HORNSBY SHIRE COUNCIL

ROCK MECHANICS STUDY

HORNSBY QUARRY

OLD MAN'S VALLEY

REPORT NO S8463/4-AD     MAY, 1990
The Shire Clerk  
Hornsby Shire Council  
296 Pacific Highway  
HORNSBY NSW 2077

ATTENTION: MR. KEVIN SMITH

Dear Sir,

RE: ROCK MECHANICS STUDY – HORNSBY QUARRY, OLD MAN’S VALLEY

Please find enclosed 6 copies, as requested by Mr. W. Latham of our report on a rock mechanics study carried out at Hornsby Quarry, Old Man's Valley. This study was undertaken in conjunction with an extended geotechnical investigation of the Old Man's Valley proposed playing field development, the results of which will be reported separately.

Should you have any queries regarding this report please do not hesitate to contact Mr. Peter Volk or the undersigned.

For and on behalf of
COFFEY & PARTNERS PTY LTD

C.P. THORNE
EXECUTIVE SUMMARY

Investigations in the vicinity of the proposed playing field development at Old Man's Valley by Coffey & Partners in 1989, concluded that additional investigations including a rock mechanics study be undertaken to further assess the stability of the eastern quarry area of the Hornsby breccia quarry.

As the toe of the proposed playing field development at Old Man's Valley will come to within 50m of the top of the present position of the eastern face of the quarry and would be within about 25m of the proposed final development profile, the stability of the quarry face is of major importance to the feasibility of the playing field development.

The aim of the rock mechanics study was to obtain additional structural data on the rock mass, both on the existing quarry face and on the rock mass behind the present face. Structural data on the quarry face was obtained by detailed line discontinuity mapping carried out along three benches. This data has been presented in the form of histograms and stereographic projections. The orientation and nature of major rock mass discontinuities beyond the eastern quarry face was investigated by three 90m, long fully cored oriented inclined boreholes.

The two boreholes located above the eastern face of the quarry confirmed that the attitude and inclination of basinal layering evident in the quarry face extends for a distance of at least 60m into the hillside. The orientation and the generally massive nature of the breccia in this area indicates that slope failure by planar sliding along bedding is unlikely. The prominent joint sets identified on the three line traverses on the quarry face were either not present or poorly developed in the rock mass behind the quarry face.

The borehole located near the south-eastern corner of the quarry indicated the presence of a broad 'transition' zone some 70m wide of material between breccia in the quarry and the Hawkesbury Sandstone. The orientation of defects and the nature of materials in this zone, is not considered to have an adverse impact on the proposed development.

In summary, the general combination of rock strength, structure and groundwater conditions in the vicinity of the Hornsby breccia quarry, is unlikely to result in an overall failure of the quarry slope, and therefore does not appear to be of general concern for the proposed development.


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Important Information about your Geotechnical Engineering Report

Appendix A - Borehole Logs
Appendix B - Stereographic Projections for Oriented Cored Boreholes
Appendix C - Data Histograms for Surface Line Mapping
Appendix D - Stereographic Projections for Surface Line Mapping
Appendix E - Tabulation of Bedding, Joint and Vein Orientations
               - Cored Boreholes

Drawing No. S8463/4-1 - Plan of Defect Orientations
Drawing No. S8463/4-2 - Geological Cross-Sections
1.0 INTRODUCTION

This report presents the results of a rock mechanics study undertaken at the request of Hornsby Shire Council in the eastern area of the Hornsby breccia quarry. The purpose of the study was to supplement earlier preliminary investigations carried out in the area, the results of which were presented in Report No. S8463/2-AC, July 1989.

The work was undertaken in general accordance with our proposal for additional rock mechanics studies, as outlined in Appendix E of the above report. The work was commissioned by Hornsby Shire Council in a letter dated 4th October 1989.

As mentioned in previous reports, the toe of the proposed playing field development at Old Man's Valley will come to within 50m of the top of the present position of the eastern face of the quarry and would be within about 25m of the proposed final development profile for the eastern face. To further assess the stability of the eastern quarry area, the aim of the present rock mechanics study was to obtain additional structural data on the rock mass, both on the existing quarry face and on the rock mass behind the face.

2.0 Previous Investigations

In 1982, Golder & Associates (Golders) undertook a slope stability investigation of the eastern face of the Hornsby Breccia Quarry (Report No. 8267037A) for the Readymix Group. This investigation comprised the drilling of two vertical diamond drill holes, Bore G1 and G2, to 49.9m and 48.4m depth respectively. Bore G1 was located at RL41.5m near the then existing base of the quarry, and Bore G2 was located some 40m east of the top of the eastern face. The principal purpose of the drilling as outlined in Golders Preliminary Report No. 82627037 was to investigate the potential for slope failure on either a breccia/sandstone interface or alternatively along bedding or foliation planes. The report stated:

"The drilling has confirmed that synclinal bedding/foliation exists; the bedding slope being generally 5 to 10° in Bore G1 and about 50° in Bore G2. Only very few actual bedding/foliation discontinuities were observed and no fracturing along these planes was encountered. Bedding/foliation planes are therefore not considered to form a potential failure plane.

Complete joint orientation was not possible as core orienting equipment was not used during drilling of the vertical holes. Joint dip angles measured were variable however, the dominant angle of about 80° noted in Bore G1 agreed with the principal joint dip established from the joint survey of the eastern face above. The joints logged in Bore G2 indicate principal joint dips of 15 to 30° and 45 to 60°.

Most joint faces were calcite filled and no clay infilling was apparent thus indicating appreciable joint strength."
The generally moderately to widely spaced presence of jointing together with the indicated appreciable joint strength is considered to preclude failure of the slope through either a single or a series of intersecting joint planes".

Subsequent to the above investigations, Coffey & Partners Pty. Ltd. (CAP) undertook in 1989 a preliminary investigation of the quarry area which included some field mapping along creek lines and surface exposures in the area above the quarry, as well as limited geological mapping of joints and bedding exposed on the eastern quarry face. This information was presented in Report No. S8463/2-AC, July 1989 which concluded that; "On the basis of information available, Golder & Associates conclusions appears reasonable. In view of the possible ramifications if the quarry were to be extended, consideration should be given to implementing a rock mechanics study in conjunction with other work".

The present rock mechanics study was undertaken concurrently with additional geotechnical investigations being carried out in the vicinity of the Old Man's Valley playing fields, the results of which will be reported separately.

In addition to survey information previously supplied by Council for the preparation of Report No. S8463/2-AC, which was used in the preparation of this report, the following information was recently provided by Council:


The survey data included the location of boreholes and test pits. Other factual data supplied, including factual data in Golders report, has not been checked and this report relies on that data.

3.0 RECENT INVESTIGATIONS

3.1 Investigation Drilling

To further access the orientation and nature of major rock mass discontinuities in the quarry area, but more particularly beyond the eastern face of the quarry, recent investigations have included the drilling of three approximately 90m long, fully cored oriented inclined boreholes, namely 101, 102 and 103 (for location see Drawing No. S8463/4-1).

Boreholes 101 and 102, are located approximately 25 metres east of a point located midway along the top of the eastern quarry face. Both holes where inclined at 65° from the horizontal. Borehole 101 was oriented at 260° (magnetic) towards the quarry, whereas borehole 102 was oriented away from the quarry at approximately 80° (magnetic). The presence of a deeply
incised creek near the quarry's eastern boundary and the adjacent constantly used quarry haul road, reduced the scope for borehole site selection. As a result of these limitation, boreholes 101 and 102 were located adjacent to the quarry-playing fields access road on Council land and borehole 103 was located on a bench near the top of south-eastern corner of the quarry.

Borehole 103 was inclined at 65° from the horizontal and oriented at 142° (magnetic). This orientation was selected so as to maximise the intersection of known joint sets.

During the drilling of the boreholes core orientation was attempted at the completion of each drilling run. In areas of highly fractured rock, particularly in near surface layers in boreholes 101 and 103, core orientation was largely unsuccessful, however, in less fractured rock the technique was successful. Appendix E contains a listing of all recorded defect orientations including bedding planes, joints and veins for each of the boreholes.

3.2 Line Discontinuity Mapping

Detailed line discontinuity mapping has been carried out along three benches on the eastern quarry face. These traverses have been designated 1989/1, 1982/2 and 1989/3 and are located as shown on Drawing No. S8463/4-1. This line mapping is additional to earlier mapping, the results of which were presented in Report No. S8463/2-AC. The three traverses are located on benches at approximately RL90 (traverse 1989/1), approximately RL70 (traverse 1989/2) and approximately RL40 (traverse 1989/3).

Information gathered from the line discontinuity mapping includes the following data on defects:

- spacing,
- length,
- continuity,
- surface roughness,
- surface hardness,
- water condition and
- structural orientation.

This information has been summarised and is presented in Appendix C in histogram form for each of the three traverses. Stereographic projections are presented for each of the traverses in Appendix D. For each of the three traverses, separate histogram plots have been prepared for, the total of all defects, joints only and, bedding defects only.

The mean structural orientation of major defect sets and defect types are summarised in Table 1.
4.0 DESCRIPTION OF ROCK MASS

4.1 General

Hornsby Quarry, situated immediately west of the proposed filling at Old Man’s Valley is sited within volcanic breccia, with the surrounding plateau area comprised of Hawkesbury Sandstone. The Sydney 1:100,000 Geological Series Sheet indicates that the quarry is located in the so called Hornsby Diatreme, which is dumbell shaped and elongate in a north-east/south-west direction for about 1.5km and generally less than 400m wide.

It is unknown whether the Hornsby Diatreme represents a single intrusion or a number of intrusions. As the dumbell shape alludes to the possibility of more than one intrusion, the number of intrusions, their relationships and effects on one another are unknown.

A diatreme can be defined as a pipe-like volcanic conduit filled with pyroclastic debris (tuff or lapilli tuff) and blocks of wall rock. Diatremes in the Sydney Basin are generally considered to have resulted from violent intrusions of molten magma into surrounding country rocks.

Drawing No. S8463/4-1 shows the interpolated boundary between the volcanic breccia of the diatreme and the Hawkesbury Sandstone. The location of this boundary has been assessed based on previous field mapping by CAP and on borehole information from past and present studies by CAP and Golders. The steepness of the boundary is uncertain. Crawford et al (Reference 2) has indicated that the boundary in other diatremes of the Sydney Basin is commonly characterised by steep sandstone walls.

The two inclined boreholes, 101 and 102 fully penetrated volcanic breccia, as did the boreholes G1 and G2 drilled by Golders. Borehole 103 however, unexpectedly intersected alternating bands of sandstone/siltstone and breccia from near the surface to a depth of about 75m, where undisturbed sedimentary rock is believed to have been intersected. The inferred orientation of the bedding, both within the breccia and the sandstone/siltstone blocks (?) appears to rapidly vary, both with rock type and depth. This geologically complex area, has been interpreted as representing a ‘transition zone’ between the relatively massive breccia exposed in the quarry and the undisturbed sandstone at the boundary of the diatreme. As shown on Drawing No. S8463/4-2, the ‘transition zone’ in the vicinity of borehole 103 may be up to 70m wide.

4.2 Lithology

The volcanic breccia at Hornsby is generally comprised of a heterogeneous mix of grey to grey-green angular to subrounded fragments of volcanic rock cemented within a fine grained dark grey tuffaceous matrix. As shown on the borehole logs, the breccia consists of bands of finer grained breccia interlayered with medium to coarse grained breccia. Within the coarser layers in particular, there is often a scattering of irregular to subrounded fragments of coal, siltstone and sandstone up to 180mm thick. In addition to the fragments of sedimentary rock within the breccia, clasts of dolerite were also noted, particularly in boreholes 101 and 102.
The presence of irregular to subrounded fragments of sedimentary rock and
dolerite within the breccia, helps to confirm the violent intrusive nature
of diatreme formation. In addition, within borehole 101 imbrication of
breccia fragments indicates flow of molten magma.

Fragments of volcanic rock within the breccia mainly range from 1 to 10mm
in size, although fragments up to 400mm were noted in outcrops. The
fragment to matrix ratio generally ranges from about 70:30 to 40:60.
Fragments of sedimentary rock within the breccia are more frequent in
borehole 101 than in nearby borehole 102, further indicating the
heterogeneous nature of the breccia.

Borehole 103 located within the 'transition-zone' near the margins of the
diatreme, shows a high proportion of sedimentary rock fragments within the
breccia bands with fragments of sandstone up to 180mm across.

Throughout the breccia there is irregular calite veining, as well as calate
infillings along joints and bedding partings. The majority of the joints
are coated with at least a veneer of calcite.

The breccia is generally of high to very high strength when fresh, with the
finer grained breccia of slightly higher strength than the medium to coarse
grained breccia.

4.3 Weathering

Boreholes 101 and 102 intersected what may be regarded as essentially fresh
breccia below depths of about 12 to 13m. In borehole 101, a number of
iron-stained joints were intersected to a depth of 65.8m, whereas in
borehole 102 which was drilled away from the quarry, the number of iron-
stained joints were considerably fewer with the deepest iron-stained joint
intersected at a depth of about 32m.

In borehole 101 a number of iron-stained joints had associated narrow bands
of slightly weathered breccia and these have been designated as slightly
weathered bands on the borehole logs. However, as mentioned above, the
rock mass below about 13m may generally be regarded as fresh, with iron-
stained joints.

Borehole 103 located above the south-eastern corner of the quarry
intersected essentially fresh sandstone from about 12m. The base of
extremely to moderately weathered sandstone and breccia occurs at about 9m.

On the eastern quarry face, the approximate boundary between the variably
weathered breccia and the underlying essentially fresh breccia occurs along
or near the bench located at RL90m.
4.4 Permeability

Although no water pressure testing or other permeability testing as such was carried out during the investigation, the losses of drill water during drilling give some indication as to the permeability characteristics of the rock mass. During the drilling of borehole 101, a number of highly fractured zones were intersected in which complete drill water loss was experienced. These conditions were unexpected and were not apparent from previously available subsurface data. Complete drill water losses were recorded on fourteen occasions during the drilling of borehole 101, with the majority of the losses recorded in the upper half of the hole. For precise locations see the borehole logs in Appendix A. When complete drill water losses were experienced, the hole was cemented. Partial drill water losses were also recorded at twelve locations most of which are in the upper half of the hole.

In comparison with borehole 101, borehole 102 recorded complete drill water losses on only three occasions, at depths 10.3m, 17.0m and 65.5m with only one partial drill water loss at 58.9m. Borehole 103 did not experience any noticeable losses of drill water over its full length.

