated will enter the existing sewage network in Creek Street. The existing downstream sewer system has sufficient capacity to cater for the development.

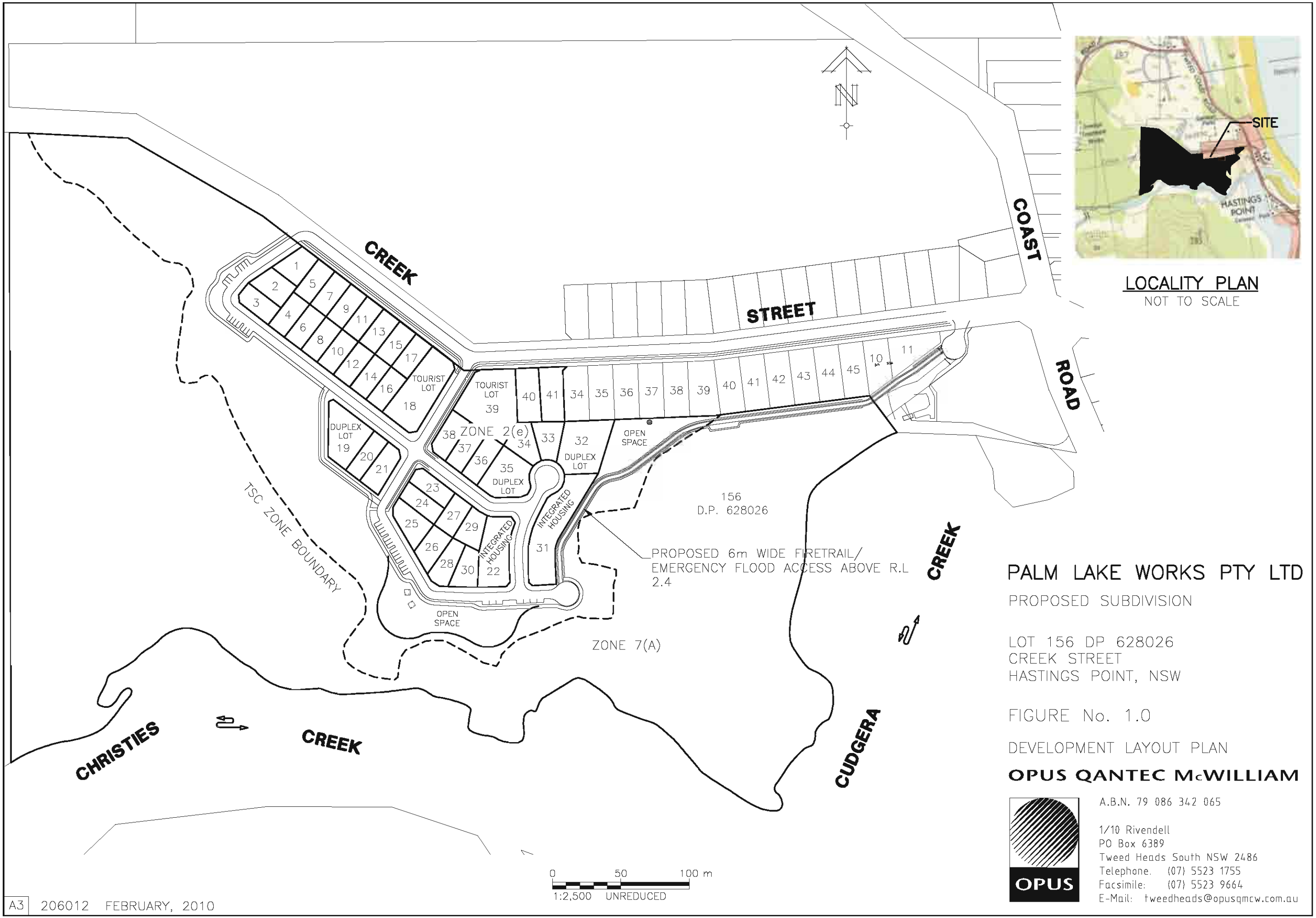
g) Electrical and telecommunications services would be supplied by connection to the existing utilities in Creek Street and Coast Road. Solid waste collection services would be provided by Tweed Shire Council's waste contractor.

13. REFERENCES

AUSTRALIAN WETLANDS	(2005)	Tweed Coast Estuaries Management Plan 2004-2008 for Cudgen, Cudgera and Mooball Creeks
AUSTROADS	(1988)	Guide to Traffic Engineering Practice. Part 2 Roadway Capacity
	(2005)	Guide to Traffic Engineering Practice. Part 5 Intersections at Grade.
BUREAU OF METEOROLOGY	(2003)	Estimation of Probable Maximum Precipitation in Australia: Generalised Short Duration Method
DEPARTMENT OF LAND & WATER CONSERVATION	(1997)	Acid Sulfate Soils Risk Maps Edition II - Cudgen 9641-N3
INSTITUTION OF ENGINEERS AUSTRALIA	(1987)	Australian Rainfall & Runoff: A guide to Flood Estimation
NEVILLE JONES AND ASSOCIATES	(1992)	Queensland Urban Drainage Manual
NSW GOVERNMENT	(2005)	Floodplain Development Manual
NSW RURAL FIRE SERVICE	(2001)	Planning for Bushfire Protection
PUBLIC WORKS DEPARTMENT NSW	(1984)	Manual of Practice – Sewer Design
ROADS AND TRAFFIC AUTHORITY NSW	(2002)	Guide to Traffic Generation
	(2004)	Traffic Volume Data 2004: Hunter and Northern Regions

TWEED SHIRE COUNCIL	(1999)	Development Control Plan No. 2 Site Access and Parking Code
	(2000)	Tweed Urban Stormwater Quality Management Plan
	(2004)	Development Design Specification D1 – Road Design
		Development Design Specification D5 – Road Design
		Development Design Specification D7 – Stormwater Quality
TWEED SHIRE COUNCIL	(2004)	Development Design Specification D11 - Water Supply
		Development Design Specification D12 - Sewer System
	(2006)	Development Control Plan No. 5 Flood Liable Land. Version 2.3
US ARMY CORPS OF ENGINEERS	(2005)	HEC-RAS River Analysis System Version 3.1.3
VEITCH LISTER CONSULTING PTY LTD	(1997)	Tweed Road Development Strategy.
BMT WBM PTY LTD	(2009)	Tweed Byron Coastal Creeks Flood Study Draft Report for Exhibition

FIGURES



LOCALITY PLAN
NOT TO SCALE

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 1.0

DEVELOPMENT LAYOUT PLAN

OPUS QANTEC McWILLIAM

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LEGEND

S — EXISTING SEWER

E — EXISTING ELECTRICITY

0.5 — EXISTING CONTOURS (0.5m intervals)

HIGHEST ASTRONOMICAL TIDE (RL 1.14) APPROXIMATE ONLY

CREEK

STREET

COAST ROAD

"HASTINGS COVE" (24 UNITS)

34 35 36 37 38 39 40 41 42 43 44 45

D.P. 25777

D.P. 25096

1 D.P.749336

478 D.P. 42445

2 D.P. 1017430

EXISTING SEWER PUMP STATION

CREEK

CHRISTIES CREEK

APPROXIMATE POSITION OF M.H.W.M. (D.P. 628026)

CUDGERA

0 50 100 m

1:2,500 UNREDUCED

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LOT 156 DP 628026
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HASTINGS POINT, NSW

FIGURE No. 2.0

EXISTING FEATURES PLAN

OPUS QANTEC McWILLIAM

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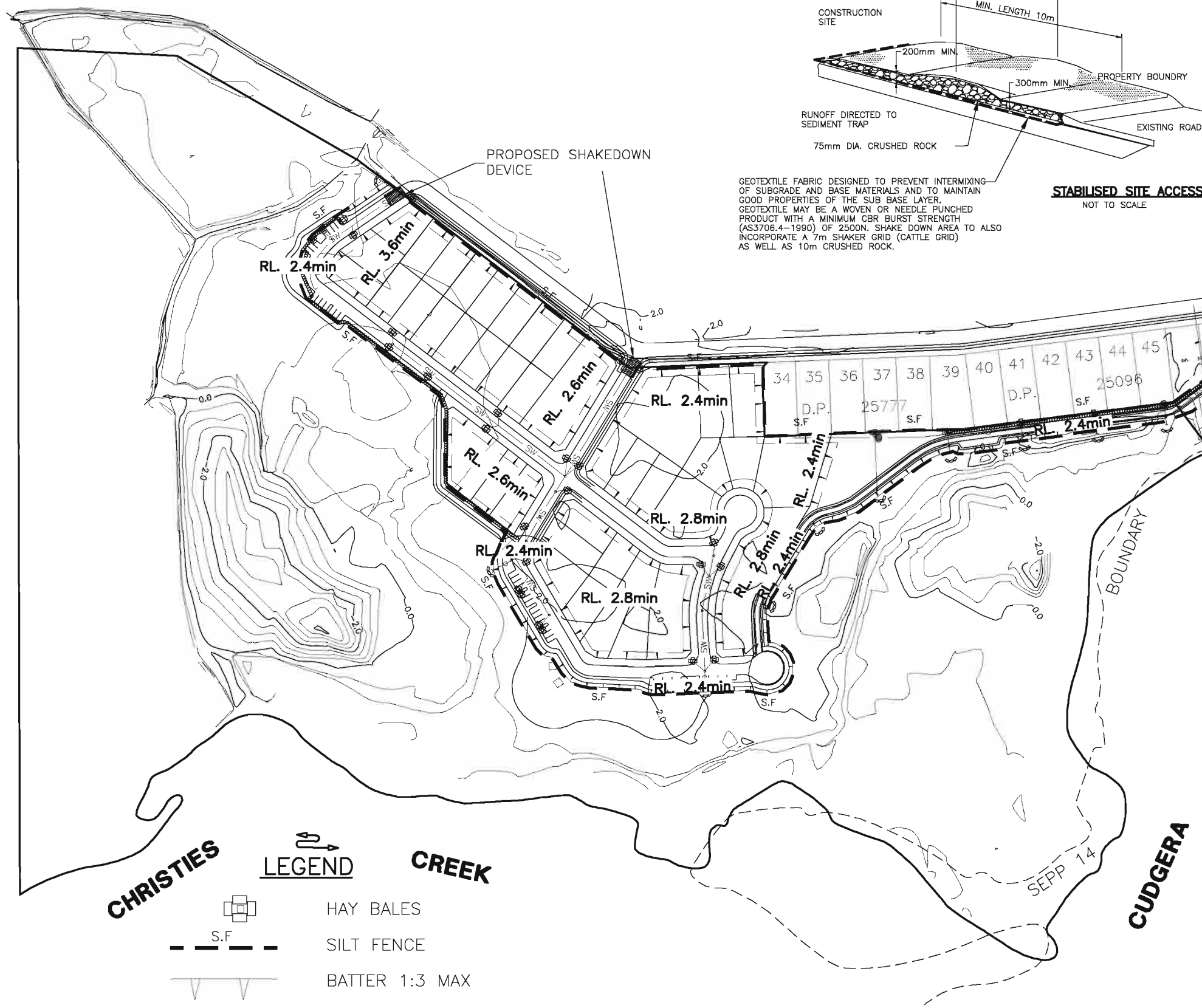
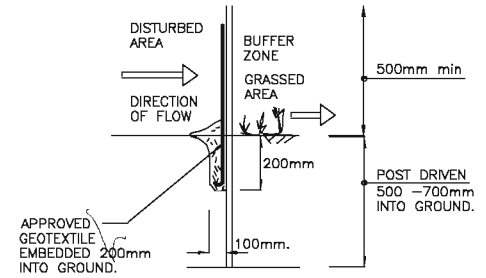


GEOTEXTILE FABRIC DESIGNED TO PREVENT INTERMIXING OF SUBGRADE AND BASE MATERIALS AND TO MAINTAIN GOOD PROPERTIES OF THE SUB BASE LAYER. GEOTEXTILE MAY BE A WOVEN OR NEEDLE PUNCHED PRODUCT WITH A MINIMUM CBR BURST STRENGTH (AS3706.4–1990) OF 2500N. SHAKE DOWN AREA TO ALSO INCORPORATE A 7m SHAKER GRID (CATTLE GRID) AS WELL AS 10m CRUSHED ROCK.

STABILISED SITE ACCESS
NOT TO SCALE



SILT FENCE
NOT TO SCALE

LEGEND

- HAY BALES
- S.F — SILT FENCE
- BATTER 1:3 MAX
- 2.0 — EXISTING CONTOURS
- PROPOSED RETAINING WALL
- R.L 2.8min — PROPOSED R.L

0 20 40 60 80m
1:2,000 UNREDUCED

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PROPOSED SUBDIVISION

LOT 156 DP 628026
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FIGURE No. 3.0

PRELIMINARY EARTHWORKS & EROSION CONTROL PLAN

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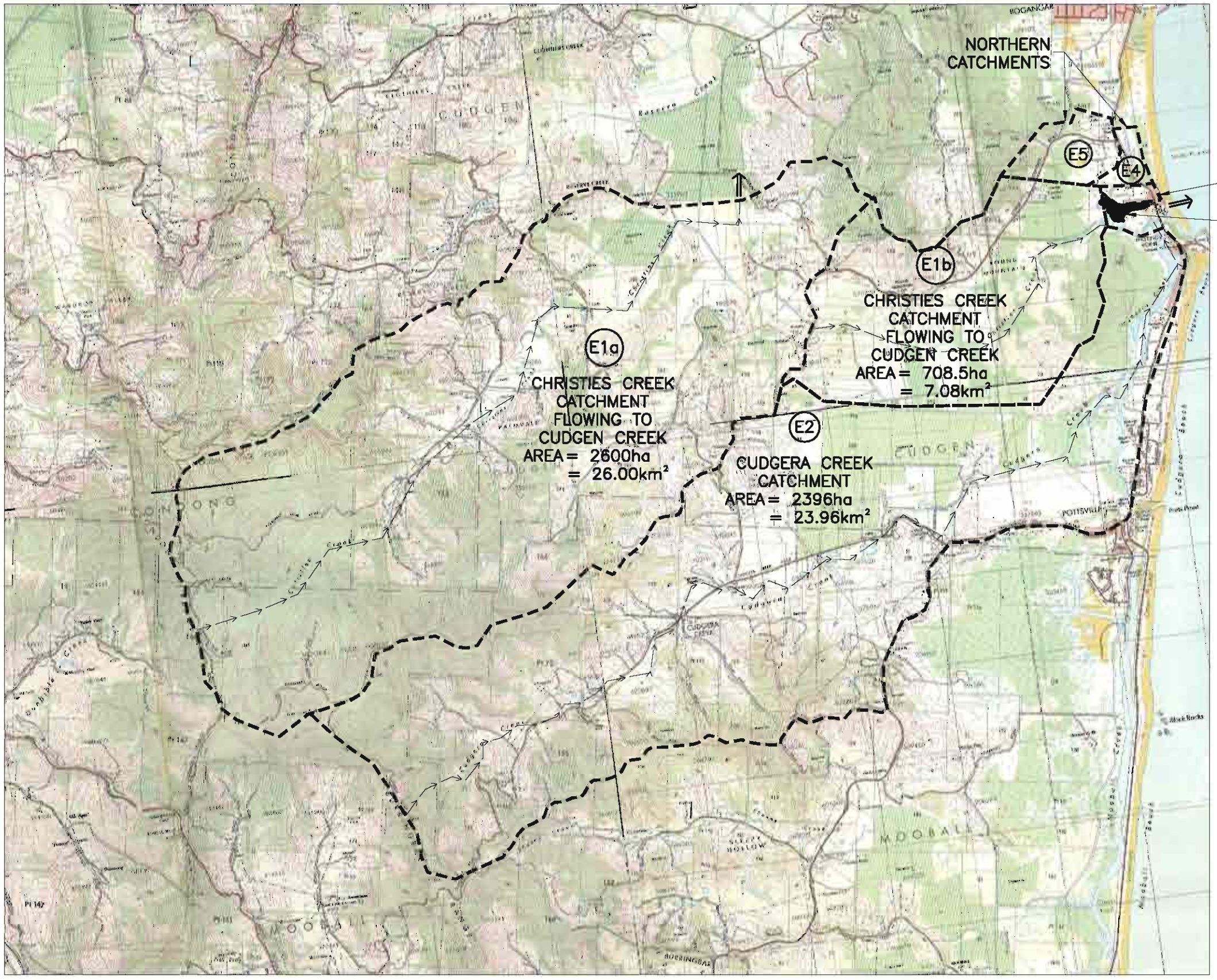

CATCHMENT	AREA (ha)
E3	12.4
E4	23.7
E5	77.34

LEGEND

E1 — CATCHMENT NAME

CATCHMENT BOUNDARIES

STREAM FLOW PATH

CATCHMENT FLOW

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PROPOSED SUBDIVISION

LOT 156 DP 628026
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FIGJRE No. 4.0

EXTERNAL CATCHMENT AREA'S

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LEGEND – ELEVATION (m)

5.00
4.25
2.50
1.25
0.5
0.0

2.49 SPOT FLOOD ELEVATION (LEVEL)

FLOW DIRECTION

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
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HASTINGS POINT, NSW

FIGURE No. 5.0

EXISTING CASE
Q100 STORM SURGE Q10 CATCHMENT
FLOW – ELEVATION

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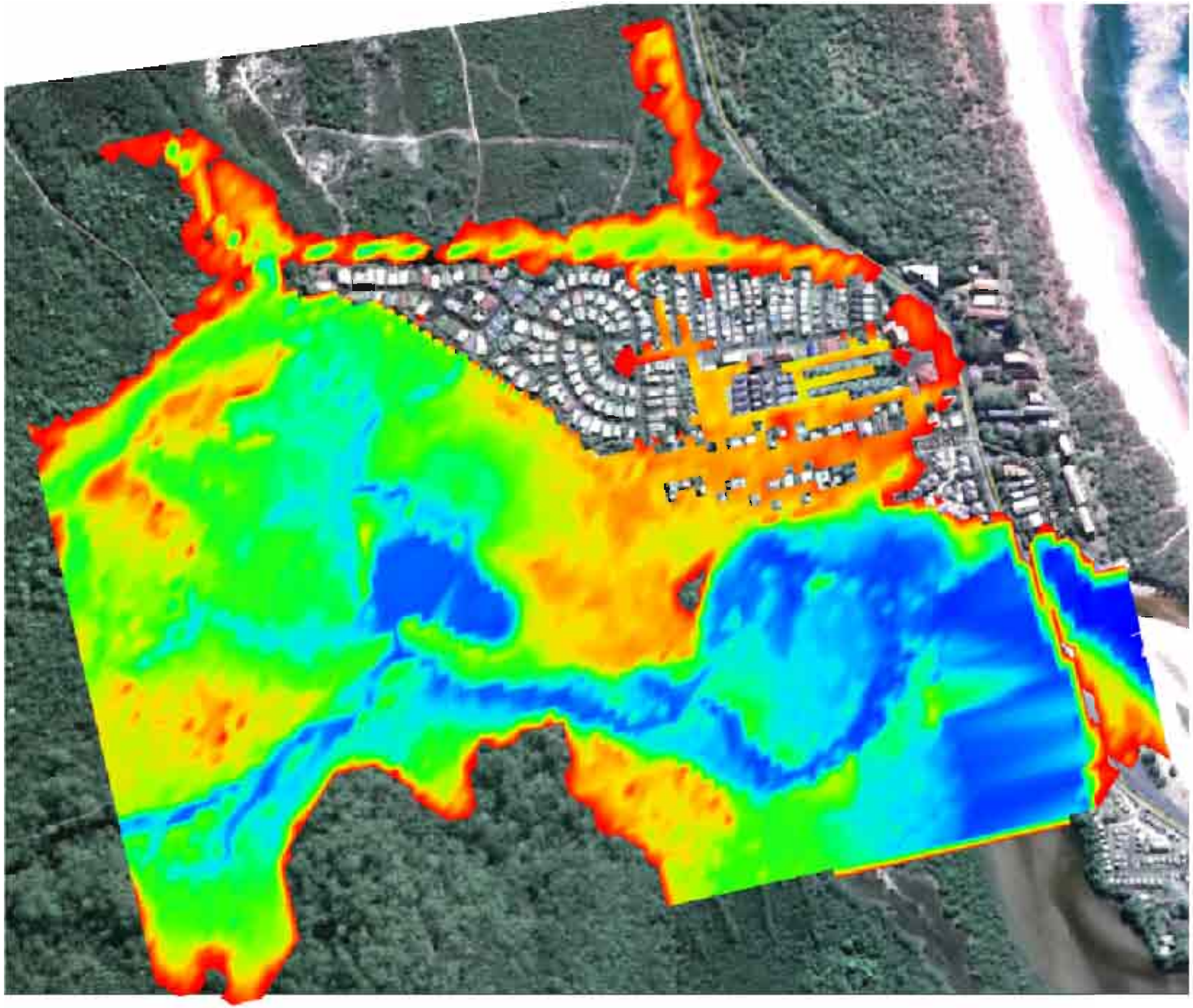

LEGEND – DEPTH (m)

2.50
2.20
1.92
1.65
1.38
1.10
0.83
0.55
0.27
0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 5.1

EXISTING CASE
Q100 STORM SURGE Q10 CATCHMENT
FLOW – DEPTH

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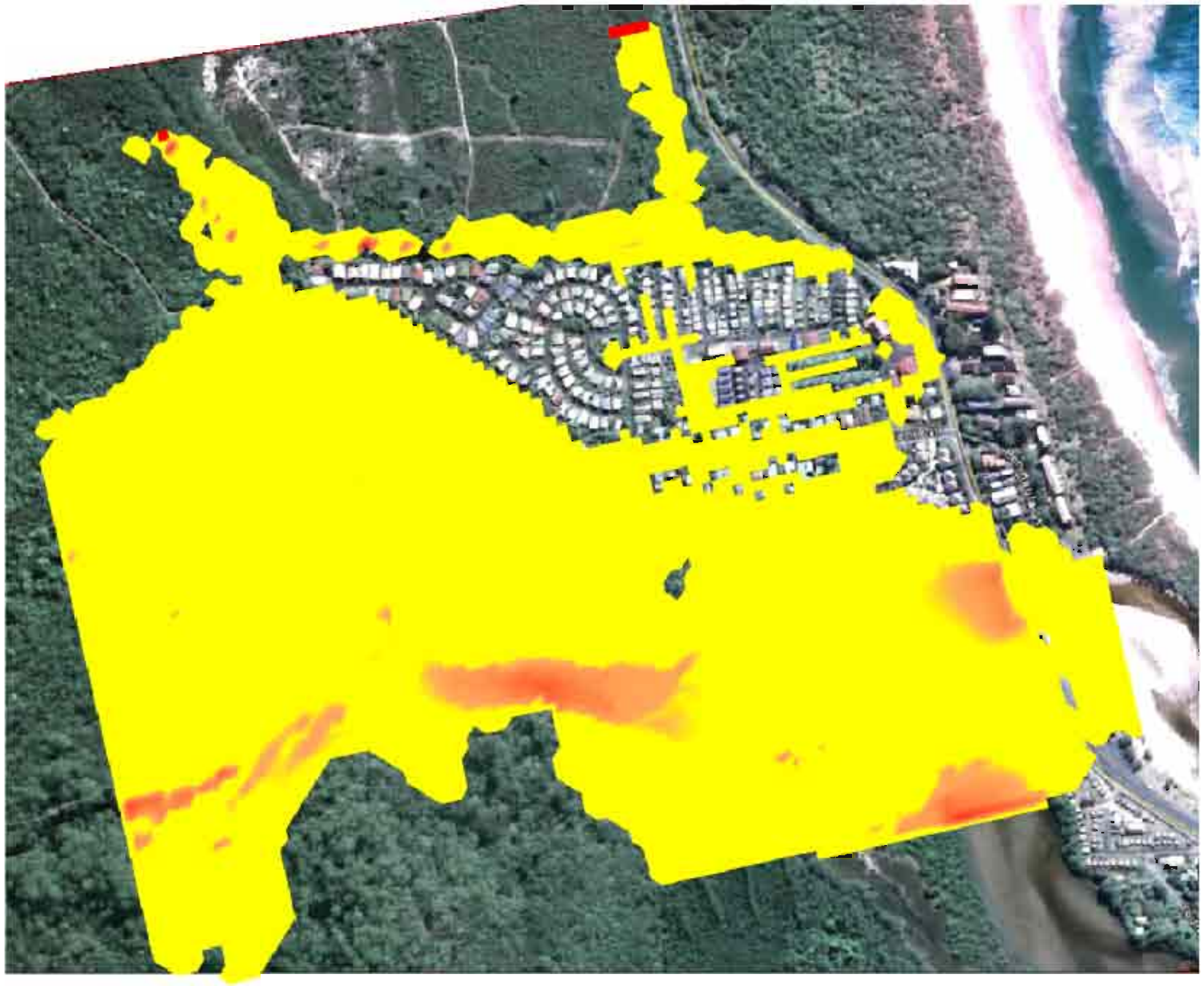

LEGEND – HAZARD (m)

HIGH	3.50
MED	0.8
	0.6
LOW	0.0

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 5.2

EXISTING CASE
Q100 STORM SURGE Q10 CATCHMENT
FLOW – HAZARD

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LEGEND – ELEVATION (m)

5.00
4.25
2.50
1.25
0.50
0.00

2.49 SPOT FLOOD ELEVATION (LEVEL)

FLOW DIRECTION

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 6.0

PROPOSED CASE
Q100 STORM SURGE Q10 CATCHMENT
FLOW – ELEVATION

OPUS QANTEC McWILLIAM

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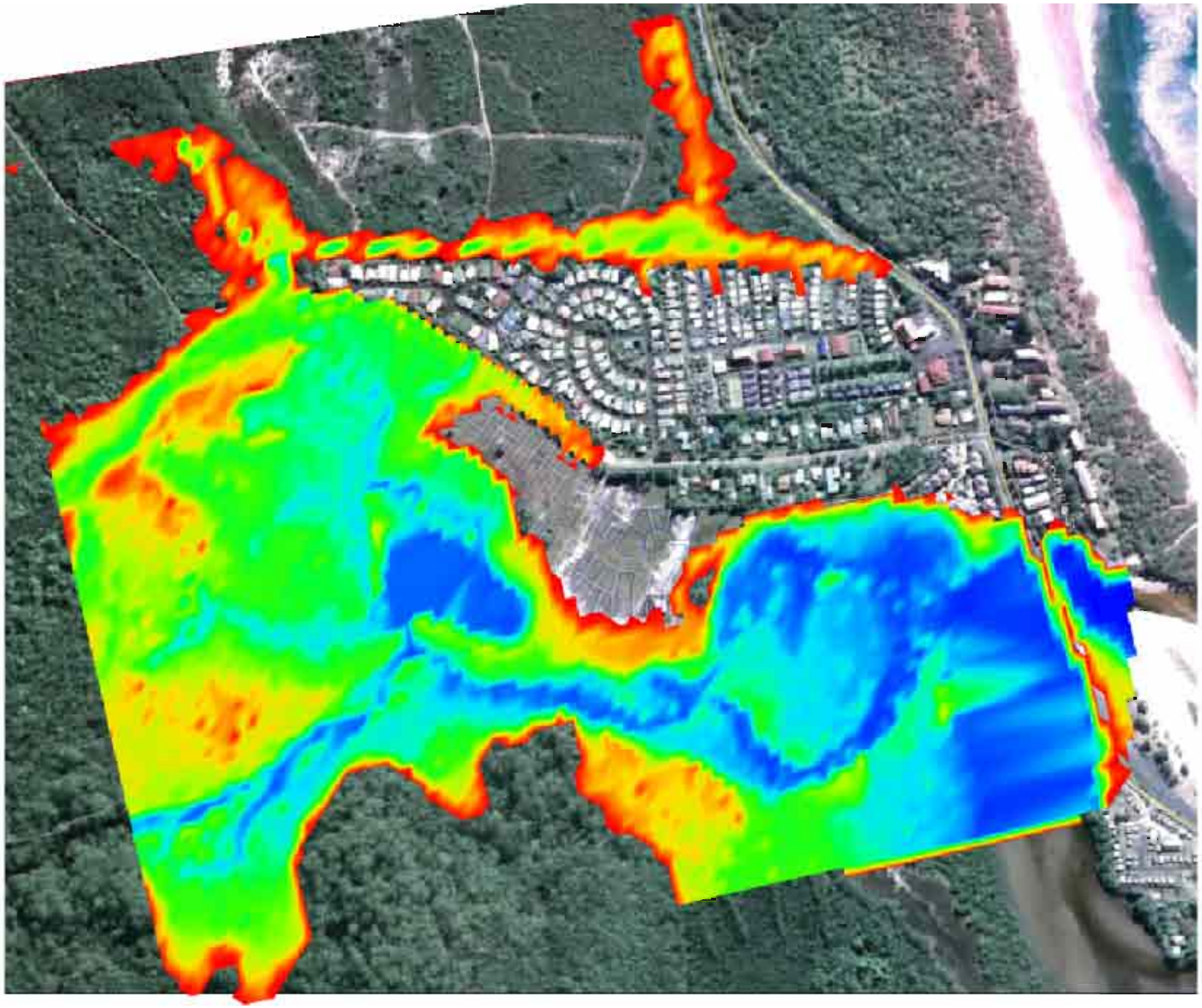

LEGEND – DEPTH (m)

2.50
2.20
1.92
1.65
1.38
1.10
0.83
0.55
0.27
0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 6.1

PROPOSED CASE
Q100 STORM SURGE Q10 CATCHMENT
FLOW – DEPTH

OPUS QANTEC McWILLIAM

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A3 206012 FEBRUARY, 2010

LEGEND – HAZARD (m)

HIGH	3.50
MED	0.80
	0.60
LOW	0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 6.2

PROPOSED CASE
Q100 STORM SURGE Q10 CATCHMENT
FLOW – HAZARD

OPUS QANTEC McWILLIAM

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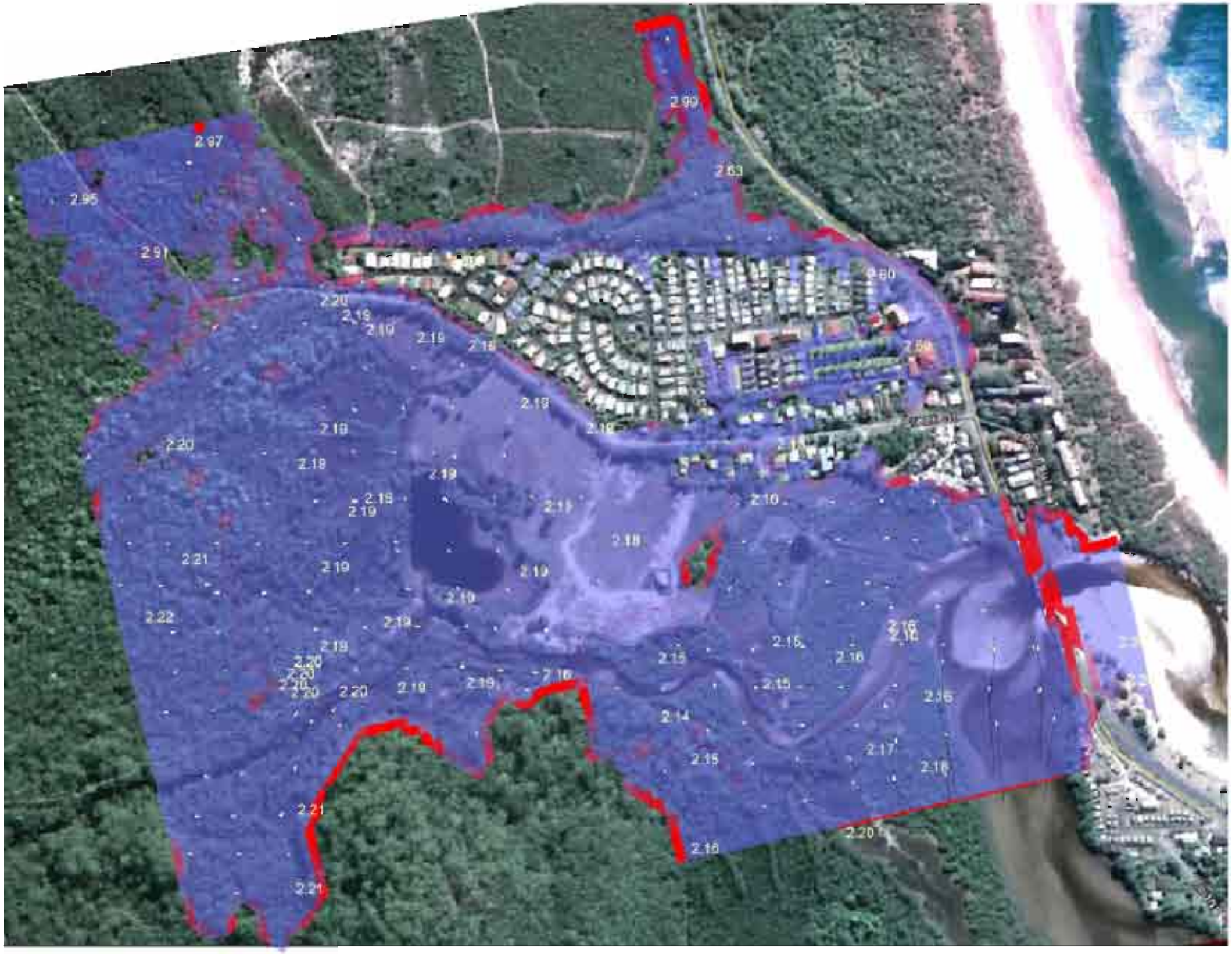

LEGEND – ELEVATION (m)

5.00
4.25
2.5
1.25
0.50
0.00

2.49 SPOT FLOOD ELEVATION (LEVEL)

FLOW DIRECTION

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 7.0

EXISTING CASE
Q20 STORM SURGE Q100 CATCHMENT
FLOW – ELEVATION

OPUS QANTEC McWILLIAM

A.B.N. 79 086 342 065

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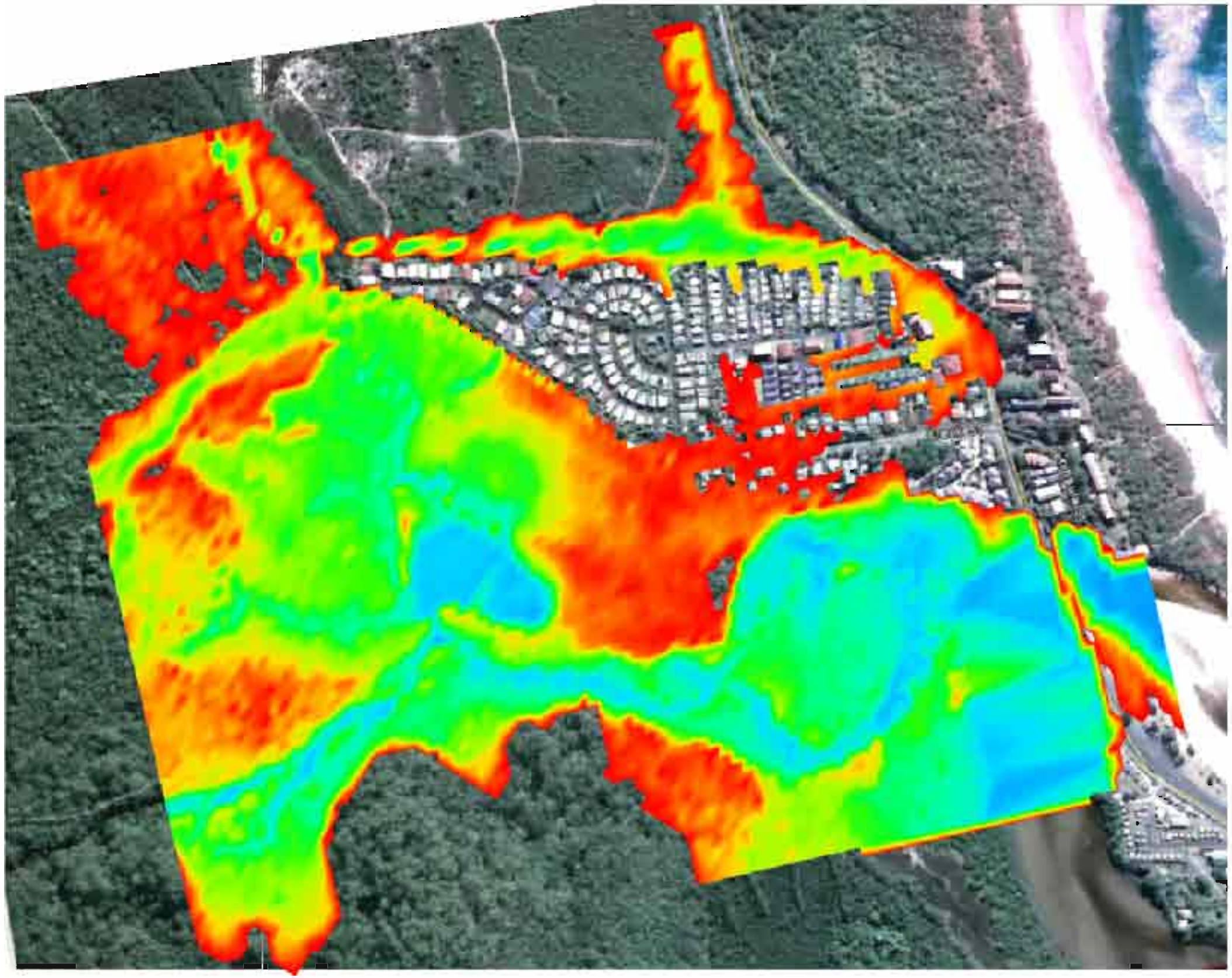

LEGEND – DEPTH (m)

2.50
2.20
1.92
1.65
1.38
1.10
0.83
0.55
0.27
0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 7.1

EXISTING CASE
Q20 STORM SURGE Q100 CATCHMENT
FLOW – DEPTH

OPUS QANTEC McWILLIAM

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LEGEND – HAZARD (m)

HIGH	3.00
MED	0.80
LOW	0.60
	0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 7.2

EXISTING CASE
Q20 STORM SURGE Q100 CATCHMENT
FLOW – HAZARD

OPUS QANTEC McWILLIAM

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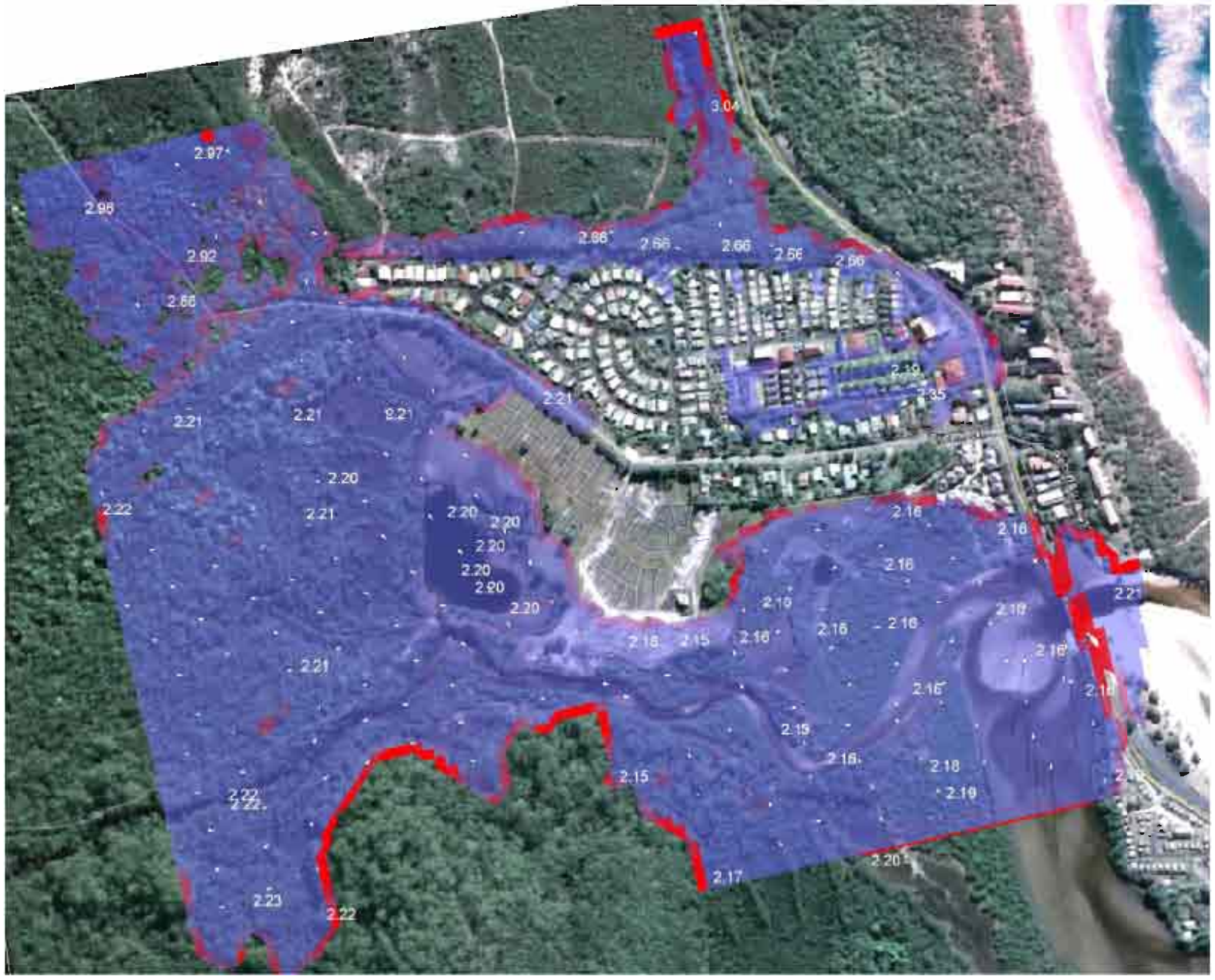

LEGEND – ELEVATION (m)

5.00
4.25
2.50
1.25
0.50
0.00

2.49 SPOT FLOOD ELEVATION (LEVEL)

FLOW DIRECTION

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 8.0

PROPOSED CASE
Q20 STORM SURGE Q100 CATCHMENT
FLOW – ELEVATION

OPUS QANTEC McWILLIAM

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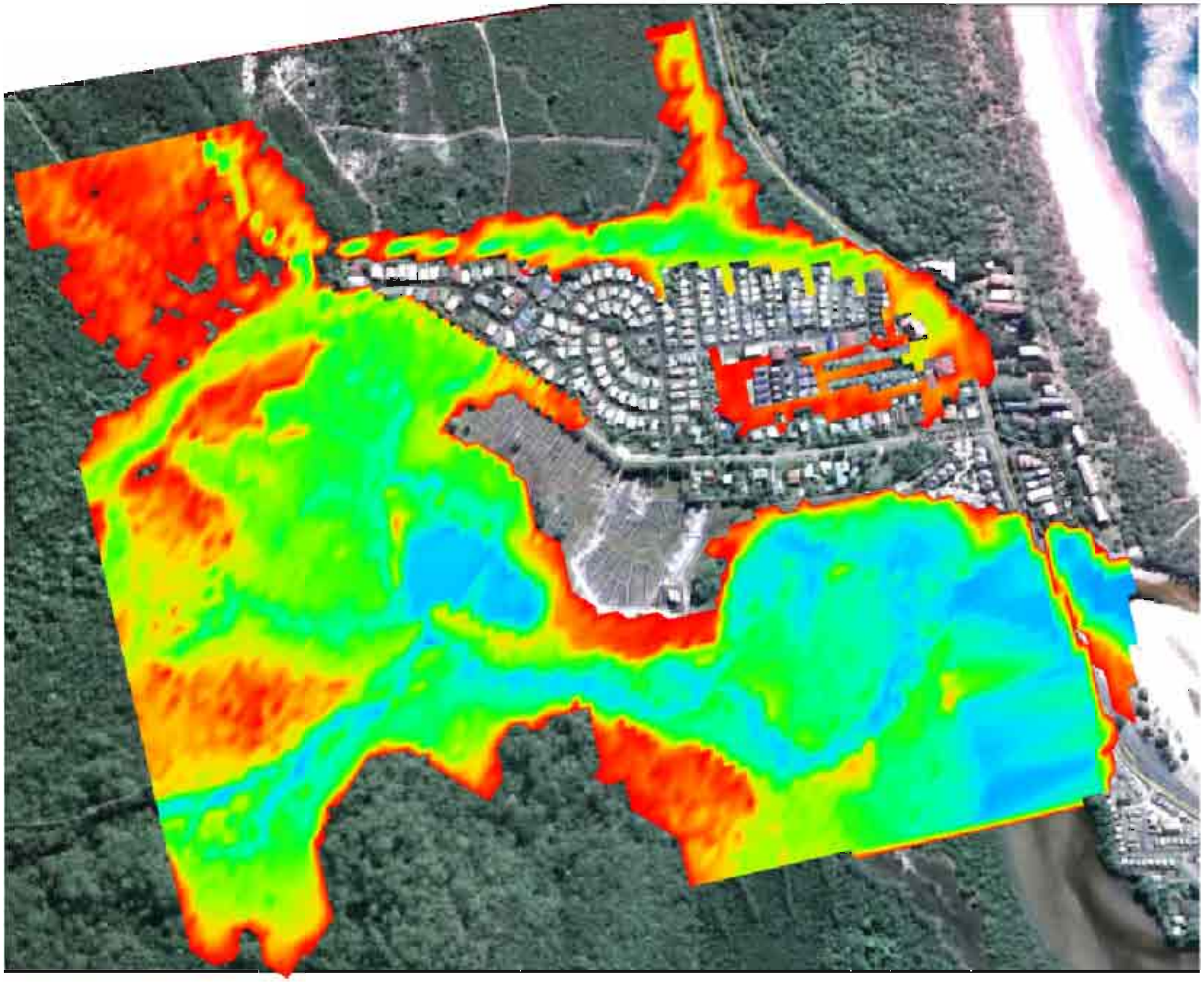

