ENVIRONMENTAL IMPACT STATEMENT

FOR

BEAUMONT QUARRY RESTORATION, CORK

Volume 3 of 3 – Appendices

Prepared for:

Cork City Council,
City Hall,
Cork

Prepared by:

Fehily Timoney & Co.,
Core House,
Pouladuff Road,
Cork

May 2007

ENVIRONMENTAL IMPACT STATEMENT

FOR

BEAUMONT QUARRY RESTORATION, CORK

Volume 3 of 3 – Appendices

DOCUMENT CONTROL SHEET

User is Responsible for the Revision Status of this Document

Rev. Nr.	Description of Changes:	Prepared by:	Checked by:	Approved by:	Date:
0	Issue to Client	JO'S	ME		11/05/07

APPENDICES

Appendix 1: Pre- Submission Correspondence with Interested Parties

Appendix 2: Abacus Transportation Traffic Surveys

Appendix 3: Air Quality Monitoring Data

Appendix 4: Site Investigation Data & Groundwater Quality Monitoring Data

Appendix 5: The Status and Designation of Irish Mammal Species

Appendix 6: Terrestrial Macroinvertebrates

Appendix 7: Description of Habitat Types found in the vicinity of Beaumont Quarry

Appendix 1

Pre- Submission Correspondence with Interested Parties

Our Ref: Q:/2006/011/09/JOS/JMC

Councillor Michael Ahern
3 Kenley Crescent
Westgate Road
Bishopstown
Cork

27 July 2006

RE: Environmental Impact Statement (EIS) and Waste Licence Application for the proposed infilling of Beaumont Quarry with inert material.

Dear Councillor Ahern

Cork City Council has appointed Fehily Timoney and Company to prepare an Environmental Impact Statement and a Waste Licence application for the proposed infilling of the disused Beaumont Quarry with inert material. It is the objective of the City Council to restore the site for use as a public amenity.

The site occupies an area of approximately 3.5 hectares. Figure 1 shows the location of the proposed development.

It is proposed to in-fill the quarry area with inert material (i.e. material which meets the criteria specified in Article 2(e) of Annex II of the European Council Directive 1999/31/EC on the Landfill of waste). A total of 250,000 tonnes of inert material is likely to be required to reach the required finished ground levels at the site.

As part of the consultation process, we would be interested in receiving any comments relevant to your area of expertise or interests by 25th August 2006. If you have no comments to make, we would be grateful if you would please acknowledge receipt of this letter.

CORE HOUSE, POULADUFF ROAD, CORK, IRELAND
T: +353 21 4964133 F: + 353 21 4964464 E: info@ftco.ie W: www.fehilytimoney.ie

If you have any queries with regard to this request, please contact the undersigned.

Yours sincerely

Jerome O'Sullivan
for and on behalf of **Fehily Timoney & Company**

Encl.

Proposed List of Organisations to be Consulted for the infilling of Beaumont Quarry

Salutation	Contact	Position	Organisation	Address 1	Address 2	Address 3	Address 4	Address 5
Mr. Lumley	Mr. Ian Lumley	Heritage Officer	An Taisce	Tailors Hall	Backlane	Dublin 8		
Mr. Matthews	Mr. Paddy Matthews	Planning Officer	The National Heritage Council	Rothe House	Kilkenny			
Mr. McCarthy	Mr Michael McCarthy	Environmental Assessment Division	Department of Environment, Heritage and Local Government	Development Applications Unit	The National Parks and Wildlife Service	Dun Sceine	Harcourt Lane	Dublin 8
Sir/Madam		Secretary	Department of Community, Rural and Gaeltacht Affairs	Dun Aimhirgin	43 – 49 Mespil Road	Dublin 4		
Mr. Wayne	Mr. John Wayne	Coordination Unit	Department of Communications Marine and Natural Resources	Leeson Lane	Dublin 2			
Ms. Twomey	Ms. Niamh Twomey	City Heritage Officer	Cork City Council	Navigation House	Albert Quay	Cork City	Co. Cork	
Ms. Brett	Ms. Ciara Brett	Executive Archaeologist	Planning & Development Directorate	Navigation House	Albert Quay	Cork City	Co. Cork	
	Mr Danny O'Keeffe	Conservation Ranger	National Parks and Wildlife Service		Government Building's	Sullivan's Quay	Cork	
Mr. Smyth	Mr. Tony Smyth	Director of Engineering	Office of Public Works	51 St, Stephen's	Dublin 2			

		Services		Green				
Dr. Newton	Dr. Stephen Newton	Senior Conservation Officer (Research & Surveys)	BirdWatch Ireland	Rockingham House	Newcastle	Co. Wicklow		
Ms. Fields	Ms. Sarah Fields	Development Officer	Irish Wildlife Trust	Sigmund Business Centre	93A Lagan Road	Dublin Industrial Estate	Glasnevin	Dublin 11
Mr. Good	Mr Jervis Good	Divisional Ecologist	Department of Environment, Heritage and Local Government	The National Parks and Wildlife Service	Governme nt Building's	Sullivan's Quay	Cork	
Mr. O Grada	Mr. Fionn O Grada	Tourism Development Officer	Department of Arts, Sport and Tourism	Kildare Street	Dublin 2			
Mr. Towey	Mr Martin Towey	Corporate Policy Planning	Irish Aviation Authority	Aviation House	Hawkins Street	Dublin 2		
Sir/Madam		Secretary	Health and Safety Authority	10 Hogan Place	Dublin 2			
Sir/Madam		Secretary	Health Service Executive	Oak House	Limetree Avenue	Millennium Park	Naas	Co. Kildare
Dr. Creighton	Dr. Ronnie Creighton	Minerals & Mining Industry	Geological Survey of Ireland	Beggars Bush	Haddingto n Road	Dublin 4		
Mr. Murphy	Mr. Sylvester Murphy	Environmental Section	Department of Agriculture and Food	Johnstown Castle Estate	Co. Wexford			

Mr. Dan Buggy

Roads Directorate,
Room 303,
2nd Floor,
City Hall,
Cork.

Mr Kevin Terry

Director of Service
Planning and Development Directorate
Navigation House
Albert Quay
Cork

Mr Gerard O'Beirne

Director of Environment
Floor 3
Norwich Union
89/90 South Mall
Cork

Mr Joe Kennelly

Recreation,AmenityandCultureDirectorate,
FirstFloor,
CorkCityCouncil,
AbbeycourtHouse,
GeorgesQuay,
Cork.

Comhairle Cathrach Chorcaí Cork City Council

Fón/Tel: 021-4966222
Líonra/Web: www.corkcity.ie
R-Phost/E-mail: planning@corkcity.ie

Planning & Development Directorate
Navigation House,
Albert Quay,
Cork.

Ref

FEHILY TIMONEY & Co.
Received by
Date
Action
Distribution 21 AUG 2006
Job No: 305
Correspondence No:
Comment: 15

Jerome O' Sullivan
Fehily Timoney and Company
Core House,
Pouladuff Road,
Cork.

16th August 2006

RE: Environmental Impact Statement for Beaumont Quarry.

Dear Mr. O' Sullivan,

In response to your letter of 27th July 2006 I comment as follows:

There are no Recorded Monuments and Places (RMP) located within the proposed development site at Beaumount Quarry. A burial ground is located outside and to the north of the site. This site, Ballintemple Graveyard (CO074-65), is listed in the RMP and so is afforded protection under National Monuments Legislation. The Zone of Archaeological Potential for this graveyard falls partially within the proposed development site.

The quarry is situated in the former demesne of Beaumont House. This house is indicated on the Ordnance Survey 1st Edition (1850's) map of the area. The country house and its demesne were dominant features of the Irish countryside throughout the 18th and 19th century. One of the features of country house demesnes was icehouses. There is an icehouse indicated on the O.S. map in approximately the northern portion of Beaumont Quarry. I note also that a townland boundary runs through the site. If the boundary is still in existence and is to be impacted upon, then it is recommended that it be fully recorded prior to its removal. I am aware that there have been considerable changes to the landscape within the proposed development site since the nineteenth century due to the former function (quarry) of the site. However there may be some areas of the site which have not been disturbed and so would require archaeological monitoring.

The details submitted are insufficient for me to give a detailed response. There are a number of questions which need to be clarified in order to fully assess what, if any, archaeological intervention is required. Is it planned to infill the entire site? Will there be any ground disturbance –and if so, to what extent? Any ground disturbance would need to be archaeologically monitored –due to the proximity to a recorded monument and the size and scale of the development.

Comhairle Cathrach Chorcaí Cork City Council

Fón/Tel: 021-4966222
Líonra/Web: www.corkcity.ie
R-Phost/E-mail: planning@corkcity.ie

Planning & Development Directorate
Navigation House,
Albert Quay,
Cork.

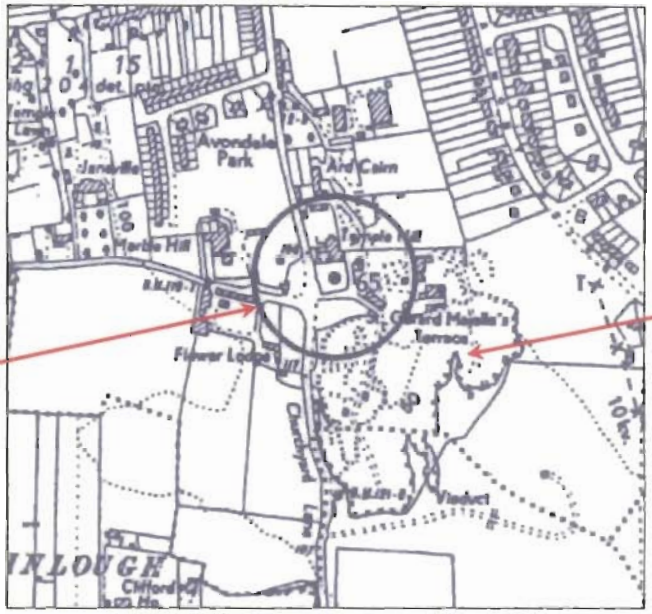
Ref

I would recommend that the Cultural Heritage section of the EIS address the above considerations. I would need to review the EIS/application when it is completed in order to comment adequately.

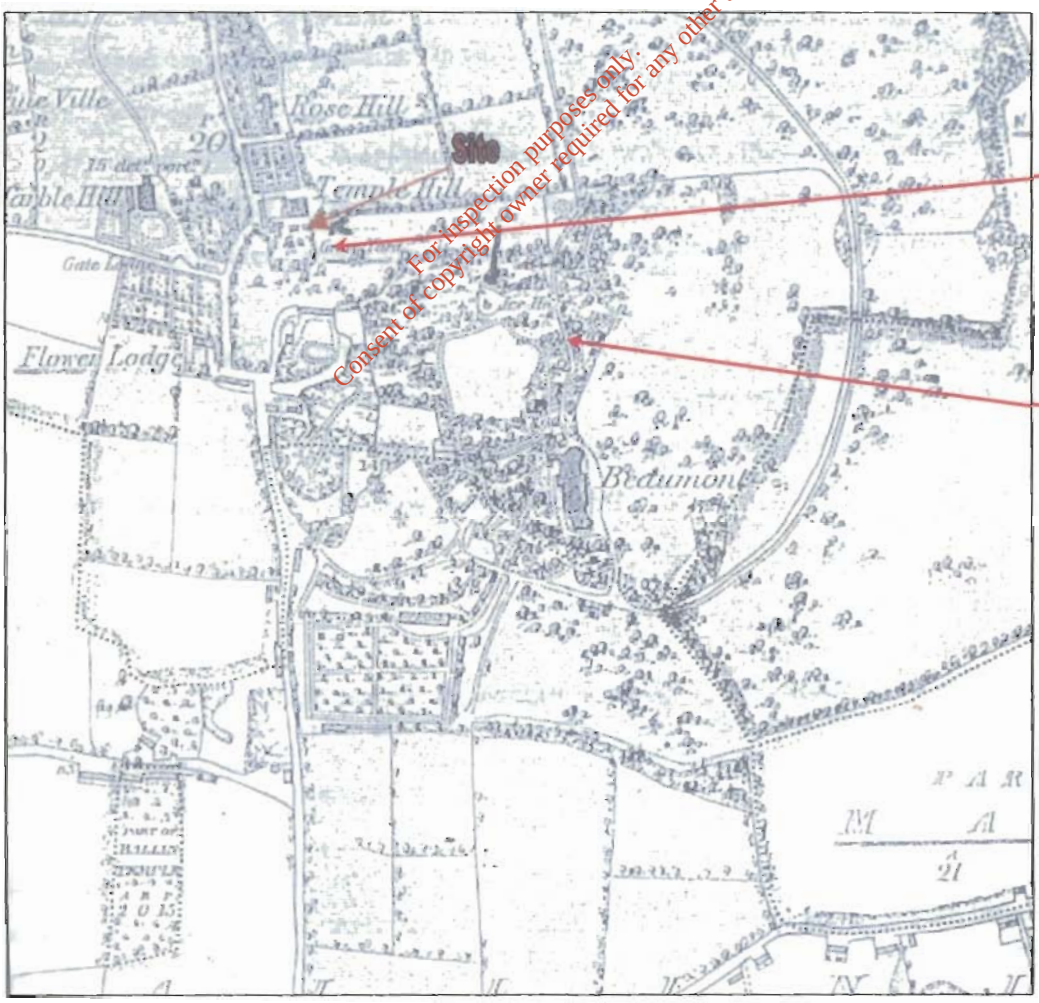
If you have any queries regarding the above please do not hesitate to contact me.

Yours sincerely

Ciara Brett
Executive Archaeologist
Cork City Council



Extract from RMP Map, Sheet 74



Department of Arts, Sport and Tourism
An Roinn Ealaíon, Spóirt agus Turasóireachta

FEHILY TIMONEY & Co.
Received by
Date
Action
Distribution 0 2 AUG 2006
Job No:
Correspondence No: 6
Comment:

Our Ref: T-21-11-3
Your Ref:

28 July, 2006

Mr Jerome O'Sullivan
Fehily Timoney & Co
Core House
Pouladuff Road
Cork.

Dear Mr Jerome O'Sullivan

Re: Correspondence from Fehily, Timony & Company

I have to tell you that I will be leaving this office in August-maybe you would inform any of your colleagues who write to me on these matters. I wonder does your company send these letters to Fáilte Ireland where Mr Paddy Mathews has professional expertise? Fáilte Ireland is clearly a prescribed body under the planning and development regulations which are currently being reviewed and, going forward, Fáilte Ireland will very much be the primary source of comment in these matters.

I have enjoyed corresponding with your firm and I wish you all well.

Yours sincerely

Fionn Ó Grada

Fionn Ó Grada
Tourism Impact Assessment

Tel: (01) 6313872
E-mail:Fionnograda@dast.gov,.ie

IRISH AVIATION AUTHORITY
ÚDARÁS EITLÍOCHTA NA hÉIREANN

AVIATION HOUSE, HAWKINS STREET, DUBLIN 2, IRELAND
TEL: (01) 671 8655 FAX: (01) 679 2934
WEB SITE: www.iaa.ie

27th July 2006

Mr. Jerome O'Sullivan
Fehily Timoney & Company
Core House
Pouladuff Road
Cork

Re: Proposed infilling of Beaumont Quarry with inert material

Dear Mr. O'Sullivan

I refer to your pre-planning query of 27th July 2006, to the Irish Aviation Authority, concerning the proposed infilling of the disused Beaumont Quarry, Cork City. I wish to advise you that we have no observations on the proposals.

Thank you for bringing the matter to our attention.

Yours sincerely

Tom Cooney
Corporate Affairs

REGISTERED OFFICE: AVIATION HOUSE, HAWKINS STREET, DUBLIN 2, IRELAND
REGISTERED No: 211082

David Kennedy Snr,
3 Majella Terrace,
Beaumont Cottages,
Cork.
021 4362228
086 3724354

Jerome O'Sullivan,
Fehily Timoney & Company,
Core House,
Pouladuff Road,
Cork.

17th August 2006.

Re: Beaumont Quarry: Proposed Infilling with Inert Material.

Dear Mr. O'Sullivan,

My wife and I live in close proximity to the Beaumont Quarry, with our residence backing onto Murphy's Lane, no more than 20 metres from the quarry boundary. We have not seen any plans for the infilling activities to be carried out and have several concerns that we wish to raise with you at this moment.

(1) In the recent past, Ascon Ltd was stationed on lands at the quarry entrance during the city main drainage works. Ascon Ltd used an entrance to the quarry lands located at the junction of Churchyard Lane and Beaumont Cottages. This entrance was used on a daily basis by heavy vehicles, vans and cars belonging to Ascon Ltd. The Ascon Ltd drivers were extremely aggressive in their driving and there were several incidents of near misses between Ascon trucks and local residents cars entering and exiting Beaumont Cottages. We would request that this entrance to the quarry is not used for any activities and remain permanently closed. We believe that this entrance is not suitable for the size and volumes of trucks that will use the quarry facility. We feel that alternative access arrangements should be made on the main Boreenmanna Road, which is large enough to cater for heavy vehicles.
The movements of the Ascon Ltd trucks up and down Churchyard Lane also proved problematic as the trucks proved to be too large for the width of the road at the top of Churchyard Lane. We feel that all trucks using the quarry facility are brought to and from the facility via the Boreenmanna Road and not allowed to use Churchyard Lane.

(2) The rear of our house looks on to the quarry via Murphy's Lane and over the years several trees have grown at the boundary of the quarry that have provided screening of the quarry from our house. We would request that these trees are not removed, as they are a valuable scenic feature at the quarry boundary. They will also help to screen the views of the infilling activities that will be carried out and possibly help to reduce noise levels at the boundary.

(3) We would request that infilling activities are only carried out Monday to Friday, between the hours of 9 am to 5 pm, with no Saturday or Sunday work. There will be a significant increase in the dust and noise levels from the increased truck movements into and out of the quarry and moving equipment working within the quarry. Our residence is within 20 metres of the quarry boundary and we feel that a respite in activities in all infilling activities at evenings, nights and weekends would be due consideration for those of us living in close proximity to the quarry.

(4) The existing quarry is frequently used by large groups of young people late at night as a general meeting place. Large amounts of cans and bottles of alcohol are regularly scattered around the quarry area where the meetings take place. It would be expected, as per experiences in other areas of the city, that the planned public amenity space shall attract young people of all ages congregating at evenings and night times. We would hope that an allowance is made when designing the quarry as a public amenity space, that a border fence will be erected at the border of the quarry and Murphy's Lane.

I would greatly appreciate if you could provide us with some indication of the plans for the public amenity space covering issues such as layout, finished levels etc. At this moment in time we have no objections in principle to the proposed infilling of the quarry and development as a public amenity space, but would welcome adequate information on the development.

Yours sincerely,

David Kennedy

David Kennedy.

CC: Cllr Donal J. Counihan, 17 Silverdale Avenue, Ballinlough, Cork.

THE DEPARTMENT OF
AGRICULTURE & FOOD
AN ROINN TALMHAÍOCHTA AGUS BIA

23rd August 2006

Mr Jerome O Sullivan
Fehily Timoney & Co
Consulting Engineers
Core House
Pouladuff Road
Cork

Your Ref: Q:/2006/011/09/JOS/JMC

RE: **Environmental Impact Statement and Waste Licence Application for Proposed infilling of Beaumont Quarry with inert material**

Dear Mr O Sullivan

I refer further to your correspondence dated 27th July 2006 in connection with the above.

As the area surrounding Beaumont Quarry is residential and the proposed works will not impact on agriculture, the Department of Agriculture and Food has no comment to make concerning the proposal.

Yours sincerely,

Louise Conroy
Environment Section
053 9163466

Johnstown Castle Estate,
Co. Wexford, Ireland.

Eastát Chaisleán Bhaile Sheonaigh,
Chontae Loch Garman, Éire.

Tel: 053 - 63400 Fax: 053 - 42839
www.agriculture.gov.ie VAT Reg. IE4773186Q

2006-011-09

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

HSE-Southern Region
South Lee Environmental Health Dept.
Father Matthew Quay
Cork

Tel: 021-4927703
Fax: 021-4927704

Mr. Jerome O`Sullivan
Fehily Timoney & Company
Core House
Pouladuff Road
Cork

FEHILY TIMONEY & Co.
Received by
Date
Action Jerome O'Sullivan
Distribution 0 6 SEP 2006
Job No:
Correspondence No: 6
Comment:

30th August 2006

RE:

Environmental Impact Statement (EIS) and Waste License Application for the proposed infilling of Beaumont Quarry with inert material.

Dear Mr. O`Sullivan,

I refer to the recent correspondence relating to the above proposed development. It is envisaged that there would be some public health concerns that we would like to bring to light at this early stage of the Environmental Impact Assessment (EIA) process.

Because of the urban location of the site, the potential impacts involve a large number of people. I have separated the areas of public health concern into construction phase and operation phase. The construction impacts while relatively short lived have the potential to impact adversely the public in the area. Once commissioned, the impacts would be negligible. The benefits of the area being provided with a new public amenity would far out weigh any negative impacts.

Construction Phase

Pest Control:

Major earthworks that would be involved in this proposed development would pose a serious risk of infestation of pests such as rats and mice. Mitigation measures should include a pest control plan with detailed inspections of the site regularly. It is also imperative that good construction practise be employed to ensure that the area is kept clear of any sources of food that would attract rodents.

Groundwater:

Measures should be taken to prevent any contamination of the groundwater during construction. Some mitigating measures that should be considered should include proper handling and storage of fuels and the availability and use of spill kits.

Water Quality:
The drinking water quality of the area should not be compromised by this proposed development. Existing published water quality data and other information regarding foul sewerage services, stormwater drainage, water supply and natural surfacewaters should be examined as part of the water environment assessment.

Noise:
Reducing the severity of potential impacts of the construction phase of this operation on the local resident should be addressed as a priority. Mitigation measures should include avoiding nighttime work and management and control of site noise to comply with Environmental Protection Agency standards. Temporary screening should be installed during noisy activities such as the actual infilling of the quarry. The local residents should be given regular information on the construction works and progress.

Dust:
A dust control programme should be employed as a mitigating measure to ensure that the local residents are not impacted by construction dust.

Operational Phase

Pest Control:
A pest control plan should still be employed once the public amenity is available.

Groundwater:
It is not envisaged that there would be any significant impacts arising for hydrogeology from the project. However, the application of herbicides should be controlled.

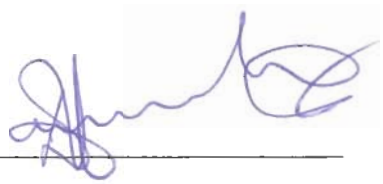
Water Quality:
It is not envisaged that there would be any significant impacts arising for water quality from the project.

Noise:
It is not envisaged that there would be any significant impacts arising for noise from the project.

Dust:
It is not envisaged that there would be any significant impacts arising for dust from the project.

If you have any queries with regard to this submission, please contact the undersigned.

Yours sincerely,



Declan Hamilton
Principal Environmental Health Officer

2006-011-09

Jerome O'Sullivan

From: Reception
Sent: 17 August 2006 09:47
To: Jerome O'Sullivan
Subject: FW: Re - Beaumont Quarry Proposed Infill

Jerome,
FYI

Mary

-----Original Message-----
From: vlevis@vodafone.ie [mailto:vlevis@vodafone.ie]
Sent: 16 August 2006 18:26
To: Reception
Subject: Re - Beaumont Quarry Proposed Infill

For the attention of Mr J O'Sullivan,

I would like to inquire as to the plans your company have to undertake work in Beaumont Quarry, Ballintemple, Cork.
As a resident of the area I would have concerns re the following - Access to the quarry for both work carried out and public access afterward?
What inert material consists of?
What timeframe will work be carried out to the quarry?
Which part/s of the quarry will be effected by the proposed infill?
If you have any documentation/maps available I would appreciate viewing such plans.

Regards
Valerie Levis
10 Beaumont Cottages,
Ballintemple,
Cork

Fehily Timoney & Co

Department of Arts, Sport and Tourism
An Roinn Ealaíon, Spóirt agus Turasóireachta

Our Ref: T-21-11-3
Your Ref: Q/2006/011/09/JOS/JMC

28 July, 2006

Mr Jerome O'Sullivan
Fehily Timoney & Co
Core House
Pouladuff Road
Cork.

Dear Mr Jerome O'Sullivan

Re: Infilling of Beaumont Quarry with inert material

I refer to your letter of 27 July, 2006 regarding the above. This Department does not have a local office or local expertise sufficient to comment in any detail on the geological aspects of this proposal. However, the Department would warmly welcome the provision of a new public leisure facility which we understand from your letter to be the final objective in this matter.

Yours sincerely

Fionn Ó Grada

Fionn Ó Grada
Tourism Impact Assessment
Tel: (01) 6313872
E-mail:Fionnograda@dast.gov,.ie

Comhairle Cathrach Chorcaí Cork City Council

Fón/Tel: 021-4966222
Líonra/Web: www.corkcity.ie
R-Phost/E-mail: planning@corkcity.ie

Planning & Development Directorate
Navigation House,
Albert Quay,
Cork.

Ref

FEHILY TIMONEY & Co.
Received by
Date
Action
Distribution 15 AUG 2006
Job No: 508.
Correspondence No:
Comment: 12.

Mr Jerome O Sullivan
Fehily Timoney and Co
Core House
Pouladuff Rd
Cork

14th August 2006

Re: EIS and Waste Licence Application for the proposed infilling of Beaumont Quarry with inert material

Dear Mr O Sullivan,

I refer to your letter in relation to an EIS and Waste Licence application for the proposed infilling of Beaumont Quarry with inert material.

I have requested a copy of the plans for this proposal from our internal team and I will revert to you if I have any comments in relation to this proposal.

Yours faithfully,

Niamh Twomey
Heritage Officer

AN TAISCE – THE NATIONAL TRUST FOR IRELAND

Our Ref: **20060816-4-Beaumont Quarry**

Mr Jerome O'Sullivan
Fehily, Timoney and Company,
Core House,
Pouladuff Road,
Cork.

16 August 2006

RE: ***Proposed Infilling of Beaumont Quarry, Co Cork***

Dear Mr O'Sullivan

Thank you for your letter of 27 July 2006.

Information should be sought and provided on the Planning and Waste Management Act compliance record of all parties involved in this proposal.

Yours sincerely,

IAN LUMLEY,
Heritage Officer.

The Tailors' Hall Back Lane Dublin 8 Telephone 01 4541786 Fax 01 4533255 Website: www.antaisce.org
Company Registration No: 12469. Charity Reference No: CHY 4741

HEALTH AND SAFETY AUTHORITY

ACHIEVING A HEALTHY AND SAFE WORKING LIFE - TOGETHER

3rd Floor, 1A South Mall, Cork.
Telephone: 1890 289 389 Fax: 021 - 425 1217 Website: http://www.hsa.ie

Fehily Timoney & Company Ltd
Core House
Pouladuff Road
Co. Cork

06 Sep 2006 Ref. 69050/1

Re: Environmental Impact Statement and Waste Licence Application for the proposed infillinf of Beaumont Quarry with inert material & your letter of July 27th 2006.

Dear Sir/Madam,

With reference to the above correspondence the Authority wishes to advise that there are no Seveso Establishments within the vicinity of the proposed development.

Yours sincerely,

Angela Moriarty
Process Industries Unit

FEHILY TIMONEY & Co.
Received by SC
Date
Action Jessaye O'Sullivan
Distribution 07 SEP 2006
Job No:
Correspondence No: 33
Comment:

"Kakuri",
Hettyfield,
Douglas, Cork.

Tel: (021) 4291400
Fax: (021) 4294496

11/08/2006

Mr. Jerome O'Sullivan
Fehily Timoney & Company
Core House
Pouladuff Road
Cork

Dear Jerome,

Thank you for your letter of 27th July regarding the EIS and Waste Licence application for the proposed infilling of Beaumont Quarry with inert material.

