Appendix 10-1: Revised report on site investigation for bay extension – Dublin Airport

REVISED REPORT ON SITE INVESTIGATION

FOR

SIX BAY EXTENSION - DUBLIN AIRPORT

CONTENTS:

Report

Appendix A - Borehole Records & Foundation Details

Appendix B - Water Level Readings

Appendix C - Chemical and Laboratory Test Results

Appendix D - Site Plans
- Figure 1
- Figure 2

Dec. 1997 - Draft Report
21 Jan. '98 - Report; Revision No. 1
26 Jan. '98 - Report; Revision No. 2

REPORT ON SITE INVESTIGATION

FOR

SIX BAY EXTENSION - DUBLIN AIRPORT

Preamble:

On the instructions of Aer Rianta, a site investigation was commenced on the 28th October 1997 and completed on the 26th November 1997. The purpose of the site investigation was to evaluate soil conditions on the above site and to determine levels and sizes of existing foundations. This Report has been revised to include further information supplied by the ARTC regarding the depth and location of two reservoirs and the location of a water main, all reported to be leaking by the ARTC.

General:

Eight number 200mm diameter Shell & Auger boreholes were put down to depths varying from 8.5 to 11.5mBGL in positions indicated by O'Connor Sutton Cronin to determine the soil profile and to obtain soil samples for identification and testing. Rotary drilling was carried out at five locations to determine the depth and size of the existing foundation.The location of the boreholes and foundation investigation are shown on Figure 1 at the rear of this Report.

Contd/...

The depth and dimensions of the foundations investigated as defined by the drillholes are shown on the sketches included in Appendix A.

The standard method of boring in soil for site investigation is known as the Cable Percussion Method. It consists of using a Shell in non cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the boreholes were lined with 200mm diameter steel casing. While the use of the Shell & Auger method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason thin lenses of granular material may not be noticed.

One undisturbed sample was taken with an nominal 100mm diameter open drive sampler, known as a U100 with an area ratio of about 25%. The sample was driven into the soil at the bottom of the borehole by the impact of the boring rods acting through a jarring link, placed immediately above the sample tube. After taking a sample, the drive head and cutting shoe were unscrewed from the sample tube and any wet or disturbed soil was removed from either end. The sample was then sealed with wax and screw on end caps secured.

Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular

Contd/...

intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined.

Standard Penetration Tests were carried out in all the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing 65Kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60° cone. The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the bearing capacity and compressibility of the soil.

Borehole water levels were recorded, together with the depths at which seepages of water or inflows can be detected and the observations are noted in the borehole logs. In general these observations do not give an accurate indication of the actual ground water conditions as the borehole is rarely left standing at the relevant depth for a sufficient time for the water level to reach equilibrium, a permeable stratum may have been sealed off by the borehole casing or water may have been added to the borehole to facilitate progress. For these reasons standpipes were installed in all the boreholes so that an accurate record of the ground water could be recorded.

Contd/...

Gas monitoring standpipes were installed in all the boreholes. The standpipes incorporate a slotted uPVC pipe, pea gravel surround, bentonite and concrete seals, and a protective cover. The above notes outline the general procedures adopted in this geotechnical site investigation and they are in accordance with British Standard Code of Practice for Site Investigation B.S. 5930: 1981.

Laboratory Work

All the samples were visually examined in the laboratory. The sulphate content, pH chloride and fluoride were determined on selected water samples and the results of these tests are contained in Appendix 'C'. Grain size analysis was also conducted on two samples and a hydrometer test on one of these samples. All these tests are included in Appendix C.

Findings

The material encountered in the Boreholes was similar and in general consisted of a layer of concrete and fill that overlies firm brown and grey sandy gravelly clay. This is in turn underlain by stiff grey silty gravelly clay which overlies hard grey silty gravelly clay that extends to final level or presumed boulder or rock at final level.

Contd/...

There are some minor variations to the above general descriptions and where these occur are shown on the accompanying borehole records.

Recommendations and Conclusions

A. General

The recommendations given and opinions expressed in this Report are based on the findings in the boreholes and trial pits, as detailed in the Borehole and Records and the results of the site and laboratory tests. Where an opinion is expressed on the material either between borehole location or below the final level of excavation, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the boreholes. It is further recommended that all foundations when excavated should be inspected to verify the information given in this Report.

B. Bearing pressures

At the location of Borehole Nos. 1 to 8 we would recommend an allowable bearing capacity of 300KN/m^2 at proposed foundation level of 3.0mBGL in the stiff grey silty gravelly clay and 450KN/m^2 at proposed foundation level of 8.5mBGL in the hard grey

Contd/...

silty gravelly clay based on the results of the Standard Penetration Tests.

Based on an imposed loading of 300KN/m^2 at a depth of 3.0mBGL, a foundation size of 7.0 x 7.0m and evaluating Mv after Stroud and Butler the calculated long term settlement is 7mm with expected settlement in the range 5 to 9mm and very little short term settlement.

Based on an imposed loading of 450KN at a depth of 8.5m a foundation size of 6.0 x 6.0m and evaluating Mv after Stroud and Butler the calculated settlement is 5mm with expected settlement in the range 4 to 6mm and very little short term settlement.

C. Slope stability

We would recommend that the top 3.0m be excavated at a slope of 2.5 horizontal to 1 vertical and the remaining 5.5m be excavated at 65° for temporary works. This will require full time monitoring of the excavation face and ground surface adjacent to the excavation by an Experienced Resident Engineer. Care should be taken to prevent ingress of water on the face of the excavation as this could lead to considerable softening with consequent loss of strength and we would recommend the face of the excavation be protected from the weather. Layers of water bearing gravel are known to exist in this glacial stratum, while not encountered in this investigation or other investigations we have

Contd/...

carried out at the airport, if encountered we would recommend that specialist advice be sought to ensure the stability of the excavation is satisfactory.

Sluffing of the face in all likelihood will occur and regular inspection of the excavation face by the resident engineer should incorporate removal of any loose material. Construction vehicles should be prevented from travelling within 1m of the top of the excavation during construction. We would recommend that the over excavated area at the side of the proposed building be backfilled with suitable granular material in 225mm layers and properly compacted.

D. Ground Water

Standpipes were installed in all the Boreholes and groundwater levels varied from 0.3m to 3.1mBGL. Samples of groundwater were taken from Borehole Nos. 1 and 7 and tested for fluorine and chlorine. Both samples contained elevated levels of fluoride and chloride, generally not present in groundwater. This indicates that a leak from a potable water supply (water main) and/or storage tank exists in the vicinity of the proposed structure. It is possible that this is contributing to the high groundwater levels recorded. The results of these tests are included in the rear of this report.

The evidence of a leak, or leaks, from a potable water supply has been confirmed by ARTC. Two underground water storage reservoirs located below the open level Carpark

Contd/...

No.2 have been identified as losing considerable quantities of water. Based on information supplied by the ARTC the floor level of these two reservoirs is 62.14MOD Malin. This is approximately 6m below the existing ground level, of 67.2 to 68.1MOD Malin, in the vicinity of the drilled boreholes. We also understand that a 150mm diameter water main, Airside adjacent to the Link Building (Main Terminal to Pier A), is also leaking. The approximate location of the two reservoirs, the leaking water main and the eight boreholes are shown on Figure 2 at the rear of this report.

In an effort to provide information to quantify the dewatering requirements during excavation and construction the groundwater in the borehole standpipes was lowered using hand bailing techniques. The ingress rate of water into the standpipes was monitored and a coefficient of permeability (k in cm/sec) was calculated. The k value ranged from $6x10^{-6}$ to $1x10^{-5}$ cm/sec.

This range is higher than would be anticipated in the low permeability Boulder Clays encountered in the boreholes. Typical values for the brown and black Boulder Clays are in the range of 10^{-7} cm/sec. Two grain size analyses of soil samples were also conducted on selected samples giving a silt/clay content in the region of 25% to 30%, consistent with typical Boulder Clays in the area.

We would point out gravel layers and pockets exist frequently in the boulder clay strata, although not observed in any of these boreholes, with permeability of up to 10^{-2} m/sec.

Contd/...

Further, Borehole No. 4 (adjacent to the Airside water main) could not be dewatered using bailing techniques, indicating a significant inflow of water at this location. This is possibly associated with the leaking potable supply noted above.

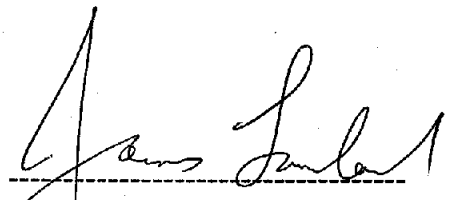
Based on the material observed in the boreholes we would anticipate that it will be necessary to provide for dewatering during excavation and construction. The volumes are not anticipated to be very large but the inflow will in all likelihood be constant requiring a full time dewatering regime.