LEGEND – DEPTH (m)

2.50
2.20
1.92
1.65
1.38
1.10
0.83
0.55
0.27
0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 8.1

PROPOSED CASE
Q20 STORM SURGE Q100 CATCHMENT
FLOW – DEPTH

OPUS QANTEC McWILLIAM

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LEGEND – HAZARD (m)

HIGH	3.00
MED	0.80
LOW	0.60
	0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 8.2

PROPOSED CASE
Q20 STORM SURGE Q100 CATCHMENT
FLOW – HAZARD

OPUS QANTEC McWILLIAM

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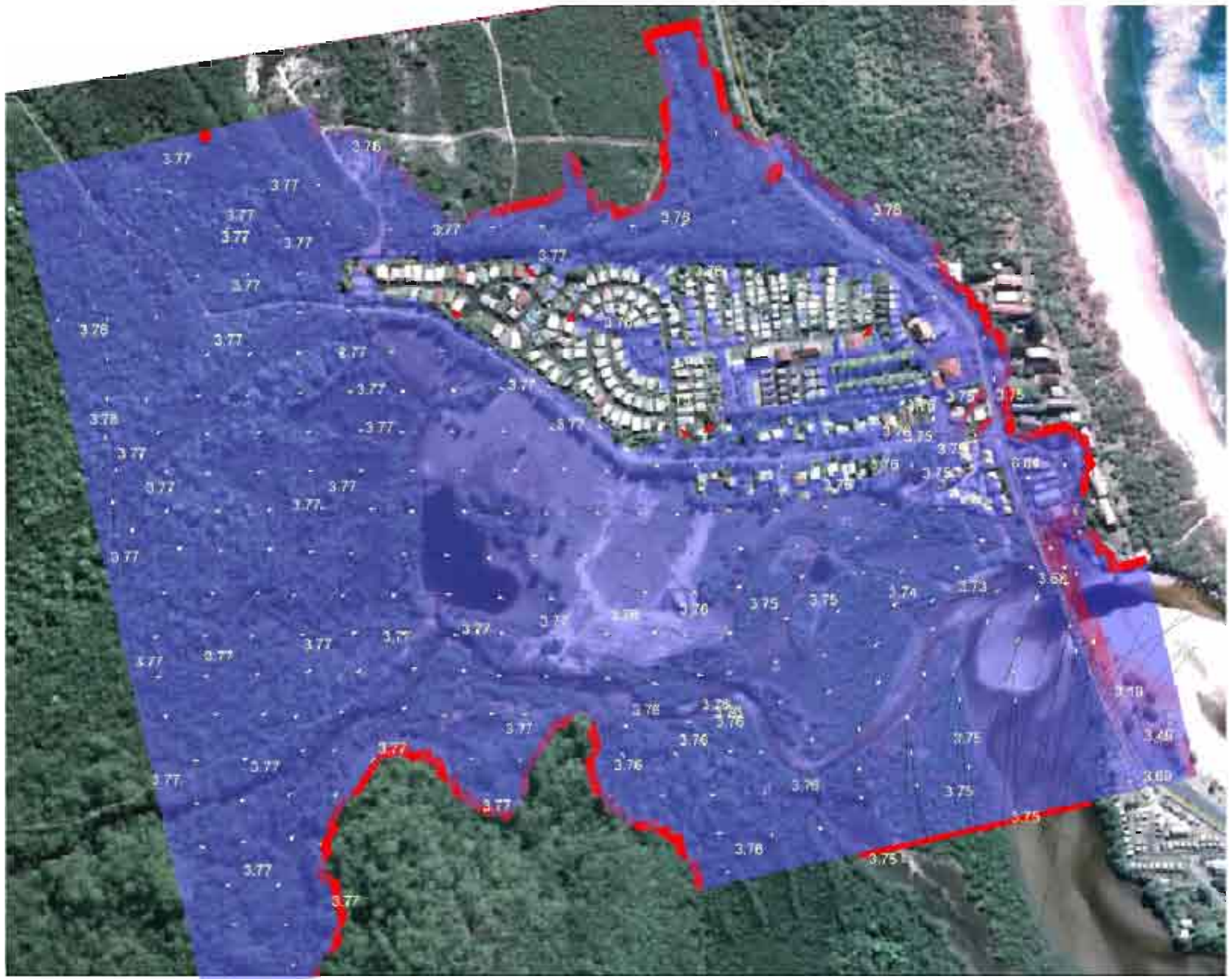

LEGEND – ELEVATION (m)

10.00
8.50
5.00
2.50
1.00
0.00

2.49 SPOT FLOOD ELEVATION (LEVEL)

FLOW DIRECTION

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 9.0

EXISTING CASE
Q100 STORM SURGE PMF FLOW–ELEVATION

OPUS QANTEC McWILLIAM

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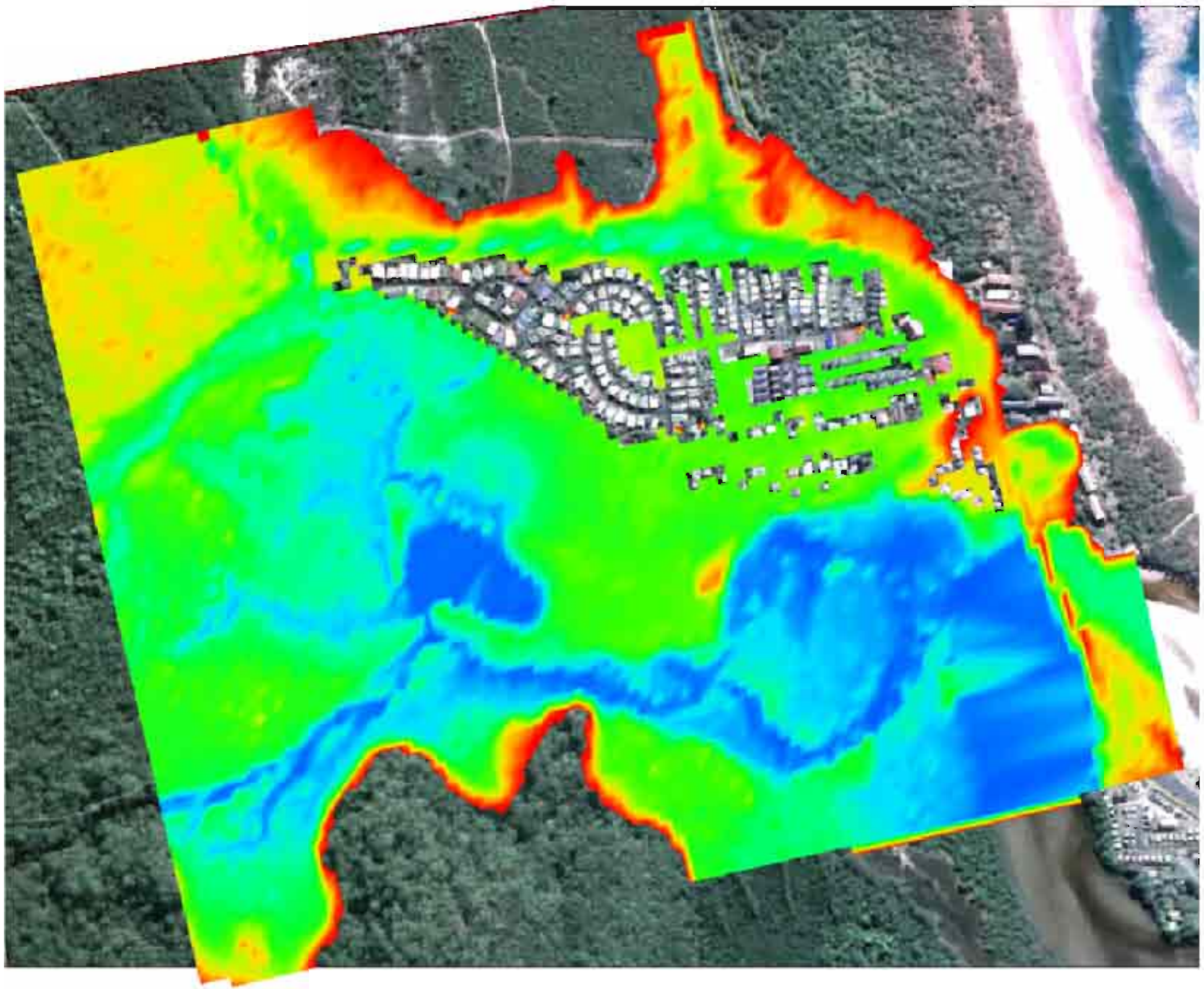

LEGEND – DEPTH (m)

4.00
3.52
3.08
2.64
2.20
1.76
1.32
0.88
0.44
0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 9.1

EXISTING CASE
Q100 STORM SURGE PMF FLOW–DEPTH

OPUS QANTEC McWILLIAM

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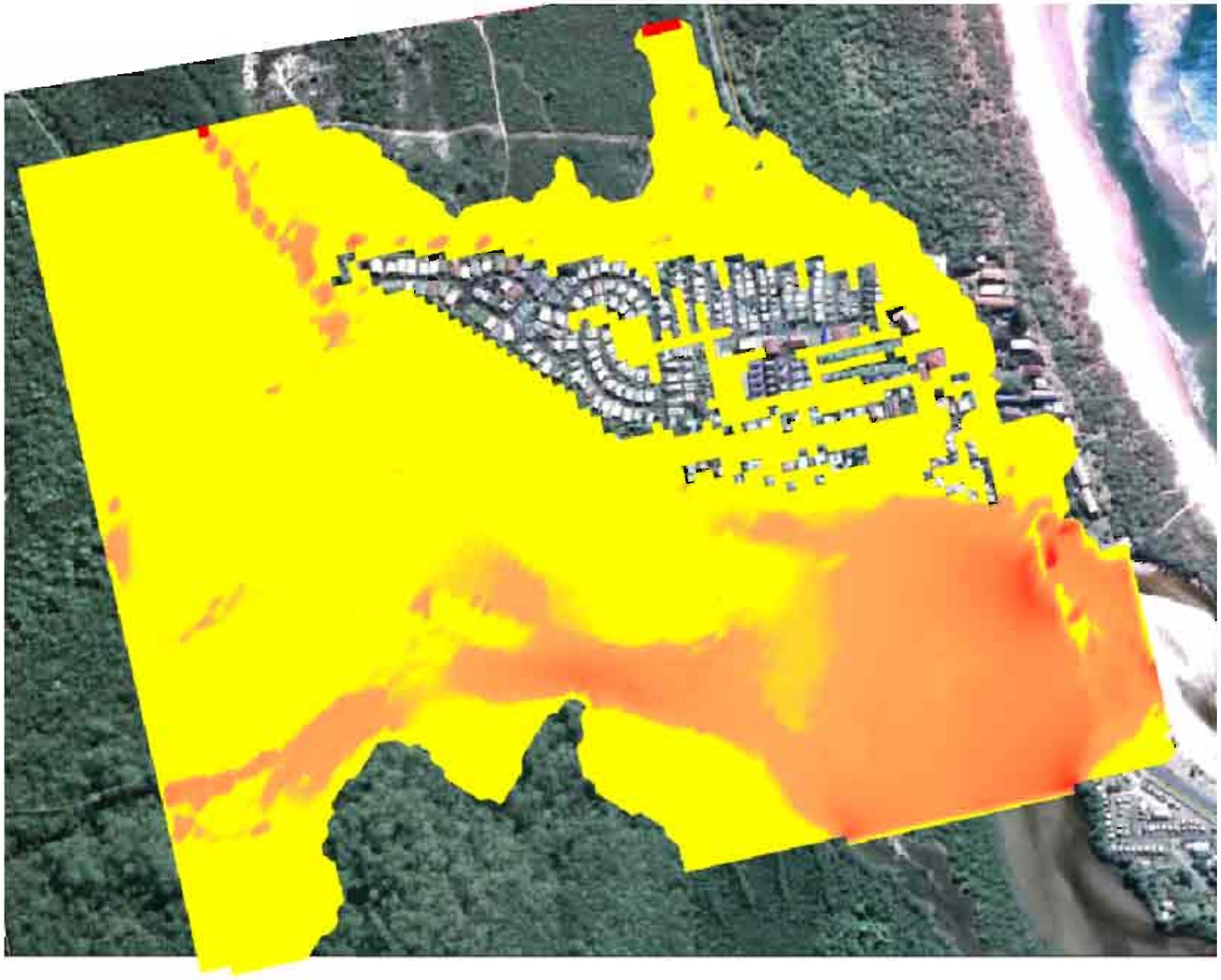

LEGEND – HAZARD (m)

HIGH	7.77
MED	0.80
	0.60
LOW	0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 9.2

EXISTING CASE
Q100 STORM SURGE PMF FLOW–HAZARD

OPUS QANTEC McWILLIAM

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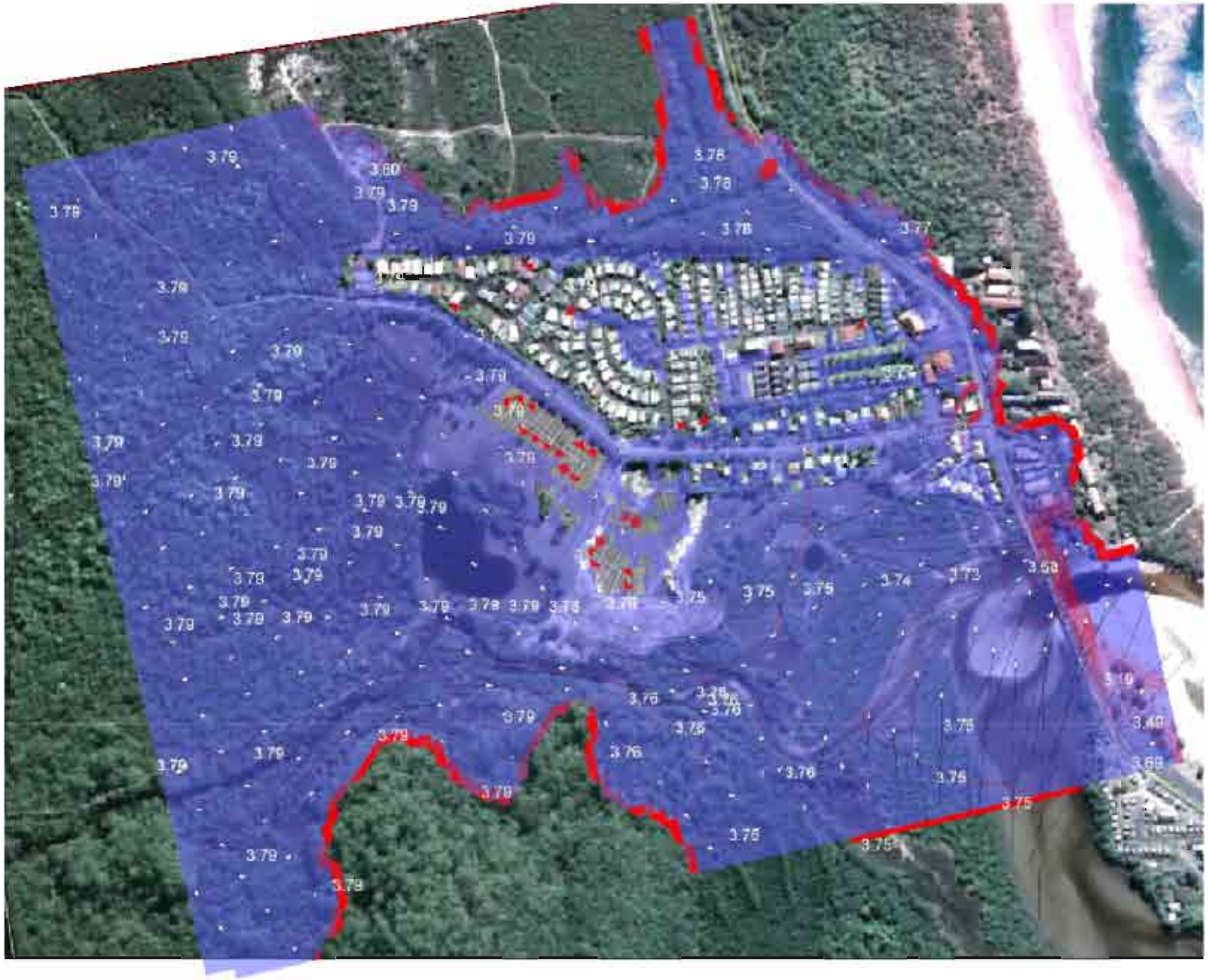

LEGEND – ELEVATION (m)

10.00
8.50
5.00
2.50
1.00
0.00

2.49 SPOT FLOOD ELEVATION (LEVEL)

FLOW DIRECTION

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 10.0

PROPOSED CASE
Q100 STORM SURGE PMF FLOW–ELEVATION

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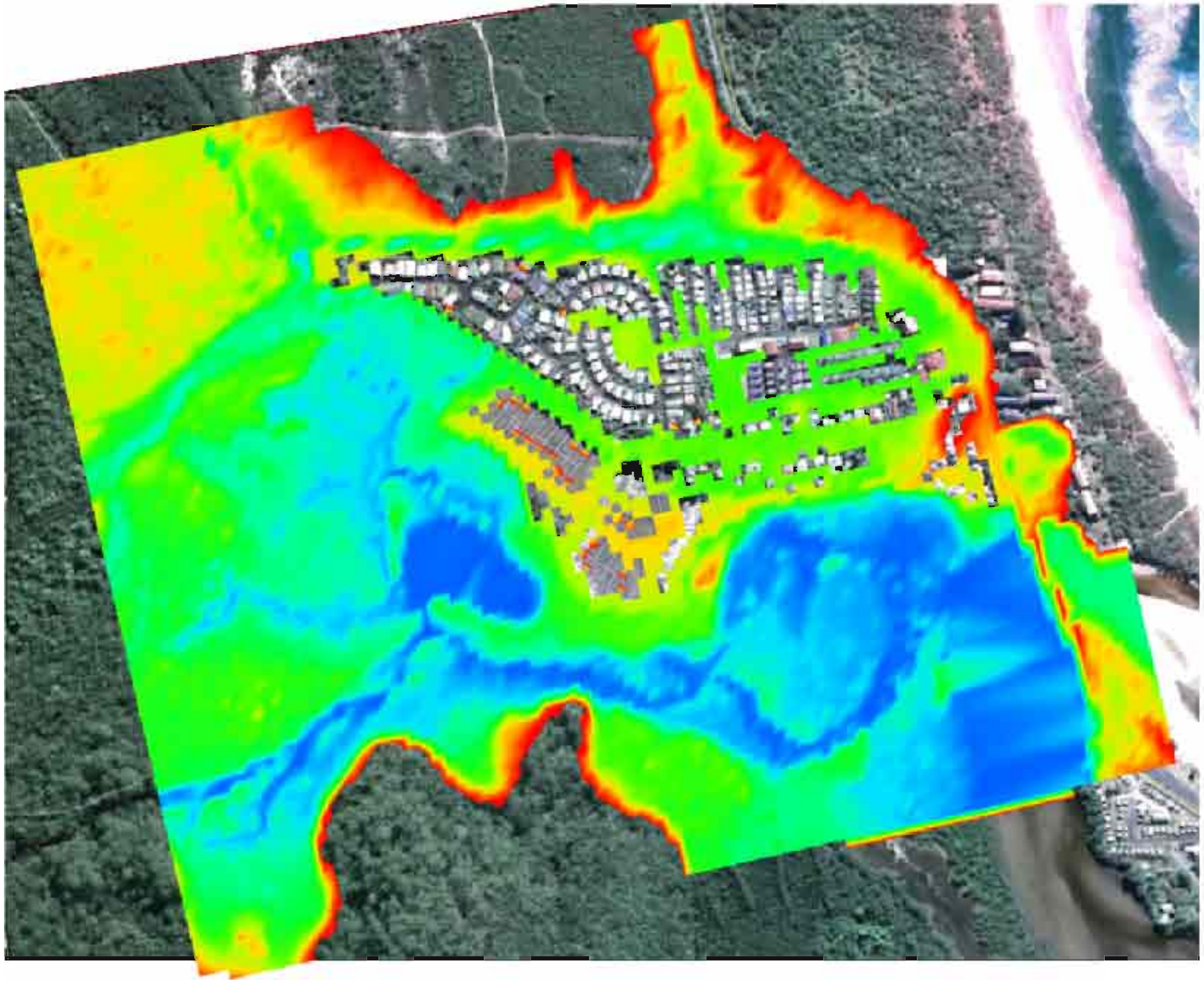

LEGEND – ELEVATION (m)

4.00
3.52
3.08
2.64
2.20
1.76
1.32
0.88
0.44
0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 10.1

PROPOSED CASE
Q100 STORM SURGE PMF FLOW–DEPTH

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LEGEND – ELEVATION (m)

HIGH	3.50
MED	0.80
	0.60
LOW	0.00

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 10.2

PROPOSED CASE
Q100 STORM SURGE PMF FLOW–HAZARD

OPUS QANTEC McWILLIAM

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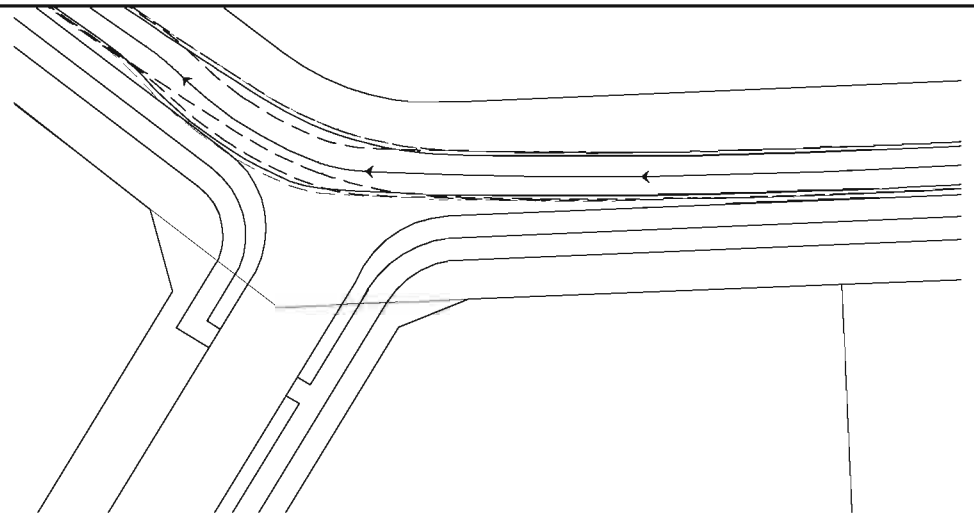
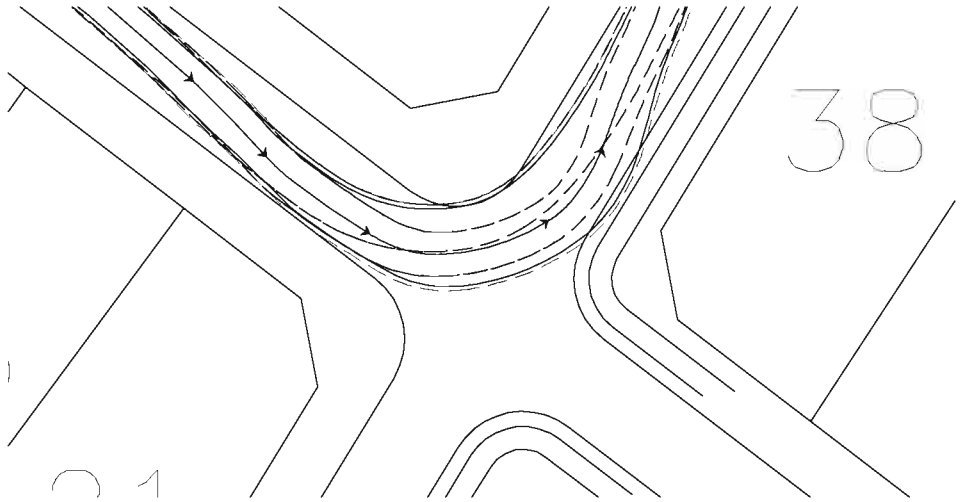


DETAIL A



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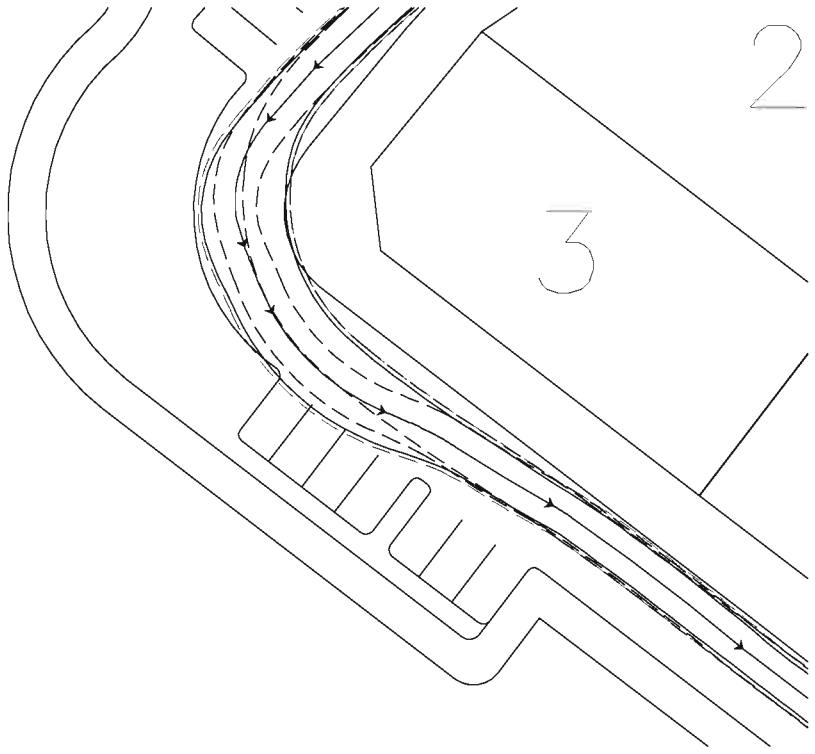

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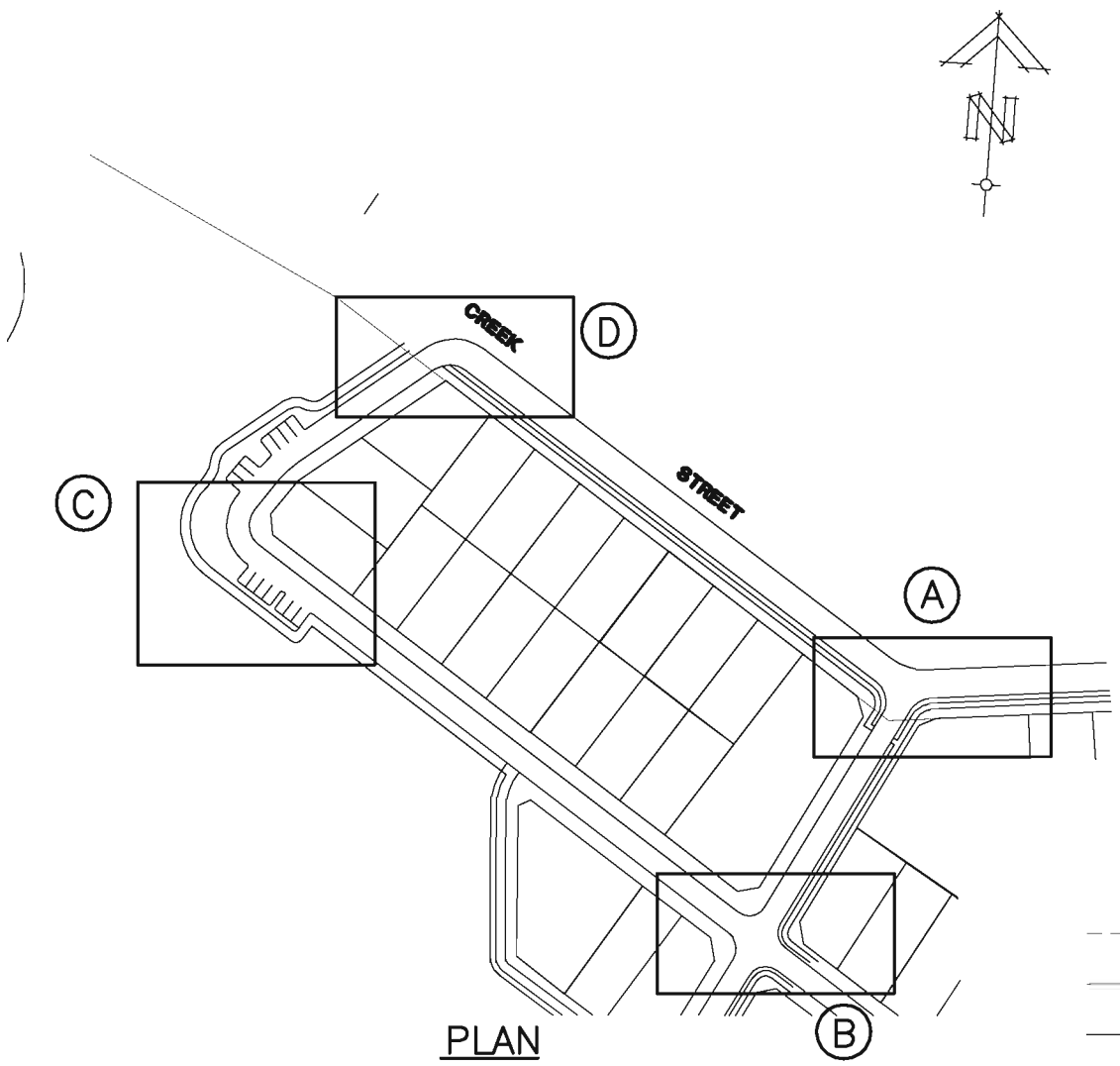
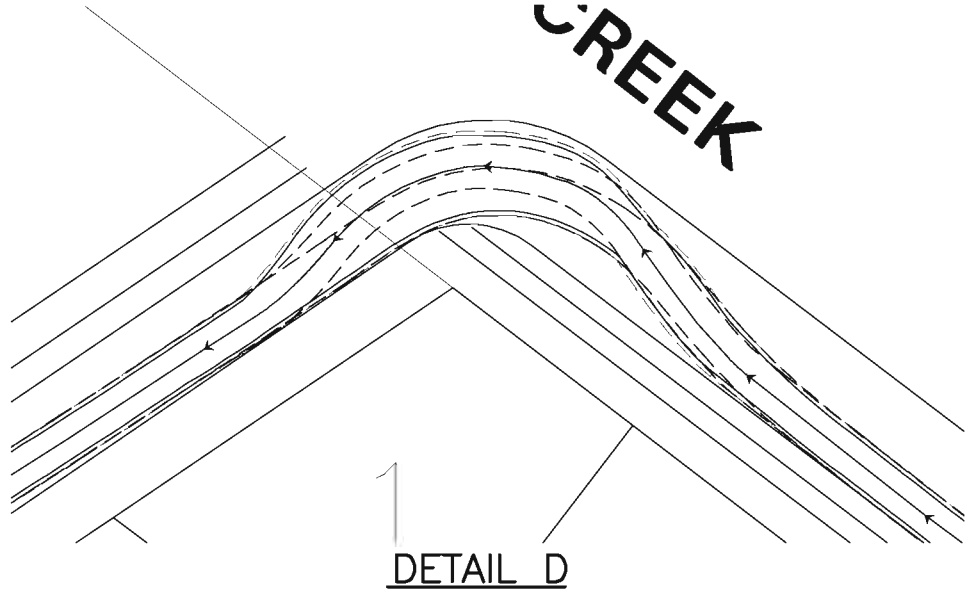


PLAN

0 20 40 60 80m

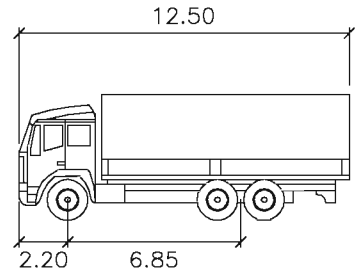
1:2,000 UNREDUCED



DETAIL D

0 5 10 15 20m

1:500 UNREDUCED



SU TRUCK meters

Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.00
Steering Angle	: 36.60

VEHICLE PROFILE

NOT TO SCALE

LEGEND

- FRONT WHEEL PATH
- BODY CLEARANCE (0.3m)
- DRIVE PATH

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 11.0

SERVICE VEHICLE CIRCULATION PLAN
1 OF 2

OPUS QANTEC McWILLIAM

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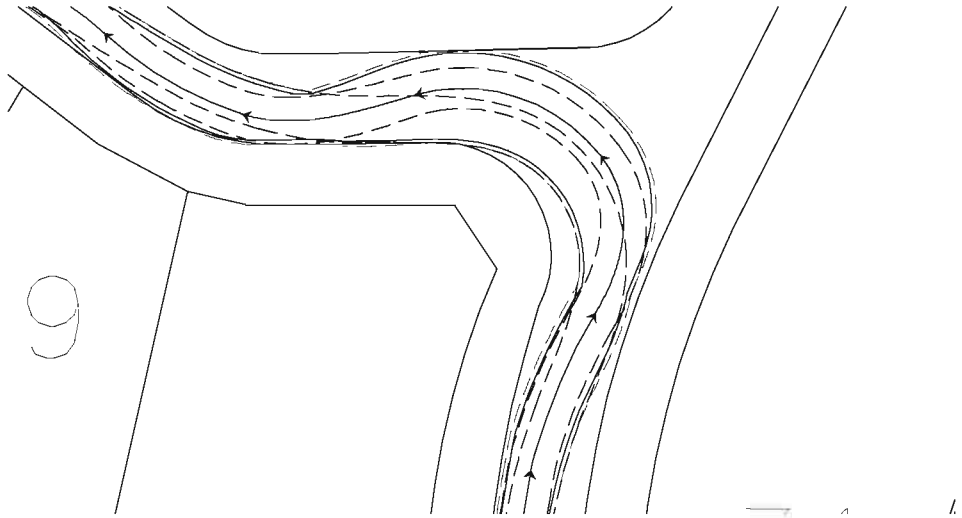
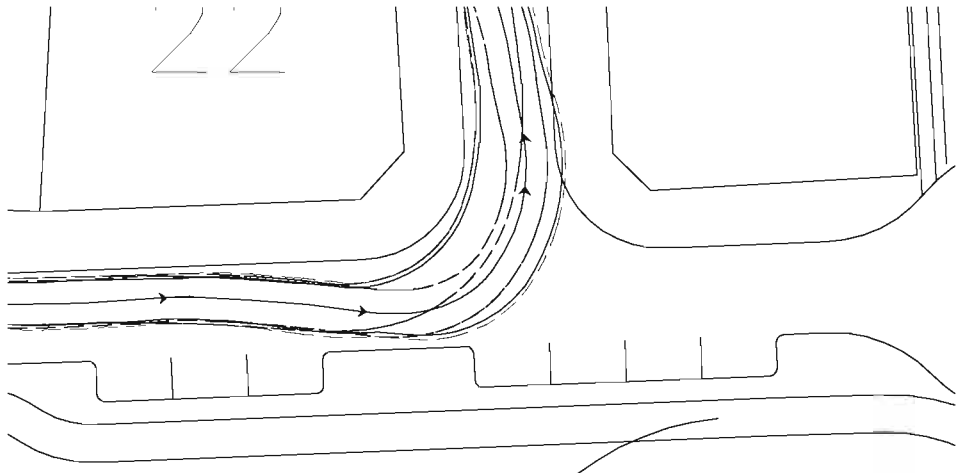
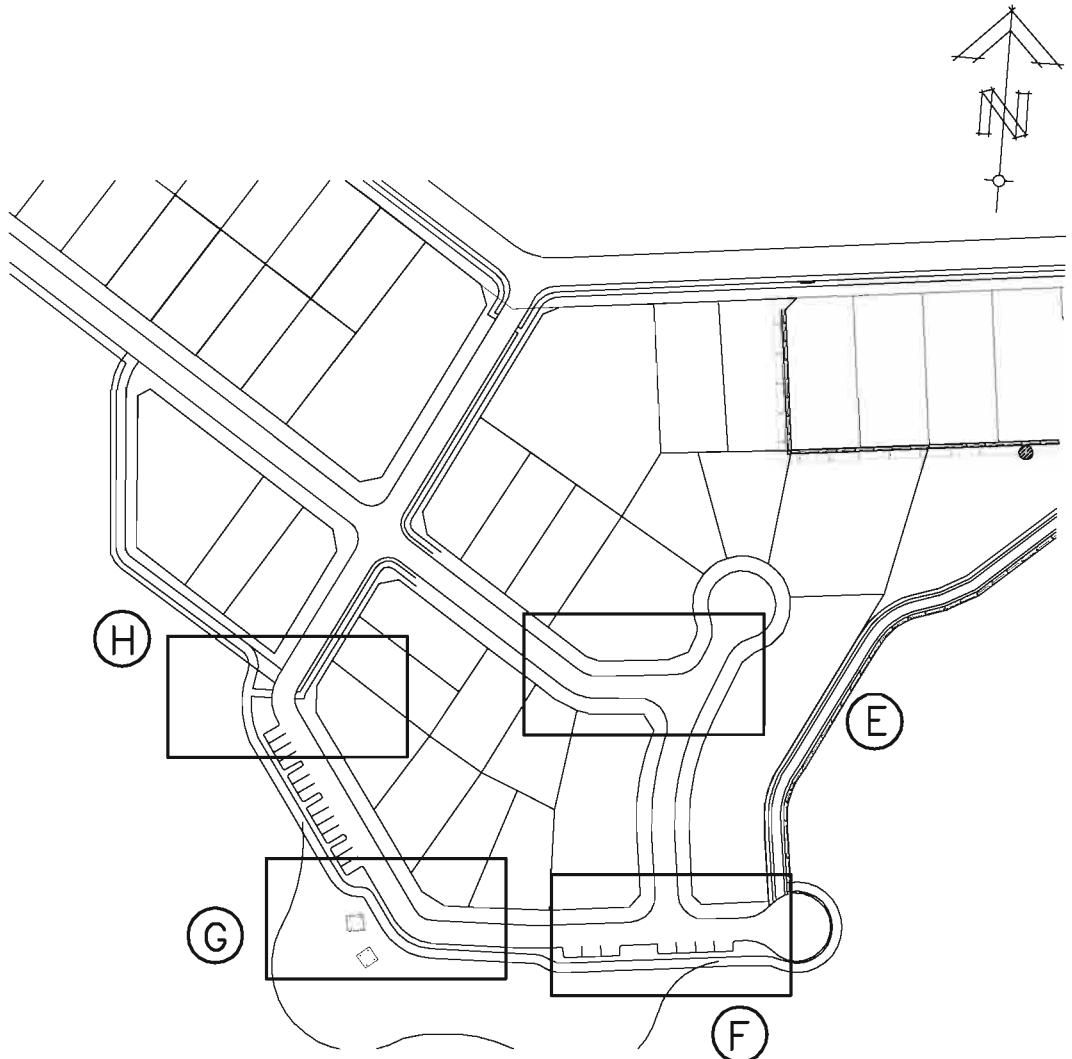


DETAIL E



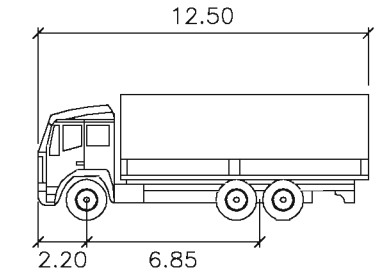
DETAIL F



PLAN

0 20 40 60 80m

1:2,000 UNREDUCED



SU TRUCK meters

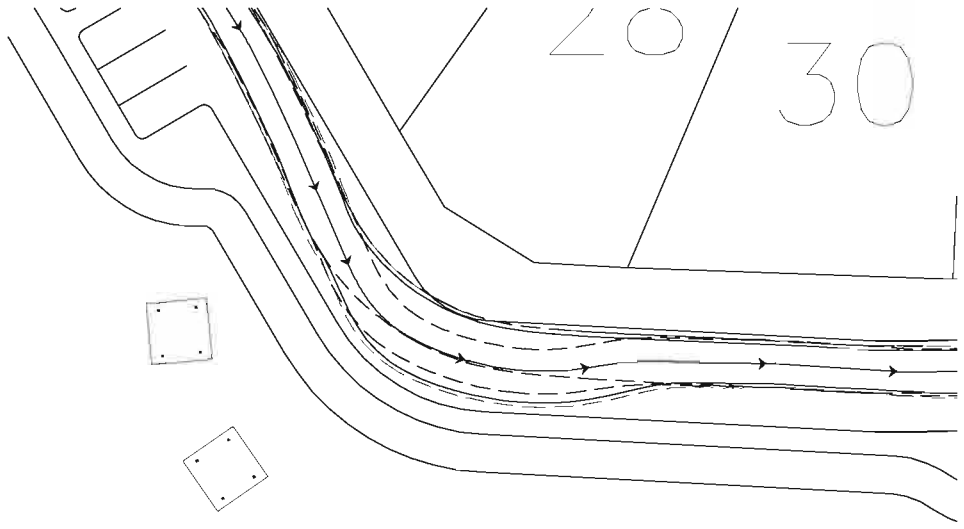
Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.00
Steering Angle	: 36.60

VEHICLE PROFILE

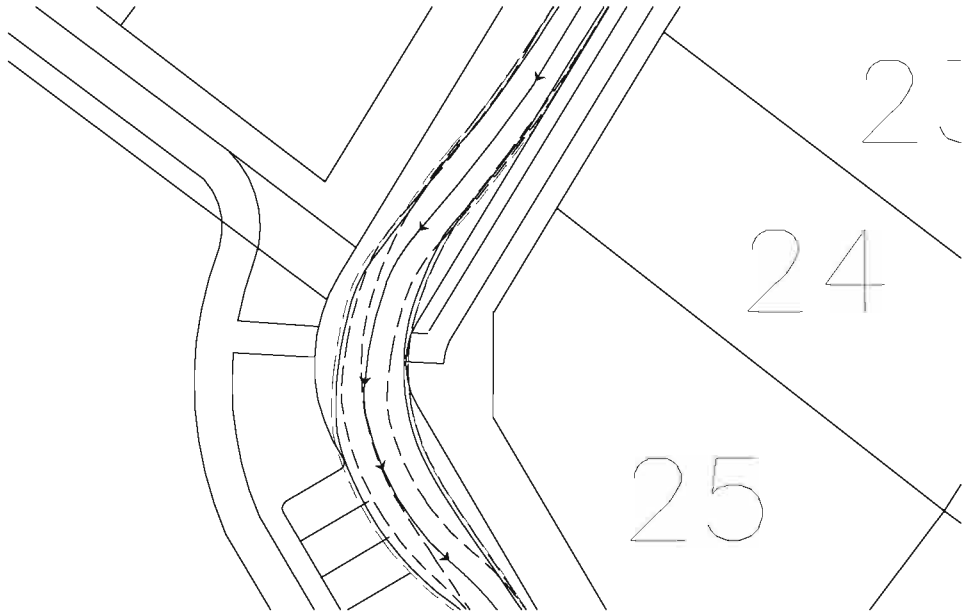
NOT TO SCALE

LEGEND

- FRONT WHEEL PATH
- BODY CLEARANCE (0.3m)
- DRIVE PATH



DETAIL G



DETAIL H

0 5 10 15 20m

1:500 UNREDUCED

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 11.1

SERVICE VEHICLE CIRCULATION PLAN
2 OF 2

OPUS QANTEC McWILLIAM

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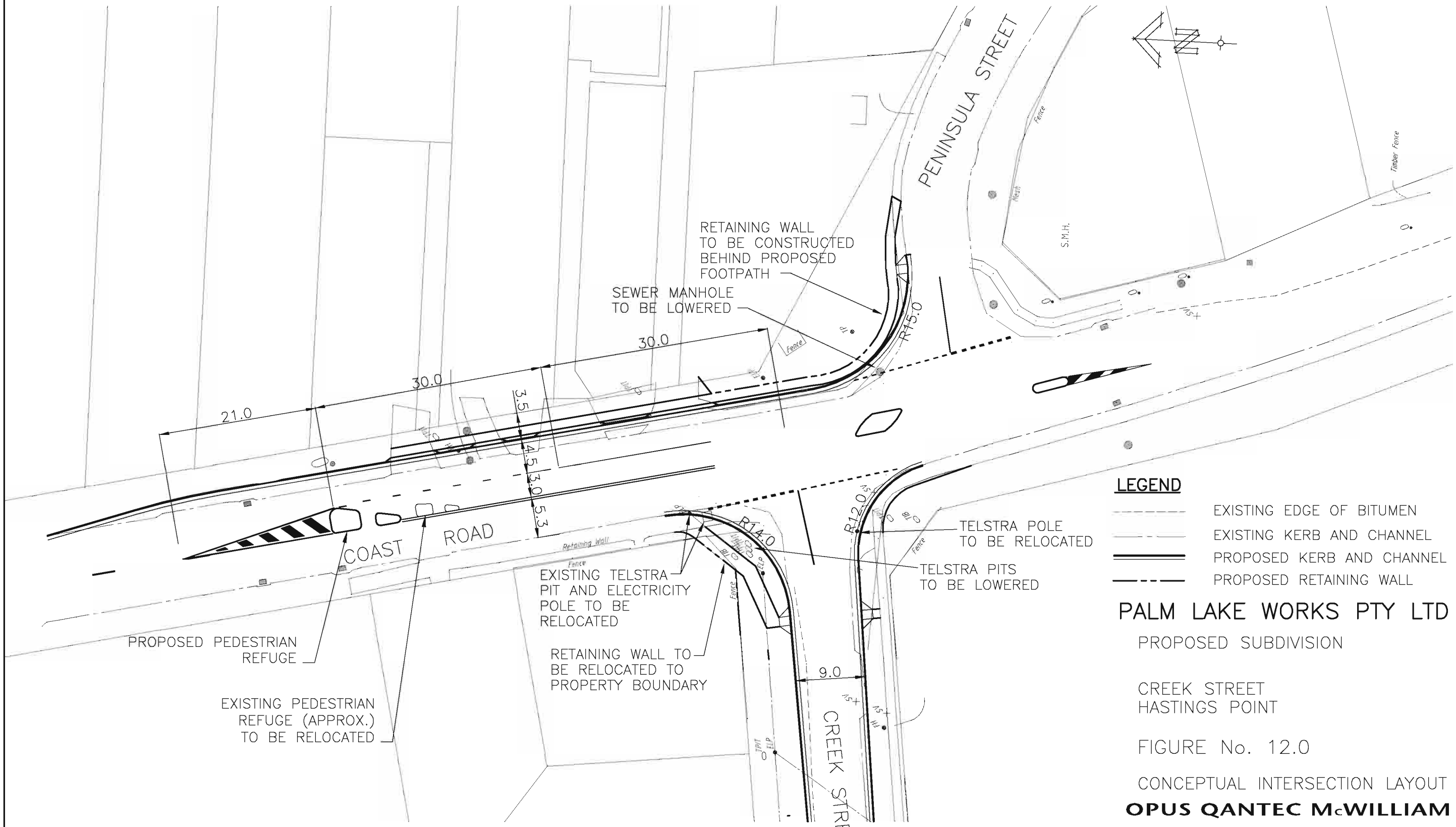