I believe that a quarry which is rarely used by the public should become a safe and attractive public amenity area. The operation of filling the quarry with inert material must be closely monitored to ensure that the work does not in any way adversely affect the quality of life of local residents.

The public must be made fully aware of what constitutes "inert material" so that ceremony does not surface during the operation.

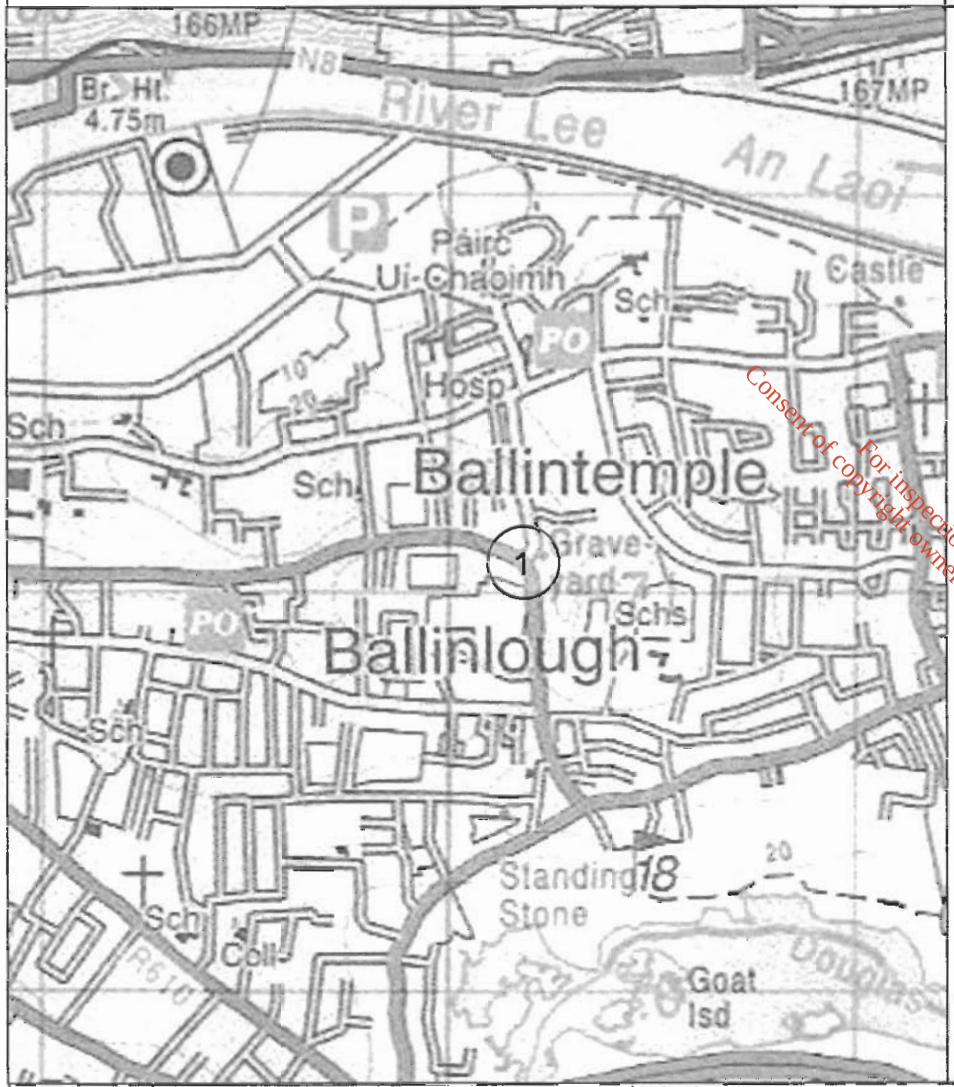
Yours sincerely,

Jim Corr (Councillor)

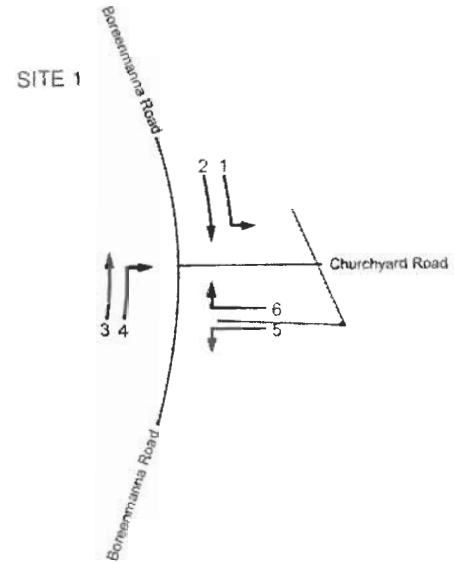
Appendix 2

Abacus Transportation Traffic Surveys

Site Location



Movement Numbers & Directions



Job number: ATH/06/239	Job date: 5th September 2006	Drawing No: ATH/06/239-1	abacus Transportation Surveys
Client: FTCO	Job day Tuesday	Author: BCK	

ABACUS TRANSPORTATION SURVEYS

BEAUMONT QUARRYTRAFFIC COUNT
MANUAL CLASSIFIED JUNCTION COUNT

SEPTEMBER 2006
ATH/06/239

SITE: 01

DATE: 5th September 2006

LOCATION: Boreenmanna Road/Churchyard Road

DAY: Tuesday

	MOVEMENT 1						MOVEMENT 2						MOVEMENT 3					
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	CAR	LGV	OGV1	OGV2	BUS	TOT	CAR	LGV	OGV1	OGV2	BUS	TOT
06:00	0	0	0	0	0	0	2	1	0	0	0	3	7	1	0	0	0	8
06:15	0	0	0	0	0	0	3	0	0	0	0	3	4	2	0	0	0	6
06:30	1	0	0	0	0	1	2	0	0	0	0	2	5	1	0	0	0	6
06:45	0	0	0	0	0	0	6	1	0	0	0	7	9	1	1	0	0	11
H/TOT	1	0	0	0	0	1	13	2	0	0	0	15	25	5	1	0	0	31
07:00	0	0	1	0	0	1	8	4	0	0	0	12	18	6	2	0	0	26
07:15	0	0	0	0	0	0	18	3	0	0	0	21	21	3	2	1	0	27
07:30	4	0	0	0	0	4	35	1	3	0	0	39	44	9	1	1	0	55
07:45	0	0	0	0	0	0	37	4	2	0	1	44	75	11	4	0	1	91
H/TOT	4	0	1	0	0	5	98	12	5	0	1	116	158	29	9	2	1	199
08:00	0	0	0	0	0	0	44	6	0	0	0	50	112	10	3	0	0	125
08:15	0	0	0	0	0	0	61	9	0	1	0	71	128	13	12	0	0	153
08:30	7	1	1	0	0	9	73	5	3	0	0	82	118	11	0	0	0	129
08:45	9	0	0	0	0	9	67	5	3	1	0	75	107	8	0	0	0	115
H/TOT	16	1	1	0	0	18	245	25	6	2	0	278	465	42	15	0	0	522
09:00	7	3	0	0	0	10	38	6	1	1	0	46	70	18	2	0	0	90
09:15	5	0	0	0	0	5	34	4	1	0	0	39	66	12	3	0	0	81
09:30	5	0	0	0	0	5	33	4	2	0	0	39	47	8	4	1	0	60
09:45	3	0	0	0	0	3	33	8	3	0	1	45	47	10	2	0	0	59
H/TOT	20	3	0	0	0	23	138	22	7	1	1	169	230	48	11	1	0	290
10:00	1	0	0	0	0	1	33	4	1	0	0	38	44	11	4	0	0	59
10:15	1	1	0	0	0	2	27	4	0	0	0	31	31	7	2	1	0	41
10:30	6	2	0	0	0	8	25	9	2	0	0	36	45	8	2	0	0	55
10:45	6	1	0	0	0	7	33	3	3	0	0	39	45	1	2	0	0	48
H/TOT	14	4	0	0	0	18	118	20	6	0	0	144	165	27	10	1	0	203
11:00	3	0	0	0	0	3	21	5	0	0	0	26	34	10	1	0	0	45
11:15	5	0	0	0	0	5	30	1	0	1	0	32	45	9	1	0	0	55
11:30	4	2	0	0	0	6	33	6	3	2	0	44	33	6	3	1	0	43
11:45	3	1	0	0	0	4	37	8	2	1	0	48	45	6	2	2	1	56
H/TOT	15	3	0	0	0	18	121	20	5	4	0	150	157	31	7	3	1	199
12:00	4	0	0	0	0	4	32	7	1	1	0	41	48	8	2	0	0	58
12:15	5	0	0	0	0	5	31	2	0	0	1	34	42	8	2	1	0	53
12:30	6	0	0	0	0	6	28	4	2	0	0	34	37	11	1	1	0	50
12:45	3	1	0	0	0	4	36	7	1	0	0	44	44	6	1	0	0	51
H/TOT	18	1	0	0	0	19	127	20	4	1	1	153	171	33	6	2	0	212

ABACUS TRANSPORTATION SURVEYS

BEAUMONT QUARRYTRAFFIC COUNT
MANUAL CLASSIFIED JUNCTION COUNT

SEPTEMBER 2006
ATH/06/239

SITE: 01

DATE: 5th September 2006

LOCATION: Boreenmanna Road/Churchyard Road

DAY: Tuesday

	MOVEMENT 1						MOVEMENT 2						MOVEMENT 3					
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	CAR	LGV	OGV1	OGV2	BUS	TOT	CAR	LGV	OGV1	OGV2	BUS	TOT
13:00	5	1	0	0	0	6	37	8	2	0	0	47	43	4	2	0	0	49
13:15	6	0	0	0	0	6	29	5	1	1	0	36	40	5	2	0	0	47
13:30	4	1	1	1	0	7	32	2	1	0	0	35	32	7	3	0	0	42
13:45	5	1	0	0	0	6	45	2	3	1	0	51	39	7	2	0	0	48
H/TOT	20	3	1	1	0	25	143	17	7	2	0	169	154	23	9	0	0	186
14:00	3	0	0	0	0	3	33	3	1	0	0	37	54	4	2	0	0	60
14:15	4	0	0	0	0	4	38	6	0	1	0	45	37	7	2	1	0	47
14:30	14	1	0	0	0	15	38	2	0	0	0	40	50	4	2	0	0	56
14:45	8	0	0	0	0	8	35	2	0	0	0	37	50	5	2	0	0	57
H/TOT	29	1	0	0	0	30	144	13	1	1	0	159	191	20	8	1	0	220
15:00	4	2	0	0	0	6	32	5	0	1	0	38	42	9	2	1	0	54
15:15	2	1	0	0	0	3	46	3	1	0	0	50	32	5	2	0	0	39
15:30	5	1	0	0	0	6	38	2	1	0	0	41	36	6	3	0	0	45
15:45	6	0	0	0	0	6	41	2	0	1	0	44	39	4	4	0	0	47
H/TOT	17	4	0	0	0	21	157	12	2	2	0	173	149	24	11	1	0	185
16:00	7	2	0	0	0	9	36	4	0	0	0	40	44	6	3	0	0	53
16:15	11	1	0	0	0	12	31	6	1	1	0	39	43	4	3	1	0	51
16:30	5	2	0	0	0	7	41	7	0	0	0	48	44	3	4	0	0	51
16:45	8	1	0	0	0	9	39	4	1	1	0	45	51	3	2	0	0	56
H/TOT	31	6	0	0	0	37	147	21	2	2	0	172	182	16	12	1	0	211
17:00	9	1	0	0	0	10	33	4	1	0	0	38	53	4	1	0	0	58
17:15	4	0	0	0	0	4	27	3	0	0	0	30	47	4	1	0	0	52
17:30	6	0	1	0	0	7	34	4	1	0	0	39	43	2	3	1	0	49
17:45	7	1	0	0	0	8	31	5	0	1	0	37	49	5	2	0	0	56
H/TOT	26	2	1	0	0	29	125	16	2	1	0	144	192	15	7	1	0	215
18:00	5	0	0	0	0	5	49	0	1	0	0	50	47	3	2	0	0	52
18:15	2	0	0	0	0	2	45	1	1	0	0	47	59	4	1	0	0	64
18:30	5	0	0	0	0	5	34	3	0	1	0	38	36	3	1	0	0	40
18:45	7	0	0	0	0	7	36	0	0	1	1	38	35	1	1	0	0	37
H/TOT	19	0	0	0	0	19	164	4	2	2	1	173	177	11	5	0	0	193
19:00	4	0	0	0	0	4	33	1	1	0	0	35	30	1	0	0	0	31
19:15	4	1	0	0	0	5	30	2	0	0	0	32	27	1	1	0	0	29
19:30	3	0	0	0	0	3	25	1	0	0	0	26	19	0	0	0	0	19
19:45	1	0	0	0	0	1	21	0	0	0	0	21	22	0	0	0	0	22
H/TOT	12	1	0	0	0	13	109	4	1	0	0	114	98	2	1	0	0	101
P/TOT	242	29	4	1	0	276	1849	208	50	18	4	2129	2514	326	112	13	2	2967

ABACUS TRANSPORTATION SURVEYS

BEAUMONT QUARRYTRAFFIC COUNT **SEPTEMBER 2006**
MANUAL CLASSIFIED JUNCTION COUNT **ATH/06/239**

SITE: 01 DATE: 5th September 2006

LOCATION: Boreenmanna Road/Churchyard Road DAY: Tuesday

	MOVEMENT 4						MOVEMENT 5						MOVEMENT 6					
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	CAR	LGV	OGV1	OGV2	BUS	TOT	CAR	LGV	OGV1	OGV2	BUS	TOT
06:00	2	0	0	0	0	2	1	0	0	0	0	1	0	0	0	0	0	0
06:15	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
06:30	4	1	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0	1
06:45	2	0	0	0	0	2	3	0	0	0	0	3	2	0	0	0	0	2
H/TOT	10	1	0	0	0	11	4	0	0	0	0	4	3	0	0	0	0	3
07:00	6	1	0	0	0	7	3	1	0	0	0	4	5	0	0	0	0	5
07:15	4	1	0	0	0	5	6	0	0	0	0	6	2	1	1	0	0	4
07:30	22	5	2	0	0	29	3	0	0	0	0	3	7	3	0	0	0	10
07:45	28	5	1	0	0	34	18	2	0	0	0	20	16	2	0	0	0	18
H/TOT	60	12	3	0	0	75	30	3	0	0	0	33	30	6	1	0	0	37
08:00	33	6	1	1	0	41	22	5	0	0	0	27	18	1	0	0	0	19
08:15	41	7	1	0	0	49	32	11	1	0	0	44	10	1	0	0	0	11
08:30	45	4	2	0	0	51	51	5	0	0	0	56	24	0	0	0	0	24
08:45	72	9	2	0	0	83	26	4	1	0	0	31	24	2	0	0	0	26
H/TOT	191	26	6	1	0	224	131	25	2	0	0	158	76	4	0	0	0	80
09:00	41	6	2	0	0	49	25	6	0	0	0	31	10	1	1	0	0	12
09:15	37	2	2	0	0	41	18	3	0	0	0	21	3	1	2	0	0	6
09:30	26	4	2	0	0	32	26	4	2	0	0	32	13	1	1	0	0	15
09:45	18	7	0	0	0	25	17	4	0	0	0	21	8	1	0	0	0	9
H/TOT	122	19	6	0	0	147	86	17	2	0	0	105	34	4	4	0	0	42
10:00	19	10	3	0	0	32	21	4	0	0	0	25	8	0	0	0	0	8
10:15	17	2	2	0	0	21	25	5	0	0	0	30	7	0	0	0	0	7
10:30	17	7	1	0	0	25	26	4	2	0	0	32	5	1	0	0	0	6
10:45	23	3	2	0	0	28	31	6	0	0	0	37	6	5	0	0	0	11
H/TOT	76	22	8	0	0	106	103	19	2	0	0	124	26	6	0	0	0	32
11:00	22	5	0	0	0	27	18	2	0	0	0	20	7	1	1	0	0	9
11:15	22	6	0	0	0	28	11	6	0	0	0	17	5	0	0	0	0	5
11:30	20	1	0	0	0	21	19	8	2	0	0	29	3	2	1	0	0	6
11:45	28	3	2	0	0	33	19	5	2	0	0	26	11	2	0	0	0	13
H/TOT	92	15	2	0	0	109	67	21	4	0	0	92	26	5	2	0	0	33
12:00	24	4	2	0	0	30	21	5	1	0	0	27	7	0	1	0	0	8
12:15	23	2	1	0	0	26	28	5	0	0	0	33	6	1	0	0	0	7
12:30	18	4	1	0	0	23	29	4	1	0	0	34	7	3	0	0	0	10
12:45	21	2	2	0	0	25	40	4	0	0	0	44	7	4	0	0	0	11
H/TOT	86	12	6	0	0	104	118	18	2	0	0	138	27	8	1	0	0	36

ABACUS TRANSPORTATION SURVEYS

BEAUMONT QUARRYTRAFFIC COUNT
MANUAL CLASSIFIED JUNCTION COUNT

SEPTEMBER 2006
ATH/06/239

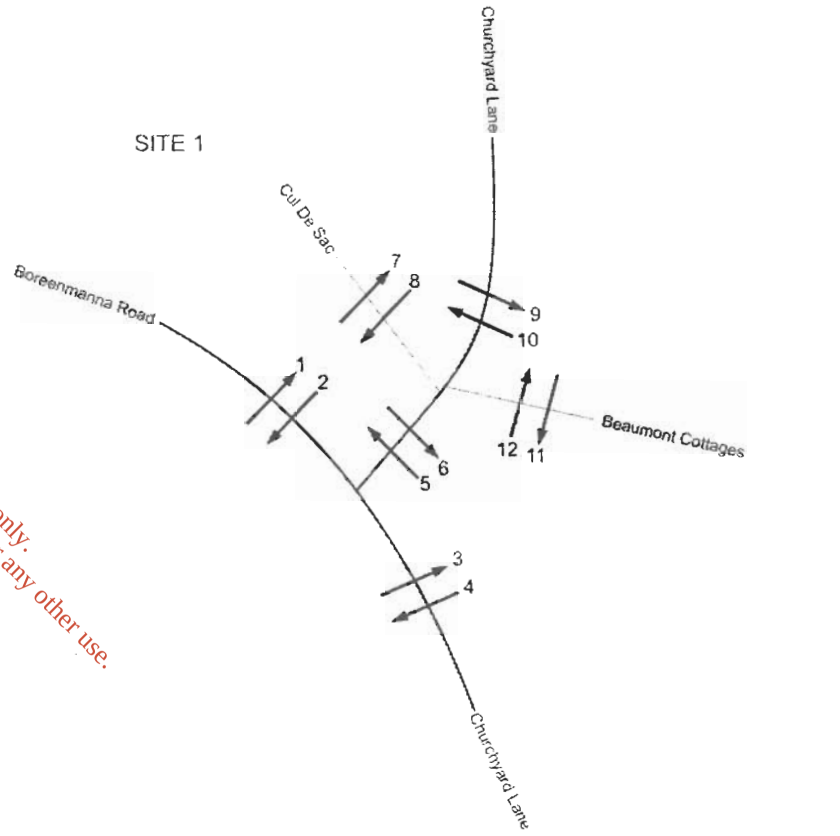
SITE: 01 **DATE:** 5th September 2006

LOCATION: Boreenmanna Road/Churchyard Road **DAY:** Tuesday

	MOVEMENT 4						MOVEMENT 5						MOVEMENT 6					
TIME	CAR	LGV	OGV1	OGV2	BUS	TOT	CAR	LGV	OGV1	OGV2	BUS	TOT	CAR	LGV	OGV1	OGV2	BUS	TOT
13:00	26	4	0	0	0	30	41	2	1	0	0	44	10	3	0	0	0	13
13:15	29	3	1	0	0	33	28	9	0	0	0	37	7	0	0	0	0	7
13:30	34	6	1	0	0	41	24	3	1	0	0	28	8	1	1	0	0	10
13:45	45	6	1	0	0	52	21	6	1	0	1	29	12	1	0	0	0	13
H/TOT	134	19	3	0	0	156	114	20	3	0	1	138	37	5	1	0	0	43
14:00	35	5	2	0	0	42	32	4	0	0	0	36	9	1	1	0	0	11
14:15	31	2	2	0	0	35	40	5	1	0	0	46	11	2	0	0	0	13
14:30	38	3	1	0	0	42	18	6	0	0	0	24	9	0	0	0	0	9
14:45	29	4	1	0	0	34	16	4	1	0	0	21	14	2	1	0	0	17
H/TOT	133	14	6	0	0	153	106	19	2	0	0	127	43	5	2	0	0	50
15:00	22	4	1	0	0	27	31	5	2	0	0	38	10	0	0	0	0	10
15:15	27	6	3	0	1	37	19	3	0	0	0	22	9	2	0	0	0	11
15:30	24	3	2	0	0	29	18	7	1	0	0	26	12	3	0	0	0	15
15:45	28	3	1	0	0	32	24	2	0	0	0	26	3	4	0	0	0	7
H/TOT	101	16	7	0	1	125	92	17	3	0	0	112	34	9	0	0	0	43
16:00	26	4	2	0	0	32	18	3	0	0	0	21	8	1	0	0	0	9
16:15	24	2	1	0	0	27	24	3	3	0	0	30	4	3	0	0	0	7
16:30	27	3	1	0	0	31	27	4	2	0	0	33	3	2	0	0	0	5
16:45	31	5	3	0	0	39	31	4	0	0	0	35	5	0	1	0	0	6
H/TOT	108	14	7	0	0	129	100	14	5	0	0	119	20	6	1	0	0	27
17:00	24	4	2	0	0	30	32	4	0	0	0	36	5	1	0	0	0	6
17:15	25	4	1	0	0	30	33	6	0	0	0	39	3	1	0	0	0	4
17:30	26	3	1	0	0	30	41	2	1	0	0	44	15	4	0	0	0	19
17:45	23	2	1	0	0	26	33	7	0	0	0	40	5	0	0	0	0	5
H/TOT	98	13	5	0	0	116	139	19	1	0	0	159	28	6	0	0	0	34
18:00	34	2	0	0	0	36	29	4	1	0	0	34	4	1	0	0	0	5
18:15	40	2	1	0	0	43	22	4	0	0	0	26	7	0	0	0	0	7
18:30	29	5	1	0	0	35	23	1	0	0	0	24	8	1	0	0	0	9
18:45	27	2	0	0	0	29	24	3	0	0	0	27	6	0	0	0	0	6
H/TOT	130	11	2	0	0	143	98	12	1	0	0	111	25	2	0	0	0	27
19:00	24	1	0	0	0	25	20	2	0	0	0	22	4	0	0	0	0	4
19:15	26	1	1	0	0	28	17	1	1	0	0	19	5	1	0	0	0	6
19:30	21	0	1	0	0	22	14	1	0	0	0	15	4	0	0	0	0	4
19:45	20	2	0	0	0	22	15	0	0	0	0	15	2	0	0	0	0	2
H/TOT	91	4	2	0	0	97	66	4	1	0	0	71	15	1	0	0	0	16
P/TOT	1432	198	63	1	1	1695	1254	208	28	0	1	1491	424	67	12	0	0	503

Site Location

Pedestrian Movement Numbers & Directions



Job number: ATH/06/292	Job date: 5th September 2006	Drawing No: ATH/06/292-1	abacus Transportation Surveys
Client: FTCO	Job day: Tuesday	Author: BCK	

ABACUS TRANSPORTATION SURVEYS

BEAUMONT QUARRY TRAFFIC COUNT
MANUAL PEDESTRIAN COUNT

SEPTEMBER 2006
ATH/06/292

SITE: 01

DATE: 5th September 2006

LOCATION: Boreenmanna Road/Churchyard Road/Cul de Sac/Beaumont Cottages

DAY: Tuesday

	MVT 1			MVT 2			MVT 3			MVT 4			MVT 5			MVT 6		
TIME	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT
07:00	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15	1	0	1	0	0	0	0	0	0	0	2	2	0	0	0	1	0	1
07:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1
H/TOT	3	0	3	1	0	1	0	0	0	0	2	2	0	0	0	2	0	2
08:00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
08:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30	0	0	0	0	0	0	2	0	2	1	0	1	1	0	1	0	0	0
08:45	0	0	0	3	0	3	2	0	2	0	0	0	0	0	0	0	0	0
H/TOT	0	0	0	4	0	4	4	0	4	1	0	1	1	0	1	0	0	0
09:00	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
09:15	1	0	1	0	0	0	2	0	2	1	0	1	0	0	0	0	0	0
09:30	1	0	1	0	0	0	3	0	3	2	0	2	2	0	2	0	0	0
09:45	0	0	0	2	0	2	0	0	0	2	0	2	0	0	0	0	0	0
H/TOT	2	0	2	2	0	2	6	0	6	5	0	5	2	0	2	0	0	0
10:00	2	0	2	4	0	4	1	0	1	0	0	0	0	0	0	1	0	1
10:15	0	0	0	0	0	0	2	0	2	0	0	0	1	0	1	0	0	0
10:30	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1
10:45	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0
H/TOT	3	0	3	4	0	4	7	0	7	0	0	0	1	0	1	2	0	2
11:00	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
11:15	0	0	0	1	0	1	1	0	1	1	0	1	0	0	0	1	0	1
11:30	0	0	0	2	0	2	1	0	1	1	0	1	1	0	1	0	0	0
11:45	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1
H/TOT	1	0	1	4	0	4	2	0	2	3	0	3	1	0	1	2	0	2
12:00	1	0	1	0	0	0	2	1	3	1	0	1	1	1	2	0	0	0
12:15	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
12:30	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	1	0	1
12:45	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1
H/TOT	1	0	1	1	0	1	2	1	3	4	0	4	1	1	2	2	0	2

ABACUS TRANSPORTATION SURVEYS

BEAUMONT QUARRY TRAFFIC COUNT
MANUAL PEDESTRIAN COUNT

SEPTEMBER 2006
ATH/06/292

SITE: 01

DATE: 5th September 2006

LOCATION: Boreenmanna Road/Churchyard Road/Cul de Sac/Beaumont Cottages

DAY: Tuesday

	MVT 1			MVT 2			MVT 3			MVT 4			MVT 5			MVT 6		
TIME	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT
13:00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
13:15	0	0	0	2	0	2	0	0	0	2	0	2	0	0	0	2	0	2
13:30	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
13:45	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0
H/TOT	0	0	0	3	0	3	1	0	1	4	0	4	0	0	0	2	0	2
14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
14:45	2	0	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
H/TOT	2	0	2	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0
15:00	1	1	2	1	0	1	1	2	3	0	0	0	0	0	0	0	0	0
15:15	0	0	0	1	0	1	1	0	1	0	0	0	1	0	1	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	2	1	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	3	2	5	3	0	3	2	2	4	0	0	0	1	0	1	0	0	0
16:00	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
16:15	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0
16:30	0	0	0	2	0	2	1	0	1	1	0	1	0	0	0	2	0	2
16:45	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0
H/TOT	0	0	0	3	0	3	2	0	2	3	0	3	1	0	1	2	0	2
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0
17:30	2	0	2	3	0	3	1	0	1	1	0	1	0	0	0	0	0	0
17:45	1	0	1	3	0	3	0	0	0	2	0	2	0	0	0	1	0	1
H/TOT	3	0	3	7	0	7	1	0	1	4	0	4	0	0	0	1	0	1
18:00	0	0	0	1	0	1	0	0	0	2	0	2	0	0	0	1	0	1
18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:30	0	0	0	1	0	1	0	0	0	1	0	1	1	0	1	0	0	0
18:45	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
H/TOT	1	0	1	2	0	2	0	0	0	3	0	3	1	0	1	2	0	2
P/TOT	19	2	21	34	0	34	29	3	32	27	2	29	9	1	10	15	0	15

