**Westbound**

| | | | | | |
|---|---|---|---|---|---|
| Operating Speed (85th percentile) | V | 110 | 110 | km/h | |
| Longintudinal Grade | $a_2$ | 1 | 1 | % | |
| SSD | | 205 | 235 | m | |
| SISD | | 296.81 | 326.85 | m | |

| **ASD - Terminating Road** | | Cars | Trucks | | |
|---|---|---|---|---|---|
| Reaction time - Rural locality | $R_T$ | 2 | 2 | sec | AGRD03 T5.2 |
| Operating Speed (85th percentile) | V | 40 | 40 | km/h | |
| Coefficient of Deceleration | d | 0.362 | 0.22 | | T3.1 |
| **Exiting Southern property** | | | | | |
| Longintudinal Grade | a | -5 | -5 | % | |
| ASD | | 42 | 59 | m | |

**MGSD**

| | | | | |
|---|---|---|---|---|
| Operating Speed (85th percentile) | V | 110 | km/h | |
| **Entering Turning left** | | | | |
| Acceptance gap | $t_a$ | 5 | sec | T2.4 worst case |
| Follow up headway | $t_f$ | 3 | sec | T2.4 worst case |
| Gap distance ($t_a$ only) | $D_a$ | 152.79 | m | |
| Gap distance ($t_a$ & $t_f$) | $D_a$ | 244.464 | m | |

| **Entering Turning right** | | | | |
|---|---|---|---|---|
| Acceptance gap | $t_a$ | 5 | sec | T2.4 worst case |
| Follow up headway | $t_f$ | 3 | sec | T2.4 worst case |
| Gap distance ($t_a$ only) | $D_a$ | 152.79 | m | |
| Gap distance ($t_a$ & $t_f$) | $D_a$ | 244.464 | m | |

**Local Government Engineering Services**

# Proposed Highway Intersection and Turning Lane Upgrade

**Gwydir Highway Glen Innes NSW**

## Geotechnical Report -Rev.1

Report No. RGS30969.1 – AB Rev.1

14 December 2016

REGIONAL
GEOTECHNICAL SOLUTIONS

Manning-Great Lakes

Port Macquarie

Coffs Harbour

RGS30969.1 – AB Rev.1

14 December 2016

Local Government Engineering Services
162 Otho Street
INVERELL NSW 2360

**Attention: Andrew Dekkers**

Dear Andrew

**RE: Proposed Highway Intersection and Turning Lane Upgrade – Gwydir Highway Glen Innes NSW**

**Geotechnical Report -Rev.1**

Regional Geotechnical Solutions Pty Ltd (RGS) has completed geotechnical investigations and assessment for the proposed intersection to be constructed on the Gwydir Highway to the west of Glen Innes NSW.

This revised report has been prepared following review of the original report by Roads and Maritime Services (RMS). RMS have requested that the following:

- Lowest measured CBR of 4% to be adopted for pavement thickness design;
- Minimum Pavement thickness of 450mm;
- Flexible granular pavement rather than bound pavement;
- Two coat seal wearing surface rather than AC;
- Interface drain between the existing and new pavements; and
- Adoption of RMS specifications.

This report presents the results of the investigations, pavement designs and general construction requirements for the proposed works.

If you have any questions regarding this project, or require any further assistance with this or any other project, please do not hesitate to contact the undersigned.

For and on behalf of

**Regional Geotechnical Solutions Pty Ltd**

**Adam Holzhauser**

Senior Geotechnical Engineer

**Regional Geotechnical Solutions Pty Ltd**
ABN 51141848820

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**Figures**



**Appendices**

# 1 INTRODUCTION

This report presents the results of geotechnical investigations and assessment undertaken by Regional Geotechnical Solutions Pty Ltd (RGS) for the proposed intersection and turning lanes to be constructed on a section of the Gwydir Highway approximately 15km to the west of Glen Innes NSW.

The new intersection and associated east and west bound turning lanes are required to enable access to a proposed new wind farm and quarry. The quarry will provide material to the wind farms being constructed in the Glen Innes area and will also be used long term by Council for other applications once the windfarms are constructed.

Initially two alternative locations were considered for the new intersection (refer to Diagram 1), with investigations undertaken at both these locations. The preferred location at the time of the investigations was Site 1, however since the investigation Site 2 has been chosen for the site of the new intersection. In this regard the results of the investigations for both sites have been included within this report for information only. The comments and recommendations provided herein are related to Site 2.

The intersection will include:

- A new road to the south of the Gwydir Highway to provide access to one of the proposed wind farms and the proposed new quarry;
- Widening of the east bound lane of the Gwydir Highway to enable the construction of a left hand turning lane onto the new access road;
- Widening of the east bound lane of the Gwydir Highway to enable the construction of a merging lane when exiting the access road west bound onto the Gwydir Highway; and
- Widening of the east bound lane off the Gwydir Highway to enable the construction of a right hand turning lane into the new access road.

**Diagram 1: Site Location**


The purpose of the geotechnical assessment is to provide the following:

- An assessment of the subsurface conditions below proposed pavements;
- An assessment of subsurface conditions below the existing highway shoulder where new turning lanes are proposed;
- An assessment of existing highway pavement profile;
- Pavement thickness designs for the new sections of pavement; and
- Recommendations on pavement construction, including subgrade preparation tying in of new and existing pavements and drainage recommendations.

## 2 FIELD WORK

Fieldwork for the assessment was undertaken on August 2016 and comprised the following:

- An initial walkover assessment of each site, involving the visual assessment of site conditions near the proposed intersection and assessment of existing pavement surface conditions.
- The excavation of test pits including:
    - Eight test pits at Site 1; and
    - Two test pits at Site 2.

- Collection of samples from the test pits for laboratory testing as detailed in Section 3.

The site walkover, test pitting and logging was undertaken by a Senior Geotechnical Engineer from RGS. Engineering logs of the test pits are presented in Appendix A. The approximate test locations are presented on Figure 1 (Site 1) and Figure 2 (Site 2).

## 3 LABORATORY TESTING

Samples collected during the fieldwork were sent to a NATA registered geotechnical testing laboratory where the following testing was undertaken.

**Site 1**

- Six Moisture content tests;
- Two Particle Size Distribution (PSD) on the existing pavement gravel;
- Two Atterberg Limits tests on the existing pavement gravel;
- Two CBRs on the existing pavement subgrade;
- Two CBRs on subgrade material below the proposed pavements.

**Site 2**

- Two CBRs on the existing pavement subgrade.

The laboratory testing was undertaken in accordance with the relevant RMS test methods. The results of the laboratory testing are presented and discussed in Section 4.3. A copy of the laboratory test results sheets is provided in Appendix B.

## 4 SITE CONDITIONS

### 4.1 Site location and Surface Conditions

The proposed works are located on the Gwydir Highway approximately 15km to the west of Glen Innes as illustrated in Diagram 1 and is situated at an elevation of approximately 1,100m. The area is characterised by gently to moderately undulating residual topography. Site 1, the primary subject of this report is located on a gently sloping north facing hill of about 2 to 3°.

The Google Earth image in Diagram 2 illustrate the site setting.

**Diagram 1: Site Location**


The Gwydir Highway runs in a general east west direction, traversing a north facing slope and rising to the west at about 1°. A row of mature poplars, approximately 10m from the road shoulder, line the northern side of the highway.

The road is formed near grade over the eastern extents transitioning into cut over the western extent to the west of the proposed intersection. A large well defined unlined table drain is located along the southern upslope side of the road, with an invert level below that of the pavement formation. The northern shoulder and verge fall to the north away from the pavement formation. The pavement is well drained.

The highway is in good condition and appears to have been upgraded sometime in the past five years or so. The pavement is sealed to approximately 0.5m outside the fog line, with the shoulders graded away from the pavement formation.

Selected site photographs are provided below.

**Plate 1: Selected Site Photographs**

1. Looking east along the Gwydir Highway alignment from the location of the proposed new access road intersection.

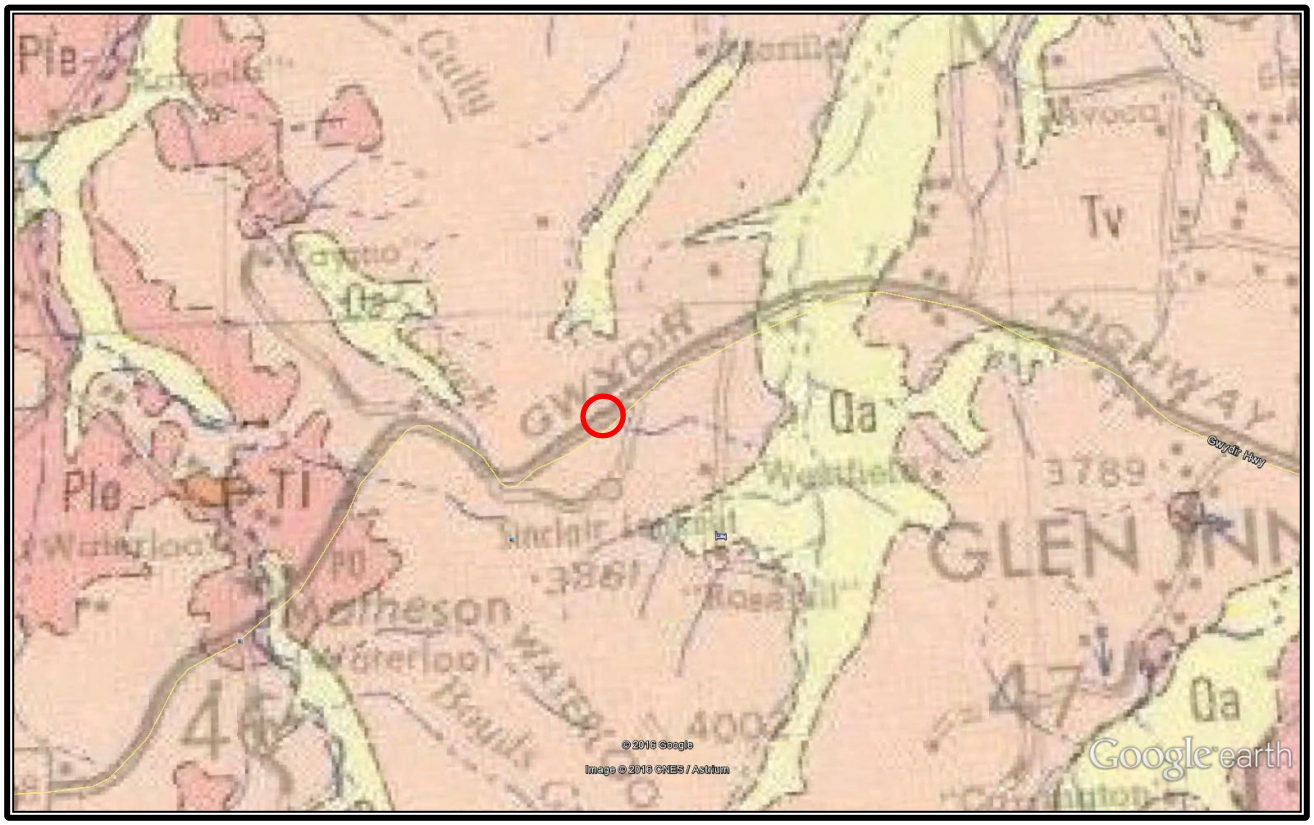
2. Looking west along the Gwydir Highway alignment.