LEGEND

- EXISTING EDGE OF BITUMEN
- EXISTING KERB AND CHANNEL
- PROPOSED KERB AND CHANNEL
- PROPOSED RETAINING WALL

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

CREEK STREET
HASTINGS POINT

FIGURE No. 12.0

CONCEPTUAL INTERSECTION LAYOUT

OPUS QANTEC McWILLIAM

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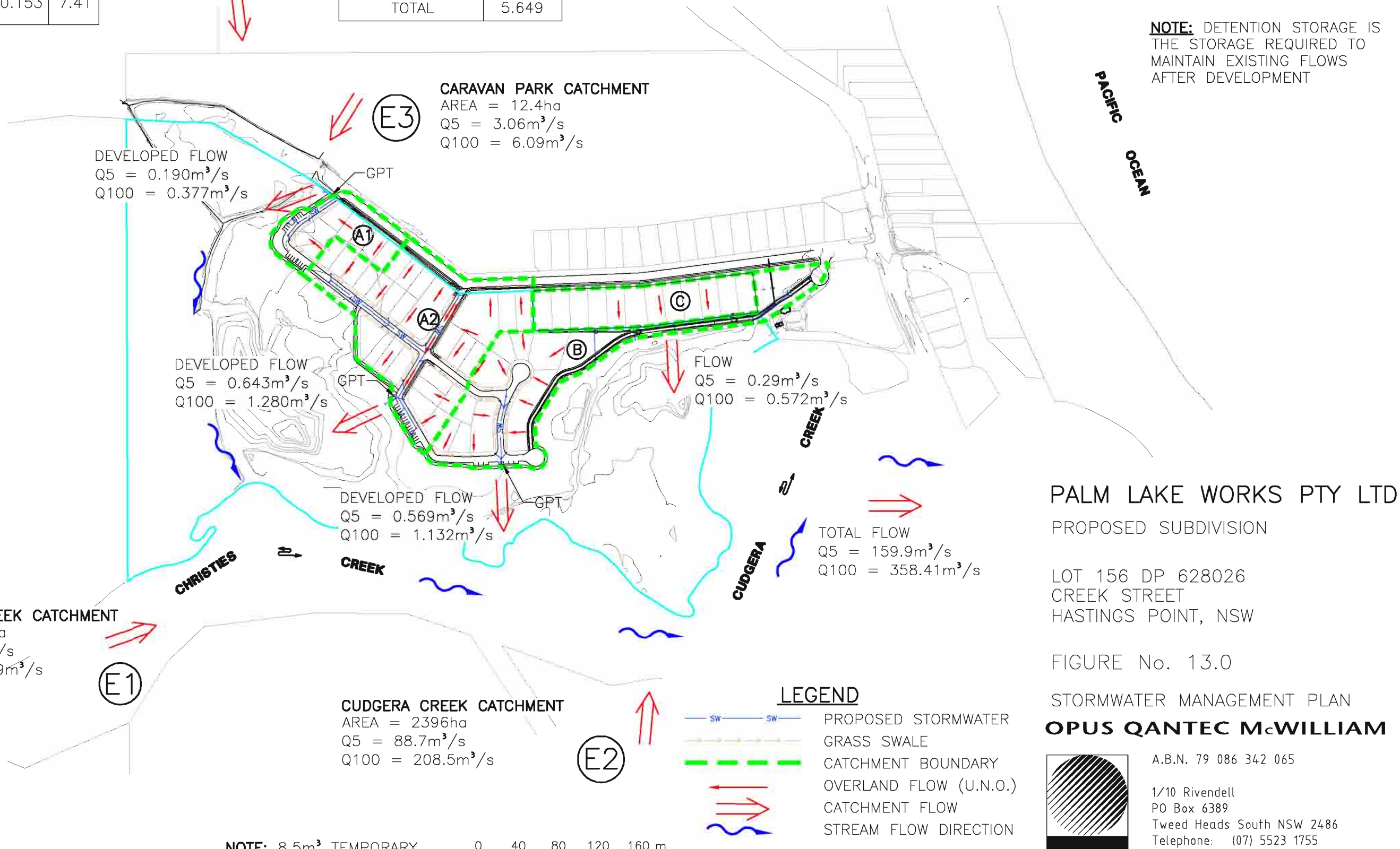
	E5	E4
AREA (ha)	77.34	23.7
Q5 (m^3/s)	14.91	3.64
Q100 (m^3/s)	30.153	7.41

SUB CATCHMENT	AREA(ha)	Q_5 (m^3/s)		Q_{100} (m^3/s)	
		EXISTING	POST DEVELOPMENT	EXISTING	POST DEVELOPMENT
A1	0.627	0.128	0.190	0.258	0.377
A2	2.329	0.434	0.643	0.875	1.280
B	1.803	0.383	0.569	0.772	1.132
C	0.890	0.290	0.290	0.572	0.572
TOTAL	5.649				



NOTE: DETENTION STORAGE IS THE STORAGE REQUIRED TO MAINTAIN EXISTING FLOWS AFTER DEVELOPMENT

LEGEND

- PROPOSED STORMWATER
- GRASS SWALE
- CATCHMENT BOUNDARY
- OVERLAND FLOW (U.N.O.)
- CATCHMENT FLOW
- STREAM FLOW DIRECTION

NOTE: $8.5m^3$ TEMPORARY DETENTION STORAGE PER RESIDENTIAL LOT

0 40 80 120 160 m
1:4,000 UNREDUCED

A3 206012 FEBRUARY, 2010

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 13.0

STORMWATER MANAGEMENT PLAN

OPUS QANTEC McWILLIAM

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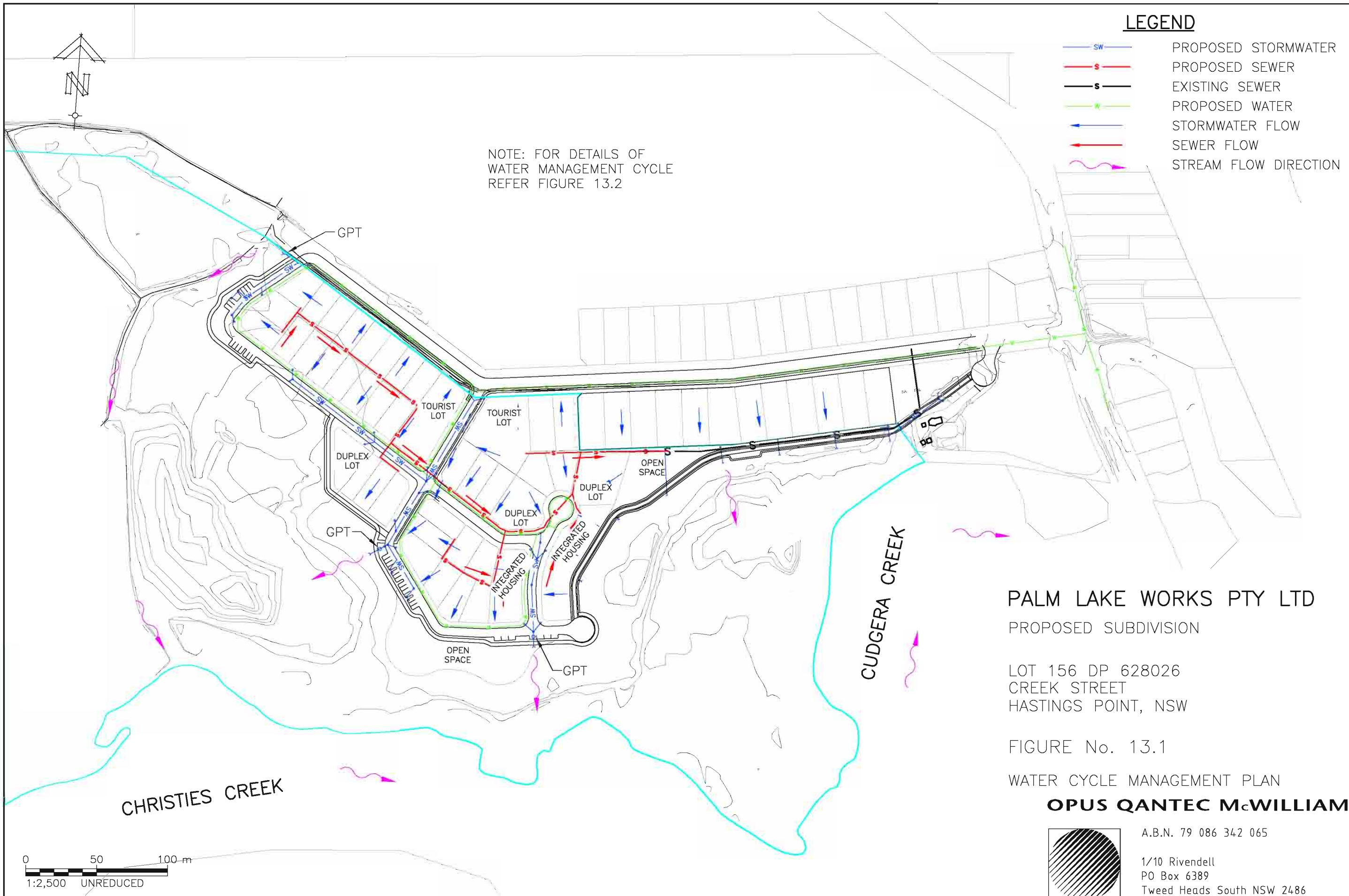

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 13.1

WATER CYCLE MANAGEMENT PLAN

OPUS QANTEC McWILLIAM

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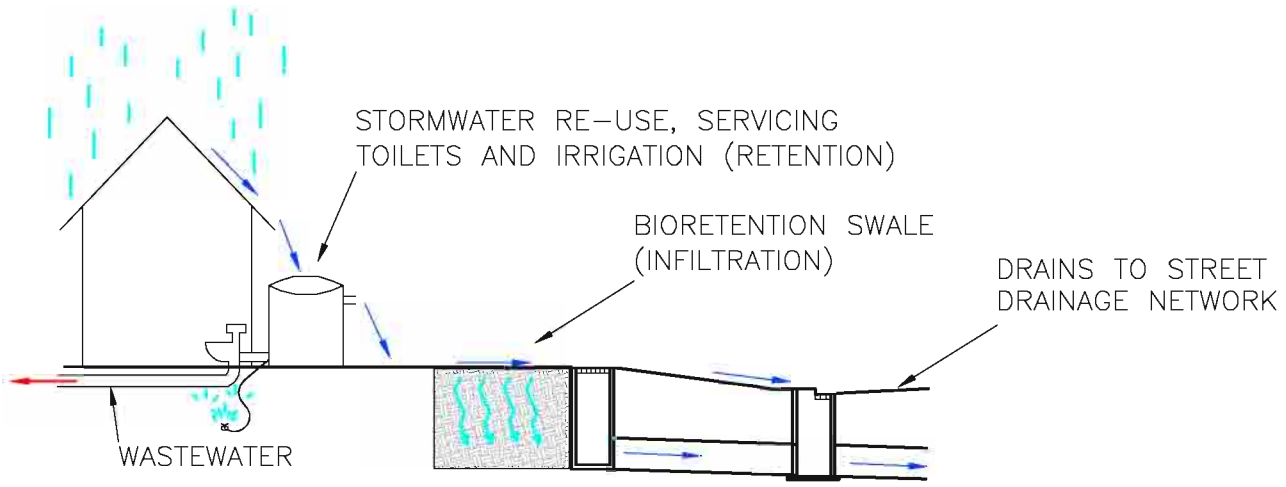
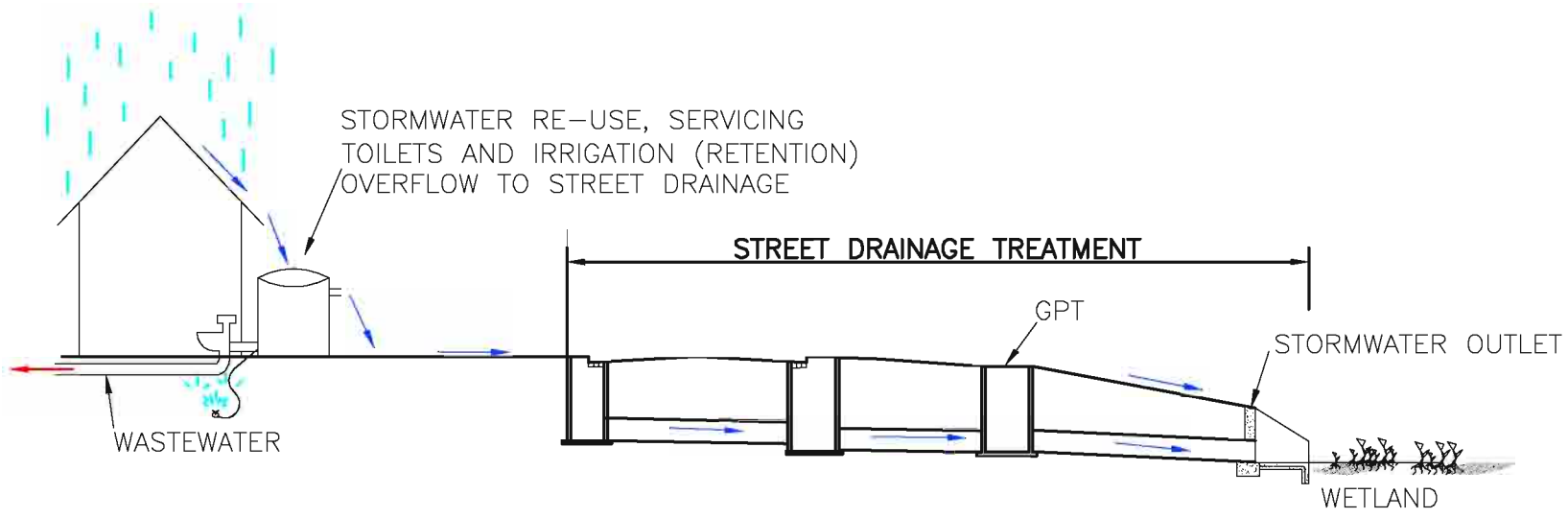


PROPOSED WATER MANAGEMENT CYCLE TOURIST LOTS

NOT TO SCALE



PROPOSED WATER MANAGEMENT CYCLE
RESIDENTIAL/DUPLEX & INTEGRATED HOUSING

NOT TO SCALE

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 13.2

WATER CYCLE MANAGEMENT DETAIL

OPUS QANTEC McWILLIAM

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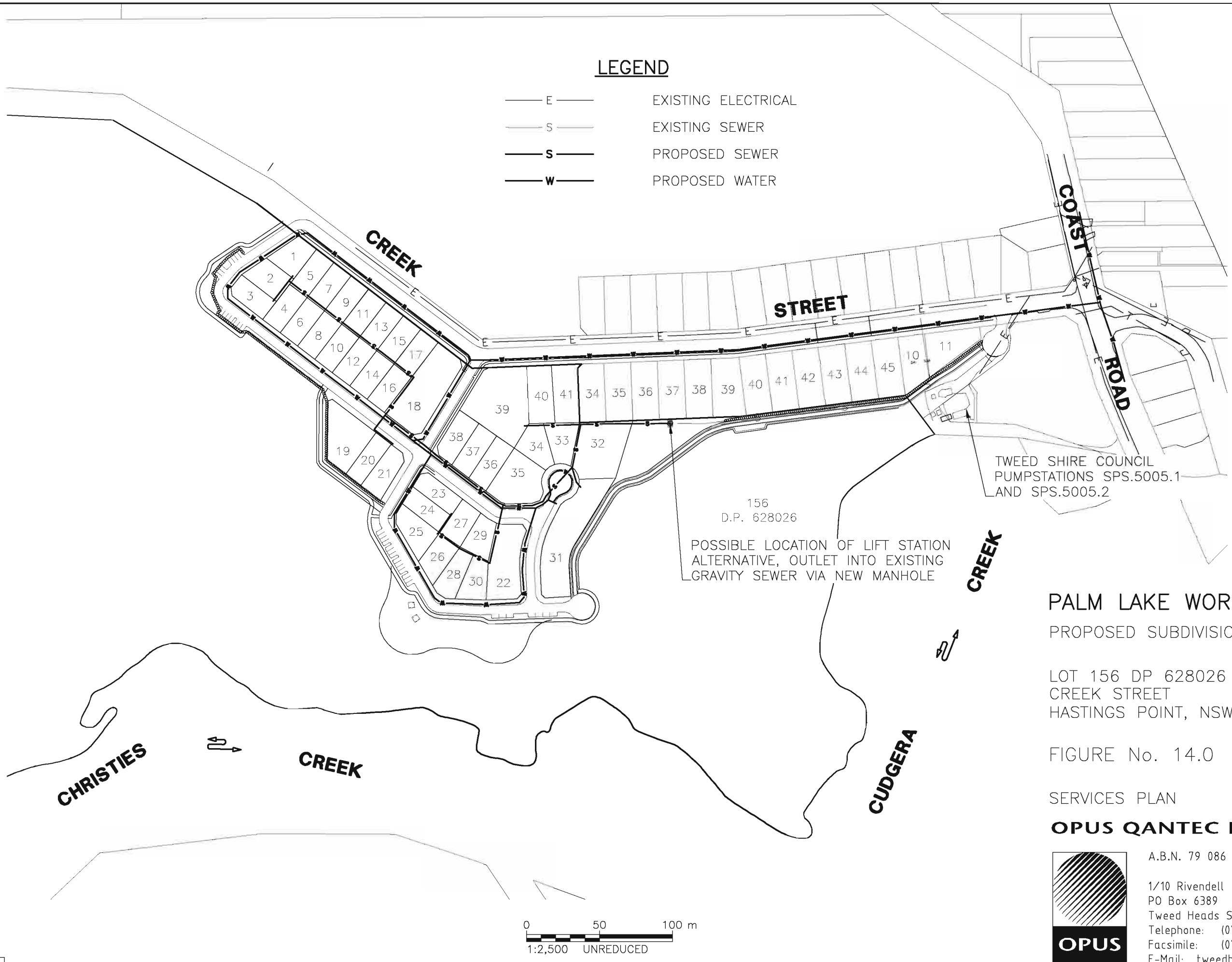


PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 14.0

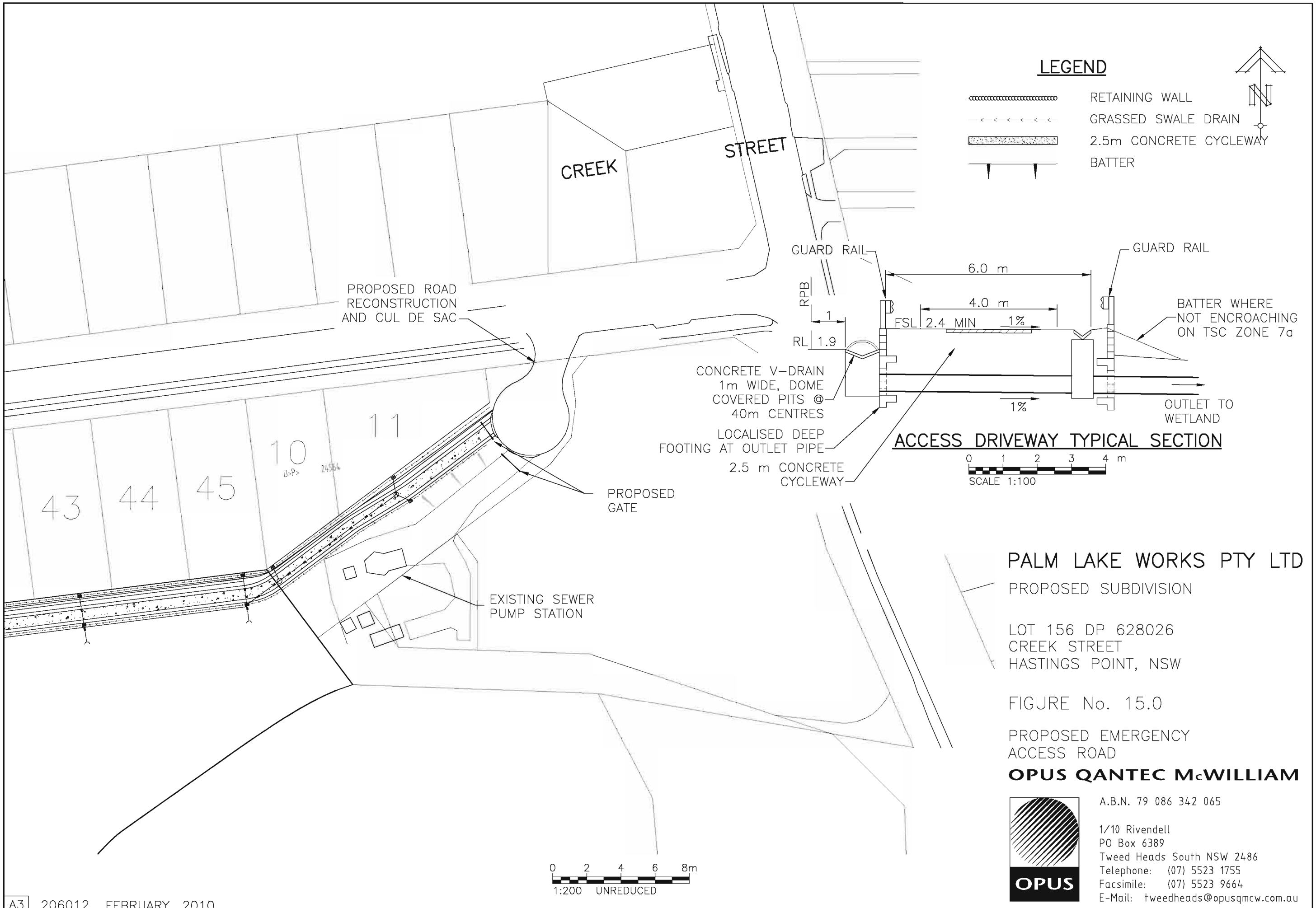
SERVICES PLAN

OPUS QANTEC McWILLIAM

A.B.N. 79 086 342 065

1/10 Rivendell
PO Box 6389
Tweed Heads South NSW 2486
Telephone: (07) 5523 1755
Facsimile: (07) 5523 9664
E-Mail: tweedheads@opusqmcw.com.au

A3 206012 FEBRUARY, 2010



PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 15.0

PROPOSED EMERGENCY ACCESS ROAD

OPUS QANTEC McWILLIAM

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CREEK STREET

40 41 34 35 36 37 38 39 40 41 42 43 44 45

34 33 32 35 31

1 2 3 4

SW

PASSING BAY

2.5m CONCRETE CYCLEWAY
0.75m GRAVEL SHOULDER

LEGEND

- RETAINING WALL
- GRASSED SWALE DRAIN
- 2.5m CONCRETE CYCLEWAY
- BATTER

0 10 20 30 40m
1:1,000 UNREDUCED

A3 206012 FEBRUARY, 2010

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 16.0

ACCESS ROAD DETAILS

OPUS QANTEC McWILLIAM

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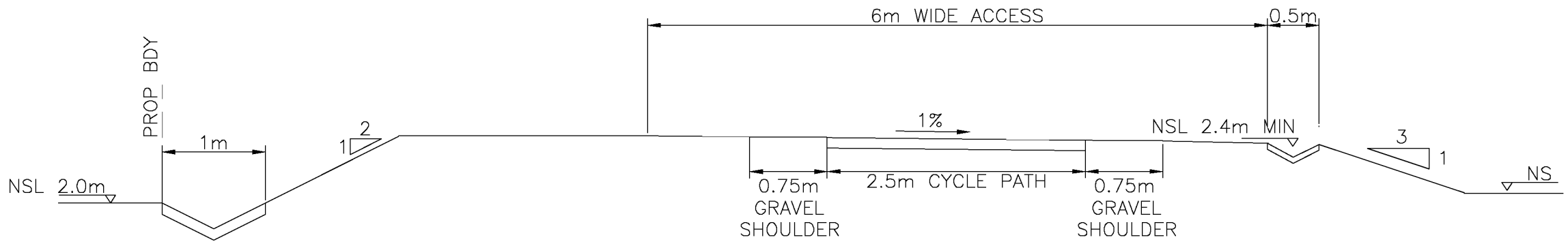
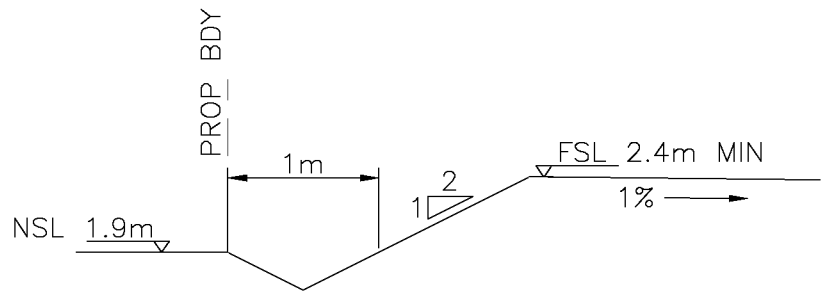
E-Mail: tweedheads@opusqmcw.com.au



SECTION 2



SECTION 1

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1:50 UNREDUCED

A3 206012 FEBRUARY, 2010

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 16.1

ACCESS ROAD CROSS SECTIONS

OPUS QANTEC McWILLIAM

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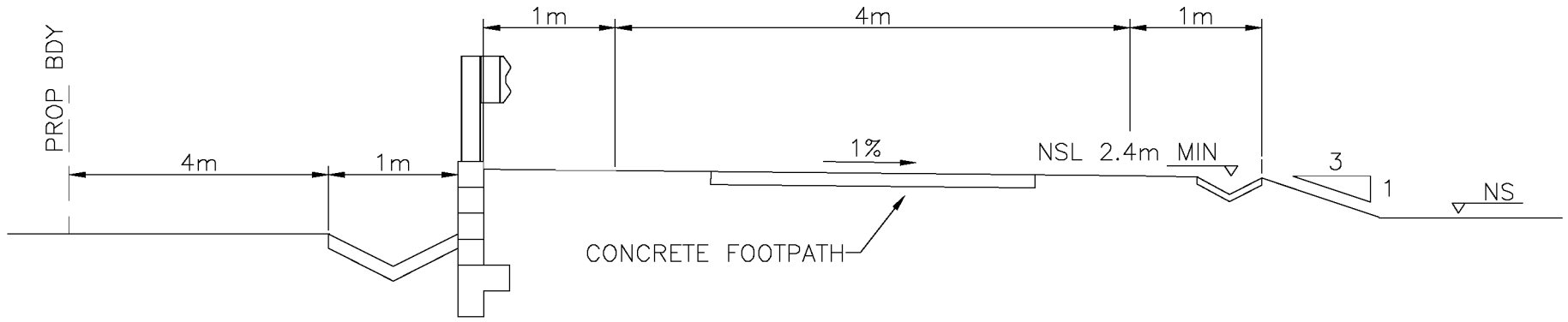
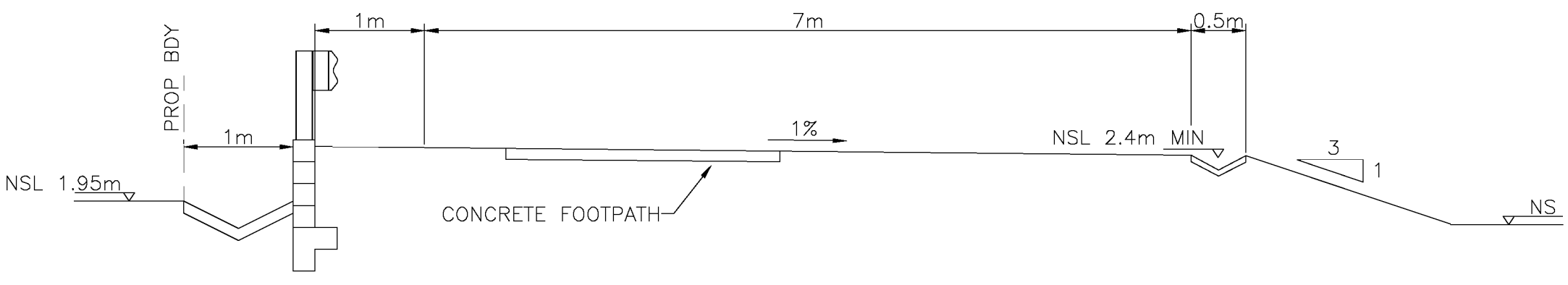


SECTION 4



SECTION 3

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1:50 UNREDUCED

A3 206012 FEBRUARY, 2010

PALM LAKE WORKS PTY LTD

PROPOSED SUBDIVISION

LOT 156 DP 628026
CREEK STREET
HASTINGS POINT, NSW

FIGURE No. 16.2

ACCESS ROAD CROSS SECTIONS

OPUS QANTEC McWILLIAM

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APPENDIX A

Preliminary Acid Sulfate Soil Management Plan

PALM LAKE WORKS PTY LTD

PRELIMINARY ACID SULFATE SOIL MANAGEMENT PLAN

PROPOSED FILLING
LOT 156 DP 628026 CREEK STREET
HASTINGS POINT NSW

OPUS QANTEC McWILLIAM

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PO Box 6389, TWEED HEADS SOUTH NSW 2486

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Facsimile: 07 5523 9664
E-mail: tweedheads@opusqmcw.com.au

MARCH 2008

DOCUMENT HISTORY PAGE

PROJECT NAME:

PROJECT NUMBER: 206012

DOCUMENT TITLE: PRELIMINARY ACID SULFATE SOIL MANAGEMENT PLAN

AUTHOR:

CLIENT: PALM LAKE WORKS PTY LTD

DESCRIPTION: FOR PROPOSED FILLING LOT 156 DP 628026 CREEK STREET HASTINGS POINT NSW

REVISION / ISSUE RECORD

DATE	DESCRIPTION	REV	AUTHOR	VERIFIED

DISTRIBUTION RECORD

	REVISION No. / Qty Issued				
RECIPIENT	**A**	**B**	**C**	**D**	**E**

TABLE OF CONTENTS

APPENDIX A

FIELD pH RESULTS

1. INTRODUCTION

This Acid Sulfate Soil Management Plan forms part of the Development Application and Statement of Environmental Effects for proposed filling in Creek Street, Hastings Point in the Shire of Tweed NSW. It shall be read in conjunction with the Engineering Impact Assessment Report.

It identifies testing frequency and procedures used to detect the presence of acid sulfate soils and the amelioration measures to mitigate potential problems.

2. DESCRIPTION OF THE SITE

The site is located on Lot 156 DP 628026 Creek Street, Hastings Point. The location is shown in Figure 1.0 of the Engineering Impact Assessment.

The approximately 50% of the site is identified in the Acid Sulfate Soil Map for Tweed Heads (9641 S4) published by Department of Land & Water Conservation 1997 as having a “High Probability of acid sulfate soils at or near the ground surface” and investigation for the presence of acid sulfate soils is recommended. The remainder of the site is identified as disturbed terrain and warrants an acid sulfate soils investigation. The existing site features are shown in Figure 2.0 of the Engineering Impact Assessment.

3. PROPOSED ACTIVITES

The current proposal is to fill the flood liable land as a precursor to residential development of the entire lot. Figure 3.0 of the Engineering Impact Assessment outlines the extent of the proposed filling works. The proposed development layout is also given in Figure 3.0. The proposed development may expose acid sulfate soils by excavation for service trenches and footings up to 2m below the existing surface. The location and depth of the trenches has not been determined. Consequently it is necessary to carry out detailed investigation for acid sulfate soil as described below prior to construction.

4. INVESTIGATION

A 0.5kg soil sample was taken at the surface and depths of 0.5m, 1.0m, 1.5m and 2.0m below the natural surface. 16 sampling locations evenly distributed over the development area were used in accordance with the ASSMAC Assessment Guidelines (1998) resulting in a total of 80 samples.

5. TESTING REGIME

All 80 samples were tested for field pH (pHF) and oxidised pH (pHFOX). 20 samples were tested in accordance with the Chromium Reducible Sulfur (Method 22B) and Acid Neutralising Capacity Methods (Method 19A2) described in the ASSMAC Assessment Guidelines (1998).

6. RESULTS

A report on the ASS Investigation was prepared by Soil Surveys Engineering Pty Ltd (July 2004) and is included in Appendix B of the Engineering Impact Assessment. A copy of the test results for field pH tests from this report are appended in Appendix A. These results indicate that Actual Acid Sulfate Soils (AASS) and Potential Acid Sulfate Soils (PASS) are present on the subject site. Test results from the soil Surveys Report based on the Chromium Reducible Sulphur method are given in Appendix B.

7. REMEDIAL ACTION

Sandy soils have been encountered in this locality. Action thresholds for sandy soil types are listed in Table 4.4 of the Assessment Guidelines (ASSMAC 1998). The test results show an Oxidisable Sulfur percentage of 0.03% or greater and a TAA of 18 mol H^+/tonne or greater, therefore the treatment procedures described below must be implemented. Due to the irregular distribution of Acid and Sulfur trails throughout the site, we recommend adopting a single liming rate for all excavations below natural surface.

1. All trench excavation material shall be backfilled within 24 hours.
2. Stormwater runoff from trench spoil stockpiles shall be collected and retained on site. It shall only be released if the pH is greater than 6.5.
   If the pH of the water is less than 6.5 it shall be treated with agricultural lime or an approved alternative until it exceeds 6.5. Furthermore additional lime shall be applied to the soil stockpile and it shall be backfilled into the bottom of the trench immediately.
3. Excavated material shall be treated with agricultural lime at a rate of 21.3kg/tonne.

8. REPORTING

The Contractor shall report all cases to Council where the pH of collected leachate is less than 4.5.

9. CONCLUSION

The proposed excavation of service trenches and footings associated with the residential subdivision in Creek Street, Hastings Point will result in disturbance of acid sulfate soils. The application of amelioration measures described in this Management Plan will mitigate adverse impacts.

10. REFERENCE

STONE Y, AHERN CR & BLUNDEN B	(1998)	Acid Sulfate Soils Manual 1998. Acid Sulfate Management Advisory Committee, Wollongbar NSW Australia.

Report Prepared By

TRAVIS SERESHEFF

Engineer

Approved for Issue

MARTIN FINDLATER

Branch Manager

RPEQ 1969

APPENDIX A

FIELD pH RESULTS

(PRELIMINARY ACID SULFATE SOIL MANAGEMENT)

ALS Environmental

QUALITY CONTROL REPORT

Client	:	SOIL SURVEYS ENGINEERING P/L	Laboratory	:	ALS Environmental Brisbane	Page	: 1 of 16
Contact	:	PATRICK KIDD	Contact	:	Michael Heery		
Address	:	9/39 LAWRENCE DRIVE NERANG QLD AUSTRALIA 4211	Address	:	32 Shand Street Stafford QLD Australia 4053	No. of samples	: 22
Project	:	204 4808	Quote number	:	---	Date received	: 29 Jun 2004
Order number	:	B5702	Unique Report ID	:	00701	Date issued	: 12 Jul 2004
C-O-C number	:	- Not provided -					
Site	:	- Not provided -					
E-mail	:	pkidd@soilsurveys.com.au	E-mail	:	Michael.Heery@alsenviro.com	Work order	: **EB0403190**
Telephone	:	(07)5596-1528	Telephone	:	61-7-32437222		
Facsimile	:	(07)5578-3916	Facsimile	:	61-7-32437259		

This final report was issued on Monday, July 12, 2004 for the ALSE work order reference EB0403190 and supersedes any reports with this reference.
Results apply to the samples as submitted. All pages of this report have been checked and approved for release.
ND: Unable to determine the result due to sample matrix interference.
Particular samples required dilution prior to analysis due to matrix interferences. LOR values have been adjusted accordingly.

ALSE - QUALITY, SERVICE and TECHNOLOGY provided GLOBALLY

NATA Accredited Laboratory - 825

The Laboratory is accredited by the National Association of Testing Authorities, Australia. The test(s) reported herein have been performed in accordance with its scope of accreditation. This document shall not be reproduced except in full.

This document has been digitally signed by those names who appear on this report and are the authorised signatories. Digital signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	Position	Department
Greg Greenland	Senior Organic Chemist	Inorganics - NATA 818 (Brisbane)
Greg Greenland	Senior Organic Chemist	Organics - NATA 818 (Brisbane)
Kim McCabe	Inorganics Supervisor	Inorganics - NATA 818 (Brisbane)
Shaun Crabb	Metals Team Leader	Inorganics - NATA 818 (Brisbane)

Quality Control Report - Laboratory Duplicates

The quality control term **Laboratory Duplicate** refers to an intralaboratory split sample randomly selected from the sample batch. Laboratory duplicates provide information on method precision and sample heterogeneity.
- Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** = *Limit of Reporting,* ***RPD*** = *Relative Percent Difference.*
* Indicates failed QC.
The permitted ranges for the RPD of Laboratory Duplicates (relative percent deviation) are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:-
- Result < 10 times LOR, no limit - Result between 10 and 20 times LOR, 0% - 50% - Result > 20 times LOR, 0% - 20%

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EA055-103: Moisture Content						
EA055: Moisture Content - (QC Lot: 10246)				%	%	%
EB0403135-004	- Anonymous -	Moisture Content (dried @ 103°C)	0.1 %	43.5	46.3	6.2
EA055: Moisture Content - (QC Lot: 10246)				%	%	%
EB0403135-011	- Anonymous -	Moisture Content (dried @ 103°C)	0.1 %	82.9	74.5	10.7
EA055: Moisture Content - (QC Lot: 10247)				%	%	%
EB0403190-005	204 4808 5A	Moisture Content (dried @ 103°C)	0.1 %	5.1	4.9	5.0
EA055: Moisture Content - (QC Lot: 10247)				%	%	%
EB0403190-012	204 4808 12A	Moisture Content (dried @ 103°C)	0.1 %	4.3	5.0	16.4
EG005T: Total Metals by ICP-AES						
EG005T: Total Metals by ICP-AES - (QC Lot: 10541)				mg/kg	mg/kg	%
EB0403128-001	- Anonymous -	Arsenic	1 mg/kg	13	12	0.0
		Cadmium	1 mg/kg	<1	<1	0.0
		Chromium	1 mg/kg	12	10	15.6
		Nickel	1 mg/kg	10	7	25.8
EG005T: Total Metals by ICP-AES - (QC Lot: 10541)				mg/kg	mg/kg	%
EB0403128-011	- Anonymous -	Arsenic	1 mg/kg	52	54	5.5
		Cadmium	1 mg/kg	<1	<1	0.0
		Chromium	1 mg/kg	8	8	0.0
		Copper	1 mg/kg	16	16	0.0
		Lead	1 mg/kg	14	14	0.0
		Nickel	1 mg/kg	4	4	0.0
		Zinc	1 mg/kg	27	28	5.2

ALS Environmental

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EG005T: Total Metals by ICP-AES - (QC Lot: 10543)				mg/kg	mg/kg	%
EB0403190-001	204 4808 1A	Arsenic	1 mg/kg	<1	<1	0.0
		Cadmium	1 mg/kg	<1	<1	0.0
		Chromium	1 mg/kg	<1	<1	0.0
		Copper	1 mg/kg	<1	<1	0.0
		Lead	1 mg/kg	<1	<1	0.0
		Nickel	1 mg/kg	<1	<1	0.0
		Zinc	1 mg/kg	1	1	0.0
EG005T: Total Metals by ICP-AES - (QC Lot: 10543)				mg/kg	mg/kg	%
EB0403190-011	204 4808 11A	Arsenic	1 mg/kg	<1	<1	0.0
		Cadmium	1 mg/kg	<1	<1	0.0
		Chromium	1 mg/kg	<1	<1	0.0
		Copper	1 mg/kg	<1	<1	0.0
		Lead	1 mg/kg	2	2	0.0
		Nickel	1 mg/kg	<1	<1	0.0
		Zinc	1 mg/kg	2	2	0.0
EG035T: Total Mercury by FIMS						
EG035T: Total Mercury by FIMS - (QC Lot: 10542)				mg/kg	mg/kg	%
EB0403190-001	204 4808 1A	Mercury	0.1 mg/kg	<0.1	<0.1	0.0
EG035T: Total Mercury by FIMS - (QC Lot: 10542)				mg/kg	mg/kg	%
EB0403190-011	204 4808 11A	Mercury	0.1 mg/kg	<0.1	<0.1	0.0
EG035T: Total Mercury by FIMS - (QC Lot: 10544)				mg/kg	mg/kg	%
EB0403236-001	- Anonymous -	Mercury	0.1 mg/kg	<0.1	<0.1	0.0

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EP068: Pesticides by GCMS						
EP068A: Organochlorine Pesticides (OC) - (QC Lot: 10217)				mg/kg	mg/kg	%
EB0403155-001	- Anonymous -	alpha-BHC	0.05 mg/kg	<0.12	<0.12	0.0
		Hexachlorobenzene (HCB)	0.05 mg/kg	<0.12	<0.12	0.0
		beta-BHC	0.05 mg/kg	<0.12	<0.12	0.0
		gamma-BHC	0.05 mg/kg	<0.12	<0.12	0.0
		delta-BHC	0.05 mg/kg	<0.12	<0.12	0.0
		Heptachlor	0.05 mg/kg	<0.12	<0.12	0.0
		Aldrin	0.05 mg/kg	<0.12	<0.12	0.0
		Heptachlor epoxide	0.05 mg/kg	<0.12	<0.12	0.0
		trans-Chlordane	0.05 mg/kg	<0.12	<0.12	0.0
		alpha-Endosulfan	0.05 mg/kg	<0.12	<0.12	0.0
		cis-Chlordane	0.05 mg/kg	<0.12	<0.12	0.0
		Dieldrin	0.05 mg/kg	<0.12	<0.12	0.0
		4.4'-DDE	0.05 mg/kg	<0.12	<0.12	0.0
		Endrin	0.05 mg/kg	<0.12	<0.12	0.0
		beta-Endosulfan	0.05 mg/kg	<0.12	<0.12	0.0
		4.4'-DDD	0.05 mg/kg	<0.12	<0.12	0.0
		Endrin aldehyde	0.05 mg/kg	<0.12	<0.12	0.0
		Endosulfan sulfate	0.05 mg/kg	<0.12	<0.12	0.0
		4.4'-DDT	0.2 mg/kg	<0.2	<0.2	0.0
		Endrin ketone	0.05 mg/kg	<0.12	<0.12	0.0
		Methoxychlor	0.2 mg/kg	<0.2	<0.2	0.0
EP068B: Organophosphorus Pesticides (OP) - (QC Lot: 10217)				mg/kg	mg/kg	%
EB0403155-001	- Anonymous -	Dichlorvos	0.05 mg/kg	<0.12	<0.12	0.0
		Demeton-S-methyl	0.05 mg/kg	<0.12	<0.12	0.0
		Monocrotophos	0.2 mg/kg	<0.2	<0.2	0.0
		Dimethoate	0.05 mg/kg	<0.12	<0.12	0.0
		Diazinon	0.05 mg/kg	<0.12	<0.12	0.0
		Chlorpyrifos-methyl	0.05 mg/kg	<0.12	<0.12	0.0
		Parathion-methyl	0.2 mg/kg	<0.2	<0.2	0.0
		Malathion	0.05 mg/kg	<0.12	<0.12	0.0
		Fenthion	0.05 mg/kg	<0.12	<0.12	0.0
		Chlorpyrifos	0.05 mg/kg	<0.12	<0.12	0.0
		Parathion	0.2 mg/kg	<0.2	<0.2	0.0
		Pirimphos-ethyl	0.05 mg/kg	<0.12	<0.12	0.0
		Chlorfenvinphos	0.05 mg/kg	<0.12	<0.12	0.0
		Bromophos-ethyl	0.05 mg/kg	<0.12	<0.12	0.0
		Fenamiphos	0.05 mg/kg	<0.12	<0.12	0.0
		Prothiofos	0.05 mg/kg	<0.12	<0.12	0.0
		Ethion	0.05 mg/kg	<0.12	<0.12	0.0
		Carbophenothion	0.05 mg/kg	<0.12	<0.12	0.0
		Azinphos Methyl	0.05 mg/kg	<0.12	<0.12	0.0