ABACUS TRANSPORTATION SURVEYS

BEAUMONT QUARRY TRAFFIC COUNT
MANUAL PEDESTRIAN COUNT

SEPTEMBER 2006
ATH/06/292

SITE: 01

DATE: 5th September 2006

LOCATION: Boreenmanna Road/Churchyard Road/Cul de Sac/Beaumont Cottages

DAY: Tuesday

	MVT 7			MVT 8			MVT 9			MVT 10			MVT 11			MVT 12		
TIME	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT
07:00	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	1	0	1
07:15	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	1	0	1
07:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	2	0	2
H/TOT	0	0	0	1	0	1	0	0	0	1	0	1	6	0	6	4	0	4
08:00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0	2
08:15	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1
08:30	0	0	0	0	0	0	0	0	0	0	0	0	3	5	8	2	0	2
08:45	0	0	0	3	0	3	0	0	0	0	0	0	3	1	4	3	0	3
H/TOT	0	0	0	4	0	4	0	0	0	1	0	1	6	6	12	8	0	8
09:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
09:15	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	3	0	3
09:30	1	0	1	0	0	0	0	0	0	0	0	0	2	0	2	1	0	1
09:45	0	0	0	2	0	2	0	0	0	0	0	0	2	6	8	0	0	0
H/TOT	2	0	2	2	0	2	0	0	0	0	0	0	5	6	11	7	0	7
10:00	1	0	1	4	0	4	0	0	0	0	0	0	0	0	0	3	0	3
10:15	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	2	0	2
10:30	1	0	1	3	0	3	0	0	0	0	0	0	1	0	1	1	0	1
10:45	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
H/TOT	4	0	4	8	0	8	0	0	0	0	0	0	1	0	1	9	0	9
11:00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
11:15	0	0	0	2	0	2	0	0	0	1	0	1	0	0	0	1	0	1
11:30	0	0	0	2	0	2	0	0	0	0	0	0	3	0	3	3	0	3
11:45	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0
H/TOT	0	0	0	6	0	6	0	0	0	1	0	1	4	0	4	4	0	4
12:00	2	1	3	0	0	0	0	0	0	0	0	0	1	0	1	3	1	4
12:15	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
12:30	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
12:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	3	1	4	2	0	2	0	0	0	0	0	0	2	0	2	3	1	4

ABACUS TRANSPORTATION SURVEYS

BEAUMONT QUARRY TRAFFIC COUNT **SEPTEMBER 2006**
MANUAL PEDESTRIAN COUNT **ATH/06/292**

SITE: 01 DATE: 5th September 2006

LOCATION: Boreenmanna Road/Churchyard Road/Cul de Sac/Beaumont Cottages DAY: Tuesday

	MVT 7			MVT 8			MVT 9			MVT 10			MVT 11			MVT 12		
TIME	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT	ADULT	CHILD	TOT
13:00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
13:15	0	0	0	3	0	3	0	0	0	0	0	0	4	1	5	0	0	0
13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
13:45	1	0	1	0	0	0	0	0	0	0	0	0	3	2	5	1	1	2
H/TOT	1	0	1	4	0	4	0	0	0	0	0	0	7	3	10	2	1	3
14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	2	0	2
14:45	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3
H/TOT	2	0	2	0	0	0	0	0	0	1	0	1	0	0	0	3	2	5
15:00	1	1	2	1	0	1	0	0	0	0	0	0	0	0	0	1	2	3
15:15	0	0	0	2	0	2	0	0	0	0	0	0	1	0	1	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	2	1	3	1	0	1	0	0	0	0	0	0	1	0	1	1	0	1
H/TOT	3	2	5	4	0	4	0	0	0	0	0	0	2	0	2	2	2	4
16:00	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	1	0	1
16:15	0	0	0	0	0	0	1	0	1	0	0	0	2	0	2	2	0	2
16:30	0	0	0	3	0	3	0	0	0	0	0	0	1	0	1	0	0	0
16:45	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0	2
H/TOT	0	0	0	4	0	4	1	0	1	0	0	0	5	0	5	5	0	5
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
17:15	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0
17:30	2	0	2	3	0	3	0	0	0	0	0	0	3	0	3	1	0	1
17:45	0	0	0	2	0	2	0	0	0	0	0	0	3	0	3	0	0	0
H/TOT	2	0	2	6	0	6	0	0	0	0	0	0	7	0	7	2	0	2
18:00	2	0	2	0	0	0	0	0	0	0	0	0	2	0	2	1	0	1
18:15	4	0	4	1	0	1	0	0	0	0	0	0	1	0	1	2	0	2
18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
18:45	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H/TOT	8	1	9	1	0	1	0	0	0	0	0	0	3	0	3	5	0	5
P/TOT	25	4	29	42	0	42	1	0	1	4	0	4	48	15	63	54	6	60

Appendix 3

Air Quality Monitoring Data

2006-011-09

southern scientific services ltd.

OUR REF: RP 2006, FEHILY TIMONEY & CO. 17

ANALYSIS REPORT

CUSTOMER:	**FEHILY TIMONEY & COMPANY**	**SAMPLE TYPE:**	**FILTER**
ADDRESS:	Core House Pouladuff Road, Cork	**DATE SAMPLED:**	-
		DATE RECEIVED:	17 August 2006
REPORT TO:	**JEROME O' SULLIVAN**	**DATE ANALYSED:**	17-21 August 2006
ORDER NO:	-	**DATE REPORTED:**	21 August 2006
SAMPLING PT:	**2006-011-09**	**WORK NO.:**	**15599 C**

TABLE OF RESULTS

LAB REF	YOUR REF:	PM_{10}, µg/m³
C06-Aug 283	ST1	**19.4**
C06-Aug 284	ST 2	**9.7**

Jennifer Keane
Chemistry Laboratory

- **The results relate only to the items tested.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**

FEHILY TIMONEY & Co.
Received by ST.
Date
Action Jerome O'S
Distribution 29 AUG 2006
Job No:
Correspondence No: 9
Comment:

dunrine | killarney | county kerry | ireland | telephone +353 (0)64 33922 | fax +353 (0)64 39022
web site www.southernscientificireland.com | e-mail info@southernscientificireland.com

registered in ireland no 323196 | vat reg no IE 6343196 M

2006-011-09

southern scientific services ltd.

OUR REF: RP 2006 FEHILY TIMONEY & CO. 16 **PAGE 1/1**

ANALYSIS REPORT

CUSTOMER:	**FEHILY TIMONEY & COMPANY**	**SAMPLE TYPE:**	**DUST**
ADDRESS:	Core House Pouladuff Road, Cork	**DATE SAMPLED:**	11 July – 09 August 2006
		DATE RECEIVED:	11 August 2006
REPORT TO:	**JEROME O' SULLIVAN**	**DATE ANALYSED:**	16 – 17 August 2006
ORDER NO:	-	**DATE REPORTED:**	18 August 2006
SAMPLING PT:	**BEAU-WLR** **2006-011-09**	**WORK NO.:**	**15578 C**

TABLE OF RESULTS

LAB REF:	YOUR REF:	TOTAL DUST mg/m²/Day	ORGANIC DUST mg/m²/Day	INORGANIC DUST mg/m²/Day
C06-Aug 237	ST 1	414	169	245
C06-Aug 238	ST 2	85	51	34
C06-Aug 239	ST 3	279	129	150

Jennifer Keane
Chemistry Laboratory

- **The results relate only to the items tested.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**

FEHILY TIMONEY & Co.
Received by
Date
Action
Distribution 29 AUG 2006
Job No:
Correspondence No: 6
Comment:

dunrine || killarney || county kerry | ireland | telephone +353 (0)64 33922 | fax +353 (0)64 39022
web site www.southernscientificireland.com | e-mail info@southernscientificireland.com

registered in ireland no 323196 | vat reg no IE 6343196 M

Appendix 4

Site Investigation Data & Groundwater Quality Monitoring Data

99-099-11

Strata Record

Depth	Description
GL	
	HARD CORE FILL.
0.10	
	DARK BROWN STIFF CLAY.
0.70	
	GREY HARD LIMESTONE.
5	
	Borehole Complete / Incomplete 30'

Drill Penetration, Testing and Sampling

Depth From	Depth To	OH / Core	Core Length	Core Recovery	Flush Return	Casing Depth	Water Level
GL	To 30.00	OH			100%	1.50	DRY

Groundwater Records

	WATER ENCOUNTERED 1	2	3
Depth Struck			
Casing Depth			
Inflow			
Depth 5 mins			
Depth 10 mins			
Depth 15 mins			
Depth 20 mins			
Cut off at			

WATER LEVELS	Depth	Casing	Time
Morning			
Evening	DRY	1.50	
Other	DRY		
Other			

FLUSH	Flush Type	From	To
	AIR	GL	30.00
	Loss of Flush		

FIELD RECORDS

O/H and Coring Number	Type	Metres Today	Metre Total
GL to 30	OH	30	30

Depth at end of Shift Type	Bore Hole	Casing
S	1	1.50
P		
H		

Backfill:

Remarks:- Visitors, Instructions, Weather, etc.

Crew E. DAVIES S. DAVIES E. BRODY

Drillers Signature E D

Client Signature

SITE BEAUMONT QUARRY.

JOB No.

RIG TYPE KNEIBEL 77

DAY THURSDAY

DATE 3.2.2000

Move From:-

BH No. 1

BRIODY DAVIES SITE INVESTIGATION LTD. Nº 0167

Daily Drilling Record

Strata Record

Depth	Description
30.00	GREY HARD LIMESTONE.
	Borehole Complete / Incomplete 50m

Drill Penetration, Testing and Sampling

Depth From	To	OH / Core	Core Length	Core Recovery	Flush Return	Casing Depth	Water Level
30	50.00	OH			100%	150	DRY

0-45 CONCRETE WITH FLUSH COVER.

SPOIL BACKFILL.

30.00 BENTONITE SEAL.

42.50 GRAVEL FILTER 50 TO 42.50

SLOTTED PIPE FROM 49.50 TO 43.50.

50m

Groundwater Records

WATER ENCOUNTERED	1	2	3
Depth Struck			
Casing Depth	50.00		
Inflow	SLOW		
Depth 5 mins			
Depth 10 mins			
Depth 15 mins			
Depth 20 mins	49.00	1.30pm	
Cut off at			

WATER LEVELS	Depth	Casing	Time
Morning	DRY	150	8AM
Evening	47.41	NIL	5PM
Other			
Other			

FLUSH	Flush Type	From	To
	AIR	30.00	50
Loss of Flush			

FIELD RECORDS

O/H and Coring				Depth at end of Shift		
Number	Type	Metres Today	Metre Total	Type	Bore Hole	Casing
30 TO 50	OH	20	20	S	1	150
				P		
				H		

Backfill: STANDPIPE.

Remarks:- Visitors, Instructions, Weather, etc.

INSTRUCTIONS TO DRILL TO 50m FOR WATER STRIKE.

Crew E DAVIES S DAVIES E BRIODY

Drillers Signature

Client Signature

SITE BEAUMOUNT QUARRY

JOB No.

RIG TYPE KNEBEL T7

DAY FRIDAY

DATE 4.2.2000

Move From:-

BH No. 1

BRIODY DAVIES SITE INVESTIGATION LTD. Nº 0168

Daily Drilling Record

Strata Record

Depth	Description
GL	
	HARD CORE FILL.
0.15	
	DARK BROWN STIFF CLAY.
1.65	
	BLACK SANDY GRAVELLY FILL.
5.80	
	GREY VERY WEATHERED CLAYEY LIMESTONE.
8.15	
	GREY HARD LIMESTONE.
9.40	
	BROWN STIFF CLAY.
10.40	
	GREY LIMESTONE VERY CLAYEY
	Borehole Complete / Incomplete 31

Drill Penetration, Testing and Sampling

Depth From	Depth To	OH / Core	Core Length	Core Recovery	Flush Return	Casing Depth	Water Level
GL	31.00	OH			100%	6.00	DRY

GL
CONCRETE FLUSH.
0.50 STEEL COVER.
BACKFILL SPOIL.
21.50
BENTONITE SEAL.
23.50
GRAVEL FILTER FROM 31 TO 23.50.
50 SLOTTED PIPE FROM 30.50 TO 24.50

Groundwater Records

WATER ENCOUNTERED	1	2	3
Depth Struck	28.00		
Casing Depth	6.10		
Inflow	SLOW		
Depth 5 mins			
Depth 10 mins			
Depth 15 mins			
Depth 20 mins	26.38		
Cut off at			

WATER LEVELS	Depth	Casing	Time
Morning			
Evening	25.50	STAND PIPE	7PM
Other			
Other			

FLUSH	Flush Type	From	To
	AIR	GL	31.00
	Loss of Flush		

FIELD RECORDS

O/H and Coring	Number	Type	Metres Today	Metre Total
	GL to 31	OH	31	31

Depth at end of Shift	Type	Bore Hole	Casing
	S	2.0	6.10
	P		
	H		

Backfill: STAND PIPE.

Remarks:- Visitors, Instructions, Weather, etc.

Crew E DAVIES E BRIODY S DAVIES

Drillers Signature E D W

Client Signature

SITE BEAUMOUNT QUARRY

JOB No.

RIG TYPE KNEBEL 77

DAY FRIDAY

DATE 4.2.2000

Move From:- 1

BH No. 2

BRIODY DAVIES SITE INVESTIGATION LTD. Nº 0169

Daily Drilling Record

Strata Record

Depth	Description
GL	DARK BROWN TOPSOIL. FILL.
085	BROWN STONEY SANDY CLAY FILL.
140	GREY LIMESTONE/ BOULDER CLAY FILL.
755	GREY HARD LIMESTONE SOME THIN CLAYEY LAYERS.
2600	BROWN SOFT CLAY.
2689	GREY HARD LIMESTONE.

Borehole Complete / Incomplete — 28m

Drill Penetration, Testing and Sampling

Depth From	Depth To	OH / Core	Core Length	Core Recovery	Flush Return	Casing Depth	Water Level
GL	28.00	OH.			100%	610	DRY

GL FLUSH COVER IN CONCRETE. 050

BACKFILL SPOIL.

190 BENTONITE SEAL.

2170.

2200 50mm SLOTTED PIPE. FROM 28 TO 2200.

GRAVEL FILTER FROM 28 TO 2170.

28m. C DAVIES

Groundwater Records

WATER ENCOUNTERED	1	2	3
Depth Struck	26.00.		
Casing Depth	610.		
Inflow	SLOW.		
Depth 5 mins			
Depth 10 mins			
Depth 15 mins			
Depth 20 mins			
Cut off at			

WATER LEVELS	Depth	Casing	Time
Morning	2150	610	
Evening			
Other			
Other			

FLUSH	Flush Type	From	To
	AIR	GL	2800
	Loss of Flush		

FIELD RECORDS

O/H and Coring				Depth at end of Shift		
Number	Type	Metres Today	Metre Total	Type	Bore Hole	Casing
GL-28	OH	28	28	S	3	610
				P		
				H		

Backfill: STAND PIPE.

Remarks:- Visitors, Instructions, Weather, etc.

Crew E BRIODY. S DAVIES.

Drillers Signature

Client Signature

SITE BEAUMOUNT QUARRY.

JOB No.

RIG TYPE KNEBEL 77.

DAY SATURDAY.

DATE 5.2.00.

Move From:- 2.

BH No. 3.

BRIODY DAVIES SITE INVESTIGATION LTD. № 0170

Daily Drilling Record

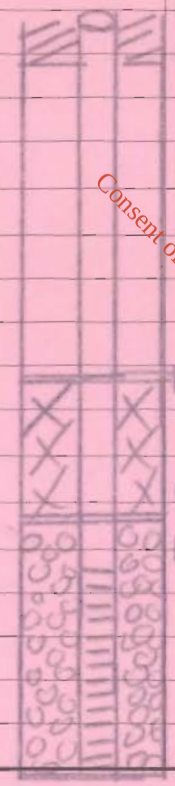
Strata Record

Depth	Description
GL	
	BROWN SANDY TOPSOIL.
015	
	DARK VERY SANDY STONEY CLAY.
135	
	CLAYEY WEATHERED BROKEN LOOSE LIME/ STONE.
325	
	VERY HARD GREY LIMESTONE.
935	
	VERY CLAYEY LIMESTONE.
985	
	GREY HARD LIMESTONE.
1600	CLAYEY LIMESTONE WATER.
1710	HARD GREY LIMESTONE.

Borehole Complete / Incomplete 183 METRES

Drill Penetration, Testing and Sampling

Depth From	Depth To	OH / Core	Core Length	Core Recovery	Flush Return	Casing Depth	Water Level
GL	1800	OH			100%	3.10	DRY



GL
0.50 CONCRETE WITH FLUSH COVER.
BACKFILL SPOIL.
10.50 BENTONITE SEAL.
11.50
12.00 SLOTTED PIPE 18-12M
GRAVEL FILTER FROM 18 TO 11.50.
16M

Groundwater Records

WATER ENCOUNTERED	1	2	3
Depth Struck	16.00		
Casing Depth	3.10		
Inflow	SLOW		
Depth 5 mins			
Depth 10 mins			
Depth 15 mins			
Depth 20 mins			
Cut off at			

WATER LEVELS	Depth	Casing	Time
Morning			
Evening			
Other			
Other			

FLUSH	Flush Type	From	To
	AIR	GL	1800
	Loss of Flush		

FIELD RECORDS

O/H and Coring				Depth at end of Shift		
Number	Type	Metres Today	Metre Total	Type	Bore Hole	Casing
GL-18	OH	18	18	S P H	4	310

Backfill: STAND PIPE.

Remarks:- Visitors, Instructions, Weather, etc.

INSTALLATION COMPLETE ON MONDAY 7.2.00

Crew C. DAVIES. BRIODY. S. DAVIES

Drillers Signature

Client Signature

SITE BEAUMONT QUARRY.

JOB No.

RIG TYPE KNEBEL T7

DAY SATURDAY

DATE 5.2.00

Move From:- 3.

BH No. 4

BRIODY DAVIES SITE INVESTIGATION LTD. Nº 0171

Daily Drilling Record

A DEPTH TO BEDROCK SURVEY AT BEAUMONT QUARRY, BALLINTEMPLE, CORK

GA00/2
March 2000

Survey carried out on behalf of

FEHILY TIMONEY & COMPANY
CORE HOUSE
POULADUFF ROAD
CORK

BY

GeoArc ltd.

Office 5, Unit 35, Kilkerrin Park, Liosban Estate, Tuam Road, Galway, Ireland.
Tel: +353-91-770327, 087-2668002, Fax: +353-91-771279
e-mail: geoarc@gofree.indigo.ie

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

The following report details the results of a geophysical survey which was carried out at Beaumont quarry, Ballintemple, Cork from the 22nd to the 24th of February 2000. This limestone quarry has been inactive for a number of years but was used as a source of dimension stone in the past. Much of the quarry floor has been back-filled in the intervening period, with material comprising a mixture of soil, rubble and stone. The survey was commissioned by Fehily Timoney & Co in an attempt to determine the depth to bedrock/quarry floor over the site.

It was proposed to carry out a resistivity survey utilising the Vertical Electrical Sounding (VES) technique which provides information on the variation of resistivity with depth beneath a fixed point. It was also proposed to conduct a limited VLF survey to assess the broad lateral resistivity variations over the site.

1.1 LOCATION AND DESCRIPTION OF THE SURVEY AREA

Beaumont quarry is located south of Ballintemple to the southeast of Cork city. The quarry site is located to the east of the road from Ballinlough to Ballintemple immediately to the south of a graveyard and a housing estate. Figures 1 and 3 show the general and detailed location of the quarry site respectively.

A site visit was not undertaken previous to survey commencement and the client stated that the ground surface was overgrown but suitable for the deployment of a ground-contacting geophysical technique which required access for a distance of between 32m and 64m for each individual reading. However, on arrival at the site it was observed that all of the southern limb of the quarry was completely overgrown with mature bushes and briars and the remaining area was overgrown to a lesser extent. After a detailed walk-over of the site it was concluded that only a small north-south linear area along the extreme south-east wall of the quarry could be surveyed.

Discussions were held with Malcolm Dowling of Fehily Timoney & Co. and it was arranged to deploy a JCB operator to clear access lines where the vegetation comprised only briars.

It was initially proposed to conduct the VES survey over a regularly spaced grid with stations located at 50m intervals. This survey specification was altered in view of the inaccessibility of much of the site and in an attempt to locate individual soundings along lines of relatively flat topography. A total of 32 VES were completed over three parts of the site and the location of these may be seen in Figure 3. The VLF survey was not carried out due to the irregularity of the survey grid which would cause gridding problems when attempting to contour the data. Additional soundings were conducted instead of the VLF survey.

1.2 GEOLOGY OF THE SURVEY AREA

Beaumont quarry is situated on the northern edge of a relatively narrow east-west band of Carboniferous Limestone (Figure 2). Old Red Sandstone outcrops to the north and south of the Carboniferous Limestone. The bedrock forms part of the Little Island

Formation and is composed mainly of mudbank limestones with massive crinoidal wackestones appearing towards the top of the formation (Geology of South Cork, Ordnance Survey of Ireland, 1994)

2.0 METHODOLOGY

A regular geophysical survey grid could not be established due to the conditions on site as described above. Therefore, a series of north-south lines were established where access was possible and these lines were measured relative to eachother and to the quarry edge. Figure 3 shows the location of these lines and the respective VES locations.

2.1 THE RESISTIVITY METHOD

Resistivity surveying relies on the principle that most of the rock forming minerals are poor conductors of electric current. Ground currents are mainly conducted by ions present in water contained in pores or fissures within rocks. Consequently clays, unconsolidated sands and loose gravel will be more conductive (less resistive) than compact bedrock due to the increased volume of water present in the former materials.

The methodology involved in resistivity surveying requires injecting a current into the ground by means of two current electrodes (steel rods) and measuring the potential difference (voltage) induced by this current with a second pair of electrodes (potential electrodes). The value obtained gives an indication of how well electrical currents are conducted within the sub-surface. In practice the resistance is measured rather than the conductivity. Additional information on the technique may be found in Appendix A.

2.1.1 Vertical Electrical Sounding

Vertical electrical sounding (VES) or 'electrical drilling' is a type of resistivity survey which measures the variation of resistivity with depth using a co-linear electrode array where the spacing between the electrodes is systematically increased about a fixed point. As the array length is increased the electric current penetrates to greater depths and the resistivities of increasingly deeper materials contribute to the values measured at the surface. The measured resistivities can then be correlated with known resistivities of common rocks and materials. Thus, on interpretation of a line of soundings, a geo-electric section of the sub-surface may be compiled with estimated depth to bedrock and differentiation between the various sub-surface resistivity layers. Ideally borehole data should be available to allow for the correlation of different resistivity layers with actual geological layers and thus lead to the compilation of a geologic section. Additional information on the VES technique and diagrams of the same may be found in Appendix A.

The equipment used for the VES survey was the SAS300 Terrameter (Resistivity Meter) and the BGS256 Offset Wenner Sounding system consisting of two multicored cables. The Offset Wenner technique (Barker, 1981) is a variation of the classic Wenner technique but it allows for the control of lateral variation of the electric properties in the two half spreads in which it is possible to subdivide any quadripole linear array.

The maximum extension of the cables is 256m i.e. 128m either side of the sounding location, but as the technique assumes a flat horizontally stratified earth the maximum extension is only suitable on ground with minimum topographical variation.

Topography greatly influences electrical surveys as current flow lines tend to follow the ground surface. In surveys with varying topography equipotential surfaces are distorted and spurious readings may result. The soundings were located north-south mainly for access purposes but this orientation also coincided with minimum topographical variation. However, this orientation did have some topographical variation which was particularly pronounced at the most northerly and southerly ends of the survey lines. The maximum possible extension of the cable was 64m at any point along the survey lines. A total of 32 vertical electrical soundings were carried out at station spacing of 10m (Figure 3), 15 soundings achieved a cable expansion of 64m and the remaining soundings were 32m.

In practice a switching device is used to change from one adjacent set of four electrodes to the other. Using this technique two resistance values are obtained which are averaged to provide the Offset Wenner Resistances D1 and D2. The electrode spacing is increased exponentially according to the series a= 0.5, 1, 2, 4, 8, 16, 32, etc. Additional points for the construction of the resistivity curve are obtained by measuring the resistances obtained with the other electrodes arrangements of the 5 electrodes Ra, Rb and Rc (Figure A1 - Appendix A).

3.0 DATA PROCESSING

3.1 VERTICAL ELECTRICAL SOUNDING SURVEY

The measured resistances were typed into a file in the format required by the VES processing and interpretation program - Resix^{Plus}, Version 2. This program converts measured resistances to apparent resistivities and then calculates a field curve of apparent resistivities versus electrode spacing which is plotted on a logarithmic scale.

The Resix^{Plus} program has a number of different options for interpreting a sounding curve. Forward modelling is a manual operation which allows to user to specify model layer resistivities and thickness to produce a theoretical curve of a multi-layered earth where all contacts are horizontal. The layer resistivities and thickness' are selected on the basis of observations of the field curve and using knowledge of known resistivities of rocks and overburden materials.

The program then compares the theoretical curve with the field curve. The percentage **Fitting Error** indicates how well the two curves compare and the theoretical curve may be modified to produce a best fit with the field curve. The availability of actual sub-surface information, e.g. borehole information, on the layer thickness' and resistivities may be used to constrain the forward model.

The Resix^{Plus} program also allows the data to be inverted which is an iterative process which achieves a closer fit between the model and the field data.

The Resix^{Plus} program also has an 'Estimate' command which automatically generates a theoretical curve from analysis of the field curve. This command was utilised to interpret some of the sounding curves but the layer thickness' were unrealistic so Forward modelling was used to interpret the sounding curves.

Equivalence is an inherent problem in the interpretation of sounding curves where a number of different models will yield the same result but the subsurface layer parameters (thickness' and resistivities) may vary significantly. The Resix^{Plus} program calculates and displays the equivalence models.

The 32 sounding curves and the raw data from this survey may be seen in Appendix B.

3.1.1 ERROR CALCULATIONS

The Offset Wenner technique enables the calculation of a number of errors which provide information on the data quality and the deviation of the sub-surface from horizontal stratification. These errors are defined as follows:

Observational Error

This error (e_o) includes all the small random effects such as observer error and instrument error. It is expressed as a percentage and normally varies from +5 to -5%. It is calculated from the formula:

$$e_o = \{R_A - (R_B + R_C)\}/R_A$$

Table 1 shows the calculated root mean square observational error for each of the soundings. The majority of the soundings display reasonably good quality data (Observational errors < 2%) with the exception of S2, S4 and S15 which all have errors greater than +/- 5%.

Offset Error

The Offset Error (e_a) is a measure of the effects of subsurface lateral resistivity variations. Such variations may be produced by changes in the depth to bedrock or the presence of weathered fissure zones which pass laterally into more massive bedrock. Offset error values greater than 20% indicate the presence of strong lateral resistivity variation. It is calculated from the formula:

$$e_a = (R_{D1} - R_{D2})/R_D$$

Table 1 shows the root mean square offset error for each of the soundings. The majority of the soundings (20) display offset errors greater than 20% indicating a high degree of inhomogenity in the sub-surface along the sounding lines. Consequently interpretations for such curves should be viewed with caution.

4.0 RESULTS AND INTERPRETATION

It must be noted that the theory upon which the vertical electrical sounding technique is based assumes certain field conditions - the most important being - lateral homogeneity within the sub-surface and the presence of horizontally layered strata. Departures from these conditions, such as lateral inhomogenities in the sub-surface material, the presence of vertical contacts, or dipping layers, leads to errors in interpretation which are not quantifiable in terms of an error range. However, as described in the previous section, certain errors are quantifiable and analysis of the offset errors indicate that the majority of the soundings display a significant degree of lateral inhomogenity and therefore the interpretation of these soundings should be viewed with caution.

