EJE Architecture

Ballina High School Redevelopment

Burnet Street Ballina NSW

Geotechnical Report

Report No. RGS30738.1 - AB

16 February 2016

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Manning-Great Lakes

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16 February 2016

EJE Architecture
412 King Street
NEWCASTLE NSW 2300

Attention: Grant Schultz

Dear Grant

RE: Ballina High School Redevelopment – Burnet Street Ballina NSW

Geotechnical Report

Regional Geotechnical Solutions Pty Ltd (RGS) has completed geotechnical investigations and assessment at Ballina High School which comprises four adjoining properties and where it is proposed to demolish the existing buildings and redevelop the site as a new 1,200 student high school.

A Phase 1 site contamination assessment (SCA) was undertaken in conjunction with the geotechnical assessment presented herein, the results of which are presented in a separate report, RGS30738.1–AC.

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

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1 INTRODUCTION

This report presents the results of the geotechnical investigations and assessment undertaken by Regional Geotechnical Solutions Pty Ltd (RGS) for the proposed Ballina High School Redevelopment. The site comprises four adjoining lots bound by Cherry, Swift, Martin and Bentinck Streets as identified below:

- Lot 392, DP755684;
- Lot 478, DP729251;
- Lot 1, DP083219; and
- Lot 477, DP729251.

The purpose of the work was to obtain geotechnical information on site conditions as the basis for providing comments and recommendations in relation to the development on:

- General site conditions and geology including;
    - Soil profile;
    - Depth of fill;
    - Depth to weathered rock if encountered; and
    - Groundwater levels
- Site earthworks including general site preparation and advice on filling and compaction control, temporary and permanent batters and reuse of site won material;
- Site classification to AS2870 – 2011 and assessment of characteristic surface movements (y_s);
- Alternative footing types and foundation design parameters including allowable/ultimate bearing pressures and data to calculate expected settlements;
- Assessment of durability requirements (aggressivity) for buried steel and concrete elements;
- Assessment of site subsoil classification for earthquake design in accordance with AS1170.4-2007;
- Assessment of insitu permeability for onsite stormwater disposal;
- Pavement thickness designs - flexible and rigid options and pavement construction advice; and
- Acid sulfate soils assessment, and advice with regard to treatment if encountered.

2 PROPOSED DEVELOPMENT

The development will involve the demolition of the existing buildings and construction of a new 1,200 student high school facility. The development is still in the concept planning stages. As such specific details of the proposed building configuration and location are yet to be determined. It is anticipated, however, that the new buildings will consist of a combination of possibly linked single, double and possibly sections comprising three stories. The buildings will typically comprise slab on ground and suspended first and second floor slabs with reinforced concrete and masonry superstructure and light weight roof.

The proposed building layout is unknown, however, the majority of the buildings are likely to be constructed over the southern portion of the site in place of the existing buildings once demolished.

The site is flat and the buildings are expected to be constructed at similar to existing grade with only minor site regarding of less than about 0.5m cut and fill anticipated. Large scale excavations for basements etc. are not anticipated. Therefore any deeper excavations are likely to be limited to trench excavations to about 1.2m for the installation of services.

3 FIELD WORK

Fieldwork for the investigation was undertaken in January 2016 and comprised a site walkover assessment and intrusive investigations. The site walkover included the observation and assessment of the site in the relation to the surrounding landscape, existing site surface features and the external condition of the existing buildings.

Intrusive investigations included:

- The drilling of six boreholes (BH1 to BH6) to depths of up to approximately 15m with a truck mounted drill rig using a combination of auger drilling and wash boring methods. Standard penetration tests (SPT) were carried out throughout the soil profile at approximately 1.5m intervals to aid in the assessment of the soil strength profile and density of the sands.
- Electronic Friction Cone Penetration Testing (CPTs) at fifteen locations (CPT-1 to CPT-15). The tests were conducted to depths of between12.8m and 22.2m.
- The drilling of thirteen boreholes (HA1 to HA13) using a hand auger to depths of up to 1.6m.
- Three insitu falling head permeability tests (HA11, HA12 and HA13).
- Installation of three standpipe piezometers to depths of 6m (GW1, GW2 and GW3).
- Collection of samples for subsequent laboratory testing as outlined in Section 4.

Groundwater level measurements of the standpipe piezometers were undertaken on one occasion approximately one week after installation as detailed in Table 2.

The fieldwork was undertaken by a Senior Geotechnical Engineer from RGS. Engineering logs of the boreholes and the CPT data plot sheets are presented in Appendix A. The approximate locations, obtained by taped measurements from existing site features, are presented on Figure 1.

4 LABORATORY TESTING

The samples collected were sent to NATA registered contract laboratories for analysis where the following geotechnical testing was undertaken.

- Two soil aggressivity test suites to assess durability requirements for buried concrete and steel elements in accordance with AS2159-2009 – Piling Design and Installation;
- Twelve acid sulfate soil screening tests;
- Three acid sulfate soils chromium reducible sulfur (CRS); and
- Two Californian Bearing Ratio (CBR) test.

The results of the testing are presented and discussed in the relevant sections of this report. A copy of the laboratory test results sheet is provided in Appendix B.

The samples collected for environmental contamination assessment were submitted to a specialised laboratory for analysis, the results of which are presented and discussed in report No. RGS30738.1 - AC.

5 SITE CONDITIONS

5.1 Surface conditions

The site is located in Ballina CBD on a flat low lying estuarine spit associated with the Richmond River which lies approximately 600m to 700m to the north and south. The Google earth image below illustrates the site setting and features.

Diagram 1: Site Setting and Features

Ballina High School occupies an area of approximately 6ha comprising open playing fields over the northern portion and the existing school buildings and facilities over the southern portion. Numerous garden beds, shrubs and large trees including eucalypt, Norfolk pine and fig are scattered around the site. The existing buildings include some single but predominately double storey masonry with slab on ground and concrete and timber upper floor levels. The buildings vary in age with the earliest building dating from about 1915. Articulated construction methods have been used in the more recent buildings.

Generally the buildings are in good external condition with no apparent signs of damage that could be attributed to ground related issues. Cracks in one of the north facing walls of one of the

buildings located in the central northern portion of the site (refer to Photograph 4) appear to be the result of a structural issue and not a potential ground related issue.

Selected site photographs are provided below.

Plate 1 Selected Site Photographs

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>1. Older style two storey buildings with lower level masonry and upper level timber.</td><td>2. Two storey full masonry with concrete floor slabs and reinforced concrete frames.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>3. Playing field to the north of the school buildings.</td><td>4. Crack in brickwork, appears superficial and not related to potential ground issues.</td></tr>
</table>

5.2 **Subsurface conditions**

The 1:25,000 Coastal Quaternary Geology map of Tweed Heads indicates the site is underlain by Quaternary alluvial deposits comprising river gravels, sand and clay.

In summary the investigations have encountered a deep alluvial sand profile comprising:

Fill: Silty sand fill was encountered to depths of up to 0.6m but generally to about 0.3m depth. The fill was predominately encountered over the southern developed portion of the site, and is likely to be associated with the past building works

Topsoil: Silty sand topsoil was encountered over the northern portion and parts of the southern portion of the site to a depth of up to 0.3m; overlying

Alluvial soils: Alluvial sand, loose to depths of between 2.5 to 3.5m, increasing to medium dense, then dense to very dense from depths of 10 to 12m. The testing indicates the dense sands extend to depths in excess of 25m (CPT-3).

The CPT testing identified some thin localised lenses of soft clays throughout the profile. Of note are the following soft clay layers that were encountered:

- CPT-2A - soft clay layer approximately 0.7m thick at a depth of 2.8m. It is noted that the soft clay layer was not encountered in CPT-2 which was undertaken approximately 1m from CPT-2A;
- BH2 - soft clay layer encountered from 5.2 to 7.1m;
- BH3 - soft clay layer encountered from 5.6 to 7.0m.

Based on the testing undertaken the soft clay appears to be localised, in discontinuous lenses or pockets rather than continues layers or bands. They also appear to be confined to the south-western portion of the site (Refer to Figure 1).

Further details of the profile encountered are provided in the engineering logs presented in Appendix A. The CPT data plots are also provided in Appendix A.

Groundwater

Groundwater seepage was encountered during the drilling of the boreholes and CPT testing at the depths varying between 0.9m to 2.0m. A summary of the groundwater observations within the standpipe piezometers installed at the site are presented in Table 1.

Table 1: Summary of Groundwater Observations

Borehole	Inflow Depth During Drilling (m)	Standing Water depth (28/1/16)
BH2 (GW1)	1.2 (18/1/2016)	1.45 (1230)
BH5 (GW2)	1.2 (20/1/2016)	1.40 (1400)
BH6 (GW3)	1.2 (21/1/2016)	1.30 (1415)

5.3 Laboratory Test Results

The laboratory test results are presented in Appendix B, with the results of the aggressivity testing and acid sulfate soils testing discussed in Section 9 and Section 11 respectively.

The results of the CBR testing are presented in Table 2.

Table 2: Laboratory CBR Test Results

Sample Location	Sample ID	Sample Depth (m)	Material type	Natural Moisture Content (%)	Optimum Moisture Content (%)	Maximum Dry Density (t/m³)	CBR (%)
HA12	CBR1	0.3 to 0.5	Silty Sand	16.5	17.2	1.7	11.0
BH3	CBR2	0.3 to 0.5	Silty Sand	26.0	23.2	1.51	11.0

6 GENERAL SITE CONDITIONS AND GEOTECHNICAL CONSIDERATIONS

The site is located within an estuarine environment underlain by a deep alluvial sand profile with an upper profile - 2.5 to 3.5m, of loose sand overlying medium dense then dense sands from around 10 to 12m depth. Some localised lenses or pockets of soft clay were encountered, typically less than 0.2 to 0.5m thick. Some zones of soft clays up to about 1.8m thick were encountered over the south western portion of the site in BH2 and BH3 at depths of 5.2 and 5.6m depth respectively. Considering the depth and apparent localised nature of the soft layers they are not likely to have a significant impact on the proposed single to double storey structures proposed.

Based on the conditions encountered and in consideration of the anticipated development details shallow footings founded within the upper sand profile are likely to be feasible for the most part. Some localised deeper footings including piles may be required for any isolated highly loaded structural elements such as lift shafts. Further details with regard to footing and foundation design parameters are provided in Section 8.

The acid sulfate soil analysis indicates the soils encountered below the water table from depths of below about 1.5m are weak acid sulfate soils. Such soils will require treatment if exposed during excavation. An acid sulfate soils management plan (ASSMP) should be prepared if excavations below the water table are expected that will impact the acid sulfate soils.

Large scale deep excavations such as basements are unlikely to be required, however, some localised excavations of the order of 1.2m are anticipated for service trenches. Excavations, where possible should be limited to no deeper than about 1.2m to alleviate the potential issues associated with excavations in sand below the water table. Furthermore, excavations below this depth will expose the acid sulfate soils triggering the need for an ASSMP.

The site is located within an aggressive environment. In accordance with AS2159 – 2009 Piling Design and Installation concrete elements should be designed for a very severe exposure classification and steel elements for a moderate exposure classification.

7 SITE PREPARATION AND EARTHWORKS

7.1 **Site Preparation**

General site preparation requirements will include the demolition of the existing structures and removal of vegetation. Given the age of the majority of the buildings they are likely to be constructed with asbestos-containing material (such as the fibro sheeting, linoleum tiles, pipe lagging etc.) and the finishes, such as paints, are likely to contain heavy metals including zinc and lead. All asbestos-containing material should be removed and disposed of by appropriately licenced contractors. If not already completed a hazardous material survey should be undertaken by an Occupational Hygienist.

Once all potentially harmful materials are removed the remainder of the structures can be demolished. Care should be taken during demolition and site works to limit vibrations, particularly during compaction of any fill. The buildings on the site are likely to be founded on shallow footings within the upper loose sand profile, along with the neighbouring buildings. The sands will settle if subjected to excessive vibrations which could result in damage to the structures.

Once demolition is completed, including the removal of the old footings and services, site works will include the removal of all fill and building debris, root affected material and any obvious deleterious or contaminated material. All such material should be suitably disposed of off-site in accordance with regulatory requirements. It is noted that waste classification testing may be required to appropriately assess disposal requirements.

Construction working platforms approximately 300mm thick will improve site trafficability over the exposed sand subgrade following stripping. Clean building rubble including crushed brick and concrete could be used for this application

7.2 **Excavation Conditions**

Excavations to anticipated depths of up to 1.2m for the installation of services will generally encounter sand, the excavation of which could be achievable using conventional trenching plant including small to medium excavators, backhoes and chain trenching machines.

Vertical excavations within sands will be difficult to achieve and some trench over-break should be expected. In dry sands the trench walls are expected to lay at or near the natural angle of repose of the sands at about 30 to 35°. Stepper excavations may be achievable where there is some moisture within the sands, but this should not be relied upon within regard to assessing appropriate trench wall geometry. Excavations below the water table will not be possible in the sands without

using some form of trench wall support such as sheet piling installed well below the base of the proposed excavation.

Lengths of open excavation should be limited to the extent of pipework that can be laid and backfilled within several hours. Large lengths of open unsupported trenching should be avoided and all excavation work should be undertaken in accordance with the Safe Work Australia '*Excavation Code of Practice (March 2015)*

Excavations should not be undertaken where loads are located within the zone of influence of the excavation toe (area within a line drawn up at 35° (max) of the toe of the excavation. This includes adjoining traffic loads, construction loads and loads imposed by nearby structures. The trench should be fully supported in situations where the minimum load setback distances cannot be achieved.

Entry into unsupported trenches should be avoided and appropriate signage and barricading should be installed around all open excavations to prevent entry. Where entry into the trench is required appropriate shoring, such as a trench shield or similar, should be used. Alternatively, where space permits the sides of the trenches can be battered at no steeper than 1.5H:1V (33°).

Groundwater seepage into excavations should be expected below depths of about 1.2m and possibly shallower following periods of rainfall. Dewatering of excavations will be difficult if seepage is encountered and as such works should be planned to avoid intercepting the groundwater where possible. Alternative methods of installation such as underboring (HDD) should be considered where interception of the groundwater table is anticipated.

Large scale excavations are not anticipated and given the potential issues associated with excavations below the water table in sands and the presence of ASS are not recommended. If such excavations are proposed, such as basement levels, then further geotechnical advice should be sought. Such excavations will require the installation of full perimeter retention systems, such as a secant pile wall, installed prior to excavation commencing. A large scale perimeter dewatering system will also be required to lower the water table within the excavations and the basement will need to be designed as fully tanked or a permanent dewatering system designed and constructed.

7.3 **Retention**

7.3.1 Batters

Excavations are anticipated to extend to depths of up to about 1.2m with proposed filling of up to about 0.5m. Given the space available permanent cut and fill batters will likely fulfil the requirements of excavation and fill retention over the majority of the site.

Table 3 provides recommendations on maximum temporary and permanent batter slopes within the natural soils and controlled fill.

Table 3: Temporary & Permanent Batter Slopes

Material	Maximum Vertical Batter Height	Temporary Batters	Permanent Batters
Sand	1.2m	1.5H:1V	3H:1V
Well Graded Granular Fill	0.5	0.5H:1V	1.5H:1V

Flatter batters will be required if seepage is encountered during excavation and during rainfall and should be assessed by a Geotechnical Engineer on completion of excavation to assess batter requirements.

Temporary batters should be trimmed smooth to reduce erosion. Permanent cut or fill batter slopes should be protected against erosion by rapidly establishing vegetation cover or covering with a proprietary product such as Enviromat, Jute Mesh, Grassroots or other similar products.

Surface water flows from upslope should be diverted away from the slope face by constructing a berm and / or surface drain along the crest of the slope that collects and discharges water to the stormwater system or down slope in a controlled manner.

7.3.2 Retaining Walls

Permanent retaining walls may be required over some parts of the site. It is anticipated that retaining walls will extend to maximum heights of up to about 1m. Conventional gravity retaining walls, such as reinforced concrete filled block walls, segmental stacked block walls or cantilevered retaining walls would be feasible for permanent support.

Gravity or cantilever retaining walls should be designed on the basis of a triangular lateral earth pressure distribution using the following parameters:

- All retaining elements should be uniformly founded within natural sands or controlled fill below any uncontrolled fill or topsoil. For bearing pressure recommendations refer to Section 8;
- For cantilever walls where movement is of little concern, an active earth pressure coefficient (k_a) of 0.33 may be adopted for the fill assuming a horizontal backfill surface;
- If the top of the wall is retaining areas which are sensitive to movement, an "at rest" earth pressure coefficient (k_o) of 0.5 should be adopted;
- A bulk unit weight of 20kN/m^3 should be adopted for the soil profile behind the retaining wall;
- Any surcharge affecting the walls (e.g. traffic loads, adjacent footings, retaining walls or inclined slopes, or construction loads or stockpiles) should be allowed for in the design.
- Even with appropriate drainage as described below it is recommended that an allowance for potential water pressure build-up equivalent to one third the wall height be made in the design.

The retaining walls should be designed as fully drained with measures incorporated to provide drainage of the ground behind the wall. The wall backfill should comprise free draining granular material such as 20mm drainage gravel. Subsoil drains should comprise a geocomposite drain or

geotextile (Bidim A34 or similar) wrapped gravel drain at the toe of the back of the wall. The drains should discharge to the stormwater system. Where appropriate, flushing points should be incorporated into the design.

7.4 **Subgrade Preparation, Fill Placement and Compaction Control**

Minor site regrading including up to about 0.5m of fill is likely to be required to raise site levels below building areas. The following general comments and recommendations are provided as a guide for the preparation of the subgrade over these areas:

- All root affected material, topsoil, over wet material and any uncontrolled fill or otherwise unsuitable material should be stripped and stockpiled for later reuse for landscaping purposes. These materials are not considered suitable for reuse as engineered fill.
- Following stripping to the required foundation level the exposed subgrade should be proof rolled to identify any wet, excessively deflecting or otherwise deleterious material. Any such areas will require over excavation to a sound base and replacement with a select fill. The required depth of stripping is likely to be around 0.2 to 0.3m. Excessive trafficking of the exposed subgrade should be avoided to reduce the potential for pumping of the underlying groundwater which could result in heaving of the subgrade.
- Beneath floor slabs approved fill should be placed in layers not exceeding 300mm loose thickness and be compacted to a minimum dry density ratio of not less than 98% Standard Compaction or 75% density index where sand fill is used. Fill should be placed and maintained at ±2% of Standard OMC.
- Filling below structures should be carried out in accordance with Level 1 inspection and testing as defined in AS3798 – 2007. Level 2 filling would be suitable if all structural elements are designed to be supported on the underlying natural sands. If the fill is not placed in accordance with Level 1 requirements the site would be classified as Class P in accordance with AS2870 – 2011.
- Beneath pavement areas the upper 300mm of the subgrade materials should be compacted to a minimum density ratio of 100% Standard compaction.
- Filling below pavements should be carried out in accordance with Level 2 construction monitoring and testing as defined in AS3798 – 2007. Depending on the extent of filling required for practical reasons it may be more efficient to undertake all filling under Level 1 inspection and testing.

7.5 **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 200mm. Provided it is clean and appropriately crushed and proceeded the bricks and concrete generated from the demolition of the buildings and concrete slabs would produce a suitable fill material that could be reused for engineered fill. Any such material should be assessed in accordance with the NSW EPA Resource Recovery Exemption under Part 9, Clauses 91 and 92 of the Protection of the Environment Operations (Waste) Regulation 2014 – *The Recovered Aggregate Exemption 2014*. The existing sands and silty sands could also be reused.

The use of clay soils is not recommended and their use will result in significantly higher shrink/swell related ground surface movements. Their use will also require more rigorous earthwork monitoring and compaction control, and increased potential for delays due to wet weather resulting in possibly greater eventual cost to earthworks compared with the use of weathered rock or recycled concrete materials.

8 FOOTINGS AND FOUNDATION DESIGN PARAMETERS

8.1 Options

Details on the proposed building layout, configuration and loading are yet unknown, but they are likely to comprise predominately single and double storey as discussed in Section 2. The existing two storey masonry buildings are likely to be supported on shallow footings, are serviceable, and appear to be performing well, with no significant damaged that could be attributable to ground related issues observed. On this basis and in consideration of the subsurface conditions encountered it may be feasible to support the buildings on shallow footings. Alternatively, if building loads are high or settlement constraints cannot be met in the upper loose sands, piles would be feasible. Piles may also be required in certain situations such as within lift pits where excavations near or below the water table will render shallow footings impractical.

8.2 Site Classification

The proposed buildings are commercial and therefore AS2870-2011 "*Residential Slabs and Footings*" does not strictly apply. Provided the performance expectations presented in AS2870-2011 are acceptable than the guidance provided in AS2870 - 2011 could be used in assessing footing and slab requirements for the proposed buildings.

Based on the conditions encountered the site as a whole could be considered to be Class "S" (slightly reactive) due to the presence of some clay over parts of the site within the upper soil profile. Shrink / swell related ground surface movements (Ys) of up to 20mm have been estimated for the site in its current condition.

Shrink / swell related movements can be affected by alterations to the soil profile by cutting and filling, and by the suction related effects of trees close to the building area. The effects of any such cutting, filling, tree planting, or tree removal or planting should be taken into account when selecting design values for differential movement across the building. The site classification presented above is based on current site conditions and will require reassessment on completion of earthworks if site levels are altered by more than 0.4m.

It is noted that there are numerous medium to large trees scattered over the site with some areas being containing abundant trees and vegetation and other being cleared and devoid of any vegetation apart from grass. Removal of the trees will result in disturbance of the generally sand profile that should be rectified by backfilling and compacting affected areas prior to construction over. re)

Site maintenance must comply with the recommendations and advice provided in CSIRO Sheet BTF18 "*Foundation Maintenance and Footing Performance: A Homeowners Guide*" a copy of which can be obtained from www.publish.csiro.au/pid/7076.htm.

8.3 Shallow Footings

Shallow footings could include pad and / or strip footings, stiffened raft slabs or waffle pods founded within the upper loose to medium dense sands or controlled fill.

Consideration should be given to the soft clays that were encountered at depths of around 5m to 6m over the south western portion of the site in BH2 and BH3. Buildings with high structural loadings, in excess of that typical of a two storey residential structure, should be avoided over this part of the site if possible. If this cannot be avoided then further geotechnical assessment should be undertaken once details of the proposed buildings are known, such as location, footing configuration and imposed loads, to assess the potential for and extent of, any consolidation settlement of the underlying soft clay.

Table 4 provides foundation design parameters for shallow footings.

Table 4: Shallow footing design Parameters

Founding Material	Minimum Founding Depth (m)	Minimum Footing Dimension (m)	Allowable Base Bearing Pressure (kPa)	Estimated Elastic Settlement (1) (mm)
Alluvial Sand (Loose)	0.5	0.5	100	6
Alluvial Sand (Medium Dense)	0.8	0.5	150	3
Controlled Fill	0.5	0.5	100	3

NOTE:

1. *Estimated maximum settlement only and will vary depending on the density of the founding material and dimensions of the footings. For critical cases specific assessment should be undertaken.*

The sands will tend to loosen following excavation of footings as the surface is unconfined. This is typical of sand soils and can be overcome by wetting down and compacting with a vibrating plate compactor just prior to placing concrete to increase near surface compaction.

The base of the footings should be assessed by a geotechnical engineer and Dynamic Cone Penetration (DCP) testing undertaken in the base of the footing excavations to assess that the recommended founding material has been reached and to check initial assumptions about foundation conditions and possible variations between footing locations.

8.4 Piles

Pile types that limit the exposure of the underlying ASS would be preferable and could include driven piles (timber, concrete or steel) or steel screw piles. Consideration should be given to the potential impacts of driving piles on nearby structures as a result of settlement of the upper loose sand profile due to ground inducted vibrations during pile driving. Timber piles would alleviate the issue of the highly aggressive environment (Refer to Section 9).

Other feasible pile types could include fully cased bored piles or grout injected (CFA). These pile types will impact on the ASS and therefore trigger the need for an ASSMP and treatment of the excavated drilling spoil.

For pile design in accordance with AS2159-2009, 'Piling-Design and installation', the ultimate geotechnical strength ($Rd,_{ug}$) can be calculated using the ultimate end bearing capacity values provided in Table 5. Calculation of the design geotechnical strength (Rd,g) requires an assessment of the geotechnical strength reduction factor (Φg), which is based on a series of project specific variables. In assessing a suitable geotechnical strength reduction factor for this project, the following assumptions have been made:

- Design of piles and pile groups will be undertaken in accordance with the recommendations presented in this report;
- Limited geotechnical involvement will occur during pile installation;
- Some performance monitoring of the supported structure would be undertaken during or after construction;
- No pile testing will be undertaken;
- The foundations will be designed by a designer of at least moderate experience in similar geotechnical profiles and pile design;
- Established pile design methods will be used.

Based on the above assumptions and in accordance with AS2159-2009 a risk rating of 2.93 is estimated. Therefore, assuming the pile configuration will have low redundancy a Geotechnical Strength Reduction Factor of Φ_g=0.52 would be appropriate for the site. If at least 10% of the piles are statically load tested the Geotechnical Strength Reduction Factor could be increased to 0.63.

If any of the assumptions outlined above are not correct, the Geotechnical Strength Reduction Factor may change and further advice should be sought.

Table 5: Summary of Pile Design Parameters

Founding Material	Minimum Founding Depth (m)	Pile Type	Ultimate End Bearing Capacity (1) (MPa)	Ultimate Shaft Adhesion (MPa)	Serviceability End Bearing Pressure (2) (MPa)	Allowable End Bearing Pressure (3) (MPa)	Young's Modulus, E (MPa)
Sand (Medium Dense)	7.5	Non-displacement	1.5	0.02	0.6	0.5	10
		Displacement	3.0	0.04	1.2	1.0	20
Sand (Dense)	12	Non-displacement	4.5	0.06	1.8	1.5	50
		Displacement	8.5	0.1	3.4	2.8	60

NOTES:

1. *Ultimate end bearing values occur at large displacements (approx. 5% of pile diameter).*
2. *Limit state design requires the piles to be designed for an acceptable level of serviceability, which typically assumes a maximum settlement of not more than 1% of pile diameter. If the structure is more sensitive or less sensitive to settlement than this value assumes, serviceability criteria should be re-assessed.*
3. *Allowable values based on factor of safety (FOS) of 3.*

At least the initial stages of pile installation should be observed by a suitably experienced geotechnical engineer to assess that the recommended founding material has been reached and to check initial assumptions about foundation conditions and possible variations between test locations.

9 AGGRESSIVITY TO BURIED STRUCTURAL ELEMENTS

The aggressivity test results presented in Table 6 below were compared to the exposure classifications provided in Australian Standard AS2159-2009, *Piling Design and Installation*.