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EP068S: Organochlorine Pesticide Surrogate - (QC Lot: 10217)				%	%	%
EB0403155-001	- Anonymous -	Dibromo-DDE	0.1 %	90.3	92.2	2.1
EP068T: Organophosphorus Pesticide Surrogate - (QC Lot: 10217)				%	%	%
EB0403155-001	- Anonymous -	DEF	0.1 %	Not determined	Not determined	0.0
EP068A: Organochlorine Pesticides (OC) - (QC Lot: 10217)				mg/kg	mg/kg	%
EB0403190-004	204 4808 4A	alpha-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		Hexachlorobenzene (HCB)	0.05 mg/kg	<0.05	<0.05	0.0
		beta-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		gamma-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		delta-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		Heptachlor	0.05 mg/kg	<0.05	<0.05	0.0
		Aldrin	0.05 mg/kg	<0.05	<0.05	0.0
		Heptachlor epoxide	0.05 mg/kg	<0.05	<0.05	0.0
		trans-Chlordane	0.05 mg/kg	<0.05	<0.05	0.0
		alpha-Endosulfan	0.05 mg/kg	<0.05	<0.05	0.0
		cis-Chlordane	0.05 mg/kg	<0.05	<0.05	0.0
		Dieldrin	0.05 mg/kg	<0.05	<0.05	0.0
		4,4'-DDE	0.05 mg/kg	<0.05	<0.05	0.0
		Endrin	0.05 mg/kg	<0.05	<0.05	0.0
		beta-Endosulfan	0.05 mg/kg	<0.05	<0.05	0.0
		4,4'-DDD	0.05 mg/kg	<0.05	<0.05	0.0
		Endrin aldehyde	0.05 mg/kg	<0.05	<0.05	0.0
		Endosulfan sulfate	0.05 mg/kg	<0.05	<0.05	0.0
		4,4'-DDT	0.2 mg/kg	<0.2	<0.2	0.0
		Endrin ketone	0.05 mg/kg	<0.05	<0.05	0.0
		Methoxychlor	0.2 mg/kg	<0.2	<0.2	0.0

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EP068B: Organophosphorus Pesticides (OP) - (QC Lot: 10217)				mg/kg	mg/kg	%
EB0403190-004	204 4808 4A	Dichlorvos	0.05 mg/kg	<0.05	<0.05	0.0
		Demeton-S-methyl	0.05 mg/kg	<0.05	<0.05	0.0
		Monocrotophos	0.2 mg/kg	<0.2	<0.2	0.0
		Dimethoate	0.05 mg/kg	<0.05	<0.05	0.0
		Diazinon	0.05 mg/kg	<0.05	<0.05	0.0
		Chlorpyrifos-methyl	0.05 mg/kg	<0.05	<0.05	0.0
		Parathion-methyl	0.2 mg/kg	<0.2	<0.2	0.0
		Malathion	0.05 mg/kg	<0.05	<0.05	0.0
		Fenthion	0.05 mg/kg	<0.05	<0.05	0.0
		Chlorpyrifos	0.05 mg/kg	<0.05	<0.05	0.0
		Parathion	0.2 mg/kg	<0.2	<0.2	0.0
		Pirimphos-ethyl	0.05 mg/kg	<0.05	<0.05	0.0
		Chlorfenvinphos	0.05 mg/kg	<0.05	<0.05	0.0
		Bromophos-ethyl	0.05 mg/kg	<0.05	<0.05	0.0
		Fenamiphos	0.05 mg/kg	<0.05	<0.05	0.0
		Prothiofos	0.05 mg/kg	<0.05	<0.05	0.0
		Ethion	0.05 mg/kg	<0.05	<0.05	0.0
		Carbophenothion	0.05 mg/kg	<0.05	<0.05	0.0
		Azinphos Methyl	0.05 mg/kg	<0.05	<0.05	0.0
EP068S: Organochlorine Pesticide Surrogate - (QC Lot: 10217)				%	%	%
EB0403190-004	204 4808 4A	Dibromo-DDE	0.1 %	117	117	0.3
EP068T: Organophosphorus Pesticide Surrogate - (QC Lot: 10217)				%	%	%
EB0403190-004	204 4808 4A	DEF	0.1 %	111	111	0.0

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EP068A: Organochlorine Pesticides (OC) - (QC Lot: 10310)				mg/kg	mg/kg	%
EB0403184-001	- Anonymous -	alpha-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		Hexachlorobenzene (HCB)	0.05 mg/kg	<0.05	<0.05	0.0
		beta-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		gamma-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		delta-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		Heptachlor	0.05 mg/kg	<0.05	<0.05	0.0
		Aldrin	0.05 mg/kg	<0.05	<0.05	0.0
		Heptachlor epoxide	0.05 mg/kg	<0.05	<0.05	0.0
		trans-Chlordane	0.05 mg/kg	<0.05	<0.05	0.0
		alpha-Endosulfan	0.05 mg/kg	<0.05	<0.05	0.0
		cis-Chlordane	0.05 mg/kg	<0.05	<0.05	0.0
		Dieldrin	0.05 mg/kg	<0.05	<0.05	0.0
		4.4'-DDE	0.05 mg/kg	<0.05	<0.05	0.0
		Endrin	0.05 mg/kg	<0.05	<0.05	0.0
		beta-Endosulfan	0.05 mg/kg	<0.05	<0.05	0.0
		4.4'-DDD	0.05 mg/kg	<0.05	<0.05	0.0
		Endrin aldehyde	0.05 mg/kg	<0.05	<0.05	0.0
		Endosulfan sulfate	0.05 mg/kg	<0.05	<0.05	0.0
		4.4'-DDT	0.2 mg/kg	<0.2	<0.2	0.0
		Endrin ketone	0.05 mg/kg	<0.05	<0.05	0.0
		Methoxychlor	0.2 mg/kg	<0.2	<0.2	0.0
EP068B: Organophosphorus Pesticides (OP) - (QC Lot: 10310)				mg/kg	mg/kg	%
EB0403184-001	- Anonymous -	Dichlorvos	0.05 mg/kg	<0.05	<0.05	0.0
		Demeton-S-methyl	0.05 mg/kg	<0.05	<0.05	0.0
		Monocrotophos	0.2 mg/kg	<0.2	<0.2	0.0
		Dimethoate	0.05 mg/kg	<0.05	<0.05	0.0
		Diazinon	0.05 mg/kg	<0.05	<0.05	0.0
		Chlorpyrifos-methyl	0.05 mg/kg	<0.05	<0.05	0.0
		Parathion-methyl	0.2 mg/kg	<0.2	<0.2	0.0
		Malathion	0.05 mg/kg	<0.05	<0.05	0.0
		Fenthion	0.05 mg/kg	<0.05	<0.05	0.0
		Chlorpyrifos	0.05 mg/kg	<0.05	<0.05	0.0
		Parathion	0.2 mg/kg	<0.2	<0.2	0.0
		Pirimphos-ethyl	0.05 mg/kg	<0.05	<0.05	0.0
		Chlorfenvinphos	0.05 mg/kg	<0.05	<0.05	0.0
		Bromophos-ethyl	0.05 mg/kg	<0.05	<0.05	0.0
		Fenamiphos	0.05 mg/kg	<0.05	<0.05	0.0
		Prothiofos	0.05 mg/kg	<0.05	<0.05	0.0
		Ethion	0.05 mg/kg	<0.05	<0.05	0.0
		Carbophenothion	0.05 mg/kg	<0.05	<0.05	0.0
		Azinphos Methyl	0.05 mg/kg	<0.05	<0.05	0.0

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EP068S: Organochlorine Pesticide Surrogate - (QC Lot: 10310)				%	%	%
EB0403184-001	- Anonymous -	Dibromo-DDE	0.1 %	102	104	1.3
EP068T: Organophosphorus Pesticide Surrogate - (QC Lot: 10310)				%	%	%
EB0403184-001	- Anonymous -	DEF	0.1 %	100	100	0.3
EP068A: Organochlorine Pesticides (OC) - (QC Lot: 10310)				mg/kg	mg/kg	%
EB0403190-022	204 4808 22A	alpha-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		Hexachlorobenzene (HCB)	0.05 mg/kg	<0.05	<0.05	0.0
		beta-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		gamma-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		delta-BHC	0.05 mg/kg	<0.05	<0.05	0.0
		Heptachlor	0.05 mg/kg	<0.05	<0.05	0.0
		Aldrin	0.05 mg/kg	<0.05	<0.05	0.0
		Heptachlor epoxide	0.05 mg/kg	<0.05	<0.05	0.0
		trans-Chlordane	0.05 mg/kg	<0.05	<0.05	0.0
		alpha-Endosulfan	0.05 mg/kg	<0.05	<0.05	0.0
		cis-Chlordane	0.05 mg/kg	<0.05	<0.05	0.0
		Dieldrin	0.05 mg/kg	<0.05	<0.05	0.0
		4.4'-DDE	0.05 mg/kg	<0.05	<0.05	0.0
		Endrin	0.05 mg/kg	<0.05	<0.05	0.0
		beta-Endosulfan	0.05 mg/kg	<0.05	<0.05	0.0
		4.4'-DDD	0.05 mg/kg	<0.05	<0.05	0.0
		Endrin aldehyde	0.05 mg/kg	<0.05	<0.05	0.0
		Endosulfan sulfate	0.05 mg/kg	<0.05	<0.05	0.0
		4.4'-DDT	0.2 mg/kg	<0.2	<0.2	0.0
		Endrin ketone	0.05 mg/kg	<0.05	<0.05	0.0
		Methoxychlor	0.2 mg/kg	<0.2	<0.2	0.0

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EP068B: Organophosphorus Pesticides (OP) - (QC Lot: 10310)				mg/kg	mg/kg	%
EB0403190-022	204 4808 22A	Dichlorvos	0.05 mg/kg	<0.05	<0.05	0.0
		Demeton-S-methyl	0.05 mg/kg	<0.05	<0.05	0.0
		Monocrotophos	0.2 mg/kg	<0.2	<0.2	0.0
		Dimethoate	0.05 mg/kg	<0.05	<0.05	0.0
		Diazinon	0.05 mg/kg	<0.05	<0.05	0.0
		Chlorpyrifos-methyl	0.05 mg/kg	<0.05	<0.05	0.0
		Parathion-methyl	0.2 mg/kg	<0.2	<0.2	0.0
		Malathion	0.05 mg/kg	<0.05	<0.05	0.0
		Fenthion	0.05 mg/kg	<0.05	<0.05	0.0
		Chlorpyrifos	0.05 mg/kg	<0.05	<0.05	0.0
		Parathion	0.2 mg/kg	<0.2	<0.2	0.0
		Pirimphos-ethyl	0.05 mg/kg	<0.05	<0.05	0.0
		Chlorfenvinphos	0.05 mg/kg	<0.05	<0.05	0.0
		Bromophos-ethyl	0.05 mg/kg	<0.05	<0.05	0.0
		Fenamiphos	0.05 mg/kg	<0.05	<0.05	0.0
		Prothiofos	0.05 mg/kg	<0.05	<0.05	0.0
		Ethion	0.05 mg/kg	<0.05	<0.05	0.0
		Carbophenothion	0.05 mg/kg	<0.05	<0.05	0.0
		Azinphos Methyl	0.05 mg/kg	<0.05	<0.05	0.0
EP068S: Organochlorine Pesticide Surrogate - (QC Lot: 10310)				%	%	%
EB0403190-022	204 4808 22A	Dibromo-DDE	0.1 %	97.7	98.0	0.3
EP068T: Organophosphorus Pesticide Surrogate - (QC Lot: 10310)				%	%	%
EB0403190-022	204 4808 22A	DEF	0.1 %	93.7	95.0	1.4

Quality Control Report - Method Blank and Laboratory Control Samples (LCS)

The quality control term **Method / Laboratory Blank** refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC type is to monitor potential laboratory contamination. The quality control term **Laboratory Control Sample (LCS)** refers to a known, interference free matrix spiked with target analytes or certified reference material. The purpose of this QC type is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits, with the exception of surrogates, based on statistical evaluation of actual laboratory data. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Abbreviations: LOR = Limit of reporting.
* Indicates failed QC.

Matrix Type: SOIL

Analyte name	LOR	Method blank result	Actual Results: Spike concentration	Actual Results: Spike Recovery LCS	Recovery Limits: Dynamic Recovery Limits Low	Recovery Limits: Dynamic Recovery Limits High
EG005T: Total Metals by ICP-AES						
EG005T: Total Metals by ICP-AES - (QC Lot: 10541)		mg/kg	mg/kg	%	%	%
Arsenic	1 mg/kg	<1	13.76	94.4	70	130
Cadmium	1 mg/kg	<1	2.82	94.3	70	130
Chromium	1 mg/kg	<1	61.59	100	70	130
Copper	1 mg/kg	<1	54.68	99.8	70	130
Lead	1 mg/kg	<1	55.50	97.6	70	130
Nickel	1 mg/kg	<1	55.10	102	70	130
Zinc	1 mg/kg	<1	105.3	101	70	130
EG005T: Total Metals by ICP-AES - (QC Lot: 10543)		mg/kg	mg/kg	%	%	%
Arsenic	1 mg/kg	<1	13.76	100	70	130
Cadmium	1 mg/kg	<1	2.82	95.7	70	130
Chromium	1 mg/kg	<1	61.59	103	70	130
Copper	1 mg/kg	<1	54.68	106	70	130
Lead	1 mg/kg	<1	55.50	101	70	130
Nickel	1 mg/kg	<1	55.10	103	70	130
Zinc	1 mg/kg	<1	105.3	102	70	130
EG035T: Total Mercury by FIMS						
EG035T: Total Mercury by FIMS - (QC Lot: 10542)		mg/kg	mg/kg	%	%	%
Mercury	0.1 mg/kg	<0.1	1.34	103	70	130
EG035T: Total Mercury by FIMS - (QC Lot: 10544)		mg/kg	mg/kg	%	%	%
Mercury	0.1 mg/kg	<0.1	1.34	102	70	130

Matrix Type: SOIL

Analyte name	LOR	Method blank result	Actual Results: Spike concentration	Actual Results: Spike Recovery LCS	Recovery Limits: Dynamic Recovery Limits Low	Recovery Limits: Dynamic Recovery Limits High
EP068: Pesticides by GCMS						
EP068A: Organochlorine Pesticides (OC) - (QC Lot: 10217)		mg/kg	mg/kg	%	%	%
alpha-BHC	0.05 mg/kg	<0.05	0.25	102	54	113
Hexachlorobenzene (HCB)	0.05 mg/kg	<0.05	0.25	99.4	50	119
beta-BHC	0.05 mg/kg	<0.05	0.25	88.4	59	113
gamma-BHC	0.05 mg/kg	<0.05	0.25	89.5	59	113
delta-BHC	0.05 mg/kg	<0.05	0.25	100	62	106
Heptachlor	0.05 mg/kg	<0.05	0.25	100	50	109
Aldrin	0.05 mg/kg	<0.05	0.25	94.3	59	111
Heptachlor epoxide	0.05 mg/kg	<0.05	0.25	99.2	51	118
trans-Chlordane	0.05 mg/kg	<0.05	0.25	98.7	53	113
alpha-Endosulfan	0.05 mg/kg	<0.05	0.25	98.3	63	115
cis-Chlordane	0.05 mg/kg	<0.05	0.25	99.8	55	117
Dieldrin	0.05 mg/kg	<0.05	0.25	95.0	64	111
4.4'-DDE	0.05 mg/kg	<0.05	0.25	94.9	64	108
Endrin	0.05 mg/kg	<0.05	0.25	89.4	55	111
beta-Endosulfan	0.05 mg/kg	<0.05	0.25	92.8	61	113
4.4'-DDD	0.05 mg/kg	<0.05	0.25	90.4	57	114
Endrin aldehyde	0.05 mg/kg	<0.05	0.25	97.9	41	117
Endosulfan sulfate	0.05 mg/kg	<0.05	0.25	86.8	50	118
4.4'-DDT	0.2 mg/kg	<0.2	0.25	94.3	56	109
Endrin ketone	0.05 mg/kg	<0.05	0.25	93.9	60	113
Methoxychlor	0.2 mg/kg	<0.2	0.25	91.2	54	106
EP068B: Organophosphorus Pesticides (OP) - (QC Lot: 10217)		mg/kg	mg/kg	%	%	%
Dichlorvos	0.05 mg/kg	<0.05	0.25	90.7	43	110
Demeton-S-methyl	0.05 mg/kg	<0.05	0.25	97.4	44	114
Monocrotophos	0.2 mg/kg	<0.2	0.25	98.4	31	116
Dimethoate	0.05 mg/kg	<0.05	0.25	96.6	51	112
Diazinon	0.05 mg/kg	<0.05	0.25	93.4	58	108
Chlorpyrifos-methyl	0.05 mg/kg	<0.05	0.25	102	51	111
Parathion-methyl	0.2 mg/kg	<0.2	0.25	98.6	49	110
Malathion	0.05 mg/kg	<0.05	0.25	97.8	57	113
Fenthion	0.05 mg/kg	<0.05	0.25	98.0	48	113
Chlorpyrifos	0.05 mg/kg	<0.05	0.25	88.2	55	110
Parathion	0.2 mg/kg	<0.2	0.25	99.2	52	111
Pirimphos-ethyl	0.05 mg/kg	<0.05	0.25	97.1	49	111
Chlorfenvinphos	0.05 mg/kg	<0.05	0.25	97.2	50	112
Bromophos-ethyl	0.05 mg/kg	<0.05	0.25	97.7	53	112
Fenamiphos	0.05 mg/kg	<0.05	0.25	97.2	47	115
Prothiofos	0.05 mg/kg	<0.05	0.25	98.0	48	115
Ethion	0.05 mg/kg	<0.05	0.25	88.0	56	110
Carbophenothion	0.05 mg/kg	<0.05	0.25	98.6	49	113
Azinphos Methyl	0.05 mg/kg	<0.05	0.25	85.5	37	116

ALS Environmental

Matrix Type: SOIL

Analyte name	LOR	Method blank result	Actual Results: Spike concentration	Actual Results: Spike Recovery LCS	Recovery Limits: Dynamic Recovery Limits Low	Recovery Limits: Dynamic Recovery Limits High
EP068S: Organochlorine Pesticide Surrogate - (QC Lot: 10217)		%	mg/kg	%	%	%
Dibromo-DDE	0.1 %	105	1.25	91.2	79	127
EP068T: Organophosphorus Pesticide Surrogate - (QC Lot: 10217)		%	mg/kg	%	%	%
DEF	0.1 %	98.1	1.25	88.2	73	114

ALS Environmental

Matrix Type: SOIL

Analyte name	LOR	Method blank result	Actual Results: Spike concentration	Actual Results: Spike Recovery LCS	Recovery Limits: Dynamic Recovery Limits Low	Recovery Limits: Dynamic Recovery Limits High
EP068A: Organochlorine Pesticides (OC) - (QC Lot: 10310)		mg/kg	mg/kg	%	%	%
alpha-BHC	0.05 mg/kg	<0.05	0.25	97.8	54	113
Hexachlorobenzene (HCB)	0.05 mg/kg	<0.05	0.25	98.3	50	119
beta-BHC	0.05 mg/kg	<0.05	0.25	102	59	113
gamma-BHC	0.05 mg/kg	<0.05	0.25	100	59	113
delta-BHC	0.05 mg/kg	<0.05	0.25	103	62	106
Heptachlor	0.05 mg/kg	<0.05	0.25	96.9	50	109
Aldrin	0.05 mg/kg	<0.05	0.25	97.6	59	111
Heptachlor epoxide	0.05 mg/kg	<0.05	0.25	101	51	118
trans-Chlordane	0.05 mg/kg	<0.05	0.25	95.1	53	113
alpha-Endosulfan	0.05 mg/kg	<0.05	0.25	91.6	63	115
cis-Chlordane	0.05 mg/kg	<0.05	0.25	100	55	117
Dieldrin	0.05 mg/kg	<0.05	0.25	97.0	64	111
4.4'-DDE	0.05 mg/kg	<0.05	0.25	95.4	64	108
Endrin	0.05 mg/kg	<0.05	0.25	102	55	111
beta-Endosulfan	0.05 mg/kg	<0.05	0.25	98.0	61	113
4.4'-DDD	0.05 mg/kg	<0.05	0.25	98.5	57	114
Endrin aldehyde	0.05 mg/kg	<0.05	0.25	96.9	41	117
Endosulfan sulfate	0.05 mg/kg	<0.05	0.25	96.4	50	118
4.4'-DDT	0.2 mg/kg	<0.2	0.25	93.3	56	109
Endrin ketone	0.05 mg/kg	<0.05	0.25	101	60	113
Methoxychlor	0.2 mg/kg	<0.2	0.25	95.9	54	106
EP068B: Organophosphorus Pesticides (OP) - (QC Lot: 10310)		mg/kg	mg/kg	%	%	%
Dichlorvos	0.05 mg/kg	<0.05	0.25	100	43	110
Demeton-S-methyl	0.05 mg/kg	<0.05	0.25	98.8	44	114
Monocrotophos	0.2 mg/kg	<0.2	0.25	86.9	31	116
Dimethoate	0.05 mg/kg	<0.05	0.25	96.0	51	112
Diazinon	0.05 mg/kg	<0.05	0.25	98.6	58	108
Chlorpyrifos-methyl	0.05 mg/kg	<0.05	0.25	98.6	51	111
Parathion-methyl	0.2 mg/kg	<0.2	0.25	100	49	110
Malathion	0.05 mg/kg	<0.05	0.25	97.8	57	113
Fenthion	0.05 mg/kg	<0.05	0.25	98.2	48	113
Chlorpyrifos	0.05 mg/kg	<0.05	0.25	104	55	110
Parathion	0.2 mg/kg	<0.2	0.25	102	52	111
Pirimphos-ethyl	0.05 mg/kg	<0.05	0.25	100	49	111
Chlorfenvinphos	0.05 mg/kg	<0.05	0.25	93.0	50	112
Bromophos-ethyl	0.05 mg/kg	<0.05	0.25	92.7	53	112
Fenamiphos	0.05 mg/kg	<0.05	0.25	92.7	47	115
Prothiofos	0.05 mg/kg	<0.05	0.25	96.0	48	115
Ethion	0.05 mg/kg	<0.05	0.25	97.8	56	110
Carbophenothion	0.05 mg/kg	<0.05	0.25	95.4	49	113
Azinphos Methyl	0.05 mg/kg	<0.05	0.25	101	37	116
EP068S: Organochlorine Pesticide Surrogate - (QC Lot: 10310)		%	mg/kg	%	%	%
Dibromo-DDE	0.1 %	90.9	1.25	101	79	127

ALS Environmental

Matrix Type: SOIL

Analyte name	LOR	Method blank result	Actual Results: Spike concentration	Actual Results: Spike Recovery LCS	Recovery Limits: Dynamic Recovery Limits Low	Recovery Limits: Dynamic Recovery Limits High
EP068T: Organophosphorus Pesticide Surrogate - (QC Lot: 10310)		%	mg/kg	%	%	%
DEF	0.1 %	92.0	1.25	94.8	73	114

ALS Environmental

Quality Control Report - Matrix Spikes (MS)

The quality control term **Matrix Spike (MS)** refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC type is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQO's). Surrogate DQO's based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). 'Ideal' recovery ranges stated may be waived in the event of sample matrix interferences. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** *= Limit of Reporting,* ***RPD*** *= Relative Percent Difference.*

* Indicates failed QC.

Matrix Type: SOIL

					Actual Results		Recovery Limits	
					Sample Result	Spike Recovery	Static Limits	
Analyte name	Laboratory Sample ID	Client Sample ID	LOR	Spike Concentration		MS	Low	High
EG005T: Total Metals by ICP-AES								
EG005T: Total Metals by ICP-AES - (QC Lot: 10541)				mg/kg	mg/kg	%	%	%
Arsenic	EB0403128-002	- Anonymous -	1 mg/kg	50.0	141	122	70	130
Cadmium			1 mg/kg	50.0	<1	98.9	70	130
Chromium			1 mg/kg	50.0	10	98.0	70	130
Copper			1 mg/kg	50.0	19	102	70	130
Lead			1 mg/kg	50.0	17	95.6	70	130
Nickel			1 mg/kg	50.0	4	95.6	70	130
Zinc			1 mg/kg	50.0	35	92.0	70	130
EG005T: Total Metals by ICP-AES - (QC Lot: 10543)				mg/kg	mg/kg	%	%	%
Arsenic	EB0403190-001	204 4808 1A	1 mg/kg	50.0	<1	104	70	130
Cadmium			1 mg/kg	50.0	<1	102	70	130
Chromium			1 mg/kg	50.0	<1	96.7	70	130
Copper			1 mg/kg	50.0	<1	105	70	130
Lead			1 mg/kg	50.0	<1	101	70	130
Nickel			1 mg/kg	50.0	<1	101	70	130
Zinc			1 mg/kg	50.0	1	101	70	130
EG035T: Total Mercury by FIMS								
EG035T: Total Mercury by FIMS - (QC Lot: 10542)				mg/kg	mg/kg	%	%	%
Mercury	EB0403190-001	204 4808 1A	0.1 mg/kg	10.0	<0.1	104	70	130
EG035T: Total Mercury by FIMS - (QC Lot: 10544)				mg/kg	mg/kg	%	%	%
Mercury	EB0403236-003	- Anonymous -	0.1 mg/kg	10.0	<0.1	95.8	70	130

Matrix Type: SOIL

Analyte name	Laboratory Sample ID	Client Sample ID	LOR	Spike Concentration	Actual Results: Sample Result	Actual Results: Spike Recovery MS	Recovery Limits: Static Limits Low	Recovery Limits: Static Limits High
EP068: Pesticides by GCMS								
EP068A: Organochlorine Pesticides (OC) - (QC Lot: 10217)				mg/kg	mg/kg	%	%	%
beta-BHC	EB0403155-006	- Anonymous -	0.05 mg/kg	0.25	<0.05	85.5	70	130
gamma-BHC			0.05 mg/kg	0.25	<0.05	82.6	70	130
Heptachlor			0.05 mg/kg	0.25	<0.05	87.3	70	130
Aldrin			0.05 mg/kg	0.25	<0.05	94.2	70	130
Dieldrin			0.05 mg/kg	0.25	<0.05	85.3	70	130
Endrin			0.05 mg/kg	0.25	<0.05	87.0	70	130
4,4'-DDT			0.05 mg/kg	0.25	<0.2	77.5	70	130
EP068B: Organophosphorus Pesticides (OP) - (QC Lot: 10217)				mg/kg	mg/kg	%	%	%
Diazinon	EB0403155-006	- Anonymous -	0.05 mg/kg	0.25	<0.05	98.4	70	130
Chlorpyrifos-methyl			0.05 mg/kg	0.25	<0.05	97.8	70	130
Pirimphos-ethyl			0.05 mg/kg	0.25	<0.05	83.8	70	130
Bromophos-ethyl			0.05 mg/kg	0.25	<0.05	89.6	70	130
Prothiofos			0.05 mg/kg	0.25	<0.05	84.2	70	130
EP068S: Organochlorine Pesticide Surrogate - (QC Lot: 10217)				mg/kg	%	%	%	%
Dibromo-DDE	EB0403155-006	- Anonymous -	0.1 %	1.25	100	104	10	136
EP068T: Organophosphorus Pesticide Surrogate - (QC Lot: 10217)				mg/kg	%	%	%	%
DEF	EB0403155-006	- Anonymous -	0.1 %	1.25	93.4	Not determined	10	110
EP068A: Organochlorine Pesticides (OC) - (QC Lot: 10310)				mg/kg	mg/kg	%	%	%
beta-BHC	EB0403186-001	- Anonymous -	0.05 mg/kg	0.25	<0.05	91.6	70	130
gamma-BHC			0.05 mg/kg	0.25	<0.05	88.1	70	130
Heptachlor			0.05 mg/kg	0.25	<0.05	98.1	70	130
Aldrin			0.05 mg/kg	0.25	<0.05	98.1	70	130
Dieldrin			0.05 mg/kg	0.25	<0.05	86.8	70	130
Endrin			0.05 mg/kg	0.25	<0.05	94.8	70	130
4,4'-DDT			0.05 mg/kg	0.25	<0.2	83.6	70	130
EP068B: Organophosphorus Pesticides (OP) - (QC Lot: 10310)				mg/kg	mg/kg	%	%	%
Diazinon	EB0403186-001	- Anonymous -	0.05 mg/kg	0.25	<0.05	87.2	70	130
Chlorpyrifos-methyl			0.05 mg/kg	0.25	<0.05	85.6	70	130
Pirimphos-ethyl			0.05 mg/kg	0.25	<0.05	81.5	70	130
Bromophos-ethyl			0.05 mg/kg	0.25	<0.05	85.3	70	130
Prothiofos			0.05 mg/kg	0.25	<0.05	89.6	70	130
EP068S: Organochlorine Pesticide Surrogate - (QC Lot: 10310)				mg/kg	%	%	%	%
Dibromo-DDE	EB0403186-001	- Anonymous -	0.1 %	1.25	103	104	10	136
EP068T: Organophosphorus Pesticide Surrogate - (QC Lot: 10310)				mg/kg	%	%	%	%
DEF	EB0403186-001	- Anonymous -	0.1 %	1.25	100	94.0	10	110

APPENDIX B

CHROMIUM REDUCIBLE SULFUR TEST RESULTS

(PRELIMINARY ACID SULFATE SOIL MANAGEMENT)

Soil & Water Laboratories P/L
19 Finchley Street, Milton, QLD. 4064
Phone: (07) 3369 6668; Fax: (07) 3503 9063

Chromium Reducible Sulphur, Titratable Actual Acidity & Acid Neutralising Capacity Test Results

(methods 2A2, 19A2, 22B, 23A & 23F)

Ref. Number: GOL-4808

Date: 01/07/2004 Location: Hastings Point

Project Number: 204-4808

Sample Number	Identification	Description	Moisture as received (85oC) (%)	Reaction to H2O2	Reaction to HCl	Init. pH (KCl)	ANC (%CaCO3 Eq.)	ANC (mol. H+/tonne)	a-ANC (eq. mol. H+/t)	TAA (mol. H+/tonne)	SCr (%S)	SCr (mol. H+/t)
1	BH01 0.0m	Silty SAND (SM), fine to medium grained, grey to black, medium ploasticity fines, moist.	4.5%	Low	None	4.5	n/a	n/a	n/a	10	0.00	0
10	BH02 2.0m	Silty SAND (SM), fine to medium grained, grey to black, medium ploasticity fines, moist.	20.5%	High	Low	4.7	n/a	n/a	n/a	10	0.04	22
13	BH03 1.0m	SAND (SP), fine to medium grained, grey to white, moist.	4.1%	Low	Low	5.4	n/a	n/a	n/a	5	0.00	0
20	BH04 2.0m	SAND (SP), fine to medium grained, light grey , trace of low plasticity fines, moist	21.9%	Low	Low	6.3	n/a	n/a	n/a	0	0.09	58
23	BH05 1.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, moist.	25.3%	Low	Low	4.9	n/a	n/a	n/a	10	0.02	9
25	BH05 2.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, moist.	21.4%	Moderate	Low	4.9	n/a	n/a	n/a	10	0.05	34
30	BH06 2.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, wet.	29.3%	Low	Low	4.5	n/a	n/a	n/a	13	0.12	75
33	BH07 1.0m	Silty SAND (SM), fine to medium grained, dark grey, low plasticity fines, wet.	30.1%	Low	Low	4.7	n/a	n/a	n/a	10	0.06	36
37	BH08 0.5m	Silty SAND (SM), fine to medium grained, dark grey, low plasticity fines, moist.	5.5%	Low	Low	5.1	n/a	n/a	n/a	5	0.01	6
41	BH09 0.0m	Silty SAND (SM), fine to medium grained, dark grey, low plasticity fines, moist.	7.9%	Low	Low	4.2	n/a	n/a	n/a	13	0.01	6
43	BH09 1.0m	Silty SAND (SM), fine to medium grained, grey mottled black, low plasticity fines, moist.	34.1%	Low	Low	4.0	n/a	n/a	n/a	58	0.44	277
50	BH10 2.0m	Silty SAND (SM), fine to medium grained, grey mottled black, low plasticity fines, moist.	21.9%	Low	Low	4.8	n/a	n/a	n/a	10	0.12	75
54	BH11 1.5m	Silty SAND (SM), fine to medium grained, brown to black, low plasticity fines, wet.	26.4%	High	Low	4.4	n/a	n/a	n/a	18	0.05	32
57	BH12 0.5m	SAND (SP), fine to medium grained, yellow to white, moist.	4.1%	Low	Low	5.5	n/a	n/a	n/a	3	0.01	6
61	BH13 0.0m	Silty SAND (SM), fine to medium grained, low plasticity fines, just moist.	5.8%	High	Low	4.6	n/a	n/a	n/a	5	0.01	6
65	BH13 2.0m	Silty SAND (SM), fine to medium grained, brown to black, low plasticity fines, wet.	24.7%	Low	Low	4.2	n/a	n/a	n/a	25	0.15	95
70	BH14 2.0m	Silty SAND (SM), fine to medium grained, brown to black, low plasticity fines, wet.	24.4%	Low	Low	4.5	n/a	n/a	n/a	23	0.09	58
71	BH15 0.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, just moist.	7.4%	Low	Low	5.0	n/a	n/a	n/a	5	0.02	15
75	BH15 2.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, moist.	21.2%	Moderate	Low	4.8	n/a	n/a	n/a	10	0.04	22
80	BH16 2.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, moist.	22.5%	High	Low	4.8	n/a	n/a	n/a	15	0.10	62

Determinations have been derived by the adoption of published test methods recommended by National Committee for Acid Sulphate Soils (NatCASS); Queensland Acid Sulphate Soils Management Advisory Committee (QASSMAC); Queensland Acid Sulphate Soils Investigation Team (QASSIT) & Queensland Department of Natural Resources, Mines and Energy; as described in the 'Acid Sulphate Soils Laboratory Methods Guidelines 2004'.

APPENDIX B

Soils Surveys Engineering Pty Ltd
Acid Sulfate Soil & Contamination Investigation

SOIL SURVEYS

PROJECT NO. 204-4808

JULY 2004

WALTER ELLIOTT HOLDINGS PTY LTD

ACID SULFATE SOIL & CONTAMINATION INVESTIGATION

PROPOSED FILLING

LOT 156 CREEK STREET

HASTINGS POINT

Soil Surveys Engineering Pty Limited
Specialists in Applied Geotechnics
A.B.N. 70 054 043 631

www.soilsurveys.com.au

SOIL SURVEYS

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Gold Coast Office
Job No: 204-4808
Ref: 4808a
Author: Patrick Kidd

3 August 2004

Walter Elliott Holdings Pty Ltd
C/- Blueland Engineers
PO Box 6389
Tweed Heads South, NSW 2486

ATTENTION: MR MARTIN FINDLATER

Dear Sir,

RE: ACID SULFATE SOIL & CONTAMINATION INVESTIGATION - PROPOSED FILLING, LOT 156 CREEK STREET, HASTINGS POINT.

Enclosed is a copy of our report for the above project dated July, 2004. Three copies of the report have been issued.

Authority to proceed with the investigation was received from Mr Walter Elliott by correspondence dated 2 June 2004.

Should you have any queries regarding this report, please do not hesitate to contact Patrick Kidd or Albert Rutten at our Gold Coast Office.

Yours faithfully,

A. M. RUTTEN (RPEQ 2202)

for and on behalf of
SOIL SURVEYS ENGINEERING PTY LIMITED

Brisbane	Gold Coast	Sunshine Coast
Level 2, 19 Finchley Street Milton Qld PO Box 317 Paddington Qld 4064 Australia Ph 617 3369 6000 Fax 617 3369 6660 brisbane@soilsurveys.com.au	Unit 9, 39 Lawrence Drive Nerang Qld PO Box 2743 Nerang Qld 4211 Australia Ph 617 5596 1528 Fax 617 5578 3916 goldcoast@soilsurveys.com.au	11 Production Avenue Kawana Waters Qld PO Box 2 Buddina Qld 4575 Australia Ph 617 5493 1980 Fax 617 5493 2837 sunshinecoast@soilsurveys.com.au

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APPENDICES

1.0 INTRODUCTION

This report presents the results of a factual acid sulfate soil and contamination investigation carried out by Soil Surveys Engineering Pty Limited in June, 2004 to assess the subsurface conditions for proposed filling at the Lot 156 Creek Street, Hastings Point.

The factual investigation was carried out at the request of Mr Martin Findlater of Blueland Engineers with only the results of laboratory testing requested to be reported as per the details set out in Blueland Engineers' letter dated 7 May 2004.

Authorisation to proceed with the investigation received from Walter Elliott Holdings Pty Ltd was dated 2nd June, 2004.

2.0 PROPOSED DEVELOPMENT

It is understood that the filling and potential construction of the subdivision is likely to require selective excavation and stripping to about 1.0m below the existing ground surface level.

3.0 SCOPE OF SERVICES

The scope of services provided by Soil Surveys Engineering Pty Limited for the acid sulfate soil investigation as detailed in our proposal 203-4095p dated 19th May, 2003 was directed towards assessment of the following:-

- The nature and type of upper level subsurface materials in the area of the site
- Collection of samples and laboratory testing for Actual and Potential Acid Sulfate Soils, (AASS) and (PASS).
- Collection of samples and laboratory testing with respect to contamination on site.

4.0 INVESTIGATION METHOD

4.1 Field Investigation

To provide the required evaluations the following field investigation was undertaken, generally to the details as nominated in Blueland Engineers' brief dated 7 May 2004.

- Drilling and sampling of 16 bores to depths of 2.0m and 6 bores to 2.5m BH's 1 to 6 using a Jacro 105 drilling rig, note that bore 1 to 6 were drilled to 6.0m depth , however acid sulfate samples were only collected from the upper 2m. Sample locations were dispersed across the entire site where the works are proposed.
- Drilling and sampling of 75 locations using hand equipment.

All work including the soil classification descriptions and field sampling was carried out in general accordance with the following procedures:-

AS1726 - 1993	Geotechnical Site Investigations
AS1289	Methods of Testing Soils for Engineering Purposes
Tweed Local Environment Plan 2000 - Clause 35	
ASSMAC	Acid Sulfate Soil Manual

Notes relating to this report, borehole record sheets, and a site plan detailing borehole and sampling locations are included in the appendices.

Fieldwork was carried out on the 21st to the 24th June, 2004. All soil samples were transferred to a chilled esky for transport to the laboratory.

4.2 Laboratory Assessments

4.2.1 Soil

A staged testing program was carried out on recovered soil samples as follows:-

Test Method	Test Objective
ph_i, ph_{ox} and Reaction to CHI	Qualitative screening
TAA (Total Actual Acidity)	Quantitative - acid trail
CRS (Chromium Reducible Sulfur)	Quantitative - sulfur trails
Heavy Metals **As, Cd, Cu, Pb, Hg, Zn, Cr, Ni**	Quantitative screening
Organochlorine & Organophosphate Pesticides	Quantitative screening

pH_F, pH_{FOX}, TPA, TAA and CRS testing was carried out in accordance with procedures outlined in ASSMAC, "Acid Sulfate Soil Manual". Heavy Metals, Organochlorine and Organophosphate Pesticides testing was carried in accordance with Australian Standards.

Laboratory test results are summarised in Section 5.5 and certificates are included in Appendix 'C'.

Laboratory Assessments

Laboratory assessments were undertaken by the following laboratories:-

Acid Sulfate Soils

- Soil & Water Laboratories Pty Limited — 19 Finchley Street, Milton, Qld, Ph: 07) 3503 9063
- ALS Environmental — 32 Shand Street, Stafford, Qld, Ph: 07) 32437222

5.0 INVESTIGATION FINDINGS

5.1 Site Description

The site of the proposed development is located to the west of the town of Hastings Point, on the southern side of Creek Street. The site is bounded by a creek to the east, west and south and by residential properties and Creek Street to the north.

At the time of the investigation, the site was occupied by a caravan in the central northern portion of the site, elsewhere the site was clear of existing structures. Vegetation generally consisted of low height grass cover with scattered trees around the edges of the site with some small clumps of trees also towards the edges of the site. A drain is present on the site flowing from south to north in the western end of the site. The banks of the drain are lined with Melaleuca trees.

At the time of the investigation the site was being used to graze horses. Access to the site is via a gate off Creek Street.

5.2 Regional Geology

The coastal landforms, of which this site forms part, are essentially dependent on the basement geology and the river erosion and deposition processes. Low rises in the flood plain in this area are commonly residual soils and shallow rock (mainly phyllite and metasandstone), while the relatively flat flood plains consist of alluvial soils.

The reason for two systems side by side is explained in terms of Pleistocene ice ages when, at times, the level of the sea was some 100 metres lower than the present level. Major rivers then entered the sea somewhere on the continental shelf. Progressive rising and falling sea levels resulted in depositional and erosional processes.

Prominent along the low lying areas of the eastern, northern and north-western coasts of Australia, particularly below RL 5.0 AHD, iron sulfide layers are found. These sulfide layers formed when the sea level rose and inundated the land. Seawater containing sulfate mixed with land sediments. These sulfide sediments, when exposed to air oxidise to produce sulfuric acid, thus the term Acid Sulfate Soils.

5.3 Subsurface Conditions

The natural subsurface conditions encountered in the boreholes were relatively consistent between bore locations and were dominated by an alluvial sequence comprising upper level interbedded silty sands and sands with occasional clayey sand and very occasional silty clay lenses encountered to the depths investigated.

5.4 Groundwater

Groundwater was noted in all boreholes except BH16 ranging from 0.1 to 1.55m depth with steady water levels recorded at depths ranging from 0.55 to 1.85m.

5.5 Laboratory Testing - Soils

A total of 80 soil samples were submitted to a staged acid sulfate testing program as follows and 22 combined samples were submitted for contamination testing:-

5.5.1 Preliminary Screening Tests

Testing was carried out on representative soil samples recovered from the boreholes to provide preliminary qualitative assessment of the presence of acid sulfate soils (ASS). This testing was in the form of assessing the pH of the sample before and following oxidation with 30% hydrogen peroxide (H_2O_2). This test involved measuring a known quantity of soil sample from a particular depth in the strata; the field pH (pH_F) of the sample was then measured and recorded. Following this, a uniform volume of hydrogen peroxide was then added to the sample. Each sample was left to react / oxidise for 1 hour and the pH following oxidation (pH_{FOX}) was recorded.

This is a quick, qualitative assessment of the potential acidity of the soil. Reactivity to hydrochloric acid (HCl) was also assessed as a qualitative determination of the neutralising carbonate content including calcium carbonate (shells) within the soil. The results of these screening tests were used as an additional tool in determining which soil samples should be further assessed by quantitative laboratory testing.

Laboratory test certificates containing screening (qualitative) test results of pH_F and pH_{FOX} are presented in Appendix 'C', where $pH_F < 4.0$ generally indicates actual A.S.S. and $pH_{FOX} < 3.0$ indicates potential A.S.S.

5.5.2 Quantitive Tests

A total of 20 CRS & TAA analyses (Chromium Reducible Sulphur and Total Actual Acidity), were carried out on recovered soil samples based on the results of the screening tests to quantify the actual and potential acid hazard within the soils.

TAA is a measure of the soils existing acidity prior to oxidation of sulfidic material. The CRS test quantifies the sulfur trail.

Table 1 presents a summary of quantitative test results. Laboratory test certificates are presented in Appendix 'C'.