In summary, it appears that the rock mass in the vicinity of borehole 101, which is located nearest to the quarry face, has a number of highly permeable fractured zones. The permeability of these zones may have increased as a result of the opening up of fractures either from the relief of stresses associated with excavation or from blasting.

Observation of the upper three benches of the eastern quarry face (down to approximately RL40m) did not reveal any significant zones of seepage which indicate that water levels in the adjacent breccia may have been effectively drawn down to near quarry floor level. Observation of piezometric levels in boreholes in the vicinity of Councils playing fields support this view, with water levels in some boreholes at depths greater than 50m.

4.5 Structure

4.5.1 Bedding

Within Hornsby Quarry the volcanic breccia of the Hornsby Diatreme shows a particularly well defined basinal layering. This is particularly evident on the eastern face of the quarry where the strata dips steeply to the south-east on the northern half of the face, flattening out to almost horizontal in the central area before steepening on the southern face where the dip is to the north-east.
The results of the mapping of bedding planes, particularly along Line Mapping Traverses 1989/1, 1989/2 and 1989/3 is shown on Drawing No. S8463/4-1. The mapping indicates that the dip of the bedding planes in the quarry ranges from less than 10° up to 75°. As shown on the stereographic plots for bedding presented in Appendix D, the bedding orientations generally plot along an arc, reflecting the basinal layering in the breccia. Beds in the northern half of the quarry face mostly dip towards the east-south-east at about 8° to 32° whereas beds on the southern half of the quarry face mostly dip towards the north-east at about 15 to 25°. Towards the centre of the eastern quarry face, the number of bedding plane intersections were fewer on each of the traverses, but more particularly on Traverse 1989/3. This was in part due to the massive nature of the breccia in these locations.

The data histograms for the three line mapping traverses presented in Appendix C, indicates that the majority of bedding partings were 6 to 20m in length discrete to semi-continuous, with ridges and stained. The increase in spacing between bedding measurements for traverses 1989/1 and 2 and 1989/3 is however, largely the result of coarser screening applied to traverse 1989/3.

Towards the south-east corner of the quarry, particularly in the area below borehole 103, the breccia appears to be more massive than elsewhere in the quarry. The relatively few bedding planes in this area may either indicate the presence of a thick breccia layer conformable with the strata in the remainder of the quarry, or alternatively, it may represent the northern extremity of the 'transition zone' shown on Drawing No. S8463/4-2.

Bedding or foliation was generally indistinct in much of the breccia intersected in inclined cored boreholes 101 and 102. Appendix E presents a tabulation of bedding plane orientations obtained by core orientation. As shown, relatively few measurements were obtained and the results show a surprisingly wide scatter of orientations. Bedding planes measured in borehole 101 below depths of 58m, generally indicated dip directions to the south, south-west and west at angles ranging from 5° to 29°. These orientations appear to conflict with the relatively consistent trends shown on the line mapping traverses which are located a distance of 40m to the west, and with the bedding angles recorded in borehole 61.
### TABLE 1

**SUMMARY OF MAJOR DEFECT SET ORIENTATIONS**

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<th>DATA SOURCE</th>
<th>DEFECT TYPE</th>
<th>DEFECT SET</th>
<th>MEAN ORIENTATION DIP (deg)</th>
<th>DIP DIRECTION (deg)</th>
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<td>A</td>
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<td></td>
<td>J</td>
<td>C</td>
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<td>D</td>
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<td></td>
<td>B</td>
<td>D'</td>
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<td>B</td>
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<td>F</td>
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*J* - Joint  
*B* - Bedding  
*V* - Vein
Bedding plane orientations obtained in borehole 102 show relatively consistent trends, with dips to the north-east and south-east (i.e. into the hillside) at angles ranging from 8° to 28°. These orientations appear consistent with measurements obtained for the three line mapping traverses and they indicate that for at least the upper 25m of borehole 102, the orientation of the bedding is away from the quarry.

Previous investigations by Golders indicated that in borehole G2 below depths of about 30m, bedding plane dips of 48° and 50° were noted. No evidence of such high angle bedding was noted in boreholes 101 or 102. In addition, these boreholes were generally indistinctly bedded with very few bedding plane partings.

4.5.2 Jointing

Line mapping along three benches on the eastern quarry face, namely Traverses 1989/1, 2 and 3 has confirmed the existence of two major joint sets identified during previous studies. As shown on the stereographic plots presented in Appendix D and as summarised in Table 1, the principal joint set (designated defect set A) dips at 82° with a dip direction of 270°. The minor joint set (designated defect set B) is also steeply dipping at about 83°, with a dip direction of about 180°. In addition to these orthogonal joint sets, a subordinate joint set (defect set C) steeply dipping at 80°, with a dip direction of 245° was identified on Traverse 1989/2. This subordinate joint set was also present on Traverses 1989/1 and 3 but was not as pronounced.

Observations of the lower benches below Traverse 1989/3 on the eastern quarry face indicated similar joint orientations to those outlined above. Observations of defect set A indicated a spacing between joints typically ranging from 0.6m to 2m. Defect set B has a similar spacing between joints to set A and are distinctive in outcrop. Towards the lower central part of the quarry, a number of the more continuous joints belonging to defect set B were points of minor seepages.

Throughout the quarry and in the three boreholes the majority of the joints were planar and rough and either clean or coated/infilled with calcite. Borehole 101 had a number of limonite stained joints to a depth of 65.8m, but in general the majority of the joints were planar, rough and calcite coated.

Joint sets identified in each of the three boreholes did not show any consistent pattern, compared with the joint sets identified in the line mapping. The steeply dipping orthogonal sets identified on the eastern quarry face were not present in the boreholes.

In borehole 101 the major joint set may reflect defect set B identified on the quarry face and in borehole 102 the third largest joint set may reflect joint set A, however, these correlations may be just coincidental. Contrasting with the above, borehole 102 identified two major relatively shallow dipping joint sets with dip angles of 34° and 35° and dip
directions of 340° and 026°, respectively. These low angle joints did not appear to be well developed in the quarry face, which indicates that either they were masked by other rock mass defects or alternatively the orientation of defects in the vicinity of borehole 102 is different to that of the defects on the quarry face.

As very few joint measurements were made in borehole 103, it is difficult to obtain a reliable picture of the jointing in the area, however, from the few measurements it appears that joints in the sandstone dip to the north-north-west at an angle of about 55°.

The orientation of the calcite veins as measured in boreholes 101 and 102 have as expected a general tendency to parallel the major joint directions.

5.0 SLOPE STABILITY

The bedding planes within the breccia, which reflect basinal layering, are potential planes of weakness within the rock mass. In the past, a number of planar slope failures have taken place along these bedding planes, as evidenced by the extensive 65° face on the southern side of the quarry. A smaller number of minor planar slope failures, also along bedding planes have occurred on the northern quarry face. Therefore, the orientation of bedding in the eastern quarry area near the toe of the proposed playing field development is critical in the overall assessment of slope stability.

As mentioned in Section 4.5.1 the bedding plane orientations measured in the upper parts of borehole 102 are consistent with the measurements obtained from the line mapping, that is, they dip away from the quarry. The bedding in this area is therefore considered to be favourably oriented with respect to possible bedding plane failures. In addition, the generally massive nature of the breccia in the area behind the present quarry face further indicates that slope failure by planar sliding along bedding is unlikely.

The wide variation in bedding orientations recorded below depths of 58m in borehole 101 may represent a discrete contorted zone which was not apparent in nearby Line Mapping Traverse 1989/3 or in borehole G1. As this possible zone occurs well below the proposed development, and set back some distance from the quarry face, it is not considered to have an adverse impact on the overall stability of the slope.

Line mapping confirmed the presence of orthogonal joint sets in the quarry, with the major set striking north-south, dipping 80° west and the minor set striking east-west and dipping 83° south.

As shown on Drawing Nos. S8463/4–1 and 2, the breccia/sandstone contact is believed to pass along or near to the southern boundary of the present quarry. Borehole 103 is located in a highly variable 'transition zone' between the relatively massive breccia in the quarry and the undisturbed sandstone at the boundary of the diatreme. The strength of the siltstones, silty sandstones and sandstone within the breccia in this 'transition zone' vary from very low to high, whereas the breccia itself is generally of high
strength. No reliable bedding or joint orientations were obtained in borehole 103 above the breccia/sandstone contact at 75m. Below 75m, the joints appear to be dipping at angles of about 70° with dip directions between 331° and 009°. Should the joints in the "transition zone" be of a similar orientation to those in the intact sandstone, then the jointing within the 'transition zone' is considered to be oriented favourably with respect to possible failure of the slope below the proposed development.

As most joint faces within the breccia are planar, rough and calcite coated, with little or no clay infillings, the rock mass could be expected to have appreciable joint strengths. In addition, as the spacing between joints and bedding plane defects is generally moderately to widely spaced, failure of the slope through either a discrete defect plane or a series of intersecting defects is highly unlikely.

The eastern quarry face appears to be well drained in that no significant areas of groundwater seepage were observed on the quarry face down to about RL40. Below this depth a number of joints, belonging to defect set B show signs of minor seepage. This conclusion is supported in that boreholes located in the playing field area above the quarry have piezometric levels up to 50m below the surface.

The proposed filling is unlikely to significantly load the quarry face as it now stands, nor is it likely to adversely affect groundwater conditions behind the face. The installation of drainage measures in and around the proposed playing field development will limit the amount of water entering the slope.

6.0 SUMMARY AND CONCLUSIONS

The recent investigations into the stability of the eastern quarry area in the vicinity of the proposed playing field development has identified the following major features:

- A broad 'transition zone' some 70m wide located along the southern side of the quarry believed to be comprised of a chaotic mix of sedimentary blocks and volcanic breccia. Jointing in this area is believed to be steeply dipping to the north.

- A general continuation of the bedding/basinal layering orientation as observed on the central area of the eastern quarry face for at least 60m eastwards into the hillside and for at least the upper 50m of the present quarry.

- Major joint sets identified on the eastern quarry face were either not present or poorly defined in the area beyond the existing quarry face.

- The eastern quarry face and adjacent rock mass appears to be well drained.
As the proposed playing field development is unlikely to significantly load the quarry face as it now stands, and with the general combination of rock strength, structure and groundwater conditions, the overall failure of the quarry slope does not appear to be of general concern for the proposed development.

Provided any future blasting adjacent to the final quarry outline is designed to produce sound slopes with minimal blast induced fractures then the above information indicates that the eastern quarry face should remain stable to the depths and at the slopes proposed.

For and on behalf of

COFFEY & PARTNERS PTY LTD

REFERENCES


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 unrefrigerated 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.

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.

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 professionals 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.

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 minimize the likelihood of boring log misinterpretation, give contractors ready access to the complete geotechnical engineering report prepared or authorized for their use. Those who do not provide such access may proceed under the 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.

* For further information on this aspect, reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by The Institution of Engineers Australia, National Headquarters, Canberra, 1987.
APPENDIX A

BOREHOLE LOGS
SOIL DESCRIPTIONS

Classification of Material based on Unified Classification System (refer SAA Site Investigation Code AS1726-1975 Add., No. 1 Table D1).

Moisture Condition based on appearance of soil

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dry</td>
<td>Looks and feels dry; cohesive soils usually hard, powdery or friable, granular soils run freely through hands.</td>
</tr>
<tr>
<td>moist</td>
<td>Soil feels cool, darkened in colour; cohesive soils usually weakened by moisture, granular soils tend to cohere, but one gets no free water on hands on remoulding.</td>
</tr>
<tr>
<td>wet</td>
<td>Soil feels cool, darkened in colour; cohesive soils weakened, granular soils tend to cohere, free water collects on hands when remoulding.</td>
</tr>
</tbody>
</table>

Consistency based on unconfined compressive strength (Qu) (generally estimated or measured by hand penetrometer)

<table>
<thead>
<tr>
<th>Term</th>
<th>very soft</th>
<th>soft</th>
<th>firm</th>
<th>stiff</th>
<th>very stiff</th>
<th>hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qu kPa</td>
<td>25</td>
<td>50</td>
<td>100</td>
<td>200</td>
<td>400</td>
<td></td>
</tr>
</tbody>
</table>

If soil crumbles on test without meaningful result, it is described as friable.

Density Index (generally estimated or based on penetrometer results).

<table>
<thead>
<tr>
<th>Term</th>
<th>very loose</th>
<th>loose</th>
<th>medium dense</th>
<th>dense</th>
<th>very dense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density index</td>
<td>10 %</td>
<td>15</td>
<td>35</td>
<td>65</td>
<td>85</td>
</tr>
</tbody>
</table>

ROCK DESCRIPTIONS

Weathering based on visual assessment

<table>
<thead>
<tr>
<th>Term</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>Rock substance unaffected by weathering.</td>
</tr>
<tr>
<td>Slightly Weathered</td>
<td>Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.</td>
</tr>
<tr>
<td>Moderately Weathered</td>
<td>Rock substance affected by weathering to the extent that staining extends throughout whole of the rock substance and the original colour of the fresh rock is no longer recognisable.</td>
</tr>
<tr>
<td>Highly Weathered</td>
<td>Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and signs of chemical or physical decomposition of individual minerals are usually evident. Porosity and strength may be increased or decreased when compared to the fresh rock substance, usually as a result of the leaching or deposition of iron. The colour and strength of the original fresh rock substance is no longer recognisable.</td>
</tr>
<tr>
<td>Extremely Weathered</td>
<td>Rock substance affected by weathering to the extent that the rock exhibits soil properties, i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.</td>
</tr>
</tbody>
</table>

Strength based on point load strength index, corrected to 50 mm diameter \( (S_{50}) \) (refer I.S.R.M., Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1). (Generally estimated: \( x \) indicates test result).

<table>
<thead>
<tr>
<th>Classification</th>
<th>extremely low</th>
<th>very low</th>
<th>low</th>
<th>medium</th>
<th>high</th>
<th>very high</th>
<th>extremely high</th>
</tr>
</thead>
<tbody>
<tr>
<td>( S_{50} ) MPa</td>
<td>0.03</td>
<td>0.1</td>
<td>0.3</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

The unconfined compressive strength is typically about \( 20 \times S_{50} \) but the multiplier may range, for different rock types, from as low as 4 to as high as 30.