Table 6: Results of Soil Aggressivity Testing

Sample Location	Sample Depth (m)	Sample Type	pH	Soluble Sulfate (mg/kg)	Chloride (mg/kg)	Resistivity (ohm.cm)
BH2	2.5 to 2.95	Soil	3.2	280	3	2,500
BH6	2.5 to 2.95	Soil	3.3	308	16	2,500

The laboratory results indicate a **very severe** exposure classification for concrete and **moderate** for steel elements.

10 EARTHQUAKE DESIGN REQUIREMENTS

In accordance with AS1170.4-2007 based on the soil profile encountered the site would be considered a Class C_e site. A site hazard factor of 0.05 can be adopted for the purposes of earthquake design in Ballina.

11 ACID SULFATE SOILS

The acid sulfate soils risk map for Ballina indicates Ballina High School is located in an area of low probability of acid sulfate soils.

The results of the ASS screening tests indicate that the majority of the soils tested from below the water table have a high potential for acid sulfate soils. The testing indicates the soils are naturally acidic (refer to Section 9) with pH levels of around 3. The chromium reducible sulphur (CRS) testing undertaken on three representative samples indicates the soils are potential acid sulfate soils. Therefore if the soils below the water table (about 1.2m depth) will be disturbed through excavation or pile installation, any soils excavated will require treatment with lime at a rate of 6 kg of fine agricultural lime per tonne of soil. An Acid Sulfate Soils Management Plan ASSMP will be required for the site were disturbance of the ASS will occur. RGS can prepare such a plan if required, however, it is recommended that preparation of the ASSMP is undertaken once details of the proposed development such as excavation depths, excavation volumes are known.

12 PERMEABILITY AND STORMWATER INFILTRATION

Insitu falling head permeability tests were undertaken at three locations across the site to assess the insitu permeability of the upper soil profile. All tests were undertaken within 100mm diameter boreholes over a depth range of 1m from the ground surface. Table 7 summarise the results of the permeability testing.

Table 7 Results of Insitu Falling Head Permeability Testing

Location	Coefficient of Permeability (K) (m/sec)
HA11	7.96×10^{-4}
HA12	2.98×10^{-4}
HA13	4.63×10^{-4}

The values obtained through the in-situ permeability tests are representative of those expected for the fine sand tested. On the basis of the permeability results the sands that make up the upper profile would be expected to have good drainage conditions and would be suitable for onsite disposal of stormwater.

In evaluating the requirements of the onsite stormwater infiltration system, the design should take into account the coefficient of permeability as presented in Table 7 with due allowance for the effects of the siltation in the longer term, as well as the influence of the groundwater table within 1.2m of the ground surface, which is likely to rise and fall with rapidly in response to rainfall and river levels. Consideration should also be given to the underlying ASS when design the system, and excavation depths should be limited to no more than about 1m depth.

13 PAVEMENTS

13.1 Pavement Design

Pavement thickness profiles, material specifications and compaction requirements for the proposed car parking pavements are provided on the pavement thickness design sheets presented in Appendix C. The pavements will be used for car parking and possible limited use by light to medium rigid trucks such as rigid delivery vehicles and weekly garbage collection. In areas with tight turning circles and high screwing loads rigid concrete pavements or an AC seal of at least 40mm thickness are recommended. Flexible and rigid pavement options have been provided.

At this stage no information is availed in regard to pavement location, pavement level or size of the car parking areas. Therefore taking into account the anticipated usage as described above a design traffic loading of 1×10^5 Equivalent Standard Axles (ESA) (or 4×10^4 Heavy Vehicle Axle Groups for rigid pavement design) has been adopted.

CBR testing on the anticipated subgrade materials that are likely to be encountered below the pavements indicate a CBR value of 11%. There a design CBR value of 11% has been adopted for the pavement designs presented herein. If different materials form the pavement subgrade, such

as fill greater than 300mm deep, further geotechnical advice should be sought and it may be necessary to carry out further CBR testing on the imported fill material to assess CBR values and carry out additional pavement thickness designs.

13.2 **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. The surface of the car park could be constructed at similar to existing levels and should be graded in a manner that promotes rapid drainage to the outer edge and to drainage pits through the central portion as appropriate. The drains should discharge in a controlled manner to the council stormwater system. Table drains and / or kerb and guttering should be constructed along both sides of 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 that promotes rapid drainage and discharge away from the pavement.

Where it is not possible to construct table drains as described above, alternatives such as subsoil drains can be used. Subsoil drains should be constructed around the perimeter of car park pavements and along both sides of any access driveways. The invert level of subsurface drains should extend the full depth of the pavement profile. Subsoil drains should discharge to the council stormwater system away from pavements.

It is recommended that the pavement and pavement seal extend at least 0.5m onto the shoulder beyond the outer edge of the trafficable surface to provide lateral confinement and reduce potential moisture ingress at the edge of the pavement.

14 LIMITATIONS

The findings presented in the report and used as the basis for recommendations presented herein were obtained using normal, industry accepted geotechnical 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.

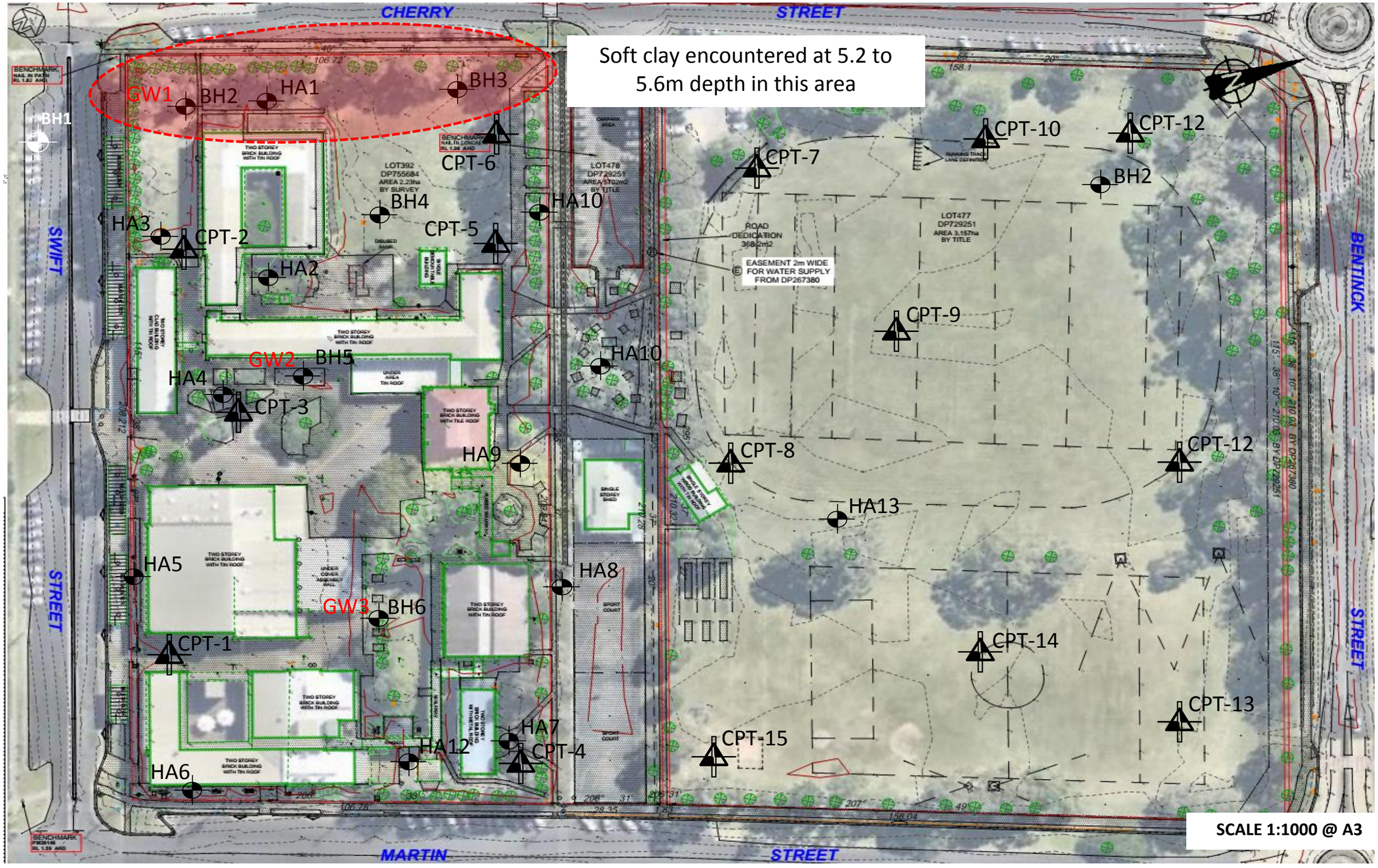
For and on behalf of

Regional Geotechnical Solutions Pty Ltd

Adam Holzhauser

Senior Geotechnical Engineer

Figures



REGIONAL GEOTECHNICAL SOLUTIONS	**Client**	EJE Architecture	Job No. RGS30738.1
	Project:	Ballina High School Redevelopment Ballina NSW	Drawn By: Adam Holzhauser Date: 18-Feb-16
	Title:	Test Location Plan	Drawing No. **FIGURE 1**

Appendix A

Results of Field Investigations

ENGINEERING LOG - BOREHOLE

REGIONAL GEOTECHNICAL SOLUTIONS

BOREHOLE NO: **BH1**

CLIENT: EJE Architects | **PAGE:** 1 OF 2

PROJECT NAME: Ballina High School Redevelopment | **JOB NO:** RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1 | **DATE:** 18/1/16

DRILL TYPE: Truck Mounted Drill Rig | **SURFACE RL:**

BOREHOLE DIAMETER: 100 mm | **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
ADTC							**TOPSOIL:** Silty SAND, fine, dark grey, contains rootlets	M				TOPSOIL:GRASS
						SP	0.30m **Clayey SAND:** Fine, pale grey brown mottled orange brown					ALLUVIAL
		1.00m SPT 2,2,2 N=4		1.0			0.60m **SAND:** Fine, pale grey		L			
		2.50m SPT 2,2,3 N=5		2.0								
		4.00m SPT 5,7,8 N=15		3.0								
		5.50m SPT 5,6,6 N=12		4.0								
		7.00m SPT 9,10,11 N=21		5.0		SP		W	MD			
		8.50m SPT 11,12,13 N=25		6.0								
		10.00m		7.0								
				8.0								
				9.0								

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: **BH1**

CLIENT: EJE Architects

PAGE: 2 OF 2

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1

DATE: 18/1/16

DRILL TYPE: Truck Mounted Drill Rig

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
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	
ADTC		SPT 12,14,13 N=27		11.0		SP	**SAND:** Fine, pale grey *(continued)*	W	MD			
		11.50m SPT 11,14,14 N=28		12.0								
		13.00m SPT 12,15,16 N=31		13.0					D			
		14.50m SPT 12,17,17 N=34		14.0								
				15.0			14.95m Hole Terminated at 14.95 m					
				16.0								
				17.0								
				18.0								
				19.0								

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

REGIONAL GEOTECHNICAL SOLUTIONS

BOREHOLE NO: BH2
CLIENT: EJE Architects
PAGE: 1 OF 2
PROJECT NAME: Ballina High School Redevelopment
JOB NO: RGS30738.1
LOGGED BY: LD
LOCATION: Refer to Figure 1
DATE: 18/1/16

DRILL TYPE: Truck Mounted Drill Rig
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
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
							TOPSOIL: Sandy SILT, low plasticity, black	M < w_P	F			TOPSOIL:GRASS
							0.50m					
ADTC						CL	0.65m **CLAY:** Medium plasticity, grey		St			ALLUVIAL
		1.00m SPT 2,2,1 N=3		1.0			**SAND:** Fine, grey					
				2.0		SP		M	L			
		2.50m SPT 1,2,1 N=3		3.0								
							3.50m					
		4.00m SPT 6,9,12 N=21		4.0		SP	**SAND:** Fine, grey, with trace of gravel, fine, rounded	W	MD			
				5.0								
							5.20m					
		5.50m SPT 0,0,0 N=0		6.0		CH	**Silty CLAY:** Medium to high plasticity, dark grey	M > w_P	S			6.00: Standpipe installed
		7.00m SPT 6,8,9 N=17		7.0			7.10m **SAND:** Fine, grey					
						SP			L			
				8.0			8.00m **SAND:** FIne, grey, with trace of gravel, fine, rounded					
		8.50m SPT 7,12,12 N=24				SP		W				
				9.0			9.00m **SAND:** Fine, grey		MD			
						SP						
		10.00m										

WB

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH2
PAGE: 2 OF 2
JOB NO: RGS30738.1
LOGGED BY: LD
DATE: 18/1/16

CLIENT: EJE Architects
PROJECT NAME: Ballina High School Redevelopment
LOCATION: Refer to Figure 1

DRILL TYPE: Truck Mounted Drill Rig
BOREHOLE DIAMETER: 100 mm
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
WB		SPT 12,14,14 N=28		11.0		SP	**SAND:** Fine, grey *(continued)*	W	MD			
		11.50m SPT 10,12,17 N=29		12.0								
		13.00m SPT 10,16,19 N=35		13.0					D			
		14.50m SPT 10,14,19 N=33		14.0								
				15.0			15.00m					
							Hole Terminated at 15.00 m					
				16.0								
				17.0								
				18.0								
				19.0								

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH3

CLIENT: EJE Architects

PAGE: 1 OF 2

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: LD

LOCATION: Refer to Figure 1

DATE: 19/1/16

DRILL TYPE: Truck Mounted Drill Rig

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

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
ADTC		0.10m 0.20m E					**TOPSOIL:** Sandy SILT, low plasticity, dark brown	M < w_P				TOPSOIL
							0.40m **CLAY:** Medium plasticity, grey	M > w_P	F			ALLUVIAL
		0.80m 0.90m SPT 2,2,3 N=5		1.0		CL	0.80m **SAND:** Fine, grey	M	L			
						SP	1.60m **Sandy CLAY:** Medium plasticity, grey	M > w_P	F			
		2.50m SPT 2,2,2 N=4		2.0 3.0		CL	2.00m **SAND:** Fine, grey					
		4.00m SPT 5,6,7 N=13		4.0 5.0		SP		W	L			
WB		5.50m SPT 1,1,2 N=3		6.0		CL	5.60m **Silty CLAY:** Medium to high plasticity, dark grey	M > w_P	S	HP HP	50 35	5.60: SPT sunk on addition
		7.00m SPT 7,10,13 N=23		7.0 8.0		SP	7.00m **SAND:** Fine, grey	W	MD			
		8.50m SPT 8,11,15 N=26		9.0								
		10.00m										

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH3
PAGE: 2 OF 2
JOB NO: RGS30738.1
LOGGED BY: LD
DATE: 19/1/16

CLIENT: EJE Architects
PROJECT NAME: Ballina High School Redevelopment
LOCATION: Refer to Figure 1

DRILL TYPE: Truck Mounted Drill Rig
BOREHOLE DIAMETER: 100 mm
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
WB		SPT 8,14,15 N=29		11.0		SP	**SAND:** Fine, grey *(continued)*	W	MD			
		11.50m SPT 10,14,13 N=27		12.0								
		13.00m SPT 8,12,14 N=26		13.0								
		14.50m SPT 6,11,11 N=22		14.0								
				15.0			14.95m Hole Terminated at 14.95 m					
				16.0								
				17.0								
				18.0								
				19.0								

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 (Glass jar, sealed and chilled on site)
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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 - BOREHOLE

BOREHOLE NO: BH4

CLIENT: EJE Architects

PAGE: 1 OF 2

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1

DATE: 20/1/16

DRILL TYPE: Truck Mounted Drill Rig

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

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
ADTC							0.10m **TOPSOIL:** Silty SAND, fine, dark grey, contains rootlets					TOPSOIL:GRASS
						SP	0.50m **Silty SAND:** Fine, dark grey					ALLUVIAL
							SAND: Fine, grey	M	L			
		1.00m SPT 2,3,2 N=5		1.0								
				2.0								
		2.50m SPT 2,2,3 N=5		3.0								
		4.00m SPT 6,9,13 N=22		4.0					MD			
WB				5.0		SP						
		5.50m SPT 8,11,17 N=28		6.0				W				
		7.00m SPT 6,7,9 N=16		7.0								
				8.0								
		8.50m SPT 10,19,19 N=38		9.0					D			
		10.00m										

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
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		UCS (kPa)
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Density

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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 - BOREHOLE

BOREHOLE NO: BH4
PAGE: 2 OF 2
JOB NO: RGS30738.1
LOGGED BY: AH
DATE: 20/1/16

CLIENT: EJE Architects
PROJECT NAME: Ballina High School Redevelopment
LOCATION: Refer to Figure 1

DRILL TYPE: Truck Mounted Drill Rig
BOREHOLE DIAMETER: 100 mm
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
WB		SPT 10,14,19 N=33		11.0		SP	**SAND:** Fine, grey *(continued)*	W	D			
		11.50m SPT 16,25,25 N=50		12.0					D - VD			
		13.00m SPT 9,17,16 N=33		13.0								
				14.0					D			
		14.50m SPT 10,18,27 N=45		15.0			14.95m Hole Terminated at 14.95 m					
				16.0								
				17.0								
				18.0								
				19.0								

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
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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 - BOREHOLE

BOREHOLE NO: BH5

CLIENT: EJE Architects

PAGE: 1 OF 2

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1

DATE: 20/1/16

DRILL TYPE: Truck Mounted Drill Rig

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

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
							FILL: Silty SAND, fine, dark grey, contains a trace of fine to medium gravel and brick fragments	D				FILL:GRASS
							0.45m					
ADTC		1.00m SPT 2,3,3 N=6		1.0			**SAND:** Fine, pale grey	M				ALLUVIAL
		2.50m SPT 2,2,2 N=4		2.0					L - MD			
		4.00m SPT 2,4,6 N=10		3.0								
		5.50m SPT 7,9,12 N=21		4.0				W	MD			
		7.00m SPT 5,12,20 N=32		5.0		SP						
		8.50m SPT 9,13,13 N=26		6.0								6.00: Standpipe installed
WB		10.00m		7.0					D			
				8.0								
				9.0								

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: **BH5**

CLIENT: EJE Architects

PAGE: 2 OF 2

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1

DATE: 20/1/16

DRILL TYPE: Truck Mounted Drill Rig

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

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
WB		SPT 8,17,21 N=38		11.0		SP	**SAND:** Fine, pale grey *(continued)*	W	D			ALLUVIAL
		11.50m SPT 12,14,27 N=41		12.0								
		13.00m SPT 15,23,29 N=52		13.0			Trace of fine shell fragments		VD			
		14.50m SPT 12,30/150 N=R		14.0								
				15.0			14.95m Hole Terminated at 14.95 m					
				16.0								
				17.0								
				18.0								
				19.0								

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH6

CLIENT: EJE Architects

PAGE: 1 OF 2

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1

DATE: 21/1/16

DRILL TYPE: Truck Mounted Drill Rig

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

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
ADTC							**TOPSOIL:** Silty SAND, fine, dark grey, contains rootlets					TOPSOIL:GRASS
						SP	0.30m **Silty SAND:** Fine, dark grey	M				ALLUVIAL
		1.00m SPT 3,4,4 N=8		1.0			0.50m **SAND:** Fine, pale grey					
				2.0					L			
		2.50m SPT 1,1,1 N=2		3.0								
WB		4.00m SPT 6,9,10 N=19		4.0								
				5.0		SP		W				
		5.50m SPT 4,10,9 N=19		6.0								6.00: Standpipe installed
		7.00m SPT 8,10,10 N=20		7.0					MD			
				8.0								
		8.50m SPT 6,7,11 N=18		9.0								
		10.00m										

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH6
PAGE: 2 OF 2
CLIENT: EJE Architects
JOB NO: RGS30738.1
PROJECT NAME: Ballina High School Redevelopment
LOGGED BY: AH
LOCATION: Refer to Figure 1
DATE: 21/1/16

DRILL TYPE: Truck Mounted Drill Rig
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
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
WB		SPT 12,14,30 N=44		11.0		SP	**SAND:** Fine, pale grey *(continued)*	W	D			
		11.50m SPT 12,20,20 N=40		12.0								
		13.00m SPT 14,25/150 N=R		13.0								
				14.0			14.50m					
				15.0			Hole Terminated at 14.50 m					
				16.0								
				17.0								
				18.0								
				19.0								

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: **BH-HA1**

CLIENT: EJE Architects
PAGE: 1 OF 1

PROJECT NAME: Ballina High School Redevelopment
JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1
DATE: 18/1/16

DRILL TYPE: Hand Auger
SURFACE RL:

BOREHOLE DIAMETER: 100 mm
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
HA		ASb ES 0.10m 0.30m ES 0.50m		0.5 1.0 1.5		SP CL SP	**FILL:** Silty SAND, fine to medium grained, dark grey, contains roots and rootlets, trace of brick fragments and plaster 0.45m **Silty SAND:** Fine, dark grey, contains roots and rootlets 0.60m **Sandy CLAY:** Medium plasticity, grey brown mottled orange brown 0.90m **SAND:** Fine, pale grey brown 1.25m Hole Terminated at 1.25 m Borehole collapsing below water table	M M > w_P M W	L F L			FILL:GARDEN BED OLD TOPSOIL ALLUVIAL

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH-HA2

CLIENT: EJE Architects
PAGE: 1 OF 1
PROJECT NAME: Ballina High School Redevelopment
JOB NO: RGS30738.1
LOGGED BY: AH
LOCATION: Refer to Figure 1
DATE: 18/1/16

DRILL TYPE: Hand Auger
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
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
HA		ASb ES 0.10m					**FILL/TOPSOIL:** Silty SAND, dark grey, contains roots and a trace of fine gravel in upper 100-200mm	M	L			FILL/TOPSOIL:GRASS
							0.45m					
				0.5		SP	**Silty SAND:** Fine, dark grey					ALLUVIAL
							0.95m					
				1.0		SP	**SAND:** Fine, pale grey brown					
	▶						1.25m	W				
							Hole Terminated at 1.25 m Borehole collapsing below water table					
				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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: **BH-HA3**

CLIENT: EJE Architects

PAGE: 1 OF 1

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1

DATE: 18/1/16

DRILL TYPE: Hand Auger

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

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
HA		ASb ES 0.10m					**FILL:** Silty SAND, fine, dark brown, contains rootlets and a trace of medium to coarse gravel					FILL:GRASS
							0.20m					
		0.30m ASb ES 0.40m				SP	**Silty SAND:** Fine, dark grey					OLD TOPSOIL
							0.40m					
				0.5		SP	**Silty SAND:** Fine, pale grey mottled brown, contains a trace of roots and cemented sand nodules	M	L			ALLUVIAL
				1.0								
				1.5				W				
							1.60m					
							Hole Terminated at 1.60 m Borehole collapsing below water table					

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: **BH-HA4**

CLIENT: EJE Architects

PAGE: 1 OF 1

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1

DATE: 18/1/16

DRILL TYPE: Hand Auger

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

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
HA		ASb ES 0.10m					**FILL:** Silty SAND, fine grained, brown, contains rootlets	D				FILL:GRASS
						SP	0.25m **SAND:** Fine, pale grey					ALLUVIAL
				0.5		SP	0.50m **Silty SAND:** Fine, dark grey					
						SP	0.80m **SAND:** Fine, pale brown	M	L			
				1.0		SP	1.20m	W				
							Hole Terminated at 1.20 m Borehole collapsing below water table					
				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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH-HA5

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT: EJE Architects
PAGE: 1 OF 1
PROJECT NAME: Ballina High School Redevelopment
JOB NO: RGS30738.1
LOGGED BY: AH
LOCATION: Refer to Figure 1
DATE: 18/1/16

DRILL TYPE: Hand Auger
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
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
HA	Not Encountered	0.20m ASb ES 0.30m					**WOODCHIP MULCH:** Pale brown 0.15m	M				GARDEN BED
							FILL: Silty SAND, fine, contains clay fines, gravel, organic matter and brick/concrete fragments 0.30m					FILL
				0.5			Hole Terminated at 0.30 m Refusal on brick/concrete fragments					
				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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH-HA6

CLIENT: EJE Architects | **PAGE:** 1 OF 1

PROJECT NAME: Ballina High School Redevelopment | **JOB NO:** RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1 | **DATE:** 18/1/16

DRILL TYPE: Hand Auger | **SURFACE RL:**

BOREHOLE DIAMETER: 100 mm | **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
HA		0.10m ASb ES 0.20m		0.5			**FILL/TOPSOIL:** Silty SAND, fine, dark grey, contains rootlets	M				FILL/TOPSOIL:GRASS
				1.0		SP	0.60m **SAND:** Fine, grey brown	W	L			ALLUVIAL
				1.5			1.20m Hole Terminated at 1.20 m Borehole collapsing below water table					

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH-HA7

CLIENT: EJE Architects

PAGE: 1 OF 1

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1

DATE: 18/1/16

DRILL TYPE: Hand Auger

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

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
		0.10m					**FILL/TOPSOIL:** Silty SAND, fine, dark brown, contains rootlets and trace of plastic					FILL/TOPSOIL:GRASS
		ASb ES 0.20m					0.25m					
HA				0.5		SP	**Clayey SAND:** Fine, dark brown	M				ALLUVIAL
							0.65m **SAND:** Fine, pale grey		L			
	▶			1.0		SP		W				
							1.10m Hole Terminated at 1.10 m Borehole collapsing below water table					
				1.5								

RG LIB 1.02.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS30738.1 LOGS BH-HA1 TO BH-HA13 DRAFT.GPJ <<DrawingFile>> 02/02/2016 10:19 8.30.004 Datgel Lab and In Situ Tool

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: **BH-HA8**

CLIENT: EJE Architects

PAGE: 1 OF 1

PROJECT NAME: Ballina High School Redevelopment

JOB NO: RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1

DATE: 18/1/16

DRILL TYPE: Hand Auger

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

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
HA		0.20m ASb ES 0.30m		0.5			**FILL:** Silty SAND, fine to medium grained, dark brown, contains clay fines and a trace of fine gravel					FILL:GRASS
						SP	0.50m **Clayey SAND:** Fine, pale grey brown mottled orange brown		L - MD			ALLUVIAL
							0.75m **SAND:** Fine, pale brown	M				
	▶			1.0		SP			L			
							1.25m	W				
							Hole Terminated at 1.25 m Borehole collapsing below water table					
				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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: **BH-HA9**