TABLE 1 QUANTITATIVE TEST RESULTS SUMMARY

Borehole No.	Depth (m)	Classification (AS1726-1993)	TAA [1] (mole H^+/t)	SCR [2] (%)
BH1	0	Silty Sand (SM)	10	0.00
BH2	2.0m	Silty Sand (SM)	10	0.04
BH3	1.0m	Sand (SP)	5	0.00
BH4	2.0m	Sand (SP)	0	0.09
BH5	1.0	Silty Sand (SM)	10	0.02
BH5	2.0	Silty Sand (SM)	10	0.05
BH6	2.0	Silty Sand (SM)	13	0.12
BH7	1.0	Silty Sand (SM)	10	0.06
BH8	0.5	Silty Sand (SM)	5	0.01
BH9	0.0	Silty Sand (SM)	13	0.01
BH9	1.0	Sandy Sand (SM)	58	0.44
BH10	2.0	Silty Sand (SM)	10	0.12
BH11	1.5	Silty Sand (SM)	18	0.05
BH12	0.5	Sand (SP)	3	0.01
BH13	0.0	Silty Sand (SM)	5	0.01
BH13	2.0	Silty Sand (SM)	25	0.15
BH14	2.0	Silty Sand (SM)	23	0.09
BH15	0.0	Silty Sand (SM)	5	0.02
BH15	2.0	Silty Sand (SM)	10	0.04
BH16	2.0	Silty Sand (SM)	15	0.1

Note:
1) Total Actual Acidity
2) Chromium Reducible Sulfur

6.0 DISCUSSION OF RESULTS

6.1 Soil Classification

The majority of samples recovered from the field investigation program were classified as silty sand (SM) and Sand (SP).

An appraisal of the topography and soil classification suggested that there is potential for acid sulfate conditions to develop across the site.

6.2 Results of Laboratory Testing

Results of screening tests (pH_F pH_{FOX}) generally confirmed the indications of the soil classifications.

The test results indicate acid sulfate soils are present, as actual and potential acid sulfate soils. Actual acid sulfate soils are due to oxidation as the water table fluctuates and potential acid sulfate soils have limited previous oxidation.

Generally pH_F values ranged between 2.6 and 7.7 with pH_{FOX} values ranging between 1.3 and 6.9.

Results of qualitative laboratory testing, ie. TAA and CRS tests indicated existing and potential Acid Sulfate Soils (ASS) to be present on the site.

It is understood that further interpretation of results and the preparation of an Acid Sulfate Management Plan (ASMP) will be undertaken by Blueland Engineers as requested.

7.0 CONTAMINATION TESTING

Contamination testing was carried out on 22 combined samples as requested.

Testing was carried out by ALS Environmental and results are presented in Appendix D.

8.0 LIMITATIONS

We have prepared this factual report for use by **WALTER ELLIOT HOLDINGS PTY LTD** and **BLUELAND ENGINEERS** in accordance with currently accepted environmental and geotechnical guidelines. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties other than **WALTER ELLIOT HOLDINGS PTY LTD** their associated consultants. It may not contain sufficient information for the purposes of other parties or for other uses.

Soil Surveys Engineering Pty Limited offers a documentation review service to verify that the intent of recommendations is properly reflected in the A.S.M.P. It is recommended that clients avail themselves of this service; our standard rates will apply.

P. KIDD

A. M. RUTTEN (RPEQ 2202)

for and on behalf of
SOIL SURVEYS ENGINEERING PTY LIMITED

APPENDICES

APPENDIX A
NOTES RELATING TO THIS REPORT

INTRODUCTION

These notes are provided by Soil Surveys Engineering Pty Limited (the Company) to complement the geotechnical report in regard to classification methods and field procedures. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and at the time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

Soils - The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726-1993 (Geotechnical Site Investigations), where appropriate. In general, descriptions cover the following properties - soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the dominant particle size and behaviour as set out in AS 1726-1993.

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, shear vane, laboratory testing or engineering examination. The strength terms are defined in AS1726-1993 Table A4.

Non-cohesive soils are classified on the basis of relative density usually based on insitu testing or engineering examination (see AS1726-1993 Table A5).

Rocks - Rock types are classified by their geological names (AS1726-1993 Table A6), together with

Table 1 Estimated strength descriptions given to rock based on engineering examination

Strength Term	Approximate Qu (MPa)
Extremely Weak	< 1.0
Very Weak	1.0 - 5.0
Weak	5.0 - 25
Medium Strong	25 - 50
Strong	50 - 100
Very Strong	100 - 250
Extremely Strong	> 250

Ref ISRM "Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses"

descriptive terms regarding weathering (AS1726-1993 Table A9), strength (refer Table 1 below), defects (AS1726-1993 Table A10), etc. Where strength testing (ie Point Loads) is carried out, AS1726-1993 Table A8 is used. Where relevant, further information regarding rock classification is attached.

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon sample disturbance, (information on strength and structure).

Undisturbed samples are taken by pushing a thin walled sample tube, usually 50mm diameter (U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength, volume change potential and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application.

Test Pits - These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling - A borehole of 50 to 100mm diameter is advanced by manually operated equipment. Refusal of the augers can occur on a variety of materials such as hard clay, gravel or rock fragments and does not necessarily indicate rock level.

Continuous Spiral Flight Augers - The borehole is advanced using 75 to 300 mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the augers. Information from the drilling (as distinct from specific sampling) is of relatively lower reliability due to remoulding, inclusion of cuttings from above or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table has a lower reliability than augering above the water table. Various drill bits are attached to the base of the augers during the drilling. The depth of refusal of the different bit types can provide information as to the strength of the material encountered. Generally two different bit types are used. The 'V' bit is a V shaped steel bit and the 'TC' bit is a tungsten carbide tipped screw type bit.

Wash Boring - The borehole is usually advanced by a rotary bit with water or fluid pumped down the hollow drill rods and returned up in the space between the rods and the soil or casing, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration. More accurate information on soil strata is gained by regular testing and sampling using the Standard Penetration Test (SPT) and undisturbed thin walled tube samples (U50).

Mud Stabilized Drilling - Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilize the borehole. The term "mud" encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from regular intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling - A continuous core sample is obtained using a diamond or tungsten carbide tipped core barrel. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable method of investigation. In rocks, NMLC coring (nominal 52 mm diameter) is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses is determined on site by the supervisor. If the location of the loss is uncertain, it is placed at the top end of the run, when the core is placed in a storage tray and recorded on the log.

Standard Penetration Tests - Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" - Test 6.3.1. The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm, the upper 150 mm being neglected due to possible disturbance from the drilling method. In dense sands, very hard clays or weak rock, the full 450 mm

penetration may not be practicable and the test is discontinued at a reduced penetration.

In the case where full penetration is obtained with successive blow counts for each 150 mm of, say 4, 6 and 7 blows, the record shows,

4, 6, 7 N = 13

In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm, the record shows:

15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, it is noted on the borehole logs.

A modification to the SPT test is where the same driving system is used with a solid 60^0 tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid SPT are shown as "N_c" on the borehole logs, together with the number of blows per 150 mm penetration.

Cone Penetration Tests - Test Method - Cone Penetration Tests (CPT) are carried out in accordance with AS 1289 Test 6.5.1-1977, using an electrical friction-cone penetrometer.

The test essentially comprises the measurement of resistance to penetration of a cone of 35.7 mm diameter pushed into the soil at a rate of 10-20 mm per second by hydraulic force. The resistance to penetration is recorded in terms of pressure on the end area of the cone (cone resistance, q_c, in MPa) and friction on the side of the 135 mm long sleeve immediately above the top of the cone (friction resistance, f_s, in kPa). These forces are measured by electrical transducers (strain gauges) within the cone device. The ratio between friction resistance and cone resistance is also calculated as a percentage, ie.-

$$\textit{Friction Ratio } (FR) = \frac{\textit{Friction Resistance, } f_s \textit{ (kPa)} \times 100}{\textit{cone resistance, } q_c \textit{ (kPa)}}$$

The friction ratio, FR, is generally low in sands (less than 1% or 2%) and generally higher in clays (say 3% or more). The interpretation of sandy clays, clayey sands and material with a high silt content is more difficult, but intermediate values (between 1% and 3%) would be expected. Highly organic clays and peats generally have a friction ratio in excess of 5%.

Static cone data is recorded in the field on disc for later presentation using computer aided drafting.

The equipment can be operated from any conventional drill rig. A total applied load in the range of 4 to 10 tonnes is required for practical purposes, although lighter loads may be used. The cone penetrometers are available with various capacities of cone resistance ranging up to 100 MPa for general purpose investigations, while a range of 0 to 10 MPa can be used where more sensitive investigations of soft clay are required.

The cone resistance value provides a continuous measure of soil strength or density, and together with the friction ratio, provide very useful indications of the presence of narrow bands of geotechnically significant layers such as thin, soft clay layers or lenses of sand which might otherwise be missed using conventional drilling methods.

The lithology of the encountered soils is interpreted from static cone data and is generally presented on the static cone log sheets.

It is important to note that the lithology is interpreted information and is based on research by Schmertmann (1970), Sanglerat (1972), Robinson and Campinalli (1986), modified to suit local conditions as indicated by borehole information and laboratory testing.

As soils generally change gradually it is sometimes difficult to accurately describe depths of strata changes, although greater accuracy is obtained with the static cone compared with conventional drilling. In addition, friction ratios decrease in accuracy with low cone resistance values, and in desiccated soils. As a result, some overlap and minor discrepancies may exist between static cone and nearby borehole information.

Portable Dynamic Cone Penetrometers - Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 100mm increments of penetration.

The DCP comprises a Cone of 20 mm diameter with 30 degree taper attached to steel rods of smaller section.

The cone end is driven with a 9 kg hammer falling 510 mm (AS. 1289 Test 6.3.2). The test was developed initially for pavement subgrade investigations, and empirical correlations of the test results with California Bearing Ratio have been published by various Road Authorities. The Company has developed their own correlations with Standard Penetration tests and Density Index tests in sands.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems.

- Although groundwater may be present in lower permeability soils, it may enter the hole slowly or perhaps not at all during the time the hole is open.
- A localized perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be bailed out of the bore and mud must be washed out of the hole or "reverted" if water observations are to be made.

More reliable measurements can be made by use of standpipes which are read after stabilizing at periods ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc.) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is important to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms and the attached explanatory notes summarize important aspects of the Laboratory Test Procedures adopted.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal the information and interpretation may not be relevant if the design proposal is changed. If this happens, the Company

will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects and recommendations or suggestions for design and construction. Since the test sites in any exploration represent a very small proportion of the total site and since the exploration only identifies actual ground conditions at the test sites, even under the best circumstances actual conditions may vary from those inferred to exist. No responsibility is taken for:-

- Unexpected variations in ground and/or groundwater conditions.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of other persons.
- Any work where the company is not given the opportunity to supervise the construction using the Companies designs/recommendations.

If differences occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are more readily resolved when conditions are exposed than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances, where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer. We would be happy to assist in this regard as an extension of our investigation commission.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

i) Site visits during construction to confirm reported ground conditions

ii) Site visits to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, the stability of a filled or excavated slope; or

iii) Full-time engineering presence on site.

In the vast majority of cases it is advantageous to the principal for the geotechnical engineer who wrote the investigation report to be involved in the construction stage of the project.

APPENDIX B
BOREHOLE RECORDS

Soil Surveys Engineering Pty. Limited

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BOREHOLE RECORD SHEET

Borehole Number : 1

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V, TC, WB, RR, NMLC, Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.30		FILL SAND (SP) Loose, fine to medium grained, grey, moist.		D
	1.0 ▼ ▽ 1.05		FILL SAND (SP) Loose to medium dense, fine to medium grained, grey-brown, some silt fines, moist.		D
	1.80		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown, wet.		D
	2.0		SAND (SP) Medium dense, fine to medium grained, grey, wet.		D
	3.0				
	4.0				
	5.0				
	5.60		Silty SAND (SM) Medium dense, fine to medium grained, grey, wet.		
	6.0	6.00	Borehole Terminated 6.00m		
	7.0				
	8.0				
	9.0				
	10.0				

COMMENTS

1) Groundwater noted at 1.05m. 2) Steady water noted at 0.9m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 2

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.25		FILL Silty SAND (SM) Very loose to loose, fine to medium grained, dark grey, moist.		D
	0.80		FILL SAND (SP) Loose, fine to medium grained, grey, some silt fines, moist.		
	1.0		FILL Silty SAND (SM) Loose, fine to medium grained, dark brown, moist.		D
	▼ ▽ 1.25				
	1.65		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown, organic matter, wet.		D
	2.0		SAND (SP) Medium dense, fine to medium grained, grey, wet.		
	3.0				
	4.0				
	5.0				
	5.50		Silty SAND (SM) Medium dense, fine to medium grained, grey, wet.		
	6.0				
	6.00		Borehole Terminated 6.00m		
	7.0				
	8.0				
	9.0				
	10.0				

COMMENTS

1) Groundwater noted at 1.25m. 2) Steady water noted at 1.3m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Lutton

Date : 27 7 04

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BOREHOLE RECORD SHEET

Borehole Number : 3

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.15		FILL Silty SAND (SM) Loose, fine to medium grained, grey-brown, moist.		D
	1.0		FILL SAND (SP) Medium dense, fine to medium grained, light grey bleached brown, moist.		D
	1.30 ▼				D
	1.70 ▽		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown, some organic matter, wet.		D
	2.0		SAND (SP) Medium dense to dense, fine to medium grained, grey-brown, some silt fines, wet.		
	3.0				
	4.0				
	5.0				
	6.0				
	6.00		Borehole Terminated 6.00m		
	7.0				
	8.0				
	9.0				
	10.0				

COMMENTS

1) Groundwater noted at 1.3m. 2) Steady water noted at 1.85m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 4

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.30 ▼ ▽		NATURAL Silty SAND (SM) Very loose to loose, fine to medium grained, grey-brown, organic matter, moist.		D
	1.0		Silty SAND (SM) Loose, fine to medium grained, grey-brown, trace of organic, moist.		D
	1.00		SAND (SP) Medium dense, fine to medium grained, grey, wet.		D
	2.0				
	3.0				
	3.30		Silty SAND (SM) Dense to very dense, fine to medium grained, dark grey-brown, wet.		
	4.0				
	5.0				
	6.0				
	6.00		Borehole Terminated 6.00m		
	7.0				
	8.0				
	9.0				
	10.0				

COMMENTS

1) Groundwater noted at 0.3m. 2) Steady water noted at 0.55m. 3) DCP Refusal at 3.6m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Shelton

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 5

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / ad / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.15		FILL Silty SAND (SM) Loose, fine to medium grained, grey-brown, moist		D
	0.75		FILL Silty SAND (SM) Loose to medium dense, fine to medium grained, grey-brown, moist.		D
	1.0		FILL SAND (SP) Loose, fine to medium grained, grey, some silt fines, wet.		D
	1.10		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, wet.		
	1.55		SAND (SP) Medium dense, fine to medium grained, grey, wet.		
	2.0				
	3.0				
	3.10		Silty SAND (SM) Very dense, fine to medium grained, dark grey-brown, wet.		
	4.0				
	5.0				
	5.10		Silty SAND (SM) Dense, fine to medium grained, grey-brown, wet.		
	6.0				
	6.00		Borehole Terminated 6.00m		
	7.0				
	8.0				
	9.0				
	10.0				

COMMENTS

1) Groundwater noted at 0.70m. 2) Steady water noted at 0.80m. 3) DCP Refusal at 3.2m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27 T 104

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BOREHOLE RECORD SHEET

Borehole Number : 6

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, some organics, moist.		D
	1.0		SAND (SP) Medium dense, fine to medium grained, grey, wet.		D
	1.10		Silty SAND (SM) Loose, fine to medium grained, grey-brown, wet.		D
	2.0				
	1.90		Silty SAND (SM) Medium dense, fine to medium grained, grey-brown, wet.		
	2.60		Silty SAND (SM) Very dense, fine to medium grained, dark grey-brown, wet, (Indurated)		
	3.0				
	4.0				
	5.0				
	5.40		Silty SAND (SM) Dense, fine to medium grained, dark grey-brown, wet, (Indurated)		
	6.0				
	6.00		Borehole Terminated 6.00m		
	7.0				
	8.0				
	9.0				
	10.0				

COMMENTS

1) Groundwater noted at 0.1m. 2) Steady water noted at 0.6m. 3) DCP Refusal at 2.6m & 3.2m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 7

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V, TC, WB, RR, NMLC, Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		NATURAL Organic CLAY (CO) Firm, high plasticity, dark grey-brown, organics, moist.		
			SAND (SP) Loose, fine to medium grained, grey-brown, some silt fines, wet.		D
	1.0				D
					D
	2.0				D
	2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 0.1m. 2) Steady water noted at 0.6m.

▼ Water First Noted ∇ Water Steady Level

Approved : Trevor Carlton

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 8

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting :

Northing :

RL :

Logger : RB

Driller : RB

Drilling Rig : Jacro105

Drilling Method (V, P, WB, RR, NMLC, Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		FILL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, moist		D
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, some silt fines, moist.		
	▼ ▽ 0.75				D
	1.0		NATURAL Silty SAND (SM) Loose, fine to medium grained, brown bleached grey, wet.		D
	1.50		Borehole Terminated 1.50m		D
	2.0				
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 0.75m. 2) Steady water noted at 0.7m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 9

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting :

Northing :

RL :

Logger : RB

Driller : RB

Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / HMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		FILL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, moist.		
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, some silt fines, moist.		D
	0.90				
	1.0 ▽ 0.95				D
			NATURAL Organic CLAY (CO) Firm, high plasticity, dark grey-brown, organics, moist.		
			Silty SAND (SM) Loose, fine to medium grained, brown bleached grey, wet.		D
	2.0 2.00				
			Borehole Terminated 2.00m		D
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 0.95m. 2) Steady water noted at 1.0m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 10

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting :

Northing :

RL :

Logger : RB

Driller : RB

Drilling Rig : Jacro105

Drilling Method						Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
V	TC	WB	RR	NMLC	Casing					
						0.10		FILL Silty SAND (SM) Loose, fine to medium grained, dark gre-brown, moist.		
								FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
						0.90				
						1.0		NATURAL Silty SAND (SM) Medium dense, fine to medium grianed, grey-brown, wet.		D
										D
						1.80				
						2.0		SAND (SP) Medium dense, fine to medium grained, grey, wet.		D
						2.00				
								Borehole Terminated 2.00m		
						3.0				
						4.0				
						5.0				

COMMENTS

1) Groundwater noted at 0.9m. 2) Steady water noted at 0.95m.

▼ Water First Noted ▽ Water Steady Level

Approved : Ian Cutten

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 11

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.15		FILL Silty SAND (SM) Loose, fine to medium grained, dark gre-brown, moist.		
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
	1.0 ▽ 0.95				
	▼ 1.10		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown bleached grey, some organics, moist.		D
			SAND (SP) Medium dense, fine to medium grained, grey bleached brown, wet.		D
	2.0 2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 1.1m. 2) Steady water noted at 1.0m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Carlton

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 12

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V, TC, WB, RR, NMLC, Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
	0.80				
	1.0		FILL SAND (SP) Loose, fine to medium grained, bleached brown, moist.		D
	1.40		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown bleached grey, some organics, moist.		D
	▼ 1.55		SAND (SP) Medium dense, fine to medium grained, grey bleached brown, wet.		D
	2.0				
	2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 1.55m. 2) Steady water noted at 1.5m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Carter

Date : 27/7/04

Soil Surveys Engineering Pty. Limited

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BOREHOLE RECORD SHEET

Borehole Number : 13

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting :

Northing :

RL :

Logger : RB

Driller : RB

Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		FILL SAND (SP) Loose, fine to medium grained, dark grey-brown, moist		D
	0.80		FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
	1.0 ▼ ▽ 1.10		NATURAL SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, moist.		D
	2.0		SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, wet.		D
	2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 1.55m. 2) Steady water noted at 1.0m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

Soil Surveys Engineering Pty. Limited

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BOREHOLE RECORD SHEET

Borehole Number : 14

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.15		FILL SAND (SP) Loose, fine to medium grained, dark grey-brown, moist.		
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
	0.85				
	1.0		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, wet.		D
	1.40				
			SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, wet.		D
	2.0				D
	2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 0.85m. 2) Steady water noted at 0.9m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Rankin

Date : 27/7/04

Soil Surveys Engineering Pty. Limited

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BOREHOLE RECORD SHEET

Borehole Number : 15

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting :

Northing :

RL :

Logger : RB

Driller : RB

Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.13		FILL SAND (SP) Loose, fine to medium grained, dark grey-brown, moist.		
	1.0		FILL SAND (SP) Loose, fine to medium grained, grey, moist.		D
	▽ 1.40				D
	▼ 1.50		NATURAL Organics CLAY (CO) Firm, high plasticity, dark brown, moist.		D
	2.0		SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, wet.		D
	2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 1.5m. 2) Steady water noted at 1.4m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 16

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / Tc / WB / RR / NMLC / Casing)	Depth	Graphic	Description	Samples and Remarks
	0.15		FILL SAND (SP) Loose, fine to medium grained, dark grey-brown, moist.	
	0.90		FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.	D
	1.0		NATURAL SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, wet.	D
	2.00		Borehole Terminated 2.00m	D
	2.0			D
	3.0			
	4.0			
	5.0			

COMMENTS

1) Groundwater not observed.

Approved : Tom Rutten

Date : 27/7/04

APPENDIX C
ACID SULFATE LABORATORY TEST RESULTS

Soil Surveys Engineering
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Milton Qld. 4064

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Screening Test Results

Issued: 29/6/04,12:17 PM

Ref. No. : GOL4808 Project : **204-4808, Hastings Point for Soil Surveys Engineering P/L Nerang**

Ref. No.	I.D.	Soil Type (truncated description)	Date Sampled	Reaction to Peroxide	Reaction to HCl	pHF 1:5 suspension in 1 molar NaCl	pHFOX 1:5 suspension in 1 molar NaCl
1	BH01 0.00-0.00	Silty SAND (SM), dark grey-brown	-	Slight	Nil	4.0	2.1
2	BH01 0.00-0.50	Silty SAND (SM), dark grey-brown	-	Slight	Slight	3.4	3.2
3	BH01 0.00-1.00	Silty SAND (SM), brown-grey	-	Slight	Nil	4.2	3.7
4	BH01 0.00-1.50	Silty SAND (SM), dark grey-black	-	Slight	Slight	3.9	3.7
5	BH01 0.00-2.00	Silty SAND (SM), dark grey-black	-	Moderate	Slight	4.1	2.2
6	BH01 0.00-2.00	Silty SAND (SM), dark grey	-	Moderate	Slight	6.7	6.1
7	BH02 0.00-0.50	Silty SAND (SM), grey-brown	-	Moderate	Slight	7.1	6.0
8	BH02 0.00-1.00	Silty SAND (SM), dark brown	-	Slight	Slight	4.7	4.5
9	BH02 0.00-1.50	Silty SAND (SM), dark brown	-	Slight	Nil	4.1	3.9
10	BH02 0.00-2.00	Silty SAND (SM), grey	-	Strong	Slight	4.5	3.0
11	BH03 0.00-0.00	Silty SAND (SM), grey	-	Moderate	Nil	4.1	3.7
12	BH03 0.00-0.50	Silty SAND (SM), light brown-white	-	Slight	Slight	4.6	4.1
13	BH03 0.00-1.00	Silty SAND (SM), light brown-white	-	Slight	Slight	4.8	4.2
14	BH03 0.00-1.50	Silty SAND (SM), dark brown	-	Slight	Slight	3.9	3.5
15	BH03 0.00-2.00	Silty SAND (SM), grey	-	Slight	Slight	4.1	2.7
16	BH04 0.00-0.00	Silty SAND (SM), grey	-	Slight	Strong	7.7	6.9
17	BH04 0.00-0.50	Silty SAND (SM), grey-brown	-	Moderate	Moderate	6.5	2.7
18	BH04 0.00-1.00	Silty SAND (SM), grey-brown	-	Slight	Slight	7.1	3.2
19	BH04 0.00-1.50	Silty SAND (SM), light grey	-	Slight	Slight	7.4	5.7
20	BH04 0.00-2.00	Silty SAND (SM), light grey	-	Slight	Slight	7.1	2.2
21	BH05 0.00-0.00	Silty SAND (SM), dark grey-brown	-	Slight	Slight	3.7	3.0
22	BH05 0.00-0.50	Silty SAND (SM), dark brown	-	Slight	Slight	3.9	4.3
23	BH05 0.00-1.00	Silty SAND (SM), grey-brown	-	Slight	Slight	4.2	3.8
24	BH05 0.00-1.50	Silty SAND (SM), grey-brown	-	Slight	Slight	4.6	3.1
25	BH05 0.00-2.00	Silty SAND (SM), light grey-brown	-	Moderate	Slight	4.7	2.3
26	BH06 0.00-0.00	Silty SAND (SM), dark grey-brown	-	Strong	Slight	4.0	3.3
27	BH06 0.00-0.50	Silty SAND (SM), light brown-grey	-	Slight	Slight	4.4	4.0
28	BH06 0.00-1.00	Silty SAND (SM), brown	-	Slight	Slight	4.8	3.9
29	BH06 0.00-1.50	Silty SAND (SM), light brown-grey	-	Slight	Slight	4.6	2.4
30	BH06 0.00-2.00	Silty SAND (SM), dark brown	-	Slight	Slight	4.7	2.3
31	BH07 0.00-0.00	Sandy SILT (ML), dark grey-brown	-	Slight	Slight	4.2	3.7
32	BH07 0.00-0.50	Silty SAND (SM), light brown-grey	-	Slight	Slight	4.6	3.9
33	BH07 0.00-1.00	Silty SAND (SM), dark brown-grey	-	Slight	Slight	4.5	3.5
34	BH07 0.00-1.50	Silty SAND (SM), brown-grey	-	Slight	Slight	4.5	2.9
35	BH07 0.00-2.00	Silty SAND (SM), light brown	-	Slight	Slight	4.5	2.5
36	BH08 0.00-0.00	Silty SAND (SM), light grey-brown	-	Moderate	Slight	4.1	3.7
37	BH08 0.00-0.50	Silty SAND (SM), light grey	-	Slight	Slight	4.1	3.9
38	BH08 0.00-1.00	Silty SAND (SM), grey-brown	-	Slight	Slight	4.1	3.9
39	BH08 0.00-1.50	Silty SAND (SM), grey-brown	-	Slight	Slight	4.1	3.1

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Screening Test Results

Issued: 29/6/04,12:17 PM

Ref. No. : GOL4808 Project : **204-4808, Hastings Point for Soil Surveys Engineering P/L Nerang**

Ref. No.	I.D.	Soil Type (truncated description)	Date Sampled	Reaction to Peroxide	Reaction to HCl	pHF 1:5 suspension in 1 molar NaCl	pHFOX 1:5 suspension in 1 molar NaCl
40	BH08 0.00-2.00	Silty SAND (SM), grey-brown	-	Slight	Slight	4.3	3.0
41	BH09 0.00-0.00	Silty SAND (SM), dark grey	-	Slight	Slight	2.6	2.8
42	BH09 0.00-0.50	Silty SAND (SM), light brown	-	Slight	Slight	3.4	3.2
43	BH09 0.00-1.00	Silty SAND (SM), dark brown-black	-	Slight	Slight	3.4	1.3
44	BH09 0.00-1.50	Silty SAND (SM), dark brown	-	Slight	Slight	4.0	2.1
45	BH09 0.00-2.00	Silty SAND (SM), dark brown	-	Slight	Slight	4.6	1.9
46	BH10 0.00-0.00	Silty SAND (SM), dark brown-grey	-	Slight	Slight	3.3	3.1
47	BH10 0.00-0.50	Silty SAND (SM), light grey-brown	-	Slight	Slight	3.9	3.7
48	BH10 0.00-1.00	Silty SAND (SM), light grey-brown	-	Slight	Slight	4.0	3.8
49	BH10 0.00-1.50	Silty SAND (SM), grey-brown	-	Slight	Slight	4.2	4.0
50	BH10 0.00-2.00	Silty SAND (SM), grey-brown	-	Slight	Slight	4.5	2.3
51	BH11 0.00-0.00	Silty SAND (SM), dark grey-brown	-	Slight	Slight	3.4	3.4
52	BH11 0.00-0.50	Silty SAND (SM), grey	-	Slight	Slight	3.6	3.5
53	BH11 0.00-1.00	Silty SAND (SM), dark brown	-	Moderate	Slight	4.0	4.0
54	BH11 0.00-1.50	Silty SAND (SM), dark brown-grey	-	Strong	Slight	4.0	2.5
55	BH11 0.00-2.00	Silty SAND (SM), dark brown-grey	-	Slight	Slight	4.2	2.3
56	BH12 0.00-0.00	SAND (SP), white-grey	-	Slight	Slight	4.8	4.1
57	BH12 0.00-0.50	SAND (SP), white	-	Slight	Slight	5.7	5.5
58	BH12 0.00-1.00	Silty SAND (SM), grey-brown	-	Slight	Slight	4.4	3.2
59	BH12 0.00-1.50	Silty SAND (SM), dark grey-brown	-	Slight	Slight	3.9	3.1
60	BH12 0.00-2.00	Silty SAND (SM), grey-brown	-	Slight	Slight	4.3	2.2
61	BH13 0.00-0.00	Silty SAND (SM), grey-white	-	Strong	Slight	4.3	4.1
62	BH13 0.00-0.50	Silty SAND (SM), light grey-brown	-	Slight	Slight	4.4	4.1
63	BH13 0.00-1.00	Silty SAND (SM), light grey-brown	-	Slight	Slight	4.4	4.2
64	BH13 0.00-1.50	Silty SAND (SM), dark grey-brown	-	Slight	Slight	4.2	4.0
65	BH13 0.00-2.00	Silty SAND (SM), dark grey-brown	-	Slight	Slight	4.4	2.5
66	BH14 0.00-0.00	Silty SAND (SM), dark grey-brown	-	Moderate	Slight	4.4	3.7
67	BH14 0.00-0.50	Silty SAND (SM), grey	-	Slight	Slight	3.8	4.0
68	BH14 0.00-1.00	Silty SAND (SM), dark brown-black	-	Slight	Slight	3.7	3.5
69	BH14 0.00-1.50	Silty SAND (SM), dark brown-black	-	Slight	Slight	3.9	3.5
70	BH14 0.00-2.00	Silty SAND (SM), dark grey-brown	-	Slight	Slight	4.1	1.9
71	BH15 0.00-0.00	Silty SAND (SM), dark grey-black	-	Moderate	Slight	4.7	4.3
72	BH15 0.00-0.50	Silty SAND (SM), light grey-brown	-	Slight	Slight	4.9	4.5
73	BH15 0.00-1.00	Silty SAND (SM), light grey	-	Slight	Slight	5.4	4.7
74	BH15 0.00-1.50	Silty SAND (SM), dark grey	-	Slight	Slight	5.1	4.8
75	BH15 0.00-2.00	Silty SAND (SM), light grey-brown	-	Moderate	Slight	3.6	3.5
76	BH16 0.00-0.00	Silty SAND (SM), dark grey-brown	-	Slight	Slight	3.9	3.7
77	BH16 0.00-0.50	Silty SAND (SM), grey-brown	-	Slight	Slight	3.8	3.7
78	BH16 0.00-1.00	Silty SAND (SM), brown	-	Slight	Slight	4.1	4.0

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Screening Test Results

Issued: 29/6/04,12:17 PM

Ref. No. : **GOL4808** Project : **204-4808, Hastings Point for Soil Surveys Engineering P/L Nerang**

Ref. No.	I.D.	Soil Type (truncated description)	Date Sampled	Reaction to Peroxide	Reaction to HCl	pHF 1:5 suspension in 1 molar NaCl	pHFOX 1:5 suspension in 1 molar NaCl
79	BH16 0.00-1.50	Silty SAND (SM), dark grey-brown	-	Slight	Slight	**4.3**	**3.2**
80	BH16 0.00-2.00	Silty SAND (SM), dark grey-brown	-	Strong	Slight	**4.5**	**2.0**

Soil & Water Laboratories P/L
19 Finchley Street, Milton, QLD. 4064
Phone: (07) 3369 6668; Fax: (07) 3503 9063

Chromium Reducible Sulphur, Titratable Actual Acidity & Acid Neutralising Capacity Test Results

(methods 2A2, 19A2, 22B, 23A & 23F)

Ref. Number: GOL-4808

Date: 01/07/2004 Location: Hastings Point

Project Number: 204-4808

Sample Number	Identification	Description	Moisture as received	Reaction to		Init. pH	ANC		a-ANC	TAA	SCr	
			(85oC) (%)	H2O2	HCl	(KCl)	(%CaCO3 Eq.)	(mol. H+/tonne)	(eq. mol. H+/t)	(mol. H+/tonne)	(%S)	(mol. H+/t)
1	BH01 0.0m	Silty SAND (SM), fine to medium grained, grey to black, medium ploasticity fines, moist.	4.5%	Low	None	4.5	n/a	n/a	n/a	10	0.00	0
10	BH02 2.0m	Silty SAND (SM), fine to medium grained, grey to black, medium ploasticity fines, moist.	20.5%	High	Low	4.7	n/a	n/a	n/a	10	0.04	22
13	BH03 1.0m	SAND (SP), fine to medium grained, grey to white, moist.	4.1%	Low	Low	5.4	n/a	n/a	n/a	5	0.00	0
20	BH04 2.0m	SAND (SP), fine to medium grained, light grey , trace of low plasticity fines, moist	21.9%	Low	Low	6.3	n/a	n/a	n/a	0	0.09	58
23	BH05 1.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, moist.	25.3%	Low	Low	4.9	n/a	n/a	n/a	10	0.02	9
25	BH05 2.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, moist.	21.4%	Moderate	Low	4.9	n/a	n/a	n/a	10	0.05	34
30	BH06 2.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, wet.	29.3%	Low	Low	4.5	n/a	n/a	n/a	13	0.12	75
33	BH07 1.0m	Silty SAND (SM), fine to medium grained, dark grey, low plasticity fines, wet.	30.1%	Low	Low	4.7	n/a	n/a	n/a	10	0.06	36
37	BH08 0.5m	Silty SAND (SM), fine to medium grained, dark grey, low plasticity fines, moist.	5.5%	Low	Low	5.1	n/a	n/a	n/a	5	0.01	6
41	BH09 0.0m	Silty SAND (SM), fine to medium grained, dark grey, low plasticity fines, moist.	7.9%	Low	Low	4.2	n/a	n/a	n/a	13	0.01	6
43	BH09 1.0m	Silty SAND (SM), fine to medium grained, grey mottled black, low plasticity fines, moist.	34.1%	Low	Low	4.0	n/a	n/a	n/a	58	0.44	277
50	BH10 2.0m	Silty SAND (SM), fine to medium grained, grey mottled black, low plasticity fines, moist.	21.9%	Low	Low	4.8	n/a	n/a	n/a	10	0.12	75
54	BH11 1.5m	Silty SAND (SM), fine to medium grained, brown to black, low plasticity fines, wet.	26.4%	High	Low	4.4	n/a	n/a	n/a	18	0.05	32
57	BH12 0.5m	SAND (SP), fine to medium grained, yellow to white, moist.	4.1%	Low	Low	5.5	n/a	n/a	n/a	3	0.01	6
61	BH13 0.0m	Silty SAND (SM), fine to medium grained, low plasticity fines, just moist.	5.8%	High	Low	4.6	n/a	n/a	n/a	5	0.01	6
65	BH13 2.0m	Silty SAND (SM), fine to medium grained, brown to black, low plasticity fines, wet.	24.7%	Low	Low	4.2	n/a	n/a	n/a	25	0.15	95
70	BH14 2.0m	Silty SAND (SM), fine to medium grained, brown to black, low plasticity fines, wet.	24.4%	Low	Low	4.5	n/a	n/a	n/a	23	0.09	58
71	BH15 0.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, just moist.	7.4%	Low	Low	5.0	n/a	n/a	n/a	5	0.02	15
75	BH15 2.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, moist.	21.2%	Moderate	Low	4.8	n/a	n/a	n/a	10	0.04	22
80	BH16 2.0m	Silty SAND (SM), fine to medium grained, grey to black, low plasticity fines, moist.	22.5%	High	Low	4.8	n/a	n/a	n/a	15	0.10	62

Determinations have been derived by the adoption of published test methods recommended by National Committee for Acid Sulphate Soils (NatCASS); Queensland Acid Sulphate Soils Management Advisory Committee (QASSMAC); Queensland Acid Sulphate Soils Investigation Team (QASSIT) & Queensland Department of Natural Resources, Mines and Energy; as described in the 'Acid Sulphate Soils Laboratory Methods Guidelines 2004'.

APPENDIX D
CONTAMINATION LABORATORY TEST RESULTS

ALS Environmental

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). *Abbreviations:* ***CAS number*** = *Chemical Abstract Services number,* ***LOR*** = *Limit of Reporting.* ***# Indicates a raised LOR.***
When date(s) are shown bracketed, these have been assumed by the laboratory for process purposes.

Analytical Results

	Client Sample ID :	204 4808 1A	204 4808 2A	204 4808 3A	204 4808 4A	204 4808 5A
	Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
	Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
	Laboratory Sample ID :	EB0403190-001	EB0403190-002	EB0403190-003	EB0403190-004	EB0403190-005
Analyte	*CAS number*	*LOR*	*Units*			
EA055: Moisture Content						
Moisture Content (dried @ 103°C)		0.1	%	4.8	7.5	9.5	6.4	5.1
EG005T: Total Metals by ICP-AES						
Arsenic	7440-38-2	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	1	mg/kg	<1	<1	<1	<1	<1
Copper	7440-50-8	1	mg/kg	<1	<1	<1	<1	<1
Lead	7439-92-1	1	mg/kg	<1	<1	2	<1	<1
Nickel	7440-02-0	1	mg/kg	<1	<1	<1	<1	<1
Zinc	7440-66-6	1	mg/kg	1	<1	1	1	2
EG035T: Total Mercury by FIMS						
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)						
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
4.4'-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
4.4'-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
4.4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2

ALS Environmental

Analytical Results

	Client Sample ID :	204 4808 1A	204 4808 2A	204 4808 3A	204 4808 4A	204 4808 5A
	Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
	Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
	Laboratory Sample ID :	EB0403190-001	EB0403190-002	EB0403190-003	EB0403190-004	EB0403190-005
Analyte	*CAS number*	*LOR*	*Units*			
EP068B: Organophosphorus Pesticides (OP)						
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Demeton-S-methyl	8022-00-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Bromophos-ethyl	2104-96-3	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE		0.1	%	113	108	94.0	117	112
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.1	%	113	109	95.8	111	119

ALS Environmental

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: 204 4808 6A Sample Matrix Type / Description: SOIL / SOIL Sample Date / Time: 22 Jun 2004 15:00 Laboratory Sample ID: EB0403190-006	204 4808 7A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-007	204 4808 8A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-008	204 4808 9A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-009	204 4808 10A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-010
EA055: Moisture Content								
Moisture Content (dried @ 103°C)		0.1	%	2.7	5.3	15.9	10.7	3.2
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	1	mg/kg	<1	<1	3	2	2
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	1	mg/kg	<1	<1	1	<1	<1
Copper	7440-50-8	1	mg/kg	<1	<1	<1	<1	<1
Lead	7439-92-1	1	mg/kg	<1	<1	1	2	1
Nickel	7440-02-0	1	mg/kg	<1	<1	<1	<1	<1
Zinc	7440-66-6	1	mg/kg	<1	<1	3	2	<1
EG035T: Total Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Demeton-S-methyl	8022-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: 204 4808 6A Sample Matrix Type / Description: SOIL / SOIL Sample Date / Time: 22 Jun 2004 15:00 Laboratory Sample ID: EB0403190-006	204 4808 7A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-007	204 4808 8A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-008	204 4808 9A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-009	204 4808 10A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-010
EP068B: Organophosphorus Pesticides (OP)								
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Bromophos-ethyl	2104-96-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE		0.1	%	112	112	115	114	117
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.1	%	114	111	115	117	117

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Analytical Results

				Client Sample ID :	204 4808 11A	204 4808 12A	204 4808 13A	204 4808 14A	204 4808 15A
				Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
				Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
				Laboratory Sample ID :	EB0403190-011	EB0403190-012	EB0403190-013	EB0403190-014	EB0403190-015
Analyte	*CAS number*	*LOR*	*Units*						
EA055: Moisture Content									
Moisture Content (dried @ 103°C)		0.1	%		5.6	4.3	33.5	21.1	4.9
EG005T: Total Metals by ICP-AES									
Arsenic	7440-38-2	1	mg/kg		<1	<1	<1	1	<1
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	1	mg/kg		<1	<1	<1	<1	<1
Copper	7440-50-8	1	mg/kg		<1	<1	<1	<1	<1
Lead	7439-92-1	1	mg/kg		2	<1	1	<1	<1
Nickel	7440-02-0	1	mg/kg		<1	<1	<1	<1	<1
Zinc	7440-66-6	1	mg/kg		2	<1	1	3	1
EG035T: Total Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
4,4'-DDE	72-55-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
4,4'-DDD	72-54-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
4,4'-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Demeton-S-methyl	8022-00-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2

Analytical Results

				Client Sample ID :	204 4808 11A	204 4808 12A	204 4808 13A	204 4808 14A	204 4808 15A
				Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
				Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
				Laboratory Sample ID :	EB0403190-011	EB0403190-012	EB0403190-013	EB0403190-014	EB0403190-015
Analyte	*CAS number*	*LOR*	*Units*						
EP068B: Organophosphorus Pesticides (OP)									
Dimethoate	60-51-5	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Bromophos-ethyl	2104-96-3	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE		0.1	%		115	117	93.6	87.6	93.2
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.1	%		115	115	93.7	83.6	91.2

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: 204 4808 16A Sample Matrix Type / Description: SOIL / SOIL Sample Date / Time: 22 Jun 2004 15:00 Laboratory Sample ID: EB0403190-016	204 4808 17A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-017	204 4808 18A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-018	204 4808 19A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-019	204 4808 20A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-020
EA055: Moisture Content								
Moisture Content (dried @ 103°C)		0.1	%	57.1	24.5	12.6	12.0	32.8
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	1	mg/kg	2	2	<1	<1	2
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	1	mg/kg	3	2	<1	<1	2
Copper	7440-50-8	1	mg/kg	<1	<1	<1	8	<1
Lead	7439-92-1	1	mg/kg	3	1	<1	38	2
Nickel	7440-02-0	1	mg/kg	<1	<1	<1	2	<1
Zinc	7440-66-6	1	mg/kg	2	2	4	95	1
EG035T: Total Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
beta-BHC	319-85-7	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
gamma-BHC	58-89-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
delta-BHC	319-86-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Heptachlor	76-44-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Aldrin	309-00-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Heptachlor epoxide	1024-57-3	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
trans-Chlordane	5103-74-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
alpha-Endosulfan	959-98-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
cis-Chlordane	5103-71-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Dieldrin	60-57-1	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
4.4'-DDE	72-55-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Endrin	72-20-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
beta-Endosulfan	33213-65-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
4.4'-DDD	72-54-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Endrin aldehyde	7421-93-4	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Endosulfan sulfate	1031-07-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
4.4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Demeton-S-methyl	8022-00-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: 204 4808 16A Sample Matrix Type / Description: SOIL / SOIL Sample Date / Time: 22 Jun 2004 15:00 Laboratory Sample ID: EB0403190-016	204 4808 17A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-017	204 4808 18A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-018	204 4808 19A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-019	204 4808 20A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-020
EP068B: Organophosphorus Pesticides (OP)								
Dimethoate	60-51-5	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Diazinon	333-41-5	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Fenthion	55-38-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Chlorpyrifos	2921-88-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Chlorfenvinphos	470-90-6	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Bromophos-ethyl	2104-96-3	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Fenamiphos	22224-92-6	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Prothiofos	34643-46-4	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Ethion	563-12-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Carbophenothion	786-19-6	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Azinphos Methyl	86-50-0	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE		0.1	%	86.7	115	98.9	94.9	94.0
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.1	%	88.8	119	99.2	100	98.2

ALS Environmental

Analytical Results

	Client Sample ID :	204 4808 21A	204 4808 22A			
	Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL			
	Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00			
	Laboratory Sample ID :	EB0403190-021	EB0403190-022			
Analyte	*CAS number*	*LOR*	*Units*			
EA055: Moisture Content						
Moisture Content (dried @ 103°C)		0.1	%	23.6	2.4	
EG005T: Total Metals by ICP-AES						
Arsenic	7440-38-2	1	mg/kg	<1	<1	
Cadmium	7440-43-9	1	mg/kg	<1	<1	
Chromium	7440-47-3	1	mg/kg	<1	<1	
Copper	7440-50-8	1	mg/kg	<1	<1	
Lead	7439-92-1	1	mg/kg	1	<1	
Nickel	7440-02-0	1	mg/kg	<1	<1	
Zinc	7440-66-6	1	mg/kg	<1	<1	
EG035T: Total Mercury by FIMS						
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	
EP068A: Organochlorine Pesticides (OC)						
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	
4.4'-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	
4.4'-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	
4.4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	
EP068B: Organophosphorus Pesticides (OP)						
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	
Demeton-S-methyl	8022-00-2	0.05	mg/kg	<0.05	<0.05	
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	

ALS Environmental

Analytical Results

	Client Sample ID :	204 4808 21A	204 4808 22A			
	Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL			
	Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00			
	Laboratory Sample ID :	EB0403190-021	EB0403190-022			
Analyte	*CAS number*	*LOR*	*Units*			
EP068B: Organophosphorus Pesticides (OP)						
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	
Bromophos-ethyl	2104-96-3	0.05	mg/kg	<0.05	<0.05	
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	
EP068S: Organochlorine Pesticide Surrogate						
Dibromo-DDE		0.1	%	94.5	97.7	
EP068T: Organophosphorus Pesticide Surrogate						
DEF	78-48-8	0.1	%	91.8	93.7	

Method Reference Summary

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

Preparation Methods

EN69: Hot Block Digest for metals in soils sediments and sludges - Nitric/Hydrochloric Acid Digestion with H2O2 Leach (USEPA 200.2 mod, ALS QWI EN/69) This method (adapted from USEPA 200.2) utilizes Nitric / Hydrochloric acid and a 'Hot Block' apparatus for the digestion of total recoverable metals from sediments, sludges and soils.

