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GEOTECHNICAL DESKTOP STUDY REPORT

Nos. 80-88 Regent Street
Redfern NSW 2016

Prepared for

Sunny Thirdi Regent St Pty Ltd
C/- Milligan Group Pty Ltd

Report No. GS6416-2B

15th January 2016

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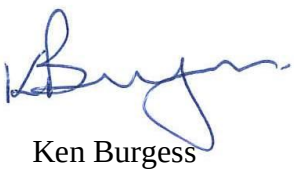

Ken Burgess

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1. Geological Survey of New South Wales, NSW Department of Mineral Resources, Geological Map of Sydney 1:100,000 Geological Series Sheet 9130, Edition 1, dated 1983.
2. NSW Department of Natural Resources, NSW Natural Resources Atlas, http://www.nratlas.nsw.gov.au/wmc/custom/homepage/home.html.
3. City of Sydney Local Environmental Plan 2012, http://www.cityofsydney.nsw.gov.au/development/planning-controls/local-environmental-plans
4. Australian Standard – AS 1726-1993 Geotechnical Site Investigation.
5. Pells P.J.N, Mostyn, G. & Walker B.F., "Foundations on Sandstone and Shale in the Sydney Region", Australian Geomechanics Journal, 1998.
6. Department of Planning and Environment, NSW Government - http://www.majorprojects.planning.nsw.gov.au
7. Publicly Available Information - https://majorprojects.affinitylive.com
8. Urban Growth NSW – Development - http://www.ugdc.nsw.gov.au/

1. INTRODUCTION

Aargus Pty Ltd (Aargus) has been commissioned by Sunny Thirdi Regent St Pty Ltd to carry out a geotechnical desktop study at nos. 80-88 Regent Street, Redfern NSW 2016. A site walkover was carried out on the 24th November 2015, and was followed by geotechnical assessment and preparation of a geotechnical desktop study report.

The purpose of the desktop study was to provide information related to regional geology, sub-surface conditions including groundwater and to provide comments on the feasibility of the proposed development from a geotechnical perspective. For this project, Aargus Pty Ltd (Aargus) carried out a scope of work consisting of a site walkover, desktop study, geotechnical appraisal and preparation of this report.

The following aspects have been addressed in this report:

- Site description;
- Proposed development;
- Inferred Subsurface Conditions; and
- Geotechnical Appraisal.

Inferred local subsurface and groundwater conditions for the subject site were based on local knowledge obtained from previous projects in the vicinity and publically available geotechnical information as well as information recorded during the site walkover inspection.

To assist in reading the report, reference should be made to the "Important Information About Your Geotechnical Report" attached as Appendix A.

2. AVAILABLE INFORMATION

Prior to preparation of this report, the following information was made available to Aargus:

- Preliminary Architectural drawings project titled "80-88 Regent Street, Redfern for Thirdi & Milligan Group" prepared by SJB Architects, referenced 5359, Revision 3 and dated 13/01/2016, including drawing nos. DA-0201 to DA-0213 inclusive;

The following details was gathered from the publicly available information (Reference 6 and 7):

Property Nos. 60-78 Regent Street, Redfern, NSW

Based on the provided information in the below link, proposed building is consisted of eighteen (18) levels excluding the Mezzanine level above ground and single basement level.

http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=6724

A geotechnical investigation report for the above property tiled "Preliminary Geotechnical Investigation 60-78 Regent Street, Redfern" prepared by SMEC Testing Services Pty Ltd, referenced Project No. 19962/4893C, Report No. 14/2341A and dated November 2014 was found on the following link:

https://majorprojects.affinitylive.com/public/fc3b7ab6d5c8968b6e0f040a92b056dd/2014-12-05%20Appendix%20W_Geotechnical%20Report.pdf

Property Nos. 7-9 Gibbons Street, Redfern, NSW

Based on the provided information in the below link, existing building is consisted of eighteen (18) levels above ground and six (6) basement levels below ground. Finished lower basement floor level and top of the lift shaft are inferred to be 8.8m Australian Height Datum (AHD) and 95.5m AHD, respectively.