CLIENT: EJE Architects | **PAGE:** 1 OF 1

PROJECT NAME: Ballina High School Redevelopment | **JOB NO:** RGS30738.1

LOGGED BY: AH

LOCATION: Refer to Figure 1 | **DATE:** 18/1/16

DRILL TYPE: Hand Auger | **SURFACE RL:**

BOREHOLE DIAMETER: 100 mm | **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
							TOPSOIL: Silty SAND, fine, dark grey, contains roots and rootlets					TOPSOIL:GRASS
		0.10m ASb ES 0.20m					0.25m **Silty SAND:** Fine, dark grey					ALLUVIAL
HA				0.5		SP	0.60m **Clayey SAND:** Fine, pale grey brown mottled orange brown	M	L			
	▶			1.0		SP	1.05m Hole Terminated at 1.05 m Borehole collapsing below water table	W				
				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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH-HA10

CLIENT: EJE Architects
PAGE: 1 OF 1
PROJECT NAME: Ballina High School Redevelopment
JOB NO: RGS30738.1
LOGGED BY: AH
LOCATION: Refer to Figure 1
DATE: 18/1/16

DRILL TYPE: Hand Auger
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
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
HA	Not Encountered	0.10m ASb ES 0.20m					**FILL/TOPSOIL:** Silty SAND, fine, dark grey, contains roots, rootlets and fine gravel 0.10m **FILL:** Sandy GRAVEL, medium to coarse grained angular basalt, pale brown 0.35m	M				FILL/TOPSOIL:GRASS FILL
				0.5			Hole Terminated at 0.35 m Refusal on Gravel					
				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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH-HA11

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT: EJE Architects
PAGE: 1 OF 1
PROJECT NAME: Ballina High School Redevelopment
JOB NO: RGS30738.1
LOGGED BY: AH
LOCATION: Refer to Figure 1
DATE: 18/1/16

DRILL TYPE: Hand Auger
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
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
HA	Not Encountered			0			**FILL:** Silty SAND, fine, brown, contains fine to medium gravel and rootlets	M				FILL:GRASS
						SP	**SAND:** Fine, pale grey	D	L			ALLUVIAL
				0.5		SP	**Silty SAND:** Fine, dark grey					
						SP	**Clayey SAND:** Fine, pale grey brown and orange brown					
						SP	**SAND:** Fine, pale grey	M	L - MD			
				1.0			Hole Terminated at 1.00 m					
				1.5								

0.20m
0.35m
0.50m
0.65m
1.00m

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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH-HA12

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT: EJE Architects
PAGE: 1 OF 1
PROJECT NAME: Ballina High School Redevelopment
JOB NO: RGS30738.1
LOGGED BY: AH
LOCATION: Refer to Figure 1
DATE: 18/1/16

DRILL TYPE: Hand Auger
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
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
HA	Not Encountered						**TOPSOIL:** Silty SAND, fine, dark grey, contains rootlets	M				TOPSOIL:GRASS
							0.30m					
						SP	**Sandy GRAVEL:** Fine, dark grey		MD			ALLUVIAL
							0.45m					
				0.5		SP	**Silty SAND:** Fine, dark grey					
							0.70m					
						SP	**SAND:** Fine, pale grey		L			0.70: Roots 20-30mm diameter
				1.0			1.10m					
							Hole Terminated at 1.10 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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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 - BOREHOLE

BOREHOLE NO: BH-HA13

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT: EJE Architects
PROJECT NAME: Ballina High School Redevelopment
LOCATION: Refer to Figure 1

PAGE: 1 OF 1
JOB NO: RGS30738.1
LOGGED BY: AH
DATE: 18/1/16

DRILL TYPE: Hand Auger
BOREHOLE DIAMETER: 100 mm
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
HA	Not Encountered			0.5			**TOPSOIL:** Silty SAND, fine, dark grey, contains rootlets 0.30m **Clayey SAND:** Fine, pale grey brown mottled orange brown SP 0.55m **SAND:** Fine, pale grey SP 0.70m **SAND:** Fine, pale grey orange brown mottle SP 1.00m	M	L			TOPSOIL:GRASS ALLUVIAL 0.35: Roots 20mm
				1.0 1.5			Hole Terminated at 1.00 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 (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
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

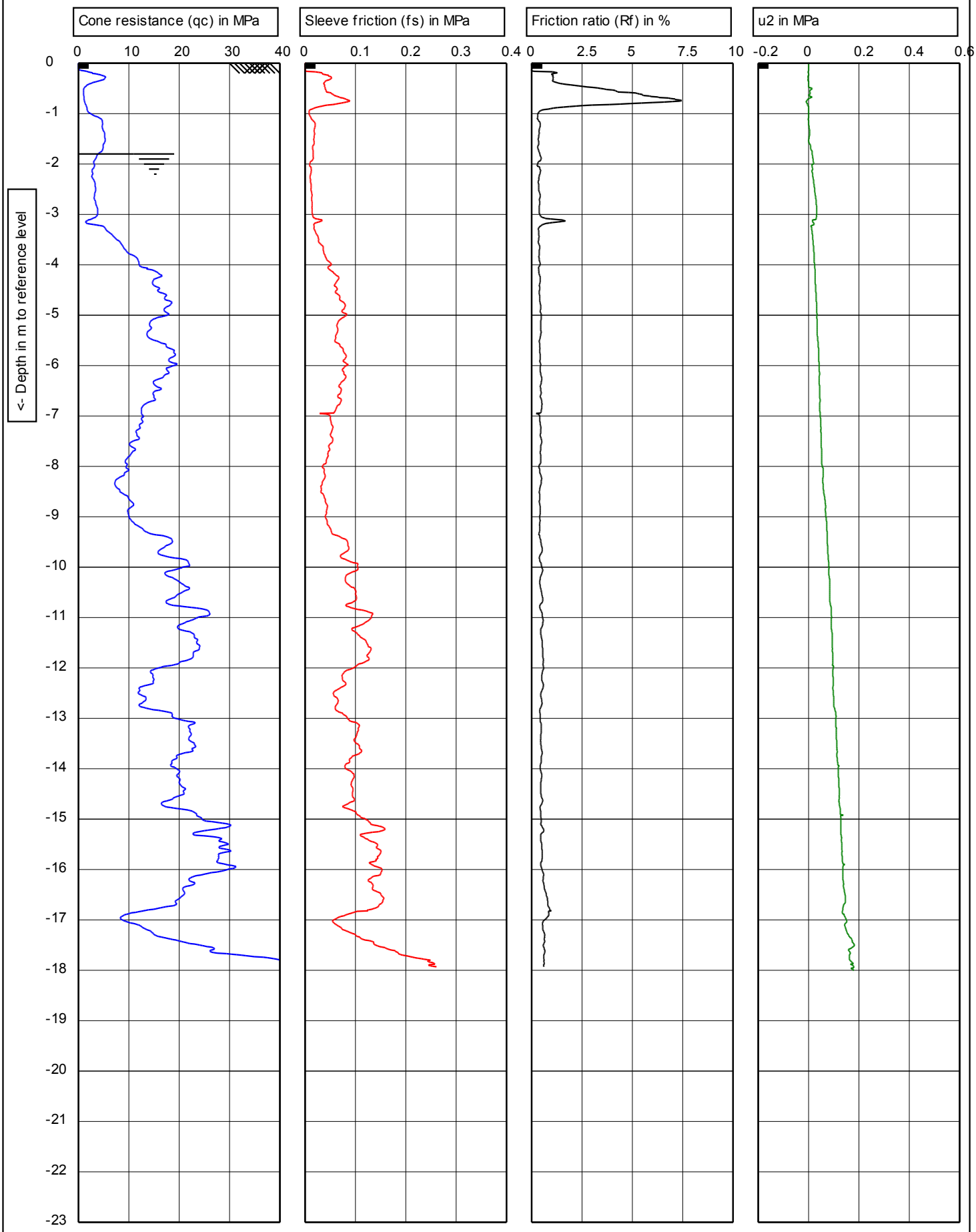
		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

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



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
150 cm²
10 cm²

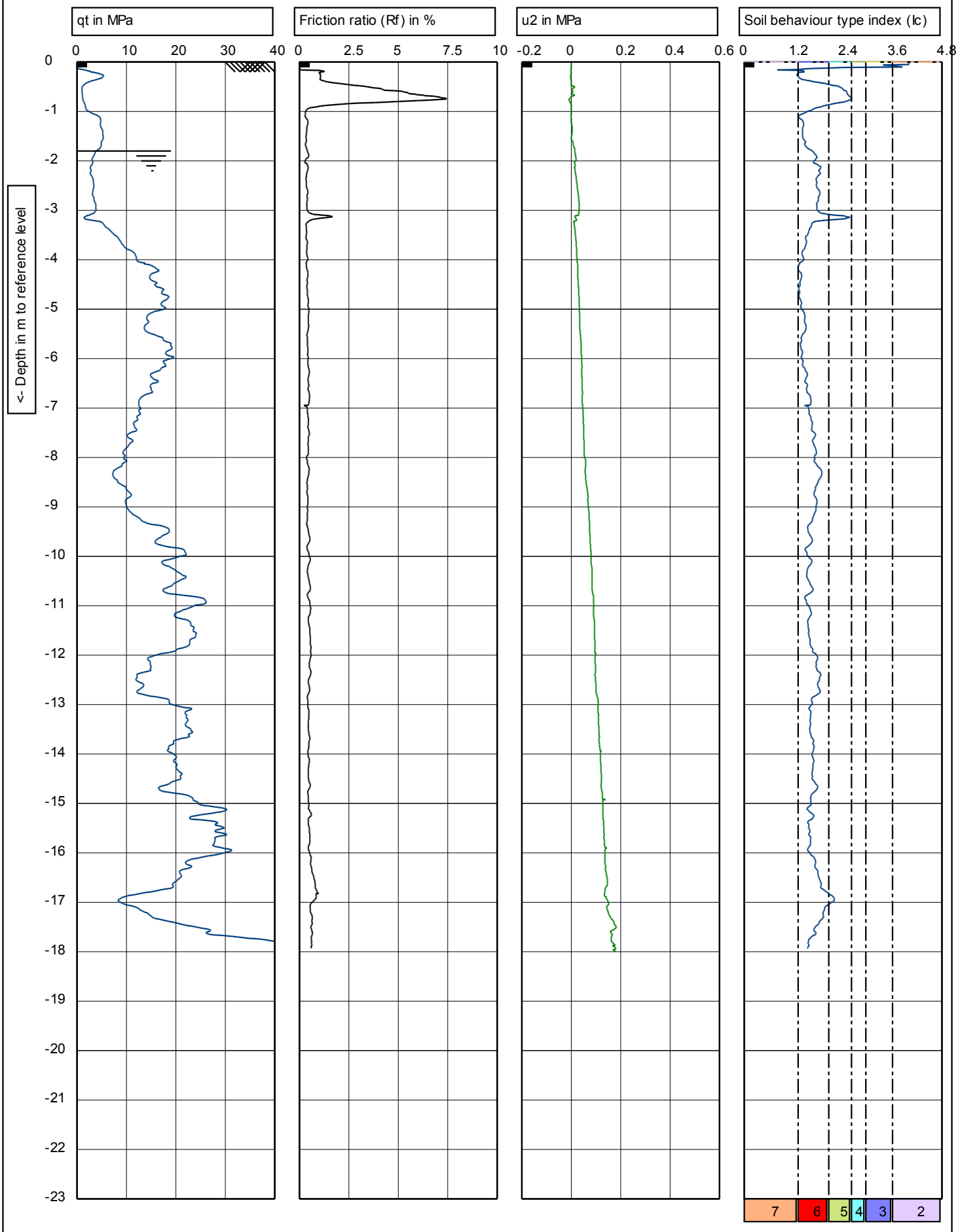
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.8**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0.1 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14062**
Project no.:	**RGS 30738**
CPT no.:	**CPT-1** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.8**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

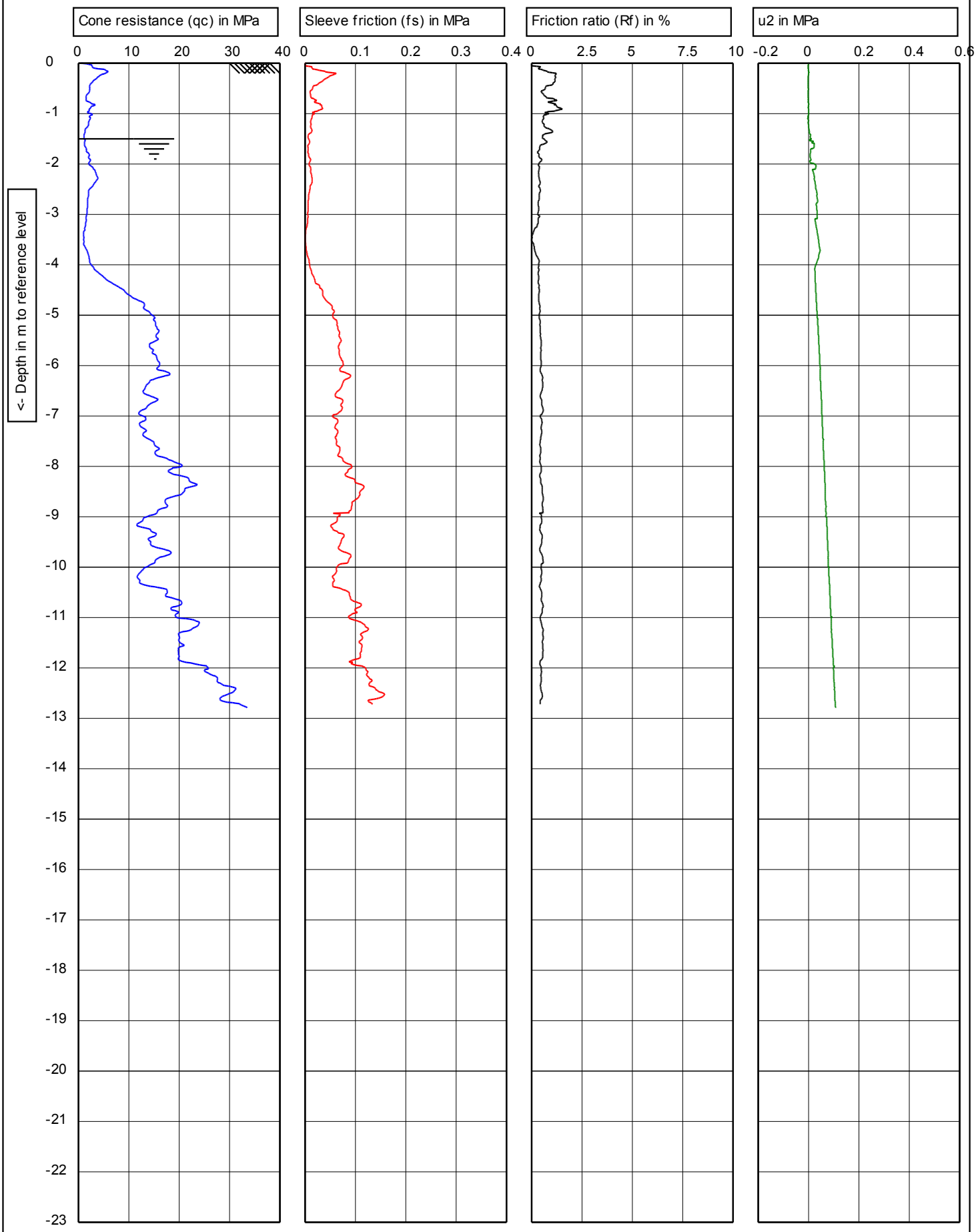
Predrill :	**0.1 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14062**
Project no.:	**RGS 30738**
CPT no.:	**CPT-1** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0.1 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.8**	Date:	**1/28/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14062**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-1** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

u2
150 cm²
10 cm²

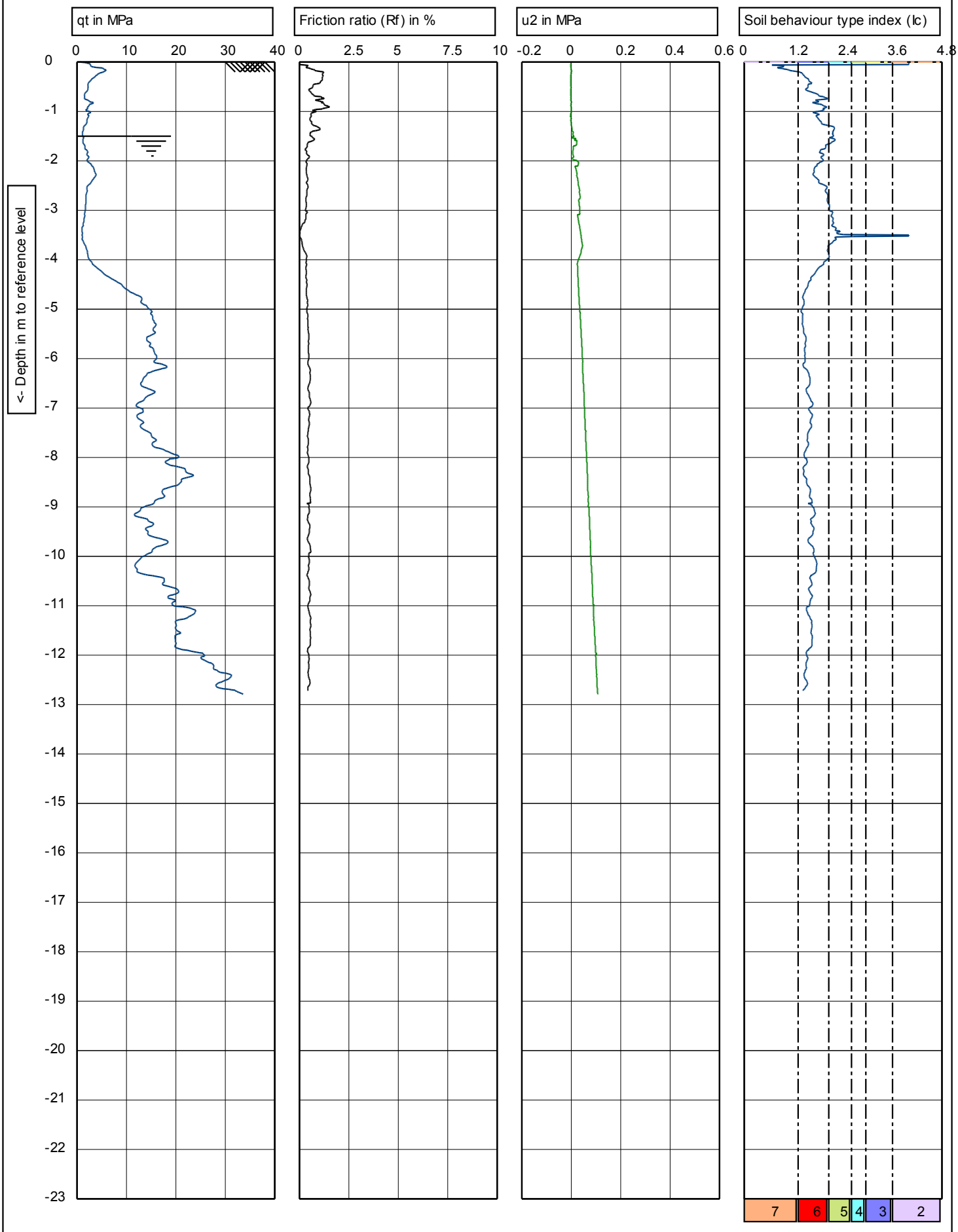
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.5**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-2** **1/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.5**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

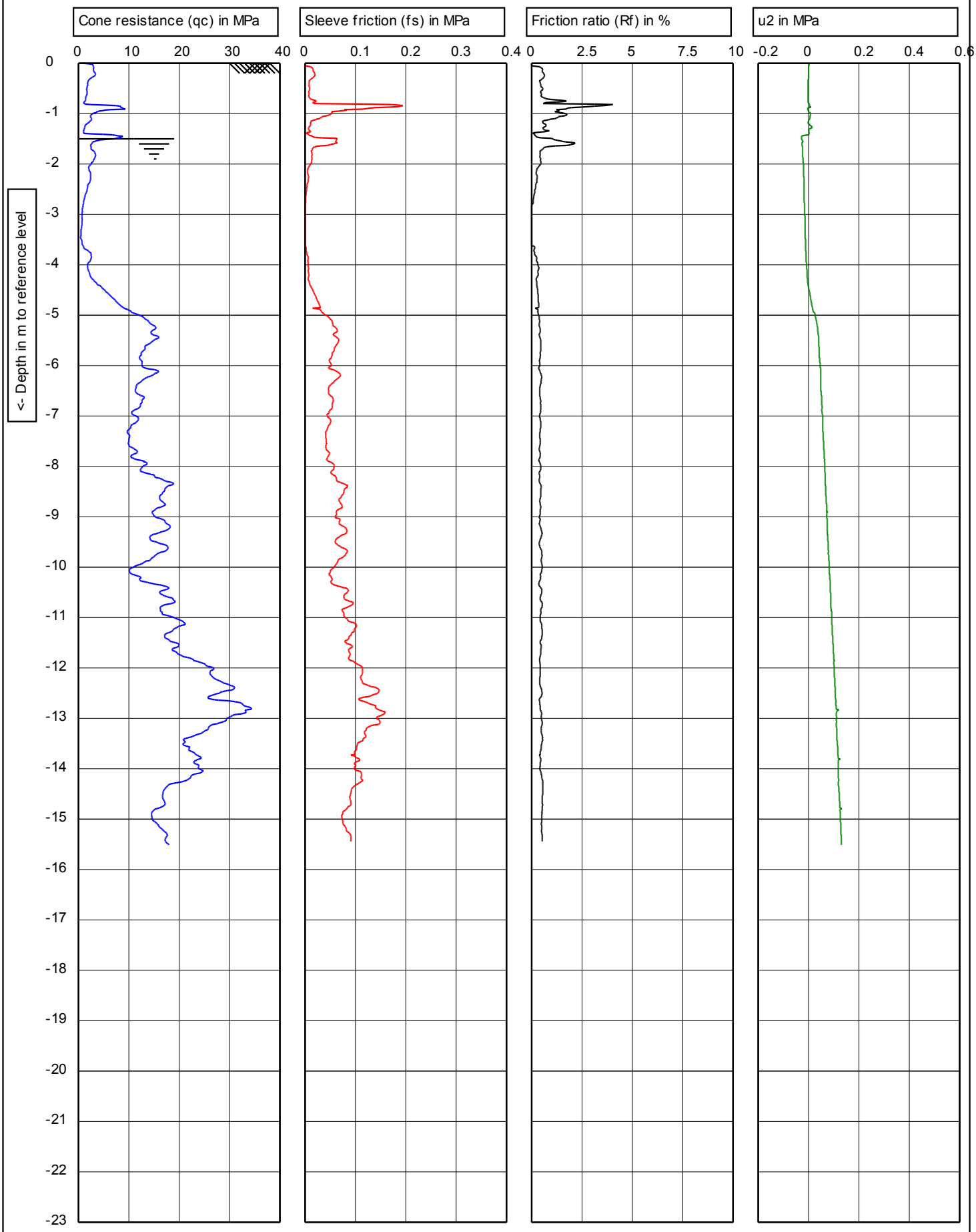
Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-2** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.5**	Date:	**1/28/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-2** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

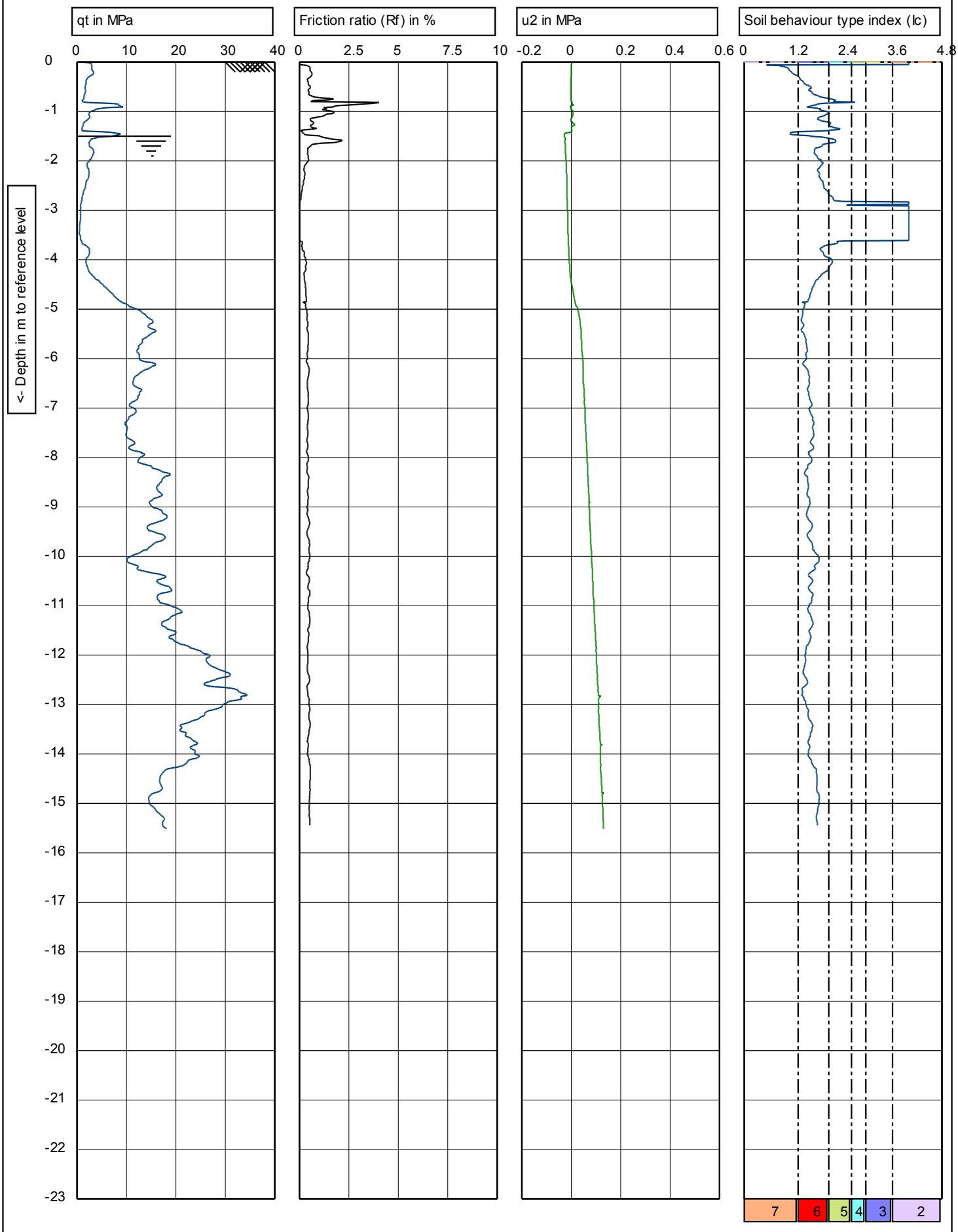
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.5**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-2A** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.5**