Defect Spacing

<table>
<thead>
<tr>
<th>Classification spacing m</th>
<th>extremely close</th>
<th>very close</th>
<th>close</th>
<th>medium</th>
<th>wide</th>
<th>very wide</th>
<th>extremely wide</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.03</td>
<td>0.1</td>
<td>0.3</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Defect description uses terms contained on AS1726 table D2 to describe nature of defect (fault, joint, crushed zone, clay seam etc.) and character (roughness, extent, coating etc.).
**graphic symbols**

**soil and rock**

### SOIL
- Asphalitic Concrete or Hotmix
- Concrete
- Topsoil
- Fill
- Peat, Organic Clays and Silts (Pt, OL, OH)
- Clay (CL, CH)
- Silt (ML, MH)
- Sandy Clay (CL, CH)
- Silty Clay (CL, CH)
- Gravelly Clay (CL, CH)
- Sandy Silt (ML)
- Clayey Sand (SC)
- Silty Sand (SM)
- Sand (SP, SW)
- Clayey Gravel (GC)
- Silty Gravel (GM)
- Gravel (GP, GW)

### ROCK
- Claystone (massive)
- Siltstone (massive)
- Shale (laminated)
- Sandstone (undifferentiated)
- Sandstone, fine grained
- Sandstone, coarse grained
- Conglomerate
- Limestone
- Coal
- Dolerite, Basalt
- Tuff
- Porphyry
- Granite
- Pegmatite
- Schist
- Gneiss
- Quartzite
- Talus
- Alluvium

### SEAMS
- Seam >0.1 m thick
  (on a scale 1:50)
- Seam 0.01 m to 0.1 m thick
  (on a scale 1:50)

### INCLUSIONS (Special purposes only)
- Rock Fragments
- Ironstone Gravel, Laterite
- Swamp
- Shale Breccia in Sandstone

### Water Level

**Surfaces**
- Known Boundary
- Probable Boundary
- Possible Boundary
# Engineering Log - Borehole

**Client:** Hornsby Shire Council  
**Project:** Old Mans Valley  
**Borehole Location:** E 30518.10 N 1524989.83

### Drilling Information
- **Drill Model and Method:** Pioneer 840
- **Drill Diameter:** 76mm
- **Hole Diameter:**
  - Diameter 1 (RL 100): 76mm
  - Diameter 2 (RL 96): 76mm
  - Diameter 3 (RL 92): 76mm
- **Borehole ID:** 101
- **Date:** AHD

### Soil Description

<table>
<thead>
<tr>
<th>Depth (RL)</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>102.1</td>
<td>CL FILL CLAY: medium plasticity, red brown sandy gravel-like to coarse grained</td>
</tr>
<tr>
<td>101.1</td>
<td>CL GRAVELY CLAY: medium plasticity, yellow brown gravel-like to coarse gravel</td>
</tr>
<tr>
<td>96.0</td>
<td>CC CLAYET GRAVEL: fine to coarse gravel, grey brown, sandy like to coarse gravel</td>
</tr>
<tr>
<td>98.8</td>
<td>RESIDUAL</td>
</tr>
<tr>
<td>97.0</td>
<td>CLAYET</td>
</tr>
<tr>
<td>99.9</td>
<td>W BRECCIA</td>
</tr>
</tbody>
</table>

### Support and Penetration
- **Support:** C casing, M mud
- **Penetration:** [Method not specified in table]

### Water Levels
- **Water Level:** Not measured

### Notes and Tests
- **Notes:** Samples and tests
- **Tests:** USO undisturbed sample 50 mm diameter

### Classification
- **Symbols and Soil Description:** Based on unified classification system
- **Moisture:**
  - D dry
  - M moist
  - W wet
  - Wo plastic limit
- **Consistency/Density Index:**
  - VS very soft
  - S stiff
  - F firm
  - Fb friable
  - VL very loose
  - L loose
  - MD medium dense
  - D dense
  - VD very dense
### Engineering Log - Borehole

**Client:** HORNSEY SHIRE COUNCIL  
**Project:** OLD MANS VALLEY  
**Borehole Location:** E 206510.10 N 1269859.83

<table>
<thead>
<tr>
<th>Hole Diameter:</th>
<th>76mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support Method</td>
<td>3 x penetration</td>
</tr>
<tr>
<td>Notes</td>
<td>samples, test, etc</td>
</tr>
<tr>
<td>R.L.</td>
<td>92</td>
</tr>
<tr>
<td>Depth Meters</td>
<td>111</td>
</tr>
</tbody>
</table>

**Classification:**
- **Material:** Clavey Gravel: fine to coarse gravel, grey brown, sand fine to coarse grained, & clay
- **Moisture Condition:** Moderately to Highly weathered breccia

**R.I.:** Surface: 102.9 m

**Structure and Additional Observations:** EW Breccia (?)

---

**Notes:**
- **Classification Symbols and Soil Description:** Based on unified classification system
- **Moisture:**
  - D dry
  - M moist
  - W wet
  - WP plastic limit
  - VD very dense

**Consistency/Density Index:**
- VS very soft
- S soft
- F firm
- S1 stiff
- VS1 very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense
### Engineering Log - Cored Borehole

**Client:** HORNSEY SHIRE COUNCIL
**Project:** OLD MANS VALLEY
**Borehole Location:**
- Hole commenced: 14.11.89
- Hole completed: 30.11.89
- Logged by: PLY
- Checked by: PLY

**Core Model and Mounting:** PIONEER B40 TRUCK
**Bore Type and Length:** NG 3.3m
**Rock Substances:**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Substance Description</th>
<th>Rock Type</th>
<th>Grain Characteristics</th>
<th>Colour, Structure, Minor Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>BRECCIA: medium to coarse grained, light grey, distinct bedding.</td>
<td>BRECCIA</td>
<td>medium to coarse grained, light grey, distinct bedding.</td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>BRECCIA: fine to medium grained, light grey, distinct bedding.</td>
<td>BRECCIA</td>
<td>fine to medium grained, light grey, distinct bedding.</td>
<td></td>
</tr>
<tr>
<td>93</td>
<td>NO CORE: 0.3m</td>
<td>BRECCIA</td>
<td>fine to medium grained, light grey, distinct bedding.</td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>BRECCIA: medium to coarse grained, light grey, distinct bedding.</td>
<td>BRECCIA</td>
<td>medium to coarse grained, light grey, distinct bedding.</td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>cement put in hole to seal water loss</td>
<td>BRECCIA</td>
<td>fine to medium grained, light grey, distinct bedding.</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>BRECCIA: medium to coarse grained, light grey, distinct bedding.</td>
<td>BRECCIA</td>
<td>medium to coarse grained, light grey, distinct bedding.</td>
<td></td>
</tr>
<tr>
<td>89</td>
<td>BRECCIA: fine to medium grained, light grey, distinct bedding.</td>
<td>BRECCIA</td>
<td>fine to medium grained, light grey, distinct bedding.</td>
<td></td>
</tr>
</tbody>
</table>

**General Defect Description:**
- JT PL Fe stained smooth
- JT PL Fe stained
- JT PL Fe stained
- JT PL Fe stained
- JT PL clean
- JT PL clean
- JT PL clean
- JT PL clean
- JT PL clean
- JT PL smooth calcite
- UU intersecting JT PL some calcite
- UU intersecting JT PL some calcite
- UU intersecting JT PL some calcite
- UU intersecting JT PL some calcite
- UU intersecting JT PL some calcite
- UU intersecting JT PL some calcite
- UU intersecting JT PL some calcite

**Graphic Log/Core Loss:**
- Core recovered (batting indicates material)
- Partial loss
- Complete loss
- No core recovered

**Point Load Test:**
- D = elemental
- A = axial

**Weathering:**
- FR = fresh
- SW = slightly weathered
- MW = moderately weathered
- HW = highly weathered
- EW = extremely weathered

**Strength:**
- EL = extremely low
- VL = very low
- L = low
- M = medium
- H = high
- VH = very high
- SH = extremely high

**Defects:**
- JT: joint
- PI: parting
- SM: seam
- C1: clay
- RO: rough
- PC: decomposed
- PL: planar
- SP: irregular
### Engineering Log - Cored Borehole

**Client:** HUNTSBURY SHIRE COUNCIL  
**Project:** OLD MANS VALLEY  
**Borehole Location:** E 363512.85 N 1296959.95

**Drill Model and Mounting:** PIONEER B44 TRUCK  
**Drill Type and Length:** NOQ 5.0m  
**Driller:** SRM  
**Checked by:** PLV

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
<th>Rock Substance</th>
<th>Strength</th>
<th>Profile</th>
<th>Core Description</th>
<th>Defect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5</td>
<td>BRECCIA: medium to coarse grained, light grey, grey, reddish, nodules on bedding plane</td>
<td>SW</td>
<td>FR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.4</td>
<td>BRECCIA: fine to medium grained, light grey, thinly bedded, calcite nodules on bedding plane</td>
<td>SW</td>
<td>FR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.2</td>
<td>BRECCIA: medium to coarse grained, light grey, thinly bedded, nodules on bedding plane</td>
<td>SW</td>
<td>FR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.5</td>
<td>BRECCIA: medium to coarse grained, light grey, reddish, nodules on bedding plane</td>
<td>SW</td>
<td>FR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.2</td>
<td>BRECCIA: fine to medium grained, light grey, grey, reddish, nodules on bedding plane</td>
<td>SW</td>
<td>FR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.0</td>
<td>BRECCIA: medium to coarse grained, light grey, grey, reddish, nodules on bedding plane</td>
<td>SW</td>
<td>FR</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**General Defect Description:**
- **Defect Type:** Various types of defects observed, including:
  - Fractured and fragmented zones
  - Thinly bedded layers
  - Thinly bedded zones

**Weathering:**
- **Strength:**
  - EL: Extremely low
  - VL: Very low
  - L: Low
  - M: Medium
  - H: High
  - VH: Very high

**Engineering Observations:**
- Water level:  
- Water inflow:  
- Coring used:  
- Barrel withdrawn:  

**Graphical Log/Core Loss:**
- Core recovered:  
- Partial loss:  
- No core recovered:  

**Method:** AS auger screwing, AD auger drilling, R rollers/friacs, W washpipe

**Point Load Test:** D = diametral, A = axial

**Weathering:**
- FR = Fresh
- SW = Slightly weathered
- MW = Moderately weathered
- HW = Highly weathered

**Strength:**
- EL = Extremely low
- VL = Very low
- L = Low
- M = Medium
- H = High
- VH = Very high

**Defects:**
- JI = Joint
- PL = Plate
- PT = Porosity
- SM = Seam
- CL = Clay
- RO = Rock
- DC = Decomposed
- PB = Plugging
- UR = Irregular
<table>
<thead>
<tr>
<th>Substrate Description</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breccia (medium to coarse grained, grey, light grey, indistinct bedding, large grains of siltstone, sandstone and coal)</td>
<td>Cracked seam 30mm thick Fe</td>
</tr>
<tr>
<td>Breccia (fine to medium grained, grey, light grey, indistinct bedding)</td>
<td>Cracked zone 20mm thick Fe</td>
</tr>
<tr>
<td>Breccia (medium to coarse grained, grey, light grey, indistinct bedding)</td>
<td>Cracked zone 40mm thick Fe</td>
</tr>
<tr>
<td>Cement polished in to seal water loss</td>
<td>Cracked zone 80mm thick</td>
</tr>
<tr>
<td>Breccia (fine to coarse grained, grey, light grey, indistinct bedding, some grading possibly due to bedding)</td>
<td>Breccia zone 100mm thick</td>
</tr>
<tr>
<td>Breccia (medium to coarse grained, grey, light grey, thin veined)</td>
<td>Breccia zone 150mm thick</td>
</tr>
<tr>
<td>Breccia (medium to coarse grained, grey, indistinct bedding, large grains of siltstone and sandstone)</td>
<td>Breccia zone 150mm thick</td>
</tr>
</tbody>
</table>

General Defect Description:
- Cracked seam 30mm thick Fe
- Cracked zone 20mm thick Fe
- Breccia zone 100mm thick
- Breccia zone 150mm thick
### Engineering Log - Cored Borehole

**Client:** Hornsey Shire Council  
**Project:** Old Mams Valley  
**Borehole Location:** E 303513.24 N 1269080.96

**Drilling Information**

<table>
<thead>
<tr>
<th>Method</th>
<th>Graphic</th>
<th>Rock Substance</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rock Type: Grain Characteristics</td>
<td>Defect Description</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colour, Structure, Minor Components</td>
<td>Type, Location, Penetrability, Strength, Coating, Thickness</td>
</tr>
<tr>
<td>PIONEER 840 TRUCK</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Graph</th>
<th>Rock Type</th>
<th>Grain Characteristics</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.78</td>
<td></td>
<td>Breccia, medium to coarse grained, grey, indistinct bedding.</td>
<td>Fractured, broken zone 200mm thick</td>
<td></td>
</tr>
<tr>
<td>3.90</td>
<td></td>
<td>Breccia, medium to coarse grained, grey, indistinct bedding.</td>
<td>Fractured, broken zone 200mm thick</td>
<td></td>
</tr>
<tr>
<td>4.12</td>
<td></td>
<td>Breccia, medium to coarse grained, grey, indistinct bedding.</td>
<td>Fractured, broken zone 200mm thick</td>
<td></td>
</tr>
<tr>
<td>4.24</td>
<td></td>
<td>Breccia, medium to coarse grained, grey, indistinct bedding.</td>
<td>Fractured, broken zone 200mm thick</td>
<td></td>
</tr>
</tbody>
</table>

**General Defect Description:**

**METHOD**  
- D- Damaged  
- P- Poorly consolidated  
- L- Low  
- V- Very  
- F- Fresh  
- S- Slightly  
- M- Medium  
- H- High  
- E- Extremely

**WEATHERING**  
- D- Damaged  
- P- Poorly consolidated  
- L- Low  
- V- Very  
- F- Fresh  
- S- Slightly  
- M- Medium  
- H- High  
- E- Extremely

**DEFECTS**  
- J- Joint  
- P- Pore  
- S- Sand  
- C- Clay  
- R- Rough  
- L- Lick  
- G- Gravel  
- D- Deformation  
- P- Planar  
- I- Irregular