4.1 VES SURVEY RESULTS (Appendix B)

The sounding curves and their respective data sets are presented in Appendix B. The interpreted resistivities and depths to various sub-surface layer are presented in Table 1. The majority of the curves (28 of 32) were interpreted as 3 layer models with the remaining interpreted as 2 layer models. The fitting error between the observed curve and the modelled curve is reasonably good for the majority of the soundings - less than 10% for 70% of the soundings but the remaining 30% of soundings displayed a fitting error of between 10% and 35%.

The general pattern displayed by the majority of the sounding curves show a decrease in resistivities from a = 0.5 to a = 4 or a = 8 followed by an increase in resistivities thereafter. This general patterns indicates the presence of a relatively high resistivity top layer, underlain by a second layer of lower resistivity which in turn is underlain by another layer of higher resistivity material. The exceptions to this general pattern are S27 to S32 which display a general increase in resistivities with depth.

Figure 4 and 5 shows the geoelectric sections derived from the sounding results. Each section comprises the results from the individual soundings on the respective line and the locations of the soundings may be seen on Figure 3. S32 is on a separate line to S27-S31 but is included with the latter. Table 1 shows the interpreted resistivity and thickness of the respective layers of the sounding curves.

4.1.1 Interpretation of VES results (Figures 4 and 5 - Geoelectric Sections and Table 1 - Resistivities and depth to sub-surface layers)

It must be noted that the topography along individual survey lines is relatively flat but as observed in Figure 3 it falls away to the north-east in the area where S11 to S26 are located and therefore does not have a horizontal surface as depicted in the geoelectric sections.

The first interpreted layer on all soundings is relatively uniform with an average thickness of 1.05m (range 0.12m at S13 to 5.7m at S19) and an average resistivity of

171 Ohm-m (range 95 - 620 Ohm m). This layer is interpreted as relatively dry fill material comprising soil and rubble as observed on the quarry surface.

The second layer is a relatively low resistivity layer with average resistivity 87.5 Ohm-m but ranges in value from 14 to 208 Ohm m. The average depth of this layer is 4.9m (range 1.7m - 10.2m). This layer is interpreted as waterlogged fill material. S19 and S27-S29 are interpreted as two layered models and in these cases the second layer is interpreted as bedrock.

The third layer on the majority of the soundings is interpreted as bedrock and the average modelled resistivity of this layer is 4330 Ohm m.

5.0 CONCLUSIONS

A depth to bedrock survey utilising the vertical electrical sounding technique was carried out on a limestone quarry site at Beaumont, Ballintemple, Cork. The quarry floor was back-filled with material consisting of soil and rubble and the objective of the survey was to ascertain the thickness of this fill material. The initial proposed survey was modified greatly due to the inaccessibility of large parts of the quarry and the limited length of the survey lines along areas of relatively homogenous topography (the VES technique requires a minimum lateral spread of 32m for effective results).

The modelled sounding data indicates that depth to bedrock/fill thickness ranges from 1.7m to 10.2m with average depth 4.9m. These results may appear to be quite variable but the large offset errors observed on the raw data (discussed in Section 3.1.1) are indicative of a significant degree of lateral variation within the subsurface which will produce ambiguous interpretations.

However, despite the lateral variations the sounding interpretations display a certain degree of consistency as observed in the geoelectric sections in Figures 4 and 5. S1 to S10 are located in the southern part of the quarry and the interpreted depth to bedrock is less than 3m at each sounding location.

S11 to S26 are located in the central part of the quarry and it is observed that the interpreted depth to bedrock increases from south to north along the survey lines - from a minimum depth of 4.45m at S11 to 10.2m at S15.

S27 to S32 are located on an area of higher ground in the north-eastern part of the quarry and again the interpreted soundings show an increase in the depth to bedrock from south to north of 0.7m at S27 to 5.1m at S30.

Survey carried out by: Martina McCarthy and Shane Rooney
Report by: Martina McCarthy

Signed _____
Martina McCarthy
March 2000

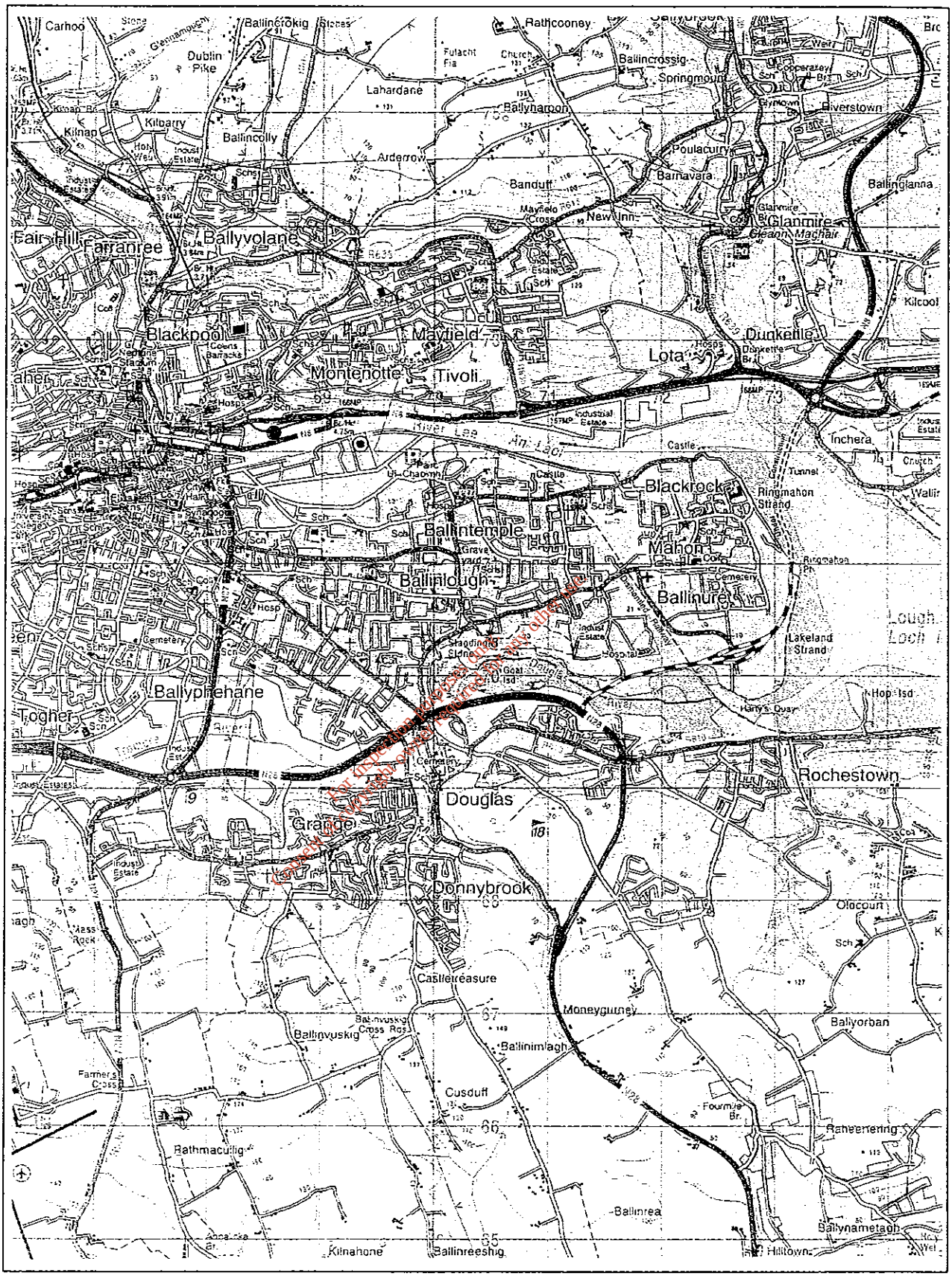


Figure 1. General location map of the survey area (Extract from the Ordnance Survey of Ireland: Discovery Series - No. 87 - Cork. Scale 1:50,000).

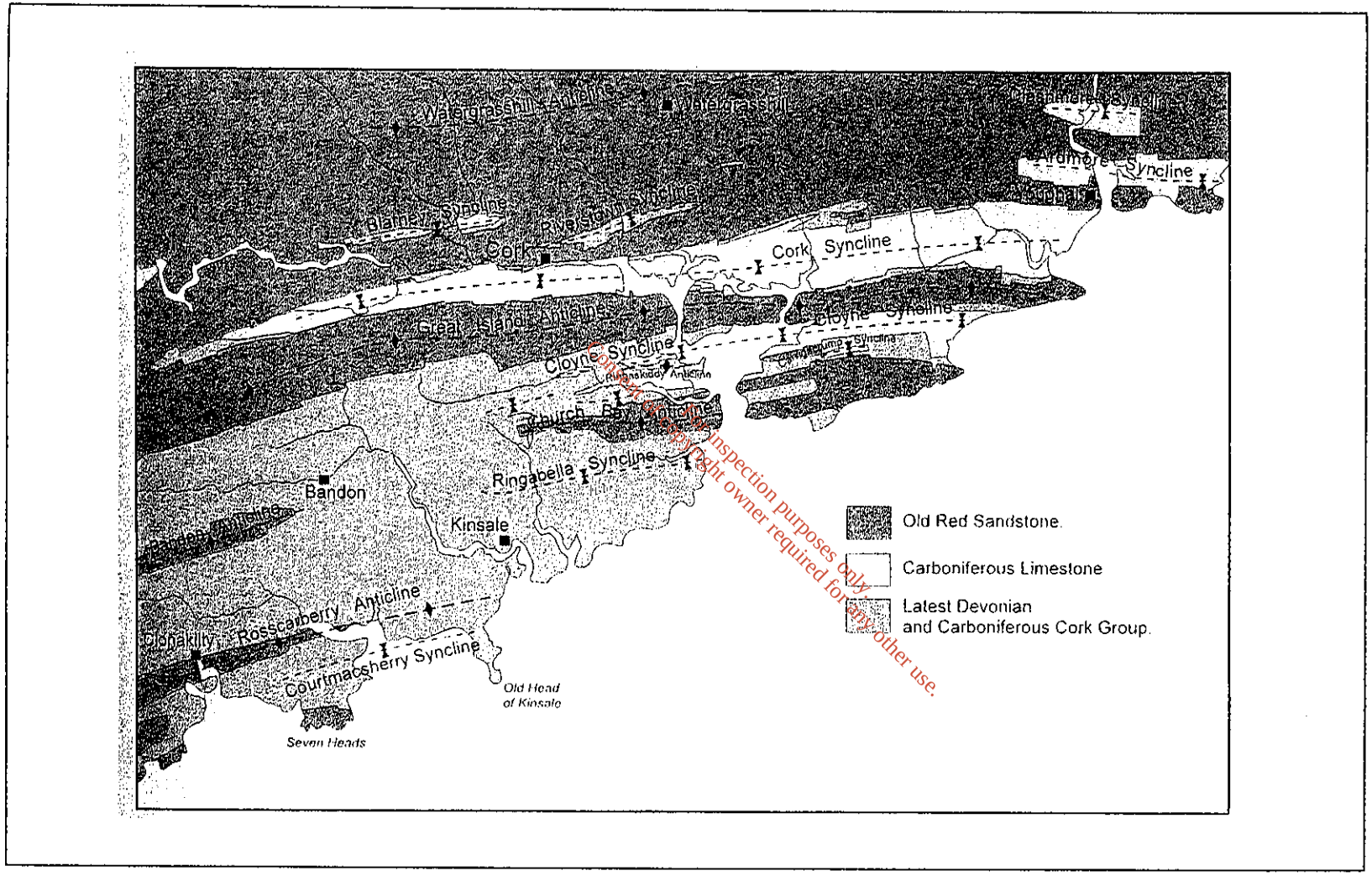
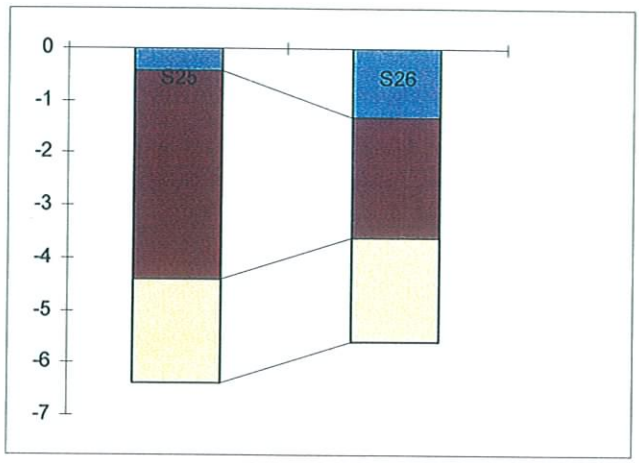


Figure 2. Simplified Geology of South Cork (after: Geology of South Cork, Geological Survey of Ireland, 1994)



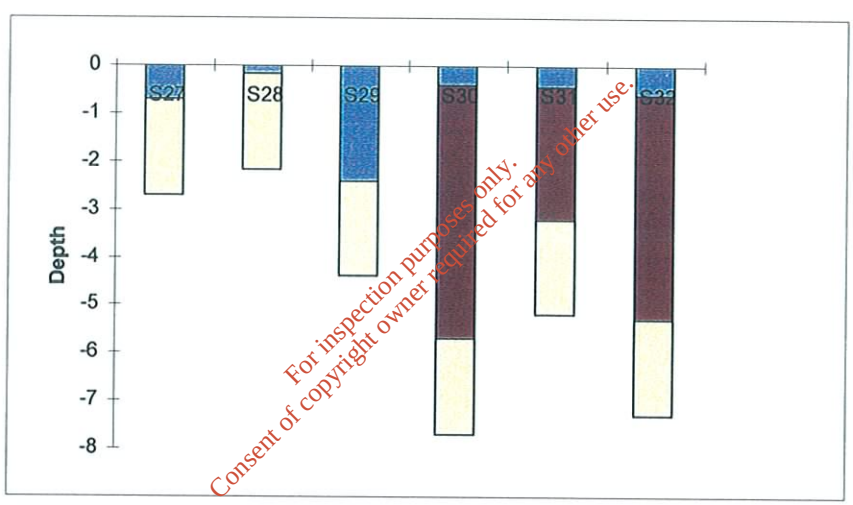


Figure 5. Geoelectric sections from soundings 25 - 32. (Respective axes not to scale). Data used to compile the geoelectric sections may be seen in Table 1. Sounding locations may be seen in Figure 3. Legend may be seen in previous Figure.

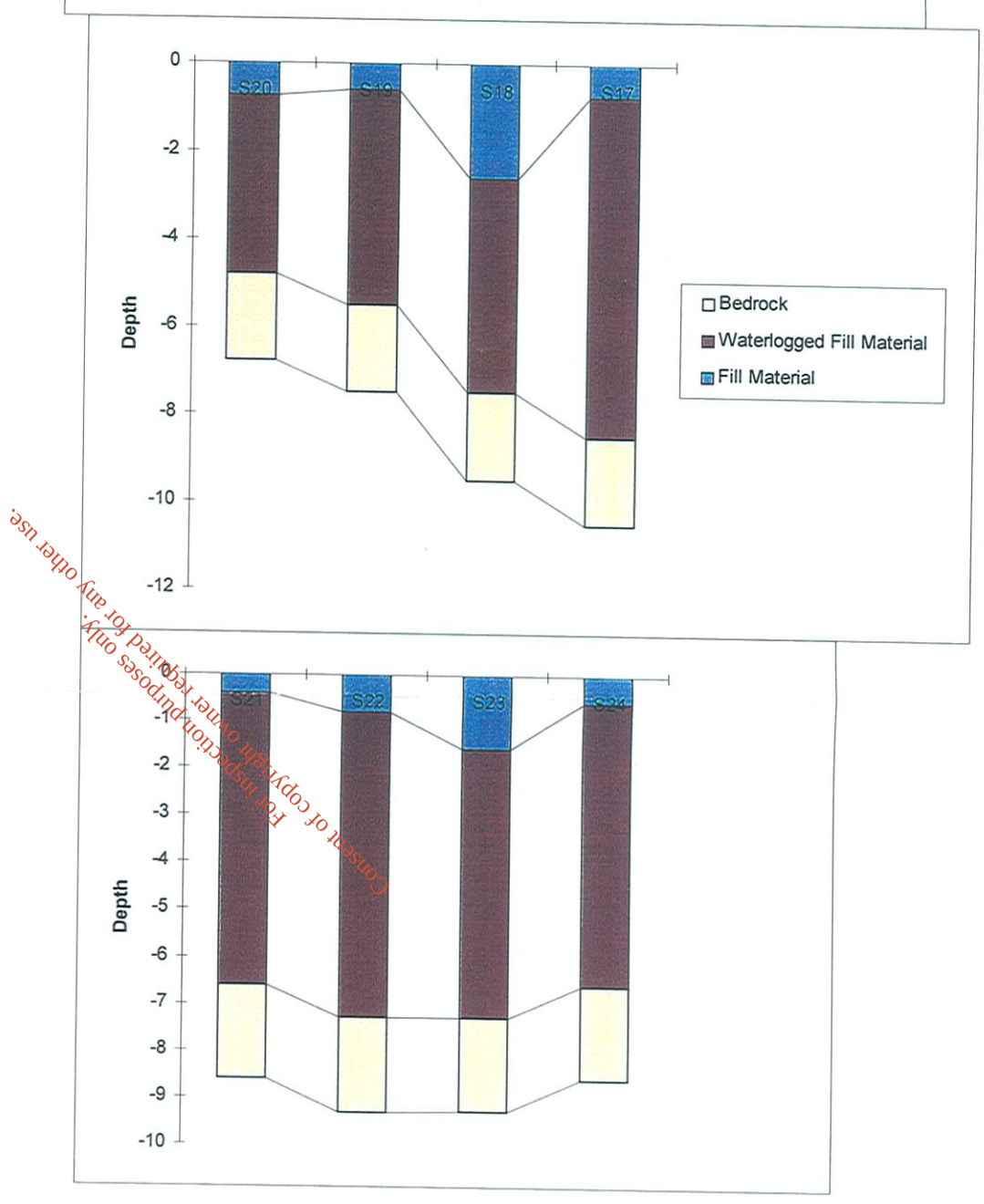


Figure 4. Geoelectric sections from soundings 1- 24. (Respective axes not to scale). Data used to compile the geoelectric sections may be seen in Table 1.

Sounding No.	Easting	Northing	DTFL	RFL	DTSL	R
S1	1005	1046	0.67m	187 Ohm m	1.77m	1
S2	1000	1046	0.47m	620 Ohm m	1.75m	1
S3	1005	1026	1m	116 Ohm m	2.2m	2
S4	1005	1016	0.75m	128 Ohm m	1.7m	2
S5	1000	1016	0.75m	118 Ohm m	1.7m	2
S6	1000	1000	0.93m	129 Ohm m	2.3m	1
S7	1005	1000	0.9m	110 Ohm m	2.2m	1
S8	1000	1026	1.2m	115 Ohm m	2.9m	4
S9	1000	1036	0.5m	140 Ohm m	2.5m	3
S10	1005	1036	0.6m	136 Ohm m	2.4m	2
S11	1020	1084	1.8m	121 Ohm m	4.45m	8
S12	1020	1094	0.8m	192 Ohm m	4.1m	1
S13	1020	1099	0.12m	122 Ohm m	10.06m	2
S14	1020	1109	1m	124 Ohm m	8.6m	1
S15	1020	1119	0.56m	95 Ohm m	10.2m	1
S16	1020	1129	2m	176 Ohm	8.7m	1
S17	1030	1129	0.75m	215 Ohm m	8.5m	1
S18	1030	1119	2.6m	150 Ohm m	7.5m	1
S19	1030	1109	5.7m	115 Ohm m		2
S20	1030	1099	0.75m	208 Ohm m	4.8m	9
S21	1040	1099	0.4m	203 Ohm m	6.6m	1
S22	1040	1109	0.8m	267 Ohm m	7.3m	1
S23	1040	1119	1.6m	215 Ohm m	7.28m	1
S24	1040	1129	0.6m	193 Ohm m	6.6m	9
S25	1050	1119	0.43m	242 Ohm m	4.4m	1
S26	1050	1129	1.3m	169 Ohm m	3.6m	1
S27	1118	1121	0.7m	96 Ohm m		4
S28	1118	1131	0.18m	59 Ohm m		3
S29	1118	1141	2.4m	285 Ohm m		1
S30	1118	1151	0.4m	129 Ohm m	5.1m	4
S31	1118	1161	0.45m	180 Ohm m	3.2m	5
S32	1128	1161	0.59m	146 Ohm m	5.3m	4
DTFL	Depth to first layer					
RFL	Resistivity of first layer					
DTSL	Depth to second layer					
RSL	Resistivity of second layer					
RTL	Resistivity of third layer					

TA

Sounding numbers and co-ordinates are presented with interpreted resistivities and depths of the model layers for eac
Offset error for each sounding and Column 10 shows the percentage fitting error between the model curve and the ob

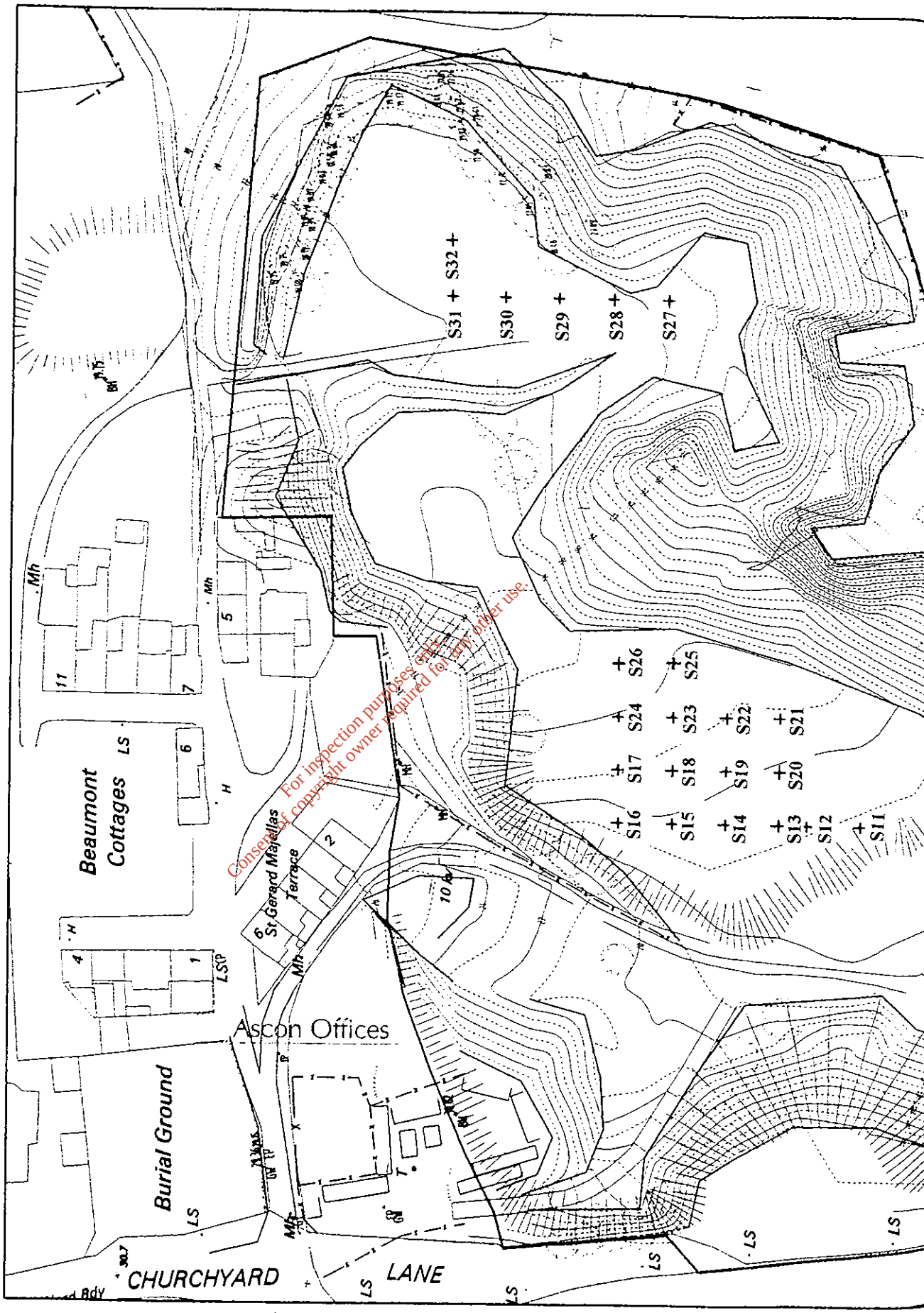


Figure 3. Map showing the VES locations relative to the quarry edge (Original map is the site layout plan a

APPENDIX A

Direct Current Vertical Electrical Sounding

Measurement of Earth Resistivity

In the direct current measurement of earth resistivity, a direct commutated, or low frequency alternating current is introduced into the ground by means of two current electrodes connected to the terminals of a portable source of e.m.f. The resulting potential distribution in the ground is mapped by means of two probes (potential electrodes) and this mapping yields information about distribution of electrical resistivity below the surface (Parasnis, 1986).

The resistance of a material is measured in Ohms (Ω) as is defined as

$$R = \Delta V/I$$

where ΔV is the voltage and I is the current

The electrical resistivity of any material is defined as the resistance to current flowing between the end faces of a cylinder of unit length and area and is measured in units of Ohm-metres (Ωm). In practice, apparent resistivities are determined rather than true resistivities since the sub-surface is not a homogenous medium. Over homogenous ground the apparent resistivity and true resistivity would be equal for any current and electrode arrangement.

The ground contacting electrodes can be configured spatially in a variety of ways called an array. Each layout of the array will sample resistivity in differing ways in an attempt to combine the ideal requirements of speed, sensitivity, depth of penetration and resolution. A compromise in terms of choice of array, spacing between electrodes and sample interval is required based on a knowledge of a particular target and the estimated depth of the same.

The apparent resistivity can be defined in several ways depending on the configuration of the current and potential electrodes.

The Offset Wenner Array is utilised for the vertical electrical sounding technique and the value of apparent resistivity is defined as

$$\rho_a = 2\pi Ra$$

where a = electrode spacing in metres.