The groundwater level will vary with time of year, rainfall and near by construction. Consequently the basement at 8.5mBGL should be designed to prevent uplift due to water pressure or the water pressure relieved . We would therefore recommend the installation of drains at basement level to assist in preventing the build up of water pressure. We would also recommend the installation of a cut off drain at a suitable level to intercept near surface in flow of water. This will act to intercept seepage of surface and possibly some of the leaking water from the water supply and reservoirs. The level of the leaks from the two reservoirs is not known at this time.

Based on the groundwater observations and the sensitivity of the bearing strata we would recommend all surfaces be blinded immediately after excavation with a layer of lean mix concrete to prevent softening due to ingress of water.

Contd/...

The results of the Chemical Tests indicate that the pH is near neutral and that the Sulphate Content is relatively low and therefore no special precautions need be taken to prevent sulphate attack of foundation concrete.



James Lombard,

SITE INVESTIGATIONS LIMITED.

APPENDIX 'A'

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 18/11/97
Type of Boring Shell & Auger

Borehole No. 1
Sheet 1 of 2
E N
Boring Completed 20/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Leg-end	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
Ground Level	m	m			m				m
CONCRETE		0.40							
FILL of silty sand		0.60							
Stiff grey silty gravelly CLAY with cobbles				D	1.00	44197			
				C(31)	1.15				
				D	2.00	44198			
				C(40)	2.15				
				D	3.00	44199			
				C(44)	3.15				
				W	3.50	46693			
				D	4.00	44200			
				C(46)	4.15				
		5.00						18/11/97	Nil
Hard grey silty gravelly CLAY with cobbles and boulders (1.5 hours)				D	5.00	39901		19/11/97	3.32
				C(67)	5.15				
				D	6.00	39902			
				C(*)	6.15				
				D	7.00	39903			
				C(*)	7.15				
				D	8.00	39904			
				C(*)	8.15				

Remarks:
Cored concrete from 0.0 to 0.3mBGL and chiselled from 0.3 to 0.4mBGL.
Chiselling 3 hours
At 6.00 74 blows to 135mm refusal
At 7.15 89 blows to 125mm refusal
At 8.15 88 blows to 110mm refusal
At 9.15 50 blows to 60mm refusal
At 9.80 74 blows to 115mm refual
Installed gas/water monitoring pipe to 10.0mBGL with pea gravel surround 5.0 to 9.8mBGL, bentonite seal 4.5 to 5.0mBGL, clay backfill 0.5 to 4.5mBGL and concreted stop cock cover at surface

KEY	- EXPLANATION
↓	- Water Strike
D	- Disturbed Sample
B	- Bulk Disturbed Sample
W	- Water Sample
U	- Undisturbed Sample
P	- Piston Sample
C(N)	- Cone Penetration Test
S(N)	- Standard Penetration Test
N	- Blows /300mm
V	- Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 18/11/97
Type of Boring Shell & Auger

Borehole No. 1
Sheet 2 of 2

Boring Completed 20/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
(Continued)	m	m			m				m
Hard grey silty gravelly CLAY with cobbles and boulders				D	9.00	39905		19/11/97	7.2
				C(*)	9.15			20/11/97	5.5
		10.00		C(*)	9.80				
Final Level									

Remarks:

KEY - EXPLANATION
- ⏚ - Water Strike
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- W - Water Sample
- U - Undisturbed Sample
- P - Piston Sample
- C(N) - Cone Penetration Test
- S(N) - Standard Penetration Test
- N - Blows /300mm
- V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 17/11/97
Type of Boring Shell & Auger

Borehole No. 2
Sheet 1 of 2
E N
Boring Completed 19/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests Type	Depth m	Ref. No.	Casing Depth	Date	Water Depth m
Ground Level	m	m							
CONCRETE		0.40							
FILL of silty sand		0.70							
Stiff grey silty gravelly CLAY				D	1.00	39906			
				C(31)	1.15				
				D	2.00	39907			
				C(40)	2.15				
				D	3.00	39908			
				C(50)	3.15				
				D	4.00	39909		24/11/97	Nil
				C(63)	4.15			25/11/97	1.1
		5.00							
Hard grey silty gravelly CLAY with cobbles and boulders (chiselling 1 hour)				D	5.00	39910			
				C(*)	5.15				
				D	6.00	39911			
				C(71)	6.15				
				D	7.00	39912			
				C(105)	7.15				
				D	8.00	39913		25/11/97	Nil
				C(*)	8.15			26/11/97	4.7

Remarks:
Cored concrete to 0.3mBGL and chiselled from 0.3 to 0.4mBGL
Chiselling 3 hours
Installed gas/water monitoring pipe to 9.0mBGL with pea gravel from 3.0 to 9.0mBGL, bentonite seal from 2.5 to 3.0mBGL backfill from 0.5to 2.5mBGL and concreted stopcock cover at surface
At 5.15 50 blows to 60mm refusal
At 8.15 50 blows to 215mm refusal
At 9.00 50 blows to 30mm refusal

KEY - EXPLANATION
↓ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 17/11/97
Type of Boring Shell & Auger

Borehole No. 2
Sheet 2 of 2

Boring Completed 19/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
(Continued)	m	m			m				m
Hard grey silty gravelly CLAY with cobbles and boulders		9.00							
Presumed BOULDER (chiselling 1.5 hours)		9.20		D	9.00	39914			
Final Level				C(*)	9.15				

Remarks:

KEY - EXPLANATION
- ↓ - Water Strike
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- W - Water Sample
- U - Undisturbed Sample
- P - Piston Sample
- C(N) - Cone Penetration Test
- S(N) - Standard Penetration Test
- N - Blows /300mm
- V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 11/11/97
Type of Boring Shell & Auger

Borehole No. 3
Sheet 1 of 2
E N
Boring Completed 14/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
Ground Level	m	m			m				m
CONCRETE (chiselling 1/2 hour)		0.40							
Stiff grey silty gravelly CLAY		4.50		D C(32)	1.00 1.15	44188			
				D C(44)	2.00 2.15	44189			
				D C(47)	3.00 3.15	44190			
				D C(47)	4.00 4.15	44191			
Hard grey silty gravelly CLAY with cobbles and boulders (chiselling 1.5 hours)				D C(60)	5.00 5.15	44192			
				D C(*)	6.00 6.15	44193			
				D C(*)	7.00 7.15	44194			
				D C(*)	8.00 8.15	44195		13/11/97	Nil

Remarks:
Cored concrete from 0.0 to 0.3mBGL and chiselling from 0.3 to 0.4mBGL.
Chiselling 2 hours
At 6.15 92 blows to 220mm refusal
At 7.15 70 blows to 125mm refusal
At 8.15 84 blows to 135mm refusal
At 9.00 50 blows to 70mm refusal
At 10.15 50 blows to 35mm refusal
Installed gas/water monitoring pipe to 10.00mBGL with pea gravel surrround from 1.00 to 10.00mBGL, bentonite seal and concreted stop cock cover at surface

KEY - EXPLANATION
↓ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 11/11/97
Type of Boring Shell & Auger

Borehole No. 3
Sheet 2 of 2

Boring Completed 14/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
(Continued)	m	m			m				m
Hard grey silty gravelly CLAY with cobbles and boulders				D C(*)	9.00 9.15	44196			
		10.00							
Final Level				C(*)	10.15				

Remarks:

KEY - EXPLANATION
- ↓ - Water Strike
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- W - Water Sample
- U - Undisturbed Sample
- P - Piston Sample
- C(N) - Cone Penetration Test
- S(N) - Standard Penetration Test
- N - Blows /300mm
- V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 11/11/97
Type of Boring Shell & Auger

Borehole No. 4
Sheet 1 of 2
E N
Boring Completed 13/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests Type	Depth m	Ref. No.	Casing Depth	Date	Water Depth m
Ground Level	m	m							
CONCRETE (chiselling 1 hour)		0.45							
FILL of silty gravelly CLAY		0.80							
Brown silty gravelly CLAY		1.00							
Firm grey brown silty gravelly CLAY		2.00		D C(12)	1.00 1.15	44274			
Hard grey silty gravelly CLAY		7.60		D C(53) D C(76) D C(88) D C(116) D C(120) D C(*)	2.00 2.15 3.00 3.15 4.00 4.15 5.00 5.15 6.00 6.15 7.00 7.15	44275 44276 44277 44278 44279 44280			
BOULDER (chiselling 1 1/4 hours)		7.90							
Hard grey silty gravelly CLAY				D C(130)	8.00 8.15	44281			