---

**NOTES:**

- Water Level:  1.2m
- Drilling Water:  7.8m
- Hole cemented due to water loss.
<table>
<thead>
<tr>
<th>Drilling Information</th>
<th>Rock Substance Description</th>
<th>Rock Mass Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>Substance Type</td>
<td>Characteristic</td>
</tr>
<tr>
<td>65</td>
<td>BRECCIA: medium to coarse grained, light grey, with irregular bedding, calcite veins</td>
<td>FR</td>
</tr>
<tr>
<td>41</td>
<td>BRECCIA: fine to medium grained, light grey, indistinct bedding, calcite veins</td>
<td>MW</td>
</tr>
<tr>
<td>65</td>
<td>BRECCIA: medium to coarse grained, light grey, indistinct bedding, calcite veins</td>
<td>FR</td>
</tr>
<tr>
<td>42</td>
<td>BRECCIA: medium to coarse grained, light grey, indistinct bedding, calcite veins</td>
<td>MW</td>
</tr>
<tr>
<td>64</td>
<td>BRECCIA: fine to medium grained, light grey, indistinct bedding, calcite veins</td>
<td>FR</td>
</tr>
<tr>
<td>43</td>
<td>BRECCIA: fine to medium grained, light grey, indistinct bedding, calcite veins</td>
<td>MW</td>
</tr>
<tr>
<td>62</td>
<td>BRECCIA: fine to medium grained, light grey, indistinct bedding, calcite veins</td>
<td>FR</td>
</tr>
<tr>
<td>46</td>
<td>BRECCIA: medium to coarse grained, light grey, indistinct bedding, calcite veins</td>
<td>MW</td>
</tr>
<tr>
<td>91</td>
<td>BRECCIA: medium to coarse grained, light grey, indistinct bedding, calcite veins</td>
<td>FR</td>
</tr>
<tr>
<td>47</td>
<td>BRECCIA: medium to coarse grained, light grey, indistinct bedding, calcite veins</td>
<td>MW</td>
</tr>
<tr>
<td>60</td>
<td>BRECCIA: medium to coarse grained, light grey, indistinct bedding, calcite veins</td>
<td>FR</td>
</tr>
<tr>
<td>65</td>
<td>BRECCIA: medium to coarse grained, light grey, indistinct bedding, calcite veins</td>
<td>MW</td>
</tr>
</tbody>
</table>

**General Defect Description:**

**Method:**

- **AS: auger coring**
- **AD: auger drilling**
- **R: reamed/cased drilling**
- **NMCL: core drilling (not measured)**
- **NO: core drilling**
- **Casing used: barrel withdrawn**

**Water Level:**

- 6.8 m

**Diameter:**

- 2.5 m

**Drilling Water:**

- Not measured

**WEATHERING:**

- FR: fresh
- SW: slightly weathered
- MW: moderately weathered
- HW: highly weathered
- EW: extremely weathered

**Strength:**

- BL: extremely low
- VL: very low
- L: low
- M: medium
- H: high
- VH: very high
- BH: extremely high

**Defects:**

- JT: jointing
- PT: planing
- SM: seam
- DC: decomposed
- PL: planer
- IR: irregular

**graphic Log/core Loss:**

- Core recovered
- Partial loss
- Complete loss

**Rec.:**

- D: drilled
- A: awaiting
- S: sampled
- W: withdrawn

**Weathering Indications:**

- Material: weathering

**Load Test:**

- D: 0
- A: 0

**No Core Recovered:**

- 0-10
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Rock Mass Characteristics</th>
<th>Substance Description</th>
<th>Rock Type: Grain Characteristics</th>
<th>Colour, Structure, Minor Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>BRECCIA: medium to coarse graained, light grey, grey, indistinct bedding</td>
<td>BRECCIA: medium to coarse gritted, light grey, grey, indistinct bedding</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
</tr>
<tr>
<td>1.5</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
</tr>
<tr>
<td>2.0</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
<td>BRECCIA: medium to coarse gritted, light grey, indistinct bedding</td>
</tr>
</tbody>
</table>

**General Defect Description:**

- **METHOD:**
  - AS: auger screening
  - AD: auger drilling
  - R: roller/rotary
  - W: westbore
  - NM: core drilling
  - M: manual drilling
  - C: casing used
  - D: depth (m)

- **POINT LOAD TEST:**
  - D: dimension
  - A: axial

- **WEATHERING:**
  - FR: fresh
  - SW: slightly weathered
  - NW: moderately weathered
  - HW: highly weathered
  - EW: extremely weathered

- **STRENGTH:**
  - EL: extremely low
  - VL: very low
  - L: low
  - M: medium
  - H: high
  - VH: very high
  - EH: extremely high

- **DEFECTS:**
  - JI: joint
  - PI: pitting
  - SM: seam
  - CL: clay
  - RO: rock
  - DC: decomposed
  - PL: planar
  - IR: irregular

- **DRILLING WATER:**
  - Partially recovered
  - Partially lost

- **RIG:**
  - PIONEER 840 TRUCK

- **DATE:**
  - 26/07/2003

- **WEIGHT:**
  - AHD: Atmospheric Height Datum
# Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Principal:** Old Mans Valley  
**Project:**  
**Borehole Location:** E 305151.86 N 1269896.65  
**Drill Model and Make:** Pioneer B40 Truck  
**Barrel Type and Length:** NO 30m  
**Fluid:** Water  
**Depth:** 265m  
**Dip:** 61°  
**R.L. Surface:** 1029 m

## Drilling Information

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Rock Substance</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-40</td>
<td>BRECCIA, medium to coarse grained, light grey, grey, thinly bedded, bleeding, opaque, bedding at 10deg DD, 25mm</td>
<td>JO PL KO 61m DD 253deg</td>
</tr>
<tr>
<td>44-65</td>
<td>dark grey band 10mm thick</td>
<td>JO PL 09m DD 111deg</td>
</tr>
<tr>
<td>43-60</td>
<td>dark grey band 10mm thick</td>
<td>JO PL 15m DD 124deg</td>
</tr>
<tr>
<td>42-67</td>
<td>BRECCIA, medium to coarse grained, dark grey, grey, thinly bedded, bleeding, at 10deg DD, 25mm</td>
<td>JO PL KO 75m DD 258deg</td>
</tr>
<tr>
<td>41-60</td>
<td>dark grey band 10mm thick</td>
<td>JO PL KO 80m DD 258deg</td>
</tr>
<tr>
<td>61-70</td>
<td>BRECCIA, medium to coarse grained, dark grey, grey, thinly bedded, bedding at 10deg DD, 25mm</td>
<td>JO PL KO 75m DD 258deg</td>
</tr>
<tr>
<td>69-79</td>
<td>dark grey band 10mm thick</td>
<td>JO PL KO 80m DD 258deg</td>
</tr>
<tr>
<td>49</td>
<td>BRECCIA, medium to coarse grained, dark grey, grey, thinly bedded, bedding at 10deg DD, 25mm</td>
<td>JO PL KO 75m DD 258deg</td>
</tr>
<tr>
<td>70</td>
<td>dark grey band 10mm thick</td>
<td>JO PL KO 80m DD 258deg</td>
</tr>
<tr>
<td>30</td>
<td>BRECCIA, medium to coarse grained, dark grey, grey, thinly bedded, bedding at 10deg DD, 25mm</td>
<td>JO PL KO 75m DD 258deg</td>
</tr>
<tr>
<td>71</td>
<td>dark grey band 10mm thick</td>
<td>JO PL KO 80m DD 258deg</td>
</tr>
<tr>
<td>25-28</td>
<td>some cobbles, fine grained, to 10mm diameter</td>
<td>JO PL KO 75m DD 258deg</td>
</tr>
</tbody>
</table>

**General Defect Description:**

- JO PL KO 75m DD 258deg
- JO PL KO 80m DD 258deg
- JO PL KO 75m DD 258deg
- JO PL KO 80m DD 258deg
- JO PL KO 75m DD 258deg
- JO PL KO 80m DD 258deg
- JO PL KO 75m DD 258deg
- JO PL KO 80m DD 258deg
- JO PL KO 75m DD 258deg
- JO PL KO 80m DD 258deg
- JO PL KO 75m DD 258deg
- JO PL KO 80m DD 258deg
- JO PL KO 75m DD 258deg
- JO PL KO 80m DD 258deg

**METHOD**  
- auger drilling  
- roller/drill core drilling  
- core sampling  
- washerless core drilling  
- core sampling  
- core sampling  
- core sampling  

**POINT LOAD TEST**  
- D - diametral  
- A - axial  

**WEATHERING**  
- FR - fresh  
- SW - slightly weathered  
- MW - moderately weathered  
- HW - highly weathered  

**STRENGTH**  
- EL - extremely low  
- VL - very low  
- L - low  
- M - medium  
- H - high  
- VH - very high  

**DEFECTS**  
- JO - joint  
- PT - parting  
- SM - seam  
- CL - cleat  
- RO - rough  
- DC - decomposed  
- PL - planar  
- IR - irregular
<table>
<thead>
<tr>
<th>Method</th>
<th>Seq.</th>
<th>R.L.</th>
<th>Substance Description</th>
<th>Rock Substance</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brecia: Fine to coarse grained, dark grey, grey, indistinct bedding.</td>
<td>Brecia</td>
<td>PR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37</td>
<td>Light grey, grey, indistinct bedding.</td>
<td>Brecia</td>
<td>Jt Pl RO 44 deg DD 169.0eg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>73</td>
<td>Jt Pl RO 45 deg DD 160.0eg</td>
<td>Brecia</td>
<td>Jt Pl RO 45 deg DD 160.0eg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36</td>
<td>Jt Pl RO 85 deg DD 170.0eg</td>
<td>Brecia</td>
<td>Urolith zone 12 mm thick DD 125 deg DD 334 deg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>74</td>
<td>Calcium vein 8 &lt; 10 mm thick</td>
<td>Brecia</td>
<td>Calcium vein 8 &lt; 10 mm thick 75 deg DD 329 deg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75</td>
<td>Calcium vein 8 &lt; 10 mm thick DD 52 deg</td>
<td>Brecia</td>
<td>Calcium vein 8 &lt; 10 mm thick 75 deg DD 154 deg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34</td>
<td>Calcium vein 8 &lt; 10 mm thick DD 52 deg</td>
<td>Brecia</td>
<td>Calcium vein 2 mm thick 146 deg DD 54 deg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>77</td>
<td>Calcium vein 2 mm thick 146 deg DD 54 deg</td>
<td>Brecia</td>
<td>Jt Pl calcite vein 1 mm thick 74 deg DD 57 deg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>76</td>
<td>Calcium vein 2 mm thick 146 deg DD 54 deg</td>
<td>Brecia</td>
<td>Calcium vein 2 mm thick 146 deg DD 54 deg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32</td>
<td>Calcium vein 2 mm thick 146 deg DD 54 deg</td>
<td>Brecia</td>
<td>Calcium vein 2 mm thick 146 deg DD 54 deg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31</td>
<td>Calcium vein 2 mm thick 146 deg DD 54 deg</td>
<td>Brecia</td>
<td>Calcium vein 2 mm thick 146 deg DD 54 deg</td>
</tr>
</tbody>
</table>

**General Defect Description:**

- **Method:** Jt Pl RO
- **Defects:**
  - Jt Pl: 10 deg DD 50 deg
  - Jt Pl: 10 deg DD 50 deg
  - Jt Pl: 10 deg DD 50 deg
  - Jt Pl: 10 deg DD 50 deg

**graphic Log/Core Loss**

- **Core Recovery:**
  - Partial loss
  - Complete loss

- **Material:**
  - No core recovered

**Point Load Test**

- D = Diameter
- A = Area

**Weathering**

- **Types:**
  - FP = Fresh
  - SW = Slightly weathered
  - MW = Moderately weathered
  - HW = Highly weathered
  - EW = Extremity

**Strength**

- **Types:**
  - EL = Extremely low
  - VL = Very low
  - L = Low
  - M = Medium
  - H = High
  - VH = Very High

**Defects**

- Jt = Joint
- PL = Placing
- SM = Stem
- CL = Clay
- RO = Rough
- DC = Decomposed
# Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Project:** Old Mans Valley  
**Borehole Location:** E 38851.88, N 1526986.90

## Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Core Type</th>
<th>Depth Mark</th>
<th>Core Length</th>
<th>Subsurface Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO 23</td>
<td>Breccia</td>
<td>23</td>
<td>25</td>
<td>Light grey, indistinct bedding.</td>
</tr>
<tr>
<td>NO 20</td>
<td>Breccia</td>
<td>20</td>
<td>25</td>
<td>Medium to coarse grained, grey, indistinct bedding.</td>
</tr>
<tr>
<td>NO 19</td>
<td>Breccia</td>
<td>19</td>
<td>25</td>
<td>Medium to coarse grained, dark grey, indistinct bedding.</td>
</tr>
</tbody>
</table>

- **Breccia:** Fine to coarse grained, light grey, indistinct bedding.
- **Breccia:** Medium to coarse grained, grey, indistinct bedding.
- **Breccia:** Medium to coarse grained, dark grey, indistinct bedding.

**Note:** Borehole 101 Terminated at 92.00 m.

## General Defect Description:

- **Water Inflow:** Not measured
- **Drilling Water:** Partial loss
- **Complete Loss:** No core recovered

## Method

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>Auger coring</td>
</tr>
<tr>
<td>AD</td>
<td>Auger drilling</td>
</tr>
<tr>
<td>NMLC</td>
<td>Core drilling</td>
</tr>
<tr>
<td>NOHQ</td>
<td>Core drilling</td>
</tr>
</tbody>
</table>

## Point Load Test

<table>
<thead>
<tr>
<th>Point Load Test</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Diamond core</td>
</tr>
</tbody>
</table>

## Weathering

<table>
<thead>
<tr>
<th>Weathering</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR</td>
<td>Fresh</td>
</tr>
<tr>
<td>SV</td>
<td>Slightly</td>
</tr>
<tr>
<td>MW</td>
<td>Moderately</td>
</tr>
<tr>
<td>HV</td>
<td>Highly</td>
</tr>
<tr>
<td>EW</td>
<td>Extremely</td>
</tr>
</tbody>
</table>

## Strength

<table>
<thead>
<tr>
<th>Strength</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SI</td>
<td>Soft</td>
</tr>
<tr>
<td>VI</td>
<td>Very soft</td>
</tr>
<tr>
<td>L</td>
<td>Low</td>
</tr>
<tr>
<td>M</td>
<td>Medium</td>
</tr>
<tr>
<td>H</td>
<td>Hard</td>
</tr>
</tbody>
</table>

## Defects

<table>
<thead>
<tr>
<th>Defects</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Very</td>
</tr>
<tr>
<td>SM</td>
<td>Slightly</td>
</tr>
<tr>
<td>CL</td>
<td>Clay</td>
</tr>
<tr>
<td>DC</td>
<td>Decomposed</td>
</tr>
</tbody>
</table>

---

*Note: The table and diagram provide detailed information on the borehole's subsurface conditions, core recovery, and drilling parameters.*
### Engineering Log - Borehole

**Client:** Hornsby Shire Council  
**Principal:**  
**Project:** Old Main Valley  
**Borehole Location:** E300519.10 M200398.83  
**Hole Committed:** 4.12.69  
**Hole Completed:** 4.12.69  
**Logged By:**  
**Checked By:** PLY