3. Looking north across the highway. Photograph illustrates areas of minor flushing in wheel paths (shinny patches).

### 4.2 Subsurface Conditions

The 1:250,000 series geological series sheet for Grafton (SH 56-6) indicates the area is underlain by Tertiary volcanics comprising basalt and dolerites. The image below represents the Google Earth image of the site overlain by the geological series map.

**Diagram 3: Geological Series Map overlain on Google Earth Image**




Detailed descriptions of the conditions encountered at Site 1 and Site 2 are provided in the engineering logs presented in Appendix A. A summary of the subsurface conditions encountered at Site 2 is provided below.

**Site 2 – TP9 & TP10**

**Wearing Surface:** Two coat spray seal 20mm thick.

**Pavement:** Gravelly sand varying between 0.05m (TP9) and 0.08m (TP10) thick. The pavement material was heavily bound and appeared to be stabilized with a cementitious product.

**Fill Subgrade:** Gravelly clay and gravelly sand was encountered below the pavement and extended to 0.38m and 0.28m in TP9 and TP10 respectively. The material appeared to be stabilized – possibly with lime.

**Natural Subgrade:** The natural subgrade comprised residual clays, medium plasticity, very stiff to hard in TP9, while in TP10 residual sand and gravel, dense to very dense, were encountered below the fill. Silty clay, medium plasticity, hard was encountered below the sand and gravel at 0.75m.

Photographs of the test pit excavations are presented in Plate 2.

**Plate 2: Photographs of the Test Pit Excavations**

1. Test Pit 9

2. Test Pit 10

No Groundwater seepage was encountered during the excavation of the test pits.

### 4.3 Laboratory Test Results

The laboratory test results are presented in Appendix B. The following tables provide a summary of these results. The results of testing undertaken on samples recovered from Site 1 have also been include to provide a more detailed assessment of overall conditions and variation in the materials.

**Table 1: Atterberg Limits and Moisture Content Test Results**

| Sample Location | Test Pit | Depth (m) | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index | Moisture Content (%) |
|---|---|---|---|---|---|---|
| Site 1 | TP2 | 0.4 to 0.8 | - - | - - | - - | 39.2 |
| | TP3 | 0.5 to 0.75 | - - | - - | - - | 28.6 |
| | TP4 | 0.05 to 0.25 | 18 | 16 | 2 | 7.7 |
| | TP5 | 0.3 to 0.5 | - - | - - | - - | 43.9 |
| | TP7 | 0.05 to 0.25 | 19 | 17 | 2 | 10.2 |
| | TP7 | 0.6 to 0.75 | - - | - - | - - | 43.0 |

**Table 2: CBR Test Results**

| Sample Location | Test Pit | Sample Depth (m) | Material type | Natural Moisture Content (%) | Optimum Moisture Content (%) | Maximum Dry Density (t/m³) | CBR (%) |
|---|---|---|---|---|---|---|---|
| **Site 1** | TP2 | 0.4 to 0.8 | Clay (medium plasticity) | 39.2 | 31.4 | 1.43 | 4.0 |
| | TP3 | 0.5 to 0.75 | Gravelly Clay (medium plasticity) | 28.6 | 19.8 | 1.74 | 25.0 |
| | TP5 | 0.3 to 0.5 | Clay (medium plasticity) | 43.9 | 36.5 | 1.33 | 5.0 |
| | TP7 | 0.6 to 0.75 | Gravelly Clay (medium plasticity) | 43.0 | 44.1 | 1.21 | 16.0 |
| **Site 2** | TP9 | 0.5 to 0.75 | Clay (medium plasticity) | 31.4 | 26.3 | 1.58 | 6 |
| | TP10 | 0.75 to 1.0 | Clay (medium plasticity) | 28.8 | 27.9 | 1.52 | 13 |

**Table 4: Summary of Particle Size Distribution Testing**

| Sieve Size | % Passing | |
|---|---|---|
| | TP4<br>0.05 – 0.25 | TP7<br>0.05 – 0.25 |
| 75mm | 100 | 100 |
| 53mm | 89 | 100 |
| 37.5mm | 85 | 100 |
| 26.5mm | 79 | 99 |
| 19mm | 75 | 95 |
| 13.2mm | 71 | 89 |
| 9.5mm | 66 | 85 |
| 6.7mm | 61 | 81 |
| 4.75mm | 56 | 76 |
| 2.36mm | 49 | 69 |
| 425µm | 27 | 41 |
| 75µm | 14 | 21 |

## 5 GENERAL SITE CONDITIONS AND GEOTECHNICAL CONSIDERATIONS

The proposed intersection is located within residual topography on a north facing slope that is generally well drained. The existing Gwydir Highway appears to have been upgrade in the past 5 years or so and is in good condition with only minor flushing observed within the wheel paths of both the east and west bound lanes. The investigations indicate that the existing pavement is heavily bound and comprises a 20mm two coat seal over a thin 0.05 to 0.08mm thick cement stabilized gravely sand, over possibly lime stabilized gravelly clay and gravelly sand to 0.38m and 0.28m in TP9 and TP10 respectively. The pavement subgrade includes residual clay, sand and gravel soils.

The new wind farm and quarry access road off the Gwydir Highway will be formed near to existing grade.

The proposed intersection upgrade works which will include widening to accommodate new turning and merging lanes.

While the new intersection will not result in an increase to existing general traffic use of the Gwydir Highway, it will result in a short term increase during the construction phase of the windfarm and an increase in heavy vehicle use both during and post construction phase. The increase in heavy vehicle use will be as a result of the long term quarry operations.

# 6 PAVEMENT DESIGN

## 6.1 Design Traffic

The pavement designs presented herein were prepared on the basis of Equivalent Standard Axles (ESA) assessed on the basis of the traffic impact assessment undertaken for the project and data provided by Glen Innes Council.

The traffic impact assessment for the project was undertaken by Bitzois Consulting (Project Number P2249 dated 2 February 2016). The report indicates the following:

- An average annual daily traffic of 1272 vehicles per day;
- 50:50 traffic spilt east west bound;
- 1.5% annual traffic growth;
- Percentage of heavy vehicles has not been provided in the report, therefore for the purpose of the assessment presented herein a value of 12% has been adopted.

The report also indicates that traffic impact will be "minor" during the operational phase of the windfarm. It is anticipated that infrequent access to the windfarm will be required during the operational phase for maintenance purposes.

The most significant increase in traffic will be during the construction phase of the wind farm project, which is understood to be 36 weeks. Peak traffic volumes during the construction phase are expected to be approximately 210 vehicle trips per day with the peak expected to occur over a 15-week period. Light vehicle movement during this period is expected to be in to the site in the morning and leaving in the afternoon, while heavy vehicle movement will be spread evenly throughout the 10 hour working day. At this point the majority of the construction traffic is expected to travel to and from the site from Glen Innes.

Glen Innes council has indicated that the Quarry will result in 120 truck movements per day, comprising 50:50 distribution in and out. The trucks will comprise ridged body trucks with dog trailer.

On the basis of the above the following design traffic loads have been calculated:

Gwydir Highway Intersection – $4.4 \times 10^6$ ESAs

New Access Road – $1.2 \times 10^6$ ESAs

The pavement thickness design presented herein is for a 40 year design life.

## 6.2 Subgrade California Bearing Ratio Testing

Two CBR tests were undertaken on the expected subgrade materials, which comprise residual silty clays of medium plasticity. The testing indicates CBR values of 6% and 13% for TP9 and TP10 respectively. Based on this testing a CBR value of 6% is considered appropriate for the pavement thickness design, howvere RMS have requested that a design CBR of 4% is adopted.

## 6.3 Evaluation of Existing Gwydir Highway Pavement

The existing pavement profile varies between 0.28m and 0.38m and appears to comprise a heavily bound upper profile, 0.05 to 0.08m thick, of cement stabilized gravelly sand over lime stabilized gravelly clay and gravelly sand.

Visual assessment of the pavement surface indicates it is generally in good condition, possibly having been upgraded in the past 5 years or so.

The existing pavement appears to be performing well but does not appear to comply with current design requirements.

### 6.4 Summary of Pavement Options and Preferred Pavement Type

There are a number of possible pavement options that could be adopted for the proposed works. The existing pavement is a heavily bound pavement and in this regard our preference is to adopt a similar bound pavement for the proposed works. A bound pavement is also recommended for the initial section (approximately 20m) of the new access road to tie in with the Gwydir Highway Works. The pavement sections in the vicinity of the intersection will be subjected to high braking and acceleration loads and high screwing loads from turning vehicles, particularly heavily loaded trucks.

The existing pavement comprises a 2 coat seal, however an AC wearing surface at least 30mm thick would provide a more durable surface to a spray seal at the intersection where high braking, acceleration and in particular screwing loads will be generated.

A bound pavement thickness design was undertaken using CIRCLY based on the pavement design data presented and discussed above.

RMS have requested that an unbound flexible pavement with two coast seal wearing surface is adopted for the upgrade works, therefore the design presented in presented in Appendix C has been undertaken on this basis.

## 7 PAVEMENT CONSTRUCTION

### 7.1 Construction Methodologies

The existing highway will need to be widened to accommodate the turning and merge lanes and exit to the access road. There is the potential for differential movements to occur between the existing and newly constructed sections of pavement possibly resulting in longitudinal cracking or deformation near the interface. Consideration will need to be given to this aspect of construction to appropriately tie the newly constructed sections with existing. The adoption of a similar pavement profile (bound payment) should help towards alleviating this potential issue.

Formation widening should be constructed as follows:

- Remove all vegetation and relocate and existing services as required.
- Strip existing topsoil and unsuitable materials from the existing verge and table drains for later reuse in landscaping areas.
- Following excavation to an appropriate foundation level, proof roll to identify any wet, excessively deflecting or heaving material. Any such areas should be over-excavated down to a stiff foundation and backfilled with a clean select material. Some soft, unsuitable areas may be encountered within the table drains where water ponds.
- Excavate level benches at least 500mm wide and no greater than 300mm high into the side of the slopes to tie in the new formation with the existing.
- Place approved fill in layers not exceeding 300mm loose thickness. Compact to a minimum dry density ratio of not less than 98% Standard Compaction. The upper 300mm of the fill layer directly below the pavement profile should be compacted to 100% Standard

Compaction. Fill should be placed and maintained at ±2% of standard OMC. The use of granular fill is preferred. Appropriate fill could include granular material or approved residual soils sourced from other areas of the site. Where clay fill is used more stringent earthworks control will be required. Clay fill should not be used within 0.5m of the bottom of the pavement (i.e. granular fill should be used over the upper 0.5m below the pavement).

- The road formation should be constructed with sufficient width to accommodate appropriate shoulders and to enable compaction near the edge of the formation.
- Construct pavements as outlined below and as per design requirements (Appendix C).

The following construction methodology is recommended for the pavements:

- Saw cut existing pavement at a location that will lie outside the wheel path of the reconstructed pavement.
- Construct appropriate bench in existing pavement profile to eliminate continuous vertical joints at the interface of the existing and new sections of the pavement.
- Construct pavement interface drain as per design drawings.
- Place new pavement over prepared subgrade as per design requirements as specific in pavement thickness design sheet presented in Appendix C.
- Place two coat seal.

Pavement construction, including sealing, should extend well beyond the outer wheel path of the pavement to provide lateral restraint to the outer wheel path and to assist in preventing ingress of moisture through the road shoulder.