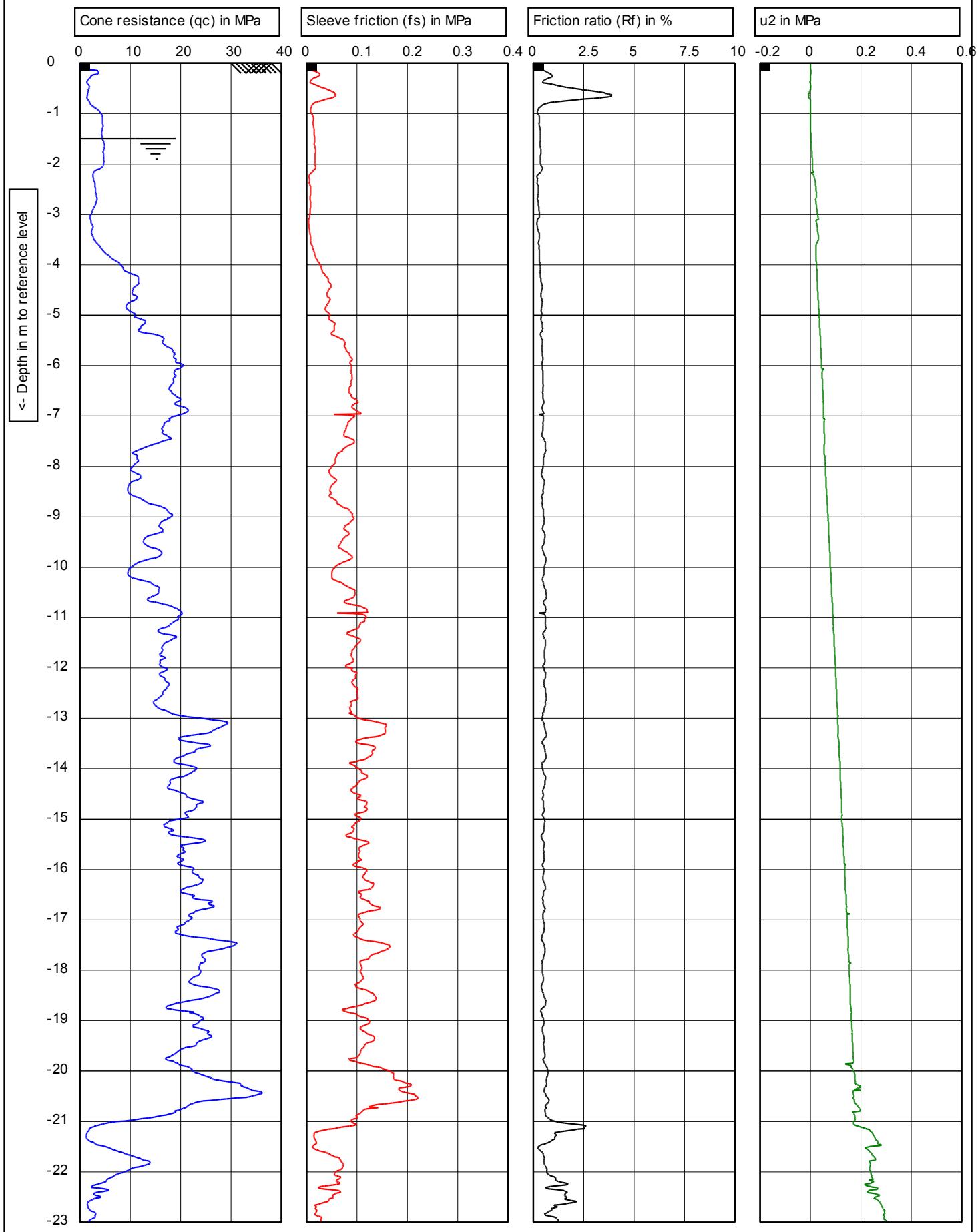
Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-2A** 2/3

1.40

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.5**	Date:	**1/28/2016**
	Project: **Geotechnical Investigation** Location: **Ballina High School** Position:			Cone no.:	**C10CFIIP.C14476**
				Project no.:	**RGS 30738**
				CPT no.:	**CPT-2A** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
150 cm²
10 cm²

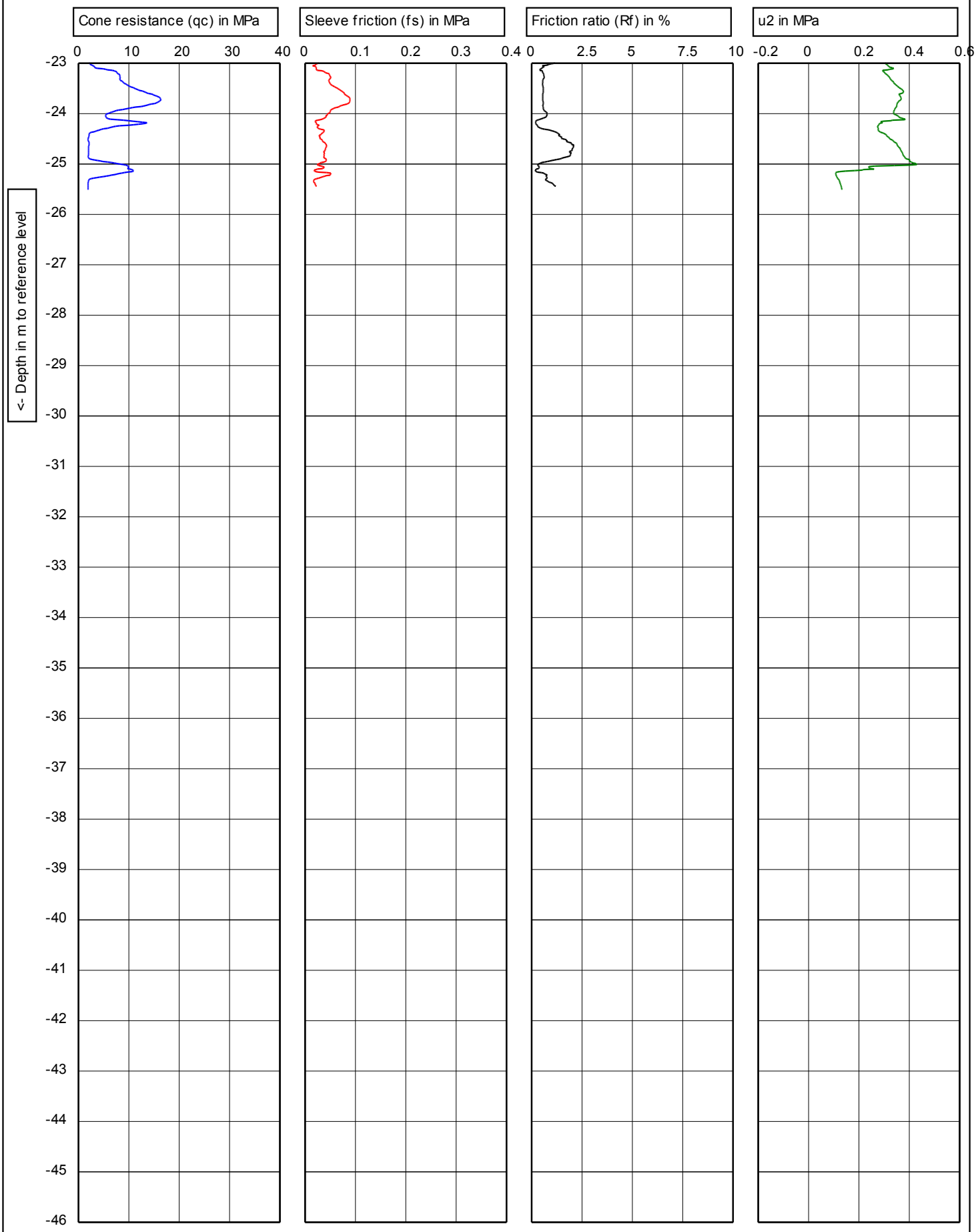
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.5**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0.14 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-3** 1/6

1.40



NEWSYD
GEOTECHNICAL
TESTING
Ph:0408292638

r u2
150 cm²
10 cm²

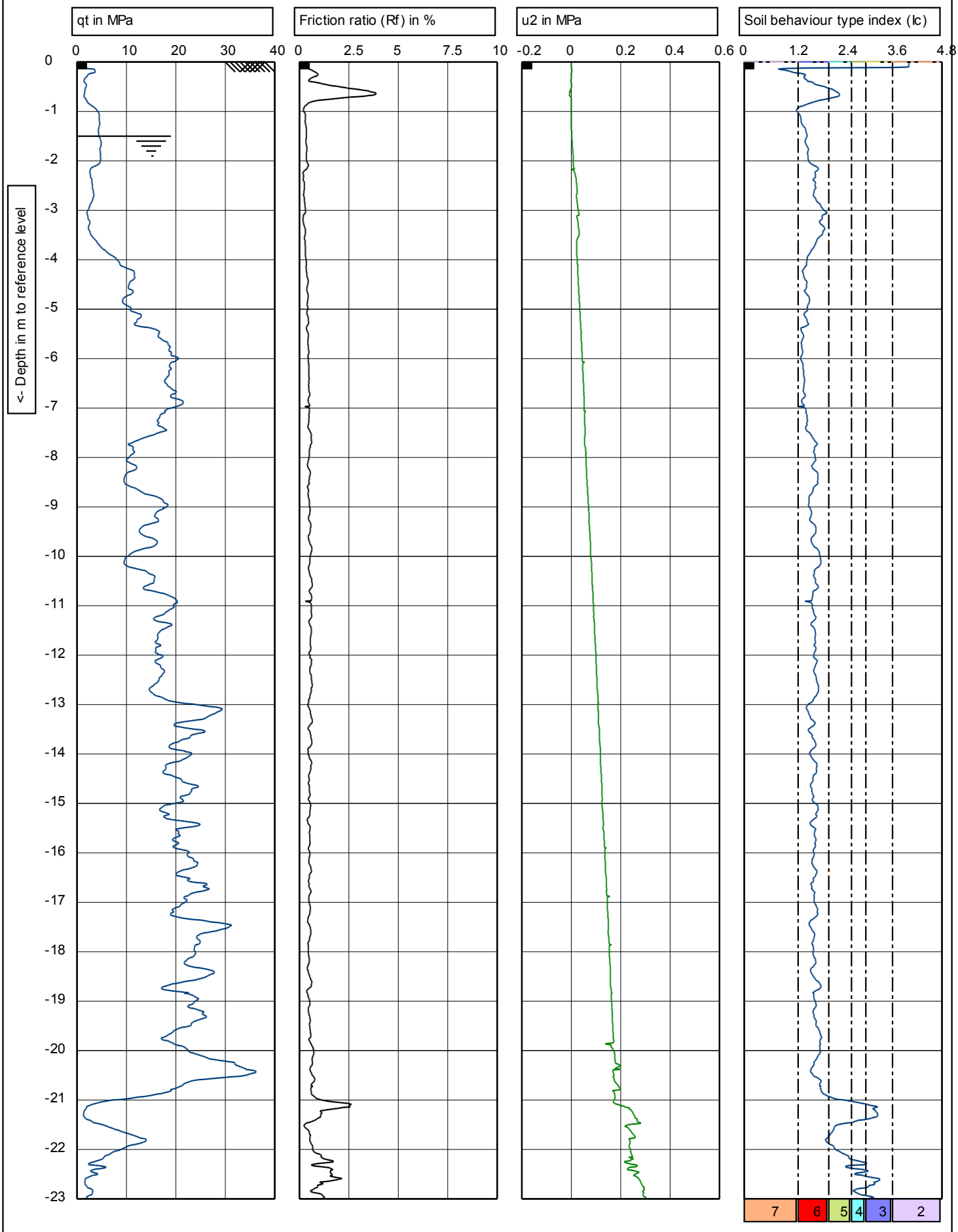
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.5**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0.14 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-3** **2/6**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

u2
150 cm²
10 cm²

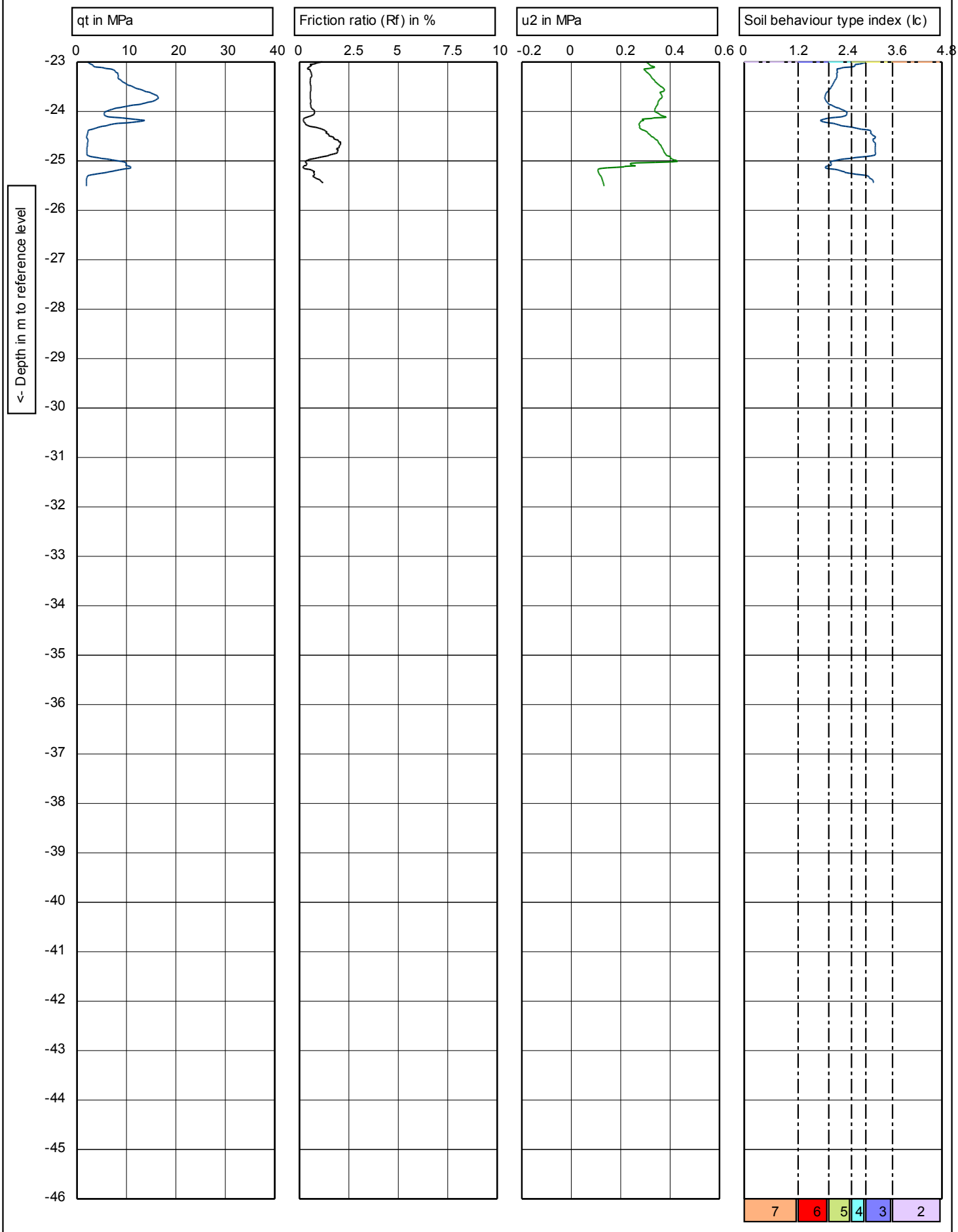
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.5**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0.14 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-3** 3/6

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.5**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

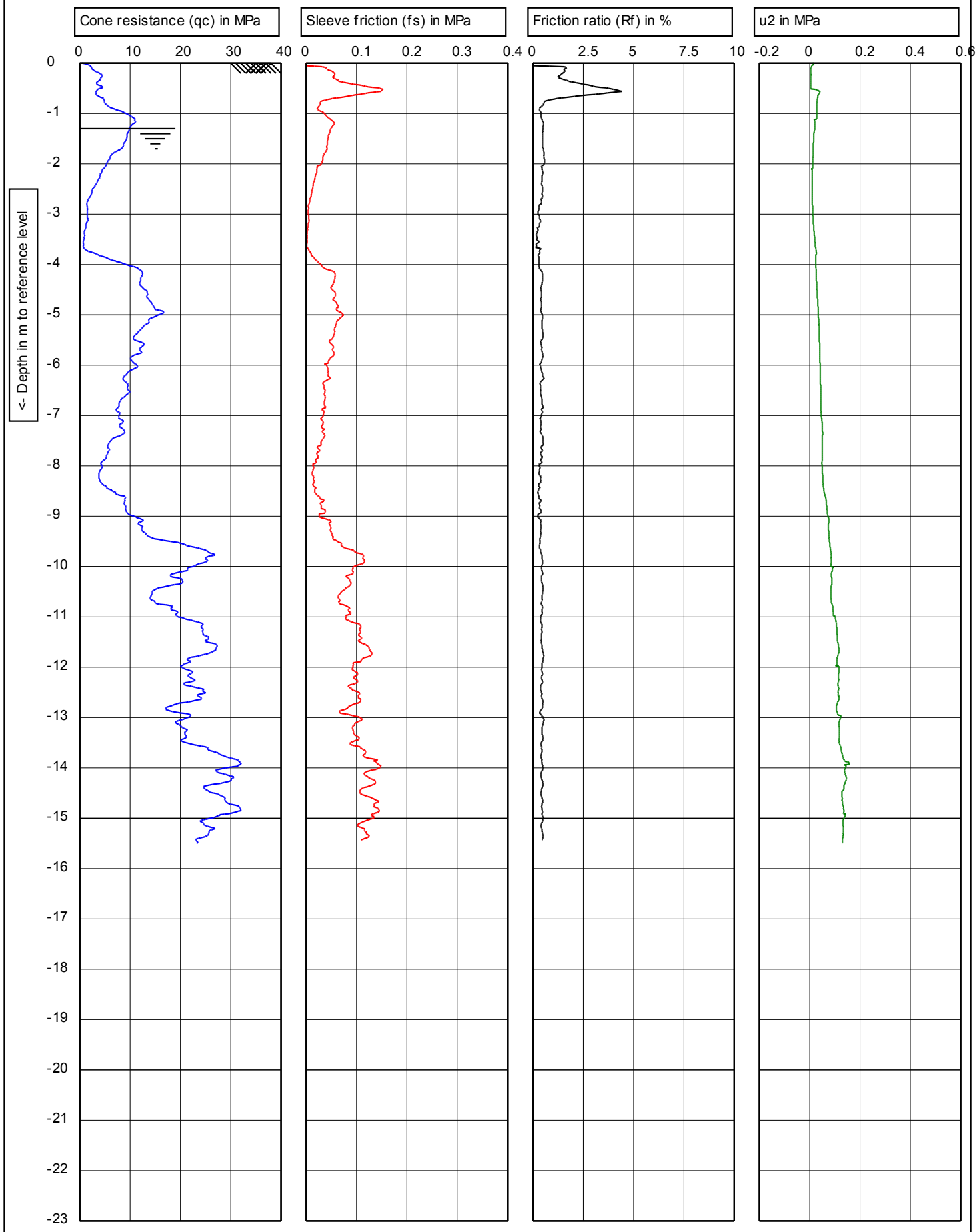
Predrill :	**0.14 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-3** 4/6

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0.14 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.5**	Date:	**1/28/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-3** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

u2
150 cm²
10 cm²

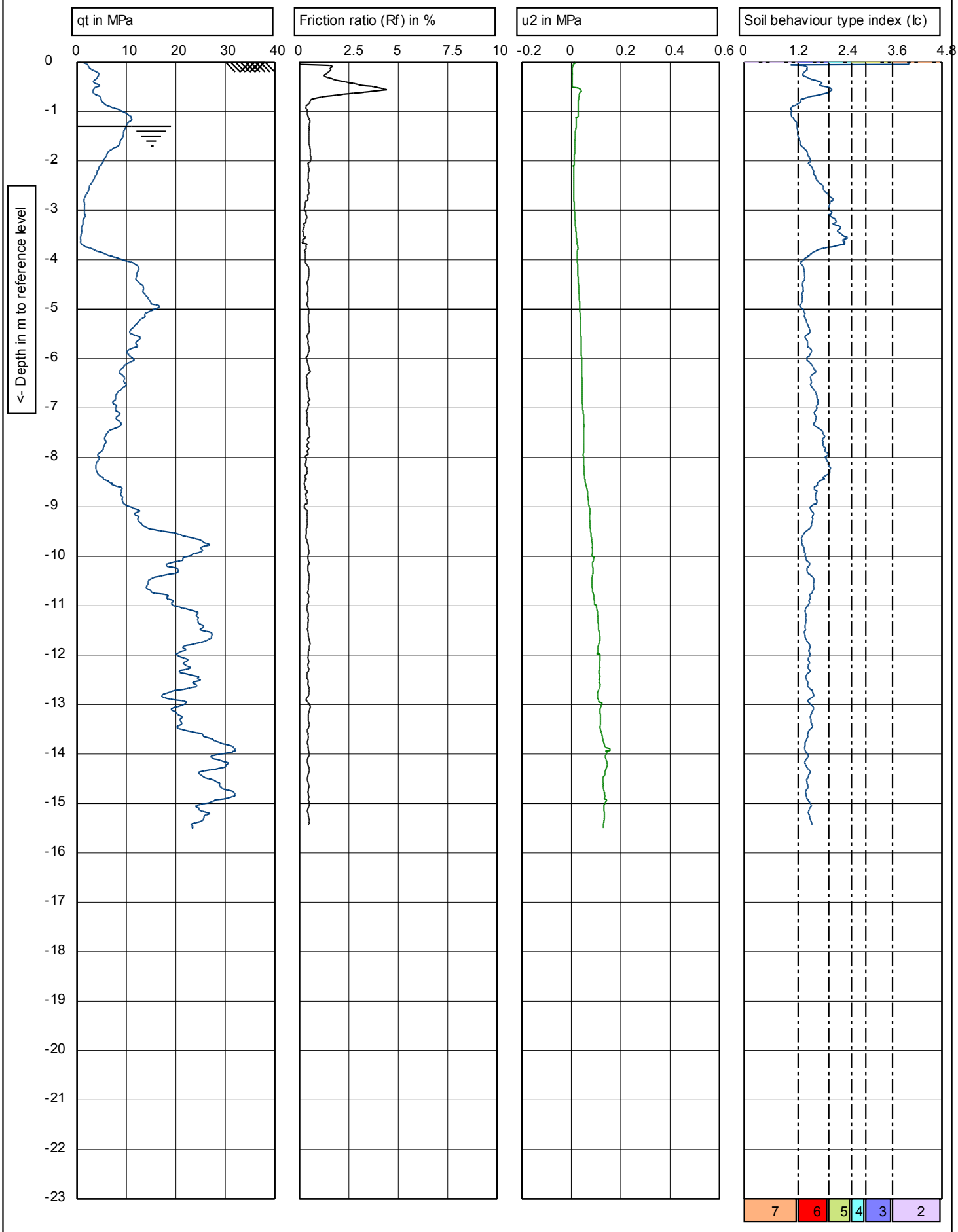
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-4** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