Apparent Resistivity Parameter

Let A, B be the current electrodes, positive and negative respectively, placed on the ground surface and M, N be the potential electrodes. If ΔV is the voltage difference between M and N, then the resistivity of a homogenous earth is given by the following equation

$$\rho = 2\pi G\, \Delta V/I$$

where
I = the current injected into the ground
G = a geometric factor accounting for the decrease in the potential field with distance from the electrodes and given by the following equation

$$1/G = 1/AM - 1/BM - 1/AN + 1/BN$$

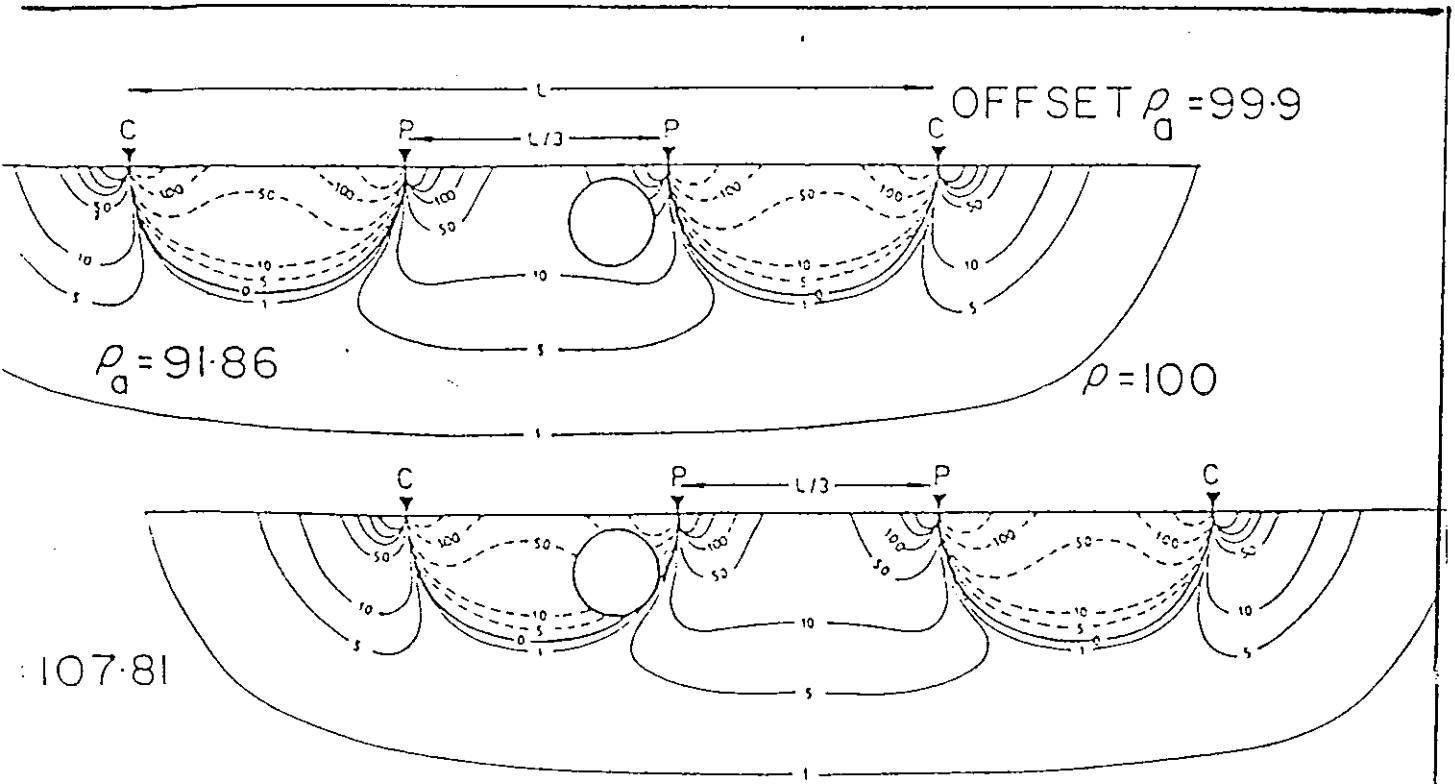
In a real situation, in which the earth's structure cannot be considered homogenous, ρ will vary on alteration of the geometric arrangement of the four electrodes and also by moving them on the ground without altering their geometry. The value of ρ obtained on substituting the measured $\Delta V/I$ and appropriate value of **G** is the apparent resistivity ρ_a.

Vertical Electrical Sounding
Sounding is employed in order to determine the variation of electrical resistivity with depth. By assuming a variation of resistivity with depth only, increasing the electrode separation causes a greater fraction of the current to return to the surface after having reached increasingly deeper levels. Hence with continual expansion of the electrode spread the potential difference and ρ_a are more relatively influenced by resistivity at deeper levels.

Offset Wenner Sounding
The BGS-256 Offset cable reduces and, in some cases, may almost remove spurious effects caused by local, near-surface and lateral resistivity variations. Figure A1 shows the Wenner electrode configuration and the signal contribution section for this array. Contours show the relative contribution to the measured resistance given by a unit volume of earth at any point in the section. As it comprises positive and negative regions of approximately equal extent, the effect of a body of anomalous resistivity lying within one of these zones is reduced by offsetting the array a distance equal to the spacing and taking an average of the two resistances measured.

Offset Wenner Sounding is conducted using a 5 electrode array with one electrode remaining fixed at the centre of the spread (Figure A1).

PARASNIS, D.S. 1986. Principles of Applied Geophysics. Chapman & Hall, London



Signal contribution section for Wenner array. The 'Offset' Principle is also shown. Apparent resistivities are those that would be measured with a fully conductive sphere in the position shown (after Barker, 1981)

FIVE - ELECTRODE ARRAY

CONFIGURATION	1	2	3	4	5	MEASURED RESISTANCE
	C	P		P	C	R_A
	C	C		P	P	R_B
	C	P		C	P	R_C
	C	P	P	C		R_{D1}
		C	P	P	C	R_{D2}

R_D

THE VARIOUS RESISTANCES MEASURED WITH THE FIVE-ELECTRODE ARRAY.

Figure A1

APPENDIX B

DATA SETS - OFFSET WENNER FIELD READINGS
SPACING ADJUSTED RESISTANCES
OBSERVED AND OFFSET ERRORS

SOUNDING CURVES

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	47.800	50.000	64.800	4.760	60.000
1.0	17.600	14.300	15.400	1.110	14.300
2.0	3.450	3.970	5.040	0.068	4.960
4.0	2.800	1.920	4.090	0.031	4.260
8.0	2.640	1.880	4.000	0.140	3.850
16.0	3.780	2.740	5.320	0.588	4.750

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	47.800	50.000	64.780	4.761	60.019	48.900	153.62
1.0	17.600	14.300	15.405	1.110	14.295	15.950	100.22
1.5							58.23
2.0	3.450	3.970	5.034	0.068	4.966	3.710	46.62
3.0							37.58
4.0	2.800	1.920	4.188	0.030	4.158	2.360	59.31
6.0							85.66
8.0	2.640	1.880	3.995	0.140	3.855	2.260	113.60
12.0							216.39
16.0	3.780	2.740	5.329	0.587	4.742	3.260	327.73
24.0							536.66
32.0							595.94

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.062	-4.499
1.0	-0.065	20.690
1.5		
2.0	0.238	-14.016
3.0		
4.0	-4.799	37.288
6.0		
8.0	0.250	33.628
12.0		
16.0	-0.338	31.902
24.0		
RMS:	1.970	26.406

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	44.700	251.000	283.000	3.160	279.000
1.0	23.400	10.800	12.000	0.794	11.300
2.0	2.880	2.410	3.940	0.216	3.730
4.0	1.640	1.820	2.830	0.085	2.740
8.0	1.630	2.340	3.690	1.140	3.530
16.0	3.330	3.180	5.440	1.670	5.170

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	44.700	251.000	282.579	3.165	279.415	147.850	464.49
1.0	23.400	10.800	12.047	0.791	11.256	17.100	107.44
1.5							70.67
2.0	2.880	2.410	3.943	0.216	3.727	2.645	33.24
3.0							30.39
4.0	1.640	1.820	2.828	0.085	2.742	1.730	43.48
6.0							65.11
8.0	1.630	2.340	4.123	1.006	3.116	1.985	99.78
12.0							266.99
16.0	3.330	3.180	6.060	1.480	4.581	3.255	327.23
24.0							516.68
32.0							533.05

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.297	-139.533
1.0	-0.780	73.684
1.5		
2.0	-0.152	17.769
3.0		
4.0	0.166	-10.405
6.0		
8.0	-23.772	-35.768
12.0		
16.0	-23.102	4.608
24.0		
RMS:	13.537	66.613

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	27.200	39.100	46.200	2.440	43.700
1.0	15.000	17.200	20.900	1.180	19.700
2.0	5.110	6.680	7.640	0.290	7.330
4.0	2.600	4.040	5.630	0.156	5.460
8.0	3.190	4.570	6.760	0.236	6.540
16.0	3.540	6.170	8.780	0.211	8.580

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	27.200	39.100	46.170	2.442	43.728	33.150	104.14
1.0	15.000	17.200	20.890	1.181	19.709	16.100	101.16
1.5							91.76
2.0	5.110	6.680	7.630	0.290	7.340	5.895	74.08
3.0							70.07
4.0	2.600	4.040	5.623	0.156	5.467	3.320	83.44
6.0							130.66
8.0	3.190	4.570	6.768	0.236	6.532	3.880	195.03
12.0							335.30
16.0	3.540	6.170	8.785	0.211	8.575	4.855	488.08
24.0							923.22
32.0							1495.75

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.130	-35.897
1.0	0.096	-13.665
1.5		
2.0	0.262	-26.633
3.0		
4.0	0.249	-43.373
6.0		
8.0	-0.236	-35.567
12.0		
16.0	-0.125	-54.171
24.0		
RMS:	0.195	37.116

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	35.500	36.500	49.000	2.230	46.200
1.0	12.300	14.400	15.700	0.835	14.900
2.0	4.580	4.020	5.940	0.184	4.610
4.0	3.130	2.710	4.760	0.196	4.530
8.0	4.340	3.320	6.750	0.161	6.610
16.0	5.860	3.620	8.440	0.218	8.230

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	35.500	36.500	48.713	2.243	46.470	36.000	113.10
1.0	12.300	14.400	15.717	0.834	14.883	13.350	83.88
1.5							69.89
2.0	4.580	4.020	5.306	0.204	5.102	4.300	54.04
3.0							56.16
4.0	3.130	2.710	4.743	0.197	4.546	2.920	73.39
6.0							126.97
8.0	4.340	3.320	6.760	0.161	6.600	3.830	192.52
12.0							320.37
16.0	5.860	3.620	8.444	0.218	8.226	4.740	476.52
24.0							891.70
32.0							1401.85

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	1.170	-2.778
1.0	-0.223	-15.730
1.5		
2.0	21.599	13.023
3.0		
4.0	0.717	14.384
6.0		
8.0	-0.311	26.632
12.0		
16.0	-0.095	47.257
24.0		
RMS:	8.837	24.407

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	32.800	34.400	40.600	2.810	37.800
1.0	11.400	12.600	15.400	0.679	15.100
2.0	4.740	5.520	7.090	0.387	6.690
4.0	2.810	4.030	5.490	0.171	5.310
8.0	3.090	3.890	6.140	0.161	5.960
16.0	3.760	6.050	8.850	0.198	8.720

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	32.800	34.400	40.605	2.810	37.795	33.600	105.56
1.0	11.400	12.600	15.587	0.671	14.916	12.000	75.40
1.5							60.56
2.0	4.740	5.520	7.083	0.387	6.696	5.130	64.47
3.0							75.24
4.0	2.810	4.030	5.485	0.171	5.314	3.420	85.95
6.0							122.10
8.0	3.090	3.890	6.130	0.161	5.969	3.490	175.43
12.0							315.74
16.0	3.760	6.050	8.884	0.197	8.687	4.905	493.11
24.0							945.51
32.0							1520.69

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	-0.025	-4.762
1.0	-2.431	-10.000
1.5		
2.0	0.184	-15.205
3.0		
4.0	0.164	-35.673
6.0		
8.0	0.310	-22.923
12.0		
16.0	-0.765	-46.687
24.0		
RMS:	1.053	26.869

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	38.600	31.600	45.900	3.620	42.300
1.0	16.300	14.800	17.600	1.380	16.300
2.0	4.770	3.890	4.980	0.211	4.780
4.0	1.880	1.750	3.010	0.064	2.940
8.0	2.080	2.170	3.850	0.112	3.740

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	38.600	31.600	45.910	3.619	42.291	35.100	110.27
1.0	16.300	14.800	17.640	1.377	16.263	15.550	97.70
1.5							72.55
2.0	4.770	3.890	4.985	0.211	4.775	4.330	54.41
3.0							35.93
4.0	1.880	1.750	3.007	0.064	2.943	1.815	45.62
6.0							68.74
8.0	2.080	2.170	3.851	0.112	3.739	2.125	106.81
12.0							205.41
16.0							324.52

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	-0.044	19.943
1.0	-0.454	9.646
1.5		
2.0	-0.221	20.323
3.0		
4.0	0.196	7.163
6.0		
8.0	-0.052	-4.235
12.0		
RMS:	0.244	13.950

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	34.100	30.600	41.400	2.940	38.500
1.0	13.200	11.800	15.200	0.732	14.400
2.0	4.490	3.530	5.790	0.260	5.520
4.0	2.600	2.090	3.620	0.112	3.550
8.0	2.780	2.140	4.380	0.133	4.250

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	34.100	30.600	41.420	2.939	38.481	32.350	101.63
1.0	13.200	11.800	15.166	0.734	14.432	12.500	78.54
1.5							57.02
2.0	4.490	3.530	5.785	0.260	5.525	4.010	50.39
3.0							50.97
4.0	2.600	2.090	3.641	0.111	3.530	2.345	58.94
6.0							84.96
8.0	2.780	2.140	4.381	0.133	4.249	2.460	123.65
12.0							229.22
16.0							359.61

SPACING	---------- ERRORS ---------	
	OBSERVED	OFFSET
0.5	-0.097	10.819
1.0	0.448	11.200
1.5		
2.0	0.173	23.940
3.0		
4.0	-1.154	21.748
6.0		
8.0	-0.068	26.016
12.0		
RMS:	0.561	19.827

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OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	32.000	37.900	45.300	2.740	42.500
1.0	16.900	17.600	23.700	1.280	22.400
2.0	7.760	7.180	9.680	0.454	9.200
4.0	4.150	3.300	5.890	0.175	5.710
8.0	4.230	3.440	6.780	0.144	6.650
16.0	5.890	4.080	9.190	0.147	8.950

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	32.000	37.900	45.270	2.742	42.528	34.950	109.80
1.0	16.900	17.600	23.690	1.281	22.409	17.250	108.39
1.5							102.72
2.0	7.760	7.180	9.667	0.455	9.212	7.470	93.87
3.0							89.94
4.0	4.150	3.300	5.887	0.175	5.712	3.725	93.62
6.0							131.96
8.0	4.230	3.440	6.787	0.144	6.643	3.835	192.77
12.0							330.15
16.0	5.890	4.080	9.143	0.148	8.996	4.985	501.15
24.0							981.22
32.0							1612.73

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.133	-16.881
1.0	0.084	-4.058
1.5		
2.0	0.269	7.764
3.0		
4.0	0.085	22.819
6.0		
8.0	-0.206	20.600
12.0		
16.0	1.017	36.309
24.0		
RMS:	0.444	20.917

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	44.200	33.700	51.200	2.720	48.500
1.0	12.900	11.200	13.500	0.729	12.800
2.0	3.940	2.730	4.710	0.121	4.580
4.0	2.240	1.610	3.220	0.113	3.130
8.0	3.050	2.200	4.710	0.196	4.480
16.0	5.260	3.010	7.250	0.310	6.940

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	44.200	33.700	51.210	2.719	48.491	38.950	122.37
1.0	12.900	11.200	13.514	0.728	12.786	12.050	75.71
1.5							53.73
2.0	3.940	2.730	4.705	0.121	4.584	3.335	41.91
3.0							38.13
4.0	2.240	1.610	3.231	0.113	3.119	1.925	48.38
6.0							85.44
8.0	3.050	2.200	4.693	0.197	4.496	2.625	131.95
12.0							261.19
16.0	5.260	3.010	7.250	0.310	6.940	4.135	415.70
24.0							751.84
32.0							1127.96

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	-0.039	26.958
1.0	-0.215	14.108
1.5		
2.0	0.191	36.282
3.0		
4.0	-0.712	32.727
6.0		
8.0	0.724	32.381
12.0		
16.0	0.000	54.414
24.0		
RMS:	0.431	34.935

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	34.400	35.200	45.300	3.390	41.700
1.0	12.000	13.500	15.100	0.743	14.400
2.0	3.640	3.470	4.800	0.090	4.710
4.0	2.100	1.870	3.520	0.067	3.450
8.0	3.030	2.150	4.440	0.266	4.170
16.0	5.490	3.080	7.200	0.329	7.040

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	34.400	35.200	45.195	3.398	41.797	34.800	109.33
1.0	12.000	13.500	15.121	0.742	14.380	12.750	80.11
1.5							51.80
2.0	3.640	3.470	4.800	0.090	4.710	3.555	44.67
3.0							39.92
4.0	2.100	1.870	3.519	0.067	3.451	1.985	49.89
6.0							85.39
8.0	3.030	2.150	4.438	0.266	4.172	2.590	130.19
12.0							274.17
16.0	5.490	3.080	7.284	0.325	6.958	4.285	430.78
24.0							735.12
32.0							1075.01

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.465	-2.299
1.0	-0.284	-11.765
1.5		
2.0	0.006	4.782
3.0		
4.0	0.077	11.587
6.0		
8.0	0.090	33.977
12.0		
16.0	-2.320	56.243
24.0		
RMS:	0.974	27.744

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	38.300	37.100	51.300	3.240	48.000
1.0	21.200	17.200	25.900	1.430	24.500
2.0	10.000	9.480	13.700	0.627	13.100
4.0	5.670	4.690	7.660	0.354	7.330
8.0	4.290	4.510	7.320	0.472	7.020

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	38.300	37.100	51.270	3.242	48.028	37.700	118.44
1.0	21.200	17.200	25.915	1.429	24.486	19.200	120.64
1.5							119.29
2.0	10.000	9.480	13.713	0.626	13.087	9.740	122.40
3.0							125.49
4.0	5.670	4.690	7.672	0.353	7.319	5.180	130.19
6.0							170.29
8.0	4.290	4.510	7.405	0.467	6.938	4.400	221.17
12.0							365.80
16.0							510.39

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.117	3.183
1.0	-0.116	20.833
1.5		
2.0	-0.197	5.339
3.0		
4.0	-0.313	18.919
6.0		
8.0	-2.323	-5.000
12.0		
RMS:	1.054	13.081

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	65.300	54.500	74.500	5.170	69.000
1.0	24.400	30.600	35.400	2.170	33.300
2.0	14.300	12.500	18.300	0.931	17.300
4.0	6.820	6.320	8.580	0.668	7.890
8.0	4.500	6.460	7.580	0.372	7.210

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	65.300	54.500	74.335	5.181	69.153	59.900	188.18
1.0	24.400	30.600	35.435	2.168	33.267	27.500	172.79
1.5							164.33
2.0	14.300	12.500	18.265	0.933	17.333	13.400	168.39
3.0							164.93
4.0	6.820	6.320	8.569	0.669	7.900	6.570	165.12
6.0							217.19
8.0	4.500	6.460	7.581	0.372	7.209	5.480	275.46
12.0							314.57
16.0							347.65

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.444	18.030
1.0	-0.198	-22.545
1.5		
2.0	0.378	13.433
3.0		
4.0	0.257	7.610
6.0		
8.0	-0.026	-35.766
12.0		
RMS:	0.298	21.684

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	63.100	49.400	65.200	5.720	59.400
1.0	32.500	37.800	49.000	3.570	45.000
2.0	18.300	20.200	26.300	1.110	25.200
4.0	5.770	8.970	9.880	0.525	9.370
8.0	4.260	5.850	7.960	0.307	7.630
16.0	4.370	4.340	6.940	0.292	6.720

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	63.100	49.400	65.160	5.724	59.436	56.250	176.71
1.0	32.500	37.800	48.784	3.586	45.198	35.150	220.85
1.5							236.21
2.0	18.300	20.200	26.305	1.110	25.195	19.250	241.90
3.0							204.22
4.0	5.770	8.970	9.887	0.525	9.363	7.370	185.23
6.0							212.15
8.0	4.260	5.850	7.948	0.307	7.641	5.055	254.09
12.0							338.38
16.0	4.370	4.340	6.976	0.290	6.685	4.355	437.81
24.0							677.21
32.0							937.08

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.123	24.356
1.0	0.881	-15.078
1.5		
2.0	-0.038	-9.870
3.0		
4.0	-0.152	-43.419
6.0		
8.0	0.289	-31.454
12.0		
16.0	-1.032	0.689
24.0		
RMS:	0.572	25.143

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	48.000	31.800	45.700	3.710	41.900
1.0	23.000	20.500	31.100	1.520	29.600
2.0	13.100	10.600	16.900	1.020	15.900
4.0	7.240	6.700	9.240	0.696	8.570
8.0	5.370	3.780	6.670	0.385	6.280
16.0	4.950	3.110	6.440	0.235	6.190

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	48.000	31.800	45.655	3.714	41.941	39.900	125.35
1.0	23.000	20.500	31.110	1.520	29.590	21.750	136.66
1.5							137.66
2.0	13.100	10.600	16.910	1.019	15.891	11.850	148.91
3.0							167.95
4.0	7.240	6.700	9.253	0.695	8.558	6.970	175.18
6.0							205.39
8.0	5.370	3.780	6.667	0.385	6.282	4.575	229.97
12.0							301.04
16.0	4.950	3.110	6.432	0.235	6.197	4.030	405.14
24.0							608.07
32.0							871.49

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.197	40.602
1.0	-0.064	11.494
1.5		
2.0	-0.118	21.097
3.0		
4.0	-0.281	7.747
6.0		
8.0	0.075	34.754
12.0		
16.0	0.233	45.658
24.0		
RMS:	0.181	30.491

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	34.400	31.600	23.200	4.060	23.800
1.0	20.300	20.300	28.800	1.270	27.400
2.0	12.800	11.600	15.900	0.921	15.100
4.0	8.520	4.880	8.140	0.448	7.680
8.0	4.120	3.380	5.510	0.296	5.210

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	34.400	31.600	25.317	3.689	21.628	33.000	103.67
1.0	20.300	20.300	28.735	1.273	27.462	20.300	127.55
1.5							130.38
2.0	12.800	11.600	15.960	0.918	15.043	12.200	153.31
3.0							171.43
4.0	8.520	4.880	8.134	0.448	7.686	6.700	168.39
6.0							179.29
8.0	4.120	3.380	5.508	0.296	5.212	3.750	188.50
12.0							240.12
16.0							293.93

SPACING	---------- ERRORS ----------	
	OBSERVED	OFFSET
0.5	-18.406	8.485
1.0	0.452	0.000
1.5		
2.0	-0.758	9.836
3.0		
4.0	0.148	54.328
6.0		
8.0	0.073	19.733
12.0		
RMS:	8.241	26.494

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	32.000	59.900	54.800	8.940	44.600
1.0	42.200	24.700	54.900	1.320	52.800
2.0	12.500	15.400	18.700	1.240	17.300
4.0	6.510	5.030	7.910	0.264	7.610
8.0	3.190	3.070	4.990	0.170	4.820

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	32.000	59.900	54.163	9.044	45.119	45.950	144.36
1.0	42.200	24.700	54.507	1.329	53.178	33.450	210.17
1.5							150.66
2.0	12.500	15.400	18.620	1.245	17.374	13.950	175.30
3.0							184.27
4.0	6.510	5.030	7.892	0.265	7.627	5.770	145.02
6.0							130.79
8.0	3.190	3.070	4.990	0.170	4.820	3.130	157.33
12.0							238.29
16.0							339.80

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	2.326	-60.718
1.0	1.431	52.317
1.5		
2.0	0.859	-20.789
3.0		
4.0	0.456	25.650
6.0		
8.0	0.000	3.834
12.0		
RMS:	1.297	38.803

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	80.500	47.100	69.500	7.110	62.400
1.0	30.500	31.000	43.100	2.000	41.100
2.0	12.800	10.100	15.500	0.801	14.700
4.0	5.290	5.460	7.720	0.409	7.310
8.0	3.060	3.740	5.200	0.197	4.990

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-I
0.5	80.500	47.100	69.505	7.109	62.396	63.800	200.43
1.0	30.500	31.000	43.100	2.000	41.100	30.750	193.21
1.5							150.71
2.0	12.800	10.100	15.500	0.801	14.700	11.450	143.89
3.0							135.97
4.0	5.290	5.460	7.720	0.409	7.310	5.375	135.09
6.0							150.63
8.0	3.060	3.740	5.193	0.197	4.996	3.400	170.90
12.0							232.56
16.0							320.94

SPACING	---------- ERRORS ----------	
	OBSERVED	OFFSET
0.5	-0.014	52.351
1.0	0.000	-1.626
1.5		
2.0	-0.006	23.581
3.0		
4.0	0.013	-3.163
6.0		
8.0	0.250	-20.000
12.0		
RMS:	0.112	27.237

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	52.200	43.600	65.400	2.930	62.400
1.0	22.200	24.200	31.600	1.670	29.900
2.0	11.900	12.200	17.000	0.840	16.200
4.0	5.810	5.810	8.130	0.513	7.670
8.0	3.910	3.880	5.840	0.283	5.560
16.0	3.150	3.710	5.560	0.185	5.310

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	52.200	43.600	65.365	2.932	62.433	47.900	150.48
1.0	22.200	24.200	31.585	1.671	29.914	23.200	145.77
1.5							154.23
2.0	11.900	12.200	17.020	0.839	16.181	12.050	151.43
3.0							152.65
4.0	5.810	5.810	8.156	0.511	7.645	5.810	146.02
6.0							170.58
8.0	3.910	3.880	5.841	0.283	5.559	3.895	195.78
12.0							258.93
16.0	3.150	3.710	5.527	0.186	5.341	3.430	344.82
24.0							532.22
32.0							768.55

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.107	17.954
1.0	0.095	-8.621
1.5		
2.0	-0.235	-2.490
3.0		
4.0	-0.650	0.000
6.0		
8.0	-0.051	0.770
12.0		
16.0	1.176	-16.327
24.0		
RMS:	0.560	10.567

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	36.600	30.300	46.500	4.900	41.600
1.0	23.000	21.500	32.000	1.760	30.100
2.0	10.100	7.840	11.400	0.891	10.500
4.0	6.860	4.400	8.640	0.231	8.190
8.0	4.040	4.120	5.930	0.467	5.710
16.0	4.300	4.110	5.840	0.437	5.600

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	36.600	30.300	46.500	4.900	41.600	33.450	105.09
1.0	23.000	21.500	31.930	1.764	30.166	22.250	139.80
1.5							117.56
2.0	10.100	7.840	11.395	0.891	10.504	8.970	112.72
3.0							121.16
4.0	6.860	4.400	8.529	0.234	8.295	5.630	141.50
6.0							158.25
8.0	4.040	4.120	6.051	0.457	5.594	4.080	205.08
12.0							329.19
16.0	4.300	4.110	5.937	0.430	5.507	4.205	422.73
24.0							509.22
32.0							523.61

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.000	18.834
1.0	0.438	6.742
1.5		
2.0	0.079	25.195
3.0		
4.0	2.568	43.694
6.0		
8.0	-4.082	-1.961
12.0		
16.0	-3.318	4.518
24.0		
RMS:	2.397	22.243

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	65.500	61.200	81.400	5.340	76.200
1.0	25.300	25.500	31.600	2.180	29.800
2.0	9.820	10.400	13.300	0.672	12.600
4.0	5.290	5.170	7.560	0.399	7.380
8.0	4.360	4.520	6.750	0.683	6.330

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	65.500	61.200	81.470	5.335	76.135	63.350	199.02
1.0	25.300	25.500	31.789	2.167	29.622	25.400	159.59
1.5							137.48
2.0	9.820	10.400	13.286	0.673	12.613	10.110	127.05
3.0							116.41
4.0	5.290	5.170	7.668	0.393	7.275	5.230	131.44
6.0							171.74
8.0	4.360	4.520	6.879	0.670	6.209	4.440	223.18
12.0							321.63
16.0							355.69

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	-0.172	6.788
1.0	-1.195	-0.787
1.5		
2.0	0.211	-5.737
3.0		
4.0	-2.856	2.294
6.0		
8.0	-3.823	-3.604
12.0		
RMS:	2.203	4.424

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	52.900	67.700	69.300	5.330	64.000
1.0	24.900	31.400	38.600	1.790	36.800
2.0	12.200	13.400	17.200	0.973	16.300
4.0	6.310	7.500	10.400	0.412	9.890
8.0	4.270	5.380	7.070	0.380	6.720