Remarks:
Cored concrete from 0.0 to 0.35m and chiselling from 0.35 to 0.45mBGL
Chiselling 2 1/4 hours
At 7.15 155 blows to 260mm refusal
At 10.15 109 blows to 181mm refusal
Installed gas/water monitoring pipe to 10.00mBGL with pea gravel surround, bentonite seal and concreted stop cock cover at surface

KEY - EXPLANATION
↓ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 11/11/97
Type of Boring Shell & Auger

Borehole No. 4
Sheet 2 of 2
Boring Completed 13/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
(Continued)	m	m			m				m
Hard grey silty gravelly CLAY				D	9.00	44282			
				C(146)	9.15				
		10.00						13/11/97	Nil
Final Level				C(*)	10.15				

Remarks:

KEY - EXPLANATION
- Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 14/11/97
Type of Boring Shell & Auger

Borehole No. 5
Sheet 1 of 2
E N
Boring Completed 18/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Leg-end	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
Ground Level	m	m			m				m
CONCRETE		0.45							
FILL of brown silty clay and sandy gravel		0.90							
Firm grey brown silty gravelly CLAY with cobbles		2.00		D C(11)	1.00 1.15	44283			
Stiff grey silty gravelly CLAY with cobbles		4.20		D C(31) D C(36) W D C(69)	2.00 2.15 3.00 3.15 3.50 4.00 4.15	44284 44285 46692 44286			
Hard grey silty gravelly CLAY with cobbles and boulders (chiselling 1 hour)				D C(87) D C(105) D C(89) D C(*)	5.00 5.15 6.00 6.15 7.00 7.15 8.00 8.15	44287 44288 44289 44290			

Remarks:
Cored concrete from 0.0 to 0.3 mBGL and chiselling from 0.3 to 0.45mBGL
Chiselling 3.5 hours
Installed gas/water monitoring pipe to 10.00mBGL with pea gravel surround from 10.00 to 4.5mBGL, bentonite seal from 3.5 to 4.5mBGL and backfill from 0.8 to 4.5mBGL with concreted stop cock cover in at surface
At 8.15 108 blows to 177mm refusal

3.5 ?

KEY - EXPLANATION
⏚ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 14/11/97
Type of Boring Shell & Auger

Borehole No. 5
Sheet 2 of 2

Boring Completed 18/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
(Continued)	m	m			m				m
Hard grey silty gravelly CLAY with cobbles and boulders (chiselling 1 hour)				D	9.00	44291			
				C(107)	9.15				
		10.00						18/11/97	Nil
Final Level				C(167)	10.15				

Remarks:

KEY - EXPLANATION
- ↓ - Water Strike
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- W - Water Sample
- U - Undisturbed Sample
- P - Piston Sample
- C(N) - Cone Penetration Test
- S(N) - Standard Penetration Test
- N - Blows /300mm
- V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 5/11/97
Type of Boring Shell & Auger

Borehole No. 6
Sheet 1 of 2
E N
Boring Completed 6/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
Ground Level	m	m			m				m
CONCRETE		0.25							
FILL of silty gravelly clay		0.90							
Firm brown silty gravelly CLAY		1.50		D C(7)	1.00 1.15	44266			
Firm grey silty gravelly CLAY		2.50		D C(12)	2.00 2.15	44267			
Stiff grey silty gravelly CLAY		4.10		D C(38)	3.00 3.15	44268			
BOULDER (chiselling 1 3/4 hours)		4.45							
Hard grey silty gravelly CLAY		5.80		D C(109)	4.50 4.65	44269			
BOULDER (chiselling 1/2 hours)		6.30		D C(107)	5.50 5.65	44270			
Hard grey silty gravelly CLAY		7.80		D D C(115)	6.00 6.50 6.65	44271 44272			
BOULDER (chiselling 2.5 hours)		8.50		D C(133)	7.50 7.65	44273		06/11/97	Nil

Remarks:
Cored cncrete at surface
Chiselling 4 3/4 hours
Installed water/gas monitoring pipe to 8.5mBGL with pea gravel surround, bentonite seal and concreted stop cock cover at surface

KEY - EXPLANATION
- Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 5/11/97
Type of Boring Shell & Auger

Borehole No. 6
Sheet 2 of 2
Boring Completed 6/11/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
(Continued)	m	m			m				m
Final Level									

Remarks:

KEY - EXPLANATION
- ↓ - Water Strike
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- W - Water Sample
- U - Undisturbed Sample
- P - Piston Sample
- C(N) - Cone Penetration Test
- S(N) - Standard Penetration Test
- N - Blows /300mm
- V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 31/10/97
Type of Boring Shell & Auger

Borehole No. 7
Sheet 1 of 2
E N
Boring Completed 31/10/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests Type	Depth m	Ref. No.	Casing Depth	Date	Water Depth m
Ground Level	m	m							
TARMAC ON CONCRETE		0.20							
HARDCORE		0.55							
Firm brown silty gravelly CLAY		1.30		D	1.00	44254			
				C(8)	1.15				
Stiff grey silty gravelly CLAY		2.50		D	2.00	44255			
				C(47)	2.15				
Hard grey silty gravelly CLAY				D	3.00	44256			
				C(57)	3.15				
				W	3.50	46691			
				D	4.00	44257			
				C(77)	4.15				
		5.40		D	5.00	44258			
				C(70)	5.15				
BOULDER (chiselling 1 3/4 hours)		5.80							
Hard grey silty gravelly CLAY				D	6.00	44259			
				C(88)	6.15				
				D	7.00	44260			
				C(91)	7.15				
				D	8.00	44261			
				C(107)	8.15				

Remarks:
Cored concrete at surface
Chiselling 3 1/4 hours
At 11.65 111 blows to 180mm refusal
Installed gas/water monitoring pipe to 11.5mBGL with pea gravel surround, bentonite seal and concreted stop cock cover at surface

KEY	- EXPLANATION
↓	- Water Strike
D	- Disturbed Sample
B	- Bulk Disturbed Sample
W	- Water Sample
U	- Undisturbed Sample
P	- Piston Sample
C(N)	- Cone Penetration Test
S(N)	- Standard Penetration Test
N	- Blows /300mm
V	- Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 31/10/97
Type of Boring Shell & Auger

Borehole No. 7
Sheet 2 of 2

Boring Completed 31/10/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
(Continued)	m	m			m				m
Hard grey silty gravelly CLAY				D C(104)	9.00 9.15	44262			
		10.00							
BOULDER (chiselling 1.5 hours)		10.30							
Hard grey silty gravelly CLAY				D C(121)	10.50 10.65	44263			
		11.50						03/11/97	Nil
Final Level				D C(*)	11.50 11.65	44264			

Remarks:

KEY - EXPLANATION
- Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 28/10/97
Type of Boring Shell & Auger

Borehole No. 8
Sheet 1 of 2
E N
Boring Completed 29/10/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Leg-end	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
Ground Level	m	m			m				m
CONCRETE		0.25							
HARDCORE		0.50							
Stiff brown silty gravelly CLAY		1.45		D	0.75	43307			
				C(26)	1.15				
Stiff grey silty gravelly CLAY		4.80		D	1.45	43302			
				U	2.00	43303			
				D	2.65	43304			
				C(39)	3.15				
				D	3.65	43305			
				D	4.40	43306			
BOULDER (chiselling 1.5 hours)		5.40		C(*)	4.85				
Hard grey silty gravelly CLAY		6.25		D	5.40	43307			
				D	6.15	43308			
BOULDER (chiselling 1 hour)		6.60		C(*)	6.20				
Hard grey silty gravelly CLAY				D	7.40	43309			
				C(100)	7.65				

Remarks:
Cored concrete from 0.0 to 0.25mBGL
Chiselling 3.5 hours
At 4.85 50 blows to 45mm refusal
At 6.15 87 blows to 120mm refusal
At 10.35 50 blows to 25mm refusal
Installed gas monitoring pipe to 10.35mBGL with pea gravel surround, bentonite seal and concreted stop cock cover at surface
Failed to recover U4 at 4.50mBGL

KEY	- EXPLANATION
↓	- Water Strike
D	- Disturbed Sample
B	- Bulk Disturbed Sample
W	- Water Sample
U	- Undisturbed Sample
P	- Piston Sample
C(N)	- Cone Penetration Test
S(N)	- Standard Penetration Test
N	- Blows /300mm
V	- Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

CONTRACT Six Bay Extension - Dublin Airport
CLIENT O'Connor Sutton Cronin
Site Address Dublin
Boring Commenced 28/10/97
Type of Boring Shell & Auger