http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=2496

A geotechnical investigation report for the above property tiled "Geotechnical Investigation 7-9 Gibbons Street, Redfern" prepared by SMEC Testing Services Pty Ltd, referenced Project No. 17166/6269B, Report No. 09/0326 and dated April 2009 was found on the following link:

https://majorprojects.affinitylive.com/public/19607c135b835faafc510515a40a9b5d/7-9%20Gibbons%20St%20-%20Attachment%2022-%20Geotechnical%20Report.pdf

Property No. 157 Redfern Street, Redfern, NSW

During the field walkover inspection, existing building within the above property was observed with eighteen (18) levels above ground.

3. SCOPE OF WORK

In accordance with the brief, Aargus carried out a scope of work that consisted of the following:

- A site walk-over inspection in order to determine the overall surface conditions and to identify any relevant site features;
- Obtaining publically available geotechnical and groundwater information relevant to the site; and
- Preparation of a desktop study report (this report).

4. SITE DESCRIPTION

The site is an approximately rhombus shape with an approximate area of 822m^2, and consists of amalgamation of five properties identified as No. 80, No, 82, No. 84, No. 86 and No. 88 Regent Street. Each property was consisted of two storey rental commercial and residential building during the site visit. Access to the commercial area through the Regent Street and access including driveway to the remaining portion through back street identified as William Lane. Some minor cracks were observed within the backyard of the existing buildings.

The site comprised existing buildings, driveways and paved areas with the remaining portion of the site covered with garden and lawn.

Site is located at approximately 300m south east to Redfern Railway Station and is bounded by the following properties, public roads and infrastructure:

- The property at No. 78 Regent Street to north of the site, which is occupied by a two storey rented commercial and residential building;
- Regent Street carriageway and road reserve to the east;
- Marian Street carriageway and road reserve to the south; and
- William Lane carriageway and road reserve to the west.

The site topography during the site visit was generally sloping towards the south.

5. PROPOSED DEVELOPMENT

The architectural drawings (referenced in Section 2) indicate the proposed development includes demolition of the existing buildings and construction of eighteen (18) storey excluding Mezzanine level building and four (4) basements for car parking. The proposed building comprises a commercial area, childcare and associated area and residential apartments. Vehicular access to the basement levels will be via a ramp from Marian Street within the south western corner of the site. Based on these drawings, the proposed basement will cover the entire site.

The elevation of the proposed lower basement level floor is 17.35m AHD, requiring a maximum excavation depth of approximately 11.8m for construction of the four basements together with floor slabs. The proposed lift shaft normally requires further excavation of approximately 1.5m below the lower basement level.

6. INFERRED SUBSURFACE CONDITIONS

6.1 Geology

Reference to the Sydney 1:100,000 Geological Series Sheet 9130 Edition 1, dated 1983, by the Geological Survey of New South Wales, Department of Mineral Resources, indicated the site is located within an area underlain by Quaternary Age Holocene Deposits, denoted as Qhd. The deposits are described as "Medium to fine-grained 'marine' sand with podsols."

The site is located at approximately 200m to the southeast of the geological boundary with an area underlain by the Ashfield Shale formation, which is denoted as Rwa. The Ashfield Shale is described as "Black to dark-grey shale and laminite."

It should be noted this geological profile does not take into account the residual soils derived from in-situ weathering of the bedrock, or the presence of fill that may have been generated from previous earthworks.

6.2 Inferred Ground Profile

Geotechnical investigation reports for property Nos. 60-78 Regent Street and Nos. 7-9 Gibbons Street referenced in Section 2 were prepared using the nearby boreholes drilled within the property No. 157 Redfern Street, Redfern. These sites lie approximately within a 60m radius, north and west of the subject site. According to provided information (referenced in Section 2) the inferred subsurface conditions are outlined in Table 1.