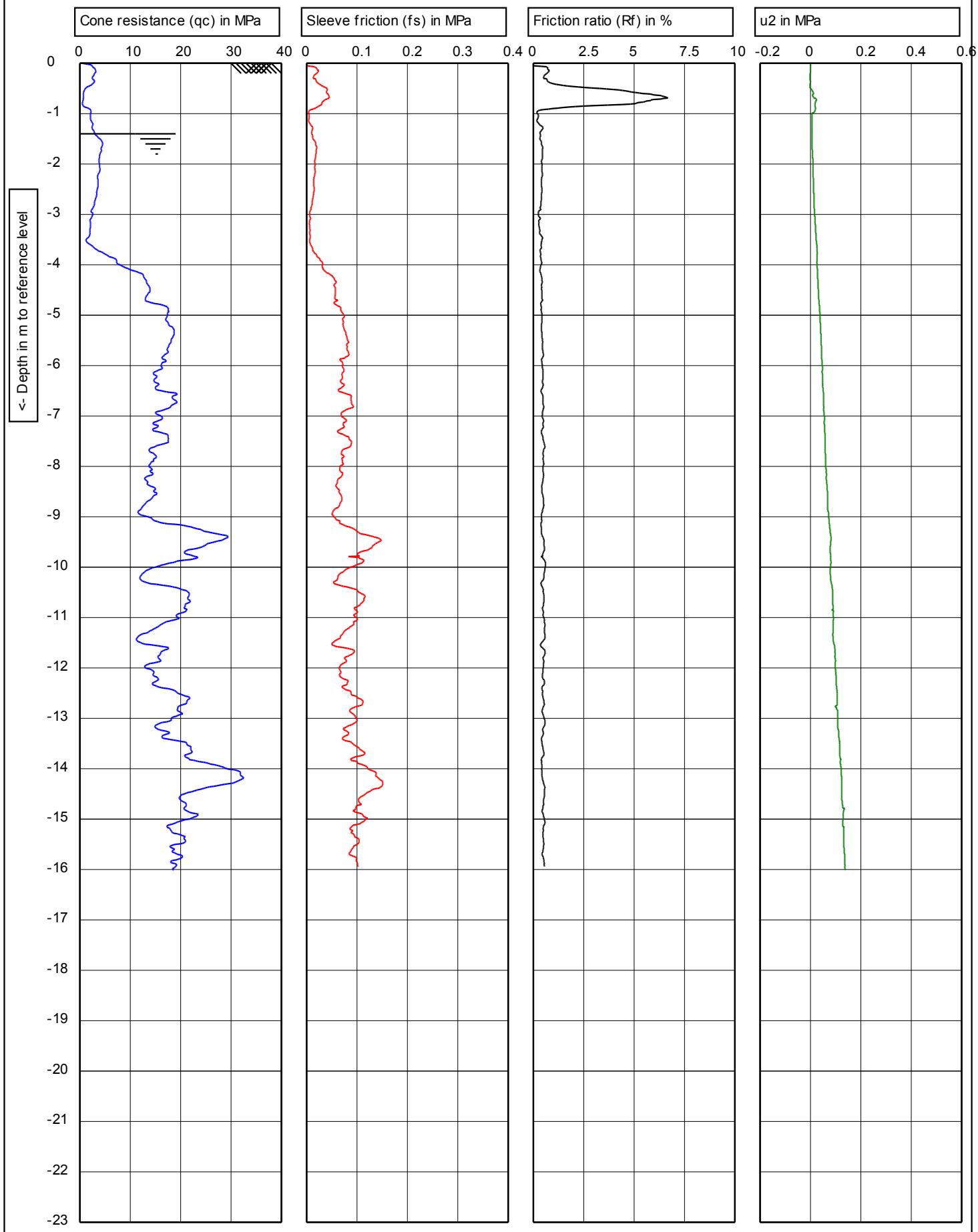
Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-4** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.3**	Date:	**1/28/2016**
	Project: **Geotechnical Investigation** Location: **Ballina High School** Position:			Cone no.:	**C10CFIIP.C14476**
				Project no.:	**RGS 30738**
				CPT no.:	**CPT-4** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

u2
150 cm²
10 cm²

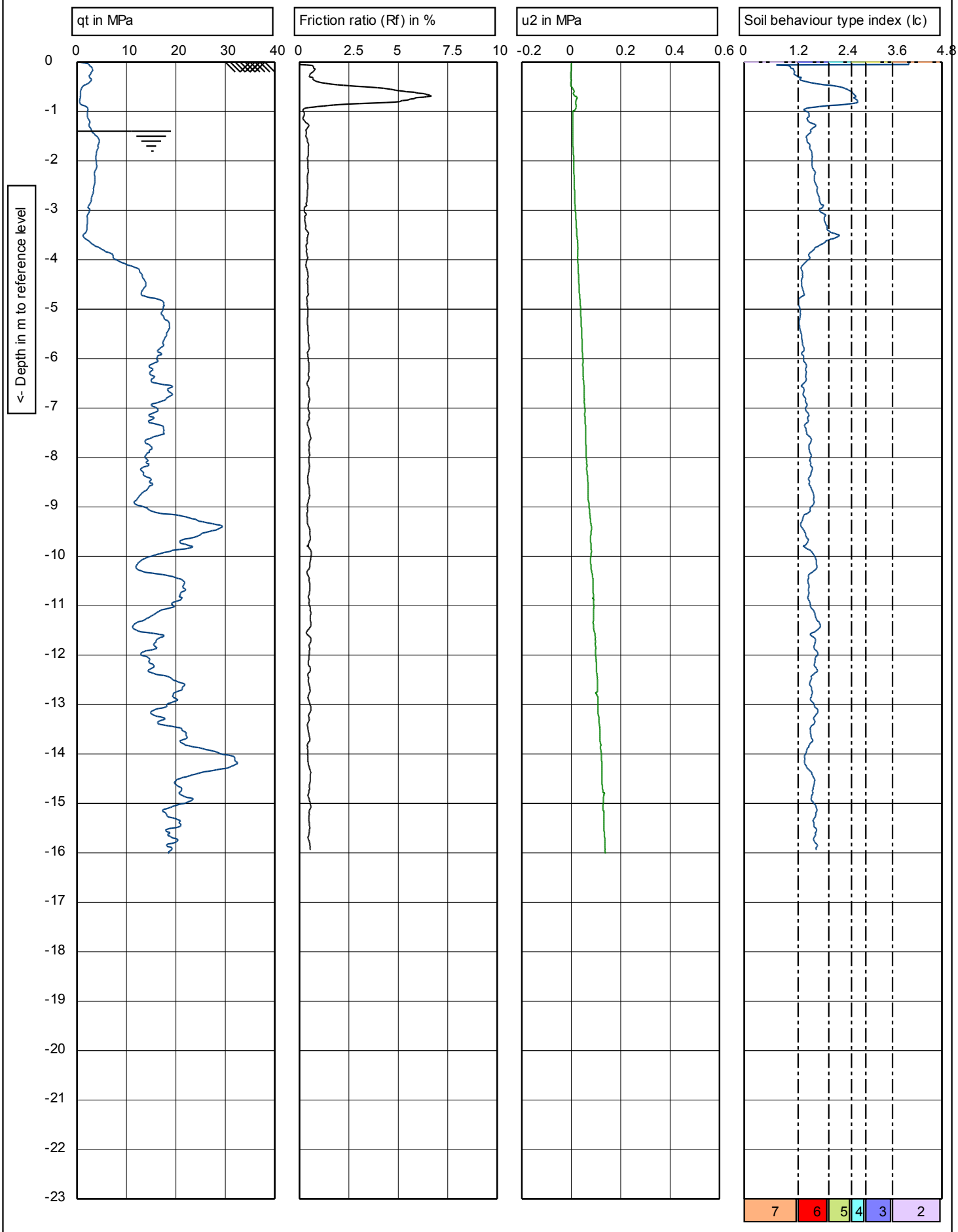
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.4**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-5** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.4**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

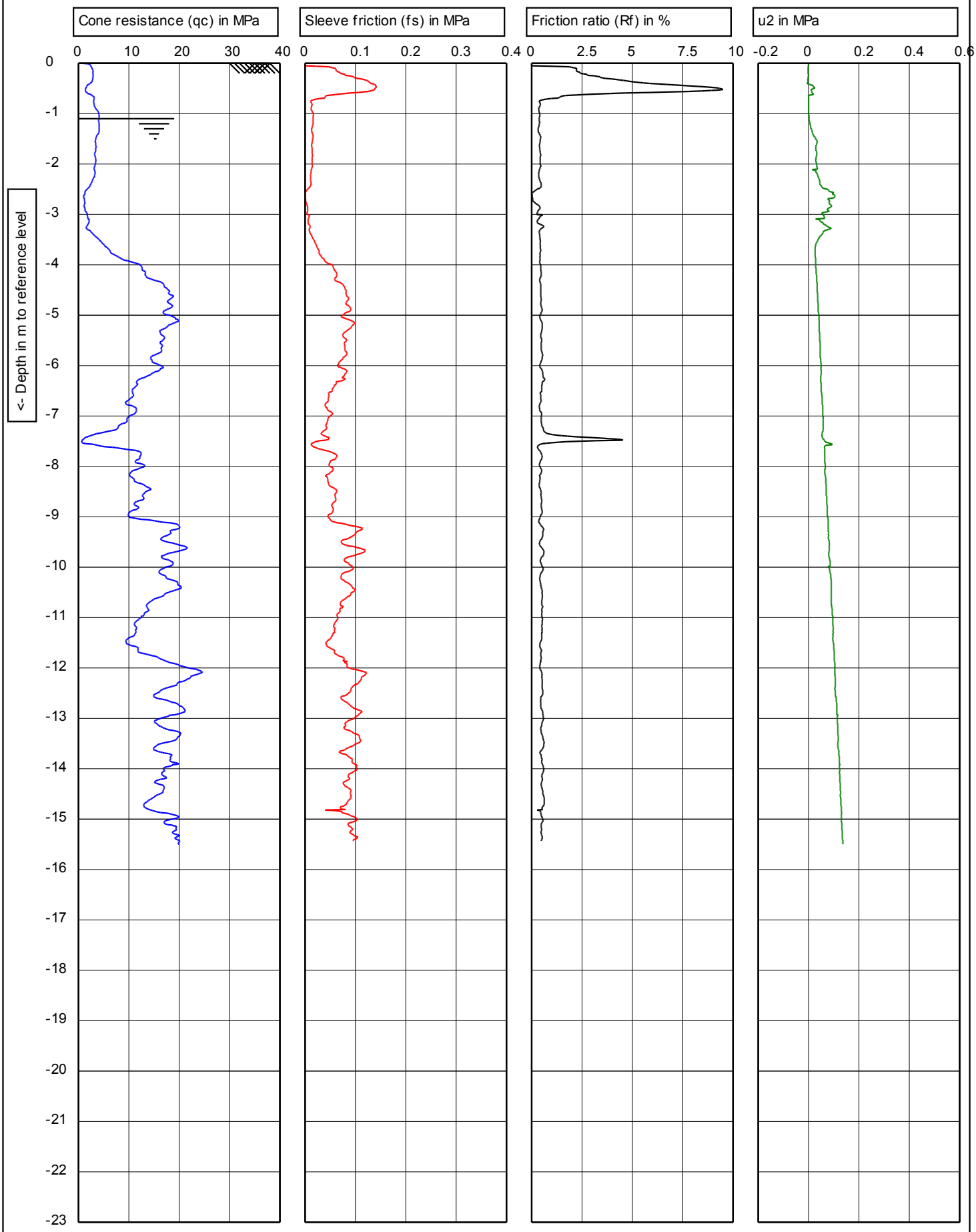
Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-5** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.4**	Date:	**1/28/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-5** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

u2
150 cm²
10 cm²

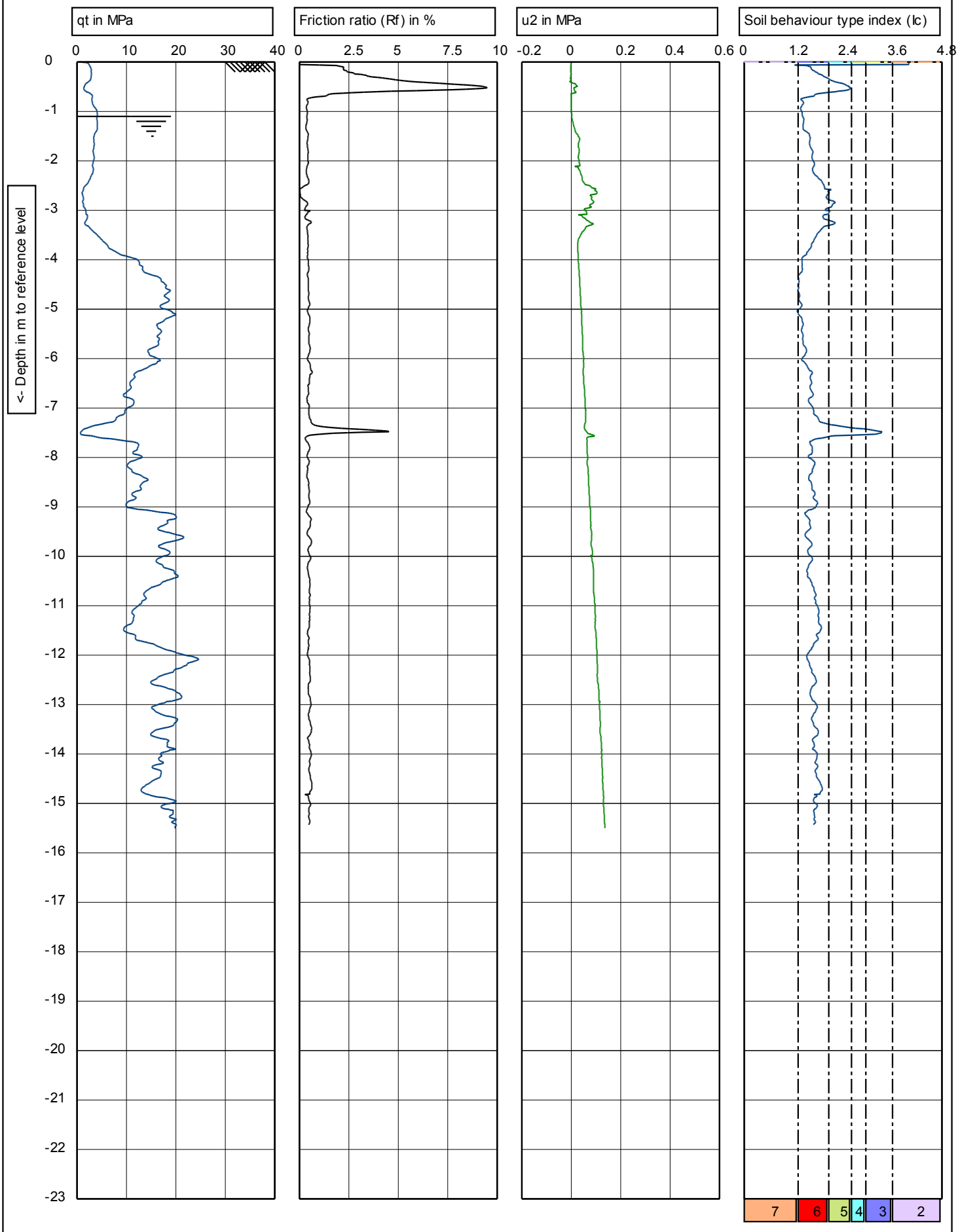
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.1**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-6** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.1**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

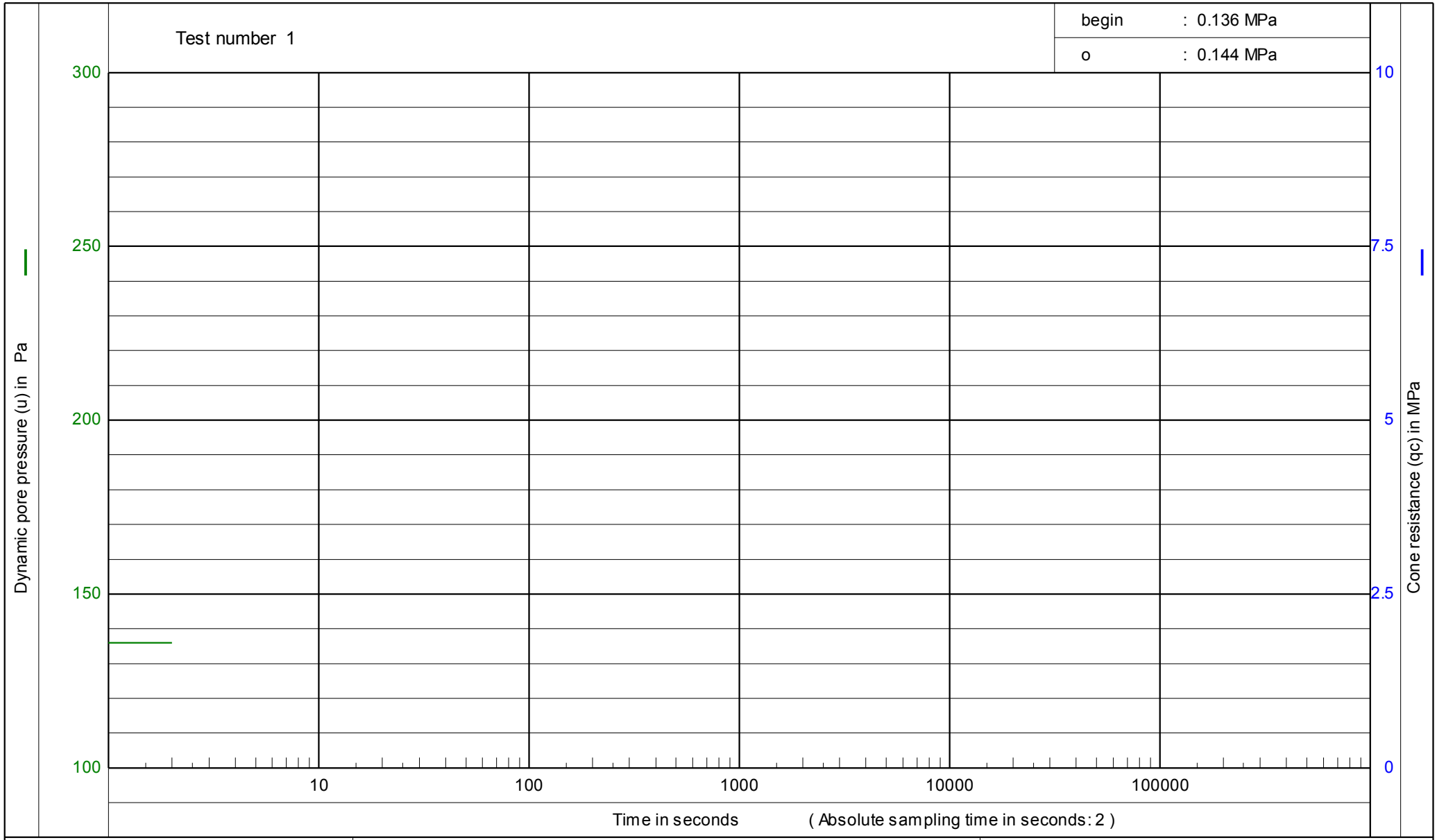
Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-6** 2/3

1.40

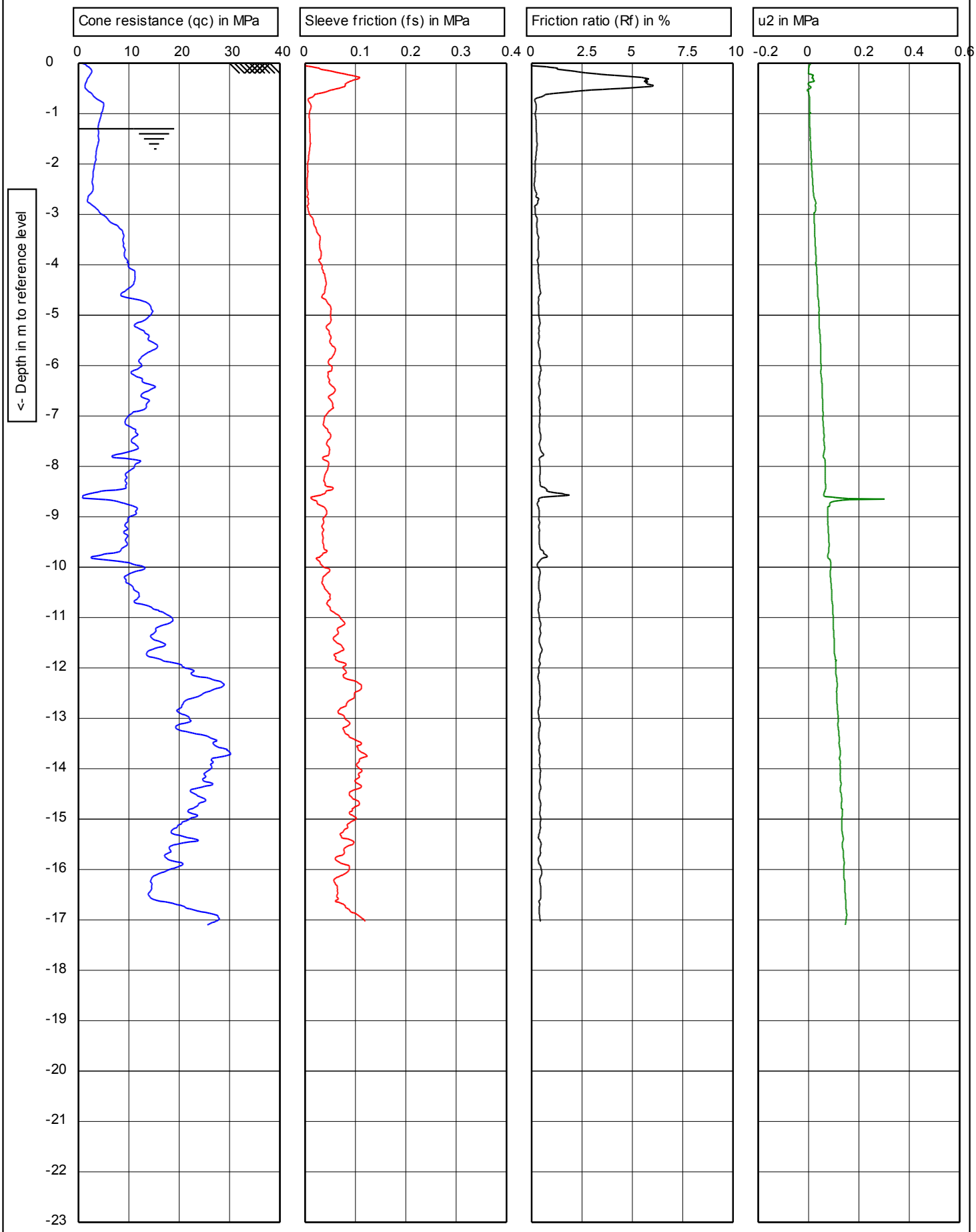
(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.1**	Date:	**1/28/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-6** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING Ph:0408292638	Test according NEN 5140 class 1	Date : 1 28 2016
	Project : Geotechnical Investigation	Project no. : RGS 30738
		CPT no. : CPT-6
	Location : allina igh School	Test depth : 15.5 m - G.L.
		Water level : -1.1 m - G.L.



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

u2
150 cm²
10 cm²

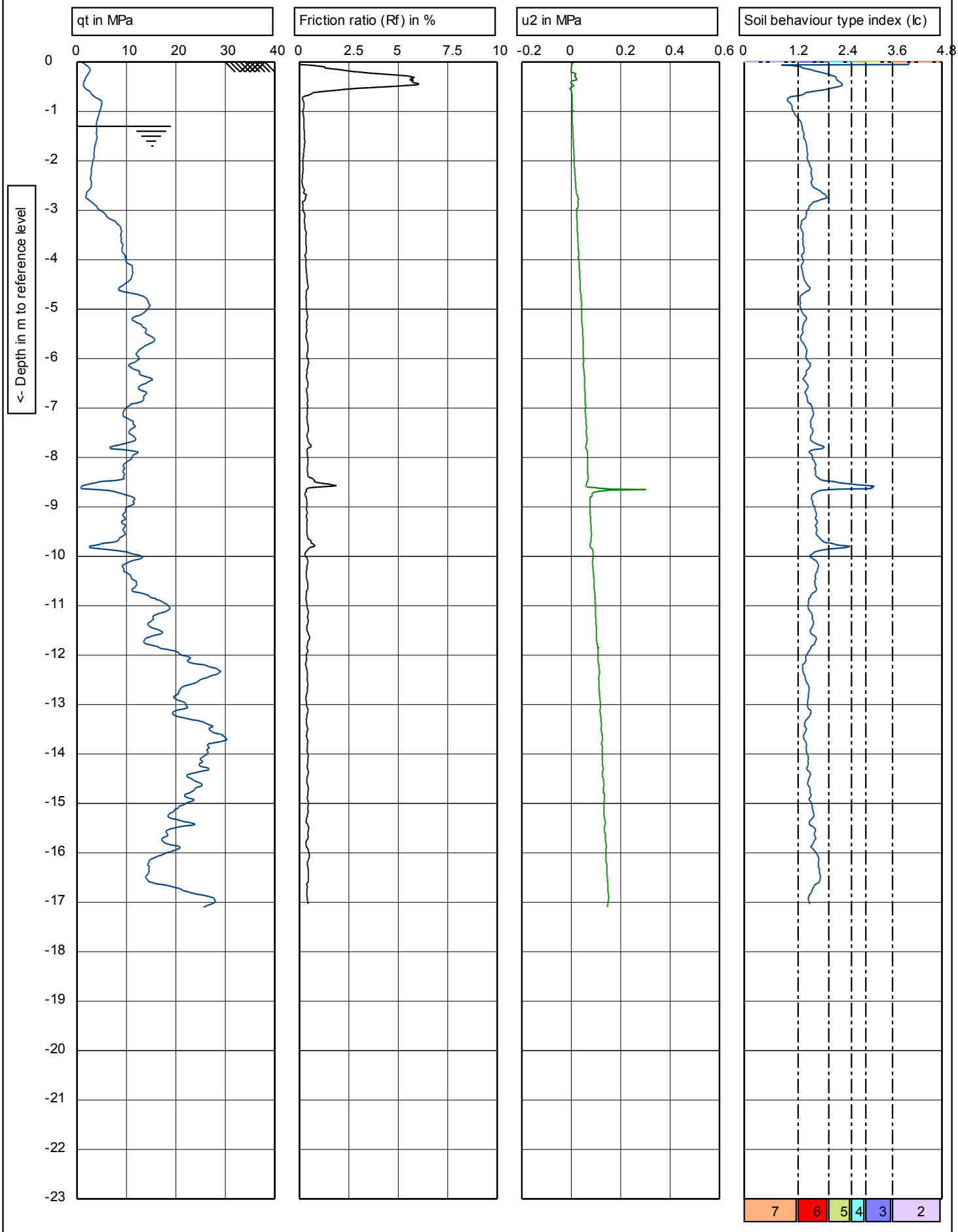
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-7** **1/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

u2
150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

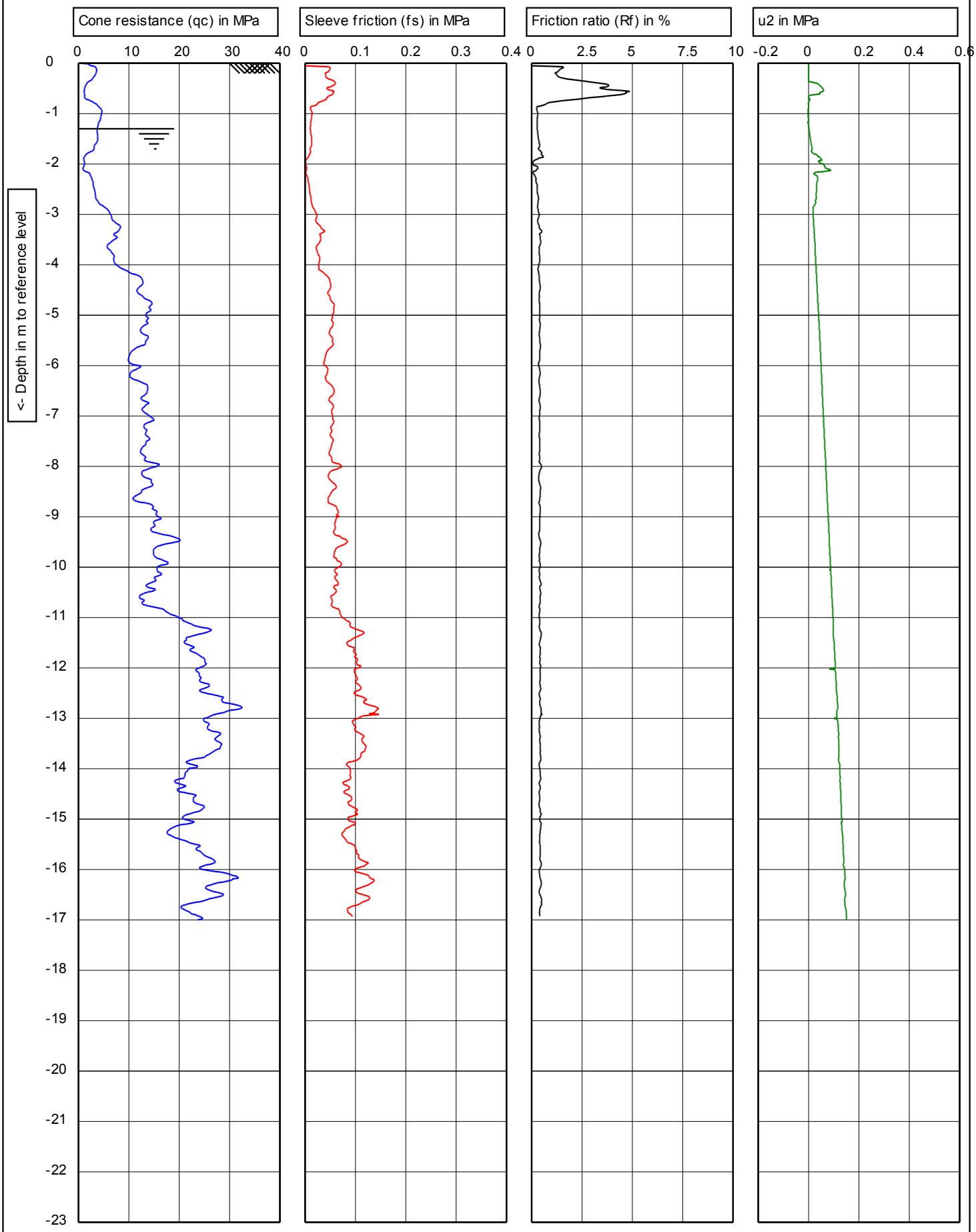
Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-7** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.3**	Date:	**1/29/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-7** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
150 cm²
10 cm²