### 7.2 Fill Materials

Materials recommended for use as engineered fill include good quality well graded granular materials (such as crushed or ripped rock), free of deleterious materials and having a maximum particle size of 100mm. Site won soils can be reused where appropriate as a general fill material including within the lower fill layers of the drainage channels.

The use of clay soils will require more rigorous earthwork monitoring and compaction control, more time drying out the soils, increased potential for delays due to inclement weather and as such greater eventual cost to earthworks compared with weathered rock materials.

Select material should meet the requirements of RMS Specification 3071 and be placed in accordance with RMS specification R44. Pavement materials should comprise DGB20 as per RMS Specification 3051 placed in accordance with RMS specification R71.

## 8 PAVEMENT DRAINAGE

The provision of adequate surface and subsurface drainage is critical to long term pavement performance, and should be considered in the design and construction of all pavements. As a minimum suitable cross-falls should be maintained both during and following construction. Table drains and / or kerb and guttering should be constructed along both sides of the pavements where appropriate. Invert levels of table drains should be constructed below the level of the pavement

profile. All drains should be constructed in a manner to promote rapid drainage and discharge away from the pavement.

Table drains are likely to be feasible but where it is not possible to construct table drains or they are not the preferred option, alternatives such as subsoil drains can be used. Subsoil drains should be constructed along the upslope side of the Gwydir Highway pavement and on both sides of the access road, which is oriented down slope. The invert level of the drains should be similar to the thickness of the pavement profile. Subsoil drains should discharge to an appropriate storm water drain down slope of the pavement formation.

It is recommended that the pavement and pavement seal extend at least 0.5m onto the shoulder beyond the outer edge of the traffic lane to provide lateral confinement and reduce potential moisture ingress at the edge of the pavement. The pavement verge should be graded away from the centreline of the pavement and towards the pavement drains.

## 9 LIMITATIONS

The findings presented in the report and used as the basis for recommendations presented herein were obtained using normal, industry accepted geotechnical and pavement design practises and standards. To our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points. If site conditions encountered during construction vary significantly from those discussed in this report, Regional Geotechnical Solutions Pty Ltd should be contacted for further advice.

This report alone should not be used by contractors as the basis for preparation of tender documents or project estimates. Contractors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

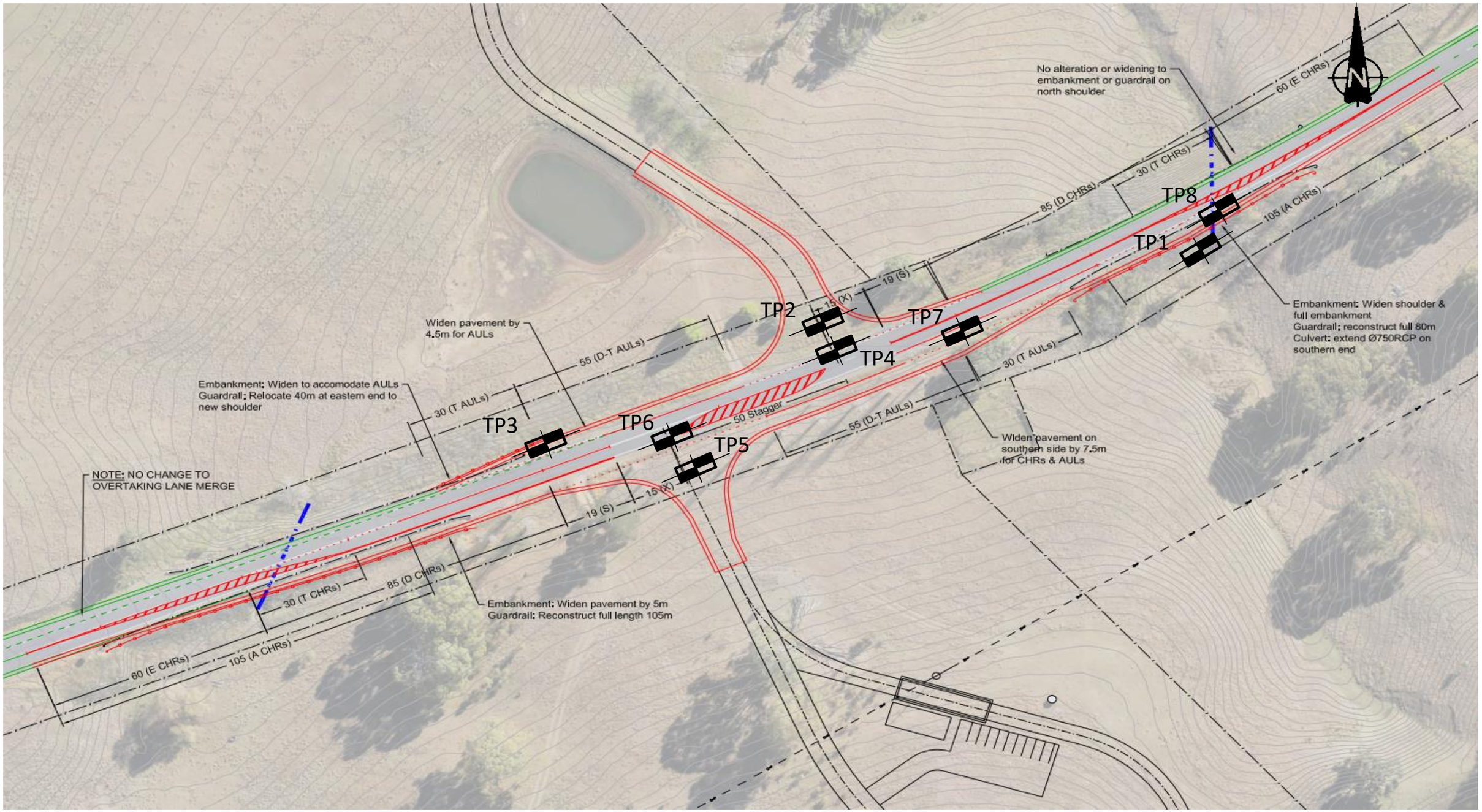
For and on behalf of

**Regional Geotechnical Solutions Pty Ltd**

**Adam Holzhauser**

Senior Geotechnical Engineer

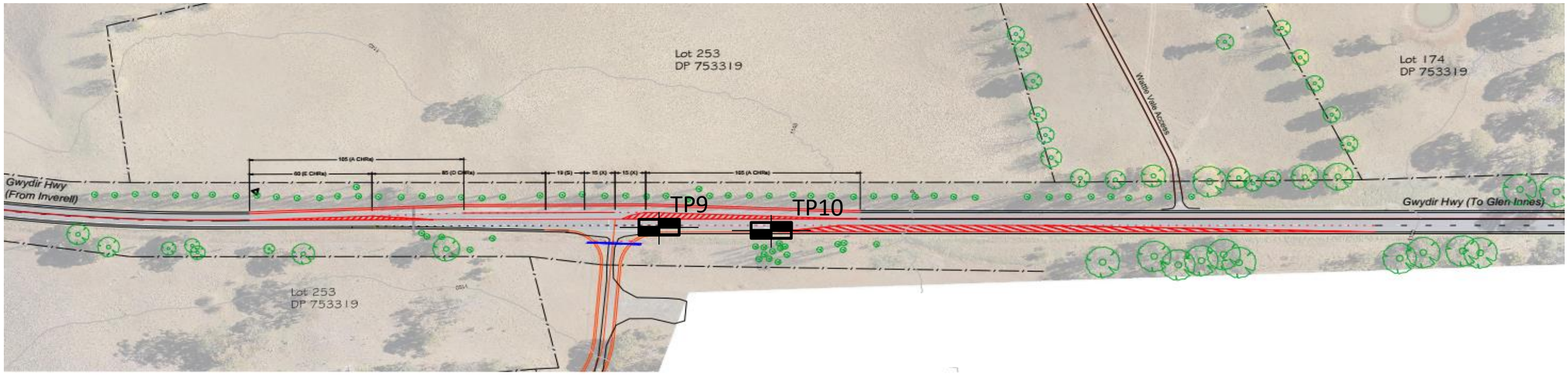
# Figures




**NOT TO SCALE**

| | | | |
|---|---|---|---|
| **Client** | Local Government Engineering Services | Job No. | RGS30969.1 |
| **Project:** | Proposed Highway Intersection and Turning Lane Upgrade<br>Gwydir Highway Glen Innes | Drawn By: | Adam Holzhauser |
| | | Date: | 20-Sep-16 |
| **Title:** | Test Location Plan - Site 1 | Drawing No. | **FIGURE 1** |

REGIONAL GEOTECHNICAL SOLUTIONS




**NOT TO SCALE**

| | | | | |
|---|---|---|---|---|
| REGIONAL GEOTECHNICAL SOLUTIONS | **Client** | Local Government Engineering Services | Job No. | RGS30969.1 |
| | **Project:** | Proposed Highway Intersection and Turning Lane Upgrade<br>Gwydir Highway Glen Innes | Drawn By: | Adam Holzhauser |
| | | | Date: | 20-Sep-16 |
| | **Title:** | Test Location Plan - Site 2 | Drawing No. | **FIGURE 2** |

# Appendix A

## Results of Field Investigations

# ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

| | | | |
|---|---|---|---|
| **CLIENT:** | Local Government Engineering Services | **TEST PIT NO:** | **TP1** |
| **PROJECT NAME:** | Proposed Highway Intersection | **PAGE:** | 1 of 1 |
| **SITE LOCATION:** | | **JOB NO:** | RGS30969.1 |
| **TEST LOCATION:** | Refer to Figure 1 | **LOGGED BY:** | AH |
| | | **DATE:** | 3/8/16 |

| | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE:** | Shovel/Hand Auger | | | **EASTING:** | **SURFACE RL:** |
| **TEST PIT LENGTH:** | 0.5 m | **WIDTH:** | 0.5 m | **NORTHING:** | **DATUM:** AHD |

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| Shovel | ▶ | | | | | | **TOPSOIL:** Gravelly SILT, low plasticity, dark grey brown, gravel is fine to coarse subangular basalt with rootlets | M > $w_P$ | | | | TOPSOIL: Weed cover<br>Seepage through Topsoil |
| | | | | | | | 0.15m | | | | | |
| | | | | | | CL | **Silty CLAY:** Medium plasticity, dark grey, brown with a trace of fine to coarse basalt gravel | M > $w_P$ | F | | | RESIDUAL |
| | | | | 0.5 | | | 0.50m | | | | | |
| HA | | | | | | CH | **Silty CLAY:** Medium to high plasticity, dark grey, brown | M > $w_P$ | F - St | | | |
| | | | | | | | | | St | | | |
| | | | | 1.0 | | | | | | | | |
| | | | | | | | 1.15m | | | | | |
| | | | | | | | Hole Terminated at 1.15 m<br>Practical Refusal on Extremely Weathered Basalt | | | | | |
| | | | | 1.5 | | | | | | | | |

**LEGEND:**

**Water**
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**
- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

**Consistency**

| | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

**Density**

| | | |
|---|---|---|
| V | Very Loose | Density Index <15% |
| L | Loose | Density Index 15 - 35% |
| MD | Medium Dense | Density Index 35 - 65% |
| D | Dense | Density Index 65 - 85% |
| VD | Very Dense | Density Index 85 - 100% |