ORG17A: Tumbler Extraction of Solids (Option A - Concentrating) - (In-house - Mechanical agitation (tumbler), ALS QWI-ORG/17 Option A) 20+0.05 g of sample and an appropriate drying agent (Na2SO4) is transferred to an extraction bottle. 150mL of organic solvent (1:1 DCM/Acetone) is added and the bottle tumbled for two hours. The solvent is decanted from the bottle, dehydrated and concentrated to the desired volume for analysis.

Analytical Methods

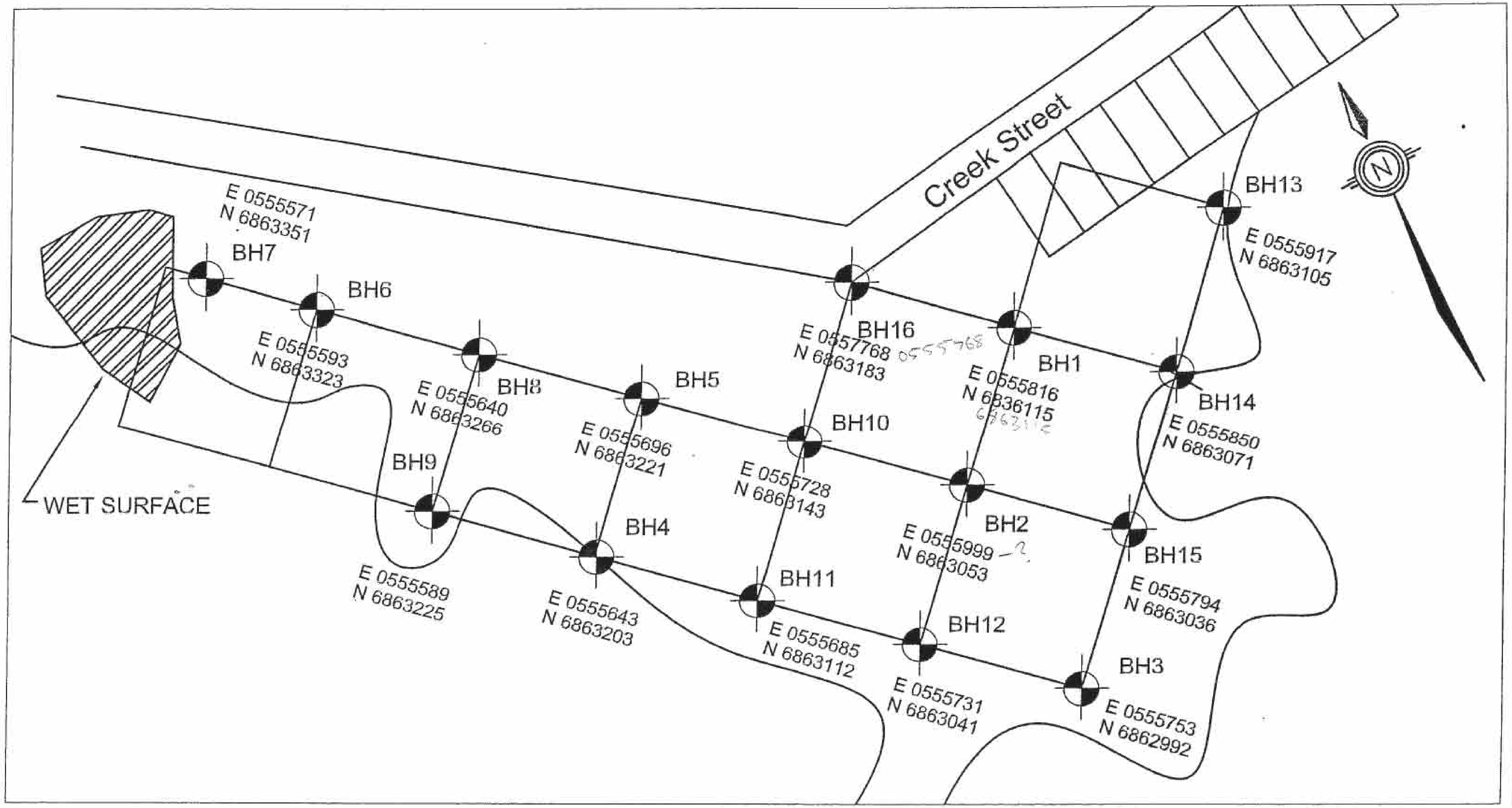
EA055-103: Moisture Content - A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees Celcius.

EP068: Pesticides by GCMS - (USEPA SW 846 - 8270D, ALS QWI-ORG/EP068) Sample extracts (ALSQWI-ORG/17 Option A) are analysed by Capillary GC/MS. Quantification is achieved using internal standard and average response factor quantification techniques against an established five-point curve.

EG035T: Total Mercury by FIMS - (AS 3550, ALS QWI-EN/EG035-1): Flow Injection Mercury - Atomic Absorption Spectrometry (FIM-AAS) is a flameless atomic absorption technique. For the determination of total mercury, an oxidation stage using a bromate/bromide reagent is employed to oxidise organic mercury compounds. The ionic mercury is reduced to atomic mercury vapour by a reducing agent ($SnCl_2$). Atomic mercury vapour is then purged into a heated quartz cell prior to quantification.

EG005T: Total Metals by ICP-AES - (APHA 20th ed., 3120; USEPA SW 846 - 6010; ALS QWI-EN/EG005): The ICPAES technique quickly breaks the sample down into atoms and ions under extremely hot plasma. Atoms are then ionized, emitting a characteristic spectrum. The spectrometer then separates the wavelengths, prior to comparison of intensities against matrix matched standards for quantification.

APPENDIX E
SITE PLANS



BOREHOLE LOCATIONS

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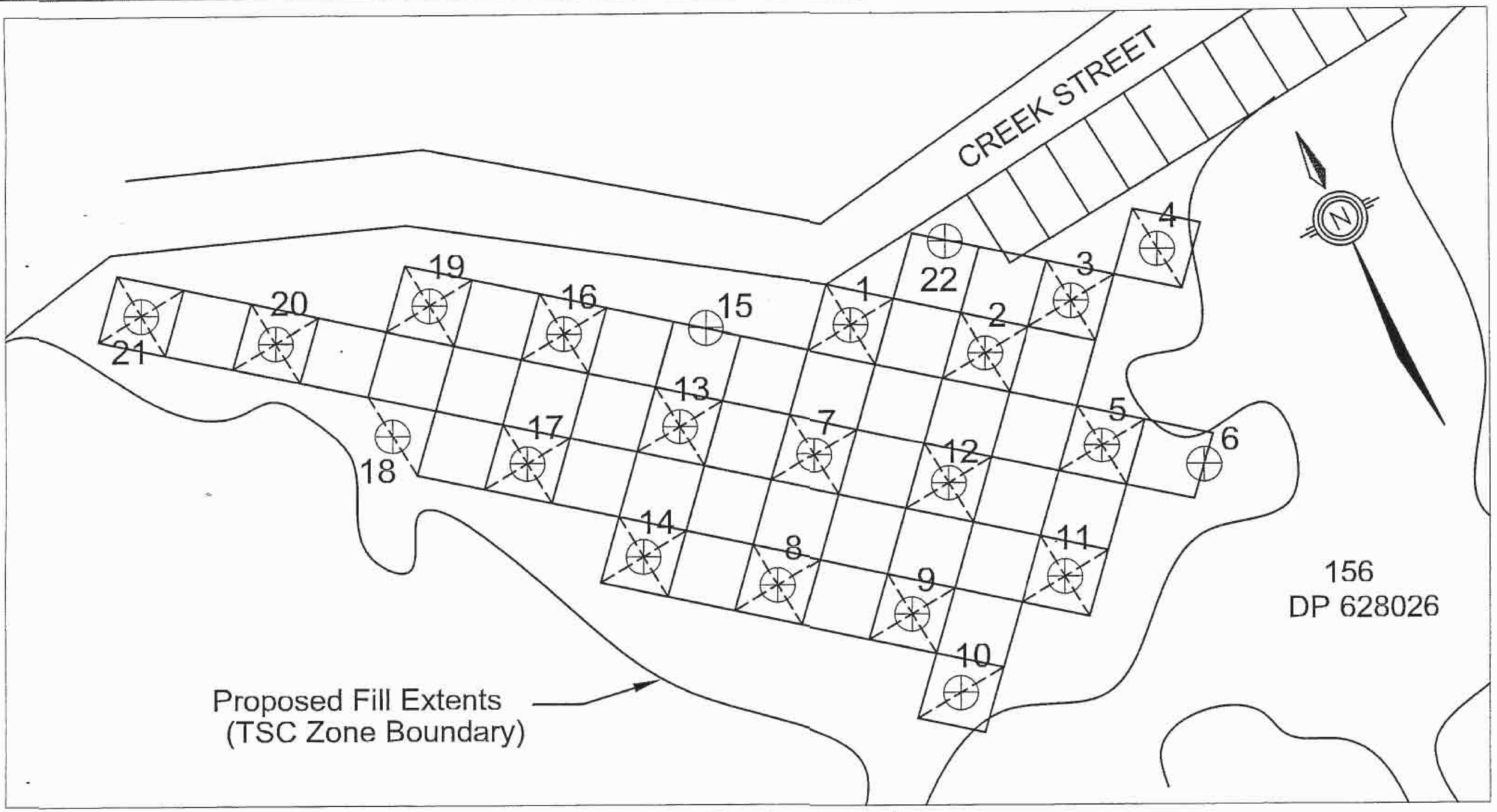
DATE 24.06.2004	SITE PLAN Proposed Filling Creek Street, Hastings point N.S.W.	DRAWING NO. 204-4808 -01	A4
CHECKED			



Contamination Testing Locations

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DRAWN D.D.	Soil Surveys SOIL SURVEYS ENGINEERING PTY.LIMITED CONSULTING GEOTECHNICAL ENGINEERS		
DATE 28.06.2004	SITE PLAN Proposed Filling Creek Street, Hastings point N.S.W.	DRAWING NO. 204-4808 -03	A4
CHECKED			

APPENDIX C

Preliminary Soil Contamination Report

PALM LAKE WORKS PTY LTD

PRELIMINARY SOIL CONTAMINATION REPORT

PROPOSED RESIDENTIAL SUBDIVISION
LOT 156 DP 628026 CREEK STREET
HASTINGS POINT NSW

OPUS QANTEC McWILLIAM

1 / 10 Rivendell, TWEED HEADS SOUTH NSW 2486
PO Box 6389, TWEED HEADS SOUTH NSW 2486

Telephone: 07 5523 1755
Facsimile: 07 5523 9664
E-mail: tweedheads@opusqmcw.com.au

MARCH 2008

DOCUMENT HISTORY PAGE

PROJECT NAME:

PROJECT NUMBER: 206012

DOCUMENT TITLE: PRELIMINARY SOIL CONTAMINATION REPORT

AUTHOR:

CLIENT: PALM LAKE WORKS PTY LTD

DESCRIPTION: FOR PROPOSED RESIDENTIAL SUBDIVISION LOT 156 DP 628026 CREEK STREET HASTINGS POINT NSW

REVISION / ISSUE RECORD

DATE	DESCRIPTION	REV	AUTHOR	VERIFIED

DISTRIBUTION RECORD

	REVISION No. / Qty Issued				
RECIPIENT	**A**	**B**	**C**	**D**	**E**

TABLE OF CONTENTS

1. INTRODUCTION

Palm Lake Works Pty Ltd have instructed Opus Qantec McWilliam to undertake a preliminary contaminated soil report for their property at Lot 156 DP 628026 Creek Street, Hastings Point, NSW. The report forms part of an assessment for proposed filling as a precursor to residential development of the property. This contamination report is to be read in conjunction with the Impact Assessment and should not be used for any other purpose.

2. SCOPE

This is a Preliminary Soil Contamination Report. The purpose is to identify areas of potential contaminated soils, which may otherwise be suitable, for residential land uses.

The investigation specifically targets contaminates used in the banana industry and agriculture in general. That is arsenic, cadmium, chromium, copper, lead, nickel, zinc, mercury, organochlorine and organophosphorous pesticides.

2.1 IDENTIFICATION

The property description is Lot 156 DP 628026 in the Parish of Cudgen, County of Rous in the Shire of Tweed. The locality is illustrated in Figure 1.0 of the Engineering Impact Assessment.

3. SITE HISTORY

A detailed site history was not available at the time of reporting. Anecdotal inquiries reveal the site has been used for cattle grazing. However, this did not preclude small crops and banana growing in the past. The testing has targeted those land uses.

4. SITE CONDITION & SURROUNDING ENVIRONMENT

The land is partially zoned 2(e) Residential Tourist and partially 7(a) Environmental Protection (Wetlands and Littoral Rainforest) under Tweed LEP 2000.

The site is located on the southern side of Creek Street and the western side of Coast Road. This is depicted in Figure 1.0 of the Engineering Impact Assessment. The site is characterised by relatively level land with the exception of some scattered holes. The site is grassed and generally cleared of trees.

Parent soil type is identified as predominantly silty sand of the Cobaki Landscape variety (Land and Water Conservation, 1996).

5. SAMPLING & ANALYSIS METHODOLOGY

The desktop assessment did not preclude previous crop growing. Therefore, a systematic sampling pattern was carried out by Soil Surveys Engineering Pty Ltd and tested by a NATA registered soil testing and sampling laboratory (ALS Environmental). The density of samples and the methodology is described in Table A of EPA NSW Contaminated Sampling Design Guidelines. Samples were collected from a depth of 150mm below the vegetated layer. The sample handling was carried out in general accordance with Section 2.5 of the EPA Guidelines for Assessing Banana Plantation Sites.

22 composite samples were made up from the individual samples from 75 test locations as illustrated in Figure 2.0. These composite samples were sent under Chain of Custody to a NATA testing laboratory.

Details of sampling locations by Soil Surveys Engineering Pty Ltd and testing results from ALS Environmental are presented in Appendix A and B respectively

5.1 BASIS FOR ASSESSMENT

The human health investigation thresholds listed in Table 1 of the National Environmental Health Forum were used for assessing the selected contaminants listed in the table. The EPA Guidelines for Assessing Banana Plantation Sites were also referenced given values outlined in the guidelines were used as they provide more conservative thresholds for contaminants than the Health-based soil investigation levels provided by the National Environmental Health Forum. These values are reproduced below for reference.

INVESTIGATION THRESHOLD	
CONTAMINANT	**THRESHOLD CONCENTRATION (mg/kg dry weight)**
Arsenic.	100
Lead.	300
Chromium	100
Copper	1000
Nickel	600
Zinc	7000

The sample results were evaluated in accordance with Section 2.4.2 of the EPA Guidelines. That is where composite subsamples are tested:

- If the individual result is less than 25% higher than the investigation threshold then the site can be considered uncontaminated.
- If any subsamples have a contamination level greater than 25% or the 95% upper confidence level exceed the threshold then the site is considered contaminated.

5.2 RESULTS

Initial sampling was performed on 22 June 2004. The report by Soil Surveys Engineering contained in Appendix B of the Engineering Impact Assessment gives the locations and detailed numbering of the samples. The sampling test locations and detailed results are reproduced in Appendix A and B respectively. In summary the results show:

- From twenty two tested laboratory samples, ranges of contaminants from testing that were greater than the limit of reporting were as follows.
  - Arsenic. (Range <1- 3 mg/kg).
  - Lead. (Range <1- 38 mg/kg).
  - Chromium (Range <1- 3 mg/kg).
  - Copper (Range <1- 8 mg/kg).
  - Nickel (Range <1- 2 mg/kg).
  - Zinc (Range <1- 95 mg/kg).
  - Organochloride pesticides (DDT, aldrin, dieldrin). (Below Level of Reading)
  - Organophosphorous pesticides. (Below Level of Reading)

- The Individual sample # 2044808 19A gave the values.
  - Lead. (Range 38 mg/kg).
  - Copper (Range 8 mg/kg).
  - Nickel (Range 2 mg/kg).
  - Zinc (Range 95 mg/kg).

All contaminants are well below the stated threshold's the higher values gained from the 19A sample can be viewed as a confined case as all other sample values range from <1 -3 mg /kg on average.

6. CONCLUSIONS & RECOMMENDATIONS

We conclude that this site is not contaminated and is suitable for residential use.

7. REFERENCES

LAND AND WATER CONSERVATION	(1996)	Soil landscapes of the Murwillumbah – Tweed Heads 1:100,000 Sheet
NATIONAL ENVIRONMENTAL HEALTH FORUM	(1998)	Health-Based Soil Investigation Levels. Soil Series No. 1. 2nd Edition
NATIONAL ENVIRONMENTAL HEALTH FORUM	(1996)	Composite Sampling. Soil Series No. 3.
NSW ENVIRONMENT PROTECTION AUTHORITY	(1997)	Contaminated Sites. - Guidelines for Assessing Banana Plantation Sites. - Guidelines for Consultants Reporting on Contaminated Sites.
NSW ENVIRONMENT PROTECTION AUTHORITY	(1995)	Contaminated Sites. - Sampling Design Guidelines.

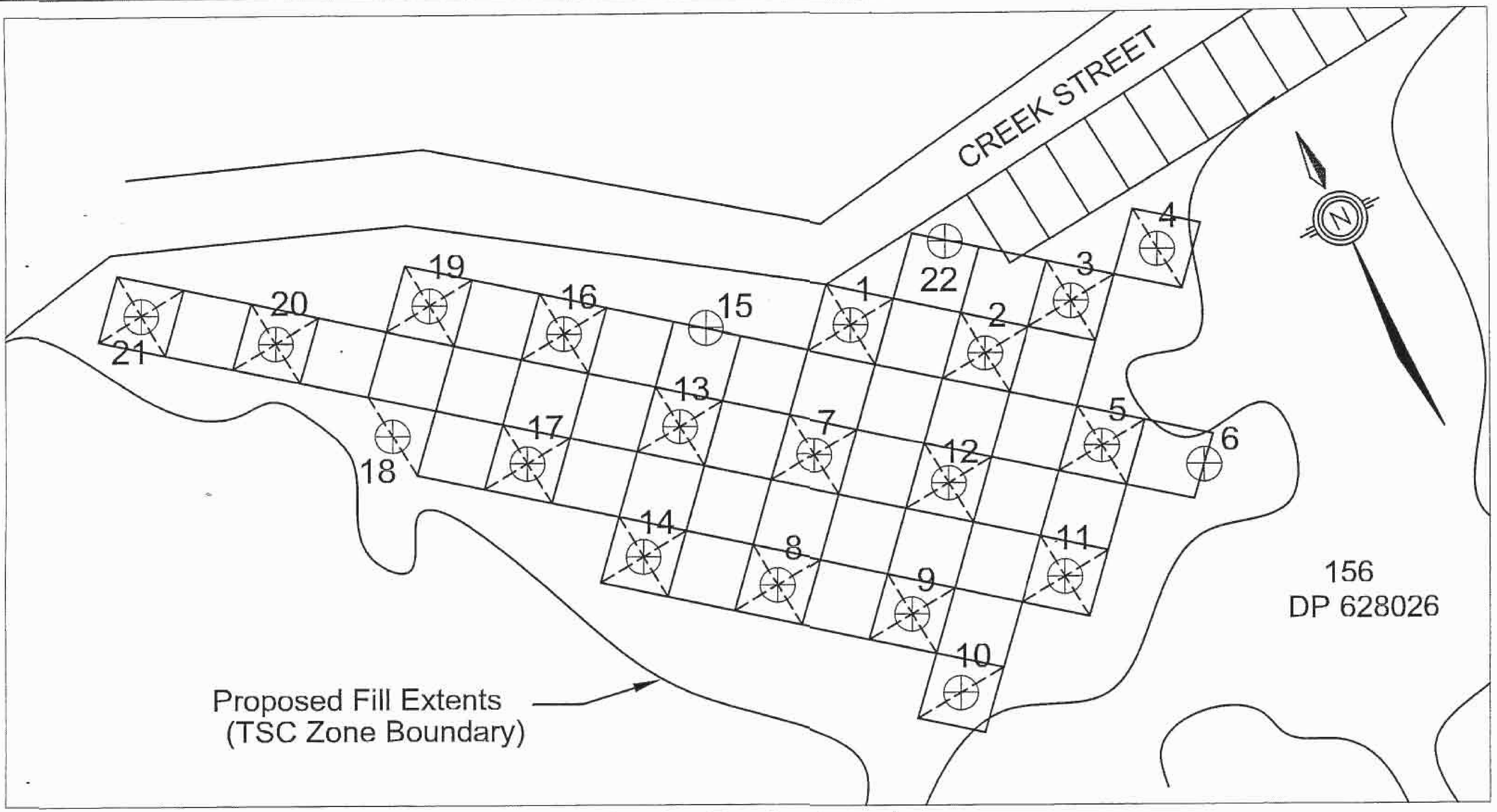
Report Prepared By	Approved for Issue
TRAVIS SERESHEFF	**MARTIN FINDLATER**
Engineer	Branch Manager
	RPEQ 1969

APPENDIX A

SOIL SURVEYS ENGINEERING PTY LTD

CONTAMINATION TESTING LOCATIONS PLAN

(PRELIMINARY SOIL CONTAMINATION REPORT)



Contamination Testing Locations

X:/drafting/[illegible]E Auto[illegible]dwg/Nerang/204-4808-03

2.5 0 7.5 12.5m

SCALE 1:250

DRAWN D.D.	Soil Surveys SOIL SURVEYS ENGINEERING PTY.LIMITED CONSULTING GEOTECHNICAL ENGINEERS		
DATE 28.06.2004	SITE PLAN Proposed Filling Creek Street, Hastings point N.S.W.	DRAWING NO. 204-4808 -03	A4
CHECKED			

APPENDIX B

ALS ENVIRONMENTAL TESTING RESULTS – DATED 12 JULY 2004

(PRELIMINARY SOIL CONTAMINATION REPORT)

ALS Environmental

CERTIFICATE OF ANALYSIS

Client	:	SOIL SURVEYS ENGINEERING P/L	Laboratory	:	ALS Environmental Brisbane	Page	: 1 of 12
Contact	:	PATRICK KIDD	Contact	:	Michael Heery		
Address	:	9/39 LAWRENCE DRIVE NERANG QLD AUSTRALIA 4211	Address	:	32 Shand Street Stafford QLD Australia 4053	No. of samples	: 22
Project	:	204 4808	Quote number	:	----	Date received	: 29 Jun 2004
Order number	:	B5702	Unique Report ID	:	00701	Date issued	: 12 Jul 2004
C-O-C number	:	- Not provided -					
Site	:	- Not provided -					
E-mail	:	pkidd@soilsurveys.com.au	E-mail	:	Michael.Heery@alsenviro.com	Work order	: **EB0403190**
Telephone	:	(07)5596-1528	Telephone	:	61-7-32437222		
Facsimile	:	(07)5578-3916	Facsimile	:	61-7-32437259		

This final report was issued on Monday, July 12, 2004 for the ALSE work order reference EB0403190 and supersedes any reports with this reference.
Results apply to the samples as submitted. All pages of this report have been checked and approved for release.
ND: Unable to determine the result due to sample matrix interference.
Particular samples required dilution prior to analysis due to matrix interferences. LOR values have been adjusted accordingly.

ALSE - QUALITY, SERVICE and TECHNOLOGY provided GLOBALLY

NATA Accredited Laboratory - 825

The Laboratory is accredited by the National Association of Testing Authorities, Australia. The test(s) reported herein have been performed in accordance with its scope of accreditation. This document shall not be reproduced except in full.

This document has been digitally signed by those names who appear on this report and are the authorised signatories. Digital signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	Position	Department
Greg Greenland	Senior Organic Chemist	Inorganics - NATA 818 (Brisbane)
Greg Greenland	Senior Organic Chemist	Organics - NATA 818 (Brisbane)
Kim McCabe	Inorganics Supervisor	Inorganics - NATA 818 (Brisbane)
Shaun Crabb	Metals Team Leader	Inorganics - NATA 818 (Brisbane)

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). *Abbreviations:* ***CAS number*** = *Chemical Abstract Services number,* ***LOR*** = *Limit of Reporting.* ***# Indicates a raised LOR.***

When date(s) are shown bracketed, these have been assumed by the laboratory for process purposes.

Analytical Results

				Client Sample ID :	204 4808 1A	204 4808 2A	204 4808 3A	204 4808 4A	204 4808 5A
				Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
				Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
				Laboratory Sample ID :	EB0403190-001	EB0403190-002	EB0403190-003	EB0403190-004	EB0403190-005
Analyte	*CAS number*	*LOR*	*Units*						
EA055: Moisture Content									
Moisture Content (dried @ 103°C)		0.1	%		4.8	7.5	9.5	6.4	5.1
EG005T: Total Metals by ICP-AES									
Arsenic	7440-38-2	1	mg/kg		<1	<1	<1	<1	<1
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	1	mg/kg		<1	<1	<1	<1	<1
Copper	7440-50-8	1	mg/kg		<1	<1	<1	<1	<1
Lead	7439-92-1	1	mg/kg		<1	<1	2	<1	<1
Nickel	7440-02-0	1	mg/kg		<1	<1	<1	<1	<1
Zinc	7440-66-6	1	mg/kg		1	<1	1	1	2
EG035T: Total Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
4,4'-DDE	72-55-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
4,4'-DDD	72-54-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
4,4'-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2

ALS Environmental

Analytical Results

	Client Sample ID :	204 4808 1A	204 4808 2A	204 4808 3A	204 4808 4A	204 4808 5A
	Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
	Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
	Laboratory Sample ID :	EB0403190-001	EB0403190-002	EB0403190-003	EB0403190-004	EB0403190-005
Analyte	*CAS number*	*LOR*	*Units*			
EP068B: Organophosphorus Pesticides (OP)						
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Demeton-S-methyl	8022-00-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Bromophos-ethyl	2104-96-3	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE		0.1	%	113	108	94.0	117	112
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.1	%	113	109	95.8	111	119

ALS Environmental

Analytical Results

				Client Sample ID :	204 4808 6A	204 4808 7A	204 4808 8A	204 4808 9A	204 4808 10A
				Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
				Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
				Laboratory Sample ID :	EB0403190-006	EB0403190-007	EB0403190-008	EB0403190-009	EB0403190-010
Analyte	*CAS number*	*LOR*	*Units*						
EA055: Moisture Content									
Moisture Content (dried @ 103°C)		0.1	%		2.7	5.3	15.9	10.7	3.2
EG005T: Total Metals by ICP-AES									
Arsenic	7440-38-2	1	mg/kg		<1	<1	3	2	2
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	1	mg/kg		<1	<1	1	<1	<1
Copper	7440-50-8	1	mg/kg		<1	<1	<1	<1	<1
Lead	7439-92-1	1	mg/kg		<1	<1	1	2	1
Nickel	7440-02-0	1	mg/kg		<1	<1	<1	<1	<1
Zinc	7440-66-6	1	mg/kg		<1	<1	3	2	<1
EG035T: Total Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
4.4'-DDE	72-55-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
4.4'-DDD	72-54-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
4.4'-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Demeton-S-methyl	8022-00-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2

ALS Environmental

Analytical Results

	Client Sample ID :	204 4808 6A	204 4808 7A	204 4808 8A	204 4808 9A	204 4808 10A
	Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
	Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
	Laboratory Sample ID :	EB0403190-006	EB0403190-007	EB0403190-008	EB0403190-009	EB0403190-010
Analyte	*CAS number*	*LOR*	*Units*					
EP068B: Organophosphorus Pesticides (OP)								
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Bromophos-ethyl	2104-96-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE		0.1	%	112	112	115	114	117
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.1	%	114	111	115	117	117

ALS Environmental

Analytical Results

				Client Sample ID :	204 4808 11A	204 4808 12A	204 4808 13A	204 4808 14A	204 4808 15A
				Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
				Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
				Laboratory Sample ID :	EB0403190-011	EB0403190-012	EB0403190-013	EB0403190-014	EB0403190-015
Analyte	*CAS number*	*LOR*	*Units*						
EA055: Moisture Content									
Moisture Content (dried @ 103°C)		0.1	%		5.6	4.3	33.5	21.1	4.9
EG005T: Total Metals by ICP-AES									
Arsenic	7440-38-2	1	mg/kg		<1	<1	<1	1	<1
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	1	mg/kg		<1	<1	<1	<1	<1
Copper	7440-50-8	1	mg/kg		<1	<1	<1	<1	<1
Lead	7439-92-1	1	mg/kg		2	<1	1	<1	<1
Nickel	7440-02-0	1	mg/kg		<1	<1	<1	<1	<1
Zinc	7440-66-6	1	mg/kg		2	<1	1	3	1
EG035T: Total Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
4.4'-DDE	72-55-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
4.4'-DDD	72-54-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
4.4'-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Demeton-S-methyl	8022-00-2	0.05	mg/kg		<0.05	<0.05	# <0.06	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2

ALS Environmental

Analytical Results

	Client Sample ID :	204 4808 11A	204 4808 12A	204 4808 13A	204 4808 14A	204 4808 15A
	Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL	SOIL / SOIL
	Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00	22 Jun 2004 15:00
	Laboratory Sample ID :	EB0403190-011	EB0403190-012	EB0403190-013	EB0403190-014	EB0403190-015
Analyte	*CAS number*	*LOR*	*Units*			
EP068B: Organophosphorus Pesticides (OP)						
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Bromophos-ethyl	2104-96-3	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	# <0.06	<0.05	<0.05
EP068S: Organochlorine Pesticide Surrogate						
Dibromo-DDE		0.1	%	115	117	93.6	87.6	93.2
EP068T: Organophosphorus Pesticide Surrogate						
DEF	78-48-8	0.1	%	115	115	93.7	83.6	91.2

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: 204 4808 16A Sample Matrix Type / Description: SOIL / SOIL Sample Date / Time: 22 Jun 2004 15:00 Laboratory Sample ID: EB0403190-016	204 4808 17A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-017	204 4808 18A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-018	204 4808 19A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-019	204 4808 20A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-020
EA055: Moisture Content								
Moisture Content (dried @ 103°C)		0.1	%	57.1	24.5	12.6	12.0	32.8
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	1	mg/kg	2	2	<1	<1	2
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	1	mg/kg	3	2	<1	<1	2
Copper	7440-50-8	1	mg/kg	<1	<1	<1	8	<1
Lead	7439-92-1	1	mg/kg	3	1	<1	38	2
Nickel	7440-02-0	1	mg/kg	<1	<1	<1	2	<1
Zinc	7440-66-6	1	mg/kg	2	2	4	95	1
EG035T: Total Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
beta-BHC	319-85-7	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
gamma-BHC	58-89-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
delta-BHC	319-86-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Heptachlor	76-44-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Aldrin	309-00-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Heptachlor epoxide	1024-57-3	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
trans-Chlordane	5103-74-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
alpha-Endosulfan	959-98-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
cis-Chlordane	5103-71-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Dieldrin	60-57-1	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
4.4'-DDE	72-55-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Endrin	72-20-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
beta-Endosulfan	33213-65-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
4.4'-DDD	72-54-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Endrin aldehyde	7421-93-4	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Endosulfan sulfate	1031-07-8	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
4.4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Demeton-S-methyl	8022-00-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2

ALS Environmental

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: 204 4808 16A Sample Matrix Type / Description: SOIL / SOIL Sample Date / Time: 22 Jun 2004 15:00 Laboratory Sample ID: EB0403190-016	204 4808 17A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-017	204 4808 18A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-018	204 4808 19A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-019	204 4808 20A SOIL / SOIL 22 Jun 2004 15:00 EB0403190-020
EP068B: Organophosphorus Pesticides (OP)								
Dimethoate	60-51-5	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Diazinon	333-41-5	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Fenthion	55-38-9	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Chlorpyrifos	2921-88-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Chlorfenvinphos	470-90-6	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Bromophos-ethyl	2104-96-3	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Fenamiphos	22224-92-6	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Prothiofos	34643-46-4	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Ethion	563-12-2	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Carbophenothion	786-19-6	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
Azinphos Methyl	86-50-0	0.05	mg/kg	# <0.12	<0.05	<0.05	# <0.06	# <0.12
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE		0.1	%	86.7	115	98.9	94.9	94.0
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.1	%	88.8	119	99.2	100	98.2

ALS Environmental

Analytical Results

	Client Sample ID :	204 4808 21A	204 4808 22A			
	Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL			
	Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00			
	Laboratory Sample ID :	EB0403190-021	EB0403190-022			
Analyte	*CAS number*	*LOR*	*Units*			
EA055: Moisture Content						
Moisture Content (dried @ 103°C)		0.1	%	23.6	2.4	
EG005T: Total Metals by ICP-AES						
Arsenic	7440-38-2	1	mg/kg	<1	<1	
Cadmium	7440-43-9	1	mg/kg	<1	<1	
Chromium	7440-47-3	1	mg/kg	<1	<1	
Copper	7440-50-8	1	mg/kg	<1	<1	
Lead	7439-92-1	1	mg/kg	1	<1	
Nickel	7440-02-0	1	mg/kg	<1	<1	
Zinc	7440-66-6	1	mg/kg	<1	<1	
EG035T: Total Mercury by FIMS						
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	
EP068A: Organochlorine Pesticides (OC)						
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	
4.4'-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	
4.4'-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	
4.4'-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	
EP068B: Organophosphorus Pesticides (OP)						
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	
Demeton-S-methyl	8022-00-2	0.05	mg/kg	<0.05	<0.05	
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	

ALS Environmental

Analytical Results

	Client Sample ID :	204 4808 21A	204 4808 22A			
	Sample Matrix Type / Description :	SOIL / SOIL	SOIL / SOIL			
	Sample Date / Time :	22 Jun 2004 15:00	22 Jun 2004 15:00			
	Laboratory Sample ID :	EB0403190-021	EB0403190-022			
Analyte	*CAS number*	*LOR*	*Units*			
EP068B: Organophosphorus Pesticides (OP)						
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	
Bromophos-ethyl	2104-96-3	0.05	mg/kg	<0.05	<0.05	
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	
EP068S: Organochlorine Pesticide Surrogate						
Dibromo-DDE		0.1	%	94.5	97.7	
EP068T: Organophosphorus Pesticide Surrogate						
DEF	78-48-8	0.1	%	91.8	93.7	

ALS Environmental

Method Reference Summary

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

Preparation Methods

EN69: Hot Block Digest for metals in soils sediments and sludges - Nitric/Hydrochloric Acid Digestion with H2O2 Leach (USEPA 200.2 mod, ALS QWI EN/69) This method (adapted from USEPA 200.2) utilizes Nitric / Hydrochloric acid and a 'Hot Block' apparatus for the digestion of total recoverable metals from sediments, sludges and soils.

ORG17A: Tumbler Extraction of Solids (Option A - Concentrating) - (In-house - Mechanical agitation (tumbler), ALS QWI-ORG/17 Option A) 20+0.05 g of sample and an appropriate drying agent (Na2SO4) is transferred to an extraction bottle. 150mL of organic solvent (1:1 DCM/Acetone) is added and the bottle tumbled for two hours. The solvent is decanted from the bottle, dehydrated and concentrated to the desired volume for analysis.

Analytical Methods

EA055-103: Moisture Content - A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees Celcius.

EP068: Pesticides by GCMS - (USEPA SW 846 - 8270D, ALS QWI-ORG/EP068) Sample extracts (ALSQWI-ORG/17 Option A) are analysed by Capillary GC/MS. Quantification is achieved using internal standard and average response factor quantification techniques against an established five-point curve.

EG035T: Total Mercury by FIMS - (AS 3550, ALS QWI-EN/EG035-1): Flow Injection Mercury - Atomic Absorption Spectrometry (FIM-AAS) is a flameless atomic absorption technique. For the determination of total mercury, an oxidation stage using a bromate/bromide reagent is employed to oxidise organic mercury compounds. The ionic mercury is reduced to atomic mercury vapour by a reducing agent (SnCl2). Atomic mercury vapour is then purged into a heated quartz cell prior to quantification.

EG005T: Total Metals by ICP-AES - (APHA 20th ed., 3120; USEPA SW 846 - 6010; ALS QWI-EN/EG005): The ICPAES technique quickly breaks the sample down into atoms and ions under extremely hot plasma. Atoms are then ionized, emitting a characteristic spectrum. The spectrometer then separates the wavelengths, prior to comparison of intensities against matrix matched standards for quantification.

APPENDIX D

Sediment Basin Sizing calculation – RUSLE Method

REVISED UNIVERSAL SOIL LOSS EQUATION

Refer to NSW Dept of Housing
Managing Urban Stormwater Soils and Construction
A. Appendix for RUSLE
Chapter 6 for Settling Zone Volume

JOB No: 206012
DESCRIPTION: Walter Elliot Holdings - Hastings Point Subdivision

SEDIMENT STORAGE ZONE VOLUME

A = R K LS P C

Where		Description	Value	
A	=	**Computed soil loss (tonnes/ha/yr)**		
R	=	**Rainfall Erosivity Factor**		
	=	$164.74\ (1.1177)^{S}\ S^{0.6444}$	**5833.618085**	
			INPUT	
		S = 2 Year ARI, 6 Hour Storm Event	16	mm/h
K	=	**Soil Erodibility Factor**	0.075	From Soil Landscapes Manual
LS	=	**Slope Length / Gradient Factor**	0.2	From Table A1
P	=	**Erosion Control Practice Factor**	0.9	From Table A2
C	=	**Ground Cover**	1.00	From Table A3
A Soil Loss	=	**78.754 (tonnes/ha/year)**		
V Volume	=	**61 (m^3/ha/year)**		
		Disturbed Surface Area (ha)	5.5	ha
		Computed soil loss	**335.50**	m^3/year
		Sediment Storage Zone Volume	**168.00**	m^3 Assuming regeneration after
			6	Months

SEDIMENT BASIN VOLUME - Type F & D Soils

V = 10 Cv A R 75TH ile, 5 day (m^3)

10	=	Unit conversion Factor	**10**
Cv	=	The volumetric runoff coefficient, defined as that portion of rainfall that runs off as stormwater	0.69
A	=	Catchment Area of the Basin ha	5.5 ha
R (Y% ile, 5 day)	=	5 day rainfall depth not exceeded in y% of rainfall events. Refer Table 6.5 p 6-21	41.5 mm
V	=	**1574.925 m^3 Settling Zone Volume**	

TOTAL BASIN VOLUME = Settling Zone Volume + Sediment Storage Zone Volume

= 1742.93 m^3

= **1743 m^3**

BASIN VOLUME PER HECTARE = 317 m^3

APPENDIX E

Soil & Water Management Plan

PALM LAKE WORKS PTY LTD

PROPOSED RESIDENTIAL SUBDIVISON
LOT 156 DP 628026 CREEK STREET
HASTINGS POINT

SOIL AND WATER MANAGEMENT PLAN

THE SOIL & WATER MANAGEMENT PLAN

1. This plan is to be read in conjunction with:
   i) the engineering plans, and
   ii) any other plans or written instructions that may be issued and relating to development at the subject site.

2. Contractors shall ensure that all soil and water management works are:
   i) located as shown in the drawings, specification and Management Plan
   ii) constructed in accordance with the:
      - Tweed Shire Council – Development Design Specification D7 – Stormwater Quality (Annexure A).
      - NSW Department of Housing - Soil and Water Management for Urban Development.
      - NSW Environmental Protection Authority – Draft Managing Urban Stormwater Construction Activities.

3. The Contractor shall nominate a competent person to inspect erosion control structures, complete the site diaries and ensure the Soil and Water Management Plan is implemented.

4. The person nominated to implement the plan shall keep a copy on site.

OBJECTIVES

- To prevent sediment erosion being transported from the site by wind and water.

LAND DISTURBANCE

5. Other than for essential thinning of plant growth, land disturbance shall be limited to that necessary for implementation of the plans of works. Ideally, lands shall not be disturbed beyond five metres from the edge of any essential construction activity as shown on the engineering plans, other than in access zones. Such zones shall be clearly identified with barrier mesh or “silt” fencing or similar materials. The location of “silt” fences should be determined on site and may vary in position to best conserve the existing vegetation and protect downstream areas. The contractor shall ensure regular watering of exposed surfaces to minimise wind erosion.

6. Where practical, thinning of plant growth in the subdivision should be by hand or approved small machine. Small branches, leaf litter and other residues shall be retained as mulch.

7. Generally, works shall be undertaken in the following sequence:
   i) where possible, divert clean water likely to run onto lands to be disturbed
   ii) install sediment control works
   iii) strip and stockpile topsoil
   iv) undertake site development works in accordance with the engineering plans
   v) rehabilitate the site
   vi) remove soil and water management works.

8. Any temporary culverts or causeways to be installed across drainage reserves should be constructed only in areas of minimal erosion hazard. Such areas should be defined in consultation with the engineer.

EROSION CONTROL

9. The maximum water velocity in the design storm event in earth based waterways should be in accordance with Table 1.

TABLE 1

MAXIMUM FLOW VELOCITIES (m/sec)
IN EARTH BASED WATERWAYS *

GROUND COVER	VELOCITY (m/sec)
Mat or sward forming grasses with Enkamat ® or other UV stabilised mesh.	2.4
Kikuyu Grass.	1.9
Jute mesh (bitumen sprayed).	1.7
Couch grass, Rhodes grass, other sward forming grasses.	1.4
Other improved perennials.	0.9
Biodegradable blankets.	0.7
Tussock grasses.	0.5
Bare soil.	0.3

- This table assumes slope gradients of less than 10 percent and, other than for base soil, good (i.e. >80%) ground cover.

10. During road works, temporary crossbanks (bunds constructed with earth, straw bales or sandbags) should be constructed to limit slope length, where possible in accordance with Table 2.

TABLE 2

RECOMMENDED MAXIMUM SPACING BETWEEN CROSS DRAINS ON HAUL ROADS

SLOPE	MAXIMUM SPACING (metres)
0 to 7%	NN
7 to 10%	70
10 to 13%	32
13 to 16%	15
>16%	NR

NN – not necessary
NR – construction of haul roads not recommended.

11. Outlets from erosion or sediment control devices should be to stable disposal areas.

12. Earth batters should be:

    i) constructed with a maximum gradient of 2(H):1(V)
    ii) properly top soiled, seeded and mulched within two weeks from completion of works.

    A recommended listing of plant species is:

Spring/Summer sowing:	**Autumn/Winter sowings:**
Couch, hulled	Couch, hulled
Couch, unhulled	Couch, unhulled
Regal Ryegrass	Regal Ryegrass
Japanese Millet	Prairie Grass
Carpet Grass	Ryecorn/Oats
Haifa White Clover	Haifa White Clover
Redquin Red Clover	Crimson Clover

    The contractor is to nominate the mixture and application rates to be used to achieve the specified coverage. An approved grass mixture for seeding should contain Broad leaf Paspalm 30%, Carpet Grass 30% and Oats/Rye Grass 30%. The contractor shall provide a list of suitable native bush and tree species where required by the drawings.

13. The contractor should stage works and implement construction techniques to minimise the length of exposure to disturbed surfaces; topsoil and grass within two weeks of completion. Temporary rehabilitation should be undertaken on disturbed areas where works have stopped and soils are expected to remain exposed for more than two weeks before either works continue or permanent rehabilitation is undertaken. If vegetative means are used, the following species mix is recommended:

    Autumn/Winter sowing
    Oats/ryecorn @ 20kg/ha
    Japanese millet @ 10kg/ha

    Spring/Summer sowing
    Japanese millet @ 20 kg/ha
    Oats/ryecorn @ 10 kg/ha

    Alternatively, the contractor shall submit a substitute mix for approval.

14. On lands where rehabilitation to native plants is not essential, fertilisers/ameliorants should include:

    i) dolomite on topsoils at a rate of 2 kilograms per tonne of soil to raise the pH to be more conducive to growth of exotic species, particularly in waterways and other areas of high soil erosion hazard,
    ii) Grower 11 (or equivalent) at 250 kilograms per hectare and trace elements according to manufacturers instructions at sowing, and
    iii) Nitram (or equivalent) at 100 kilograms per hectare in the following Spring;

SEDIMENT CONTROL

15. Sediment retarding basins and sediment traps shall be constructed to contain the minimum storage specified on the engineering drawings.

16. Existing dams to be retained as sediment retarding basins are shown on the drawings.

17. “Silt” fences or straw bale sediment traps should be placed at regular intervals immediately downslope of all unprotected disturbed lands.

    - “Silt” fences, straw bale barriers, etc., should rarely be placed along the contour, as water will run to a low point in large storm events and the structure may fail. “Silt” fences should be placed with small returns at about five to thirty metres, creating a series of small sediment traps in line. This system has the added benefit of avoiding concentrated flows.

18. Sediment barriers (eg. sandbags or straw bales) should be located upstream of stormwater inlet pits prior to the road surface being paved. These barriers should be reinstalled after completion of paving if there are disturbed or bare areas nearby likely to contribute sediment to the road surface.

DUST CONTROL

Control Measures

19. The potential dust problems due to construction activities are to be ameliorated through the implementation of dust control measures. These measures are given in the table below.