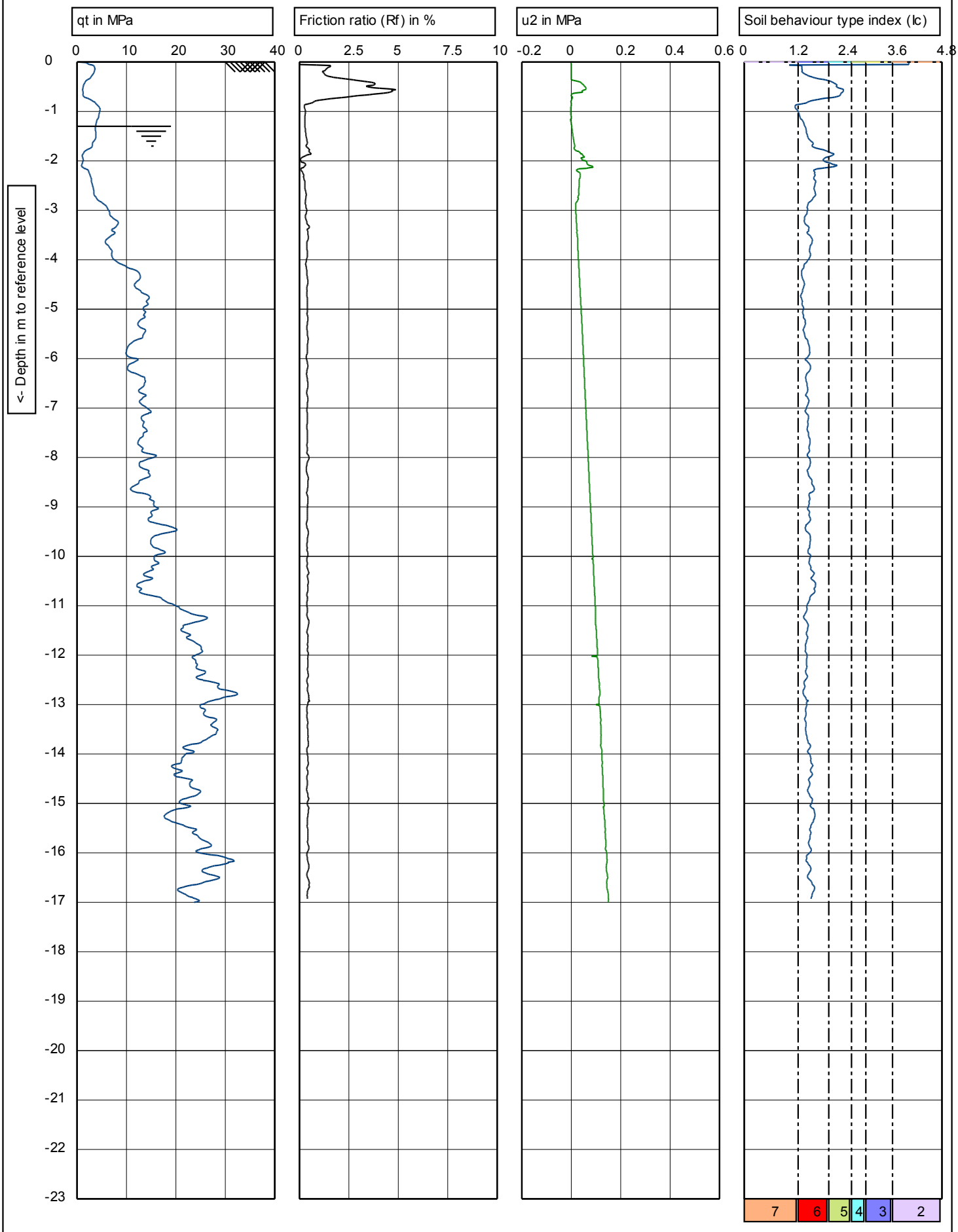
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-8** 1/3

1.40



NEWSYD
GEOTECHNICAL
TESTING
Ph:0408292638

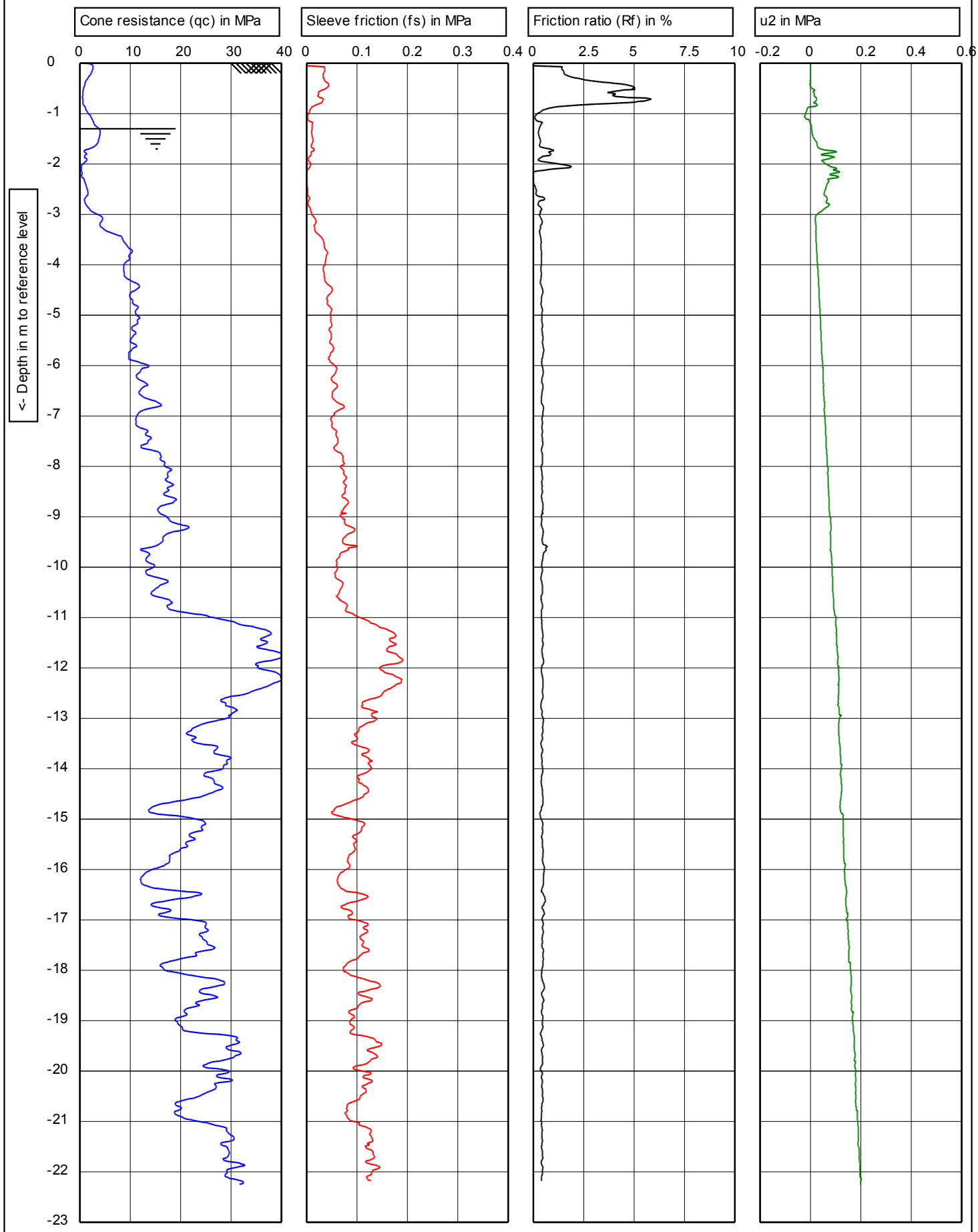
r u2 / L 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill : **0 m Predrilled**
	G.L. 0 NAP	W.L.: **-1.3**	Date: **1/29/2016**
Project: **Geotechnical Investigation**			Cone no.: **C10CFIIP.C14476**
Location: **Ballina High School**			Project no.: **RGS 30738**
Position:			CPT no.: **CPT-8** **2/3**

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.3**	Date:	**1/29/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-8** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
150 cm²
10 cm²

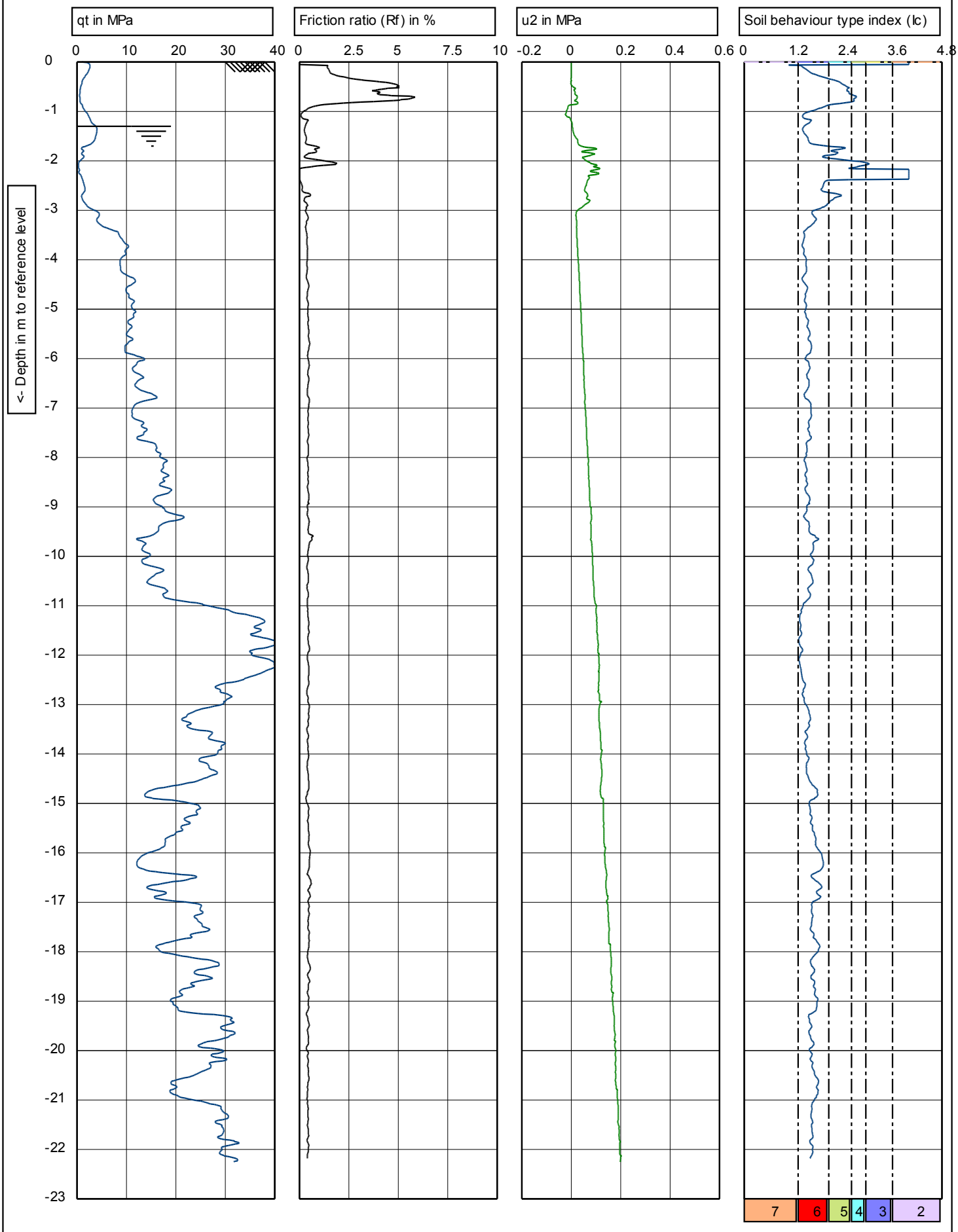
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-9** 1/3

1.40



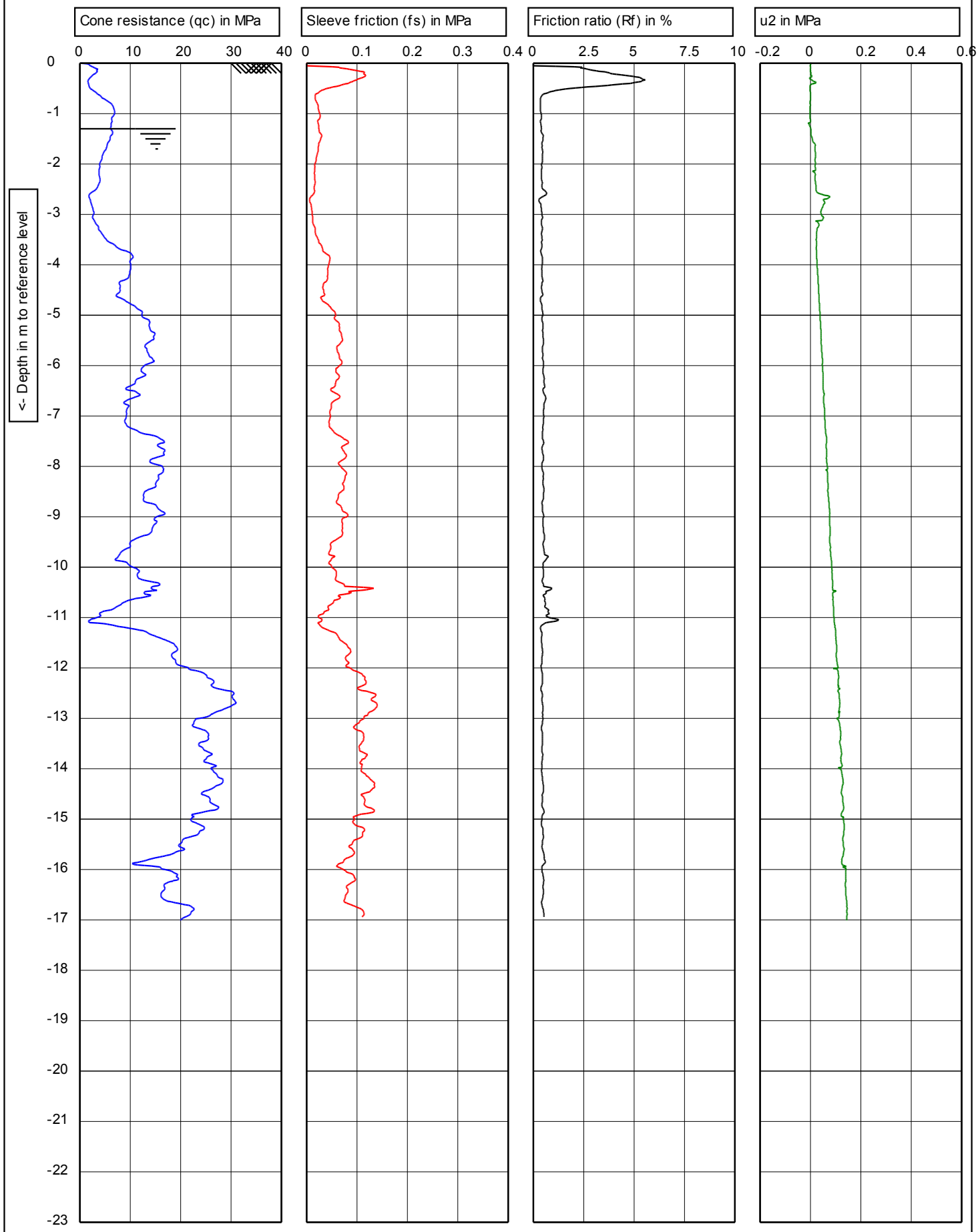
NEWSYD GEOTECHNICAL TESTING Ph:0408292638	Test according NEN 5140 class 1	Predrill :	**0 m Predrilled**
	G.L. 0 NAP — W.L.: **-1.3**	Date:	**1/29/2016**
	Project: **Geotechnical Investigation**	Cone no.:	**C10CFIIP.C14476**
	Location: **Ballina High School**	Project no.:	**RGS 30738**
	Position:	CPT no.:	**CPT-9** **2/3**

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.3**	Date:	**1/29/2016**
	Project: **Geotechnical Investigation** Location: **Ballina High School** Position:			Cone no.:	**C10CFIIP.C14476**
				Project no.:	**RGS 30738**
				CPT no.:	**CPT-9** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
150 cm²
10 cm²

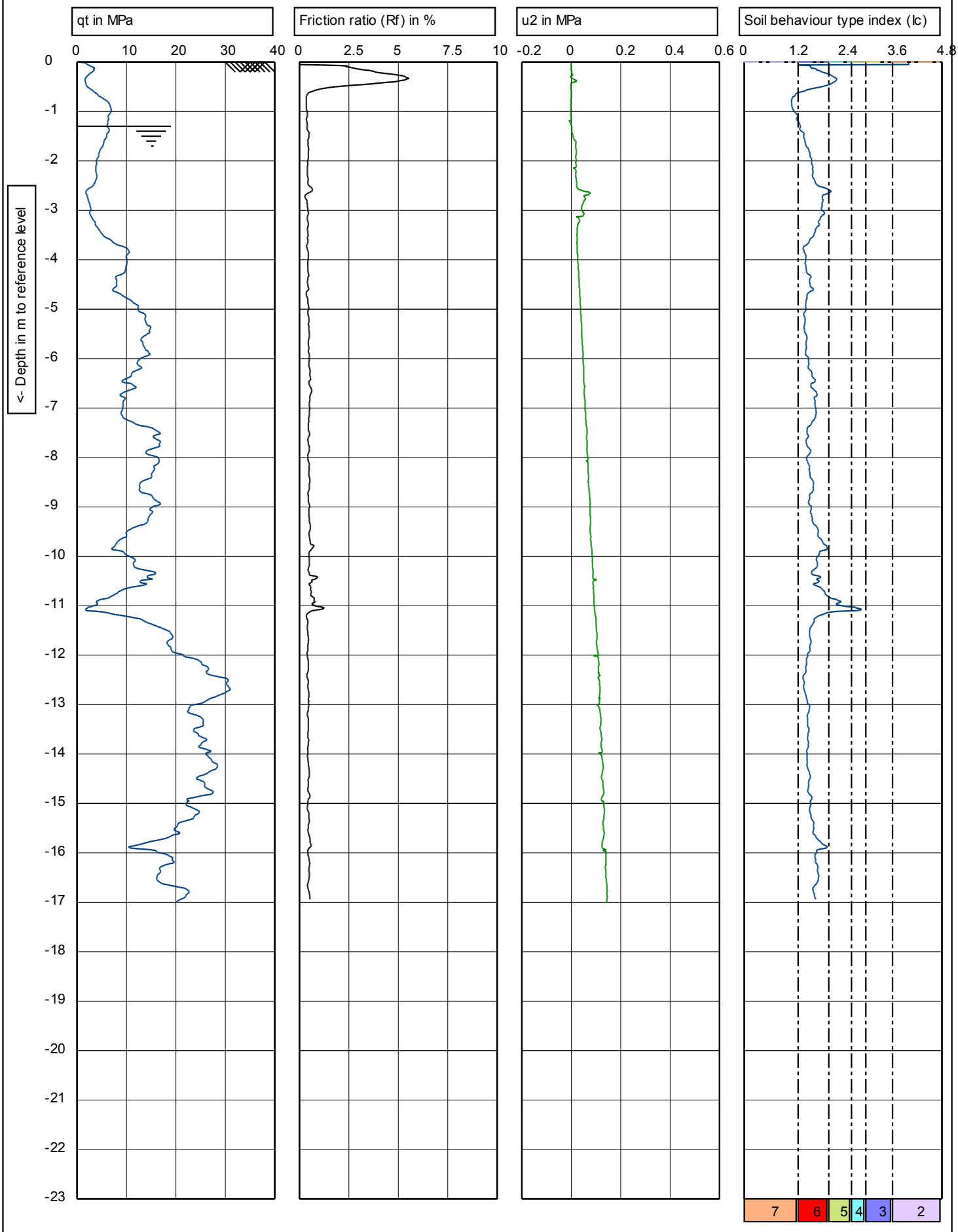
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-10** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

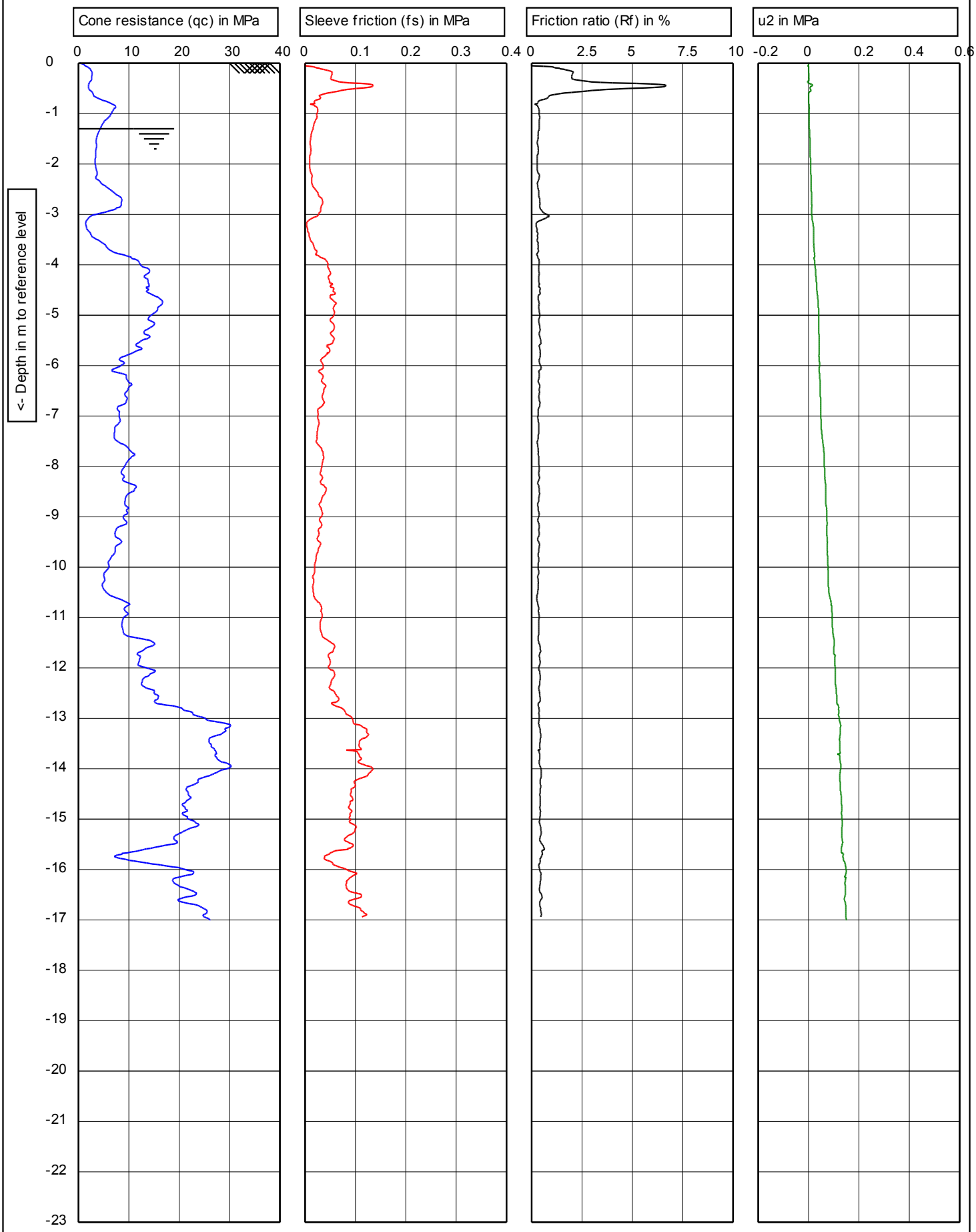
Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-10** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.3**	Date:	**1/29/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-10** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
150 cm²
10 cm²

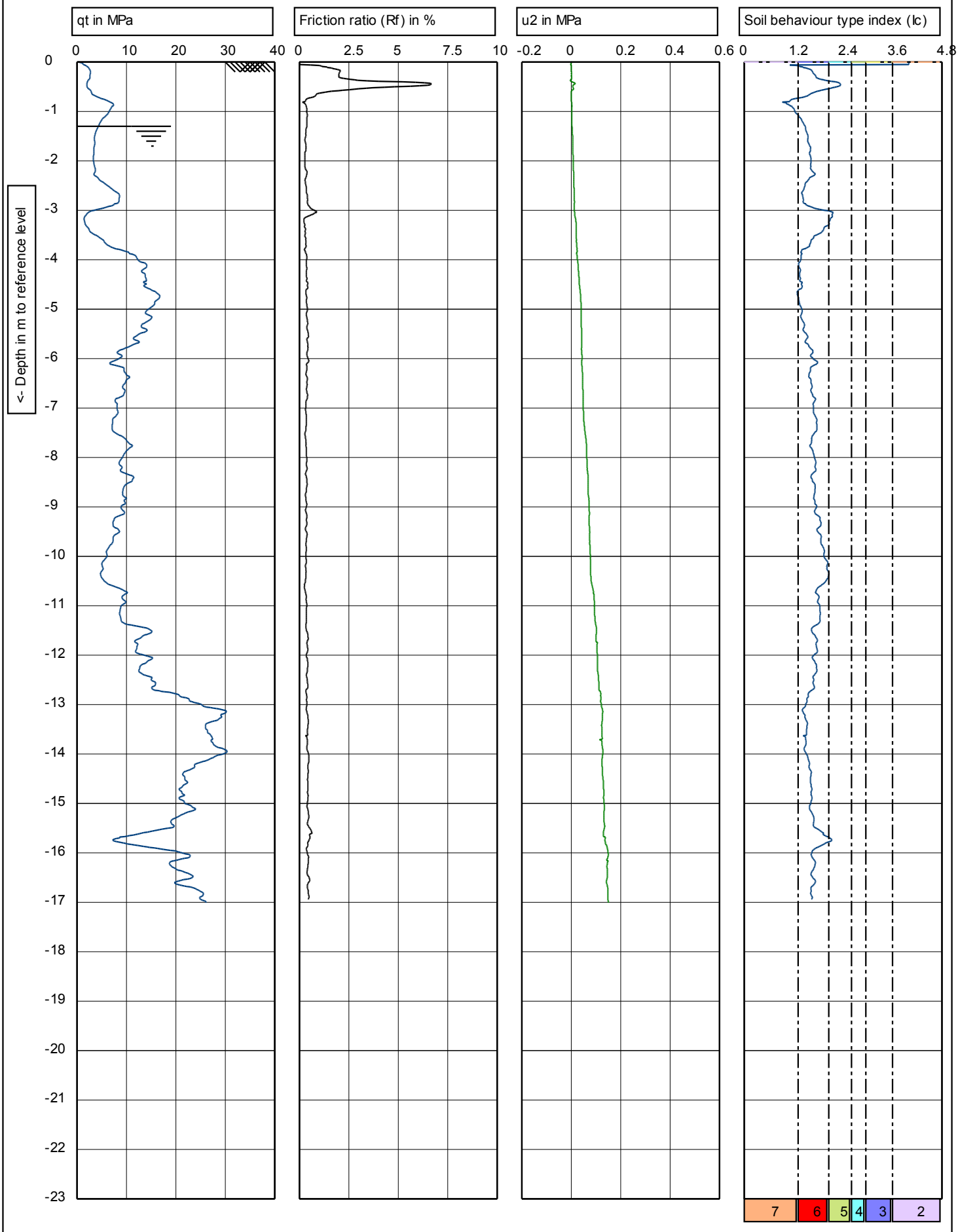
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-11** 1/3