**Moisture Condition**

| | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

# ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

**TEST PIT NO:** TP2

**CLIENT:** Local Government Engineering Services | **PAGE:** 1 of 1

**PROJECT NAME:** Proposed Highway Intersection | **JOB NO:** RGS30969.1

**SITE LOCATION:** | **LOGGED BY:** AH

**TEST LOCATION:** Refer to Figure 1 | **DATE:** 3/8/16

**EQUIPMENT TYPE:** 7.5T Excavator | **EASTING:** | **SURFACE RL:**

**TEST PIT LENGTH:** 2.4 m | **WIDTH:** 0.5 m | **NORTHING:** | **DATUM:** AHD

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| E | Not Encountered | | | | | | **TOPSOIL/FILL:** Clayey SILT, low plasticity, grey, brown with some fine to coarse gravel | $M > w_P$ | | | | TOPSOIL/FILL: Weed Cover |
| | | | | | | | 0.20m | | | | | |
| | | | | | | | **FILL:** Sandy GRAVEL, medium to coarse grained subangular, grey | $M > w_P$ | | | | FILL |
| | | | | | | | 0.30m | | | | | |
| | | | | | | CL | **Silty CLAY:** Medium plasticity, orange, brown with a trace of medium to coarse sand | $M > w_P$ | St | | | RESIDUAL |
| | | 0.40m | | | | | | | | HP | 100 | |
| | | | | 0.5 | | | | | | | | |
| | | DB | | | | | | | | | | |
| | | | | | | | | | VSt | | | |
| | | 0.80m | | | | | | | | HP | 250 | |
| | | | | 1.0 | | | | | | | | |
| | | | | | | | 1.00m | | | | | |
| | | | | | | CL | **Silty CLAY:** Medium plasticity, pale grey, mottled orange brown and dark grey, with extremely to highly weathered gravel | $M < w_P$ | H | | | EXTREMELY WEATHERED BASALT |
| | | | | | | | 1.25m | | | | | |
| | | | | | | | Hole Terminated at 1.25 m | | | | | |
| | | | | 1.5 | | | | | | | | |

**LEGEND:**

**Water**
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**
- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

**Consistency**

| | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

**Moisture Condition**

| | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

**Density**

| | | |
|---|---|---|
| V | Very Loose | Density Index <15% |
| L | Loose | Density Index 15 - 35% |
| MD | Medium Dense | Density Index 35 - 65% |
| D | Dense | Density Index 65 - 85% |
| VD | Very Dense | Density Index 85 - 100% |

# ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

| | | | |
|---|---|---|---|
| **CLIENT:** | Local Government Engineering Services | **TEST PIT NO:** | **TP3** |
| **PROJECT NAME:** | Proposed Highway Intersection | **PAGE:** | 1 of 1 |
| **SITE LOCATION:** | | **JOB NO:** | RGS30969.1 |
| **TEST LOCATION:** | Refer to Figure 1 | **LOGGED BY:** | AH |
| | | **DATE:** | 3/8/16 |

**EQUIPMENT TYPE:** 7.5T Excavator **EASTING:** **SURFACE RL:**

**TEST PIT LENGTH:** 1.4 m **WIDTH:** 0.5 m **NORTHING:** **DATUM:** AHD

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| E | Not Encountered | 0.10m | | | | | **SPRAY SEAL:** 15-20mm | | | | | WEARING SURFACE |
| | | DB 0.25m | | | | | 0.15m **FILL:** Sandy GRAVEL, fine to coarse grained angular basalt, grey, sand is fine to coarse grained with gravel up to approx 50-60mm | M | VD | | | PAVEMENT GRAVEL |
| | | 0.50m DS 0.75m | | 0.5 | | | 0.35m **FILL:** Gravelly CLAY, medium plasticity, mottled brown and orange brown, gravel is medium to coarse angular basalt and ironstone | M | | HP | 600 | FILL SUBGRADE |
| | | | | 1.0 | | CL | 0.75m **Gravelly CLAY:** Medium plasticity, brown, mottled orange brown, gravel is fine to coarse subangular basalt and ironstone | M > $w_P$ | St - VSt | HP | 450 | RESIDUAL |
| | | | | 1.5 | | | 1.10m Hole Terminated at 1.10 m | | | | | |

**LEGEND:**

**Water**
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**
- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

| Consistency | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

| Density | | |
|---|---|---|
| V | Very Loose | Density Index <15% |
| L | Loose | Density Index 15 - 35% |
| MD | Medium Dense | Density Index 35 - 65% |
| D | Dense | Density Index 65 - 85% |
| VD | Very Dense | Density Index 85 - 100% |

| Moisture Condition | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

# ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

**CLIENT:** Local Government Engineering Services
**PROJECT NAME:** Proposed Highway Intersection
**SITE LOCATION:**
**TEST LOCATION:** Refer to Figure 1

**TEST PIT NO:** TP4
**PAGE:** 1 of 1
**JOB NO:** RGS30969.1
**LOGGED BY:** AH
**DATE:** 3/8/16

**EQUIPMENT TYPE:** 7.5T Excavator
**TEST PIT LENGTH:** 1.8 m **WIDTH:** 0.5 m
**EASTING:**
**NORTHING:**
**SURFACE RL:**
**DATUM:** AHD

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| E | Not Encountered | 0.05m | | | | | 0.05m **SPRAY SEAL:** 30mm | | | | | WEARING SURFACE |
| | | DB 0.25m | | | | | **FILL:** Sandy GRAVEL, fine to coarse grained angular basalt, grey with a trace to some cobble | M | VD | | | PAVEMENT GRAVEL |
| | | | | 0.5 | | | 0.40m **FILL:** Sandy CLAY, medium plasticity, brown and orange brown, sand is fine to coarse with a trace of fine to medium gravel | M > $w_P$ | | | | FILL SUBGRADE |
| | | 0.60m DB 0.80m | | 1.0 | | CH | 0.55m **Silty CLAY:** Medium to high plasticity, brown, orange brown and grey brown | M > $w_P$ | H | HP | 500 | RESIDUAL |
| | | | | 1.5 | | | 1.10m Hole Terminated at 1.10 m | | | | | |

**LEGEND:**

**Water**
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**
- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

**Consistency**

| | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

**Density**

| | | |
|---|---|---|
| V | Very Loose | Density Index <15% |
| L | Loose | Density Index 15 - 35% |
| MD | Medium Dense | Density Index 35 - 65% |
| D | Dense | Density Index 65 - 85% |
| VD | Very Dense | Density Index 85 - 100% |

**Moisture Condition**

| | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

# ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

| | | | |
|---|---|---|---|
| **CLIENT:** | Local Government Engineering Services | **TEST PIT NO:** | **TP5** |
| **PROJECT NAME:** | Proposed Highway Intersection | **PAGE:** | 1 of 1 |
| **SITE LOCATION:** | | **JOB NO:** | RGS30969.1 |
| **TEST LOCATION:** | Refer to Figure 1 | **LOGGED BY:** | AH |
| | | **DATE:** | 3/8/16 |

**EQUIPMENT TYPE:** 7.5T Excavator **EASTING:** **SURFACE RL:**

**TEST PIT LENGTH:** 2.5 m **WIDTH:** 0.5 m **NORTHING:** **DATUM:** AHD

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| E | | | | | | | **TOPSOIL:** Clayey SILT, low plasticity, dark brown | $M > w_P$ | | | | TOPSOIL:GRASS |
| | | | | | | | 0.15m | | | | | |
| | | | | | | CL | **Silty CLAY:** Medium plasticity, orange brown with a trace of coarse sand | $M > w_P$ | St - VSt | HP | 250 | RESIDUAL |
| | | 0.25m | | | | | | | | | | |
| | | DB | | | | | | | | | | |
| | | 0.50m | | 0.5 | | | | | | | | |
| | | | | | | | | | | HP | 300 | |
| | ▶ | | | | | CL | **Silty CLAY:** Medium plasticity, grey brown with some coarse sand and fine basalt gravel | $M > w_P$ | VSt | HP | 350 | Grading into EXTREMELY WEATHERED BASALT |
| | | | | | | | 0.95m | | | | | |
| | | | | 1.0 | | | **BASALT:** Fine grained, grey and dark grey, highly fractured | | | | | HIGHLY WEATHERED BASALT LOW STRENGTH Excavates as a medium to coarse angular gravel with cobbles |
| | | | | 1.5 | | | | | | | | |
| | | | | | | | 1.80m | | | | | |
| | | | | | | | Hole Terminated at 1.80 m<br>Refusal on Highly to Moderately Weathered low to medium strength basalt | | | | | |

**LEGEND:**

**Water**

- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**

- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

| Consistency | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

| Density | | |
|---|---|---|
| V | Very Loose | Density Index <15% |
| L | Loose | Density Index 15 - 35% |
| MD | Medium Dense | Density Index 35 - 65% |
| D | Dense | Density Index 65 - 85% |
| VD | Very Dense | Density Index 85 - 100% |

| Moisture Condition | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

# ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

| | | | |
|---|---|---|---|
| **CLIENT:** | Local Government Engineering Services | **TEST PIT NO:** | **TP6** |
| **PROJECT NAME:** | Proposed Highway Intersection | **PAGE:** | 1 of 1 |
| **SITE LOCATION:** | | **JOB NO:** | RGS30969.1 |
| **TEST LOCATION:** | Refer to Figure 1 | **LOGGED BY:** | AH |
| | | **DATE:** | 3/8/16 |

| | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE:** | 7.5T Excavator | | **EASTING:** | **SURFACE RL:** | |
| **TEST PIT LENGTH:** | 1.8 m | **WIDTH:** | 0.5 m | **NORTHING:** | **DATUM:** AHD |

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| E | Not Encountered | | | | | | 0.05m **SPRAY SEAL:** 30-35mm | | | | | WEARING SURFACE |
| | | | | | | | **FILL:** Sandy GRAVEL, fine to coarse grained, grey brown, sand is fine to coarse grained | M | VD | | | PAVEMENT GARVEL |
| | | | | | | | 0.30m **FILL:** Gravelly CLAY, low to medium plasticity, dark grey with sand | M > $w_P$ | | HP | 600 | FILL SUBGRADE |
| | | 0.50m | | 0.5 | | | 0.50m | | | | | |
| | | DB | | | | CH | **Silty CLAY:** Medium to high plasticity, dark grey brown with fine to coarse sand and fine gravel | M > $w_P$ | VSt - H | HP | 450 | RESIDUAL |
| | | 0.70m | | | | | 0.75m | | | | | |
| | | | | 1.0 | | GC | **Clayey GRAVEL:** Medium to coarse grained angular basalt, clay is medium ti high plasticity, mottled grey brown and orange brown | M | VD | | | EXTREMELY WEATHERED BASALT |
| | | | | | | | 1.05m | | | | | |
| | | | | | | | Hole Terminated at 1.05 m | | | | | |
| | | | | 1.5 | | | | | | | | |

**LEGEND:**

**Water**
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**
- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

**Consistency**

| | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

**Density**

| | | |
|---|---|---|
| V | Very Loose | Density Index <15% |
| L | Loose | Density Index 15 - 35% |
| MD | Medium Dense | Density Index 35 - 65% |
| D | Dense | Density Index 65 - 85% |
| VD | Very Dense | Density Index 85 - 100% |

**Moisture Condition**

| | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

# ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

| | | | |
|---|---|---|---|
| **CLIENT:** | Local Government Engineering Services | **TEST PIT NO:** | **TP7** |
| **PROJECT NAME:** | Proposed Highway Intersection | **PAGE:** | 1 of 1 |
| **SITE LOCATION:** | | **JOB NO:** | RGS30969.1 |
| **TEST LOCATION:** | Refer to Figure 1 | **LOGGED BY:** | AH |
| | | **DATE:** | 3/8/16 |