<table>
<thead>
<tr>
<th>Method</th>
<th>Penetration</th>
<th>Water</th>
<th>Notes</th>
<th>Sampled</th>
<th>Testing</th>
<th>Description</th>
<th>Material</th>
<th>Concentration</th>
<th>Density</th>
<th>Structure and Additional Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>C</td>
<td>CL</td>
<td>193</td>
<td>CL</td>
<td></td>
<td>Clay medium plasticity, red brown gravel and sand till to coarse grained</td>
<td>M</td>
<td></td>
<td></td>
<td>FILL - contains breccia breccia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CL</td>
<td>192</td>
<td></td>
<td></td>
<td>Gravely Clay: medium plasticity, yellow brown gravel and sand till to coarse grained</td>
<td></td>
<td></td>
<td></td>
<td>RESIDUAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CL</td>
<td>191</td>
<td></td>
<td></td>
<td>Clayey gravel: fine to coarse grained and clay</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CL</td>
<td>190</td>
<td></td>
<td></td>
<td>Moderately to highly weathered breccia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes and Tests:**  
- Undisturbed sample to 80 mm diameter  
- Disturbed sample  
- Standard penetration test  
- SP1 + sample recovered  
- SP1 with solid cone  
- Vane shear  
- Pressuremeter  
- Bulk sample  
- Refusal  
- Water level  
- Water table  
- Water outflow  
- Water inflow

**Classification Symbols and Soil Description:**  
- Based on unified classification system  
- MOISTURE  
  - D: dry  
  - M: moist  
  - W: wet  
  - Wp: plastic limit

**Consistency/Density Index:**  
- VS: very soft  
- S: soft  
- F: firm  
- SI: stiff  
- VS1: very stiff  
- H: hard  
- FH: fuctional  
- VL: very loose  
- L: loose  
- MD: medium dense  
- D: dense  
- VB: very dense
## Engineering Log - Cored Borehole

**Client:** HUNTSBY SHIRE COUNCIL  
**Project:** OLD MANS VALLEY  
**Borehole Location:**  
**Drill Model and Mounting:** PIONEER B40 TRUCK  
**Borehole Type and Length:** NQ 3m  
**Slope:**  
**R.L. Surface:** 103.1 m  
**Datum:** AHD  

### Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Water Level</th>
<th>Water Inflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Rock Substance

- **Description:**  
  - Rock Type: Grain Characteristics  
  - Colour, Structure, Minor Components

### Rock Mass Defects

- **Description:**  
  - Type, Indication, Texture, Roughness, Scaling, Thickness

**General Defect Description:**

- **METHOD:** Water level
- **AD:** Water inflow
- **NC:** Not Tested  
- **MW:** Drilling Water Partial Loss
- **H:** No Core Recovered

**POINT LOAD TEST**

- **Diameter:**  
- **Point Load Test:**  
- **Fracture:**

**WEATHERING**

- **FR:** Fresh  
- **EL:** Extremely Low

**STRENGTH**

- **EL:** Extremely Low  
- **VL:** Very Low

**DEFECTS**

- **J:** Joint  
- **PR:** Piercing
### Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Date Completed:** 4.12.89  
**Logged by:** SRM  
**Checked by:** PLV

**Drilling Information**  
- **Method:** NQ  
- **Depth:** 103.1m  
- **Substance Description:**  
  - Rock Type:  
    - Breccia: Fine to coarse grained, dark grey, - grey, indistinct bedding.  
    - Breccia: Medium to coarse grained, light grey, - grey, indistinct bedding.  
- **Rock Mass Defects:**  
  - Fractures 45mm zone  
  - Fractured/damaged zone 25mm thick  
  - Calcrete vein IR < 1mm thick

---

**General Defect Description:**

| METHOD | AS: ageing  
|        | AD: ageing drilling  
|        | R: roasting/silicone  
|        | W: wash  
| NMC: core drilling  
| NQ: core drilling  
| Loss: core loss  
| Loss: core loss  

**Point Load Test**

- Type: Water Level  
- Diameter:  
- Material:
  - Recovered  
  - Not Recovered

**Weathering**

- Type:  
  - Fresh  
  - Slipped  
  - Moderately  
  - Highly  
  - Extremely

**Strength**

- Type:  
  - Extremely Low  
  - Very Low  
  - Low  
  - Medium  
  - High  
  - Very High  
  - Extreme

---

**Defects**

- JT: Joint  
- PL: Planar

---

**Borescope 102**
### Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Borehole Location:** E 305519, N 1265689.83

#### Drilling Information

<table>
<thead>
<tr>
<th>Number</th>
<th>Substance Description</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-61</td>
<td>Breccia: medium to coarse grained, grey, dark grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite 42deg.DD.239 degrees</td>
</tr>
<tr>
<td></td>
<td>Breccia: fine to coarse grained, dark grey, grey, varying from indistinct bedding, to very thinly bedded, dipping 24deg DD 114deg</td>
<td>Calcite tissues &lt;1mm thick</td>
</tr>
<tr>
<td>1-63</td>
<td>Breccia: medium to coarse grained, indistinct bedding.</td>
<td><strong>J</strong> PL RO 60deg.DD.239 degrees</td>
</tr>
<tr>
<td>1-70</td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL RO calcite 27deg.DD.21 degrees</td>
</tr>
<tr>
<td>1-27</td>
<td>Breccia: fine to coarse grained, grey, dark grey, indistinct bedding.</td>
<td><strong>J</strong> PL IR calcite</td>
</tr>
<tr>
<td>1-78</td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL RO calcite 65deg.DD.244 degrees</td>
</tr>
<tr>
<td>1-29</td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL RO calcite 67deg.DD.349 degrees</td>
</tr>
<tr>
<td>1-77</td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL RO calcite 78deg.DD.239 degrees</td>
</tr>
<tr>
<td>1-20</td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL RO calcite 76deg.DD.264 degrees</td>
</tr>
<tr>
<td>1-76</td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL RO calcite 40deg.DD.41 degrees</td>
</tr>
<tr>
<td>1-73</td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite 35deg.DD.80 degrees</td>
</tr>
<tr>
<td>1-31</td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td>Calcite vein IR RO 2mm thick</td>
</tr>
<tr>
<td>1-32</td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite 47deg.DD.316 degrees</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td>Calcite vein IR RO 2mm thick</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite 43deg.DD.132 degrees</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL RO calcite 15deg.DD.93 degrees</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td>Fissured zone with calcite 29.1 to 29.4m:</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td>Broken zone: 40mm wide</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td>Shotline (S) 3mm spacing, calcite</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL RO calcite</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> IR RO IR RO 6315 to 6316m</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td>Calcite 60mm thick</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite</td>
</tr>
<tr>
<td></td>
<td>Breccia: medium to coarse grained, light grey, grey, indistinct bedding.</td>
<td><strong>J</strong> PL calcite</td>
</tr>
</tbody>
</table>

#### General Defect Description:

- Weathering: *FR* - Fresh  
- Strength: *EL* - Extremely low  
- Defects: *JT* - Joint  
- Water Inflow: *SW* - Slightly  
- Very Low  
- SW - Slightly  
- M - Medium  
- L - Low  
- M - Medium  
- L - Low  
- H - High  
- H - High  
- HW - Highly  
- VH - Very High  
- EW - Extremely  
- EN - Extremely High  

---

**OBJECT:**
- **AS:** Auger Screening  
- **AD:** Auger Drilling  
- **NP:** NMLC Core Drilling  
- **NS:** NQ, HQ Core Drilling  
- **WM:** Water Main  

**LOSS:**
- **GR:** Graphic Log/Core Loss  
- **CL:** Core Loss  
- **AE:** Auger Effect  

**LEVEL:**
- **W:** Water Level  
- **L:** Water Inflow  

**CORE:**
- **RC:** Core Recovered  
- **RC:** Partial Loss  
- **NC:** No Core Recovered  

---

**METHOD:**
- **AS:** Auger Screening  
- **AD:** Auger Drilling  
- **NP:** NMLC Core Drilling  
- **NS:** NQ, HQ Core Drilling  
- **WM:** Water Main  

**LOSS:**
- **GR:** Graphic Log/Core Loss  
- **CL:** Core Loss  
- **AE:** Auger Effect  

**LEVEL:**
- **W:** Water Level  
- **L:** Water Inflow  

---

**WEATHERING:**
- **FR:** Fresh  
- **SW:** Slightly  
- **MW:** Moderately  
- **HW:** Highly  
- **EF:** Extremely  

**STRENGTH:**
- **EL:** Extremely Low  
- **VL:** Very Low  
- **L:** Low  
- **M:** Medium  
- **H:** High  
- **VH:** Very High  
- **EN:** Extremely High  

**DEFECTS:**
- **JT:** Joint  
- **PV:** Paving  
- **SM:** Slag  
- **CL:** Clay  
- **RO:** Rough  
- **DC:** Decomposed  
- **PL:** Planar  
- **IR:** Irregular
<table>
<thead>
<tr>
<th>Drilling Information</th>
<th>Rock Substance</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method:</td>
<td>Rock Type: Grade Characteristics:</td>
<td>Defect Description:</td>
</tr>
<tr>
<td>Depth (m)</td>
<td>Colour, structure, mineral components</td>
<td>Type, inclination, planarity, roughness,</td>
</tr>
<tr>
<td>Interval</td>
<td></td>
<td>coating, thickness</td>
</tr>
<tr>
<td>1-4</td>
<td>BRECCIA: medium to coarse grained, light grey, - grey, indistinct bedding</td>
<td>Fracture, planar, roughness, thickness</td>
</tr>
<tr>
<td>3-3.25</td>
<td>BRECCIA: fine to coarse grained, light grey, - grey, very thinly bedded, indistinct bedding</td>
<td>Planar, roughness, thickness</td>
</tr>
<tr>
<td>2-2.1</td>
<td>BRECCIA: fine to coarse grained, dark grey, - grey, indistinct bedding</td>
<td>Fracture, planar, roughness, thickness</td>
</tr>
<tr>
<td>1.5-1.6</td>
<td>BRECCIA: medium to coarse grained, light grey - grey, indistinct bedding</td>
<td>Fracture, planar, roughness, thickness</td>
</tr>
<tr>
<td>1-0.5</td>
<td>BRECCIA: fine to coarse grained, dark grey, - grey, indistinct bedding</td>
<td>Planar, roughness, thickness</td>
</tr>
</tbody>
</table>

**General Defect Description:**
- Fracture: Planar, roughness, thickness
- Planar: Roughness, thickness
- Water Inflow: Measured, Dripping Water
- Partial Loss: Core recovered (hatching indicates materials)
- Complete Loss: No core recovered

**Method:**
- Water Level: Water level
- Point Load Test: D - diameter, A - axial
- Graphic Log/Core Loss: Core recovered, Drilling Water, Partial Loss, Complete Loss

**Weathering:**
- FR: Fresh
- SW: Slightly
- MW: Moderately
- HW: Highly
- EW: Extremely

**Strength:**
- EL: Extremely low
- VL: Very low
- L: Low
- M: Medium
- H: High
- VH: Very high

**Defects:**
- JT: Joint
- PT: Parting
- SM: Seam
- CL: Clay
- RO: Rough
- DC: Decomposed
- PL: Planar
- IR: Irregular
<table>
<thead>
<tr>
<th>Borehole Location:</th>
<th>Old Mams Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill Model and Mounting:</td>
<td>Pioneer 640 Truck</td>
</tr>
<tr>
<td>Barred Type and Length:</td>
<td>No 3m</td>
</tr>
<tr>
<td>Drilling Information:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rock Substance Description</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brecia: fine to coarse grained, dark grey, light grey, distinct bedding.</td>
<td>J1 PL calcite</td>
</tr>
<tr>
<td>Brecia: medium to coarse grained, light grey, distinct bedding, seams of dolomite, coal &amp; sandstone.</td>
<td>J1 IR RO calcite</td>
</tr>
<tr>
<td>Dolerite: fine grained, light grey, massive.</td>
<td>Broken J1 IR RO calcite</td>
</tr>
<tr>
<td>Brecia: fine to coarse grained, dark grey, light grey, distinct bedding.</td>
<td>J1 PL calcite</td>
</tr>
<tr>
<td>coarse grained band 150mm thick.</td>
<td>J1 PL calcite</td>
</tr>
<tr>
<td>J1 PL RO</td>
<td></td>
</tr>
<tr>
<td>J1 PL RO calcite</td>
<td></td>
</tr>
<tr>
<td>J1 PL calcite</td>
<td></td>
</tr>
<tr>
<td>J1 PL RO calcite</td>
<td></td>
</tr>
</tbody>
</table>

General Defect Description:


POINT LOAD TEST: D - diameter, A - axial, Graphic Log/Core Loss: core recovered (drilling indicates matrix), partial loss, no core recovered.

WEATHERING: FR - fresh, SW - slightly weathered, MW - moderately weathered, HW - highly weathered, EW - extremely weathered.

STRENGTH: UL - extremely low, V1 - very low, L - low, M - medium, H - high, PL - very high, EH - extremely high.