Borehole No. 8
Sheet 2 of 2

Boring Completed 29/10/97
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests				Date	Water Depth
				Type	Depth	Ref. No.	Casing Depth		
(Continued)	m	m			m				m
Hard grey silty gravelly CLAY				D	8.90	43310			
		9.50		C(126)	9.30				
Hard brown silty gravelly CLAY				D	9.50	43311			
		10.25							
Presumed ROCK or BOULDER (chiselling 1 hour)		10.35						29/10/97	Nil
Final Level				D	10.35	43312			
				C(*)	10.40				

Remarks:

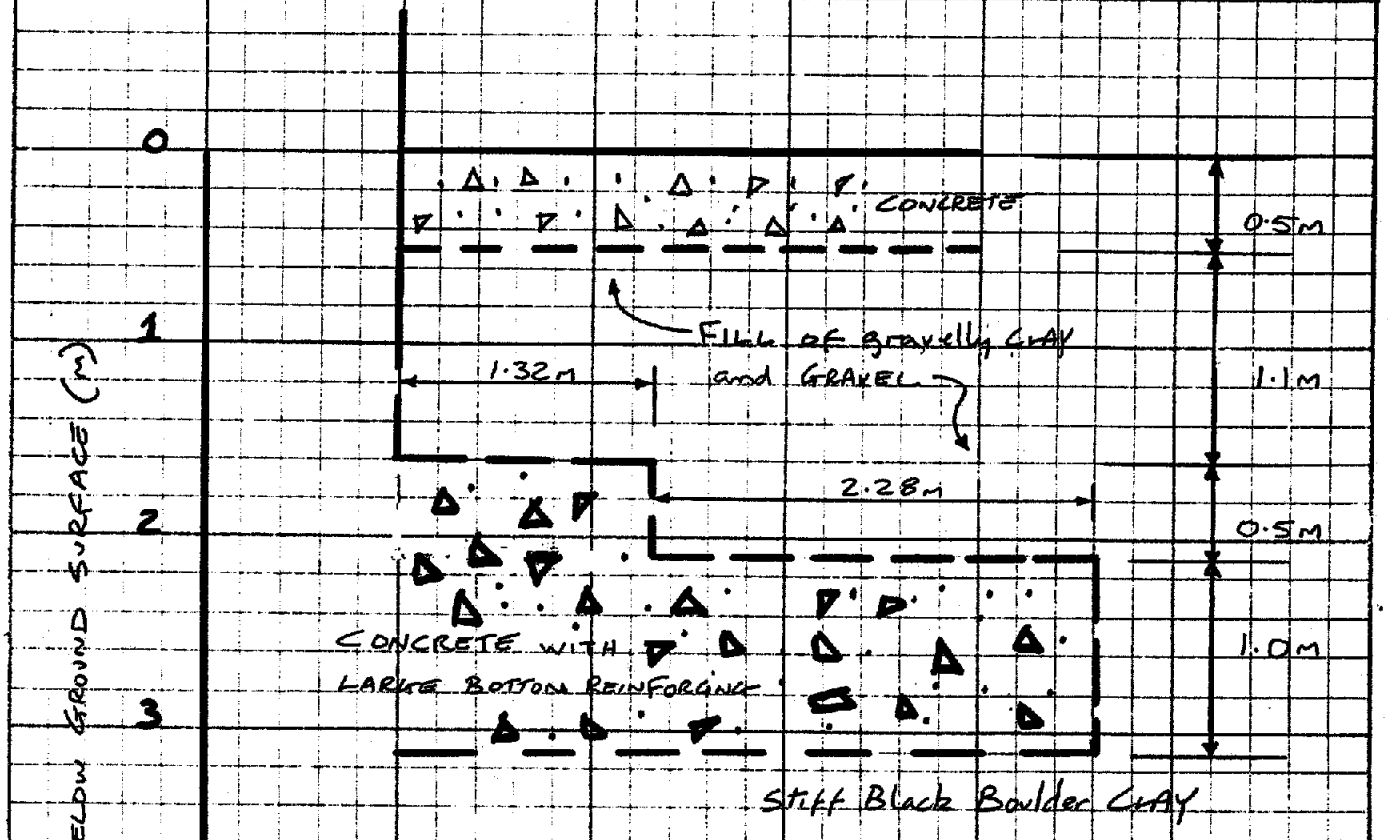
KEY - EXPLANATION
- ↓ - Water Strike
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- W - Water Sample
- U - Undisturbed Sample
- P - Piston Sample
- C(N) - Cone Penetration Test
- S(N) - Standard Penetration Test
- N - Blows /300mm
- V - Vane Test

SITE INVESTIGATIONS LTD

Contract: SIX BAY EXTENSION
Client: AER RIANTA
Site Address: DUBLIN AIRPORT

Made By: BJB
Date: 17/11/97

EXCAVATION LOCATION No. 1 (BAGGAGE LOADING AREA)



SECTION 1-1

NOTES:

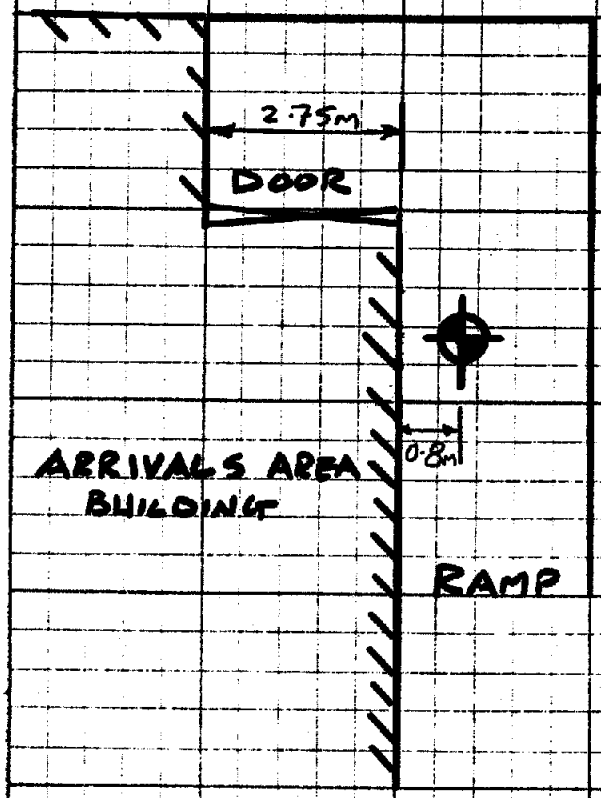
1. FOUNDATION DEPTHS, THICKNESSES AND SUBSURFACE STRATA DETERMINED USING WAGON DRILL TECHNIQUES.
2. WAGON DRILL HOLES BACKFILLED AND REPAIRED WITH CONCRETE
3. REFER TO LOCATION PLAN BY O CONNOR SUTTON CRONIN FOR LOCATION.

SITE INVESTIGATIONS LTD

Contract: Six Bay Extension
Client: Aer Rianta
Site Address: Dublin Airport

Made By: BJB
Date: 12/11/93

Excavation Location No. 2 (Arrivals Ramp)



WDL-1

0 – 1.2m BGL Concrete
1.2 – 6.2m BGL Gravel and gravelly clay (Fill)
6.2 – 7.4 mBGL Concrete
7.4 – 8.0 mBGL Stiff Black Boulder Clay

Plan Location
(Not to scale)