**EQUIPMENT TYPE:** 7.5T Excavator **EASTING:** **SURFACE RL:**

**TEST PIT LENGTH:** 1.5 m **WIDTH:** 0.5 m **NORTHING:** **DATUM:** AHD

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| E | Not Encountered | | | | | | 0.04m **SPRAY SEAL:** 35mm | | | | | WEARING SURFACE |
| | | DB 0.25m | | | | | **FILL:** Sandy GRAVEL, fine to coarse grained angular basalt, grey, sand is fine to coarse grained | M | VD | | | PAVEMENT GRAVEL |
| | | | | | | | 0.30m **FILL:** Clayey SAND, fine to coarse grained, orange brown and grey brown | M | VD | | | FILL SUBGRADE |
| | | 0.60m | | 0.5 | | | 0.58m | | | | | |
| | | DS 0.75m | | | | GC | **Gravelly CLAY:** Medium plasticity, orange brown, sand is medium to coarse subangular basalt | M < $w_P$ | H | | | RESIDUAL/EXTREMELY WEATHERED BASALT |
| | | | | | | GC | 0.85m **Clayey GRAVEL:** Medium to coarse grained angular basalt, pale grey and orange brown | M | VD | | | EXTREMELY WEATHERED/HIGHLY WEATHERED BASALT |
| | | | | 1.0 | | | 1.05m | | | | | |
| | | | | | | | Hole Terminated at 1.05 m | | | | | |
| | | | | 1.5 | | | | | | | | |

**LEGEND:**

**Water**
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**
- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

| Consistency | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

| Moisture Condition | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

| Density | | |
|---|---|---|
| V | Very Loose | Density Index <15% |
| L | Loose | Density Index 15 - 35% |
| MD | Medium Dense | Density Index 35 - 65% |
| D | Dense | Density Index 65 - 85% |
| VD | Very Dense | Density Index 85 - 100% |

# ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

**CLIENT:** Local Government Engineering Services
**PROJECT NAME:** Proposed Highway Intersection
**SITE LOCATION:**
**TEST LOCATION:** Refer to Figure 1

**TEST PIT NO:** TP8
**PAGE:** 1 of 1
**JOB NO:** RGS30969.1
**LOGGED BY:** AH
**DATE:** 3/8/16

**EQUIPMENT TYPE:** 7.5T Excavator
**TEST PIT LENGTH:** 1.1 m **WIDTH:** 0.5 m
**EASTING:**
**NORTHING:**
**SURFACE RL:**
**DATUM:** AHD

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| E | Not Encountered | | | | | | 0.03m **SPRAY SEAL:** 30mm | | | | | WEARING SURFACE |
| | | | | | | | **FILL:** Gravelly SAND, medium to coarse grained, grey brown, gravel is fine to coarse angular | M | VD | | | PAVEMENT GRAVEL |
| | | | | | | | 0.30m **FILL:** Gravelly SAND, fine to coarse grained, grey brown, gravel is medium to coarse angular with cobbles and small boulders up to 300mm diameter | M | MD - D | | | FILL SUBGRADE |
| | | 0.40m | | | | | | | | | | |
| | | DB | | 0.5 | | | | | | | | |
| | | 0.75m | | | | | 0.75m Hole Terminated at 0.75 m | | | | | |
| | | | | 1.0 | | | | | | | | |
| | | | | 1.5 | | | | | | | | |

**LEGEND:**

**Water**
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**
- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

| Consistency | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

| Density | | |
|---|---|---|
| V | Very Loose | Density Index <15% |
| L | Loose | Density Index 15 - 35% |
| MD | Medium Dense | Density Index 35 - 65% |
| D | Dense | Density Index 65 - 85% |
| VD | Very Dense | Density Index 85 - 100% |

| Moisture Condition | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

# ENGINEERING LOG - TEST PIT

**TEST PIT NO:** TP9

**CLIENT:** Local Government Engineering Services | **PAGE:** 1 of 1

**PROJECT NAME:** Proposed Highway Intersection | **JOB NO:** RGS30969.1

**SITE LOCATION:** | **LOGGED BY:** AH

**TEST LOCATION:** Refer to Figure 1 | **DATE:** 3/8/16

**EQUIPMENT TYPE:** 7.5T Excavator | **EASTING:** | **SURFACE RL:**

**TEST PIT LENGTH:** 1.2 m | **WIDTH:** 0.5 m | **NORTHING:** | **DATUM:** AHD

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | Not Encountered | | | | | | 0.02m **SPRAY SEAL:** 20mm | | | | | WEARING SURFACE |
| | | | | | | | 0.05m **FILL:** Gravelly SAND, fine to coarse grained, grey, gravel is fine, cement stabilized | D | VD | | | PAVEMENT GRAVEL Bound cement stabilised |
| | | | | | | | **FILL:** Gravelly CLAY, medium plasticity, brown, with fine to medium gravel, with fine to medium sand | M < $w_P$ | H | HP | 600 | FILL SUBGRADE Possibly stabilised |
| | | | | | | | 0.38m | | | | | |
| | | 0.50m | | 0.5 | | CL | **Silty CLAY:** Medium plasticity, orange brown, mottled grey brown, with fine to medium ironstone gravel | M > $w_P$ | VSt - H | HP | 350 | RESIDUAL |
| | | DB | | | | | | | | HP | 400 | |
| | | 0.75m | | | | | 0.80m | | | | | |
| | | | | | | | Hole Terminated at 0.80 m | | | | | |
| | | | | 1.0 | | | | | | | | |
| | | | | 1.5 | | | | | | | | |

**LEGEND:**

**Water**
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**
- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

| Consistency | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

| Moisture Condition | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

| Density | | |
|---|---|---|
| | V | Very Loose — Density Index <15% |
| | L | Loose — Density Index 15 - 35% |
| | MD | Medium Dense — Density Index 35 - 65% |
| | D | Dense — Density Index 65 - 85% |
| | VD | Very Dense — Density Index 85 - 100% |

# ENGINEERING LOG - TEST PIT

**TEST PIT NO:** TP10

**CLIENT:** Local Government Engineering Services
**PAGE:** 1 of 1
**PROJECT NAME:** Proposed Highway Intersection
**JOB NO:** RGS30969.1
**SITE LOCATION:**
**LOGGED BY:** AH
**TEST LOCATION:** Refer to Figure 1
**DATE:** 3/8/16

**EQUIPMENT TYPE:** 7.5T Excavator
**EASTING:**
**SURFACE RL:**
**TEST PIT LENGTH:** 1.2 m **WIDTH:** 0.5 m
**NORTHING:**
**DATUM:** AHD

| Drilling and Sampling | | | | | Material description and profile information | | | | | Field Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| E | Not Encountered | | | | | | 0.02m **SPRAY SEAL:** 20mm | D | VD | | | WEARING SURFACE |
| | | | | | | | 0.08m **FILL:** Gravelly SAND, fine to coarse grained, grey, gravel is fine to medium grained | M | VD | | | PAVEMENT GRAVEL Heavily bound cement stabilized |
| | | | | | | | **FILL:** Gravelly SAND, fine to coarse grained, grey, brown, gravel is fine to medium grained | | | | | FILL SUBGRADE Possibly lime stabilised |
| | | | | | | | 0.28m | | | | | |
| | | | | | | SP | **Clayey SAND:** fine to medium grained, brown | M | D - VD | | | RESIDUAL |
| | | | | 0.5 | | | 0.50m | | | | | |
| | | | | | | GP | **Clayey GRAVEL:** Fine to medium grained, subrounded ironstone, brown and dark grey | M | VD | | | |
| | | 0.75m | | | | | 0.75m | | | | | |
| | | DB | | | | CL | **Silty CLAY:** Medium plasticity, red brown and pale grey with fine to coarse ironstone gravel | $M > w_P$ | H | | | |
| | | 1.00m | | 1.0 | | | 1.00m | | | | | |
| | | | | | | | Hole Terminated at 1.00 m | | | | | |
| | | | | 1.5 | | | | | | | | |

**LEGEND:**

**Water**
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

**Strata Changes**
- Gradational or transitional strata
- Definitive or distict strata change

**Notes, Samples and Tests**

| | |
|---|---|
| $U_{50}$ | 50mm Diameter tube sample |
| CBR | Bulk sample for CBR testing |
| E | Environmental sample |
| ASS | Acid Sulfate Soil Sample |
| B | Bulk Sample |

**Field Tests**

| | |
|---|---|
| PID | Photoionisation detector reading (ppm) |
| DCP(x-y) | Dynamic penetrometer test (test depth interval shown) |
| HP | Hand Penetrometer test (UCS kPa) |

**Consistency**

| | | UCS (kPa) |
|---|---|---|
| VS | Very Soft | <25 |
| S | Soft | 25 - 50 |
| F | Firm | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff | 200 - 400 |
| H | Hard | >400 |
| Fb | Friable | |

**Moisture Condition**

| | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| $W_p$ | Plastic Limit |
| $W_L$ | Liquid Limit |

**Density**

| | | |
|---|---|---|
| V | Very Loose | Density Index <15% |
| L | Loose | Density Index 15 - 35% |
| MD | Medium Dense | Density Index 35 - 65% |
| D | Dense | Density Index 65 - 85% |
| VD | Very Dense | Density Index 85 - 100% |

# Appendix B

## Laboratory Test results

AC TESTING SERVICES

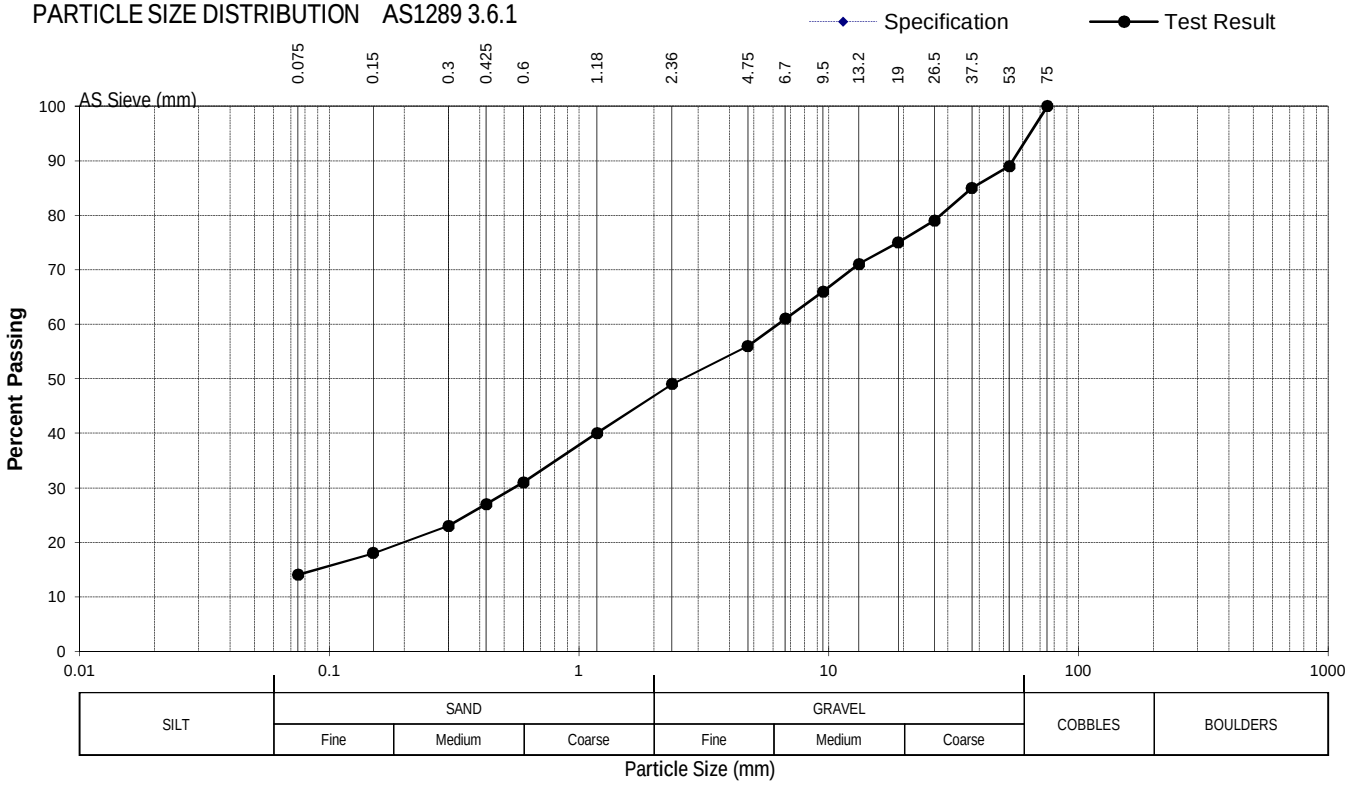
AC Testing Services:Accreditation No.19604
7 Hallidise St, Nambucca Heads, NSW 2448
ABN: 38578525858
Ph. 0438857377