1.40



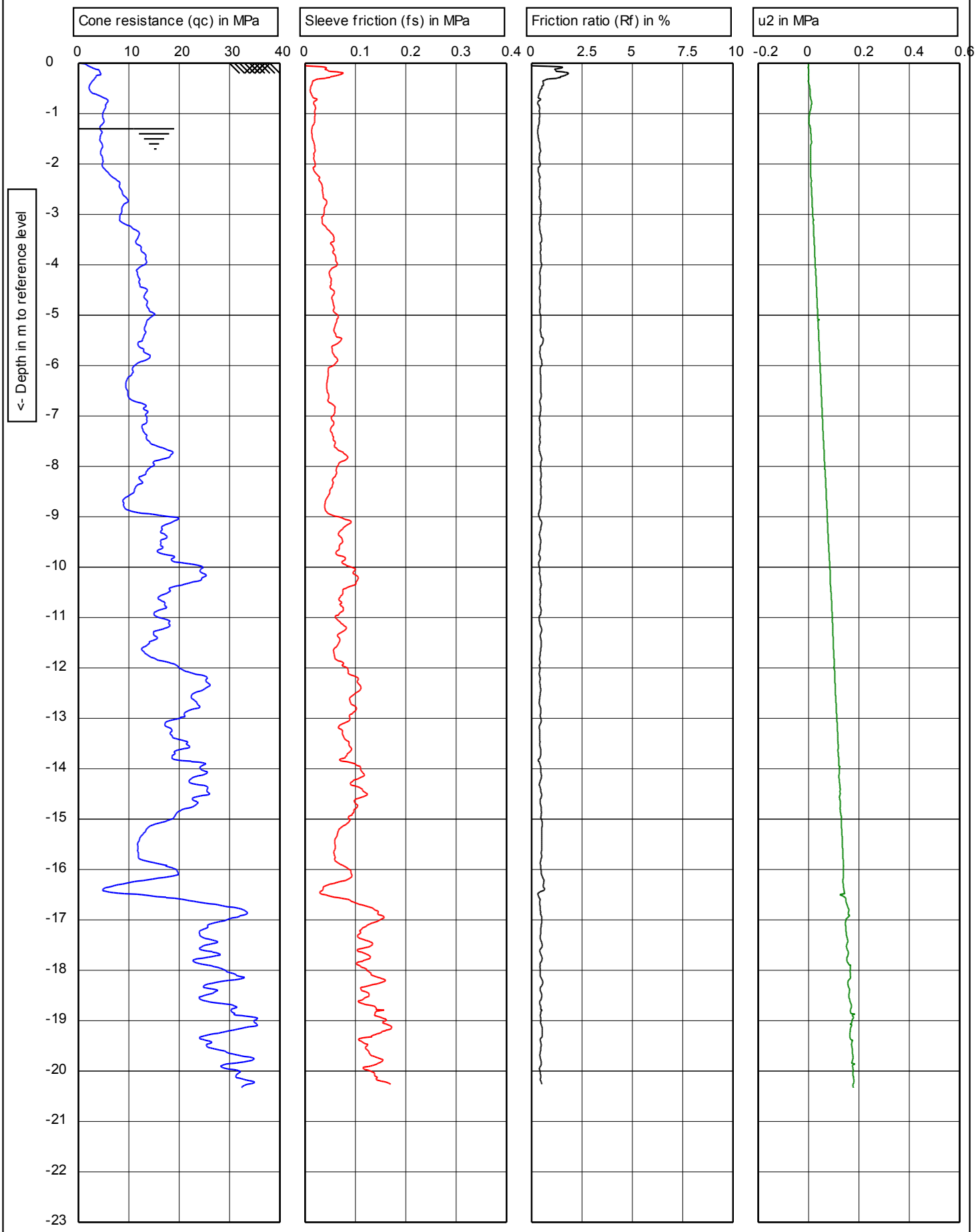
NEWSYD GEOTECHNICAL TESTING Ph:0408292638	Test according NEN 5140 class 1	Predrill :	**0 m Predrilled**
	G.L. 0 NAP — W.L.: **-1.3**	Date:	**1/29/2016**
Project: **Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
Location: **Ballina High School**		Project no.:	**RGS 30738**
Position:		CPT no.:	**CPT-11** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.3**	Date:	**1/29/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-11** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
150 cm²
10 cm²

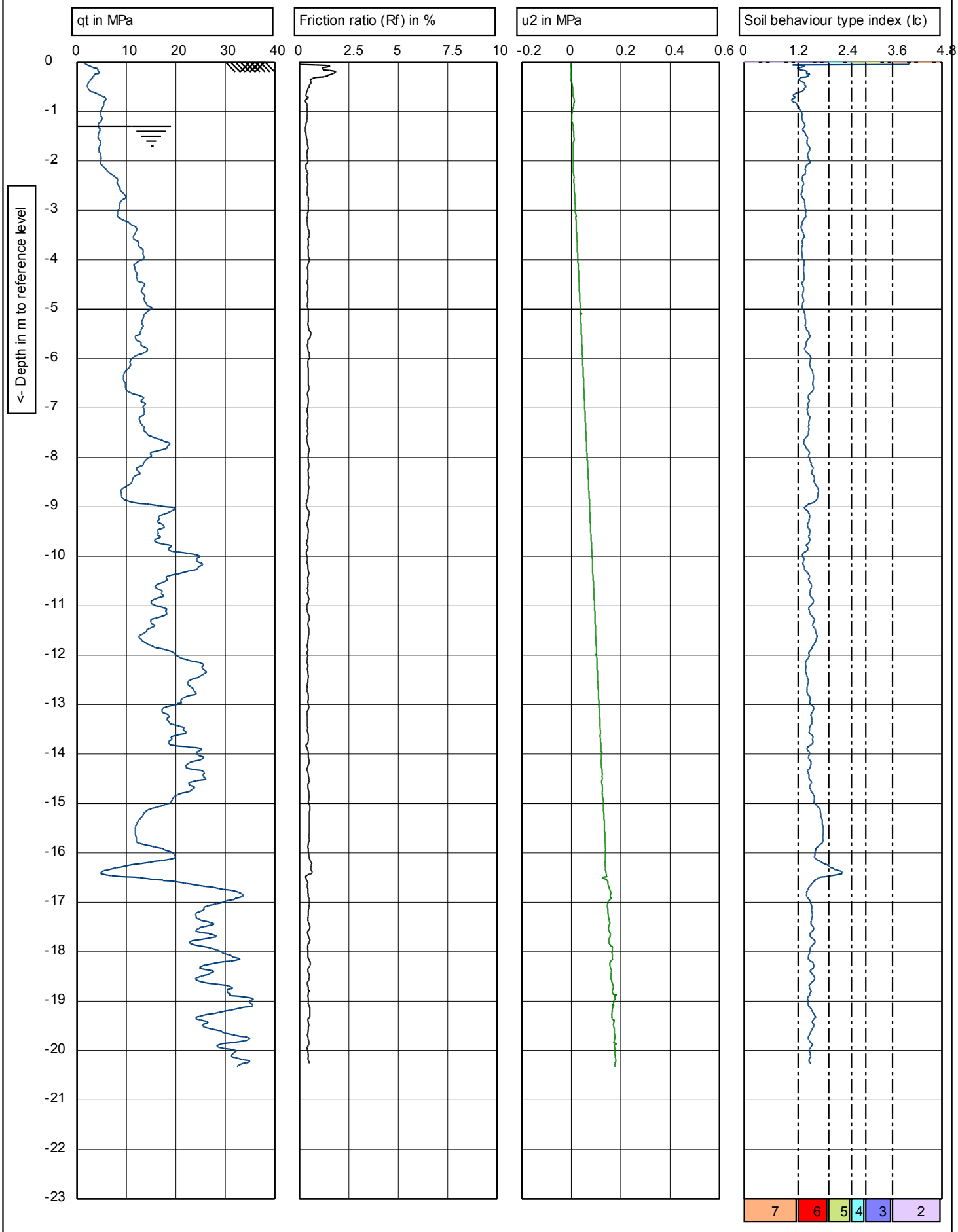
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-12** 1/3

1.40



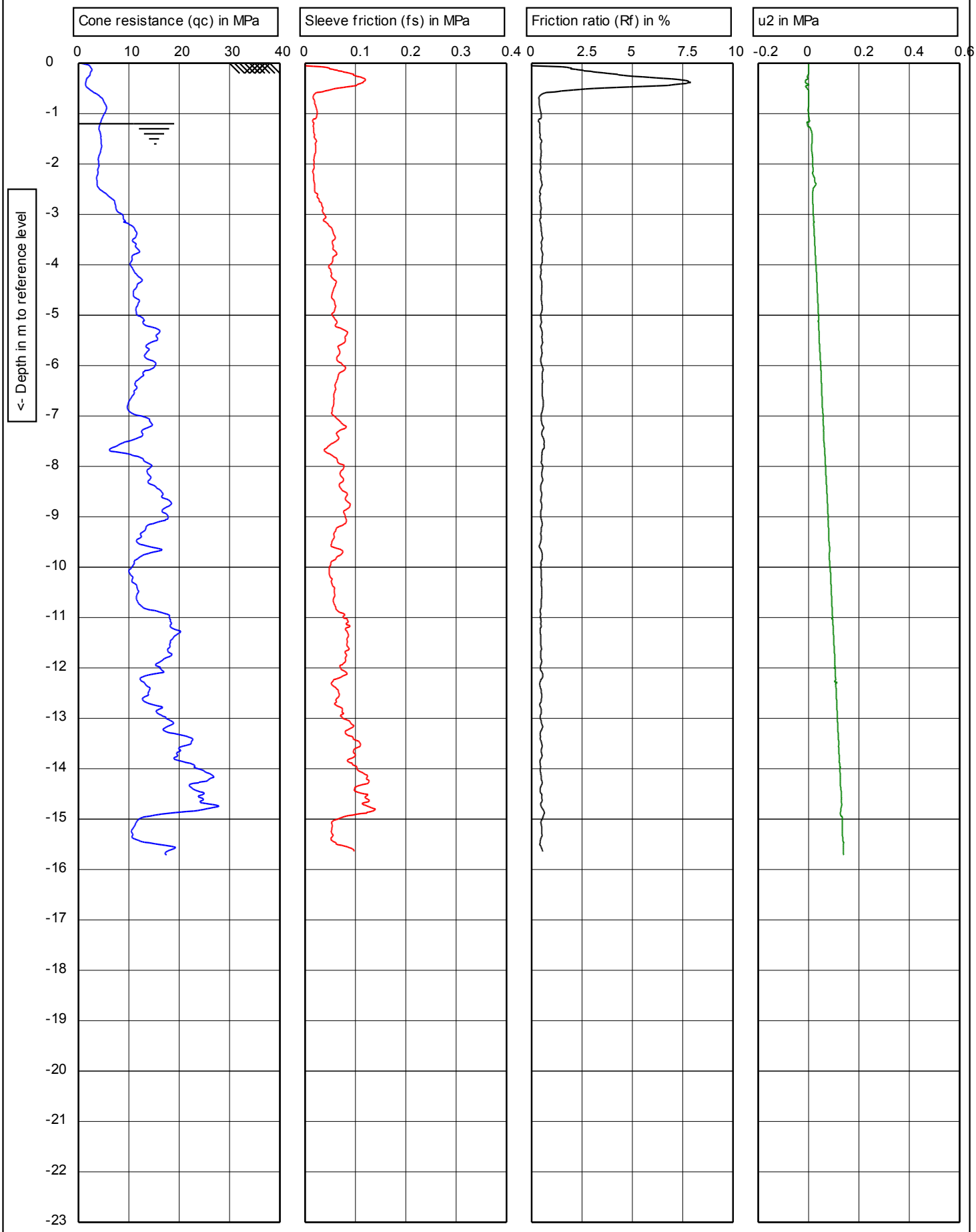
NEWSYD GEOTECHNICAL TESTING Ph:0408292638	Test according NEN 5140 class 1	Predrill :	**0 m Predrilled**
	G.L. 0 NAP / W.L.: **-1.3**	Date:	**1/29/2016**
Project: **Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
Location: **Ballina High School**		Project no.:	**RGS 30738**
Position:		CPT no.:	**CPT-12** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.3**	Date:	**1/29/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-12** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

u2
150 cm²
10 cm²

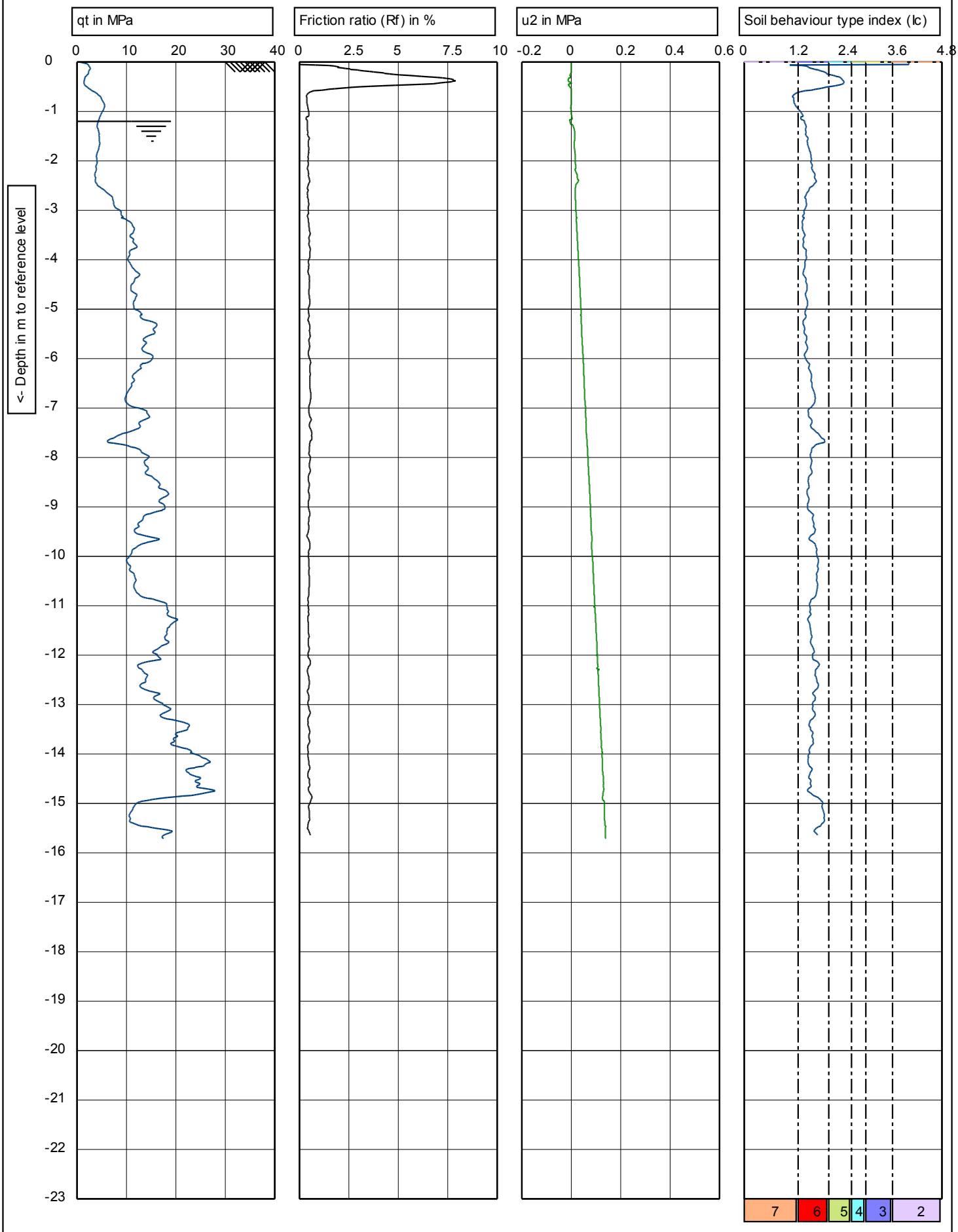
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.2**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-13** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.2**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

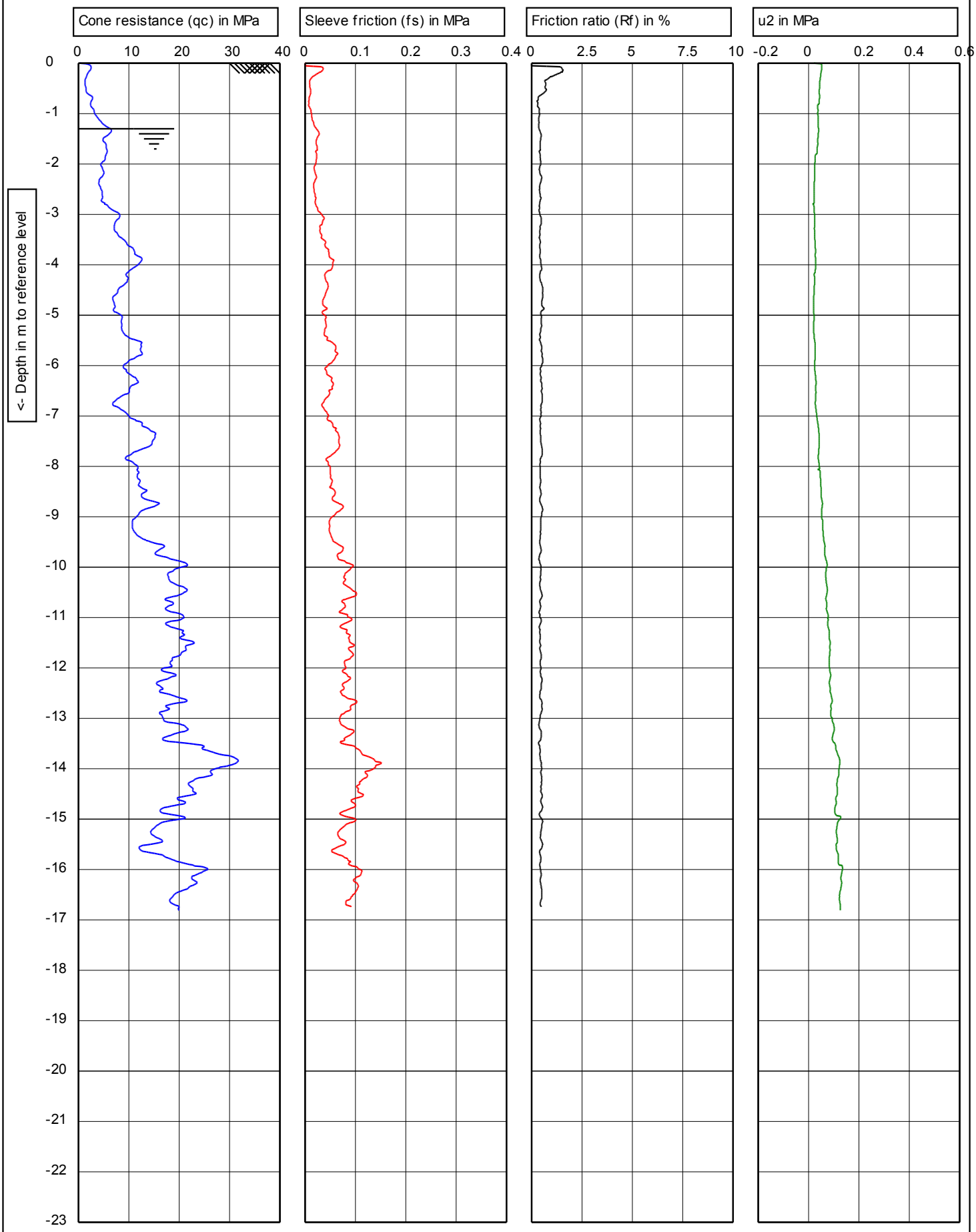
Predrill :	**0 m Predrilled**
Date:	**1/29/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-13** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.2**	Date:	**1/29/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-13** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

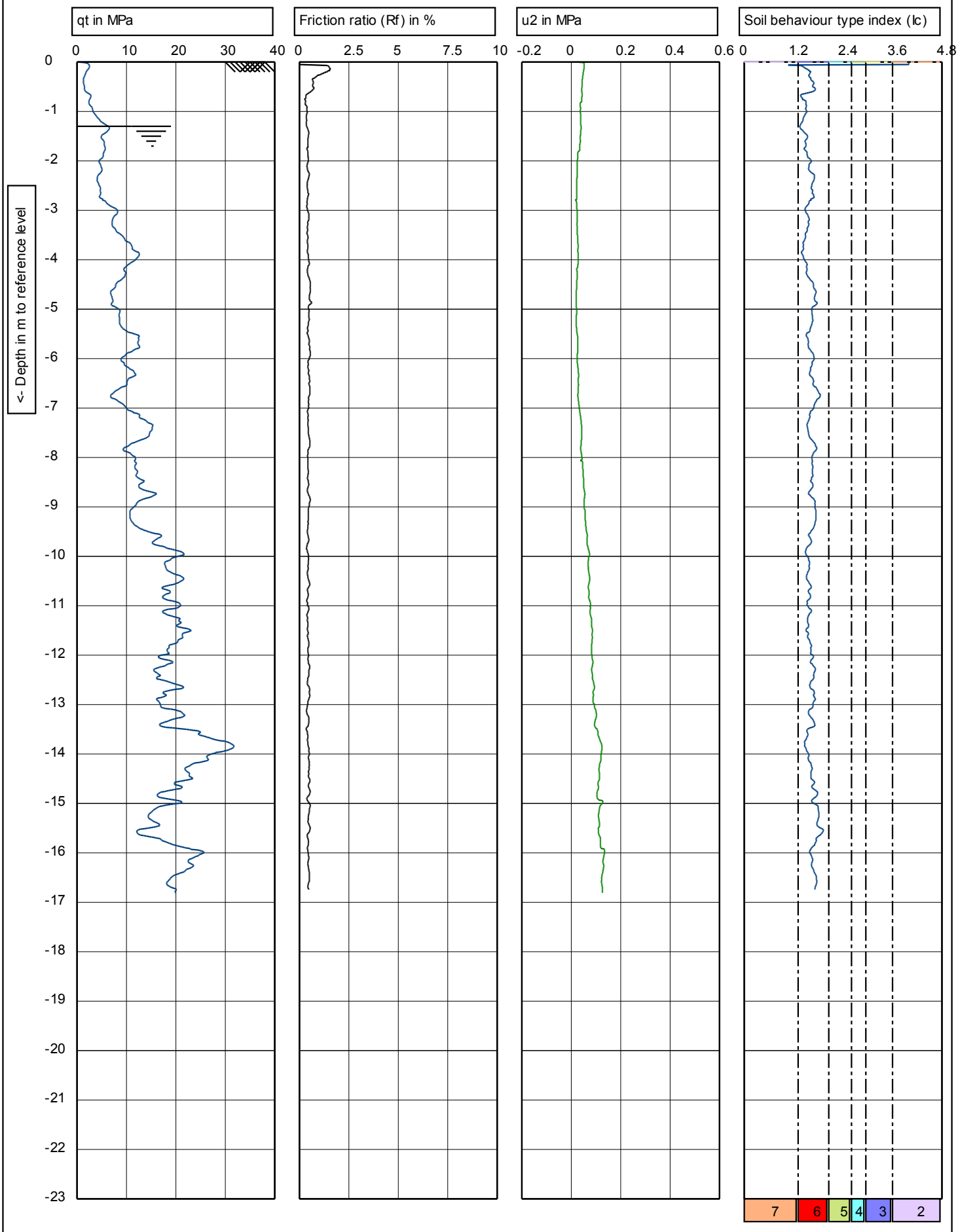
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-14** **1/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.3**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