Table 1: Summary of Inferred Subsurface Conditions within Surroundings

Unit	Description	Estimated Depth To (m)
Fill	Layer of fill or reworked insitu materials	0.5+
Residual Soil	Stiff to Very stiff Silty CLAY	3.0 - 6.0
Bedrock	Extremely Low Strength – Class V Shale	6.0 - 9.0
	Very Low Strength – Class IV Shale	10.0 - 11.0
	Low Strength – Class III Shale	12.0
	Medium Strength – Class II Shale	29.0
	High Strength Sandstone	40.0+

Our experience with other projects in the general area indicate ground conditions to be generally consistent with those outlined in Table 1 but with the potential for loose and medium dense alluvial sands to be present between approximately 0.5 and 5.0m.

Geotechnical site investigation by borehole drilling would be required to confirm the inferred underlying subsurface profiles, the strengths and degree of weathering of the soils and rock horizons as well as configuration of any bedding and defects that may be present in the rock horizons.

6.3 Groundwater

A groundwater bore search was carried out on the Natural Resources Atlas database provided by the NSW Department of Natural Resources (Reference 2). There was no groundwater information available within 0.5km radius of the site. No surface water seeping was observed within and surrounding areas of the site during site visit.

Based on local knowledge, groundwater is expected to be in order of 3.0 - 4.0m depth and in the form of seepage through the marine sands.

According to the publicly available geotechnical investigation reports referenced in Section 2, the groundwater level measured during the borehole drilling within the property No. 157 Redfern Street ranges from approximately 4.2m to 5.0m depth.

It should be noted that groundwater level may be subject to seasonal and daily fluctuations influenced by factors such as rainfall and future development of the surrounding lands. Soil moisture within the site may be influenced by events within the property and the adjoining road and properties such as damage to water mains, stormwater or sewer pipes.

7. GEOTECHNICAL APPRAISAL

7.1 General

The main geotechnical aspects that may be associated with the proposed development are assessed to include the following:

- Excavation conditions;
- Stability of Basement Excavation;
- Earth Pressure;
- Foundation;
- Groundwater Management

An appraisal of the main geotechnical aspects above based on available information from the development site is presented in the following sections.

It is considered that the bulk excavation level could be some 7m to 8m below groundwater level and would be within the weathered shale bedrock.

Consideration needs to be given to specific geotechnical issues including excavation stability, foundation conditions and temporary shoring. Geotechnical commentary regarding these geotechnical constraints and recommendations for the proposed development is presented in the following sections.

According to the information provided in the link below, the site is located within the vicinity of the future potential railway corridor as well as social, economic and environmental development of the Redfern-Waterloo area. As bulk excavation is extending to approximately 12m depth for four basemnets, it is recommended that consideration be given to the impact of the development on existing or future infrastructure, during the design and construction of the proposed development.

http://passthrough.fw-notify.net/download/175928/http://www.ugdc.nsw.gov.au/sites/default/files/file_root/BEPS1/section2_the_redfern_waterloo_area.pdf

7.2 Excavation Conditions

Excavation is expected to be through fill, alluvial soils, residual soils and then into weathered bedrock. Excavation within soil and extremely low to very low strength shale is expected to be readily achieved using a large hydraulic excavator down to the basement level. However, localised use of rock breaking equipment or ripping may be required where high strength bands are encountered.

For medium or greater strength rock, excavation will require the use of heavy ripping and/or hydraulic rock hammers. Excavation for foundations or trenches will require the use of hydraulic hammers and possibly a rock saw. Both noise and vibration will be generated by the proposed excavation work within these bedrock materials.

Details geotechnical investigation including borehole drilling and rock coring should be carried out prior to construction stage and contractors should refer to the engineering logs, core photographs and point load tests when assessing the suitability of their excavation equipment.

7.3 Stability of Basement Excavation

Due to the significant depth of excavation required, batter slopes are not recommended and shoring wall should be provided to retain the basement excavation. Shoring wall design should consider both short term (construction) and permanent conditions as well as the presence of adjacent buildings and roads.