FREQUENCY	CONTROL MEASURES
General operational practices	• Track-walked slopes • Surface rehabilitation • Limitation of topsoil stripping to current work areas • Stabilisation of stockpiles • Application of woodchip, mulching, organic matting or bitumen emulsions • Speed restriction for site vehicles • Roadways designated and maintained for site vehicles • Watering system utilised during rock face operations
Event based measures (upon identification of dust problem)	• Ensure operational practices are being carried out. • Watering of disturbed surfaces • Covering of disturbed areas and stockpiles awaiting vegetation growth • Provide screens around earthworks areas

Operational Times

20. The operational control measures are to be implemented at all times during site works. These times would depend on the contractor performing the works. Event based measures may be required outside of the operational times of the site upon identification of a dust problem.

Wind Conditions

21. During dry conditions with high winds a watering truck should be present on site during works.

Dust Monitoring

22. Monitoring of the dust emissions is to be carried out by visual inspection by the contractor.

Water Sources

23. Potable water from existing council mains is to be used for dust suppression. Alternatively water from sediment basins may be used when available.

CONSTRUCTION SEQUENCE

24. Works on the subdivision should be carried out in the following sequence:

    i) construction of sediment basin/trap
    ii) installation of barrier fencing and “silt” fencing
    iii) construct roadworks.

MAINTENANCE

25. The contractor shall:

    i) regularly maintain all soil and water management devices, including removal of accumulated sediment or trash, to ensure that more than 60 percent of the design capacity remains in the settling zone.
    ii) dispose of any sediment removed in areas where further pollution to downslope lands and waterways is unlikely.

INSPECTION

26. Inspections shall be undertaken:

    i) during any storm event that threatens to exceed the available capacity in sediment and pollution storage structures
    ii) after any storm that has caused runoff
    iii) daily, during hot or dry weather when grass cover is less than 100% on vegetated areas
    iv) weekly (on Fridays) as a matter of site routine for all site work practices
    v) before site closure or any other time when it might be otherwise unattended for more than twelve hours
    vi) testing as specified in the water quality monitoring program shall be carried out in accordance with the nominated schedule
    vii) signed, completed test results and inspection report shall be kept on site and made available on request to the engineer, Council officers and relevant authorities.

Installation

27. The contractor shall ensure a diary or record is kept documenting site work practices such as:

    i) dates of installation and removal of site work practices
    ii) repair of any damage to site work practices
    iii) rainfall depths, durations and times
    iv) storage capacity available in pollution control structures
    v) condition of site work practice structures and stabilised surfaces
    vi) time, date, volume and type of any additions of flocculants
    vii) estimates of water volumes discharged
    viii) estimates of pollutant volumes removed
    ix) water quality test results.

Program

28.
    i) Inspect catch drains, earth banks, table drains, and drop-down structures and clean as required.
    ii) Remove any stockpiled material or sediment that has encroached within two metres of a surface drain.
    iii) Restore any low spots in banks and drains to their original height and compact.
    iv) Where necessary, construct extra catch drains that help separate on-site dirty waters from other waters.
    v) Install any new erosion and sediment control measures that have become necessary since previous inspections because of severe storms or progress in the site's development.
    vi) Check to ensure that banks, channels and waterways are operating within the safe limits for their surface condition by noting any evidence of scour.
    vii) Ensure that any construction work at the site since the previous inspection has not diverted sediment and water away from any site work practice.

WATER QUALITY MONITORING PROGRAM

29. The contractor is to undertake a water quality monitoring and testing program to comply with the Department of Housing Guidelines and Clean Waters Act and Tweed Shire Council Design Specification D7 as tabulated below.

i) Monitoring

Parameter	Frequency	Reporting
Suspended Solids, Non Filterable Residue (NFR)	Monthly or during discharge event (defined as >25mm in any 24 hour period).	as per 26. Non complying test results are to be notified within 24 hours to Council officers.
pH	• if in acid sulfate soils risk area, daily or during controlled discharge event. • in areas with no identified acid sulfate risk, monthly and during controlled discharge event from sedimentation basins.	as per 26 Non comply test results are to be notified immediately to Council's Environmental & Health Services Unit.
Total P, Total N	3 monthly	as per 26

ii) Response to Monitoring, Non Compliance with ESCP, Amelioration Measures

Indicator	Response	Comments

pH too low <6.5	• If possible stop discharge and store runoff on site.
	• Respond in accordance with approved acid sulfate management plan or if no plan then:-
	  • Lime dose as per Acid Sulfate Soil Manual (Assmac), restore to acceptable pH before further discharge.
	  • Notify Council's Environmental & Health Services Unit of non compliant discharge (within 24 hours).
		Reporting as per 29 (i).

pH to high >8.5	• If possible stop discharge and store runoff on site. • Dilute with other water until pH in acceptable range. • Re-test for compliance before further discharge.	
Suspended Solids (NFR) >50mg/litre	Identify if non compliance is due to storm event greater than design storm of control devices. If so accept non compliance. If not then:- • If possible stop discharge and store runoff on site. • Use flocculation agents to lower NFR or • Pump contaminated water over grassed filter strips or buffer areas to lower NFR. • Identify (by inspection and/or analysis) if non compliance is due to damage of ineffectiveness of erosion and sediment control devices. Repair or redesign/replace if necessary (or required by Council) to ensure future compliance.	Non compliance may occur, by design, in >3 month (deemed to be 40% of the ARI one year event).

APPENDIX F

Intersection Calculation Summary

SIDRA INTERSECTION

Intersection Summary

Coast Road -Creek St Intersection

proposed upgrade

Performance Measure	Vehicles	Persons
Demand Flows - Total	752 veh/h	1128 pers/h
Percent Heavy Vehicles	2.8 %	
Degree of Saturation	0.165	
Effective Intersection Capacity	4569 veh/h	
95% Back of Queue (m)	3 m	
95% Back of Queue (veh)	0.4 veh	
Control Delay (Total)	0.40 veh-h/h	0.60 pers-h/h
Control Delay (Average)	1.9 s/veh	1.9 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	89 veh/h	134 pers/h
Effective Stop Rate	0.12 per veh	0.12 per pers
Proportion Queued	0.06	0.06
Travel Distance (Total)	258.8 veh-km/h	388.1 pers-km/h
Travel Distance (Average)	344 m	344 m
Travel Time (Total)	4.7 veh-h/h	7.1 pers-h/h
Travel Time (Average)	22.7 secs	22.7 secs
Travel Speed	54.6 km/h	54.6 km/h
Operating Cost (Total)	169 $/h	169 $/h
Fuel Consumption (Total)	23.0 L/h	
Carbon Dioxide (Total)	57.6 kg/h	
Hydrocarbons (Total)	0.083 kg/h	
Carbon Monoxide (Total)	2.70 kg/h	
NOX (Total)	0.112 kg/h	

SIDRA SOLUTIONS

Site: Coast Rd -Creek ST
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Produced by SIDRA Intersection 3.2.0.1455

www.sidrasolutions.com

SIDRA INTERSECTION

Movement Summary

Coast Road -Creek St Intersection

proposed upgrade

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Creek ST										
1	L	31	3.2	0.072	16.2	LOS C	3	0.46	0.78	25.7
3	R	31	3.2	0.072	9.4	LOS A	3	0.46	0.74	32.2
Approach		**62**	**3.2**	**0.072**	**12.8**	**LOS B**	**3**	**0.46**	**0.76**	**28.5**
Coast Road Sth										
4	L	31	3.2	0.017	7.4	LOS A	0	0.00	0.63	44.4
5	T	316	2.9	0.165	0.0	LOS A	0	0.00	0.00	60.0
Approach		**346**	**2.9**	**0.165**	**0.7**	**LOS A**		**0.00**	**0.06**	**58.3**
Coast Road North										
11	T	316	2.9	0.165	0.0	LOS A	0	0.00	0.00	60.0
12	R	29	0.0	0.058	14.5	LOS B	2	0.51	0.78	34.1
Approach		**344**	**2.6**	**0.165**	**1.2**	**LOS A**	**2**	**0.04**	**0.07**	**56.3**
All Vehicles		**752**	**2.8**	**0.165**	**1.9**	**Not Applicable**	**3**	**0.06**	**0.12**	**54.6**

Symbols which may appear in this table:

Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

Following LOS
- Based on density for continuous movements

Following Queue
- Density for continuous movement

SIDRA SOLUTIONS

Site: Coast Rd -Creek ST
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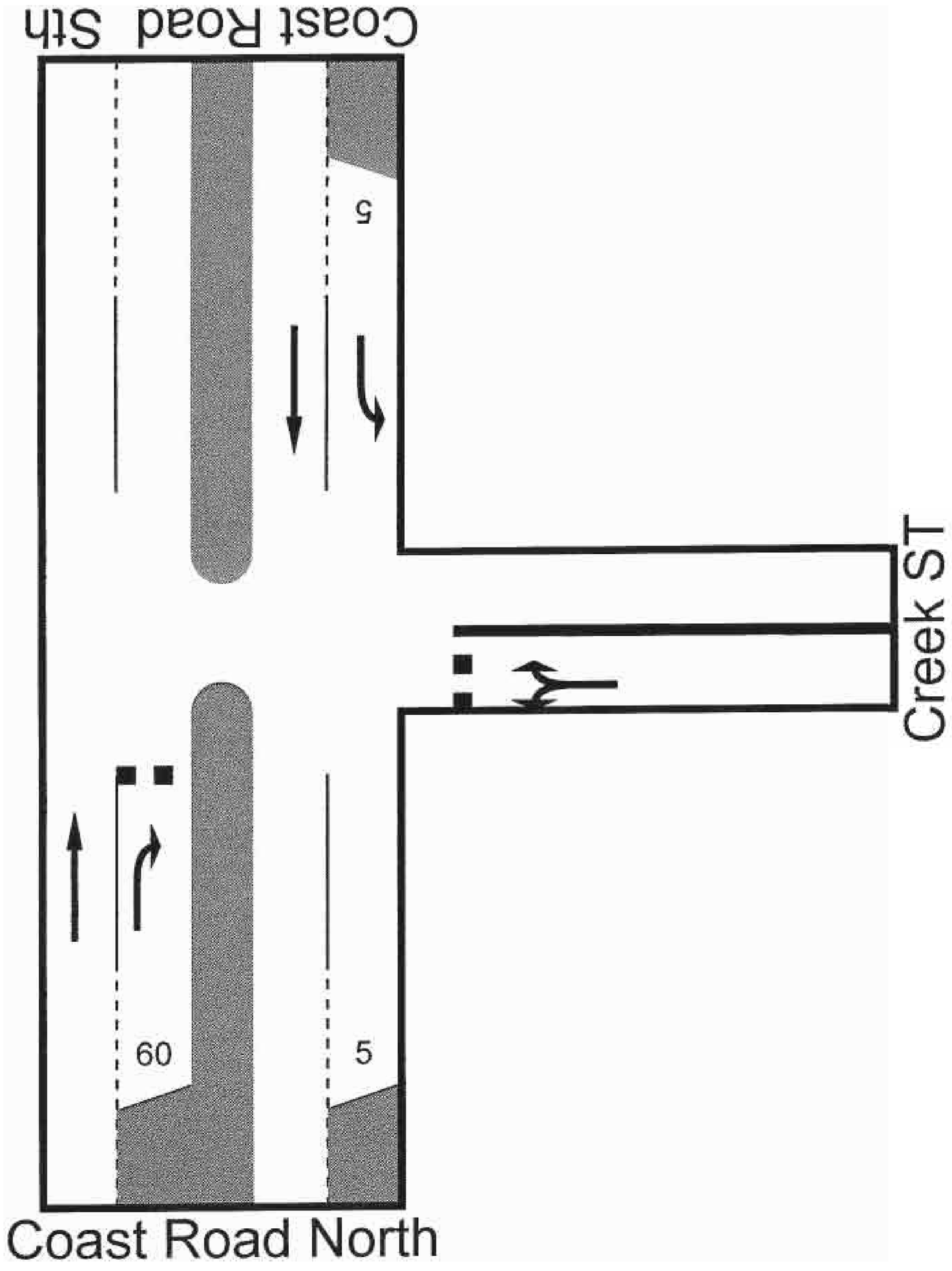
A1733, Opus Qantec McWilliam, Small Office


Coast Road Sth
5
Creek ST
60
5
Coast Road North

APPENDIX G

Soil Surveys Geotechnical Assessment

SOIL SURVEYS

PROJECT NO. 204-4808

JULY, 2004

WALTER ELLIOTT HOLDINGS PTY LTD

PROPOSED FILLING

LOT 156 CREEK STREET
HASTINGS POINT

Soil Surveys Engineering Pty Limited
Specialists in Applied Geotechnics
A.B.N. 70 054 043 631
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SOIL SURVEYS

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Gold Coast Office
Job No: 204-4808
REF: 2-4808BR
Author: Patrick Kidd

27 July, 2004

Walter Elliott Holdings Pty Ltd
C/- Blueland Engineers
PO Box 6389
TWEED HEADS NSW 2486

ATTENTION: MR MARTIN FINDLATER

Dear Sir,

RE: GEOTECHNICAL INVESTIGATION - PROPOSED FILLING- LOT156 CREEK STREET, HASTINGS POINT

Enclosed is a revised copy of our report for the above project dated July 2004. Three copies of the report have been issued.

Authority to proceed with the investigation was dated 2nd June, 2004.

Should you have any queries regarding this report, please do not hesitate to contact Patrick Kidd or Albert Rutten at our Gold Coast Office.

Yours faithfully,

A. M. RUTTEN (RPEQ 2202)

for and on behalf of
SOIL SURVEYS ENGINEERING PTY LIMITED

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APPENDICES

1.0 INTRODUCTION

This report presents the results of the geotechnical investigation carried out by Soil Surveys Engineering Pty Limited between 8th and 23rd June 2004, for the proposed filling at Creek Street, Hastings Point.

The investigation was carried out at the request of Walter Elliott Holdings Pty Ltd.

The objectives of this investigation were to assess subsurface conditions at the site in accordance with the Scope of Services detailed in Section 2.0.

Acid sulfate sampling and contamination sampling and testing was also undertaken concurrently with the geotechnical investigation and these results have been provided in a factual report.

2.0 SCOPE OF GEOTECHNICAL SERVICES

The scope of geotechnical services provided by Soil Surveys Engineering Pty Limited was directed towards evaluating the following items as detailed in our proposal 204-4808 dated 19th May, 2004.

- The nature and type of subsurface material noting depth and condition of soils.
- Earthwork recommendations
- Foundation recommendations
- Construction recommendations (where applicable)
- Predicted settlements
- Site management recommendations

3.0 PROPOSED DEVELOPMENT

It is understood the proposed development will consist of up to two metres of filling being placed on the site probably followed by the site being developed as a residential development.

4.0 GEOTECHNICAL INVESTIGATION

4.1 Field Investigation

Subsurface conditions were investigated by the following field work:-

- Drilling 16 boreholes, to depths of 2 to 6m using a 4WD mounted Jacro 105 drilling rig. Boreholes 1 to 6 were augmented by Dynamic Cone Penetrometer (DCP's) tests adjacent the boreholes.
- Performing 8 Cone Penetrometer Tests (CPT's) to depths of between 3.3m and 10.7m, using a 4WD mounted Gemco HP7 drilling rig.

The soil classification descriptions and field testing were carried out in general accordance with Australian Standards.

AS.1726 - 1993	Geotechnical Site Investigations
AS.1289	Methods of Testing Soils for Engineering Purposes

Notes relating to this report, borehole records, CPT results and a site plan showing the location of the boreholes, are included in the Appendices.

4.2 Site Description

The site of the proposed development is located to the west of the town of Hastings Point, on the southern side of Creek Street. The site is bounded by a creek to the east, west and south and by residential properties and Creek Street to the north.

At the time of the investigation, the site was occupied by a caravan in the central northern portion of the site, elsewhere the site was clear of existing structures. Vegetation generally consisted of low height grass cover with scattered trees around the edges of the site with some small clumps of trees also towards the edges of the site. A drain is present on the site flowing from south to north in the western end of the site. The banks of the drain are lined with Melaleuca trees.

At the time of the investigation the site was being used to graze horses. Access to the site is via a gate off Creek Street.

5.0 GEOTECHNICAL MODEL

5.1 Subsurface Profile

It is understood the site may have been mined in the past.

Sand backfilling utilised after the mining operation appears to be the same as the natural sand material encountered across the site, and in this case it was difficult to distinguish natural materials from fill.

Generally a full sand subsurface profile was encountered across the site with only occasional clayey sand and very occasional silty clay interbeds.

The sands encountered were typically loose to medium dense with some very loose to loose and soft bands typically where the clayey sands and silty clays interbeds were encountered. Some dense indurated sands were encountered on the site in boreholes 4,5 and 6 and in CPT 5.

The encountered subsurface profiles are presented in borehole, CPT and DCP records in the Appendices.

5.2 Groundwater

Groundwater was noted in most boreholes across the development, at depths of between 0.1m and 1.55m, but was not encountered in BH16.

Typically the standing groundwater level in coastal areas is expected to be at about RL0.5m with fluctuations of ±0.5m under normal conditions (non-flood). Rises in groundwater to RL1.5 to RL2.0 (AHD) have been recorded in the Gold Coast area under heavy and prolonged rainfall (flood conditions) and similar rises in groundwater level could well be expected in this coastal area. Groundwater levels may fluctuate with climatic conditions and may show a damped response with tidal variations close to the adjacent to Creek

Table 1 presents a summary of the groundwater intersection levels.

TABLE 1

Borehole	Groundwater Depths Below the Existing Ground Surface Level.	
	Water First Noted	Steady Water Level
1	1.05	0.9
2	1.25	1.3
3	1.3	1.85
4	0.3	0.55
5	0.7	0.8
6	0.1	0.6
7	0.1	0.6
8	0.75	0.7
9	0.95	1.0
10	0.9	0.9
11	1.1	1.0
12	1.55	1.5
13	1.55	1.0
14	0.85	0.9
15	1.5	1.4
16	NE	NE

NE = Not Encountered

6.0 ENGINEERING ASSESSMENT

6.1 Traffickability and Site Preparation

At the time of the field investigation, some problems with traffickability were encountered in the low lying areas towards the north western area of the site and along the edges of the site adjoining the creek, where water was ponding.

Problems with traffickability could arise across the site following disturbance of the upper soil layers and as a result of removal of vegetation, ie. grass and tree roots etc. No major problems are envisaged with the use of tracked equipment. Once surface vegetation has been stripped, traffickability for wheeled equipment is expected to be difficult without use of prepared tracks.

The contractors should fully inform themselves of the ground conditions on site prior to commencement of earthworks. This requirement should be explicit in any earthworks specifications or contract.

6.2 Earthworks

It is understood that filling of the site to depths of up to 2m is proposed.

Earthwork procedures should be carried out in a responsible manner in accordance with AS.3798-1996 "Guidelines on Earthworks for Commercial and Residential Developments".

Earthwork procedures should include the following:-

- Clearing, stripping and grubbing should be carried out in areas subject to earthworks. Also all soils containing organic matter should be stripped from the construction area. This material is not considered suitable for use as structural fill. Depth to the base of the root zone (stripping depth) was observed to be approximately 100 to 200mm. However, it is envisaged that thicker layers may be encountered in the lower lying areas of the site.

- Existing sloping ground, etc. should be benched to "key in" fill material and optimise compaction. Benches of sufficient width to accommodate the roller may need to be adopted in some situations. Figure 2 refers.

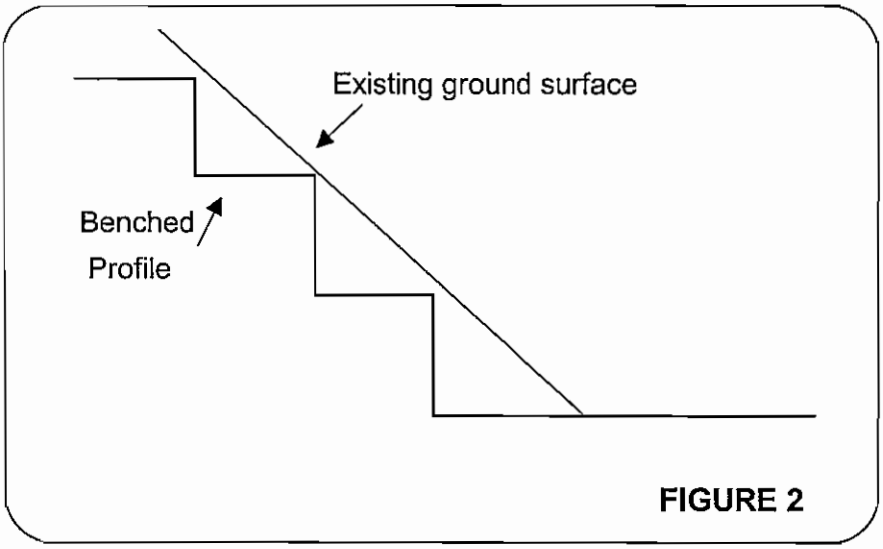

FIGURE 2

- Depressions formed by the removal of vegetation, underground elements etc. should have all disturbed weakened soil cleaned out and be backfilled with compacted select material in a controlled manner.
- In areas where fill is to be placed, the existing ground surface should be proof rolled under the supervision of an experienced geotechnical engineer to detect any soft or loose material and to compact the surficial sands. Soft/Loose soils, particularly soft clays and loose surface clayey sands, should preferably be removed. In areas of cut, proof rolling shall be deferred until after the cut operation and sufficient compaction should be achieved. The insitu soils, where free of organic and deleterious material, may be used for structural fill. Mimimal difficulties are envisaged to be encountered in compacting the clean sands encountered in the higher level areas of the site, using conventional earthworks techniques.
- Guidelines for minimum relative compaction values for insitu soils and imported fill for the building and pavements are presented in Table 3 below.

TABLE 3 MINIMUM RELATIVE COMPACTION

Location	Minimum Density Index (%)
Building Areas - residential houses	65%
Pavement Area	
a) >0.3m below pavement subgrade	65
b) ≤0.3m below pavement subgrade	75

- Field density testing in the form of Dynamic Cone Penetrometer tests should be carried out to check the standard of compaction achieved. The frequency and extent of testing should be as per guidelines in AS.3798-1996, Section 8.0.
- Backfilling for service trenches, etc. should use good quality clean sand material. The backfill should be placed in uniform layers over the full width of the excavations with the layers not exceeding 200mm loose thickness. The backfill material should be compacted to the specifications outlined above. Testing to confirm that the required degree of compaction has been achieved should be undertaken during the backfilling operation.
- Most soils encountered on site should be within the excavation limits of a small dozer (eg. Cat D4 or similar) in bulk earthworks and a medium sized backhoe (eg. Case 580 or similar) in trench excavations.

Batters

Considering the proposed maximum height of cut and fill, maximum batter angles of 18° (1V:3H) long term, and 30° short term are recommended. Steeper batters are possible by use of retaining structures. Fill batter slopes are dependent on suitable compaction being achieved.

All fill batters should be overfilled and trimmed back to design profile, no steeper than 1V:2H, to ensure compaction is achieved.

It is essential that batters be suitably protected from erosion and scour by the establishment of ground cover and shrubs, installation of surface drains, etc. Runoff should not be allowed to discharge directly across the batters.

Earthworks Supervision

Given the nature of the earthworks operation, "engineering supervision" of the earthworks operation is recommended.

It is recommended that the following "objectives" (as a minimum) are incorporated into the earthworks specification:-

- Certification that all general earthworks operations (ie. stripping, proof rolling of subgrade, etc.) have been carried out in accordance with the earthworks specification.
- Certification that fill has been placed and compacted to the required minimum density in accordance with the earthworks specification.
- Certification that the quality of any fill complies with the earthworks specification requirements.

It is recommended that all "certification" be signed off by an RPEQ or CPENG.

6.3 *Broadscale Foundation Recommendations*

6.3.1 *General*

It is understood that the likely proposed development is to generally consist of a typical residential development, with buildings up to two storeys. In the areas of typical residential construction up to two storeys, where fill is to be placed, the existing surface after stripping should be proof rolled as delineated in Section 6.2.

6.3.2 *Residential Type Development*

It is considered likely that provided suitable control of the bulk earthworks operation is undertaken, in accordance with the recommendations outlined in Sections 6.1 and 6.2, the development site will be suitable for the use of high level footings for the support of residential type structures.

Some recompaction of the footings etc. may be required at the time of excavation.

Suitable control of the Earthworks

Suitable control of the earthworks would include the steps outlined in the procedure below :-

i) Strip unsuitable material from the site.

ii) Water and compact the stripped surface using a smooth drum roller, ensuring minimum of 65% density index to generally at least 0.5m below the base of the stripped surface.

iii) Place 'clean' sands and compact in layers to achieve a minimum density index of 65% (AS.1289 - 5.5.1/5.6.1) to the proposed fill level.

iv) Note: The layer thickness that can be used will depend on whether a static or vibrating roller is used. Increased thickness is possible with a vibrating roller. The topsoil layer or sands containing significant organic matter, or more than 5% silt and clay fines, or building rubble are not recommended for use as fill. An assessment of the sands is recommended prior to placement and recompaction.

v) Testing of the stripped surface and subsequent fill layers is recommended in accordance with guidelines detailed in AS.3798-1996 'Guidelines on Earthworks for Commercial and Residential Developments'.

vi) Test method AS.1289 6.3.2 'Determination of Penetration Resistance of a soil using the 9kg Dynamic Cone Penetrometer' is recommended to verify compaction using accepted density index correlation tables.

The base of all pad and strip footings should be individually recompacted using a vibrating plate compactor prior to placement of reinforcing steel and concrete as soils may be loosened during the excavation process by machinery action. If the sand is dry, it should be saturated and left for a short period prior to vibration. Should any loose areas be encountered in the footing excavations the density of these areas must be improved. Further testing by means of dynamic cone penetrometer tests should be carried out to confirm the adequacy of the founding soils.

Average settlements in the improved sands beneath a pad footing of 1.0m width at a nominal founding depth below existing ground level and a design bearing pressure of 150kPa are estimated to be in the order of less than 25mm with anticipated differential settlements of between 25% and 50% of the calculated total settlement for adjacent pad footings founded at a similar depth. These calculations assume adequate densification of the founding sands.

This settlement will occur as immediate settlement as the construction loads are applied.

Indicative site classifications of Class 'M' are likely to result for typical residential structures, subject to individual site investigations being carried out site specific for each site/structure.

Ancillary Structures

Non structural elements such as masonry fences, garden walls etc. should be founded at least 400mm below finished ground level. It is recommended that the subsoil to at least 0.6m below the footings of ancillary structures be compacted to at least 65% Density Index. An allowable bearing pressure of 150kPa may then be adopted for design.

All ancillary structures including fences should be suitably articulated to cater for any potential differential movement.

Excavation Stability

The following general recommendations are made for short term stability of batters for bulk excavation of the proposed development if required.

For Excavation Less Than 2.0 metres Depth

- Batter angle not greater than 1V:1.5H from horizontal.
- Top of batter to be a minimum of 3.0 metres away from any building or movement sensitive structures.

For Excavation Greater Than 2.0 metres Depth

- Batter angle not greater than 1V:1.5H from horizontal
- Top of batter to be a minimum of 2.0 metres inside any boundary line, in addition to 3.0 metres distance from any building or structure.

Note: If batters are to be left untreated for any length of time a batter angle of 1V:2H is recommended and berm widths are to be strictly maintained.

7.0 CONSTRUCTION INSPECTIONS

Inspection and testing of the bulk earthworks should be carried out by Soil Surveys Engineering Pty Limited or a duly qualified and experienced Geotechnical Engineer. Should subsurface conditions other than those described in this report be encountered, Soil Surveys Engineering Pty Limited should be consulted immediately and appropriate modifications developed and implemented if necessary.

8.0 LIMITATIONS

We have prepared this report for the use of **WALTER ELLIOTT HOLDINGS PTY LTD** for design purposes in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties other than **WALTER ELLIOTT HOLDINGS PTY LTD** or their associated design consultants, ie. Architect and Civil/Structural Engineers. It may not contain sufficient information for purposes of other parties or for other uses.

Soil Surveys Engineering offer a documentation review service to verify that the intent of geotechnical recommendations is properly reflected in the design. It is recommended that clients avail themselves of this service; our standard rates will apply.

P. KIDD

A. M. RUTTEN (RPEQ 2202)

for and on behalf of
SOIL SURVEYS ENGINEERING PTY LIMITED

APPENDICES

APPENDIX A

NOTES RELATING TO THIS REPORT

INTRODUCTION

These notes are provided by Soil Surveys Engineering Pty Limited (the Company) to complement the geotechnical report in regard to classification methods and field procedures. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and at the time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

Soils - The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726-1993 (Geotechnical Site Investigations), where appropriate. In general, descriptions cover the following properties - soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the dominant particle size and behaviour as set out in AS 1726-1993.

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, shear vane, laboratory testing or engineering examination. The strength terms are defined in AS1726-1993 Table A4.

Non-cohesive soils are classified on the basis of relative density usually based on insitu testing or engineering examination (see AS1726-1993 Table A5).

Rocks - Rock types are classified by their geological names (AS1726-1993 Table A6), together with descriptive terms regarding weathering (AS1726-1993 Table A9), strength (refer Table 1 below), defects (AS1726-1993 Table A10), etc. Where strength testing (ie Point Loads) is carried out, AS1726-1993 Table A8 is used. Where relevant, further information regarding rock classification is attached.

Table 1 Estimated strength descriptions given to rock based on engineering examination

Strength Term	Approximate Qu (MPa)
Extremely Weak	< 1.0
Very Weak	1.0 - 5.0
Weak	5.0 - 25
Medium Strong	25 - 50
Strong	50 - 100
Very Strong	100 - 250
Extremely Strong	> 250

Ref ISRM "Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses"

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon sample disturbance, (information on strength and structure).

Undisturbed samples are taken by pushing a thin walled sample tube, usually 50mm diameter (U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength, volume change potential and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application.

Test Pits - These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling - A borehole of 50 to 100mm diameter is advanced by manually operated equipment. Refusal of the augers can occur on a variety of materials such as hard clay, gravel or rock fragments and does not necessarily indicate rock level.

Continuous Spiral Flight Augers - The borehole is advanced using 75 to 300 mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the augers. Information from the drilling (as distinct from specific sampling) is of relatively lower reliability due to remoulding, inclusion of cuttings from above or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table has a lower reliability than augering above the water table. Various drill bits are attached to the base of the augers during the drilling. The depth of refusal of the different bit types can provide information as to the strength of the material encountered. Generally two different bit types are used. The 'V' bit is a V shaped steel bit and the 'TC' bit is a tungsten carbide tipped screw type bit.

Wash Boring - The borehole is usually advanced by a rotary bit with water or fluid pumped down the hollow drill rods and returned up in the space between the rods and the soil or casing, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration. More accurate information on soil strata is gained by regular testing and sampling using the Standard Penetration Test (SPT) and undisturbed thin walled tube samples (U50).

Mud Stabilized Drilling - Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilize the borehole. The term "mud" encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from regular intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling - A continuous core sample is obtained using a diamond or tungsten carbide tipped core barrel. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable method of investigation. In rocks, NMLC coring (nominal 52 mm diameter) is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses is determined on site by the supervisor. If the location of the loss is uncertain, it is placed at the top end of the run, when the core is placed in a storage tray and recorded on the log.

Standard Penetration Tests - Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" - Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm, the upper 150 mm being neglected due to possible disturbance from the drilling method. In dense sands, very hard clays or weak rock, the full 450 mm

penetration may not be practicable and the test is discontinued at a reduced penetration.

In the case where full penetration is obtained with successive blow counts for each 150 mm of, say 4, 6 and 7 blows, the record shows,

4, 6, 7 N = 13

In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm, the record shows:

15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, it is noted on the borehole logs.

A modification to the SPT test is where the same driving system is used with a solid 60^0 tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid SPT are shown as "N_c" on the borehole logs, together with the number of blows per 150 mm penetration.

Cone Penetration Tests - Test Method - Cone Penetration Tests (CPT) are carried out in accordance with AS 1289 Test 6.5.1-1977, using an electrical friction-cone penetrometer.

The test essentially comprises the measurement of resistance to penetration of a cone of 35.7 mm diameter pushed into the soil at a rate of 10-20 mm per second by hydraulic force. The resistance to penetration is recorded in terms of pressure on the end area of the cone (cone resistance, q_c, in MPa) and friction on the side of the 135 mm long sleeve immediately above the top of the cone (friction resistance, f_s, in kPa). These forces are measured by electrical transducers (strain gauges) within the cone device. The ratio between friction resistance and cone resistance is also calculated as a percentage, ie.-

$$\textit{Friction Ratio } (FR) = \frac{\textit{Friction Resistance}, f_s\ (kPa) \times 100}{\textit{cone resistance}, q_c\ (kPa)}$$

The friction ratio, FR, is generally low in sands (less than 1% or 2%) and generally higher in clays (say 3% or more). The interpretation of sandy clays, clayey sands and material with a high silt content is more difficult, but intermediate values (between 1% and 3%) would be expected. Highly organic clays and peats generally have a friction ratio in excess of 5%.

Static cone data is recorded in the field on disc for later presentation using computer aided drafting.

The equipment can be operated from any conventional drill rig. A total applied load in the range of 4 to 10 tonnes is required for practical purposes, although lighter loads may be used. The cone penetrometers are available with various capacities of cone resistance ranging up to 100 MPa for general purpose investigations, while a range of 0 to 10 MPa can be used where more sensitive investigations of soft clay are required.

The cone resistance value provides a continuous measure of soil strength or density, and together with the friction ratio, provide very useful indications of the presence of narrow bands of geotechnically significant layers such as thin, soft clay layers or lenses of sand which might otherwise be missed using conventional drilling methods.

The lithology of the encountered soils is interpreted from static cone data and is generally presented on the static cone log sheets.

It is important to note that the lithology is interpreted information and is based on research by Schmertmann (1970), Sanglerat (1972), Robinson and Campinalli (1986), modified to suit local conditions as indicated by borehole information and laboratory testing.

As soils generally change gradually it is sometimes difficult to accurately describe depths of strata changes, although greater accuracy is obtained with the static cone compared with conventional drilling. In addition, friction ratios decrease in accuracy with low cone resistance values, and in desiccated soils. As a result, some overlap and minor discrepancies may exist between static cone and nearby borehole information.

Portable Dynamic Cone Penetrometers - Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 100mm increments of penetration.

The DCP comprises a Cone of 20 mm diameter with 30 degree taper attached to steel rods of smaller section.

The cone end is driven with a 9 kg hammer falling 510 mm (AS. 1289 Test 6.3.2). The test was developed initially for pavement subgrade investigations, and empirical correlations of the test results with California Bearing Ratio have been published by various Road Authorities. The Company has developed their own correlations with Standard Penetration tests and Density Index tests in sands.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems.

- Although groundwater may be present in lower permeability soils, it may enter the hole slowly or perhaps not at all during the time the hole is open.
- A localized perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be bailed out of the bore and mud must be washed out of the hole or "reverted" if water observations are to be made.

More reliable measurements can be made by use of standpipes which are read after stabilizing at periods ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc.) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is important to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms and the attached explanatory notes summarize important aspects of the Laboratory Test Procedures adopted.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal the information and interpretation may not be relevant if the design proposal is changed. If this happens, the Company

will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects and recommendations or suggestions for design and construction. Since the test sites in any exploration represent a very small proportion of the total site and since the exploration only identifies actual ground conditions at the test sites, even under the best circumstances actual conditions may vary from those inferred to exist. No responsibility is taken for:-

- Unexpected variations in ground and/or groundwater conditions.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of other persons.
- Any work where the company is not given the opportunity to supervise the construction using the Companies designs/recommendations.

If differences occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are more readily resolved when conditions are exposed than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances, where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer. We would be happy to assist in this regard as an extension of our investigation commission.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

i) Site visits during construction to confirm reported ground conditions

ii) Site visits to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, the stability of a filled or excavated slope; or

iii) Full-time engineering presence on site.

In the vast majority of cases it is advantageous to the principal for the geotechnical engineer who wrote the investigation report to be involved in the construction stage of the project.

APPENDIX B

BOREHOLE RECORDS INCLUDING DYNAMIC CONE PENETROMETER TEST RESULTS

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BOREHOLE RECORD SHEET

Borehole Number : 1

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004 Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V, TC, WB, RR, NMLC, Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.30		FILL SAND (SP) Loose, fine to medium grained, grey, moist.		D
			FILL SAND (SP) Loose to medium dense, fine to medium grained, grey-brown, some silt fines, moist.		D
	1.0 ▼ ▽ 1.05				D
			NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown, wet.		D
	1.80				
	2.0		SAND (SP) Medium dense, fine to medium grained, grey, wet.		
	3.0				
	4.0				
	5.0				
	5.60				
	6.0 6.00		Silty SAND (SM) Medium dense, fine to medium grained, grey, wet.		
			Borehole Terminated 6.00m		
	7.0				
	8.0				
	9.0				
	10.0				

COMMENTS

1) Groundwater noted at 1.05m. 2) Steady water noted at 0.9m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Elliott

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 2
Project Number : 204-4808

Project Name : Residential Subdivision
Location : LOT 156 Creek St., Hastings Point
Client : Walter Elliott Holdings Pty Ltd
Date : 21/06/2004

Page : 1

Easting : Northing : RL :
Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V, TC, WB, RR, NMLC, Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.25		FILL Silty SAND (SM) Very loose to loose, fine to medium grained, dark grey, moist.		D
	0.80		FILL SAND (SP) Loose, fine to medium grained, grey, some silt fines, moist.		D
	1.0		FILL Silty SAND (SM) Loose, fine to medium grained, dark brown, moist.		D
	▼ ▽ 1.25		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown, organic matter, wet.		D
	1.65		SAND (SP) Medium dense, fine to medium grained, grey, wet.		
	2.0				
	3.0				
	4.0				
	5.0				
	5.50		Silty SAND (SM) Medium dense, fine to medium grained, grey, wet.		
	6.0				
	6.00		Borehole Terminated 6.00m		
	7.0				
	8.0				
	9.0				
	10.0				

COMMENTS

1) Groundwater noted at 1.25m. 2) Steady water noted at 1.3m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Forbes
Date : 27 7 04

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BOREHOLE RECORD SHEET

Borehole Number : 3
Project Number : 204-4808

Project Name : Residential Subdivision
Location : LOT 156 Creek St., Hastings Point
Client : Walter Elliott Holdings Pty Ltd
Date : 21/06/2004 Page : 1

Easting : Northing : RL :
Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method: V, TC, WB, RR, NMLC, Casing

Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
0.15		FILL Silty SAND (SM) Loose, fine to medium grained, grey-brown, moist		D
		FILL SAND (SP) Medium dense, fine to medium grained, light grey bleached brown, moist.		D
1.0				D
1.30 ▼				
1.70 ▽		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown, some organic matter, wet.		D
2.0		SAND (SP) Medium dense to dense, fine to medium grained, grey-brown, some silt fines, wet.		
3.0				
4.0				
5.0				
6.0				
6.00		Borehole Terminated 6.00m		
7.0				
8.0				
9.0				
10.0				

COMMENTS
1) Groundwater noted at 1.3m. 2) Steady water noted at 1.85m.

▼ Water First Noted ▽ Water Steady Level

Approved : Sam Sutton
Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 4

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.30		NATURAL Silty SAND (SM) Very loose to loose, fine to medium grained, grey-brown, organic matter, moist.		D
	1.00		Silty SAND (SM) Loose, fine to medium grained, grey-brown, trace of organic, moist.		D
	3.30		SAND (SP) Medium dense, fine to medium grained, grey, wet.		D
	6.00		Silty SAND (SM) Dense to very dense, fine to medium grained, dark grey-brown, wet.		D
			Borehole Terminated 6.00m		

COMMENTS

1) Groundwater noted at 0.3m. 2) Steady water noted at 0.55m. 3) DCP Refusal at 3.6m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Tustin

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 5

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V, TC, WB, RR, NMLC, Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.15		FILL Silty SAND (SM) Loose, fine to medium grained, grey-brown, moist.		D
	0.75		FILL Silty SAND (SM) Loose to medium dense, fine to medium grained, grey-brown, moist.		D
	1.10		FILL SAND (SP) Loose, fine to medium grained, grey, some silt fines, wet.		D
	1.55		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, wet.		D
	3.10		SAND (SP) Medium dense, fine to medium grained, grey, wet.		
	5.10		Silty SAND (SM) Very dense, fine to medium grained, dark grey-brown, wet.		
	6.00		Silty SAND (SM) Dense, fine to medium grained, grey-brown, wet.		
			Borehole Terminated 6.00m		

COMMENTS

1) Groundwater noted at 0.70m. 2) Steady water noted at 0.80m. 3) DCP Refusal at 3.2m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 6
Project Number : 204-4808
Project Name : Residential Subdivision
Location : LOT 156 Creek St., Hastings Point
Client : Walter Elliott Holdings Pty Ltd
Date : 21/06/2004
Page : 1

Easting : Northing : RL :
Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V, TC, WB, RR, NMLC, Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, some organics, moist		D
	▽		SAND (SP) Medium dense, fine to medium grained, grey, wet.		D
	1.0				D
	1.10		Silty SAND (SM) Loose, fine to medium grained, grey-brown, wet.		D
	1.90				
	2.0		Silty SAND (SM) Medium dense, fine to medium grained, grey-brown, wet.		
	2.60				
	3.0		Silty SAND (SM) Very dense, fine to medium grained, dark grey-brown, wet, (Indurated)		
	4.0				
	5.0				
	5.40				
	6.0		Silty SAND (SM) Dense, fine to medium grained, dark grey-brown, wet, (Indurated)		
	6.00		Borehole Terminated 6.00m		
	7.0				
	8.0				
	9.0				
	10.0				

COMMENTS

1) Groundwater noted at 0.1m. 2) Steady water noted at 0.6m. 3) DCP Refusal at 2.6m & 3.2m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Cutten
Date : 27 7 04

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BOREHOLE RECORD SHEET

Borehole Number : 7

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004 Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		NATURAL Organic CLAY (CO) Firm, high plasticity, dark grey-brown, organics, moist		
			SAND (SP) Loose, fine to medium grained, grey-brown, some silt fines, wet.		D
	1.0				D
					D
	2.0				D
	2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 0.1m. 2) Steady water noted at 0.6m.

▼ Water First Noted ∇ Water Steady Level

Approved : Tom Carlton

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 8
Project Number : 204-4808
Project Name : Residential Subdivision
Location : LOT 156 Creek St., Hastings Point
Client : Walter Elliott Holdings Pty Ltd
Date : 21/06/2004
Page : 1

Easting : Northing : RL :
Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		FILL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, moist		D
	▽ ▼ 0.75		FILL SAND (SP) Loose, fine to medium grained, grey-brown, some silt fines, moist.		D
	1.0		NATURAL Silty SAND (SM) Loose, fine to medium grained, brown bleached grey, wet.		D
	1.50		Borehole Terminated 1.50m		D
	2.0				
	3.0				
	4.0				
	5.0				

COMMENTS
1) Groundwater noted at 0.75m. 2) Steady water noted at 0.7m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Sutton
Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 9

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004 Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		FILL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, moist.		D
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, some silt fines, moist.		D
	0.90 ▽ 0.95				
	1.0		NATURAL Organic CLAY (CO) Firm, high plasticity, dark grey-brown, organics, moist.		D
			Silty SAND (SM) Loose, fine to medium grained, brown bleached grey, wet.		D
	2.0 2.00				
			Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 0.95m. 2) Steady water noted at 1.0m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tim Kelly

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 10

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		FILL Silty SAND (SM) Loose, fine to medium grained, dark gre-brown, moist.		
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
	0.90				D
	1.0		NATURAL Silty SAND (SM) Medium dense, fine to medium grianed, grey-brown, wet.		D
	1.80				D
	2.0		SAND (SP) Medium dense, fine to medium grained, grey, wet.		
	2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 0.9m. 2) Steady water noted at 0.95m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Lutton

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 11

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004 Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.15		FILL Silty SAND (SM) Loose, fine to medium grained, dark gre-brown, moist.		
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
	1.0 ▽ 0.95				D
	▼ 1.10		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown bleached grey, some organics, moist		
			SAND (SP) Medium dense, fine to medium grained, grey bleached brown, wet.		D
	2.0	2.00			D
			Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 1.1m. 2) Steady water noted at 1.0m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Lantten

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 12

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V, TC, WB, RR, HMLC, Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.80		FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
	1.0		FILL SAND (SP) Loose, fine to medium grained, bleached brown, moist.		D
	1.40				D
	▽ 1.55		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark brown bleached grey, some organics, moist		
	2.0		SAND (SP) Medium dense, fine to medium grained, grey bleached brown, wet.		D
	2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 1.55m. 2) Steady water noted at 1.5m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Cutten

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 13

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.10		FILL SAND (SP) Loose, fine to medium grained, dark grey-brown, moist.		
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
	0.80		NATURAL SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, moist.		D
	1.0 ▽ ▼ 1.10		SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, wet.		D
	2.0 2.00		Borehole Terminated 2.00m		D
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 1.55m. 2) Steady water noted at 1.0m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 14
Project Number : 204-4808
Project Name : Residential Subdivision
Location : LOT 156 Creek St., Hastings Point
Client : Walter Elliott Holdings Pty Ltd
Date : 21/06/2004 Page : 1

Easting : Northing : RL :
Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / HMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.15		FILL SAND (SP) Loose, fine to medium grained, dark grey-brown, moist.		
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.		D
	0.85 ▽				
	1.0		NATURAL Silty SAND (SM) Loose, fine to medium grained, dark grey-brown, wet.		D
	1.40		SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, wet.		D
	2.0 2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS
1) Groundwater noted at 0.85m. 2) Steady water noted at 0.9m.