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	52.900	67.700	69.315	5.329	63.986	60.300	189.44
1.0	24.900	31.400	38.595	1.790	36.805	28.150	176.87
1.5							159.62
2.0	12.200	13.400	17.236	0.971	16.265	12.800	160.85
3.0							170.27
4.0	6.310	7.500	10.351	0.414	9.937	6.905	173.54
6.0							200.11
8.0	4.270	5.380	7.085	0.379	6.706	4.825	242.53
12.0							321.09
16.0							378.15

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	-0.043	-24.544
1.0	0.026	-23.091
1.5		
2.0	-0.424	-9.375
3.0		
4.0	0.947	-17.234
6.0		
8.0	-0.423	-23.005
12.0		
RMS:	0.502	20.247

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	82.600	77.400	97.400	8.220	88.800
1.0	36.600	33.900	44.000	2.490	41.600
2.0	12.800	12.600	15.200	0.868	14.300
4.0	5.340	5.810	7.650	0.422	7.230
8.0	3.840	4.000	6.010	0.310	5.610
16.0	3.470	3.510	5.510	0.236	5.290

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	82.600	77.400	97.210	8.236	88.974	80.000	251.3
1.0	36.600	33.900	44.045	2.487	41.557	35.250	221.4
1.5							171.7
2.0	12.800	12.600	15.184	0.869	14.315	12.700	159.5
3.0							141.7
4.0	5.340	5.810	7.651	0.422	7.229	5.575	140.1
6.0							162.1
8.0	3.840	4.000	5.965	0.312	5.652	3.920	197.0
12.0							271.0
16.0	3.470	3.510	5.518	0.236	5.282	3.490	350.8
24.0							521.8
32.0							720.7

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.391	6.500
1.0	-0.204	7.660
1.5		
2.0	0.211	1.575
3.0		
4.0	-0.026	-8.430
6.0		
8.0	1.509	-4.082
12.0		
16.0	-0.290	-1.146
24.0		
RMS:	0.658	5.663

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	56.800	74.400	94.600	4.630	90.700
1.0	34.300	34.000	47.100	2.360	44.700
2.0	14.000	13.600	16.900	1.270	15.600
4.0	6.660	5.930	8.430	0.436	8.000
8.0	3.910	3.320	5.420	0.231	5.200

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	56.800	74.400	94.964	4.612	90.351	65.600	206.09
1.0	34.300	34.000	47.080	2.361	44.719	34.150	214.57
1.5							204.74
2.0	14.000	13.600	16.885	1.271	15.614	13.800	173.42
3.0							168.85
4.0	6.660	5.930	8.433	0.436	7.997	6.295	158.21
6.0							155.31
8.0	3.910	3.320	5.425	0.231	5.195	3.615	181.71
12.0							239.93
16.0							317.62

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	-0.769	-26.829
1.0	0.085	0.878
1.5		
2.0	0.178	2.899
3.0		
4.0	-0.071	11.597
6.0		
8.0	-0.203	16.321
12.0		
RMS:	0.368	15.032

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	64.000	53.500	81.800	3.820	78.100
1.0	25.900	21.100	28.500	1.840	26.600
2.0	9.760	9.170	12.600	0.648	12.100
4.0	4.110	4.740	6.170	0.366	5.800
8.0	2.800	2.890	4.200	0.237	3.960

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	64.000	53.500	81.860	3.817	78.043	58.750	184.57
1.0	25.900	21.100	28.470	1.842	26.628	23.500	147.66
1.5							136.73
2.0	9.760	9.170	12.674	0.644	12.029	9.465	118.94
3.0							108.33
4.0	4.110	4.740	6.168	0.366	5.802	4.425	111.21
6.0							126.55
8.0	2.800	2.890	4.198	0.237	3.961	2.845	143.01
12.0							181.70
16.0							224.47

SPACING	---------- ERRORS ----------	
	OBSERVED	OFFSET
0.5	-0.147	17.872
1.0	0.211	20.426
1.5		
2.0	-1.168	6.233
3.0		
4.0	0.065	-14.237
6.0		
8.0	0.071	-3.163
12.0		
RMS:	0.536	14.058

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	81.300	59.300	91.600	4.920	89.700
1.0	30.400	28.600	38.200	2.360	35.700
2.0	14.200	13.200	18.500	1.000	17.500
4.0	8.060	7.690	11.400	0.666	10.700
8.0	5.710	5.180	7.880	0.537	7.340

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	81.300	59.300	93.086	4.840	88.245	70.300	220.85
1.0	30.400	28.600	38.130	2.364	35.766	29.500	185.35
1.5							180.24
2.0	14.200	13.200	18.500	1.000	17.500	13.700	172.16
3.0							177.62
4.0	8.060	7.690	11.383	0.667	10.716	7.875	197.92
6.0							238.52
8.0	5.710	5.180	7.878	0.537	7.341	5.445	273.70
12.0							338.46
16.0							381.29

SPACING	---------- ERRORS --------- OBSERVED	OFFSET
0.5	-3.244	31.294
1.0	0.367	6.102
1.5		
2.0	0.000	7.299
3.0		
4.0	0.299	4.698
6.0		
8.0	0.038	9.734
12.0		
RMS:	1.466	15.406

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	60.900	44.100	70.000	3.600	66.500
1.0	30.000	23.800	34.600	2.100	32.600
2.0	12.100	10.600	15.400	0.986	14.400
4.0	7.870	6.950	11.300	0.556	10.700
8.0	5.380	5.750	8.220	0.513	7.710

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	60.900	44.100	70.050	3.597	66.453	52.500	164.93
1.0	30.000	23.800	34.650	2.097	32.553	26.900	169.02
1.5							166.11
2.0	12.100	10.600	15.393	0.986	14.407	11.350	142.63
3.0							155.88
4.0	7.870	6.950	11.278	0.557	10.721	7.410	186.23
6.0							228.39
8.0	5.380	5.750	8.221	0.513	7.709	5.565	279.73
12.0							368.09
16.0							431.00

SPACING	---------- ERRORS ---------	
	OBSERVED	OFFSET
0.5	-0.143	32.000
1.0	-0.289	23.048
1.5		
2.0	0.091	13.216
3.0		
4.0	0.390	12.416
6.0		
8.0	-0.036	-6.649
12.0		
RMS:	0.230	19.638

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	115.000	95.300	162.000	10.500	151.000
1.0	112.000	92.500	157.000	10.400	147.000
2.0	122.000	75.000	148.000	12.300	136.000
4.0	93.600	70.500	117.000	8.350	109.000
8.0	62.300	52.300	78.200	5.110	73.000

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	115.000	95.300	161.750	10.516	151.233	105.150	330.34
1.0	112.000	92.500	157.200	10.387	146.813	102.250	642.46
1.5							944.79
2.0	122.000	75.000	148.150	12.288	135.862	98.500	1237.79
3.0							1737.48
4.0	93.600	70.500	117.175	8.338	108.837	82.050	2062.15
6.0							2477.78
8.0	62.300	52.300	78.155	5.113	73.042	57.300	2880.22
12.0							3103.96
16.0							3165.13

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.309	18.735
1.0	-0.254	19.071
1.5		
2.0	-0.202	47.716
3.0		
4.0	-0.299	28.154
6.0		
8.0	0.115	17.452
12.0		
RMS:	0.246	28.596

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	55.200	66.000	97.200	3.390	93.800
1.0	31.200	91.800	93.800	7.400	86.300
2.0	37.900	77.600	92.600	3.870	88.800
4.0	33.900	66.300	79.000	4.570	74.400
8.0	28.100	55.000	61.500	4.670	56.800
16.0	19.400	32.500	37.000	1.590	34.800

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	55.200	66.000	97.195	3.390	93.805	60.600	190.38
1.0	31.200	91.800	93.750	7.404	86.346	61.500	386.42
1.5							599.78
2.0	37.900	77.600	92.635	3.869	88.766	57.750	725.71
3.0							949.82
4.0	33.900	66.300	78.985	4.571	74.414	50.100	1259.15
6.0							1754.04
8.0	28.100	55.000	61.485	4.671	56.814	41.550	2088.54
12.0							2552.26
16.0	19.400	32.500	36.692	1.603	35.089	25.950	2608.78
24.0							2872.12
32.0							3675.12

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.010	-17.822
1.0	0.107	-98.537
1.5		
2.0	-0.076	-68.745
3.0		
4.0	0.038	-64.671
6.0		
8.0	0.049	-64.741
12.0		
16.0	1.662	-50.482
24.0		
RMS:	0.681	65.415

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	84.500	96.000	112.000	10.400	102.000
1.0	44.500	50.400	61.200	4.770	56.500
2.0	34.400	29.200	49.000	1.580	47.500
4.0	28.600	19.900	39.600	1.310	38.300
8.0	29.200	18.300	36.900	1.530	36.500
16.0	29.000	14.700	33.000	2.810	30.100

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	84.500	96.000	112.200	10.381	101.818	90.250	283.53
1.0	44.500	50.400	61.235	4.767	56.468	47.450	298.14
1.5							320.55
2.0	34.400	29.200	49.040	1.579	47.461	31.800	399.61
3.0							468.16
4.0	28.600	19.900	39.605	1.310	38.295	24.250	609.47
6.0							894.64
8.0	29.200	18.300	37.456	1.507	35.950	23.750	1193.81
12.0							1733.94
16.0	29.000	14.700	32.955	2.814	30.141	21.850	2196.61
24.0							3094.80
32.0							3334.06

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	-0.357	-12.742
1.0	-0.114	-12.434
1.5		
2.0	-0.163	16.352
3.0		
4.0	-0.025	35.876
6.0		
8.0	-3.017	45.895
12.0		
16.0	0.273	65.446
24.0		
RMS:	1.248	37.106

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	48.700	54.300	77.400	3.850	73.500
1.0	42.100	36.300	56.500	4.000	52.500
2.0	31.000	25.000	38.300	2.800	35.400
4.0	17.600	16.700	24.800	1.110	23.700
8.0	13.500	14.700	23.600	1.030	22.600
16.0	14.100	17.700	24.900	2.900	22.000

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	48.700	54.300	77.375	3.851	73.524	51.500	161.79
1.0	42.100	36.300	56.500	4.000	52.500	39.200	246.30
1.5							318.08
2.0	31.000	25.000	38.250	2.804	35.446	28.000	351.86
3.0							402.98
4.0	17.600	16.700	24.805	1.110	23.695	17.150	431.03
6.0							525.19
8.0	13.500	14.700	23.615	1.029	22.586	14.100	708.74
12.0							1124.91
16.0	14.100	17.700	24.900	2.900	22.000	15.900	1598.45
24.0							2400.78
32.0							2452.96

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	0.065	-10.874
1.0	0.000	14.796
1.5		
2.0	0.261	21.429
3.0		
4.0	-0.040	5.248
6.0		
8.0	-0.127	-8.511
12.0		
16.0	0.000	-22.642
24.0		
RMS:	0.123	15.324

OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	77.100	54.900	100.000	4.710	95.400
1.0	53.200	44.300	71.800	4.420	67.400
2.0	36.600	34.000	48.300	3.810	44.400
4.0	25.000	19.800	31.300	1.940	29.500
8.0	18.700	13.400	25.400	1.210	24.300

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	77.100	54.900	100.055	4.707	95.348	66.000	207.3
1.0	53.200	44.300	71.810	4.419	67.391	48.750	306.3
1.5							393.3
2.0	36.600	34.000	48.255	3.814	44.441	35.300	443.5
3.0							532.3
4.0	25.000	19.800	31.370	1.936	29.434	22.400	562.9
6.0							653.9
8.0	18.700	13.400	25.455	1.207	24.247	16.050	806.7
12.0							1168.2
16.0							1648.2

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	-0.110	33.636
1.0	-0.028	18.256
1.5		
2.0	0.187	7.365
3.0		
4.0	-0.446	23.214
6.0		
8.0	-0.432	33.022
12.0		
RMS:	0.294	25.093

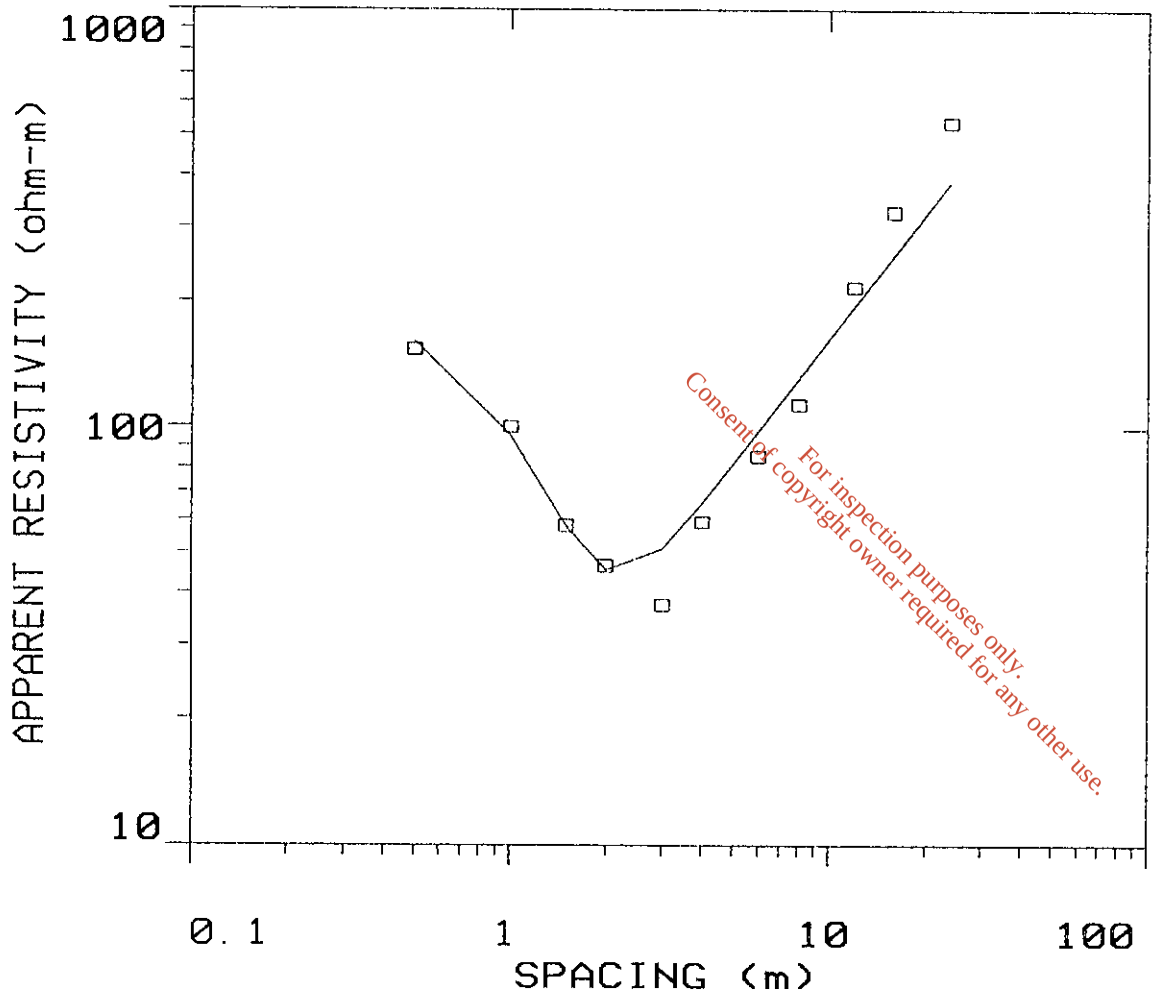
OFFSET WENNER FIELD READINGS:

SPACING	RD1	RD2	RA	RB	RC
0.5	57.400	48.500	73.900	5.860	68.400
1.0	36.200	34.600	47.900	3.910	44.200
2.0	24.600	25.000	34.600	2.060	32.600
4.0	17.800	17.300	26.400	0.960	25.500
8.0	12.300	15.500	21.000	1.040	20.100

SPACING ADJUSTED RESISTANCES

SPACING	WENNER1	WENNER2	RA	RB	RC	OFFSET	RHO-A
0.5	57.400	48.500	74.080	5.846	68.234	52.950	166.35
1.0	36.200	34.600	48.005	3.901	44.103	35.400	222.43
1.5							265.36
2.0	24.600	25.000	34.630	2.058	32.572	24.800	311.65
3.0							364.40
4.0	17.800	17.300	26.430	0.959	25.471	17.550	441.08
6.0							551.38
8.0	12.300	15.500	21.070	1.037	20.033	13.900	698.69
12.0							992.31
16.0							1233.16

SPACING	ERRORS	
	OBSERVED	OFFSET
0.5	-0.486	16.808
1.0	-0.437	4.520
1.5		
2.0	-0.173	-1.613
3.0		
4.0	-0.227	2.849
6.0		
8.0	-0.664	-23.022
12.0		
RMS:	0.436	12.990



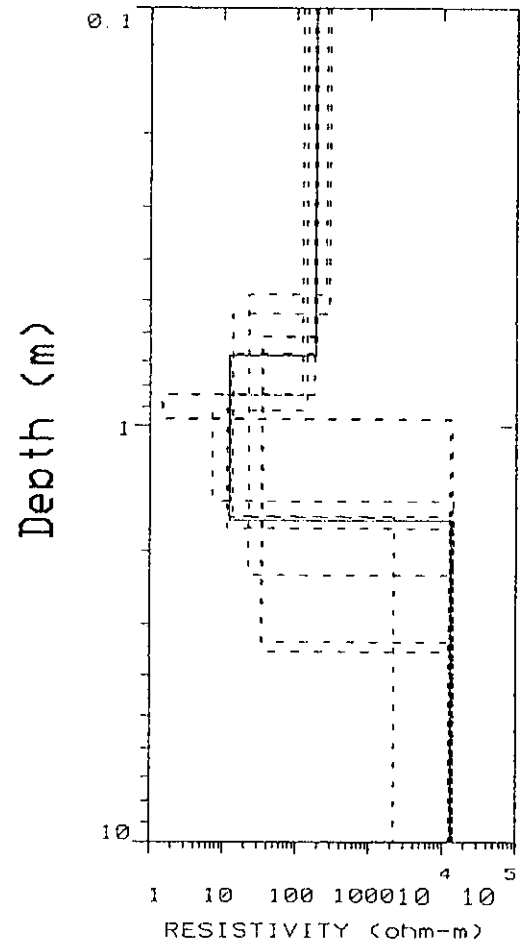
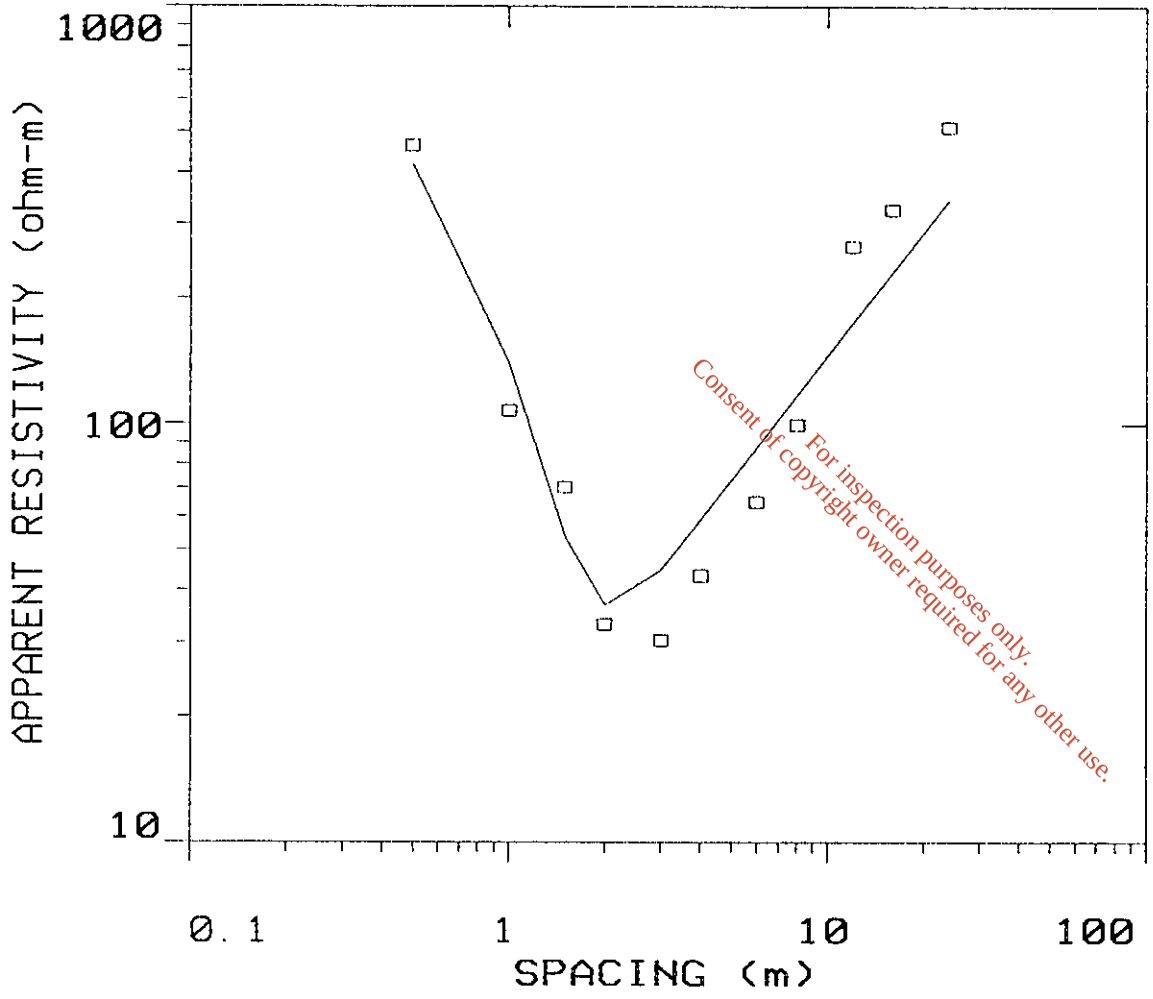


Plate: 1

FEHILY TIMONEY & CO>	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAUM-S1 / Date: FEB. 2000	
Equipment: OYO/Geocube / Sounding: 1	Azimuth: 360 deg N



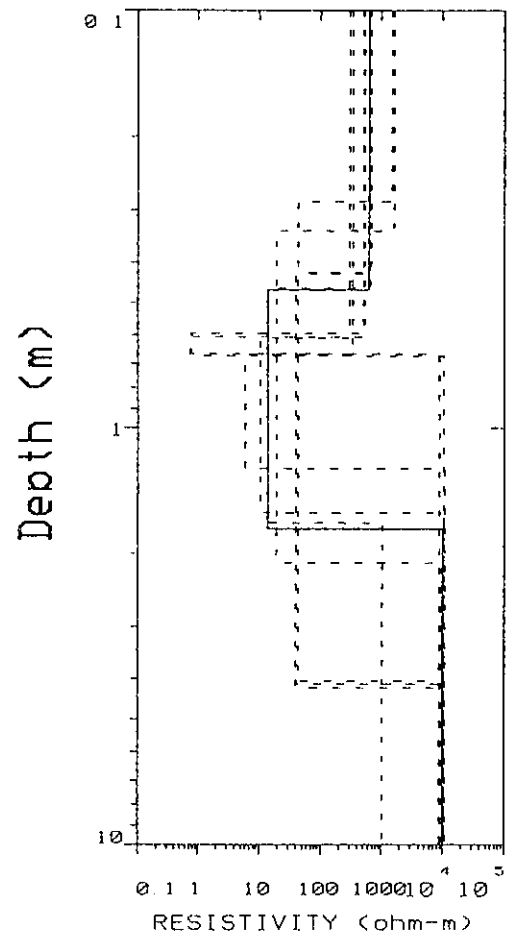
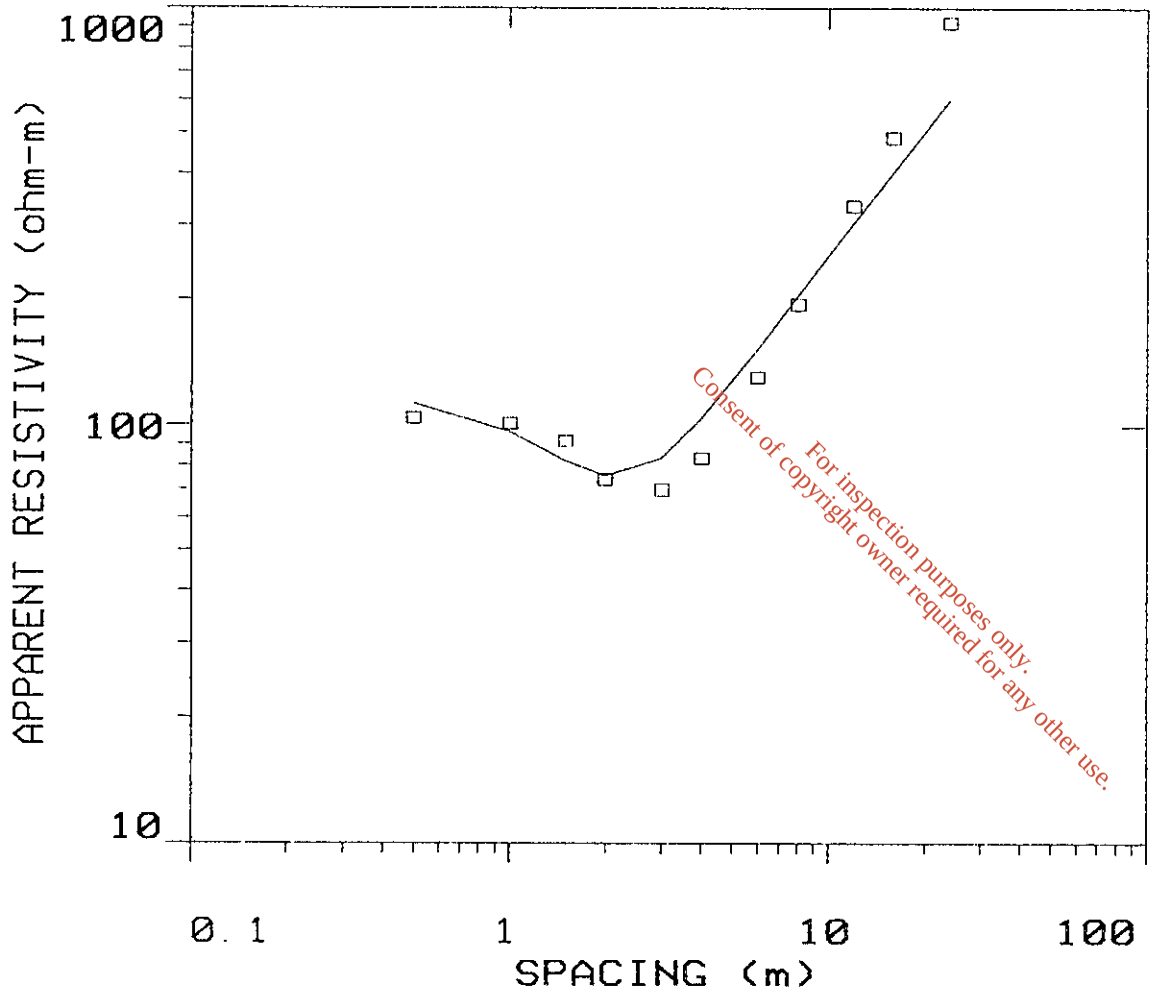


Plate: 2

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAUM-S2 / Date: Feb. 2000	
Equipment: OYO/Geomate / Sounding: 2	Azimuth: 360 deg N