Notes

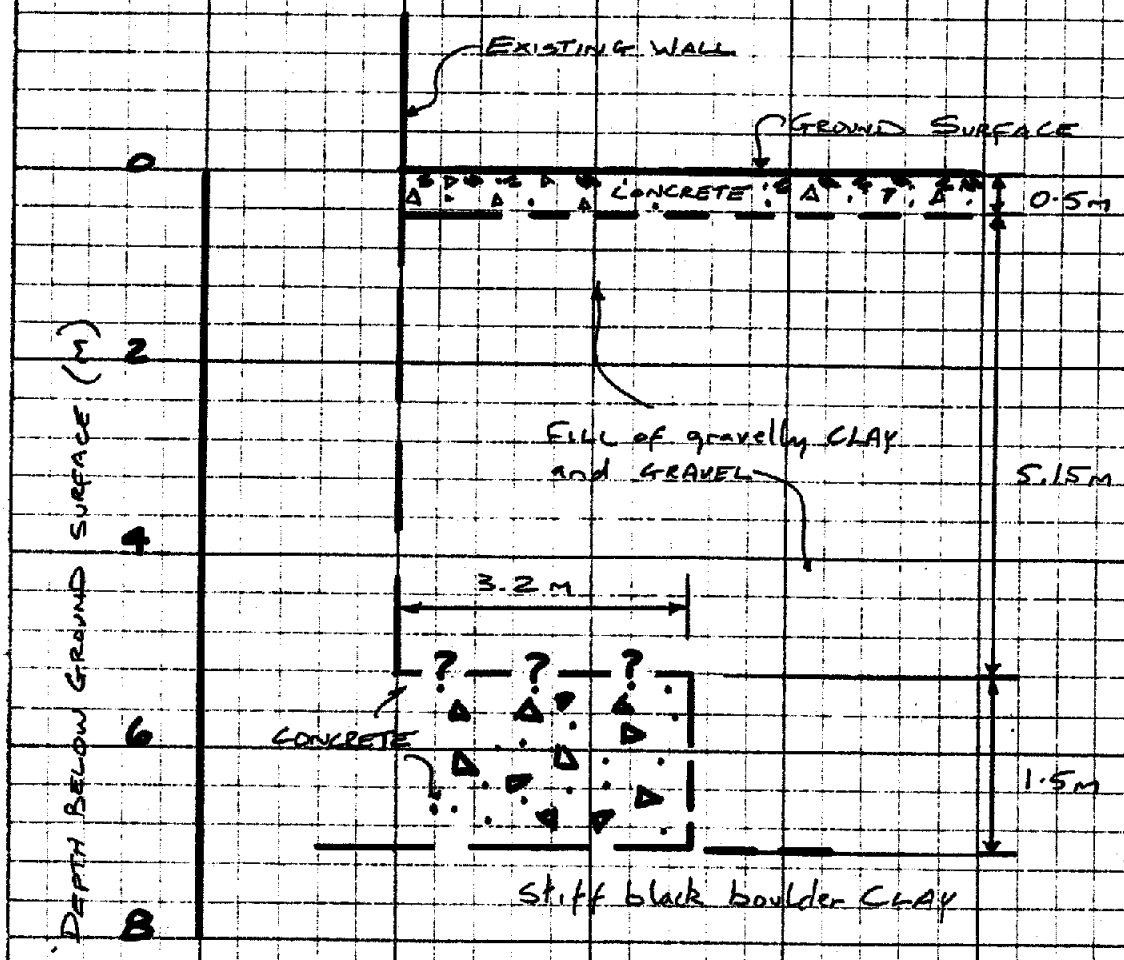
1. Foundation depth, thickness and subsurface strata determined using wagon drilling techniques.
2. Due to access restrictions only one hole could be drilled on ramp.
3. Wagon drill holes backfilled and repaired with concrete upon completion.
4. Refer to location plan by O'Connor Sutton Cronin for location.

SITE INVESTIGATIONS LTD

Contract: SIX BAY EXTENSION
Client: AER RIANTA
Site Address: DUBLIN AIRPORT

Made By: BJB
Date: 17/11/97

EXCAVATION LOCATION No. 3 (SPIRAL STAIRWAY)



SECTION 3-3

NOTES:

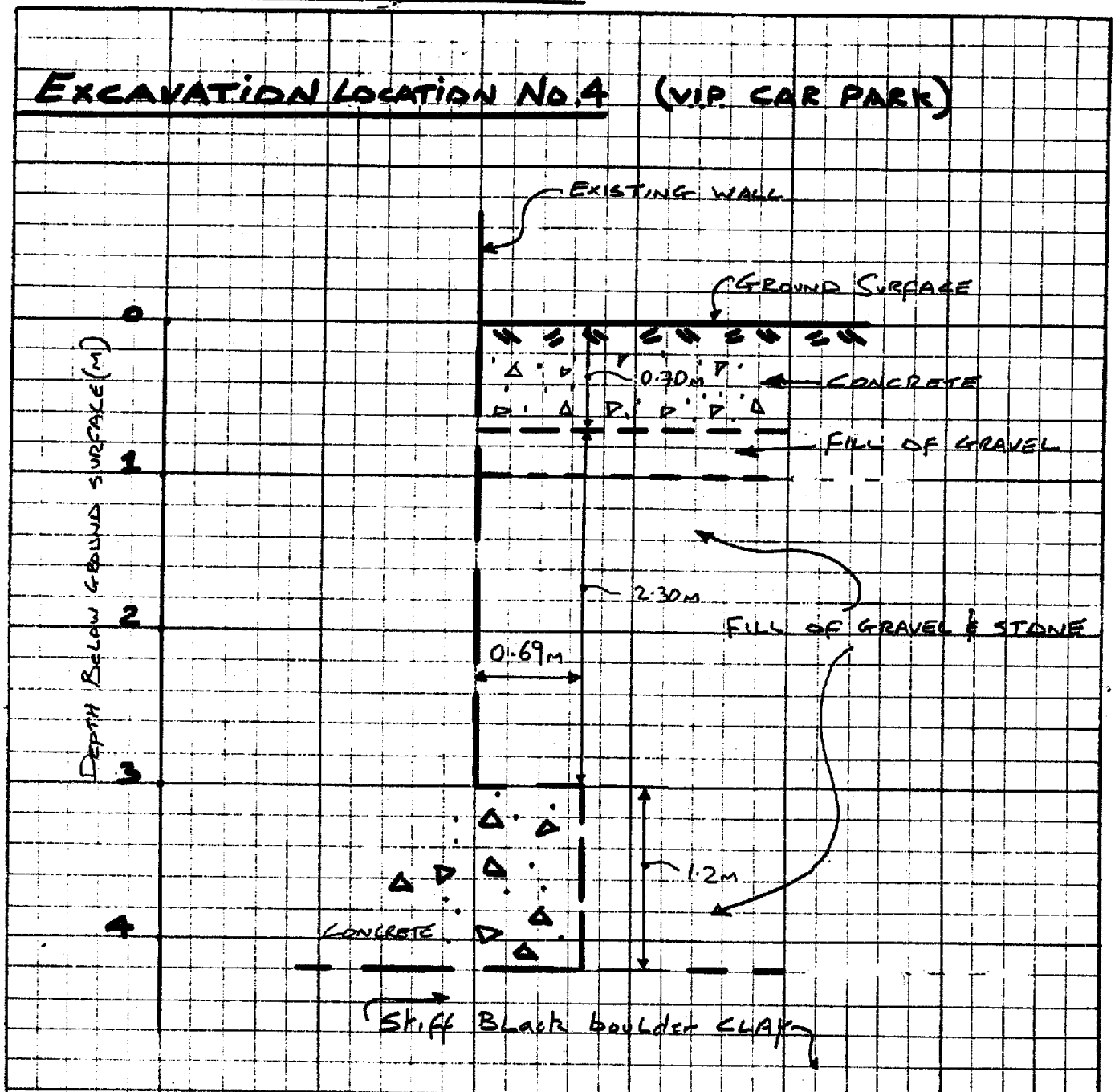
1. FOUNDATION DEPTH, THICKNESS AND SUBSURFACE STRATA DETERMINED USING WAGON DRILL TECHNIQUES.
2. DUE TO ACCESS RESTRICTIONS THE PRESENCE OF A STEP FOUNDATION ADJACENT TO THE SPIRAL STAIRWAY WAS NOT CONFIRMED.
3. WAGON DRILL HOLES BACKFILLED AND REPAIRED WITH CONCRETE
4. REFER TO LOCATION PLAN BY O'CONNOR SUTTON CRONIN FOR LOCATION

SITE INVESTIGATIONS LTD

Contract: Six Bay Extension
Client: Aer Rianta
Site Address: Dublin Airport

Made By: BJB
Date: 13/11/97

Excavation Location No.4 (V.I.P. Car Park)



Section 4-4

Notes:

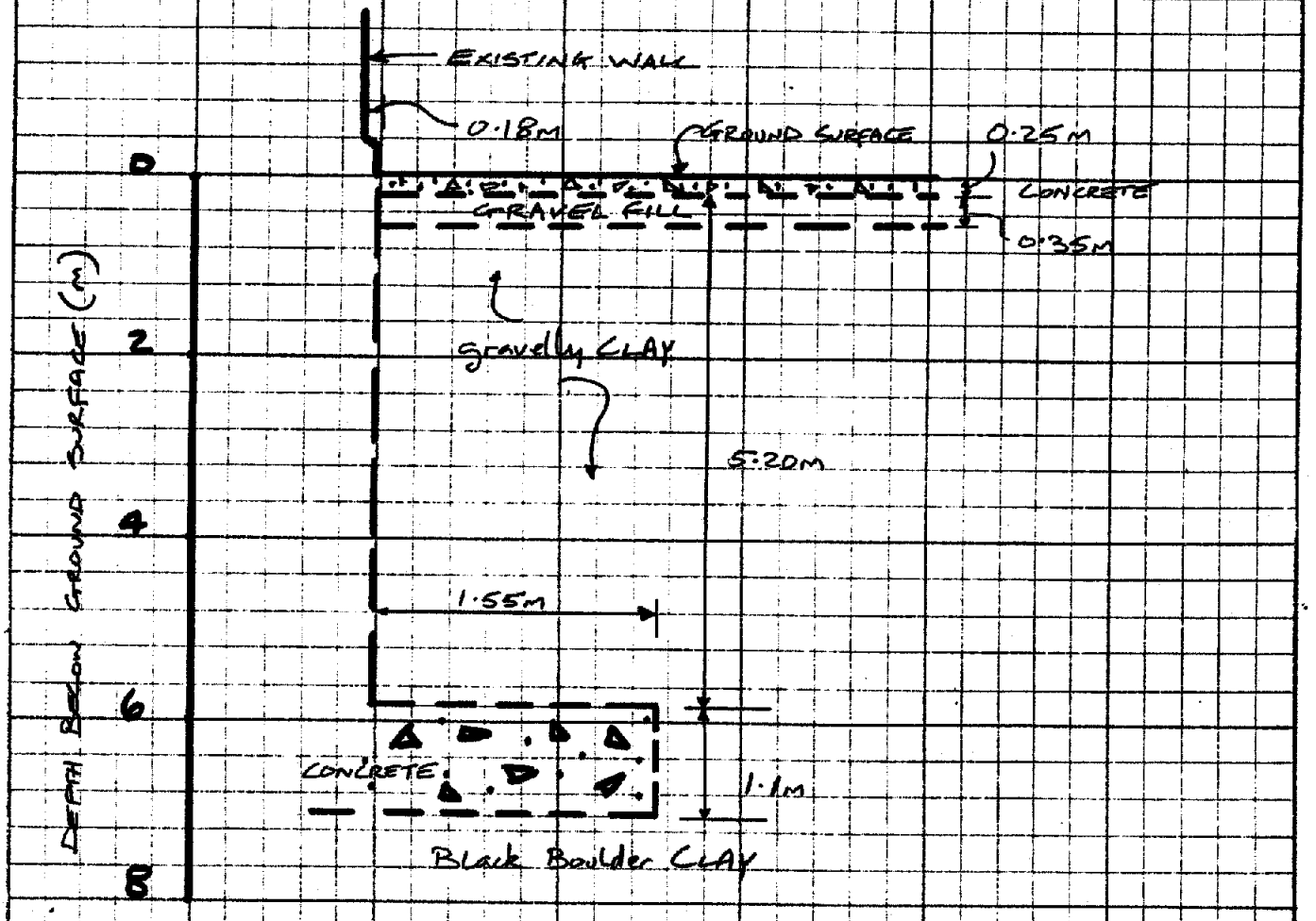
1. Foundation depth, thickness and subsurface strata determined using wagon drilling techniques
2. Wagon drill holes backfilled and repaired with concrete upon completion
3. Refer to Location Plan by O'Connor Sutton Cronin for location.

SITE INVESTIGATIONS LTD

Contract: SIX BAY EXTENSION
Client: AER RIANTA
Site Address: DUBLIN AIRPORT

Made By: BJB
Date: 17/11/97

EXCAVATION LOCATION NO 5 (V.I.P CARPARK)



SECTION 1-1

NOTES:

1. FOUNDATION DEPTH, THICKNESS AND SUBSURFACE STRATA DETERMINED USING WAGON DRILL TECHNIQUES.
2. DUE TO ACCESS RESTRICTIONS DRILL HOLES WERE DRILLED AT 15° FROM VERTICAL AND THE ABOVE DIMENSIONS CORRECTED TO HORIZONTAL AND VERTICAL
3. WAGON DRILL HOLES BACKFILLED AND REPAIRED WITH CONCRETE.
4. REFER TO LOCATION PLAN BY O'CONNOR SUTTON CRONIN FOR LOCATION.

APPENDIX 'B'

WATER LEVELS (mBGL) DUBLIN AIRPORT

BH NO	DATE 18/11	DATE 1/12	DATE 2/12	DATE 3/12	REMARKS
1	--	--	--	0.77	
2	--	--	--	1.85	
3	5.1	1.95	1.95	0.77	Pumped out to 3.95 (30 L) on 2/12
4	4.5	0.44	0.43	0.46	Pumped out to 0.45 (30 L) on 2/12
5	3.0	0.52	0.52	0.50	Pumped out to 5.7 (30 L) on 2/12
6	3.0	0.59	0.65	2.45	Pumped out to 2.95 (30 L) on 2/12
7	3.3	3.03	3.07	3.4	Pumped out to 6.4 (30 L) rose to 4.5 in 2 hours on 2/12
8	--	3.13	3.13	3.09	Pumped out to 4.0 (30 L) on the 2/12

NOTE: 1m of Pipe = 1.25 L of water

PUMPING TEST IN STANDPIPES - 10/12/97

	TIME	PUMPING TIME (min)	RECOVERY TIME (min)	VOLUME PUMPED OUT (litres)		WATER LEVEL (mBGL)	k cm/sec
BH 1	1.30 1.37 3.25 4.27	0 7 - -	- 0 108 170	30		0.030 5.370 4.580 3.90	$1x10^{-5}$
BH 2	1.15 1.24 3.26 4.23	0 9 - -	- 0 122 181	41		1.360 5.740 4.730 4.40	$1x10^{-5}$
BH 3	1.01 1.06 1.10 3.28 4.23	0 6 9 - -	- - 0 138 193	40		1.45 4.420 4.50 2.590 2.470	$5x10^{-6}$
BH4	12.25 12.28 3.22 4.29	0 3 - -	- 0 174 241	56		0.300 0.440 0.430 0.420	-
BH 5	12.36 12.55 3.19 4.30	0 19 - -	- 0 144 215	36		0.520 6.100 5.00 3.440	$5x10^{-6}$

NOTES:

1. No significant drop in groundwater was recorded during dewatering of Borehole No. 4.
2. No significant rise in water level was recorded in Borehole No. 8 after dewatering.

PUMPING TEST IN STANDPIPES - 10/12/97

	TIME	PUMPING TIME (min)	RECOVERY TIME (min)	VOLUME PUMPED OUT (litres)		WATER LEVEL (mBGL)	k (cm/sec)
BH 6	2.02 2.10 3.10 4.35	0 8 - -	- 0 60 145	30		0.760 5.20 4.50 4.18	$1X10^{-5}$
BH 7	1.54 2.00 3.14 4.33	0 4 - -	- 0 74 153	27		3.070 8.160 5.30 5.06	$6X10^{-5}$
BH 8	1.47 1.50 3.16 4.36	0 3 - -	- 0 86 166	7		2.95 3.86 3.82 3.82	-

APPENDIX 'C'

SITE INVESTIGATIONS LIMITED

SULPHATE CONTENT & pH

DUBLIN AIRPORT

BH NO.	SAMPLE NO.	SAMPLE DEPTH mBGL	pH	WATER SULPHATE AS SO3 g/l
1	46693	3.50	7.1	0.04
5	46692	3.50	7.1	0.03
7	46691	3.50	7.0	0.03

SITE INVESTIGATIONS LIMITED

Main Street, Newcastle, Co. Dublin.