Client: Regional Getoechnical Solutions
Address:1/21 Cook Drive,
Coffs Harbour, 245, NSW
Project: RGS30969-1 - LEGS
Location: Gwydir Highway Intersection - Glen Innes
Material: TP4, 0.05 - 0.25m

Report No. ACTS-665
Issue No. 1
Date Sampled: 09.08.16
Date Tested: 17.08.16
Sample No: ACTS16-08-005


# MATERIAL CLASSIFICATION REPORT

PARTICLE SIZE DISTRIBUTION AS1289 3.6.1




| Sieve Size mm | % Passing | Specification Upper | Specification Lower |
|---|---|---|---|
| 75 | 100 | | |
| 53 | 89 | | |
| 37.5 | 85 | | |
| 26.5 | 79 | | |
| 19 | 75 | | |
| 13.2 | 71 | | |
| 9.5 | 66 | | |
| 6.7 | 61 | | |
| 4.75 | 56 | | |
| 2.36 | 49 | | |
| 1.18 | 40 | | |
| 600µm | 31 | | |
| 425µm | 27 | | |
| 300µm | 23 | | |
| 150µm | 18 | | |
| 75µm | 14 | | |

| ATTERBERG LIMITS | | | Procedures |
|---|---|---|---|
| Liquid Limit | % | 18 | E |
| Plastic Limit | % | 16 | F |
| Plasticity Index | % | 2 | F |
| Linear Shrinkage | % | - | |
| Mould Length | mm | - | |
| Crumbling &/or Curling | | - | |
| Sample History | | Oven Dried ☑ Air Dried ☐ | |
| Sample Preparation | | Dry Sieved ☑ Wet Sieved ☐ | |

(A) AS 1289.3.1.1 Liquid Limit – Standard Method
(B) AS 1289.3.2.1 Plastic Limit – Standard Limit
(C) AS 1289.3.3.1 Plasticity Index – Standard Method
(D) AS 1289.34.1 Linear Shrinkage – Standard Method
(NO) Not obtainable

Or
(E) RMS T108 - Liquid Limit – Standard Method
(F) RMS T109 - Plasticity Index – Standard Method
(G) RMS T113 - Linear Shrinkage – Standard Method

**REMARKS:**

Approved Signatory:
Adam Crawford
Date: 23.08.16

NATA

Accredited for compliance with ISO/IEC 17025.

AC TESTING SERVICES

AC Testing Services:Accreditation No. 19604
7 Hallidise St, Nambucca Heads,NSW 2448
ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-665 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled: | 09.08.16 | By: | AC |
| Project: | RGS30969.1-LGES | Test Date: | 12.08.16 | Page: | 2 of 2 |
| Location: | Gwydir Highway Intersection, Glen Innes | Sample No: | ACTS16-08-005 | | |
| Material: | TP4, 0.05 - 0.25m | | | | |

# MOISTURE CONTENT REPORT

**Test Method:** **RMS T120**

**Sampling Method:** Submitted By client

**Specification:** N/A

| LOCATION | DEPTH | MOISTURE CONTENT % |
|---|---|---|
| TP4 | 0.05 - 0.25m | 7.7 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Comments:

Approved Signatory:

**Name:** **Adam Crawford**

Date of Issue 23.08.16

NATA

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Report Form No. 2 05/10/2014

AC TESTING SERVICES

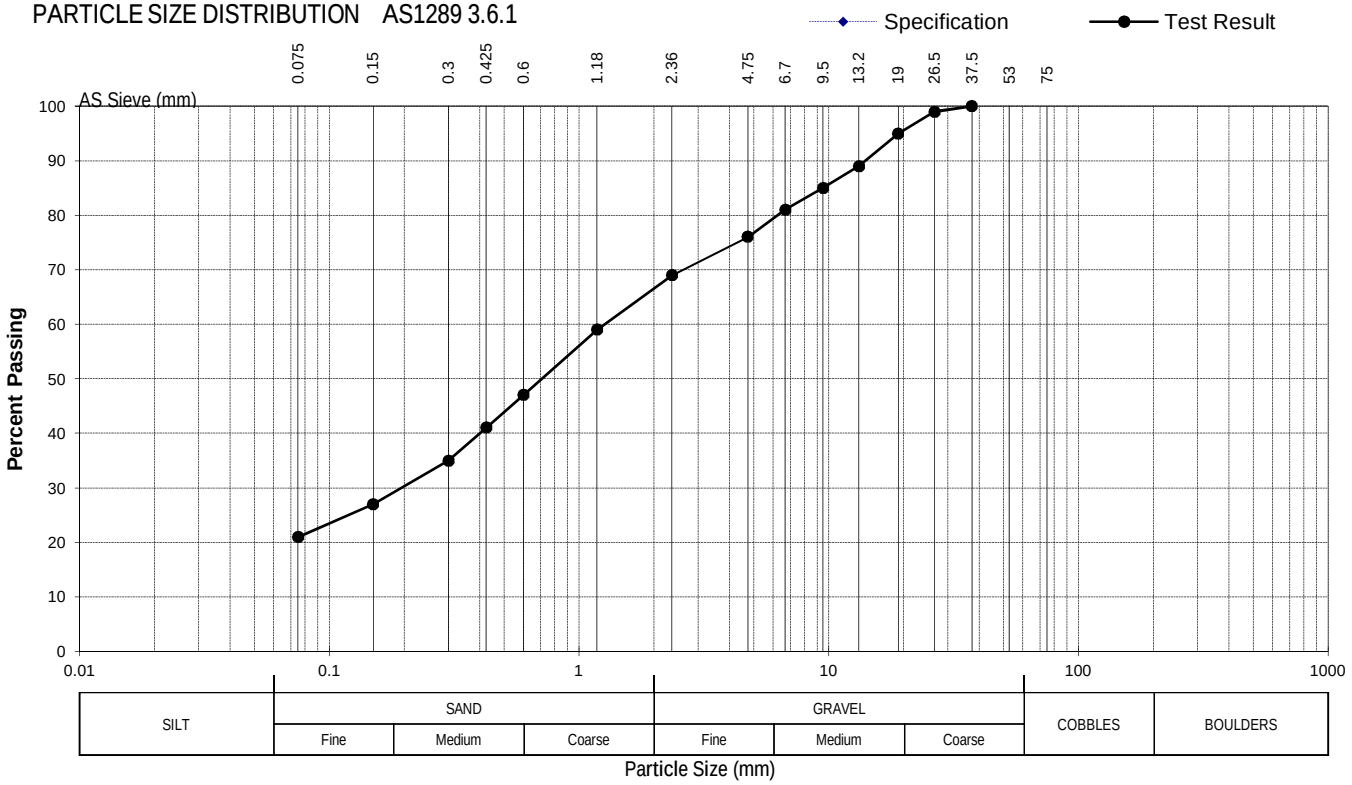
AC Testing Services:Accreditation No.19604
7 Hallidise St, Nambucca Heads, NSW 2448
ABN: 38578525858
Ph. 0438857377

Client: Regional Getoechnical Solutions
Address:1/21 Cook Drive,
Coffs Harbour, 245, NSW
Project: RGS30969-1 - LEGS
Location: Gwydir Highway Intersection - Glen Innes
Material: TP7, 0.05 - 0.25m

Report No. ACTS-666
Issue No. 1
Date Sampled: 09.08.16
Date Tested: 17.08.16
Sample No: ACTS16-08-006


# MATERIAL CLASSIFICATION REPORT

PARTICLE SIZE DISTRIBUTION AS1289 3.6.1




| Sieve Size mm | % Passing | Specification Upper | Specification Lower |
|---|---|---|---|
| 75 | | | |
| 53 | | | |
| 37.5 | 100 | | |
| 26.5 | 99 | | |
| 19 | 95 | | |
| 13.2 | 89 | | |
| 9.5 | 85 | | |
| 6.7 | 81 | | |
| 4.75 | 76 | | |
| 2.36 | 69 | | |
| 1.18 | 59 | | |
| 600µm | 47 | | |
| 425µm | 41 | | |
| 300µm | 35 | | |
| 150µm | 27 | | |
| 75µm | 21 | | |

| ATTERBERG LIMITS | | | Procedures |
|---|---|---|---|
| Liquid Limit | % | 19 | E |
| Plastic Limit | % | 17 | F |
| Plasticity Index | % | 2 | F |
| Linear Shrinkage | % | - | |
| Mould Length | mm | - | |
| Crumbling &/or Curling | | - | |
| Sample History | | Oven Dried ☑ Air Dried ☐ | |
| Sample Preparation | | Dry Sieved ☑ Wet Sieved ☐ | |

(A) AS 1289.3.1.1 Liquid Limit – Standard Method
(B) AS 1289.3.2.1 Plastic Limit – Standard Limit
(C) AS 1289.3.3.1 Plasticity Index – Standard Method
(D) AS 1289.34.1 Linear Shrinkage – Standard Method
(NO) Not obtainable

Or
(E) RMS T108 - Liquid Limit – Standard Method
(F) RMS T109 - Plasticity Index – Standard Method
(G) RMS T113 - Linear Shrinkage – Standard Method

**REMARKS:**

Approved Signatory:
Adam Crawford
Date: 23.08.16

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AC Testing Services:Accreditation No. 19604
7 Hallidise St, Nambucca Heads,NSW 2448
ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-666 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled: | 09.08.16 | By: | AC |
| Project: | RGS30969.1-LGES | Test Date: | 12.08.16 | Page: | 2 of 2 |
| Location: | Gwydir Highway Intersection, Glen Innes | Sample No: | ACTS16-08-006 | | |
| Material: | TP7, 0.05 - 0.25m | | | | |