▼ Water First Noted ▽ Water Steady Level

Approved : Tom Rankin
Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 15

Project Number : 204-4808

Project Name : Residential Subdivision

Location : LOT 156 Creek St., Hastings Point

Client : Walter Elliott Holdings Pty Ltd

Date : 21/06/2004

Page : 1

Easting : Northing : RL :

Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 5 10 15 20 25	Samples and Remarks
	0.13		FILL SAND (SP) Loose, fine to medium grained, dark grey-brown, moist.		
			FILL SAND (SP) Loose, fine to medium grained, grey, moist.		D
	1.0				D
	▽ 1.40				D
	▼ 1.50		NATURAL Organics CLAY (CO) Firm, high plasticity, dark brown, moist		
			SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, wet.		D
	2.0				
	2.00		Borehole Terminated 2.00m		
	3.0				
	4.0				
	5.0				

COMMENTS

1) Groundwater noted at 1.5m. 2) Steady water noted at 1.4m.

▼ Water First Noted ▽ Water Steady Level

Approved : [signature]

Date : 27/7/04

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BOREHOLE RECORD SHEET

Borehole Number : 16
Project Number : 204-4808
Project Name : Residential Subdivision
Location : LOT 156 Creek St., Hastings Point
Client : Walter Elliott Holdings Pty Ltd
Date : 21/06/2004 Page : 1

Easting : Northing : RL :
Logger : RB Driller : RB Drilling Rig : Jacro105

Drilling Method (V / TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	Samples and Remarks
	0.15		FILL SAND (SP) Loose, fine to medium grained, dark grey-brown, moist.	
			FILL SAND (SP) Loose, fine to medium grained, grey-brown, moist.	D
	0.90			D
	1.0		NATURAL SAND (SP) Medium dense, fine to medium grained, brown bleached grey, some silt fines, wet.	D
	2.0			D
	2.00		Borehole Terminated 2.00m	
	3.0			
	4.0			
	5.0			

COMMENTS
1) Groundwater not observed.

Approved : Ian Walter
Date : 27/7/04

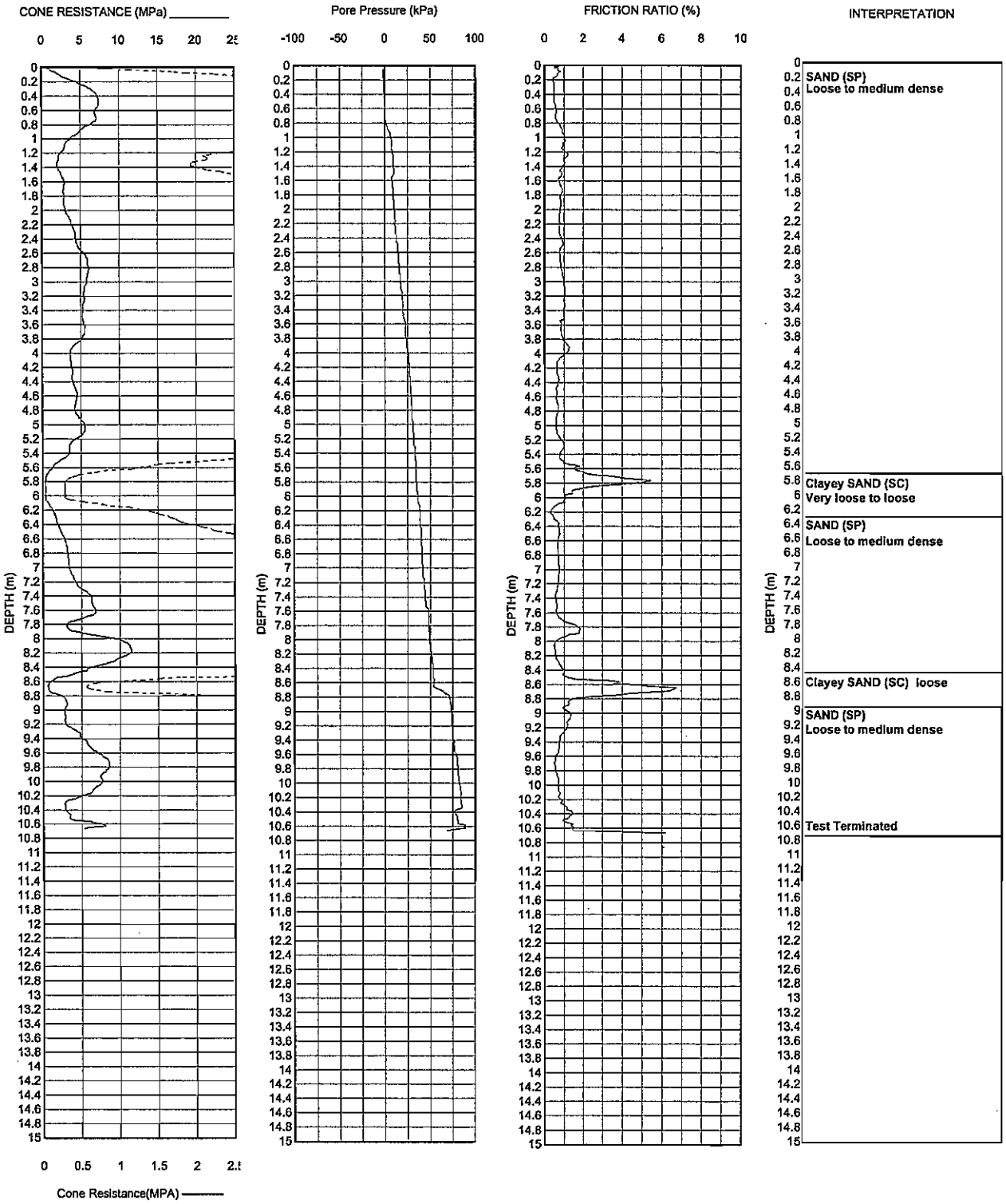
APPENDIX C

CONE PENETROMETER TEST RESULTS

Cone Penetrometer Test Record

Soil Surveys Engineering Pty Ltd
A.C.N. 054 043 831

JOB No	204-4808	CONE NO.	CPT 1
CLIENT	Walter Elliott Holdings	SURFACE R.L.	
PROJECT	Proposed Subdivision	CO-ORDINATES	
LOCATION	Lot 156 Creek Street, Hasting Point	DATE	08/06/2004

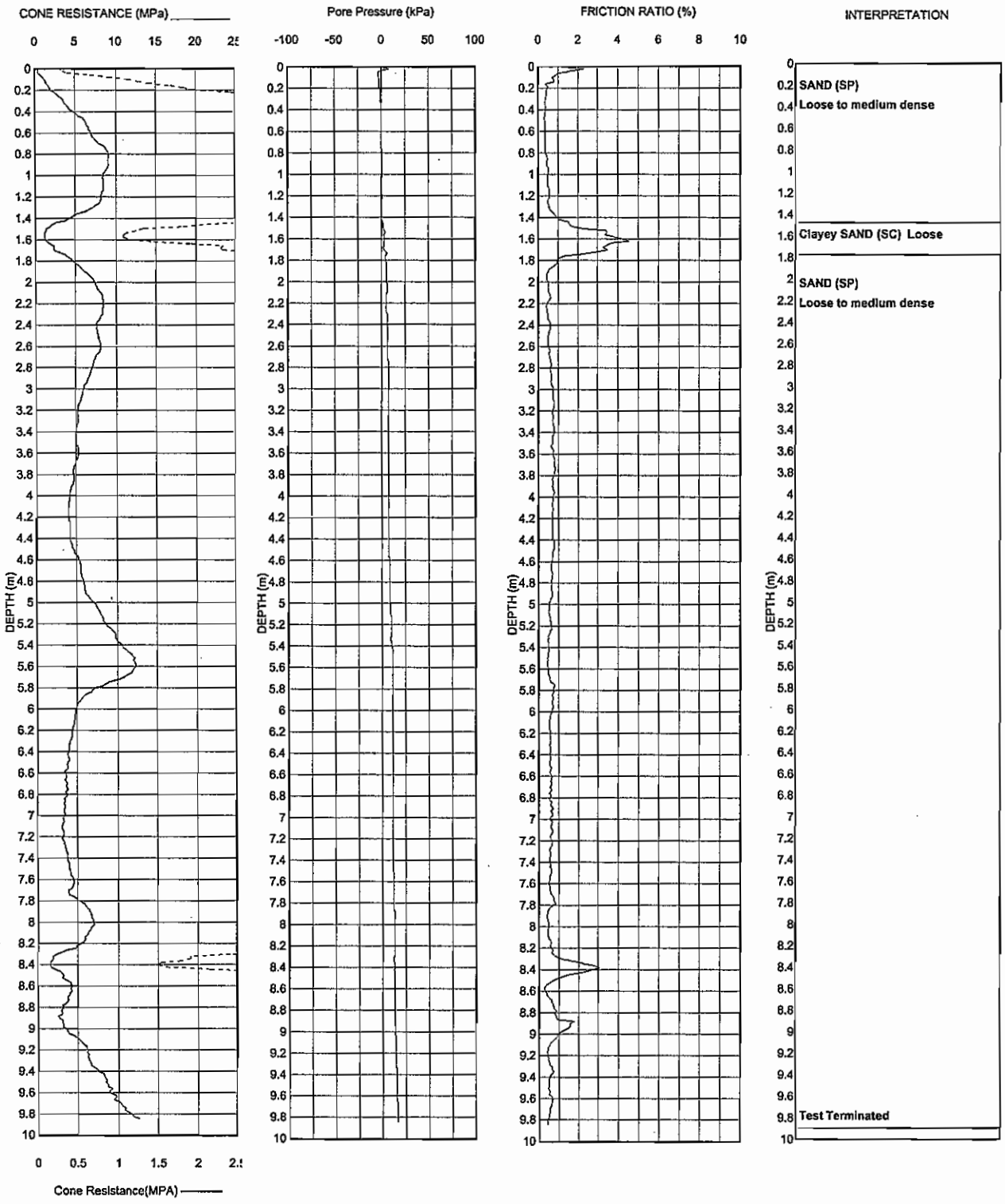


RIG	Gemco HP7	SUPERVISOR	Bob Champ
		CONE TYPE	10 sq cm Geotech (3390)

Cone Penetrometer Test Record

Soil Surveys Engineering Pty Ltd
A.C.N. 054 043 631

JOB No - 204-4808		CONE NO. - CPT 2	
CLIENT - Walter Elliott Holdings		SURFACE R.L. -	
PROJECT - Proposed Subdivision		CO-ORDINATES -	
LOCATION - Lot 156 Creek Street, Hasting Point		DATE - 08/06/2004	PAGE 1 OF 1

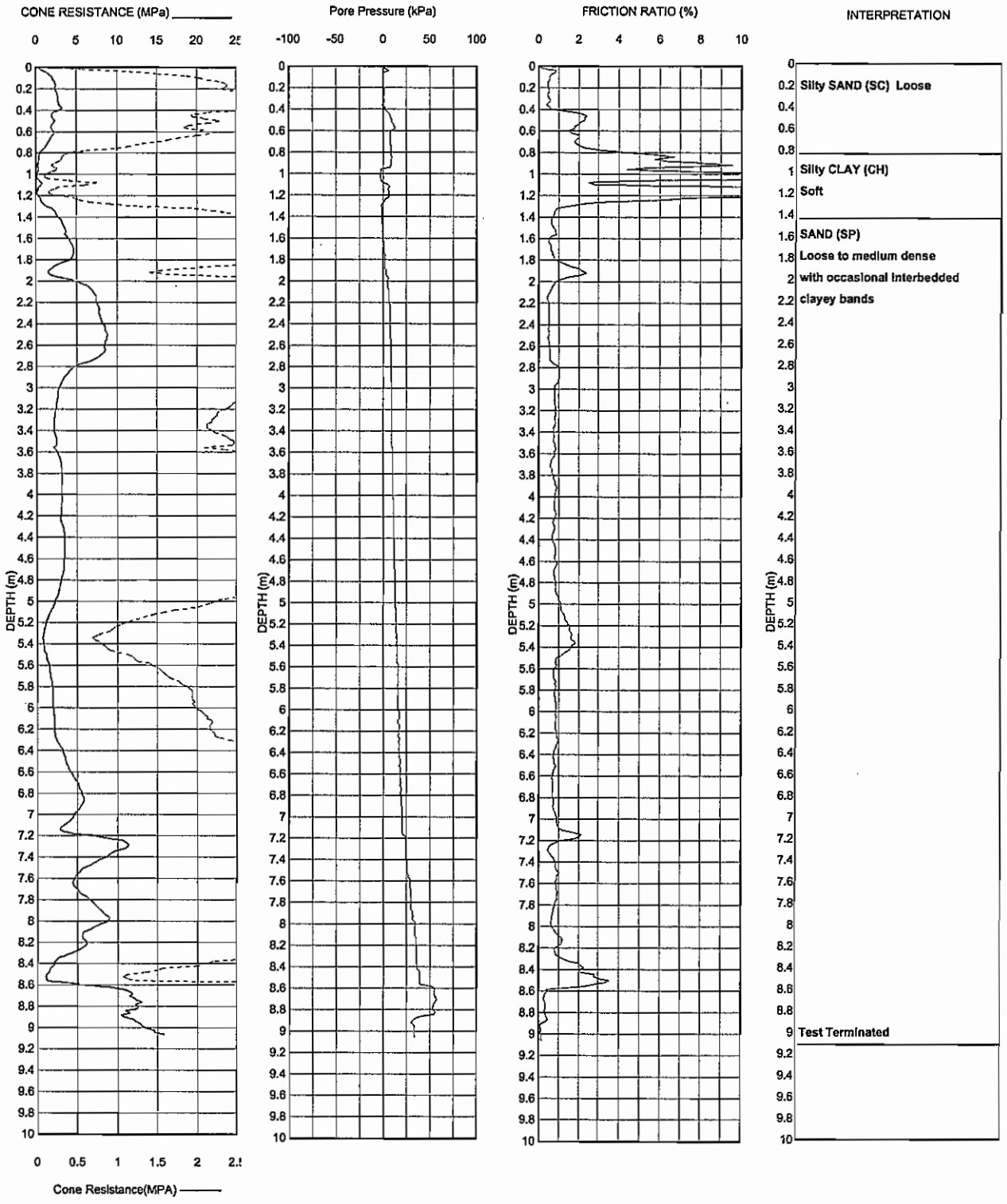


RIG - Gemco HP7		SUPERVISOR - Bob Champ	
		CONE TYPE - 10 sq cm Geotech (3390)	

Cone Penetrometer Test Record

JOB No	- 204-4808	CONE NO.	- CPT 3		
CLIENT	- Walter Elliott Holdings	SURFACE R.L.	-		
PROJECT	- Proposed Subdivision	CO-ORDINATES	-		
Soil Surveys Engineering Pty Ltd LOCATION	- Lot 156 Creek Street, Hasting Point	DATE	- 08/06/2004	PAGE 1 OF 1	

A.C.N. 054 043 631

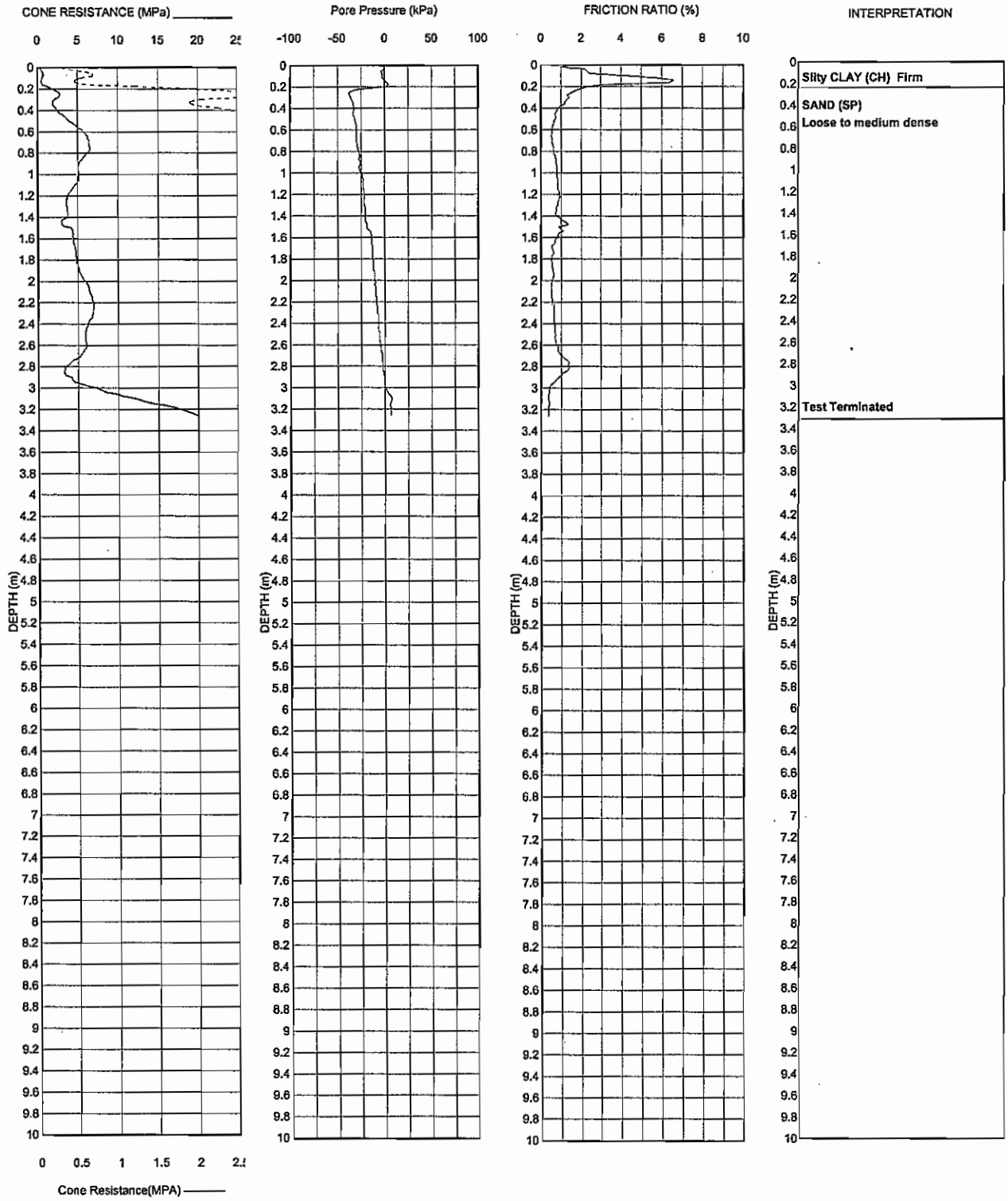


RIG	- Gemco HP7	SUPERVISOR	- Bob Champ
		CONE TYPE	- 10 sq cm Geotech (3390)

Cone Penetrometer Test Record

Soil Surveys Engineering Pty Ltd
A.C.N. 054 043 631

JOB No - 204-4808		CONE NO. - CPT 4	
CLIENT - Walter Elliott Holdings		SURFACE R.L. -	
PROJECT - Proposed Subdivision		CO-ORDINATES -	
LOCATION - Lot 156 Creek Street, Hasting Point		DATE - 08/06/2004	PAGE 1 0F 1

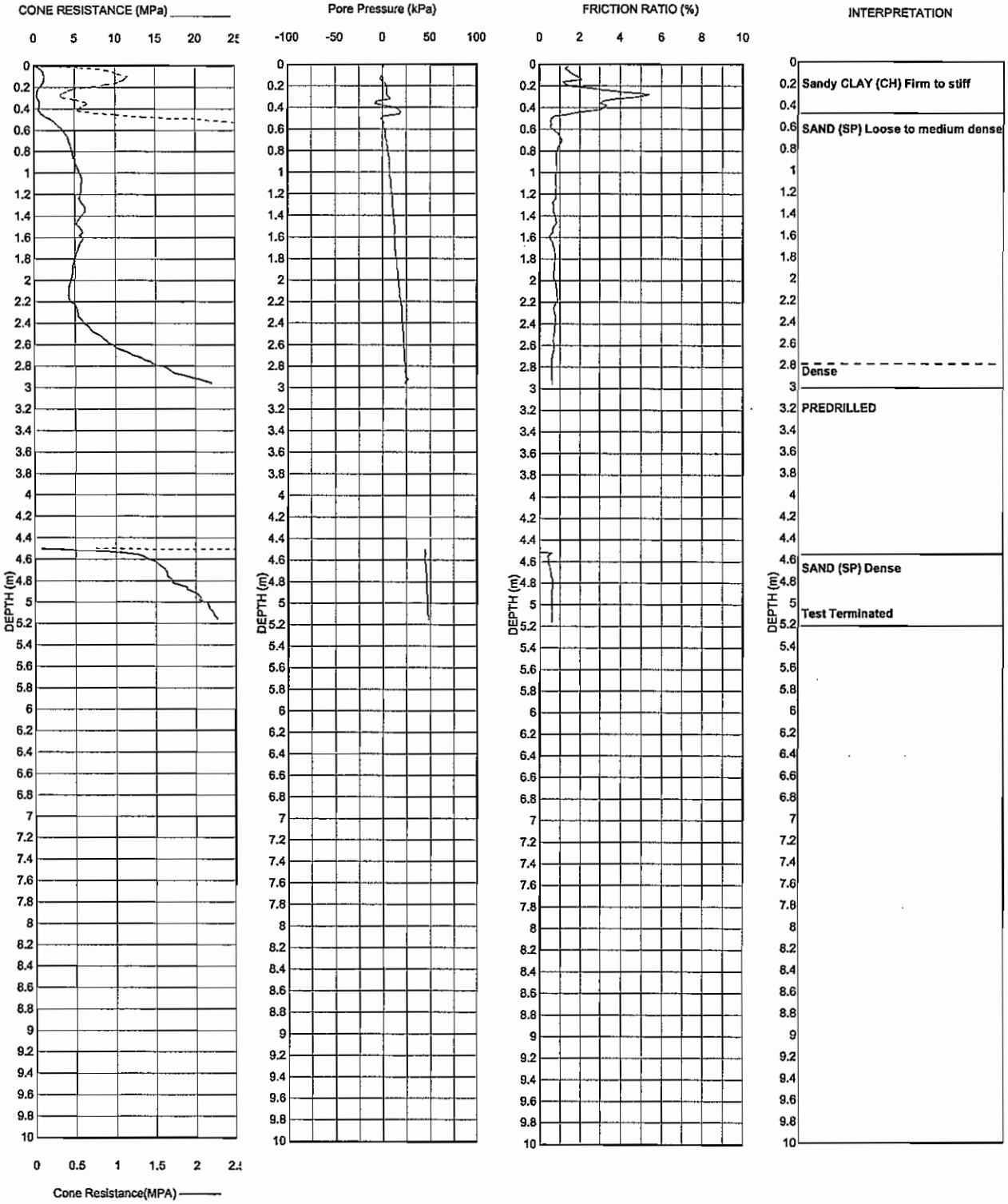


RIG - Gemco HP7		SUPERVISOR - Bob Champ	
		CONE TYPE - 10 sq cm Geotech (3390)	

Cone Penetrometer Test Record

Soil Surveys Engineering Pty Ltd
A.C.N. 054 043 631

JOB No	- 204-4808	CONE NO.	- CPT 5		
CLIENT	- Walter Elliott Holdings	SURFACE R.L.	-		
PROJECT	- Proposed Subdivision	CO-ORDINATES	-		
LOCATION	- Lot 156 Creek Street, Hasting Point	DATE	- 08/06/2004	PAGE 1 OF 1	

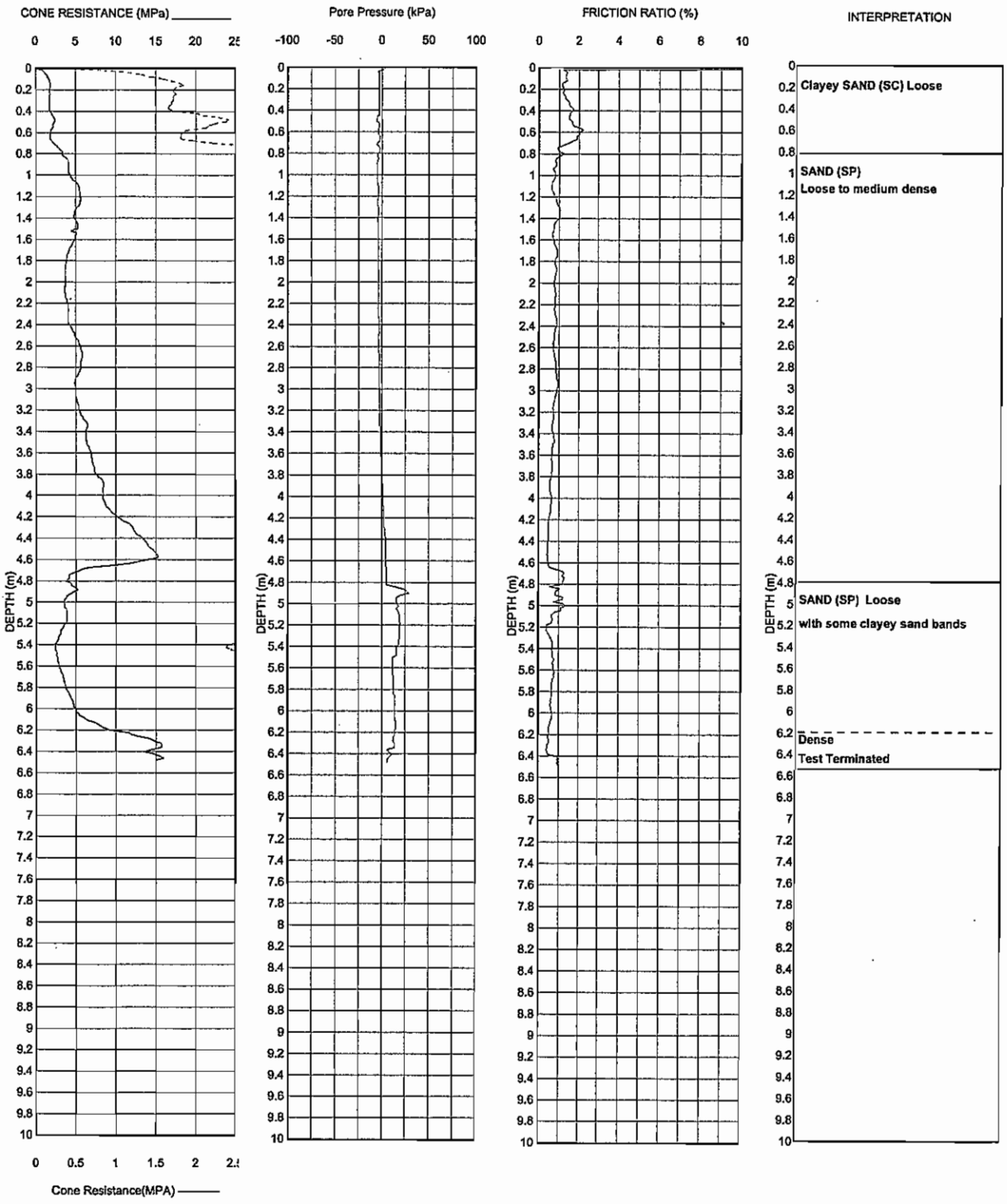


RIG	- Gemco HP7	SUPERVISOR	- Bob Champ
		CONE TYPE	- 10 sq cm Geotech (3390)

Cone Penetrometer Test Record

Soil Surveys Engineering Pty Ltd
A.C.N. 054 043 631

JOB No - 204-4808		CONE NO. - CPT 6	
CLIENT - Walter Elliott Holdings		SURFACE R.L. -	
PROJECT - Proposed Subdivision		CO-ORDINATES -	
LOCATION - Lot 156 Creek Street, Hasting Point		DATE - 08/06/2004	

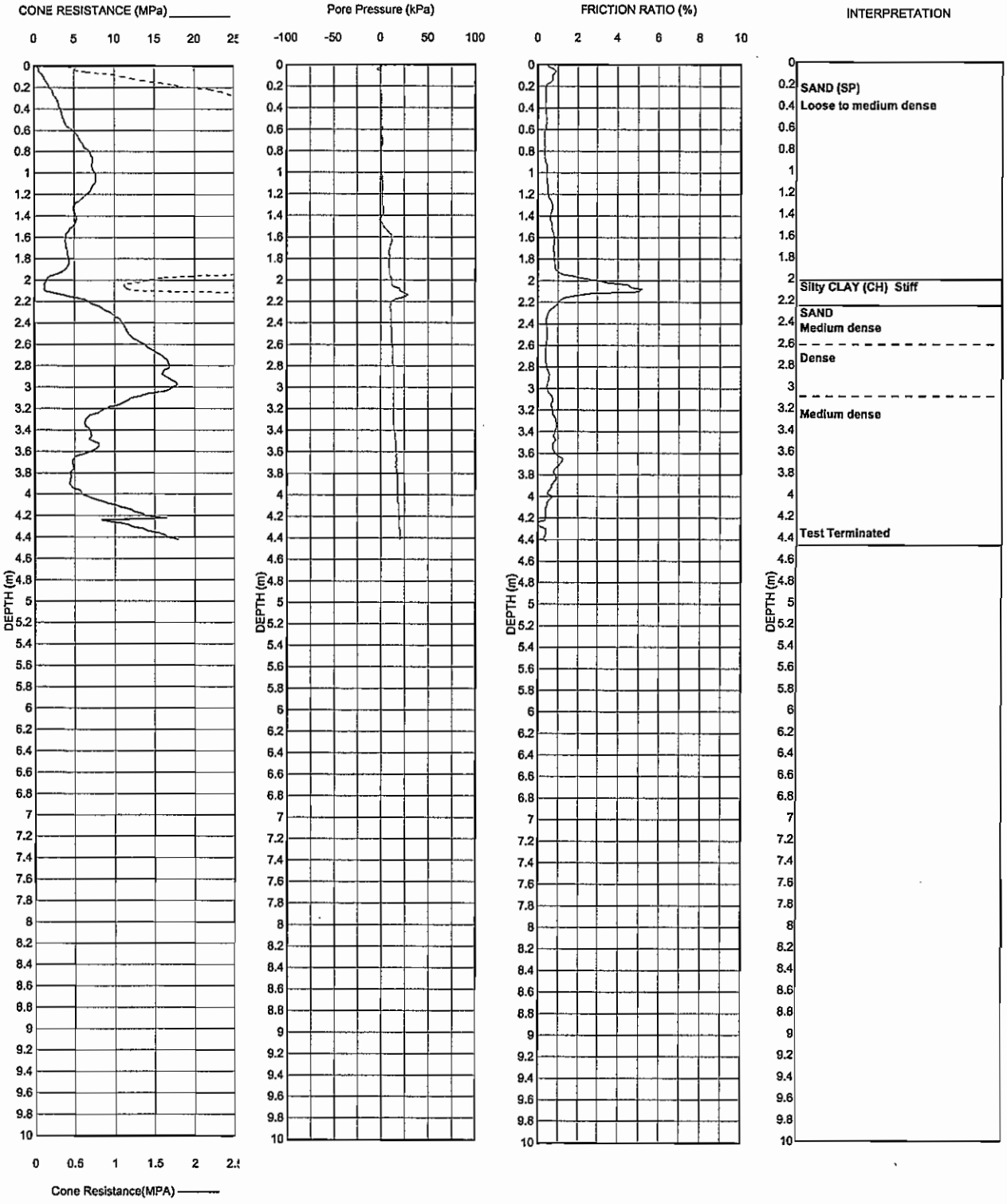


RIG - Gemco HP7		SUPERVISOR - Bob Champ	
		CONE TYPE - 10 sq cm Geotech (3390)	

Cone Penetrometer Test Record

Soil Surveys Engineering Pty Ltd
A.C.N. 054 043 831

JOB No	204-4808	CONE NO.	CPT 7		
CLIENT	Walter Elliott Holdings	SURFACE R.L.			
PROJECT	Proposed Subdivision	CO-ORDINATES			
LOCATION	Lot 156 Creek Street, Hasting Point	DATE	08/06/2004	PAGE 1 OF 1	

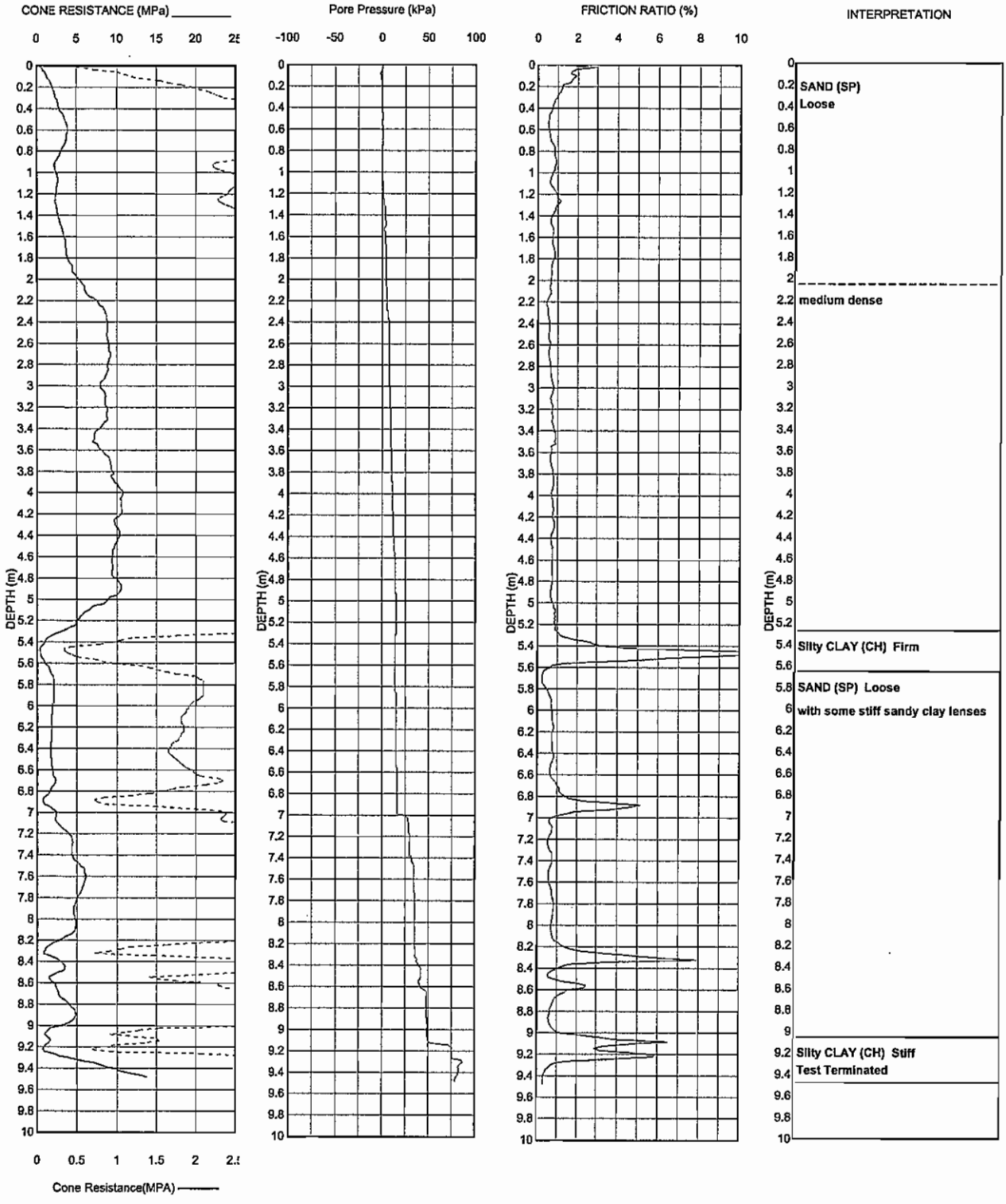


RIG	Gemco HP7	SUPERVISOR	Bob Champ
		CONE TYPE	10 sq cm Geotech (3390)

Cone Penetrometer Test Record

Soil Surveys Engineering Pty Ltd
A.C.N. 054 043 831

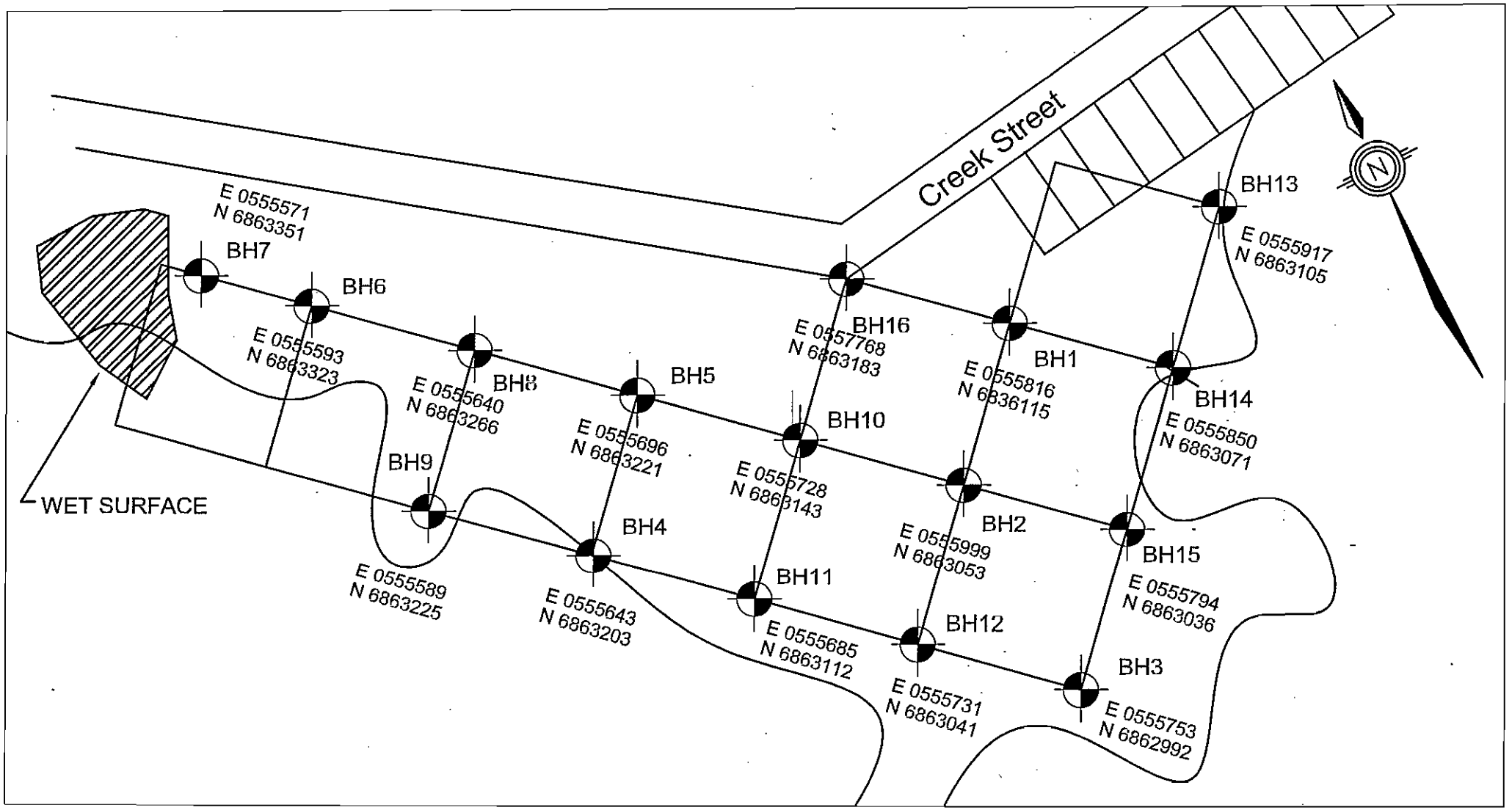
JOB No	- 204-4808	CONE NO.	- CPT 8		
CLIENT	- Walter Elliott Holdings	SURFACE R.L.	-		
PROJECT	- Proposed Subdivision	CO-ORDINATES	-		
LOCATION	- Lot 156 Creek Street, Hasting Point	DATE	- 08/06/2004	PAGE 1 OF 1	



RIG	- Gemco HP7	SUPERVISOR	- Bob Champ
		CONE TYPE	- 10 sq cm Geotech (3390)

APPENDIX D

SITE PLAN



BOREHOLE LOCATIONS

X:/drafting/CAD Autocad dwg/Nerang/204-4808-01

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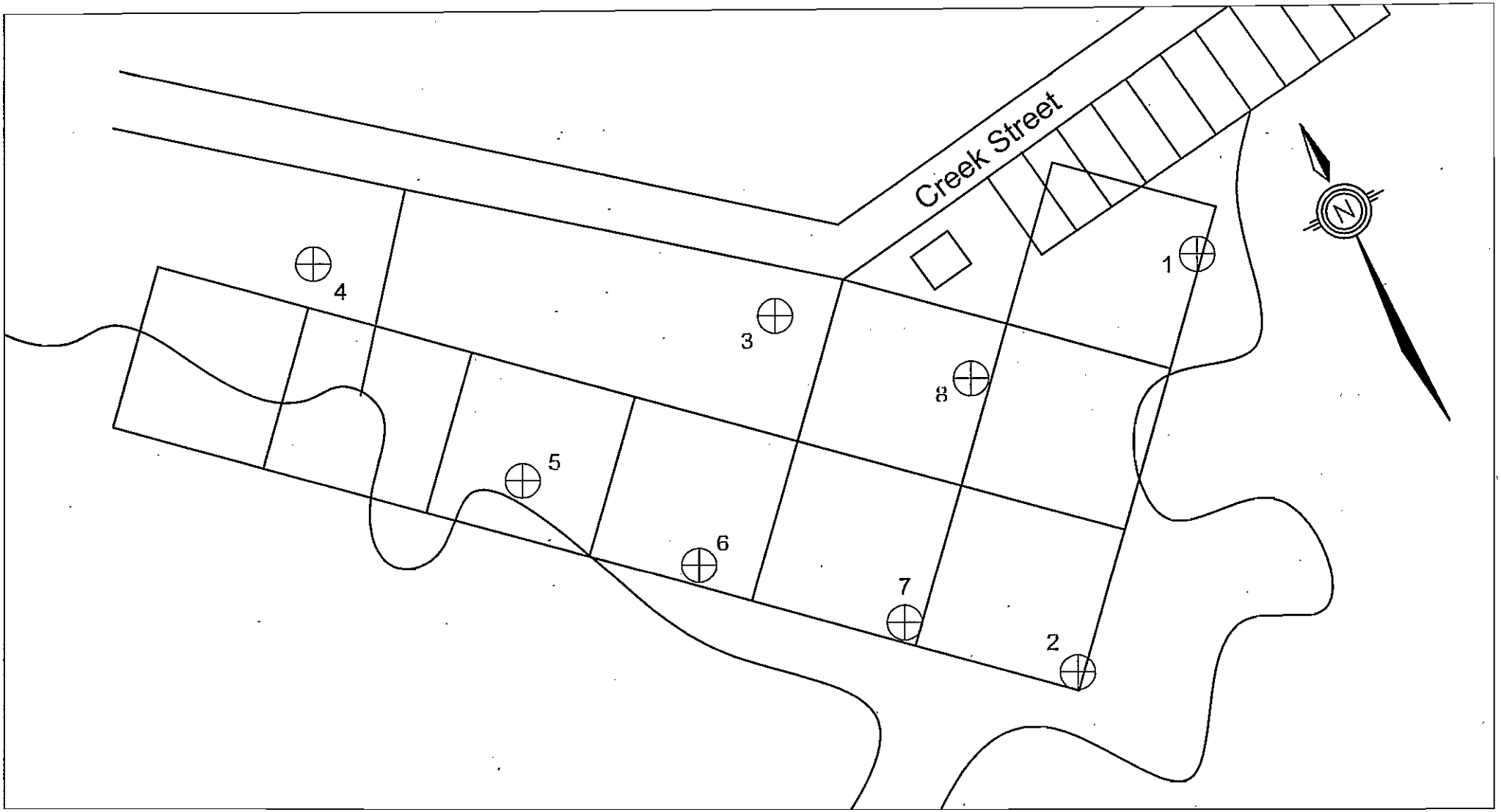
SCALE 1:250

DRAWN D.D.	Soil Surveys SOIL SURVEYS ENGINEERING PTY.LIMITED CONSULTING GEOTECHNICAL ENGINEERS		
DATE 24.06.2004	SITE PLAN Proposed Filling Creek Street, Hastings point N.S.W.	DRAWING NO. 204-4808 -01	A4
CHECKED AMR			



CPT Locations

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SCALE 1:250

DRAWN D.D.	Soil Surveys SOIL SURVEYS ENGINEERING PTY.LIMITED CONSULTING GEOTECHNICAL ENGINEERS		
DATE 24.06.2004	SITE PLAN Proposed Filling Creek Street, Hastings point N.S.W.	DRAWING NO. 204-4808 -02	A4
CHECKED AMR			