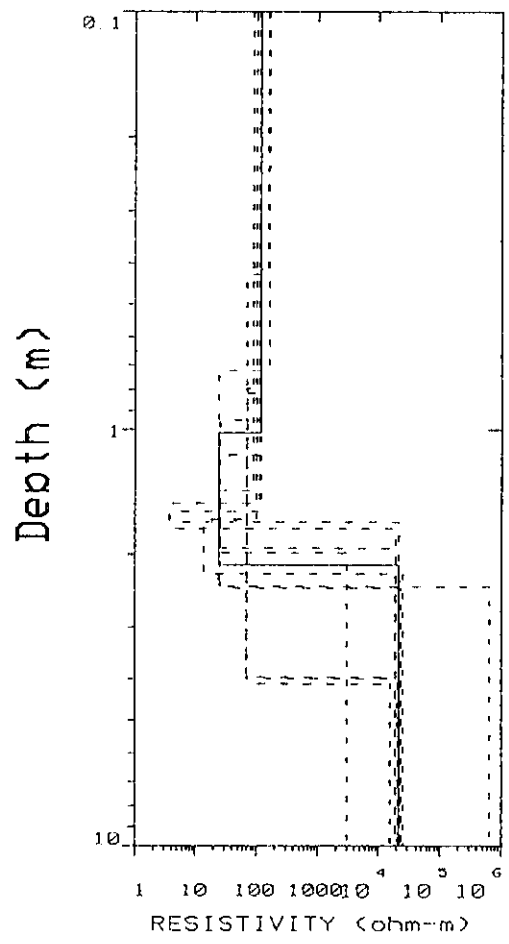
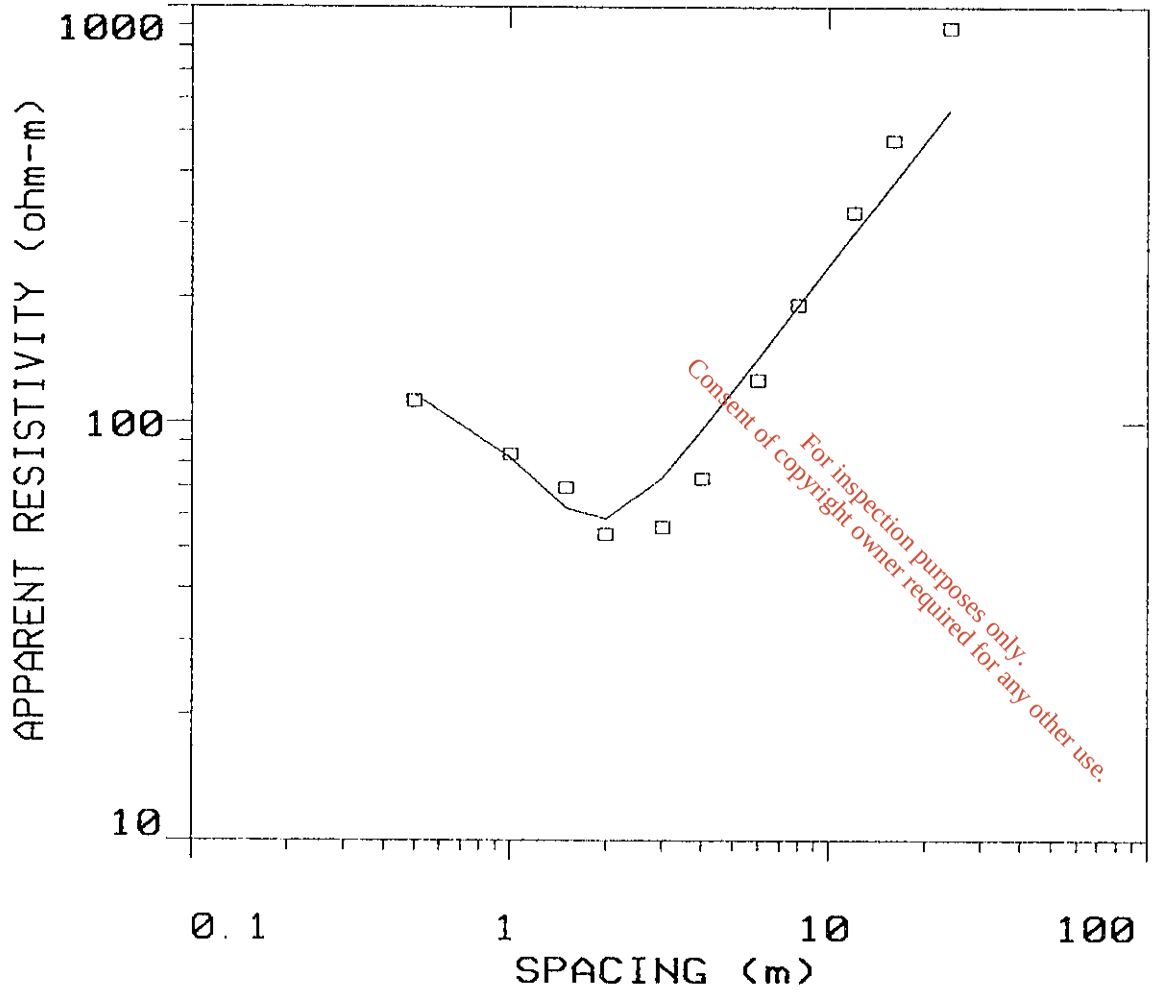


Plate: 3

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAUM-S3 / Date: Feb. 2000	
Equipment: [illegible] / Sounding: 3	Azimuth: 360 deg N



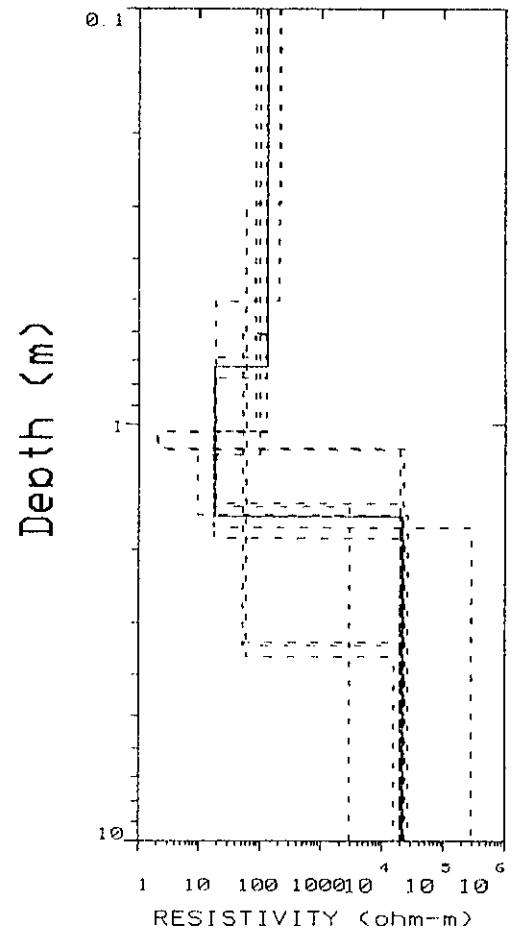
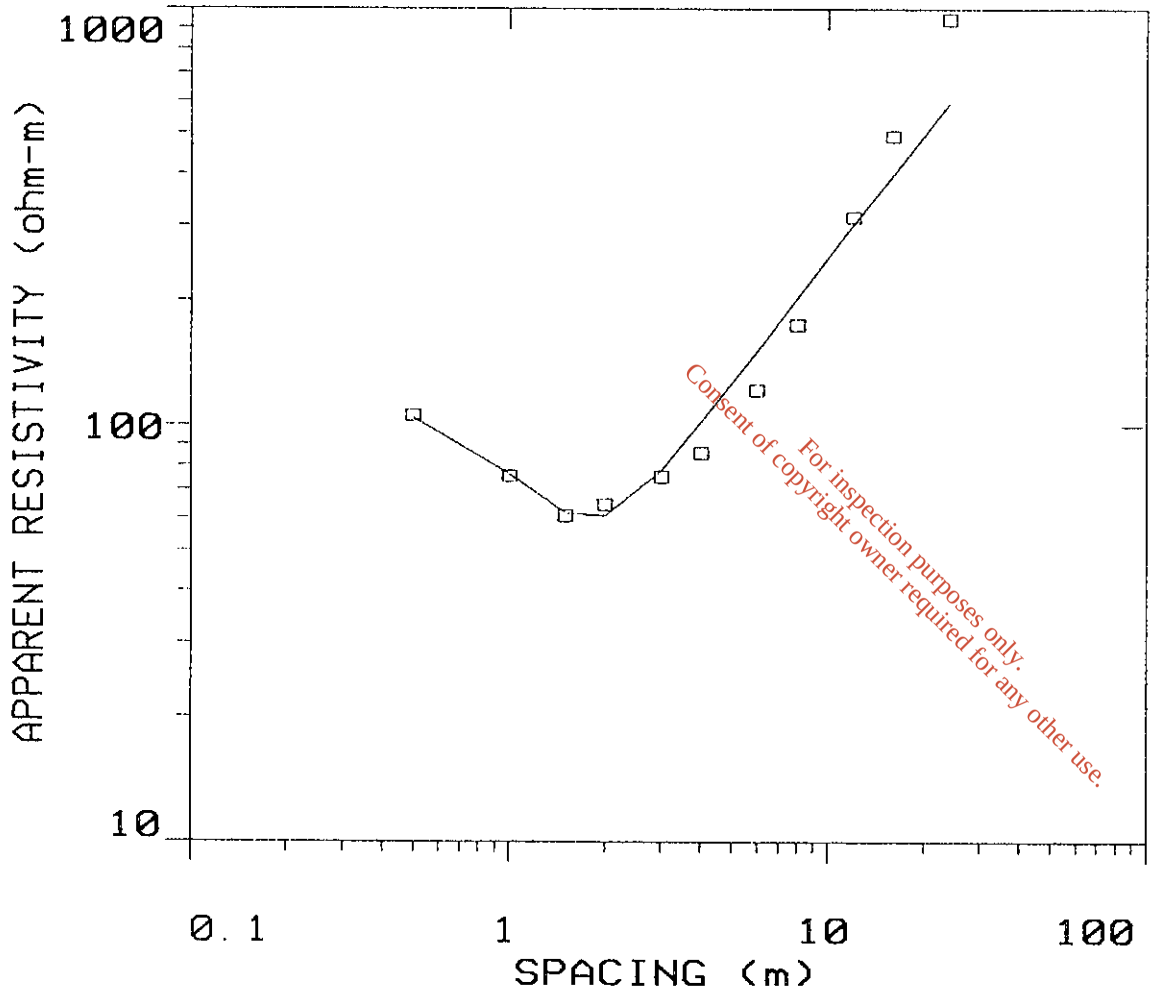


Plate: 4

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAUM-S4 / Date: Feb. 2000	
Equipment: OYO/SAS/Geosulis / Sounding: 4	Azimuth: 360 deg N



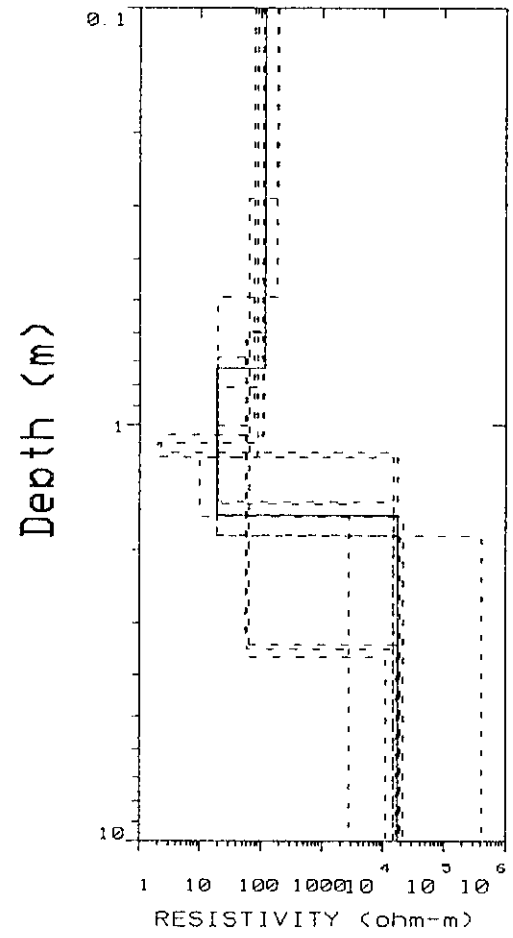
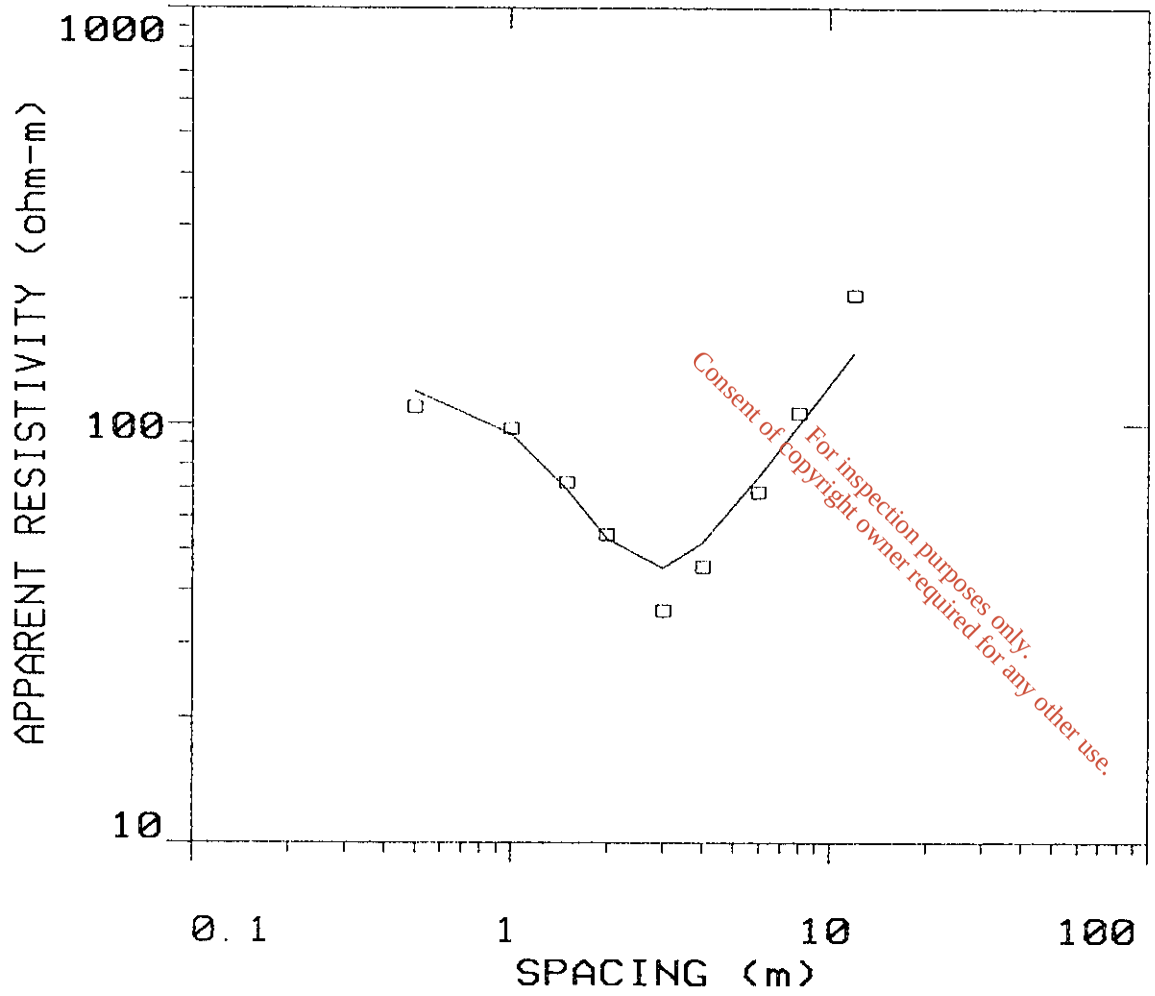


Plate: 5

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAUM-S5 / Date: Feb. 2000	
Equipment: ABEM/Geoarc	Sounding: 5 / Azimuth: 360 deg N



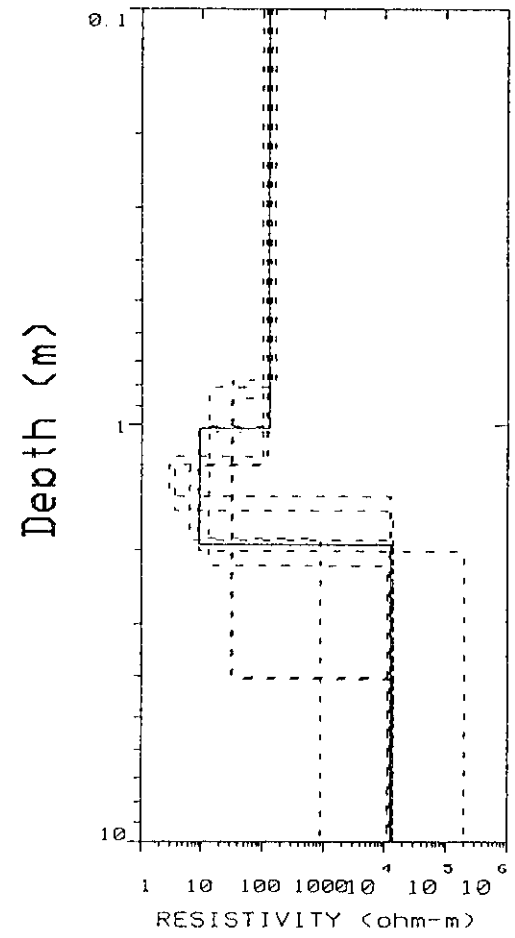
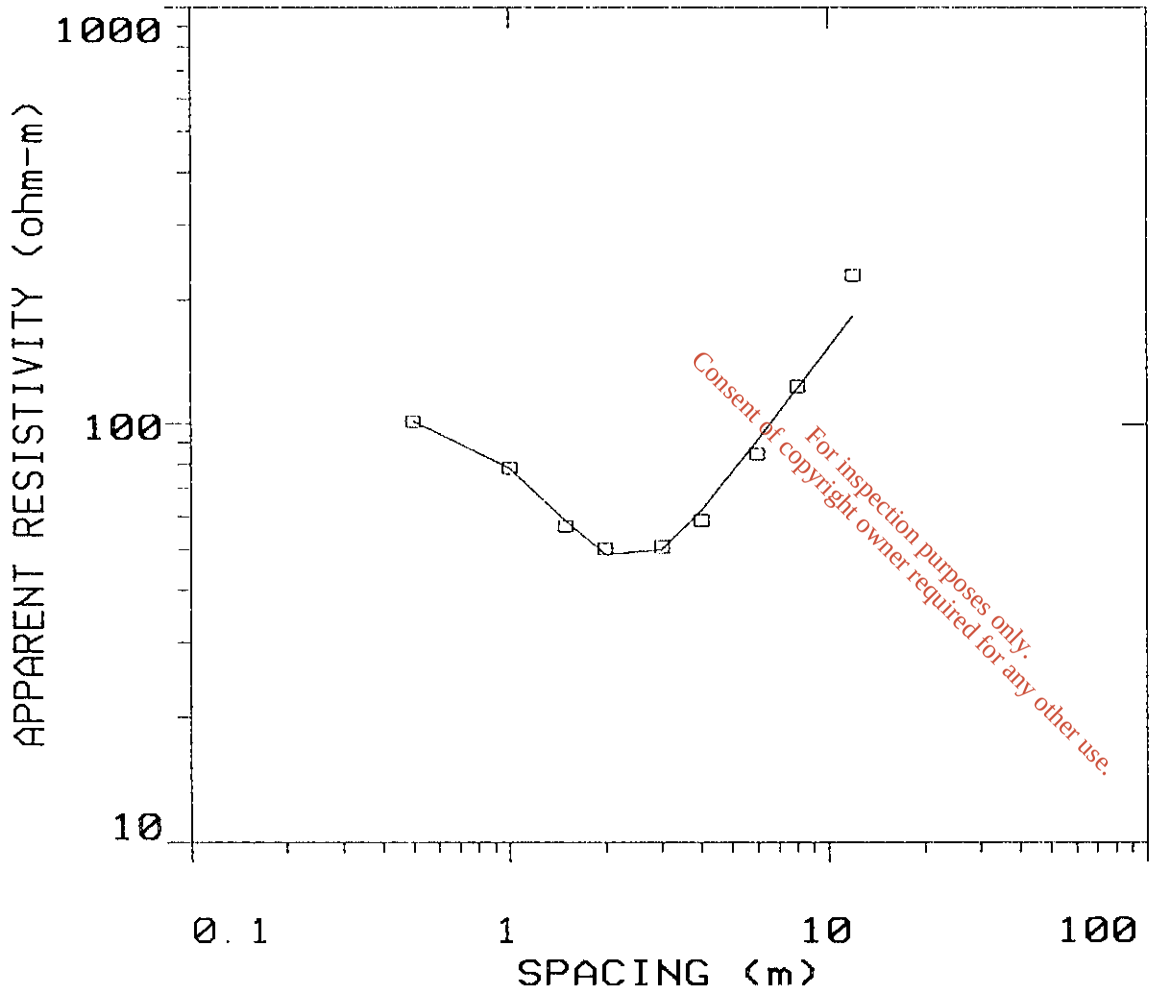


Plate: 6

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAUM-SG / Date: Feb, 2000	
Equipment: ABEM/Geometrics	Sounding: 6
	Azimuth: 360 deg N



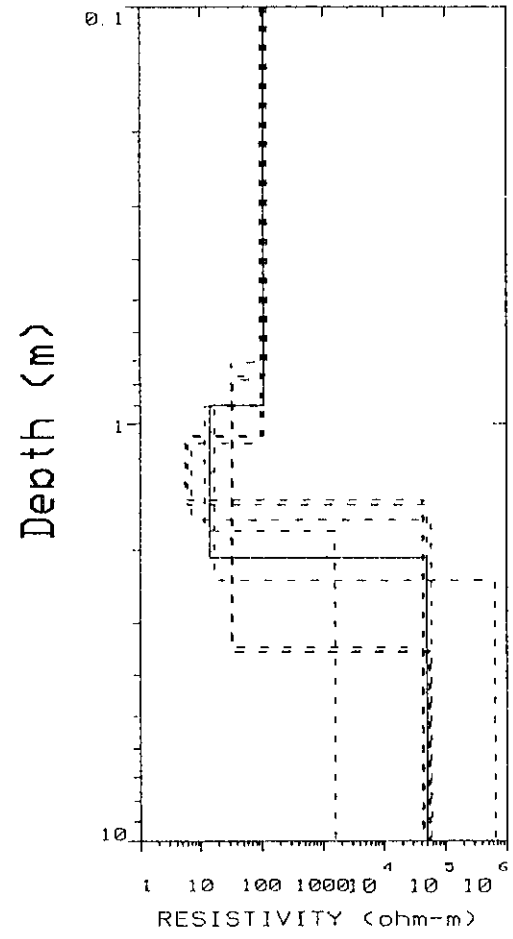
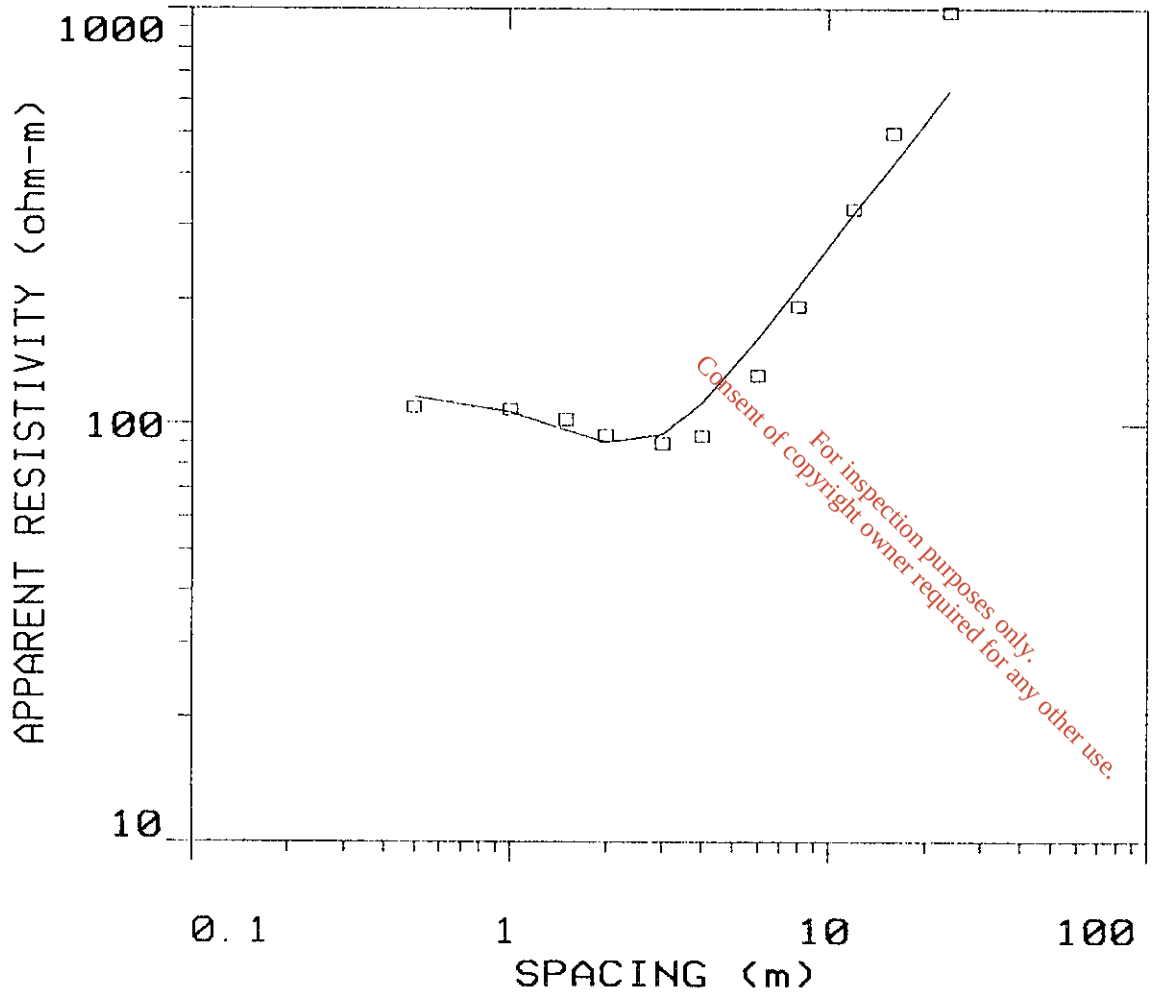


Plate: 7

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD	BEAUMONT QUARRY CORK
Data Set: BEAUM-S7 / Date: Feb. 2000	Azimuth: 360 deg N
Equipment: [illegible] / Sounding: 7	