# MOISTURE CONTENT REPORT

**Test Method:** **RMS T120**

**Sampling Method:** Submitted By client

**Specification:** N/A

| LOCATION | DEPTH | MOISTURE CONTENT % |
|---|---|---|
| TP7 | 0.05 - 0.25m | 10.2 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Comments:

Approved Signatory:

**Name:** **Adam Crawford**

Date of Issue 23.08.16

NATA

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ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-667 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled | 09.08.16 | By: | Client |
| Project: | RGS30969.1-LGES | Date Tested: | 12.08.16 | Page: | 1 of 2 |
| | Gwydir Highway Intersection | Sample No | ACTS16-08-007 | | |
| Location: | Glenn Innes | | | | |

# CALIFORNIA BEARING RATIO REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| Sample No. | | ACTS16-08-007 | | | | |
| Location | | TP 5<br>0.3 - 0.5m | | | | |
| **LABORATORY COMPACTION** | | | **LABORATORY REPORT** | | | |
| Maximum Dry Density | t/m3 | 1.33 | | | | |
| Optimum Moisture Content | % | 36.5 | | | | |
| Material Retained 19.0 mm sieve | % | 0.0 | | | | |
| Compaction Specified | % | 100.0 | | | | |
| Compaction Achieved | % | 100.0 | | | | |
| **SPECIMEN DRY DENSITY** | | | | | | |
| i At Compaction | t/m3 | 1.32 | | | | |
| ii After Soaking | t/m3 | 1.35 | | | | |
| **SPECIMEN MOISTURE CONTENT** | | | | | | |
| Field / Initial | % | 34.7 | | | | |
| i At Compaction | % | 36.6 | | | | |
| ii After Soaking | % | 38.7 | | | | |
| iii Top 30mm layer | % | 45.9 | | | | |
| iv Rest of Sample | % | 38.7 | | | | |
| **CBR TEST DETAILS** | | | | | | |
| Soaking Period | days | 10 | | | | |
| Swell | % | 2.1 | | | | |
| Surcharge mass | kg | 4.5 | | | | |
| **CALIFORNIA BEARING RATIO** | **%** | **5.0** | | | | |
| **Test Methods Used** | | A,B,C,D,J | | | | |

**Test Methods**

A. RMS T111 Dry Density/Moisture Relations of Road Materials (Standard Compaction).

C. RMS T120 Determination of Moisture Content of Road Materials (Standard Method).

D. RTA T117 Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Standard Method).

F. AS 1289 5 1.1 Dry Density/Moisture Relationship (Standard Compaction).

H. AS 1289 2.1.1 Determination of Moisture Content (Standard Method).

I. AS 1289 6.1.1 Determination of the California Bearing Ratio of A Soil -Standard Method For a Remoulded Specimens .

J. 2.5 mm result reported, NO repeat test performed.

K. Sampled according to AS 1141.3.1

NATA

Accredited for compliance with ISO/IEC 17025.

**Approved Signatory: Adam Crawford**

Date: 23.08.16

AC TESTING SERVICES

AC Testing Services:Accreditation No. 19604
7 Hallidise St, Nambucca Heads,NSW 2448
ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-667 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled: | 09.08.16 | By: | AC |
| Project: | RGS30969.1-LGES | Test Date: | 12.08.16 | Page: | 2 of 2 |
| Location: | Gwydir Highway Intersection, Glen Innes | Sample No: | ACTS16-08-007 | | |
| Material: | TP5, 0.3 - 0.5m | | | | |

# MOISTURE CONTENT REPORT

**Test Method:** **RMS T120**

**Sampling Method:** Submitted By client

**Specification:** N/A

| LOCATION | DEPTH | MOISTURE CONTENT % |
|---|---|---|
| TP5 | 0.3 - 0.5m | 43.9 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Comments:

Approved Signatory:

**Name:** **Adam Crawford**

Date of Issue 23.08.16

NATA

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ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-668 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled | 09.08.16 | By: | Client |
| Project: | RGS30969.1-LGES | Date Tested: | 12.08.16 | Page: | 1 of 2 |
| | Gwydir Highway Intersection | Sample No | ACTS16-08-008 | | |
| Location: | Glenn Innes | | | | |

# CALIFORNIA BEARING RATIO REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| Sample No. | | ACTS16-08-008 | | | | |
| Location | | TP 2<br>0.4 - 0.8m | | | | |
| **LABORATORY COMPACTION** | | | **LABORATORY REPORT** | | | |
| Maximum Dry Density | t/m3 | 1.43 | | | | |
| Optimum Moisture Content | % | 31.4 | | | | |
| Material Retained 19.0 mm sieve | % | 0.0 | | | | |
| Compaction Specified | % | 100.0 | | | | |
| Compaction Achieved | % | 100.0 | | | | |
| **SPECIMEN DRY DENSITY** | | | | | | |
| i At Compaction | t/m3 | 1.42 | | | | |
| ii After Soaking | t/m3 | 1.44 | | | | |
| **SPECIMEN MOISTURE CONTENT** | | | | | | |
| Field / Initial | % | 30.2 | | | | |
| i At Compaction | % | 31.5 | | | | |
| ii After Soaking | % | 36.4 | | | | |
| iii Top 30mm layer | % | 45.1 | | | | |
| iv Rest of Sample | % | 36.4 | | | | |
| **CBR TEST DETAILS** | | | | | | |
| Soaking Period | days | 10 | | | | |
| Swell | % | 3.3 | | | | |
| Surcharge mass | kg | 4.5 | | | | |
| **CALIFORNIA BEARING RATIO** | **%** | **4.0** | | | | |
| **Test Methods Used** | | A,B,C,D, J | | | | |

**Test Methods**

A. RMS T111 Dry Density/Moisture Relations of Road Materials (Standard Compaction).

C. RMS T120 Determination of Moisture Content of Road Materials (Standard Method).

D. RTA T117 Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Standard Method).

F. AS 1289 5 1.1 Dry Density/Moisture Relationship (Standard Compaction).

H. AS 1289 2.1.1 Determination of Moisture Content (Standard Method).

I. AS 1289 6.1.1 Determination of the California Bearing Ratio of A Soil -Standard Method For a Remoulded Specimens .

J. 2.5 mm result reported, NO repeat test performed.

K. Sampled according to AS 1141.3.1

NATA

Accredited for compliance with ISO/IEC 17025.

**Approved Signatory: Adam Crawford**

Date: 23.08.16

AC TESTING SERVICES

AC Testing Services:Accreditation No. 19604
7 Hallidise St, Nambucca Heads,NSW 2448
ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-668 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled: | 09.08.16 | By: | AC |
| Project: | RGS30969.1-LGES | Test Date: | 12.08.16 | Page: | 2 of 2 |
| Location: | Gwydir Highway Intersection, Glen Innes | Sample No: | ACTS16-08-008 | | |
| Material: | TP2, 0.4 - 0.8m | | | | |

# MOISTURE CONTENT REPORT

**Test Method:** **RMS T120**

**Sampling Method:** Submitted By client

**Specification:** N/A

| LOCATION | DEPTH | MOISTURE CONTENT % |
|---|---|---|
| TP2 | 0.4 - 0.8m | 39.2 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Comments:

Approved Signatory:

**Name:** **Adam Crawford**

Date of Issue 23.08.16

NATA

Accredited for compliance with ISO/IEC 17025.

Report Form No. 2 05/10/2014

AC TESTING SERVICES

AC Testing Services:Accreditation No.19604
7 Hallidise St, Nambucca Heads, NSW 2448
ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-669 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled | 09.08.16 | By: | Client |
| Project: | RGS30969.1-LGES | Date Tested: | 12.08.16 | Page: | 1 of 2 |
| | Gwydir Highway Intersection | Sample No | ACTS16-08-009 | | |
| Location: | Glenn Innes | | | | |

# CALIFORNIA BEARING RATIO REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| Sample No. | | ACTS16-08-009 | | | | |
| Location | | TP 3<br>0.5 - 0.75m | | | | |
| **LABORATORY COMPACTION** | | | **LABORATORY REPORT** | | | |
| Maximum Dry Density | t/m3 | 1.74 | | | | |
| Optimum Moisture Content | % | 19.8 | | | | |
| Material Retained 19.0 mm sieve | % | 0.0 | | | | |
| Compaction Specified | % | 100.0 | | | | |
| Compaction Achieved | % | 101.0 | | | | |
| **SPECIMEN DRY DENSITY** | | | | | | |
| i At Compaction | t/m3 | 1.73 | | | | |
| ii After Soaking | t/m3 | 1.75 | | | | |
| **SPECIMEN MOISTURE CONTENT** | | | | | | |
| Field / Initial | % | 18.4 | | | | |
| i At Compaction | % | 20.0 | | | | |
| ii After Soaking | % | 20.7 | | | | |
| iii Top 30mm layer | % | 21.4 | | | | |
| iv Rest of Sample | % | 20.7 | | | | |
| **CBR TEST DETAILS** | | | | | | |
| Soaking Period | days | 10 | | | | |
| Swell | % | 0.0 | | | | |
| Surcharge mass | kg | 4.5 | | | | |
| **CALIFORNIA BEARING RATIO** | **%** | **25.0** | | | | |
| **Test Methods Used** | | A,B,C,D, J | | | | |

**Test Methods**

A. RMS T111 Dry Density/Moisture Relations of Road Materials (Standard Compaction).

C. RMS T120 Determination of Moisture Content of Road Materials (Standard Method).

D. RTA T117 Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Standard Method).

F. AS 1289 5 1.1 Dry Density/Moisture Relationship (Standard Compaction).

H. AS 1289 2.1.1 Determination of Moisture Content (Standard Method).

I. AS 1289 6.1.1 Determination of the California Bearing Ratio of A Soil -Standard Method For a Remoulded Specimens .

J. 5.0mm result reported, NO repeat test performed.

K. Sampled according to AS 1141.3.1

NATA

Accredited for compliance with ISO/IEC 17025.

**Approved Signatory: Adam Crawford**

Date: 23.08.16

AC TESTING SERVICES

AC Testing Services:Accreditation No. 19604
7 Hallidise St, Nambucca Heads,NSW 2448
ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-669 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled: | 09.08.16 | By: | AC |
| Project: | RGS30969.1-LGES | Test Date: | 12.08.16 | Page: | 2 of 2 |
| Location: | Gwydir Highway Intersection, Glen Innes | Sample No: | ACTS16-08-009 | | |
| Material: | TP3, 0.5 - 0.75mm | | | | |

# MOISTURE CONTENT REPORT

**Test Method:** **RMS T120**

**Sampling Method:** Submitted By client

**Specification:** N/A

| LOCATION | DEPTH | MOISTURE CONTENT % |
|---|---|---|
| TP3 | 0.5 - 0.75m | 28.6 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Comments:

Approved Signatory:

**Name:** **Adam Crawford**

Date of Issue 23.08.16

NATA

Accredited for compliance with ISO/IEC 17025.