### Engineering Log - Cored Borehole

**Client:** HORNBY SHIRE COUNCIL  
**Project:** OLD MANS VALLEY  
**Borehole Location:** E 305851.0 N 1269889.83  
**Hole commenced:** 4.12.89  
**Hole completed:** 4.12.89  
**Logged by:** SRM  
**Checked by:** PLV  
**Drill model and mounting:** PIONEER B40 TRUCK  
**NQ 3m**  
**Fluid:** WATER  
**Bedding:** 60°deg  
**Datum:** 103.1 m  

#### Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Core Type</th>
<th>Water Level</th>
<th>Water Inflow</th>
<th>Depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NQ</td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>69</td>
<td>Breccia, fine to coarse grained, grey, dark grey, indistinct bedding.</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>49</td>
<td>Breccia, medium to coarse grained, light grey, grey, indistinct bedding.</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>58</td>
<td>Breccia, fine to coarse grained, grey, dark grey, indistinct bedding.</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>50</td>
<td>Coarse grained band 250mm thick</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>56</td>
<td>Coarse grained band 250mm thick</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>55</td>
<td>Coarse grained band 250mm thick</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>53</td>
<td>Coarse grained band 250mm thick</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>54</td>
<td>Coarse grained band 250mm thick</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>52</td>
<td>Coarse grained band 250mm thick</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>51</td>
<td>Coarse grained band 250mm thick</td>
</tr>
<tr>
<td></td>
<td>Auger</td>
<td>Water</td>
<td>Not Measured</td>
<td>50</td>
<td>Coarse grained band 250mm thick</td>
</tr>
</tbody>
</table>

#### Rock Mass Defects

- J1 PL RO calcite 60°deg DD.272 Degrees
- J1 PL RO 40°deg DD.256 degrees
- J1 PL calcite
- J1 PL RO calcite
- J1 PL RO calcite
- Calcite veins thin rock
- Tone of calcite fissures to 2mm thick 50.75 to SRK5mm
- J1 PL RO calcite
- Calcite vein <3mm thick
- J1 PL calcite
- Calcite veins up to 3mm thick
- J1 PL RO calcite
- J1 PL RO calcite
- J1 PL RO calcite
- J1 PL RO calcite
- J1 PL RO calcite

### General Defect Description:

- **Defects:**
  - J1 = joint
  - J2 = parting
  - SM = seam
  - CL = clay
  - RO = rough
  - DC = decomposed
  - PL = plane
  - IR = irregular

### Methodology

- **Methodology:**
  - AD = auger drilling
  - R = roller/forcone
  - W = waterbore
  - NO = core drilling

### Weathering

- **Weathering:**
  - FR = fresh
  - SW = slightly
  - MW = moderately
  - HW = highly

### Strength

- **Strength:**
  - EL = extremely low
  - VL = very low
  - L = low
  - H = medium
  - Vh = very high
  - EN = extremely high

### Load Test

- **Load Test:**
  - D = diametral
  - A = axial
## Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Project:** Old Mans Valley  
**Borehole Location:** E 308518.10 N 1269869.43

### Drilling Information

<table>
<thead>
<tr>
<th>No</th>
<th>Substance Description</th>
<th>Rock Mass Defects</th>
<th>Defect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>Breccia: fine to coarse grained, grey - dark grey, indistinct bedding.</td>
<td>JF PL RO calcite, JF PL RO calcite</td>
<td>Type, mineralogy, porosity, toughness, coating, thickness</td>
</tr>
<tr>
<td>57</td>
<td>JF PL RO calcite</td>
<td>JF PL RO calcite</td>
<td>Unless otherwise noted, defects follow general description below</td>
</tr>
<tr>
<td>51</td>
<td>JF PL RO calcite</td>
<td>JF PL calcite</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>JF PL calcite</td>
<td>JF PL calcite</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>JF PL calcite</td>
<td>JF PL calcite</td>
<td></td>
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<tr>
<td>60</td>
<td>JF PL calcite</td>
<td>JF PL calcite</td>
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<tr>
<td>69</td>
<td>JF PL calcite</td>
<td>JF PL calcite</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>JF PL calcite</td>
<td>JF PL calcite</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>JF PL calcite</td>
<td>JF PL calcite</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>JF PL calcite</td>
<td>JF PL calcite</td>
<td></td>
</tr>
</tbody>
</table>

### General Defect Description:

- Breccia: fine to coarse grained, light grey - grey, indistinct bedding.

### Point Load Test

- **Method:** Cone Penetration Testing
- **Diameter:** A - 42.21
- **Water Level:** Measured
- **Water Not Measured:** Drilling Water
- **Partial Loss:** E - 4.52
- **Complete Loss:** E - 4.52

### Weathering

- **FR:** Fresh
- **SW:** Slightly Weathered
- **MW:** Moderately Weathered
- **HW:** Highly Weathered
- **EW:** Extremely Weathered

### Strength

- **J:** Soft
- **EL:** Extremely Low
- **VL:** Very Low
- **L:** Low
- **MW:** Moderate
- **H:** High
- **SH:** Extremely High

### Defects

- **J:** Joint
- **EL:** Extremly Low
- **VL:** Very Low
- **CL:** Clay
- **RO:** Rough
- **DC:** Decayed
- **PL:** Planar
- **IR:** Irregular
### Drilling Information

<table>
<thead>
<tr>
<th>No.</th>
<th>P.R.</th>
<th>Depth (m)</th>
<th>Rock Substance</th>
<th>Water Level</th>
<th>Point Load Test</th>
<th>Weathering</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td></td>
<td>15.08</td>
<td>BRECCIA: fine to coarse grained, light grey, - grey, indistinct bedding.</td>
<td>Water Inflow</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>44</td>
<td></td>
<td>16.07</td>
<td>BRECCIA: fine to coarse grained, light grey, - grey, indistinct bedding.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>43</td>
<td></td>
<td>17.05</td>
<td>BRECCIA: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
<td>18.04</td>
<td>BRECCIA: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
<td>19.03</td>
<td>BRECCIA: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>20.02</td>
<td>BRECCIA: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>70</td>
<td></td>
<td>25.01</td>
<td>BRECCIA: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>39</td>
<td></td>
<td>26.00</td>
<td>BRECCIA: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71</td>
<td></td>
<td>31.09</td>
<td>BRECCIA: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td></td>
<td>32.08</td>
<td>BRECCIA: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### General Defect Description:

- **METHOD**: Drilling, coring, and sampling techniques used.
- **WEATHERING**: Fresh, slightly weathered, moderately weathered, highly weathered.
- **STRENGTH**: Extremely low, low, medium, high.
- **DEFECTS**: Cracking, scaling, backing, voids, decomposed zones, pressure. 

### Notes:

- **Water Level**: Measured.
- **Graphic Log/Core Loss**:
  - Core recovery: Measured, not measured.
  - Partial loss: D, W, MW, HV.
  - Complete loss: LW, LW, LW, LW.

**Coffey & Partners Pty. Ltd.**
<table>
<thead>
<tr>
<th>Method</th>
<th>Water Level</th>
<th>Point Load Test</th>
<th>Weathering</th>
<th>Strength</th>
<th>Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>Water level</td>
<td>D - diameter</td>
<td>Fr - flaky</td>
<td>EL - extremely loss</td>
<td></td>
</tr>
<tr>
<td>AD</td>
<td>Water level</td>
<td>A - a-axis</td>
<td>SW - slightly</td>
<td>VL - very low</td>
<td></td>
</tr>
<tr>
<td>NMCL</td>
<td>Not measured</td>
<td>D - drilled</td>
<td>MH - moderately</td>
<td>M - medium</td>
<td></td>
</tr>
<tr>
<td>NQH2</td>
<td>D - cored</td>
<td>D - drilling Water</td>
<td>HW - highly</td>
<td>H - high</td>
<td></td>
</tr>
<tr>
<td>Using Used</td>
<td>Partial loss</td>
<td>no core recovered</td>
<td>EH - extremely high</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Substance Description**

- BRECIA: Fine to coarse grained, light grey, indistinct bedding.
- BRECIA: Fine to coarse grained, dark grey, - light grey, indistinct bedding.
- BRECIA: Fine to coarse grained, dark grey, - dark grey, indistinct bedding, thinly bedded.
- BRECIA: Medium to coarse grained, light grey, indistinct bedding.
- BRECIA: Fine to coarse grained, grey, - dark grey, indistinct bedding, thinly bedded.
- BRECIA: Fine to coarse grained, dark grey, - grey, indistinct bedding.
- BRECIA: Fine to coarse grained, dark grey, - grey, indistinct bedding.
- BRECIA: Fine to coarse grained, dark grey, - grey, indistinct bedding.
- BRECIA: Fine to coarse grained, dark grey, - grey, indistinct bedding.

**Rock Mass Defects**

- JT PL beige
- JT PL RO calcarceous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous
- JT PL RO calcareous

**General Defect Description**

- General defect description
- Defect description
- Unless otherwise noted, defects follow general description below.
## Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Project:** Old Mans Valley  
**Borehole Location:** E3653110 N126499483

**Drill Model and Make:** Pioneer 840 Truck  
**Borehole Type and Length:** NQ 3m  
**Fluid:** Water  
**Angle:** -65 Deg  
**R.L. Surface:** 103.1 m  
**Depth:** 54 Deg  
**Datum:** AHD 20

### Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Hole</th>
<th>R.L.</th>
<th>Depth</th>
<th>Drilling Log</th>
<th>Substance Description</th>
<th>Rock Mass Description</th>
<th>Point Load Test</th>
<th>Defect</th>
<th>Defect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NQ</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td>Breccia: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td>PR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td>Breccia: medium to coarse grained, dark grey, - light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td>Breccia: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td>Breccia: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td>Breccia: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>26</td>
<td></td>
<td></td>
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<td>Breccia: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
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<td>Breccia: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td>Breccia: fine to coarse grained, light grey, indistinct bedding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### General Defect Description:

- **METHOD**  
  - AS: auger screening  
  - AD: auger drilling  
  - R: roller/trench  
  - W: wash core  
  - MMCL: core drilling  
  - NQ1Q: core cooling  
  - casing used: barrel withdrawn

- **POINT LOAD TEST**  
  - D: diamond  
  - A: awl

- **WEATHERING**  
  - T: fresh  
  - SW: slightly  
  - MW: moderately  
  - H: high

- **STRENGTH**  
  - EL: extremely low  
  - VL: very low  
  - M: medium  
  - H: high

- **DEFECTS**  
  - FT: fine to coarse  
  - RO: rough  
  - DC: decomposed  
  - PL: planar  
  - IR: irregular
# Engineering Log - Cored Borehole

## General Defect Description

### Subsidence Description

- **岩相描述**
  - 岩性：细粒至粗粒，深灰至暗灰色，部分岩心的直径为5mm。

### Rock Mass Defects

- **岩体缺陷**
  - 均布（FR）：
    - PL钙化
    - PL旋转
    - PL钙化

### Weathering Strength

- **风化强度**
  - FR：新鲜
  - SW：很弱
  - MW：中等
  - HW：高

### Defects

- **缺陷**
  - PL：均布
  - PT：潜在
  - SM：受控
  - CL：很弱
  - RO：中等
  - DC：未分解
  - PL：部分
  - IR：不规则
### Engineering Log - Borehole

**Client:** Hornsby Shire Council  
**Project:** Old Mams Valley  
**Borehole Location:** E304469.28 M269764.16

**Drill Model and Mounting:** 840 Truck  
**Drill Diameter:** 76mm  
**Slope:** 05° DEG  
**RL Surface:** 112.5 m

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Notes</th>
<th>Water</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>112</td>
<td>GP</td>
<td></td>
<td>Fill, gravel, fine to coarse grained, light grey band lines to coarse grained, clay medium plasticity.</td>
</tr>
<tr>
<td>111</td>
<td>CL</td>
<td></td>
<td>Gravelly clay, medium plasticity, red brown gravel, fine to coarse grained, some fine to coarse sand</td>
</tr>
</tbody>
</table>

**Commenced boring at 0.2m**

**Method:**
- AS: auger screwing
- AD: auger drilling
- S: rotary/drill
- W: washbore
- CT: cable tool
- HA: hand auger
- DT: dixi bore

**Support:**
- C: casing
- M: mud

**Penetration:**
- No resistance ranging to refusal

**Water:**
- Measured water level
- Water outflow
- Water inflow

**Consistency/Density Index:**
- VS: very soft
- V: soft
- F: firm
- SI: stiff
- VSf: very stiff
- H: hard
- Fo: fragile
- VL: very loose
- L: loose
- MD: medium dense
- D: dense
- VD: very dense

**Classification Symbols and Soil Description:**
- Based on unified classification system

**Moisture:**
- D: dry
- M: moist
- W: wet
- Wp: plastic limit

**Notes:**
- Samples and tests
  - USO: undisturbed sample 56 mm diameter
  - D: disturbed sample
  - N: standard penetration test
  - N*: SPT + sample recovered
  - No SPT with solid cone
  - V: vane shear
  - P: pressure meter
  - E: bulk sample
  - R: refusal
# Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Project:** Old Mans Valley  
**Borehole Location:** E 339469.98 N 1209764.19  
**Drill Model and Mounting:** B40 Truck  
**Well Type and Length:** NQ 3m  
**Fluid:** Water  
**Slope:** -65 Deg  
**R.I. Surface:** 112.6 m  
**Drilling Information:**

| Depth (m) | Rock Substance | Substance Description
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10.5</td>
<td>Silty Sandstone</td>
<td>Light grey, approximately horizontal bedding</td>
</tr>
<tr>
<td>9</td>
<td>Breccia</td>
<td>Light grey, lenticular bedding</td>
</tr>
<tr>
<td>10.4</td>
<td>Sandstone</td>
<td>White, light grey, laminated</td>
</tr>
<tr>
<td>10.3</td>
<td>Breccia</td>
<td>Light grey, lenticular bedding</td>
</tr>
<tr>
<td>10.2</td>
<td>Silty Sandstone</td>
<td>Dark grey, laminated, cross laminated, breccia up to 5mm thick along some bedding planes</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Band of breccia, 170mm thick along bedding plane</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Interlaminated breccia and silty sandstone in 20mm thick band</td>
</tr>
<tr>
<td>13</td>
<td>Sandstone</td>
<td>Fine grained, light grey, resistant bedding with some silty bands up to 13.7mm</td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td>Cross laminated siltstone in a band 250mm thick</td>
</tr>
</tbody>
</table>

**General Defect Description:**

- Fractured and decomposed zone 90mm thick
- Fractured zone with some clay 150mm thick
- Fractured zone with associated IR fracturing
- Fractured zone 50mm thick
- Fractured and decomposed zone 90mm thick
- Fractured and decomposed zone 90mm thick
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- Fractured and decomposed zone 90mm thick
- Fractured and decomposed zone 90mm thick
**Engineering Log - Cored Borehole**

Client: HORNSEY SHIRE COUNCIL  
Project: OLD MANS VALLEY  
Drill Model and Mounting: E45 TRUCK  
Boresite Type and Length:  

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Rock Substance</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>SILTSTONE: fine grained, dark grey, laminated, carbonaceous with bands of coal</td>
<td>Broken layer 10mm thick</td>
</tr>
<tr>
<td>89</td>
<td>SILTSTONE: fine to medium grained, grey, light grey, cross laminated, with some bands of fine to medium grained siliciclastic flow structures</td>
<td>Fractured zone including coal cleats 100mm thick</td>
</tr>
<tr>
<td>88</td>
<td>Coal fragment 80mm thick</td>
<td>CL 15M 10mm thick</td>
</tr>
<tr>
<td>87</td>
<td>Some bands of breccia material, fine to medium</td>
<td>J1 PL polished</td>
</tr>
<tr>
<td>86</td>
<td>Coal fragment 80mm thick</td>
<td>J1 PL polished</td>
</tr>
<tr>
<td>85</td>
<td>Coal fragment 80mm thick</td>
<td>J1 PL polished</td>
</tr>
<tr>
<td>84</td>
<td>Coal fragment 80mm thick</td>
<td>J1 PL polished</td>
</tr>
<tr>
<td>83</td>
<td>Coal fragment 80mm thick</td>
<td>J1 PL polished</td>
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<tr>
<td>82</td>
<td>Coal fragment 80mm thick</td>
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<tr>
<td>81</td>
<td>Coal fragment 80mm thick</td>
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<td>80</td>
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<td>69</td>
<td>Coal fragment 80mm thick</td>
<td>J1 PL polished</td>
</tr>
<tr>
<td>68</td>
<td>Coal fragment 80mm thick</td>
<td>J1 PL polished</td>
</tr>
<tr>
<td>67</td>
<td>Coal fragment 80mm thick</td>
<td>J1 PL polished</td>
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<tr>
<td>66</td>
<td>Coal fragment 80mm thick</td>
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<tr>
<td>32</td>
<td>Coal fragment 80mm thick</td>
<td>J1 PL polished</td>
</tr>
</tbody>
</table>