Based on the expected subsurface conditions and groundwater level, excavation support may be achieved by adopting a secant bored pile wall. The use of a secant pile wall creates a near impervious barrier which significantly inhibits groundwater seepage during excavation.

For the maximum retained height being considered, a temporary anchorage system is likely to be required at some locations to provide the required lateral support during construction. Where two or more rows of anchors are required to support the shoring due to significant retained height or where significant lateral movements cannot be tolerated (e.g. due to adjacent infrastructure), the shoring/basement wall should be designed as a braced structure.

Anchor installation beyond the property boundaries will be subject to approval by owners of adjoining properties, roads and infrastructure. Where an anchorage system is shown to be impractical due to the anchor length required to achieve embedment in rock and the low bond stresses expected within the alluvial soils and residual soils, consideration of other temporary support options would be necessary.

7.4 Earth Pressures

Earth retaining structures should be designed to withstand the lateral earth pressure, hydrostatic and earthquake (if applicable) pressures, and the applied surcharge loads in their zone of influence, including existing structures, traffic and construction related activities.

Typical parameters for the design of earth retaining structures in the soils and rock horizons expecting to be underlying the site are presented in Table 2.

Table 2: Typical Geotechnical Design Parameters for Retaining Walls

Units	Unit Weight (kN/m^3)	Effective Cohesion c' (kPa)	Angle of Friction ϕ' (°)	Modulus of Elasticity E_{sh} (MPa)
Fill and Alluvial Soils	17	0	26	8
Residual Soils	20	5	24	15
Class V Shale	22	25	26	65
Class IV Shale	22	50	27	150
Class III Shale	22	100	28	250

Table 3 below provides typical coefficients of lateral earth pressure for the soils and rocks potentially underlying the site. The coefficients provided are based on horizontal ground surface and fully drained conditions.

Table 3: Typical Coefficients of Lateral Earth Pressure

Units	Coefficient of Active Lateral Earth Pressure Ka	Coefficient of Active Lateral Earth Pressure at Rest Ko	Coefficient of Passive Lateral Earth Pressure Kp
Fill and Alluvial soils	0.39	0.56	2.56
Residual Soils	0.42	0.59	2.37
Class V Shale	0.3	0.5	3.0
Class IV Shale			3.0
Class III Shale			5.0

- Coefficient of active and passive lateral earth pressure K_a and K_p, respectively, can be calculated using Rankine's or Coulomb's equations, as appropriate.
- Coefficient of lateral earth pressure at rest K_o for soils, can be calculated using Jacky's equation.

7.5 Foundations

Bulk excavation is likely to expose weathered shale at bulk excavation level. However, given the potential for variable strength bedrock at bulk excavation level, it is recommended that all footings be founded on consistent subsurface materials to minimise the risk of differential settlement. Suitable footings are therefore likely to comprise a slab on grade for the basement and shallow strip and pad footings supporting internal columns and walls.

Piles may be required if axial loads on columns and walls exceeding the bearing pressure of the bearing stratum, include the need to increase the resistance against lateral seismic and wind loads.

Table 4 provides typical geotechnical parameters recommended for design of shallow and piled foundations.

Table 4: Typical Geotechnical Foundation Design Capacities

Unit	Allowable Capacity Values (kPa)	
	End Bearing Pressure[1]	**Shaft Adhesion Compression (Tension)[2]**
Fill and Alluvial Soils[4]	N/A[3]	N/A[3]
Residual Soils[4]	100	NA[3]
Class V Shale[4]	700	50 (25)
Class IV Shale[4]	1000	100 (50)
Class III Shale[4]	2500	250 (125)

[1] With a minimum embedment depth of 0.5m for deep foundations and 0.4m for shallow foundations.

[2] Clean rock socket of roughness of at least grooves of depth 1mm to 4mm and width greater than 5mm at spacing of 50mm to 200mm.Shaft Adhesion in Tension is 50% of Compression, applicable to piles only.