Report Form No. 2 05/10/2014

AC TESTING SERVICES

AC Testing Services:Accreditation No.19604
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ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-670 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled | 09.08.16 | By: | Client |
| Project: | RGS30969.1-LGES | Date Tested: | 12.08.16 | Page: | 1 of 2 |
| | Gwydir Highway Intersection | Sample No | ACTS16-08-0010 | | |
| Location: | Glenn Innes | | | | |

# CALIFORNIA BEARING RATIO REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| Sample No. | | ACTS16-08-010 | | | | |
| Location | | TP 7<br>0.6 - 0.75m | | | | |
| **LABORATORY COMPACTION** | | | **LABORATORY REPORT** | | | |
| Maximum Dry Density | t/m3 | 1.21 | | | | |
| Optimum Moisture Content | % | 44.1 | | | | |
| Material Retained 19.0 mm sieve | % | 0.0 | | | | |
| Compaction Specified | % | 100.0 | | | | |
| Compaction Achieved | % | 100.0 | | | | |
| **SPECIMEN DRY DENSITY** | | | | | | |
| i At Compaction | t/m3 | 1.21 | | | | |
| ii After Soaking | t/m3 | 1.21 | | | | |
| **SPECIMEN MOISTURE CONTENT** | | | | | | |
| Field / Initial | % | 41.2 | | | | |
| i At Compaction | % | 44.1 | | | | |
| ii After Soaking | % | 46.5 | | | | |
| iii Top 30mm layer | % | 49.7 | | | | |
| iv Rest of Sample | % | 46.5 | | | | |
| **CBR TEST DETAILS** | | | | | | |
| Soaking Period | days | 10 | | | | |
| Swell | % | 0.5 | | | | |
| Surcharge mass | kg | 4.5 | | | | |
| **CALIFORNIA BEARING RATIO** | **%** | **16.0** | | | | |
| **Test Methods Used** | | A,B,C,D, J | | | | |

**Test Methods**

A. RMS T111 Dry Density/Moisture Relations of Road Materials (Standard Compaction).

C. RMS T120 Determination of Moisture Content of Road Materials (Standard Method).

D. RTA T117 Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Standard Method).

F. AS 1289 5 1.1 Dry Density/Moisture Relationship (Standard Compaction).

H. AS 1289 2.1.1 Determination of Moisture Content (Standard Method).

I. AS 1289 6.1.1 Determination of the California Bearing Ratio of A Soil -Standard Method For a Remoulded Specimens .

J. 2.5mm result reported, NO repeat test performed.

K. Sampled according to AS 1141.3.1

NATA

Accredited for compliance with ISO/IEC 17025.

**Approved Signatory: Adam Crawford**

Date: 23.08.16

AC TESTING SERVICES

AC Testing Services:Accreditation No. 19604
7 Hallidise St, Nambucca Heads,NSW 2448
ABN: 38578525858
Ph:0438857377

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-670 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled: | 09.08.16 | By: | AC |
| Project: | RGS30969.1-LGES | Test Date: | 12.08.16 | Page: | 2 of 2 |
| Location: | Gwydir Highway Intersection, Glen Innes | Sample No: | ACTS16-08-010 | | |
| Material: | TP7, 0.6 - 0.75mm | | | | |

# MOISTURE CONTENT REPORT

**Test Method:** **RMS T120**

**Sampling Method:** Submitted By client

**Specification:** N/A

| LOCATION | DEPTH | MOISTURE CONTENT % |
|---|---|---|
| TP7 | 0.6 - 0.75m | 43.0 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Comments:

Approved Signatory:

**Name:** **Adam Crawford**

Date of Issue 23.08.16

NATA

Accredited for compliance with ISO/IEC 17025.

Report Form No. 2 05/10/2014

AC Testing Services:Accreditation No.19604
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ABN: 38578525858
Ph:0438857377

AC TESTING SERVICES

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-704 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled | 09.08.16 | By: | Client |
| Project: | RGS30969.1-LGES | Date Tested: | 08.09.16 | Page: | 1 of 1 |
| | Gwydir Highway Intersection | Sample No | ACTS16-09-049 | | |
| Location: | Glenn Innes | | | | |

# CALIFORNIA BEARING RATIO REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| Sample No. | | ACTS16-09-049 | | | | |
| Location | | TP 10<br>0.75 - 1.0m | | | | |
| **LABORATORY COMPACTION** | | | **LABORATORY REPORT** | | | |
| Maximum Dry Density | t/m3 | 1.52 | | | | |
| Optimum Moisture Content | % | 27.9 | | | | |
| Material Retained 19.0 mm sieve | % | 0.0 | | | | |
| Compaction Specified | % | 100.0 | | | | |
| Compaction Achieved | % | 101.2 | | | | |
| **SPECIMEN DRY DENSITY** | | | | | | |
| i At Compaction | t/m3 | 1.52 | | | | |
| ii After Soaking | t/m3 | 1.51 | | | | |
| **SPECIMEN MOISTURE CONTENT** | | | | | | |
| Field / Initial | % | 28.8 | | | | |
| i At Compaction | % | 27.9 | | | | |
| ii After Soaking | % | 31.2 | | | | |
| iii Top 30mm layer | % | 33.4 | | | | |
| iv Rest of Sample | % | 31.2 | | | | |
| **CBR TEST DETAILS** | | | | | | |
| Soaking Period | days | 10 | | | | |
| Swell | % | 0.9 | | | | |
| Surcharge mass | kg | 4.5 | | | | |
| **CALIFORNIA BEARING RATIO** | **%** | **13.0** | | | | |
| **Test Methods Used** | | A,B,C,D, J | | | | |

**Test Methods**

A. RMS T111 Dry Density/Moisture Relations of Road Materials (Standard Compaction).

C. RMS T120 Determination of Moisture Content of Road Materials (Standard Method).

D. RTA T117 Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Standard Method).

F. AS 1289 5 1.1 Dry Density/Moisture Relationship (Standard Compaction).

H. AS 1289 2.1.1 Determination of Moisture Content (Standard Method).

I. AS 1289 6.1.1 Determination of the California Bearing Ratio of A Soil -Standard Method For a Remoulded Specimens .

J. 2.5mm result reported, NO repeat test performed.

K. Sampled according to AS 1141.3.1

NATA

Accredited for compliance with ISO/IEC 17025.

**Approved Signatory: Adam Crawford**

Date: 19.09.16

Report Form No.3

AC Testing Services:Accreditation No.19604
7 Hallidise St, Nambucca Heads, NSW 2448
ABN: 38578525858
Ph:0438857377

AC TESTING SERVICES

| | | | | | |
|---|---|---|---|---|---|
| Client: | Regional Geotechnical Solutions | Report No. | ACTS-705 | | |
| Address: | 1/21 Cook Drive, | Issue No. | 1 | | |
| | Coffs Harbour, NSW, 2450 | Date Sampled | 09.08.16 | By: | Client |
| Project: | RGS30969.1-LGES | Date Tested: | 08.09.16 | Page: | 1 of 1 |
| | Gwydir Highway Intersection | Sample No | ACTS16-09-050 | | |
| Location: | Glenn Innes | | | | |

# CALIFORNIA BEARING RATIO REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| Sample No. | | ACTS16-09-050 | | | | |
| Location | | TP 9<br>0.5 - 0.75m | | | | |
| **LABORATORY COMPACTION** | | | **LABORATORY REPORT** | | | |
| Maximum Dry Density | t/m3 | 1.58 | | | | |
| Optimum Moisture Content | % | 26.3 | | | | |
| Material Retained 19.0 mm sieve | % | 0.0 | | | | |
| Compaction Specified | % | 100.0 | | | | |
| Compaction Achieved | % | 100.1 | | | | |
| **SPECIMEN DRY DENSITY** | | | | | | |
| i At Compaction | t/m3 | 1.58 | | | | |
| ii After Soaking | t/m3 | 1.59 | | | | |
| **SPECIMEN MOISTURE CONTENT** | | | | | | |
| Field / Initial | % | 31.4 | | | | |
| i At Compaction | % | 26.0 | | | | |
| ii After Soaking | % | 29.9 | | | | |
| iii Top 30mm layer | % | 33.1 | | | | |
| iv Rest of Sample | % | 29.9 | | | | |
| **CBR TEST DETAILS** | | | | | | |
| Soaking Period | days | 10 | | | | |
| Swell | % | 1.6 | | | | |
| Surcharge mass | kg | 4.5 | | | | |
| **CALIFORNIA BEARING RATIO** | **%** | **6.0** | | | | |
| **Test Methods Used** | | A,B,C,D, J | | | | |

**Test Methods**

A. RMS T111 Dry Density/Moisture Relations of Road Materials (Standard Compaction).

C. RMS T120 Determination of Moisture Content of Road Materials (Standard Method).

D. RTA T117 Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Standard Method).

F. AS 1289 5 1.1 Dry Density/Moisture Relationship (Standard Compaction).

H. AS 1289 2.1.1 Determination of Moisture Content (Standard Method).

I. AS 1289 6.1.1 Determination of the California Bearing Ratio of A Soil -Standard Method For a Remoulded Specimens .

J. 2.5mm result reported, NO repeat test performed.

K. Sampled according to AS 1141.3.1

NATA

Accredited for compliance with ISO/IEC 17025.

**Approved Signatory: Adam Crawford**

Date: 19.09.16

Report Form No.3

# Appendix C

## Pavement Thickness Designs

# FLEXIBLE PAVEMENT THICKNESS DESIGN

**CLIENT:** Local Government Engineering Services **Job No.:** RGS30969.1

**PROJECT:** Proposed Gwydir Highway Intersection and Turning Lane Upgrdae

**LOCATION:** Gwydir Highway West of Glen Innes

REGIONAL GEOTECHNICAL SOLUTIONS

**Date:** 14/12/2016

| | | | |
|---|---|---|---|
| **ROAD NAME:** | **Gwydir Highway** | **Refer to drawing:** | Figure 1 |
| **Chainage Interval (m):** | N/A | **Road classification ref:** | HW12 |
| **Road Classification:** | Highway (HW) | **Design Traffic:** | $4.4 \times 10^6$ |

## Subgrade Conditions

| | | | |
|---|---|---|---|
| Expected subgrade: | Natural residual clay, medium plasticity, very stiff and existing pavement profile | | |
| Adopted Subgrade CBR value: | 4% | Required subgrade compaction: | 100% Standard Compaction |
| Potential construction or performance issues: | Variable subgrade conditions comprising natural residual clay and existing highway pavement profile. Road widening will need to be approapriately benched to tie in with existing road and pavement formation profile. Some localised sections could require specific treament such as removal and replacnment of soft spots. | | |

## Pavement Design

| **Recommended Pavement Layer Thickness:** | | **Recommended Material requirements** | **Required Compaction** |
|---|---|---|---|
| Wearing course thickness (mm): | Two Coat Seal or 30mm AC | 14/7 spray seal | As per Suppliers specification |
| Base thickness (mm): | 150 | RMS specification 3051 DGB20 compliant material | 98% Modified Compaction |
| Sub-base thickness (mm): | 370 | RMS specification 3051 DGB20 compliant material | 97% Modified Compaction |
| Select thickness (mm) | as required | To RMS specification 3071, placed to RMS spec R44 | 100% Standard Copmpation |
| Total thickness (mm): | **520** | | |

## Definitions:

| | |
|---|---|
| **Design traffic loading:** | The anticipated number of equivalent standard axles (ESA), as defined by AUSTROADS, in the design lane during the design life of the pavement. |
| **Modified Compaction:** | Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.3.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent. |
| **Standard Compaction:** | Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.3.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.1.1-2003 or equivalent. |
| **Density Index:** | Minimum required Density Index AS1289 5.6.1-1998, defined as the ratio of field dry density determined by AS1289 5.3.1-2004 or equivalent to the laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent |

**Note:** Pavement design assume appropriate drainage is installed and maintained. Refer to Regional Geotechnical Solutions Report No. RGS30969.1-AB Rev.1 for recommendations regarding drainage, pavement construction and pavement tie in requiremenst.