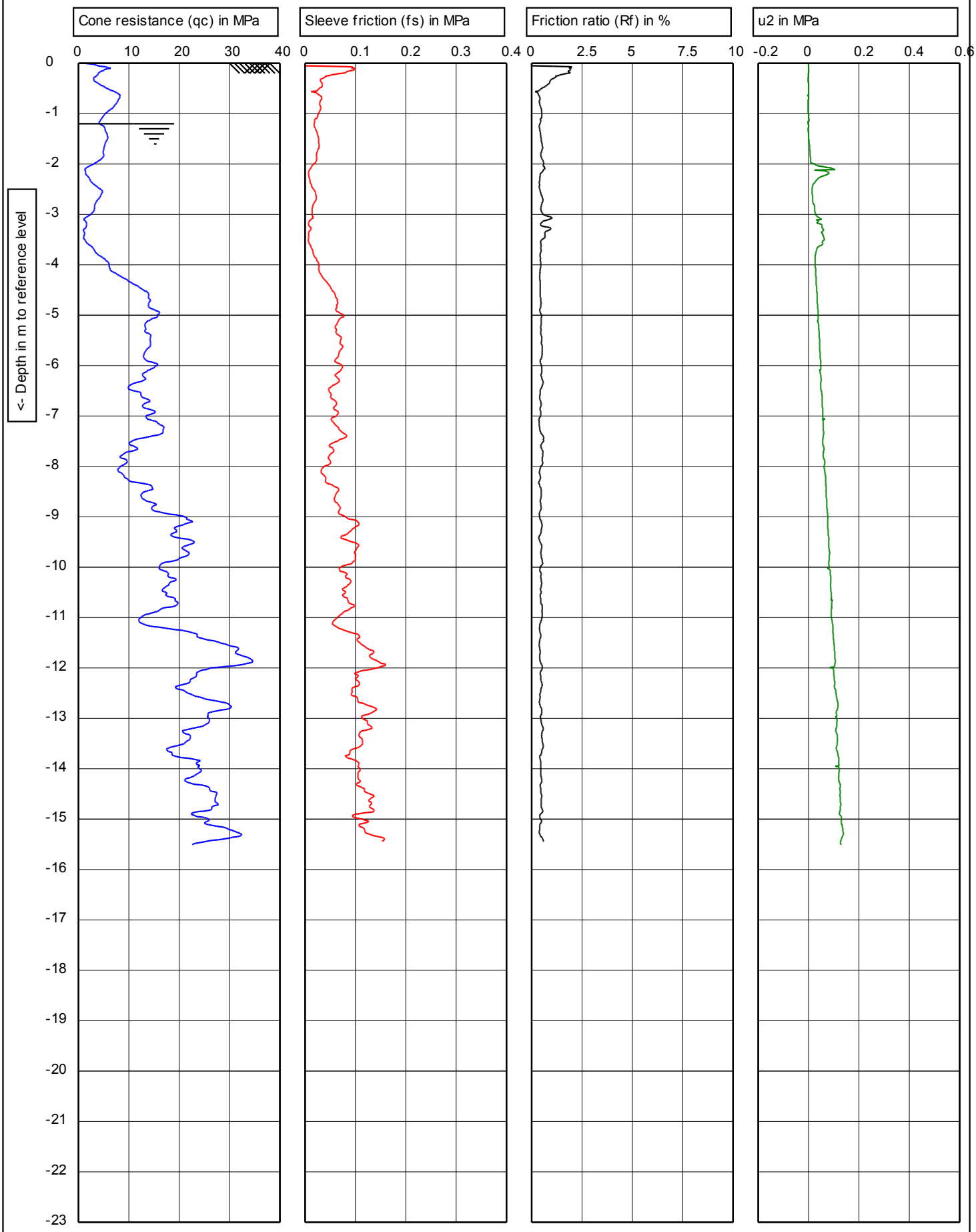
Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-14** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.3**	Date:	**1/28/2016**
	Project: **Geotechnical Investigation** Location: **Ballina High School** Position:			Cone no.:	**C10CFIIP.C14476**
				Project no.:	**RGS 30738**
				CPT no.:	**CPT-14** **3/3**

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

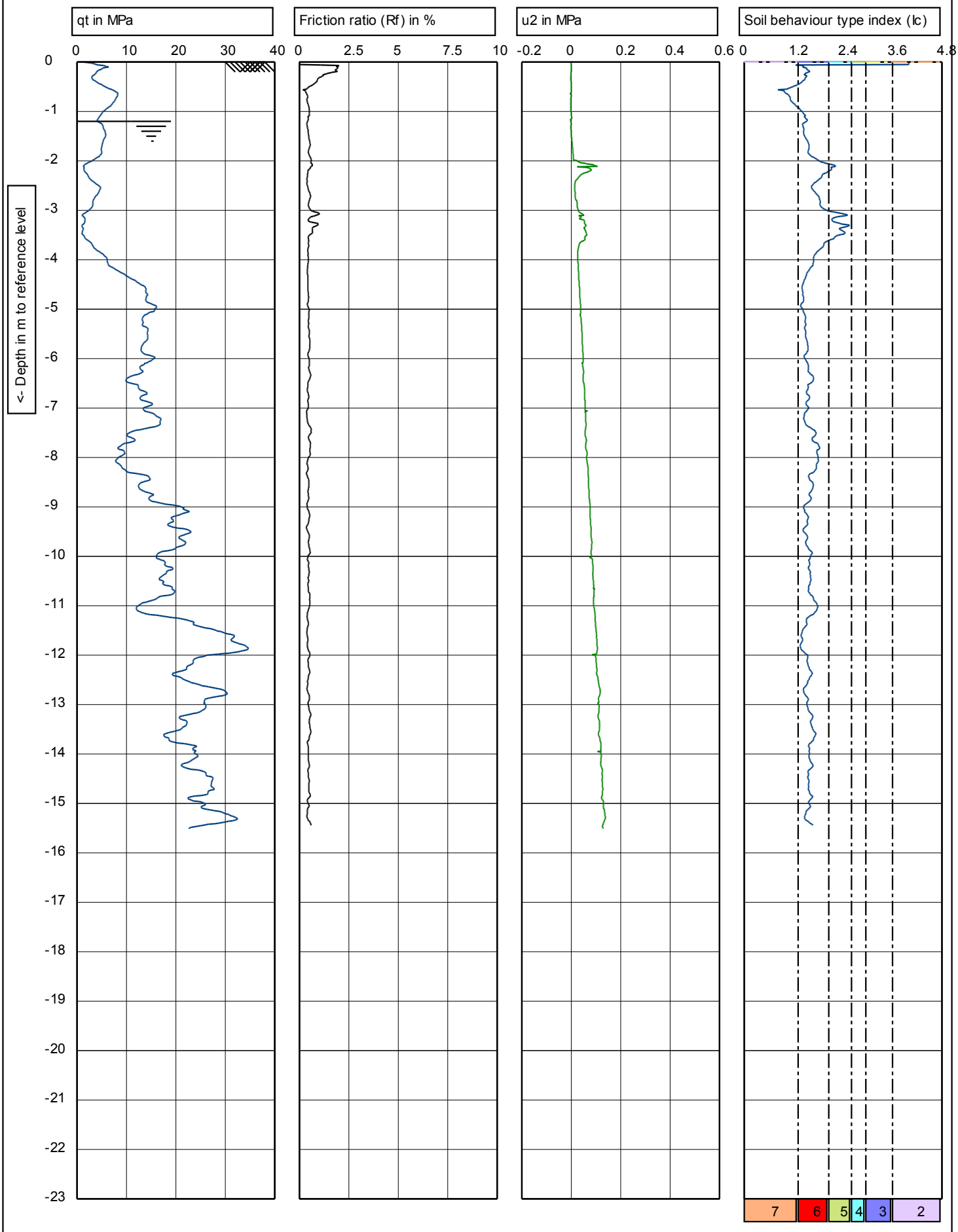
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.2**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-15** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.2**

Project: **Geotechnical Investigation**
Location: **Ballina High School**
Position:

Predrill :	**0 m Predrilled**
Date:	**1/28/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 30738**
CPT no.:	**CPT-15** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.2**	Date:	**1/28/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Ballina High School**		Project no.:	**RGS 30738**
	Position:			CPT no.:	**CPT-15** **3/3**

1.40

Appendix B

Laboratory Test results

CERTIFICATE OF ANALYSIS

Analysis By: Bio-Track Pty Ltd
ABN 91 056 237 275
Mt. Glorious Road
Highvale, Brisbane, Australia, 4520
Ph. 07 3289 7179 Fx. 07 3289 7155

DATE OF REPORT 05 FEBRUARY 2016 Page 1 of 1 Report Pages.
CLIENT NAME Adam Holzhauser c/o Regional Geotechnical Solutions Pty Ltd (Coffs Harbour)
CLIENT ADDRESS 1/21 Cook Drive Coffs Harbour 2450
PROJECT NAME Ballina High School Redevelopment YOUR PROJECT/JOB REFERENCE RGS30738.1
SAMPLING DATE NUMBER OF SAMPLES 2 SAMPLE TYPE:Soil
PACKAGING Plastic Bag ** SAMPLES DISPOSED ON 3/02/2017
DATE RECEIVED 4/02/2016 10:39:12 AM LAB REF. LR040216.448

METHODOLOGY: EC Cl as 1:5, pH 1:2.5; air dried soil in water, 30 minute rolling shake, Cl by ion selective electrode. S as 1:40 IN KCl extract measured by ICP OES.
RESIS:soil resistivity per AS1289.4.4.1 SO4 calculated as S x 3 SO3 calculated as S x 2.5

SAMPLE ID	EC	pH	Cl	S	SO4	SO3	RESIS
m depth	dS/m		mg/kg	mg/kg	%	%	ohm-cm
BH2 2.5-2.95	0.29	3.2	3	280	<0.1	<0.1	2500
BH6 2.5-2.95	0.33	3.3	16	308	<0.1	<0.1	2500

Signatory

For and behalf of Bio-Track Pty Ltd

www.biotrack.com.au
781 Mt Glorious Rd Highvale 4520

Biotrack Certificate of Analysis

Signatory: Ph:+617 3289 7179 ABN 91 056 237 275

Test Code/Name	**[1] FIELD SCREEN SUITE**		
Lab Reference (LR)	**040216.447**	Client Name	Regional Geotechnical Solutions Pty Ltd (Coffs Harbour)
SampleID	**All Samples**	Client Contact	Adam Holzhauser
		Project Name	Ballina High School Redevelopment
Report Date	5/02/2016	Job Number	RGS30738.1
Sample Received Date	4/02/2016	Order Number	
Sample Disposal Date	4/05/2016	Chain of Custody	
Sample Packaging	Plastic Bag	Client Email	adam.h@regionalgeotech.com.au
Temperature	Ambient	Client Address	1/21 Cook Drive Coffs Harbour New South Wales 2450

Analytical Method: Test Methodology for pH_f and pH_fox as per QASSIT 2004 Laboratory Methods. Indications based on pH data only.
RATE: 0 = No Reaction 2=Moderate 3=High 4=Very High (steam evolved).
TEMP: Surface temperature rise (C) oxidised sample at 5 minutes - cooling may occur for fast reaction.

S#	SampleID	pH_f	pH_Fox	Change	RATE	TEMP	Indication
1	BH1 5.5-5.95	4.7	2.0	-2.7	2	9	low TAA & high TPA & sulphide possible
2	BH1 8.5-8.85	4.3	2.0	-2.3	2	9	high TPA & sulphide possible
3	BH2 2.5-2.95	3.6	1.7	-1.9	4	1	high TPA
4	BH2 4-4.45	3.8	1.8	-2.0	4	1	high TPA
5	BH4 1-1.45	4.3	1.7	-2.6	4	1	high TPA & sulphide possible
6	BH4 2.5-2.95	4.2	2.0	-2.2	4	3	high TPA & sulphide possible
7	BH4 5.5-5.95	5.7	3.7	-2.0	0	1	low TAA
8	BH5 2.5-2.95	3.9	1.6	-2.3	4	0	high TPA & sulphide possible
9	BH5 10-10.45	4.3	2.1	-2.2	2	7	high TPA & sulphide possible
10	BH6 2.5-2.95	3.7	1.4	-2.3	4	0	high TPA & sulphide possible
11	BH6 7-7.45	4.4	2.1	-2.3	2	5	high TPA & sulphide possible
12	BH6 10-10.45	5.2	2.2	-3.0	4	26	low TAA & high TPA & sulphide possible

www.biotrack.com.au
781 Mt Glorious Rd Highvale 4520

Biotrack Certificate of Analysis

Signatory: :+617 3289 7179 ABN 91 056 237 275

Test Code/Name	[1] FIELD SCREEN SUITE		
Lab Reference (LR)	**040216.447**	Client Name	Regional Geotechnical Solutions Pty Ltd (Coffs Harbour)
SampleID	**All Samples**	Client Contact	Adam Holzhauser
		Project Name	Ballina High School Redevelopment
Report Date	5/02/2016	Job Number	RGS30738.1
Sample Received Date	4/02/2016	Order Number	
Sample Disposal Date	4/05/2016	Chain of Custody	
Sample Packaging	Plastic Bag	Client Email	adam.h@regionalgeotech.com.au
Temperature	Ambient	Client Address	1/21 Cook Drive Coffs Harbour New South Wales 2450

Analytical Method: Test Methodology for pH_f and pH_fox as per QASSIT 2004 Laboratory Methods. Indications based on pH data only.
RATE: 0 = No Reaction 2=Moderate 3=High 4=Very High (steam evolved).
TEMP: Surface temperature rise (C) oxidised sample at 5 minutes - cooling may occur for fast reaction.

S#	SampleID	pH_f	pH_Fox	Change	Rate	Indication
1	BH1 5.5-5.95	4.7	2.0	-2.7	2	low TAA & high TPA & sulphide possible
2	BH1 8.5-8.85	4.3	2.0	-2.3	2	high TPA & sulphide possible
3	BH2 2.5-2.95	3.6	1.7	-1.9	4	high TPA
4	BH2 4-4.45	3.8	1.8	-2.0	4	high TPA
5	BH4 1-1.45	4.3	1.7	-2.6	4	high TPA & sulphide possible
6	BH4 2.5-2.95	4.2	2.0	-2.2	4	high TPA & sulphide possible
7	BH4 5.5-5.95	5.7	3.7	-2.0	0	low TAA
8	BH5 2.5-2.95	3.9	1.6	-2.3	4	high TPA & sulphide possible
9	BH5 10-10.45	4.3	2.1	-2.2	2	high TPA & sulphide possible
10	BH6 2.5-2.95	3.7	1.4	-2.3	4	high TPA & sulphide possible
11	BH6 7-7.45	4.4	2.1	-2.3	2	high TPA & sulphide possible
12	BH6 10-10.45	5.2	2.2	-3.0	4	low TAA & high TPA & sulphide possible

DETERMINATION OF ACID SULFATE SOIL PROPERTIES

CERTIFICATE OF ANALYSIS

Analysis By: Bio-Track Pty Ltd ABN 91 056 237 275 781 Mt. Glorious Road Highvale, Brisbane, Australia, 4520 Ph. 07 3289 7179 Fx. 07 3289 7155

LAB REFERENCE LR050216.533 DATE OF REPORT 08 FEBRUARY 2016 @13:29:55 Page 1 of 1 Report Pages.
CLIENT NAME Adam Holzhauser c/o Regional Geotechnical Solutions Pty Ltd (Coffs Harbour) 1/21 Cook Drive Coffs Harbour 2450
PROJECT NAME Ballina High School Redevelopment YOUR PROJECT/JOB REFERENCE RGS30738.1
SAMPLING DATE NUMBER OF SAMPLES 3 Samples supplied by client SAMPLE TYPE:Soil
DATE RECEIVED 5/02/2016 12:47:09 PM PACKAGING Plastic Bag Ground Oven Dry Samples DISPOSED ON 4/02/2017

Sample ID as received. METHODOLOGY: As per (DNR QASSIT May 2004), oven dried (85˚C), >1000 um shell removed, fine grind. All reported values gravimetric, dry mass.
%sEQ (equivalent sulphur) calculated as moles TAA/624 + %S Cr + %sNAS - sANC_BT (sNAS included irrespective of pH).
LIME1 rates calculated to neutralise TPA (or TAA if >TPA)+ aS_RAS -ANC_BT/1.5 LIME2 rates calculated to neutralise TAA + aS_POS or S_Cr + aS_RAS -ANC_BT/ 1.5
NB. Lime rates assume 97% lime neutralisation but DO NOT include any safety factors. Suggested factor=1.5-2. Rates are kg/ton. Multiply by bulk density to convert to kg/m3.
Fineness Factor (FF)=1.5 CBN POS= moles carbonate alkalinity released by oxidation assuming (Ca POS - Ca KCl) + (Mg POS - Mg KCl) is due to carbonate solution.
Blanks represent unmeasured values, zeros & <0.x represent measured values. If pH KCl>4.5 then s-RAS (calculated from acid extract) may be zero for undisturbed soil. Ca NAS is the acid reactive calcium calculated as the difference between 1 M KCl and 4 M HCl soluble Ca.

ID.	DEPTH	pH	pH	TAA	TPA	TSA	S KCl	S P	S POS	S Cr	s-NAS	s EQ	Ca KCl	Ca P	Mg KCl	Mg P	CBN POS	LIME1	LIME2	sANC_BT	Ca NAS
	m	KCL	ox	m/t	m/t	m/t	%	%	%	%	%	%	mg/kg	mg/kg	mg/kg	mg/kg	m/t	kg/t	kg/t	%	mg/kg
Analytical Method Codes		23A	23B	23F	23G	23H	23Ce	23De	23Ee	22B	s20Je	s	23Vh	23Wh	23Sm	23Tm	a23U&X			s19A2	20E
BH2	4-4.45	4.46		12			0.01			0.05	<0.01	0.071	32		22				2		<10
BH5	2.5-2.95	4.48		21			0.02			0.10	<0.01	0.138	227		24				4		<10
BH6	2.5-2.95	4.42		41			0.03			0.05	<0.01	0.119	76		40				4		<10

Signatory

For and on behalf of Bio-Track Pty Ltd

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-532		
Address:	1/21 Cook Drive,	Issue No.	1		
	Coffs Harbour, NSW, 2450	Date Sampled	03.02.16	By:	Client:
Project:	RGS30738.1	Date Tested:	09.02.16	By:	AC
	EJE Architects	Sample No	See Below	Page:	1 of 1
Location:	Ballina High School Redevelopment				

CALIFORNIA BEARING RATIO REPORT

Sample No. Location		ACTS16-02-004 CBR 1 0.3-0.5m	ACTS16-02-005 CBR 2 0.3-0.5m			
LABORATORY COMPACTION			**LABORATORY REPORT**			
Maximum Dry Density	t/m3	1.70	1.51			
Optimum Moisture Content	%	17.2	23.2			
Material Retained 19.0 mm sieve	%	0.0	0			
Compaction Specified	%	100.0	100.0			
Compaction Achieved	%	100.0	100.0			
SPECIMEN DRY DENSITY						
i At Compaction	t/m3	1.70	1.50			
ii After Soaking	t/m3	1.70	1.50			
SPECIMEN MOISTURE CONTENT						
Field / Initial	%	16.5	26.0			
i At Compaction	%	16.8	22.9			
ii After Soaking	%	17.8	24.9			
iii Top 30mm layer	%	18.7	25.4			
iv Rest of Sample	%	17.8	24.9			
CBR TEST DETAILS						
Soaking Period	days	4	4			
Swell	%	0.4	1.2			
Surcharge mass	kg	4.5	4.5			
CALIFORNIA BEARING RATIO	**%**	**11.0**	**11.0**			
Test Methods Used		F,H, I, J	F,H, I, 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. 5.0 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: 10.02.16

Report Form No.3

Appendix C

Pavement Thickness Design Sheets

FLEXIBLE PAVEMENT THICKNESS DESIGN

CLIENT: EJE Architecture **Job No.:** RGS30738.1

PROJECT: Ballina High School Redevelopment

LOCATION: Ballina

REGIONAL GEOTECHNICAL SOLUTIONS

Date: 18/02/2016

ROAD NAME:	**Car Park**	**Refer to drawing:**	Figure 1
Chainage Interval (m):	N/A	**Road classification ref:**	
Road Classification:	N/A	**Design Traffic:**	1×10^5

Subgrade Conditions

Expected subgrade:	Sand		
Adopted Subgrade CBR value:	11.0%	Required subgrade compaction:	100% Standard Compaction
Potential construction or performance issues:	Trafficability of loose sand surface. Construction working platform comprising 300mm of cruched rock or recycled concrete could be used below pavement formation to reduce construction issues.		

Pavement Design

Recommended Pavement Layer Thickness:		**Recommended Material requirements**	**Required Compaction**
Wearing course thickness (mm):	Two Coat Seal or 40mm AC	14/7 spray seal or 40mm AC	As per Suppliers specification
Base thickness (mm):	100	DGB20 compliant material	98% Modified Compaction
Sub-base thickness (mm):	100	DGS20 or DGS40 compliant material	95% Modified Compaction
Select thickness (mm):	As required	Particle size ≤ 100mm dia, CBR>15%, PI<15	100% Standard Copmpation
Total thickness (mm):	**200**		

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. RGS30738.1-AB for recommendations regarding drainage and construction.

RIGID PAVEMENT THICKNESS DESIGN

CLIENT: EJE Architecture **Job No.:** RGS30738.1

PROJECT: Ballina High School Redevelopment

LOCATION: Ballina **Date:** 18-Feb-16

REGIONAL GEOTECHNICAL SOLUTIONS

ROAD NAME:	**Car Park**	**Refer to drawing:**	Figure 1
Chainage Interval (m):	N/A	**Road classification ref:**	
Road Classification:	N/A	**Design Traffic:**	4×10^4 (HVAG)

Subgrade Conditions

Expected subgrade:	Sand		
Adopted Subgrade CBR value:	11.00%	Required subgrade compaction:	100% Standard Compaction
Potential construction or performance issues:	Trafficability of loose sand surface. Construction working platform comprising 300mm of crushed rock or recycled concrete could be used below pavement formation to reduce construction issues. Alternatively, place materials by working from top of layer and spreading in front of working face.		

Pavement Design

Recommended Pavement Layer Thickness:		**Recommended Material requirements**	**Required Compaction**
Wearing course thickness (mm):	Not required		
Concrete thickness (mm)	150	32MPa concrete, SL72 reinforcment, joints @ 8m centres, dowels 24mm diameter	
Base thickness (mm):	100	Lean mix concrete or 125mm bound granular material	98% Modified Compaction
Sub-base thickness (mm):	Not required		
Select thickness (mm):	Not required		
Total thickness (mm):	250		

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
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. RGS30738.1-AB for recommendations regarding drainage and construction.

NORTHROP

Level 1, 215 Pacific Highway Charlestown NSW 2290
PO Box 180 Charlestown NSW 2290
T (02) 4943 1777 F (02) 4943 1577
E newcastle@northrop.com.au

NL150200

1st September 2016

ADW Johnson
Attention: Craig Marler
7/335 Hillsborough Rd
WARNERS BAY NSW 2282

Dear Craig,

Re: Ballina High School State Environments Assessment Report Structural Commentary

Northrop Consulting Engineers have been engaged to provide structural design services for the Ballina High School redevelopment. Northrop have undertaken a review of the Geotechnical and Phase 1 Site Contamination Assessment Reports for Ballina High School prepared by Regional Geotechnical Solutions (Report Numbers RGS30738.1-AB and RGS30738.1-AC respectively), and have also undertaken preliminary structural design of the building based on architectural drawings received on 18th August 2016.

The geotechnical report notes the soil profile is alluvial, and comprises fill and topsoil for depths between 0.3-0.6m, underlain by sandy soils to the limit of investigation (25m). The geotechnical report indicates that loose sands are present nearest ground level, with the density of sand increasing with depth. Ground water was found to be between 0.9m and 2m below current ground levels.

The geotechnical report notes localised soft clay layers in the South-West corner of the site, and notes these layers appear to be pockets rather than lenses in the soil. The report provides two foundation options, being shallow footings (pad and strip footings) which would be utilised where structural loads are low, or piled foundations where loads are higher. It is noted that high level foundations may experience settlement issues in the South-Western portion of the site, as the clay layers could settle under sustained loading relative to the adjacent sands.

Based on the architectural documents received, the new school is to be three storey construction built on the South-Western part of the site. Based on works undertaken by Northrop to date, we expect the structural loads would exceed the capacities given for high level foundations (as the three-storey building will induce large foundation loading and the theatre and sports complexes will have isolated structural supports to create open spaces). As such, we expect piled foundations would be appropriate for the majority of the structures proposed.

Given the soil profile, the presence of acid sulphate soils (see below) and the proposed structural loads we expect the most cost-efficient foundation method would be either driven timber piles or steel screw piles. Driven timber piles are a skin friction pile, and the capacities of these piles are typically determined based on empirical formulas whilst the pile is being driven. It is expected that as the pile capacity is derived from the full soil profile, the clay layers would not dramatically affect the overall capacity of this type of pile.

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Steel screw piles rely on end bearing of a steel helix at the base of the pile. Steel screw piles are typically installed to a predetermined depth nominated by a suitably qualified geotechnical engineer, and for a development of this type Northrop would specify static load testing to determine the insitu pile capacities during construction. Given the presence of clay lensing it would be expected the piles would be installed to pre-determined depths on this project to avoid the clay pockets, and as such again the pockets would not have a large effect on the foundation capacity if this piling method is utilised.

The geotechnical report notes that soils below the water table have a high potential for acid sulphates being present. Based on this, if these soils are to be disturbed it would be expected the soils would need to be treated with lime. Should these soils need to be excavated or disturbed an Acid Sulphate Soil Management Plan (ASSMP) will need to be prepared by a suitably qualified geotechnical engineer prior to construction. With the exception of in ground services and lift pits there is unlikely to be any requirement for excavation on the site, and hence the effect of Acid Sulphates being present is unlikely to have significant impact on the project. It is also noted that the pile types noted above as likely to be utilised on this project are both displacement piles, and as such will not generate any spoil which would need to be treated.

The insitu sandy soil material is likely to be suitable for the foundation of buried services and stormwater assets. Trenching 1.2m below the natural surface should be avoided where possible to limit the disturbance of acid sulphate soils. The geotechnical report suggests the water table may be variable and as such, seepage and infiltration devices should not be located at depths greater than 1m below the existing surface.

The geotechnical report suggests pavement depths of 200mm and 250mm for pavements subjected to standard vehicle axle loadings and heavy vehicle axle loadings respectively will be required.

The Phase 1 Site Contamination Assessment Report did not find any wide spread or significant levels of contamination. It is noted that soil below existing buildings and pavements could not be investigated, and will need to be monitored during construction to ensure no contaminants are present.

Asbestos (both friable and non-friable) was noted in the existing building structures at the site, and hence the demolition contractor undertaking demolition of the existing buildings will need to be appropriately licensed to remove and dispose of any asbestos. Disposal of all contaminated material will need to be carried out in accordance with the relevant statutory guidelines and requirements.

We have also undertaken a preliminary structural design based on the architectural plans provided by EJE architecture (as noted above). It is noted that an approximate column grid in the order of 9m x 9m is required, and based on our analysis works to date it is our opinion that conventionally reinforced concrete will not be cost effective, and would require substantial depth (which will increase floor-floor heights and foundation requirements). As such, based on these span configurations it is our opinion post-tensioned concrete floors will be required. We note we expect a lightweight steel roof structure will be provided in lieu of concrete at the uppermost level.

Finally, we note there is a significant cantilever proposed for the third floor on the North-Western corner of the building. Our analysis work to date indicate the most feasible structural option to support this portion of the building will be to provide a steel framed truss within the Level 3 façade (with the truss a full floor height in depth). As such, we'd suggest the façade treatment in this area will need a significant amount of structural input during the detailed design stages to ensure structural requirements are achieved whilst architectural intent is maintained.

We trust this meets your requirements, however should you require anything further, please do not hesitate to contact the undersigned.

Yours sincerely

Mark Sturgess
Associate

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