[3] N/A, Not Applicable, not recommended for the proposed building of this development.

[4] The actual depth of the underlying ground profile should be confirmed either during construction.

7.6 Groundwater Management

As the proposed bulk excavation level could be up to 7.0 or 8.0m below groundwater level, seepage flows through soils and weathered bedrock is likely to occur during excavation and/or in the long term during the design life of the building. It would therefore be prudent to give consideration to precautionary drainage measures in the design and construction of the proposed development.

7.7 Geotechnical Site Investigation

Following demolition of the existing buildings, drilling of at least two to three boreholes to at least 14.0m depth including rock coring and point load testing on rock samples should be undertaken in order to confirm and where necessary elaborate on the ground conditions and preliminary recommendations presented in this report. The geotechnical investigation should be undertaken in accordance with Australian Standard AS 1726-1993 (Reference 4) by a Geotechnical Engineer familiar with the contents of this report.

8. LIMITATIONS

The geotechnical assessment of the subsurface profile and geotechnical conditions within the proposed development area and the conclusions and recommendations presented in this report have been based on available information obtained during the work carried out by Aargus and in the provided documents listed in Section 2 of this report. Inferences about the nature and continuity of ground conditions away from and beyond the locations of field exploratory tests are made, but cannot be guaranteed.

It is recommended that should ground conditions including subsurface and groundwater conditions, encountered during construction and excavation vary substantially from those presented within this report, Aargus Pty Ltd be contacted immediately for further advice and any necessary review of recommendations. Aargus does not accept any liability for site conditions not observed or accessible during the time of the inspection.

This report and associated documentation and the information herein have been prepared solely for the use of **Sunny Thirdi Regent St Pty Ltd** and any reliance assumed by third parties on this report shall be at such parties' own risk. Any ensuing liability resulting from use of the report by third parties cannot be transferred to Aargus Pty Ltd, directors or employees.

The conclusions and recommendations of this report should be read in conjunction with the entire report.

For and on behalf of

Aargus Pty Ltd

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Reviewed By

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APPENDIX A

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL REPORT

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IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

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More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include the general nature of the structure involved, its size and configuration, the location of the structure on the site and its orientation, physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program.

To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should NOT be used:*

- when the nature of the proposed structure is changed: for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an un-refrigerated one,
- when the size or configuration of the proposed structure is altered,
- when the location or orientation of the proposed structure is modified,
- when there is a change of ownership, or

for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

Geotechnical reports present the results of investigations carried out for a specific project and usually for a specific phase of the project. The report may not be relevant for other phases of the project, or where project details change.

The advice herein relates only to this project and the scope of works provided by the Client.

Soil and Rock Descriptions are based on AS1726-1993, using visual and tactile assessment except at discrete locations where field and/or laboratory tests have been carried out. Refer to the attached terms and symbols sheets for definitions.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how

qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact. For this reason, most experienced owners retain their geotechnical consultants through the construction stage,* to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions, and thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

Subsurface conditions can change with time and can vary between test locations. Construction activities at or adjacent to the site and natural events such as flood, earthquake or groundwater fluctuations can also affect the subsurface conditions.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems.
No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professional develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

The interpretation of the discussion and recommendations contained in this report are based on extrapolation/interpretation from data obtained at discrete locations. Actual conditions in areas not sampled or investigated may differ from those predicted

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. These logs should not under any circumstances be redrawn for inclusion in architectural or other design drawings because drafters may commit errors or omissions in the

transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimise the likelihood of boring log misinterpretation, give contractors ready access in the complete geotechnical engineering report prepared or authorized for their use. Those who do not provide such access may proceed under mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are not exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

FURTHER GENERAL NOTES

Groundwater levels indicated on the logs are taken at the time of measurement and may not reflect the actual groundwater levels at those specific locations. It should be noted that groundwater levels can fluctuate due to seasonal and tidal activities.