**General Defect Description:**  
Comprehensive analysis of rock characteristics and potential defects.

**Method:**  
- AS: auger screening  
- AD: auger drilling  
- R: roller/flume  
- W: washcore  
- NMLC: core drilling  
- NGOHD: core drilling  

**Point Load Test:**  
- D: diametral  
- A: axis  

**Weathering:**  
- MW: moderately weathered  
- SW: slightly weathered  
- VL: very low  
- EL: extremely low  
- L: low  
- M: medium  
- H: high  
- VH: very high  
- EH: extremely high
## Engineering Log - Cored Borehole

**Client:** Horsby Shire Council  
**Project:** Old Mans Valley  
**Borehole Location:** E 30469908 N 1260764.16

### Drilling Information

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>R.L.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td></td>
<td>SANDY SILSTONE: fine grained, light grey, grey laminated / cross laminated. BRECBA: fine to coarse grained, dark grey, grey, indistinct bedding, to very thin, bedded.</td>
</tr>
<tr>
<td>41</td>
<td></td>
<td></td>
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<tr>
<td>75</td>
<td></td>
<td></td>
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<tr>
<td>42</td>
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<td></td>
</tr>
<tr>
<td>74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>73</td>
<td></td>
<td>SILTSTONE: fine grained, light grey, grey, indistinct bedding. BRECBA: fine to coarse grained, dark grey, grey, indistinct bedding, to very thin, bedded.</td>
</tr>
<tr>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>71</td>
<td></td>
<td>BRECBA: fine to coarse grained, dark grey, grey, indistinct bedding, some bleached bands up to 300mm thick. Bleached layer 200mm thick. Bleached layer 300mm thick.</td>
</tr>
<tr>
<td>46</td>
<td></td>
<td></td>
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<tr>
<td>70</td>
<td></td>
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<td>47</td>
<td></td>
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<tr>
<td>48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Point Load Test

- Diameter: D  
- Load: L

### Weighing

- Mass: M
- Density: D

### Strength

- Very low: VL  
- Low: L  
- Moderate: MW  
- High: H  
- Very High: VH  
- Extremely High: EH

### Defects

- Light: L  
- Medium: M  
- Dark: D  
- Loose: L  
- Hard: H  
- Extremely loose: EL

### General Defect Description

- Profile 0-50mm tough clean

### Method

- Auger screwing
- Auger drilling
- Roller/barreled
- Water pump
- Core drilling
- Core drilling
- Core drilled
- Core drilled
- Water level
- Water inflow
- Not measured
- Drilling Water
- Partial loss
- Complete loss
- No core recovered

### Graphic Log/Core Loss

- Core recovered (hatching indicates material)
- No core recovered
## Engineering Log - Cored Borehole

**Client:** Horsby Shire Council  
**Project:** Old Mans Valley  
**Borehole Location:** E 300464.63 N 1208785.40

### Drilling Information

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Substance Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>69</td>
<td>Breccia; fine to coarse grained, dark grey, banded; some bleached bands up to 300mm thick</td>
</tr>
<tr>
<td>68</td>
<td>Silstone; fine grained, grey, slight silted</td>
</tr>
<tr>
<td>67</td>
<td>Breccia; fine to coarse grained, dark grey, very flaky, banded; some bleached bands up to 150mm thick</td>
</tr>
<tr>
<td>55</td>
<td>Breccia; fine to coarse grained, dark grey, banded</td>
</tr>
<tr>
<td>53</td>
<td>Breccia; fine to coarse grained, dark grey, banded</td>
</tr>
<tr>
<td>54</td>
<td>Breccia; fine to coarse grained, dark grey, banded</td>
</tr>
<tr>
<td>52</td>
<td>Breccia; fine to coarse grained, dark grey, banded</td>
</tr>
</tbody>
</table>

### General Defect Description:

- **Method:** core drilling  
- **Point Load Test:** not measured  
- **Graphic Log/Core Loss:** core recovered, partial loss, complete loss  
- **Defects:** broken zone 100mm thick, calcite vein 2mm thick,  
- **Weathering:** FR - fresh, SW - slightly weathered  
- **Strength:** EL - extremely low, V - low  
- **Defects:** FR - extremely high, SW - slightly weathered,  
- **Silstone:** fine grained, grey, slight silted  
- **Breccia:** fine to coarse grained, dark grey, banded; some bleached bands up to 300mm thick  
- **Silstone:** fine grained, grey, slight silted  
- **Breccia:** fine to coarse grained, dark grey, very flaky, banded; some bleached bands up to 150mm thick  
- **Breccia:** fine to coarse grained, dark grey, banded; some bleached bands up to 300mm thick  
- **Silstone:** fine grained, grey, slight silted  
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- **Breccia:** fine to coarse grained, dark grey, banded; some bleached bands up to 300mm thin
## Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Project:** Old Man Valley  
**Borehole Location:** E 30046088 N 12589764.16  
**Hole commenced:** 14.12.89  
**Hole completed:** 29.12.89  
**Logged by:** SM  
**Checked by:** PLV  

### Drilling Information

<table>
<thead>
<tr>
<th>Method Code</th>
<th>Drill Type</th>
<th>Drill Type Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>HQ</td>
<td>B40 Truck</td>
<td></td>
</tr>
</tbody>
</table>

### Subsoil Description

- Rock Type: grey, massive, some clasts of low sandstone up to 15mm across.
- Colour: dark grey, grey, massive.
- Structure: none.
- Other: none.

### Rock Mass Defects

- Calcite filled fractures <1mm thick.
- Calcite vein PL <1mm thick.
- Calcite vein 1mm thick.
- Calcite vein 1mm thick IR.
- Calcite vein 2mm thick IR.
- Calcite vein 4mm thick.
- CR SM curved 3mm thick.

**General Defect Description:**

### Method

- **AS:** Air scoop drilling  
- **AD:** Air drilling  
- **NDH:** Core drilling  
- **NMLC:** Core drilling  

### Water Level

- **W:** Water level  
- **D:** Water inflow

### Point Load Test

- **D:** Diameter
- **A:** Axial

### Weathering

- **EL:** Extremely low
- **VL:** Very low
- **L:** Low
- **M:** Medium
- **H:** High
- **HN:** Very high

### Strength

- **FS:** Extremely strong
- **FS:** Strong
- **M:** Medium
- **L:** Low
- **VL:** Very low
- **EL:** Extremely low

### Defects

- **JT:** Joint
- **PL:** Parting
- **SM:** Sided
- **CL:** Clay
- **RC:** Rough
- **DC:** Decomposed
- **PL:** Planar
- **IR:** Irregular

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**Log:**

<table>
<thead>
<tr>
<th>Hole No.</th>
<th>R.L.</th>
<th>Subsoil Characteristics</th>
</tr>
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<tbody>
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<td>64</td>
<td>65</td>
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</tbody>
</table>

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**Notes:**

- Core recovery: 100%
- No core recovery: 0%
- Drilling Water: 100%
- Partial loss: 0%
- Complete loss: 0%
### Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Project:** Old Mans Valley  
**Borehole Location:** E 33049998 N 12617541.16

**Drill Model and Mounting:** B49 Truck  
**Borehole Type and Length:** NQ 3m  
**Fluid:** Water  
**Inclination:** -55 Deg  
**Reading:** 142 Deg  
**Datum:** AND

### Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Core 38mm</th>
<th>Cone 38mm</th>
<th>Rock Substance Description</th>
<th>Point Load Test</th>
<th>Defect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NQ</td>
<td></td>
<td></td>
<td>Breccia: fine to coarse grained, dark grey - grey, massive, some clasts of fine sandstone up to 150mm across</td>
<td>Fracture, decomposed zone 20mm thick</td>
<td>Fractures, decomposed zone 20mm thick</td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>55</td>
<td>D A 1730.33</td>
<td>Calcite vein PL 2mm thick</td>
<td>Calcite vein &lt;1mm thick</td>
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<td>65</td>
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<td></td>
<td>29</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### General Defect Description:

- Fractures, decomposed zone 20mm thick
- Calcite vein PL 2mm thick
- Calcite vein <1mm thick
- Breccia: fine to coarse grained, dark grey - grey, massive.

### Weathering

- FR: Fresh  
- SW: Slightly Weathered  
- MW: Moderately Weathered  
- HW: Highly Weathered  
- EW: Extremely Weathered

### Strength

- EL: Extremely Low  
- VL: Very Low  
- L: Low  
- M: Medium  
- H: High  
- VH: Very High  
- BH: Extremely High

### Defects

- JT: Joint  
- PT: Parting  
- SM: Seam  
- CL: Clay  
- RO: Rought  
- DC: Decomposed  
- PL: Plane  
- IR: Irregular
# Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Principals:** Old Mans Valley  
**Borehole Location:** E 300465.98 N 1259764.16  
**Log Number:** S6462/4  
**Office Job No:**  
**Sheet No:** 11 of 13

## Drilling Information

<table>
<thead>
<tr>
<th>Depth</th>
<th>D.L.</th>
<th>Subsistence Description</th>
<th>Rock Substance</th>
<th>Drilling Method</th>
<th>Core Loss</th>
<th>Point Load Test</th>
<th>Defect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td></td>
<td>BRECCIA, fine to coarse grained, white, light grey, massive.</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td></td>
<td>BRECCIA, fine to coarse grained, grey, massive.</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td></td>
<td>SLATESTONE, fine to medium grained, light grey, - dark grey, boudinaged, some mafic biotite lenses to 100mm thick at 75.5 and 14.4m</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
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<tr>
<td>45</td>
<td></td>
<td>BRECCIA, fine to coarse grained, white, massive.</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td></td>
<td>SANDSTONE, fine to medium grained, white, - light grey, indistinct bedding.</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td></td>
<td>SANDSTONE, fine to medium grained, white, - grey, very thinly bedded, bedding marked by dark grey laminations dipping 10deg</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td></td>
<td>SANDSTONE, fine to medium grained, white, - light grey, indistinct bedding.</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td></td>
<td>SANDSTONE, fine to medium grained, white, - grey, very thinly bedded, bedding marked by dark grey laminations dipping 10deg</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
<td>SANDSTONE, fine to medium grained, white, - light grey, indistinct bedding.</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td></td>
<td>SANDSTONE, fine to medium grained, white, - grey, very thinly bedded, bedding marked by dark grey laminations dipping 10deg</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
<td>SANDSTONE, fine to medium grained, white, - light grey, indistinct bedding.</td>
<td>rock, strength</td>
<td>NQ</td>
<td>-</td>
<td>Fract</td>
<td></td>
</tr>
</tbody>
</table>

**General Defect Description:** Partings 0.5m to 1.0m, rough, clean.

**WEATHERING:**  
- **SL:** Extremely low  
- **VL:** Very low  
- **L:** Low  
- **M:** Medium  
- **H:** High  
- **VH:** Very high

**STRENGTH:**  
- **FR:** Fresh  
- **SW:** Slightly weathered  
- **MW:** Moderately weathered  
- **HW:** Highly weathered  
- **EW:** Extremely weathered

**DEFECTS:**  
- **JT:** Joint  
- **PT:** Parting  
- **SM:** Siltstone  
- **CL:** Clay  
- **RO:** Rough  
- **DC:** Decomposed  
- **PL:** Planar  
- **IR:** Irregular
## Engineering Log - Cored Borehole

**Client:** Hornsby Shire Council  
**Location:** E 304469.08 N 1209744.16  
**Log No.:** SB463.4  
**Hole Commenced:** 14.12.89  
**Hole Completed:** 20.12.89  
**Logged By:** SRM  
**Checked By:** PLV

### Drilling Information

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Rock Substance</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>SANDSTONE: fine to medium grained, white, very thinly bedded, bedding marked by dol olys laminae dipping 10 deg.</td>
<td></td>
</tr>
<tr>
<td>35.0</td>
<td>SANDSTONE: medium to coarse grained, white to light grey, very thinly bedded, 15 degrees</td>
<td></td>
</tr>
<tr>
<td>35.5</td>
<td>SANDSTONE: fine to medium grained, light grey, very thinly bedded, some carbonaceous fragments</td>
<td></td>
</tr>
</tbody>
</table>

**Graphic Log/Core Loss**

- Water level: water inflow, not measured
- Drilling Water: partial loss, complete loss
- Core recovered: no core recovered

### Defects

- JT PL clean dipping 45 deg, DD 34 deg
- JT PL clean dipping 40 deg, DD 30 deg, 40 deg
- JT PL clean dipping 90 deg, DD 55 deg
- JT PL RO dipping 55 deg, DD 95 deg
- CR 5M 10mm thick

**General Defect Description:** Pitting 5-50mm, planar, rough, clean

**Method:**
- AS: auger drilling  
- AD: auger coring  
- R: roller/trench wash bore  
- W: NMLC core coring  
- NO: HQ core coring  
- IT: casing used, bore extracted

<table>
<thead>
<tr>
<th>Point Load Test</th>
<th>WEATHERING</th>
<th>STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>D = diameter</td>
<td>R = Roast</td>
<td></td>
</tr>
<tr>
<td>A = angle</td>
<td>SW = Slightly</td>
<td></td>
</tr>
<tr>
<td>EL = Extremely Low</td>
<td>MW = Moderately</td>
<td></td>
</tr>
<tr>
<td>VL = Very Low</td>
<td>HW = Highly</td>
<td></td>
</tr>
<tr>
<td>L = Low</td>
<td>VH = Very High</td>
<td></td>
</tr>
<tr>
<td>M = Medium</td>
<td>E = Extremely</td>
<td></td>
</tr>
<tr>
<td>H = High</td>
<td>R = Regular</td>
<td></td>
</tr>
</tbody>
</table>

**Defects:**
- JT = joint
- PI = pitting
- SM = seam
- CL = clay
- RO = rough
- DC = decomposed
- PL = planar
- IR = irregular
# Engineering Log - Cored Borehole

**Client:** Horsnby Shire Council  
**Site:** Old Mains Valley  
**Borehole Location:** E 308459.68 N 1269764.16  
**Hole Commenced:** 14.12.89  
**Hole Completed:** 23.12.89

## Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Water</th>
<th>B.L.</th>
<th>Depth</th>
<th>Graphiclog/CORE LOSS</th>
<th>Rock Substance</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>QO</td>
<td>3m</td>
<td>90</td>
<td>92</td>
<td>SANDSTONE: fine to medium grained, light grey, very finby beaded, some carbonate fragments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>93</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Borehole 103 Terminated at 92.80 m**

### General Defect Description

- Water level
- Water inflow
- Not measured
- Dillting Water
- Partial loss
- Complete loss

### Point Load Test

- Diameter of core recovered (balancing indicates material)
- No core recovered

### Weathering

- EL - extremely low
- VL - very low
- L - low
- M - medium
- H - high
- VH - very high

### Strength

- ER - extremely
- EH - extremely high

### Defects

- J1 - joint
- PT - parting
- SM - seam
- CL - clay
- RO - rough
- DC - decomposed
- PL - planar
- IR - irregular
APPENDIX B

STEREOSCOPIC PROJECTIONS FOR ORIENTATED CORED BOREHOLES
S8463/4 HORNESBY SHIRE COUNCIL - BOREHOLE 101
SCATTER DIAGRAM - POLES TO PLANE
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 117
ROTATION ANGLES: 0 0 0
S8463/4 HORNSEY SHIRE COUNCIL - BOREHOLE 101
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 117
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL - BOREHOLE 101

SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 117
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

' ' <LT> 1%
'*' <LT> 2%
'1' <LT> 4%
'2' <LT> 6%
'3' <LT> 8%
'M' MAX = 8.5
S8463/4 HORNSEY SHIRE COUNCIL - BOREHOLE 101 JOINTS
SCATTER DIAGRAM - POLES TO PLANKS
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 64
ROTATION ANGLES: 0 0 0
S8463/4 HORNSEY SHIRE COUNCIL - BOREHOLE 101 JOINTS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 64
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL - BOREHOLE 101 JOINTS

SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 64
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

' ' <LT> 1%
'+' <LT> 2%
'1' <LT> 4%
'2' <LT> 6%
'3' <LT> 8%
'M' MAX = 9.4
S8463/4 HORNBY SHIRE COUNCIL - BOREHOLE 101 BEDDINGS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 11
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL - BOREHOLE 101 BEDDINGS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 11
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL - BOREHOLE 101 BEDDINGS
SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 11

ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

' ' <LT> 1%
'+' <LT> 5%
'1' <LT> 10%
'2' <LT> 15%
'3' <LT> 20%
'M' MAX = 45.5
S8463/4 HORNSBY SHIRE COUNCIL - BOREHOLE 101 VEINS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 39
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL - BOREHOLE 101 VEINS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES:  39
ROTATION ANGLES:  0  0  0
S8463/4 HORNBY SHIRE COUNCIL - BOREHOLE 101 VEINS

SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 39
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

```
' ' <LT> 1%
'+ ' <LT> 4%
'1' <LT> 8%
'2' <LT> 12%
'3' <LT> 16%
'M' MAX = 15.4
```
S8463/4 HORNSBY SHIRE COUNCIL - BOREHOLE 102
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 78
ROTATION ANGLES: 0 0 0
S8463/4 HUNTER SHIRE COUNCIL - BOREHOLE 102
SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 78
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

\begin{array}{l}
\{1\} \quad \langle LT \rangle \quad 10 \\
\{1\} \quad \langle LT \rangle \quad 30 \\
\{1\} \quad \langle LT \rangle \quad 60 \\
\{1\} \quad \langle LT \rangle \quad 90 \\
\{1\} \quad \langle LT \rangle \quad 120 \\
\{1\} \quad \langle LT \rangle \quad 11.5 \\
\end{array}
S8463/4 HORNSBY SHIRE COUNCIL - BOREHOLE 102 JOINTS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 62
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL - BOREHOLE 102 JOINTS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 62
ROTATION ANGLES: 0 0 0
S8463/4 HORNSEY SHIRE COUNCIL - BOREHOLE 102 JOINTS

SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 62

ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

1' <LT> 1%
1' <LT> 3%
1' <LT> 6%
2' <LT> 9%
3' <LT> 12%
M' MAX = 12.9
S8463/4 HORNBY SHIRE COUNCIL - BOREHOLE 102 BEDDINGS

SCATTER DIAGRAM - POLES TO PLANES

LOWER HEMISPHERE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 5

ROTATION ANGLES: 0 0 0
S8463/4 HORNSEY SHIRE COUNCIL - HOLE 102 HEADINGS

SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 5
EQUATION ANGLES: 0 0 0
S8463/4 HORNBY SHIRE COUNCIL - BOREHOLE 102 BEDDINGS

SCMITH METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 5
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

\[
\begin{align*}
1' & < (LT) 10^\circ \\
1' & < (LT) 5^\circ \\
1' & < (LT) 10^\circ \\
2' & < (LT) 15^\circ \\
3' & < (LT) 20^\circ \\
M^i & \text{MAX } = 40.0
\end{align*}
\]
S8463/4 HORNISBY SHIRE COUNCIL - BOREHOLE 102 VEINS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 10
ROTATION ANGLES: 0 0 0
S8463/4 HORNSEY SHORE COUNCIL - BOREHOLE 102 VEINS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 10
ROTATION ANGLES: 0 0 0
S8463/4 HORNSEA SHIRE COUNCIL - HOLE HOLE 102 VEINS
SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 10
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

1'  <LT> 1%
1'  <LT> 5%
1'  <LT> 10%
1'  <LT> 15%
1'  <LT> 20%
'M'  MAX = 30.0
S8463/4 HORNSBY SHIRE COUNCIL BOREHOLE 103
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 18
ROTATION ANGLES: 0 0 0
S8463/4 HORNSEY SHIRE COUNCIL BOREHOLE 103
SCATTER DIAGRAM - POLES TO PLANES
HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 18
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL BOREHOLE 103

SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 18
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

' ' <LT> 1%
'+ ' <LT> 5%
'1' <LT> 10%
'2' <LT> 15%
'3' <LT> 20%
'M' MAX = 27.8
S8463/4 HORNBY SHIRE COUNCIL BOREHOLE 103 JINTS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 10
ROTATION ANGLES: 0 0 0
S8463/4 HORNESBY SHIRE COUNCIL  BOREHOLE 103 JOINTS
SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 10
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS
' ' <LT> 1%
'+ ' <LT> 4%
'1' <LT> 8%
'2' <LT> 12%
'3' <LT> 16%
'M' MAX = 20.0
S8463/4 HURNSBY SHIRE COUNCIL BOREHOLE 103 BEDDINGS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 5
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL BOREHOLE 103 BEDDINGS
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES:  5
ROTATION ANGLES:  0  0  0
S8463/4 HORNSEY SHIRE COUNCIL BOREHOLE 103 BEDDINGS

SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 5
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

' ' <LT> 1%
'+' <LT> 5%
'1' <LT> 10%
'2' <LT> 15%
'3' <LT> 20%
'M' MAX = 80.0
APPENDIX C

DATA HISTOGRAMS FOR SURFACE LINE MAPPING
# Geotechnical Line Mapping Data Histograms

**Client:** Hornsby Shire Council  
**Principal:**  
**Project:** Old Mans Valley  
**Location:** Hornsby Quarry

## Traverse Line Data

<table>
<thead>
<tr>
<th>Identification</th>
<th>Upper Bench of Eastern Face</th>
<th>Elevation</th>
<th>Datum</th>
<th>Lithology Type</th>
<th>All</th>
<th>Length</th>
<th>All</th>
<th>Hardness</th>
<th>All</th>
<th>Discontinuity Type</th>
<th>All</th>
<th>Continuity</th>
<th>All</th>
<th>Water</th>
<th>All</th>
<th>Discontinuity Orientation</th>
<th>All</th>
<th>Trend</th>
<th>Mean, Range</th>
<th>Plunge</th>
<th>Mean, Range</th>
</tr>
</thead>
</table>

**Data Selection:** 252 defects selected from a total of 252

- **Spacing:**
  - Frequency (%)
  - (m)
  - Frequency (%)

- **Length:**
  - Frequency (%)
  - (m)
  - Frequency (%)

- **Continuity:**
  - Data: discrete, semicontinuous, continuous

- **Hardness:**
  - Frequency (%)
  - S1, S2, S3, S4, S5, R1, R2, R3, R4, R5

- **Roughness:**
  - Frequency (%)
  - polished, smooth, ridges, steps, rough

- **Water Condition:**
  - Frequency (%)
  - Tight, dry, stained, damp, seepage, flow

---

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geotechnical line mapping
data histograms

client: HORNSBY SHIRE COUNCIL
principal: 
project: OLD MANS VALLEY
location: HORNSBY QUARRY

trace line data
identification: UPPER BENCH OF EASTERN FACE
elevation: APPROX. RL. 90M

data selection: 203 defects selected from a total of 252
lithology type: all
length: all
hardness: all
trend: mean, range
continuity: all
water: all
plunge: mean, range

data discontinuity orientation: all

datum: A.H.D.

spacing

length

continuity
discrete semicontinuous continuous

hardness

roughness

polished smooth ridges steps rough polar equal-area stereograph

water condition

joint (GN)
fault (F)
bedding (BD)
shale (SH)
unconformity (UC)
boundary (BO)
cleavage (CV)
contact (CN)
granosiall (GS)
sedimentally (SC)
valve (VM)
other
tight dry stained damp seepage flow
geotechnical line mapping data histograms

client: HORNSSY SHIRE COUNCIL
principal: 
project: OLD MANS VALLEY
location: HORNSSY QUARRY

traverse line data
identification: UPPER BENCH OF EASTERN FACE
elevation: APPROX. RL. 90M
datum: R.M.D.

data selection
31 defects selected from a total of 252
lithology type: all
length: all
hardness: all
discontinuity type: BG
continuity: all
water: all

discontinuity orientation:
trend: mean, range
plunge: mean, range

SPACING

LENGTH

SPACING

HARDNESS

ROUGHNESS

WATER CONDITION

N

Tm-240
(C) Copyright Coffey & Partners Pty. Ltd. 1997
geotechnical line mapping data histograms

client: HORNESBY SHIRE COUNCIL
principal: 
project: OLD MANS VALLEY
location: HORNESBY QUARRY

traverse line data
identification: SECOND BENCH OF EASTERN FACE

elevation: APPROX. RL. 70M
datnum: A.H.D.

data selection
347 defects selected from a total of 429

 lithology type: all
length: all
hardness: all

 discontinuity type: JN
continuity: all
water: all

discontinuity orientation: all
trend: mean, range
plunge: mean, range

spacing

length

continuity

hardness

roughness

water condition

0 2 4 6 8 10
frequency (%) 0 2 4 6 8 10

0 2 4 6
joint (JN)

0 2 4 6
fault (FL)
banding (BG)
shale (SB)
unconformity (UC)

0 2 4 6
boundary (BD)
cleavage (CV)
contact (CN)
gneissosity (GS)
schistosity (SC)
vein (VH)
other

0 2 4 6
light dry stained damp seepage flow

0 2 4 6
polished smooth ridges steps rough polar equal-area stereograph

0 2 4 6
discrete semicontinuous continuous
geotechnical line mapping data histograms

client: HORNSBY SHIRE COUNCIL
principal: OLD MANS VALLEY
location: HORNSBY QUARRY

traverse line data
identification: SECOND BENCH OF EASTERN FACE
elevation: APPROX. R.L. 70M
datum: A.H.D.

data selection
49 defects selected from a total of 429
length: all
continuity: all
water: all
discontinuity orientation: all
length: mean, range
plunge: mean, range

SPACING

LENGTH

cont

CONTINUITY

discrete
semicontinuous
continuous

HARDNESS

ROUGHNESS

polished
smooth
ridges
steps
rough

polar
equal-area
stereograph

WATER CONDITION

joint (J)
fracture (F)
bedding (B)
shale (S)
unconformity (U)
boundary (BD)
cleavage (CV)
contact (C)
gneissosity (G)
 schistosity (S)
vein (VH)
other

tight dry stained damp seepage flow
geotechnical line mapping data histograms

client: HORNSBY SHIRE COUNCIL
principal:
project: OLD MANS VALLEY
location: HORNSBY QUARRY

data selection
lithology type: all
discontinuity type: JN
length: all
continuity: all
hardness: all
water: all
discontinuity orientation: all
trend: mean, range
plunge: mean, range

elevation: APPROX. RL. 40M
datum: A.H.D.

SPACING

LENGTH

CONTINUITY

HARDNESS

ROUGHNESS

WATER CONDITION

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TH-340

1989/3

sheet 1 of 1
APPENDIX D

STEREOSCOPIC PROJECTIONS FOR SURFACE LINE MAPPING
DEFINITION OF GEOMETRICAL TERMS

POLAR & EQUATORIAL PROJECTIONS

POLAR EQUAL-AREA STEREOGRAPHIC PROJECTION
DISPLAYING DEFECT TYPES

EQUATORIAL EQUAL-AREA STEREOGRAPHIC PROJECTION
OF ABOVE CONTURD.
SCATTER DIAGRAM - POLES TO PLANES
HORIZONTAL HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 252
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL - TRAVERSE 1989/1
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 252
EQUATION ANGLES: 0 0 0
SS463/4 HORNNSBY SHIRE COUNCIL - TRAVERSE 1989/2

SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 429
ROTATION ANGLES: 0 0 0
S8463/4 HORNSBY SHIRE COUNCIL - TRAVERSE 1989/2
SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHERE - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 429
ROTATION ANGLES: 0 0 0
S8463/4 HORNSEY SHIRE COUNCIL - TRAVERSE 1989/2

SCHMIDT METHOD - UNCORRECTED - POLES TO PLANES
NORTHERN HEMISPHERE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 429
ROTATION ANGLES: 0 0 0

SHADING SYMBOLS

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'M' MAX = 8.6
S8463/4 HORNBY SHIRE (MINE) - INVERSE 1989/3

SCATTER DIAGRAM - POLES TO PLANES

LOWER HALF-SHOLE - EQUAL AREA PROJECTION

NO. OF MEASURED POLES: 105

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SCATTER DIAGRAM - POLES TO PLANES
LOWER HEMISPHER - EQUAL AREA PROJECTION
NO. OF MEASURED POLES: 105
ROTATION ANGLES: 0 0 0
APPENDIX E

TABULATION OF BEDDING, JOINT AND VEIN

ORIENTATIONS – CORED BOREHOLES
# APPENDIX E

## ORIENTATION OF BEDDING PLANE

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### APPENDIX E

**ORIENTATION OF JOINTS IN**

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**ORIENTATION OF CALCITE VEINS**

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