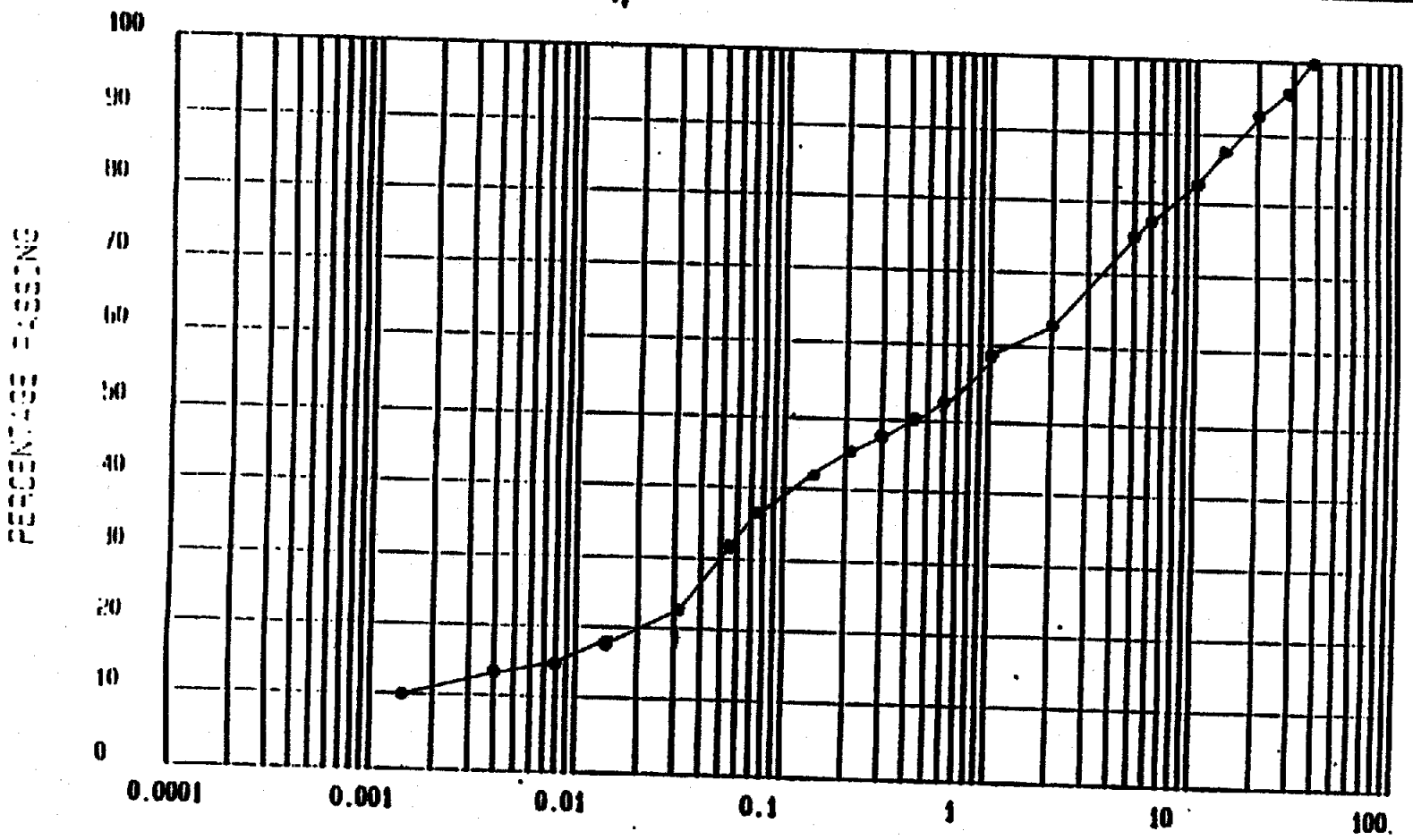
ANALYSES OF WATER SAMPLES

Date Sampled: 03/12/97

	Sample ID	Airport BH 1 @ 3.50m	Airport BH 7 @ 3.50m
Determinand	**Lab ID**	**6637**	**6638**
Chloride		*27*	*33*
Fluoride		*0.9*	*0.5*

Concentrations expressed at mg/l (ppm) unless stated otherwise

B.S.1377 PARTICLE SIZE ANALYSIS TEST NO.7a AND 7d

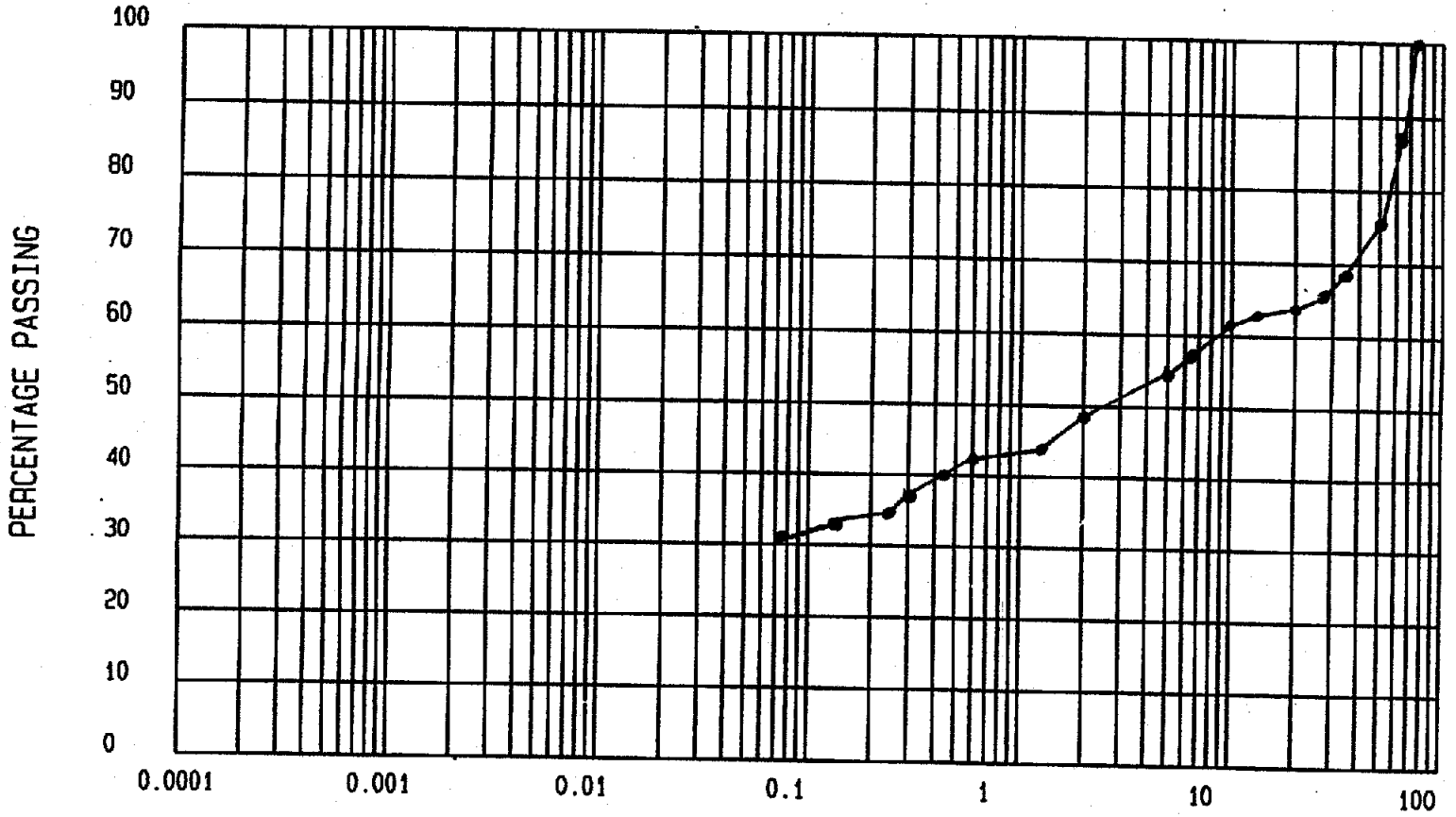


Particle size (mm)

CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	C
	SILT			SAND			GRAVEL			

S.I.ltd	Site ref : Airport	BHn : 1	Depth (m) 7.00m	Sample No. 39903

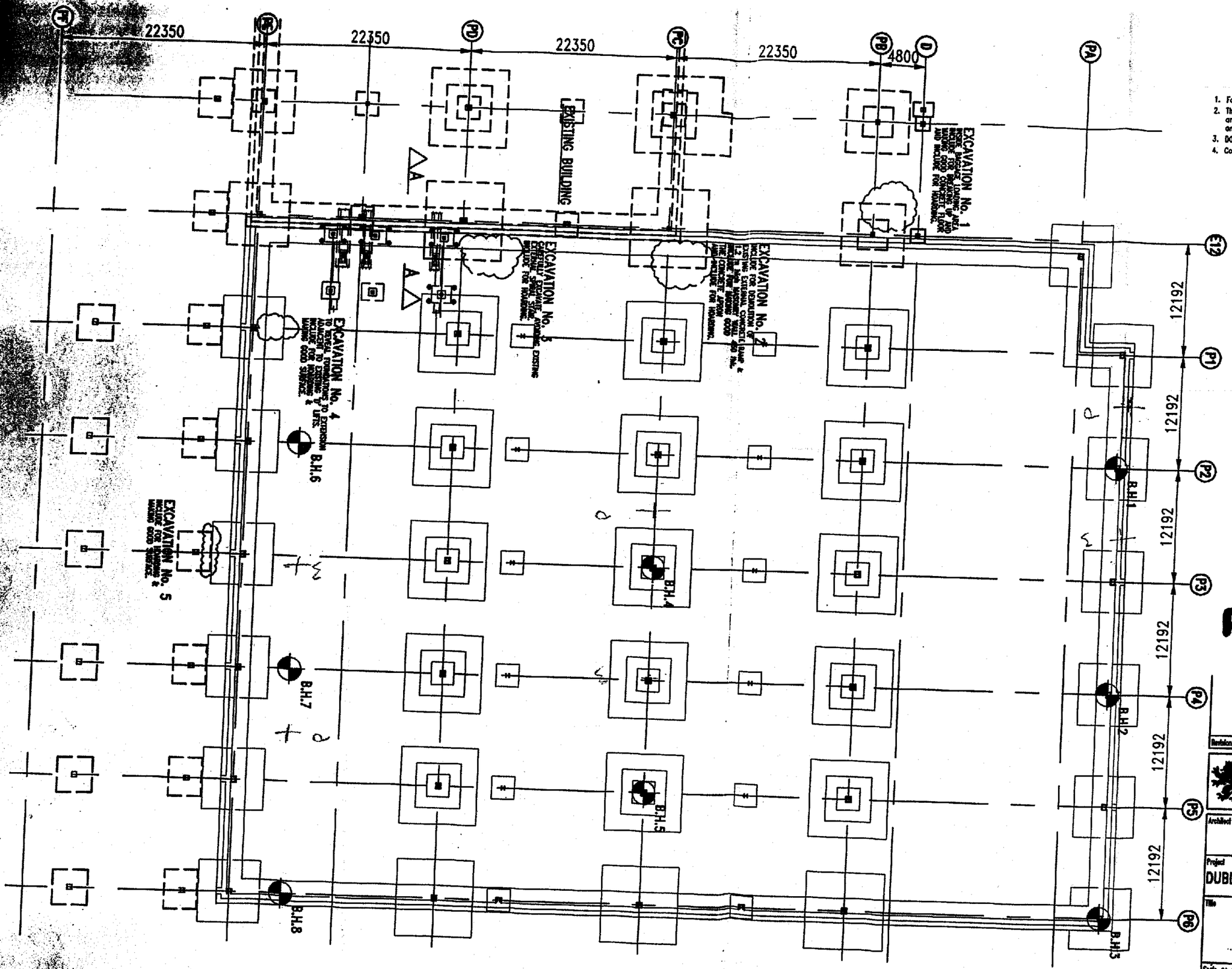
B.S.812 PARTICLE SIZE ANALYSIS



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	C
	SILT			SAND			GRAVEL			

S.I.ltd	Site ref : Airport	Depth: 2m	BH No : 2	SAMPLE : 39907

APPENDIX 'D'



PROPOSED BASEMENT(FOUND.'s INCLUDED) PLAN

1:100

NOTES

1. For setting out refer to Architects details.
2. This drawing to be read in conjunction with all other Architectural and Engineering drawings and all other relevant drawings and Specifications.
3. DO NOT SCALE THIS DRAWING. Use figure dimensions only.
4. Concrete to be Grade –

FIGURE 1

Revision	Date	Drn. By	Chkd By

O'CONNOR SUTTON CRONIN
CONSULTING STRUCTURAL AND CIVIL ENGINEERS
2 HOLLES STREET, DUBLIN 2.
TELEPHONE 6610677 FAX 6610620
e-mail: osc@osc.ie
Web Address: http://indigo.ie/~osc

IS/EN 9001

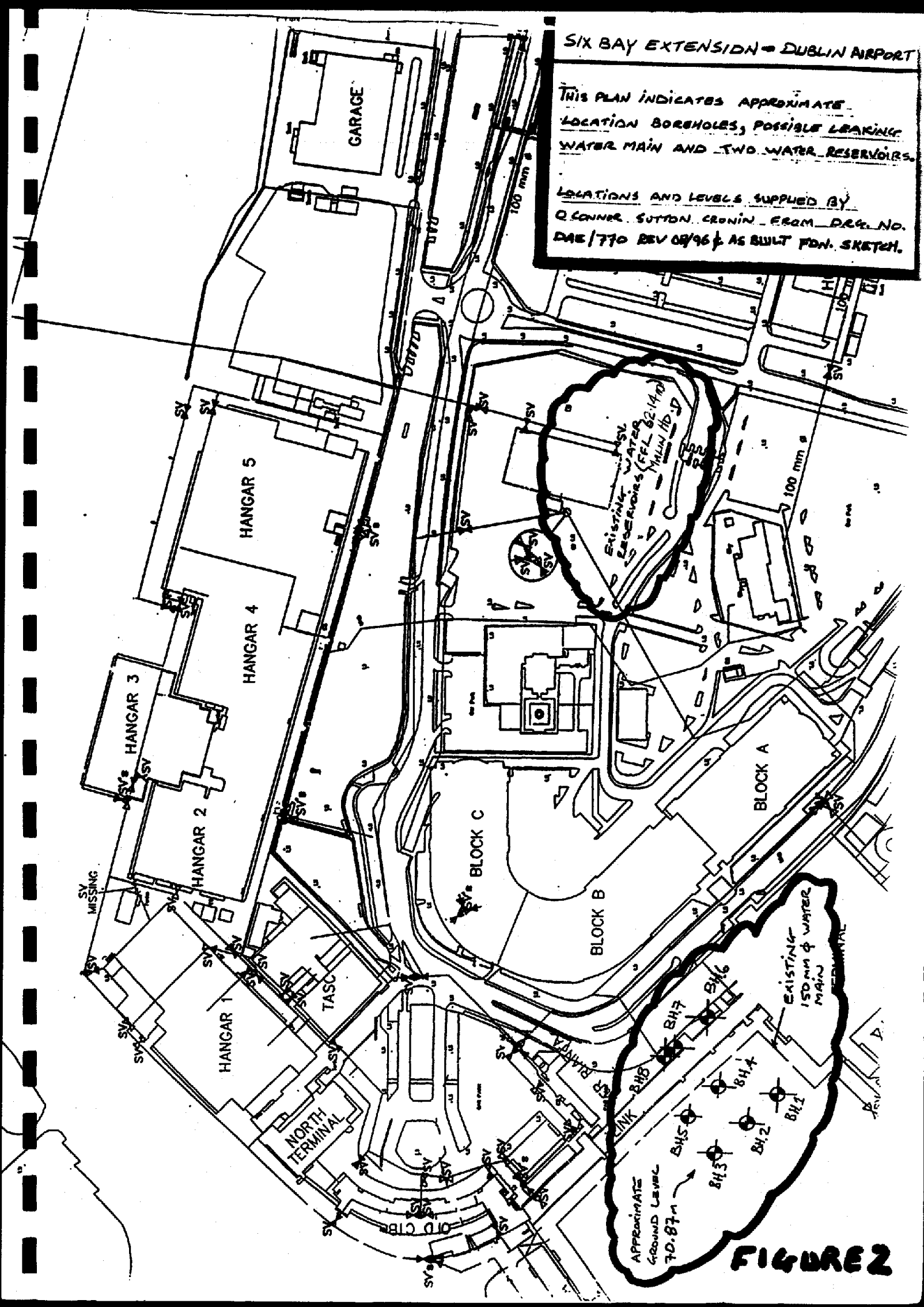
Architect: AER RIANTA ARCH.s DEPT.

Project: DUBLIN AIRPORT, TERMINAL BUILDING

Title: EXTRACT FROM SITE INVESTIGATION DRAWING No. S I.

Scale do not scale	DRN BY	K.F.	DRAWING NUMBER	REV
Date DEC.97	CHKD BY			
	APRD BY			
ROOM: GBD	ISSUE: 1	REV: 1		

PROJECT No. A46


SIX BAY EXTENSION - DUBLIN AIRPORT
THIS PLAN INDICATES APPROXIMATE LOCATION BOREHOLES, POSSIBLE LEAKING WATER MAIN AND TWO WATER RESERVOIRS.
LOCATIONS AND LEVELS SUPPLIED BY O'CONNOR SUTTON CRONIN FROM DRG. NO. DAE/770 REV 08/96 & AS BUILT FDN. SKETCH.
GARAGE
HANGAR 5
HANGAR 4
HANGAR 3
HANGAR 2
HANGAR 1
TASC
NORTH TERMINAL
OLD CTB
BLOCK A
BLOCK B
BLOCK C
EXISTING WATER RESERVOIRS (FSL 62.14 OD)
EXISTING 150mm ø WATER MAIN
100 mm ø
SV
SV MISSING
BH1
BH2
BH3
BH4
BH5
BH6
BH7
BH8
APPROXIMATE GROUND LEVEL 70.87m
FIGURE 2