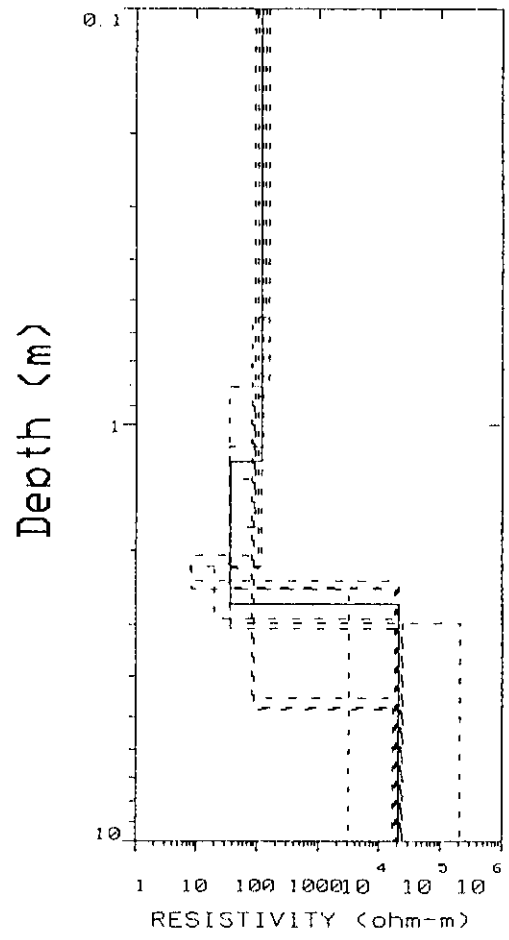
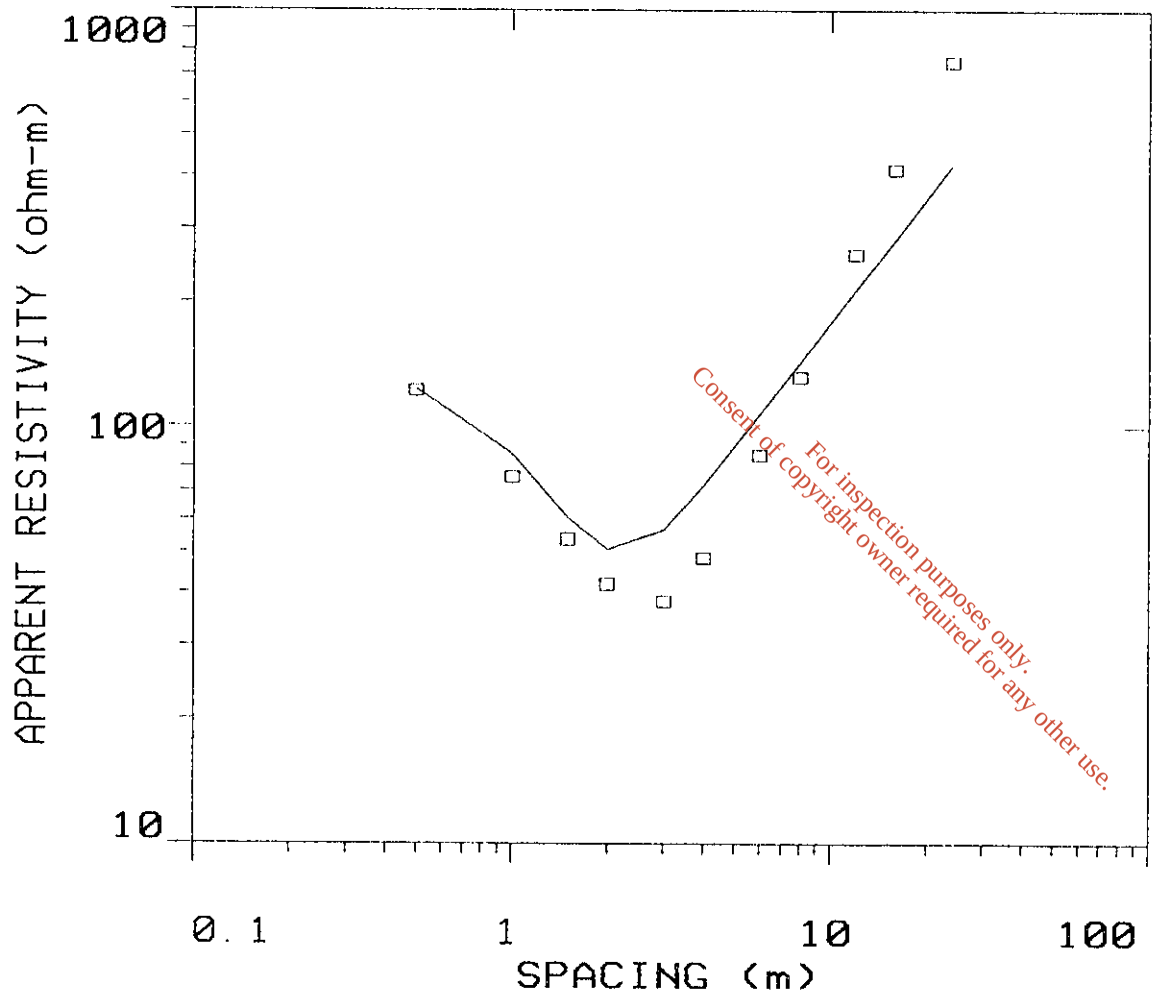


Plate: 8

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAUM-S8 / Date: Feb. 2000	
Equipment: OGI ZOND/Geoarc	Sounding: 8 / Azimuth: 360 deg N



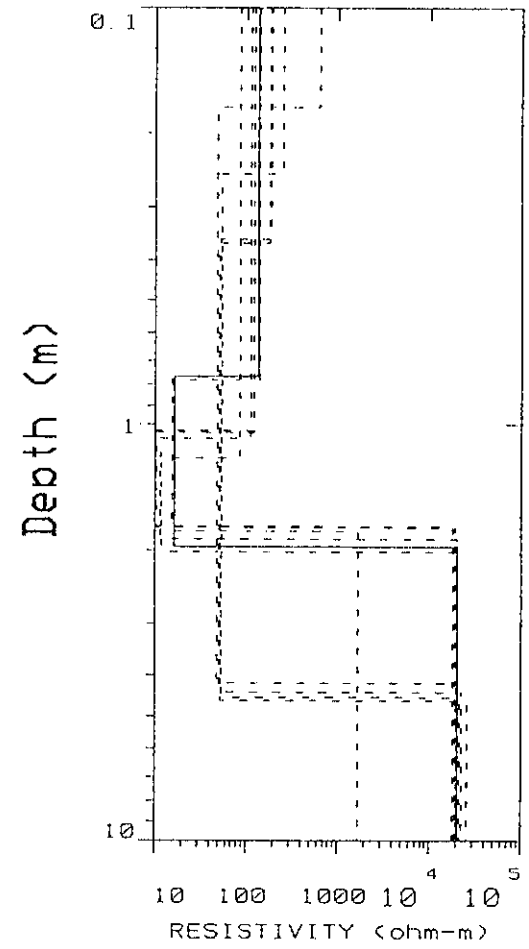
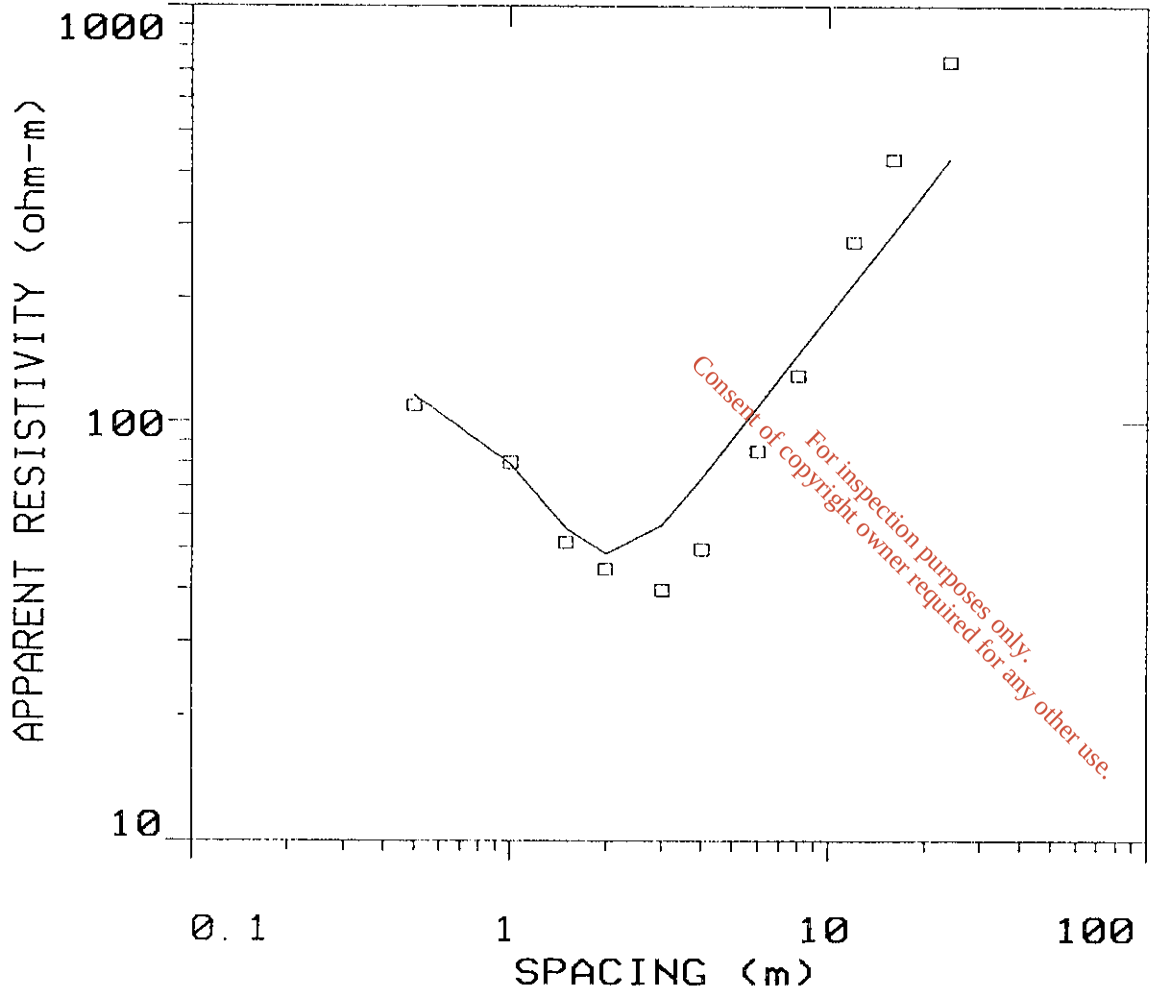


Plate: 9

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAUM-S9 / Date: Feb. 2000	
Equipment: MGS2S/Terrameter / Sounding: 9	Azimuth: 360 deg N



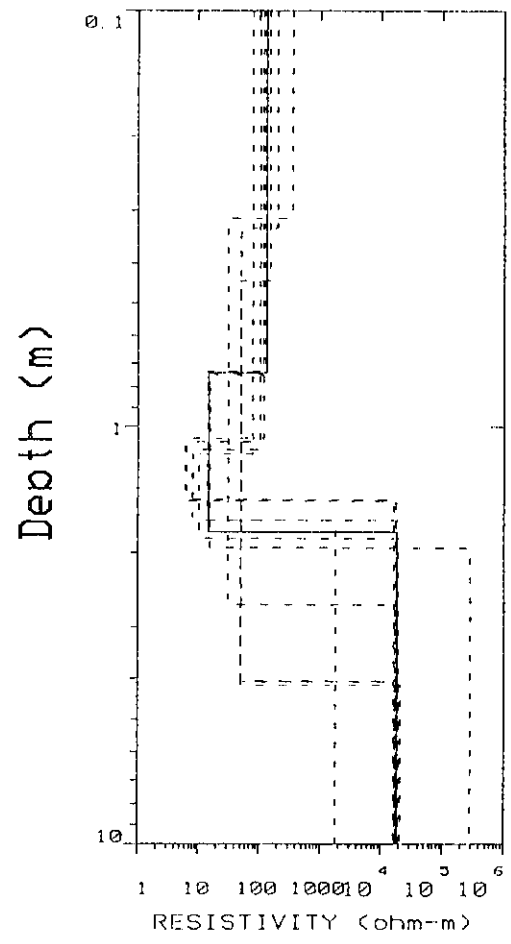
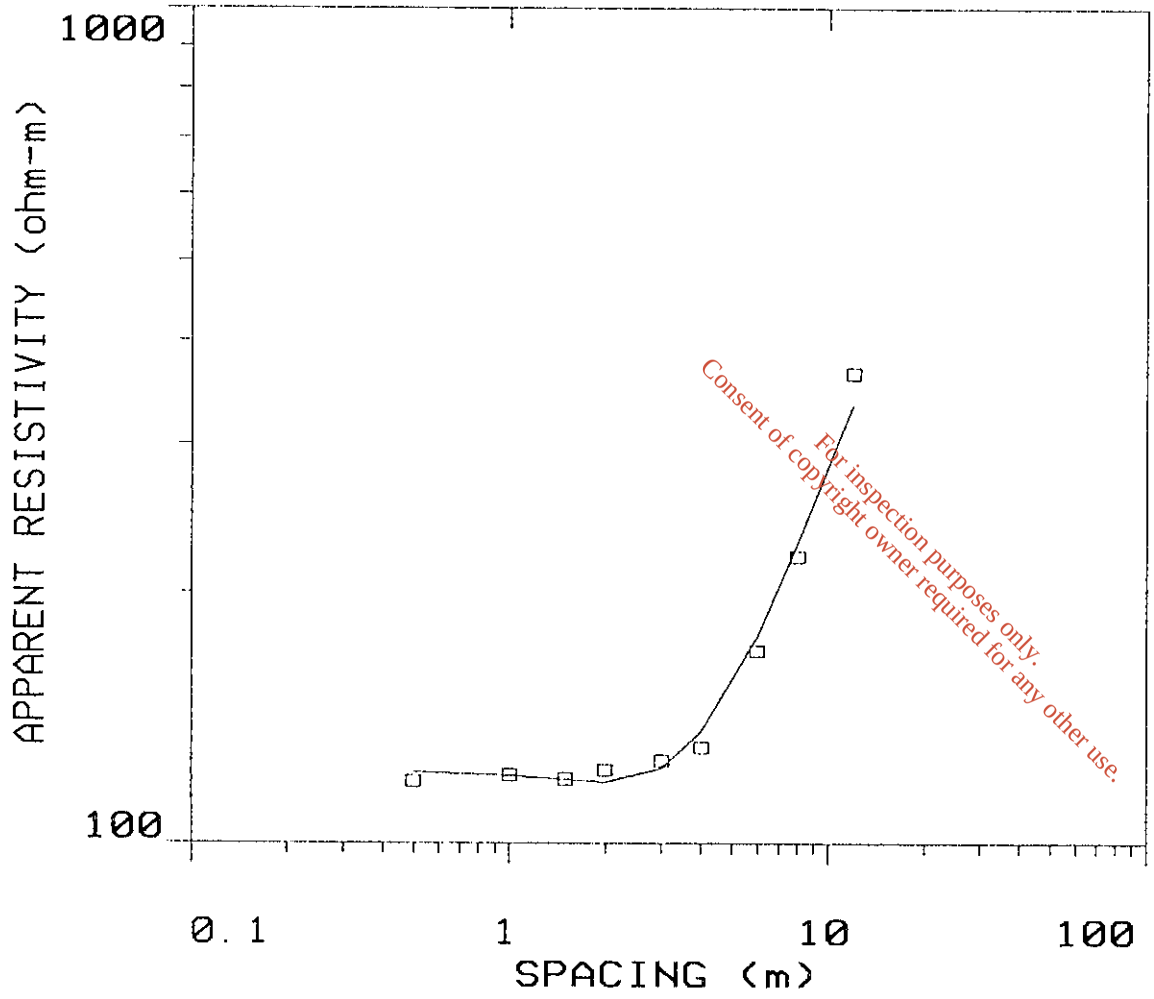


Plate: 10

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BCAU-S10 / Date: Feb. 2000	
Permanent: BG5256/Geoarc	Sounding: 10 / Azimuth: 360 deg N



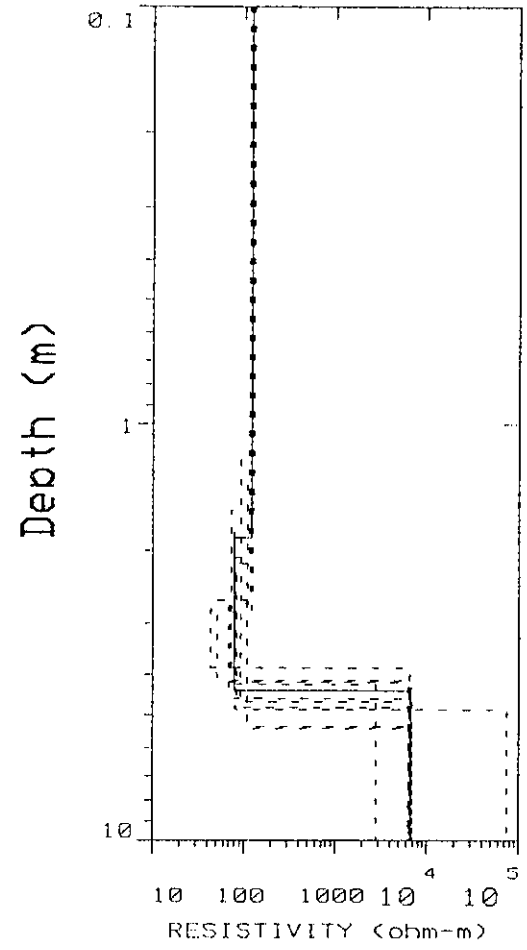
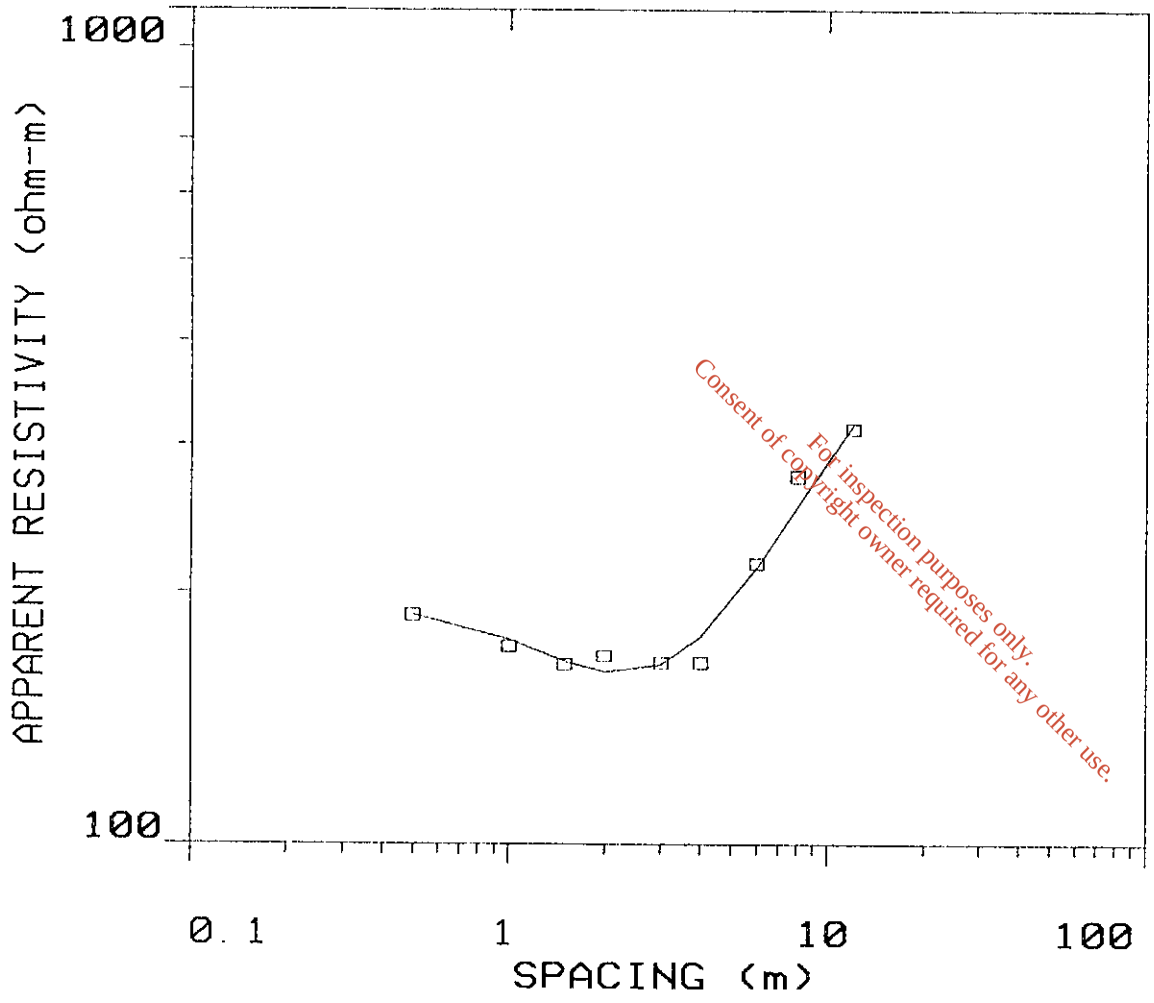


Plate: 11

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S11 / Date: Feb. 2000	
Equipment: ABEM SAS4000/Geoarc	Sounding: 11 / Azimuth: 360 deg N



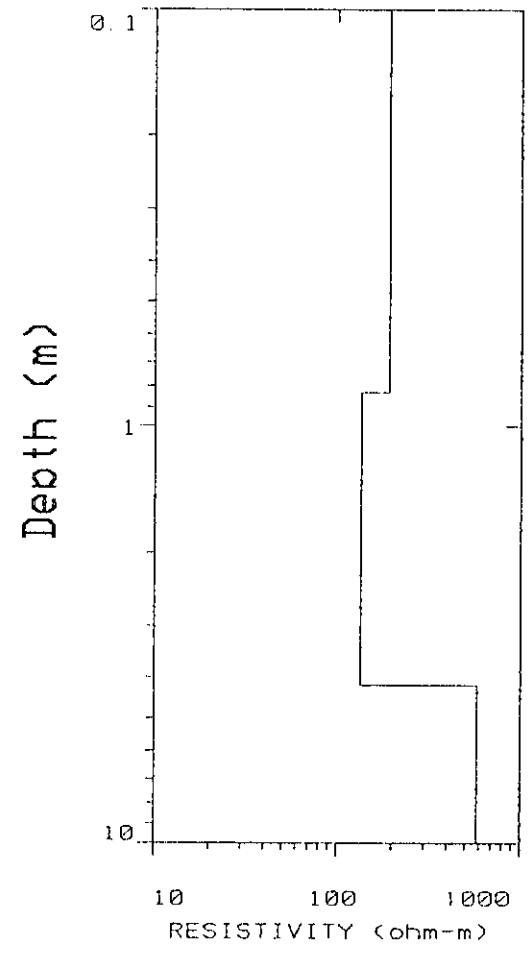
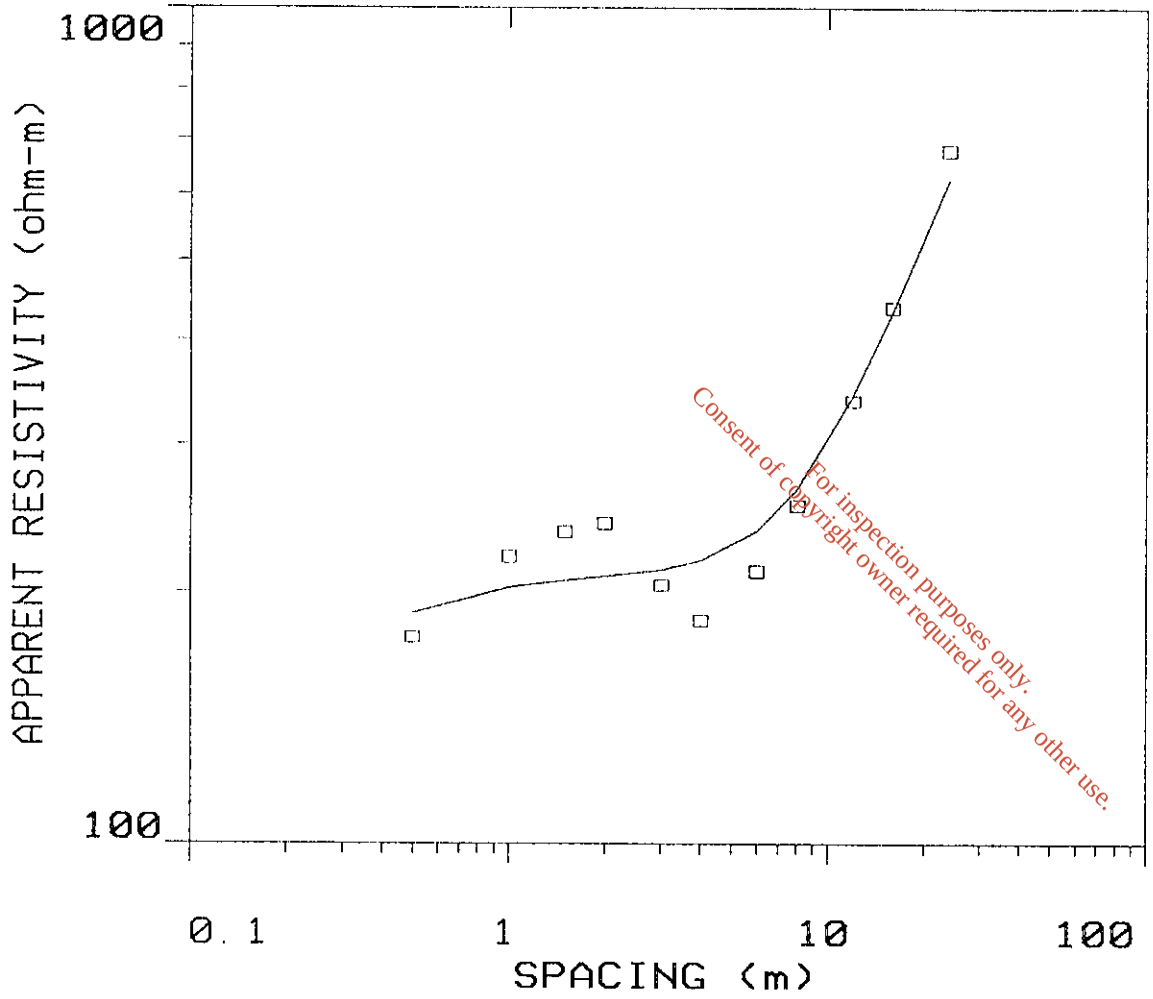


Plate: 12

FEHILY TIMONEY & CO.	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S12 / Date: Feb. 2000	
Equipment: ABEM/Geoarc / Sounding: 12	Azimuth: 360 deg N



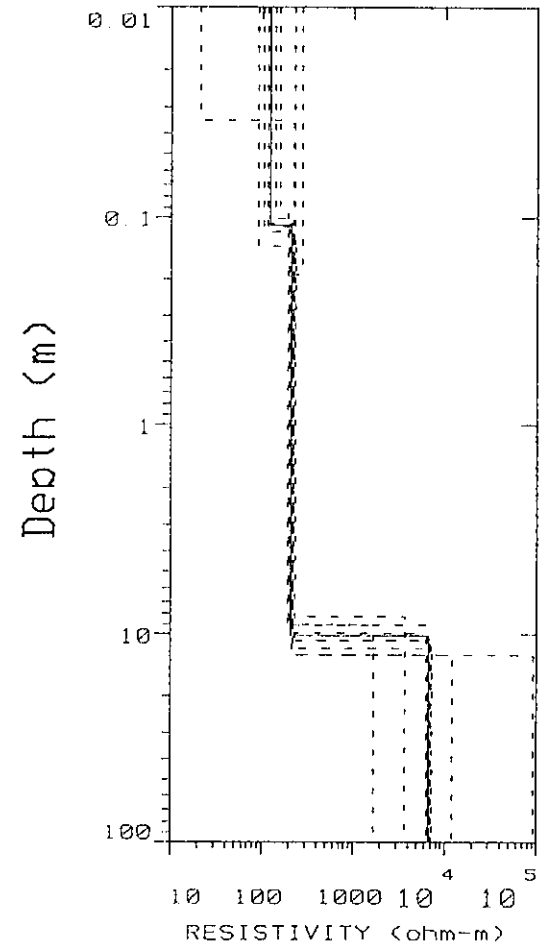
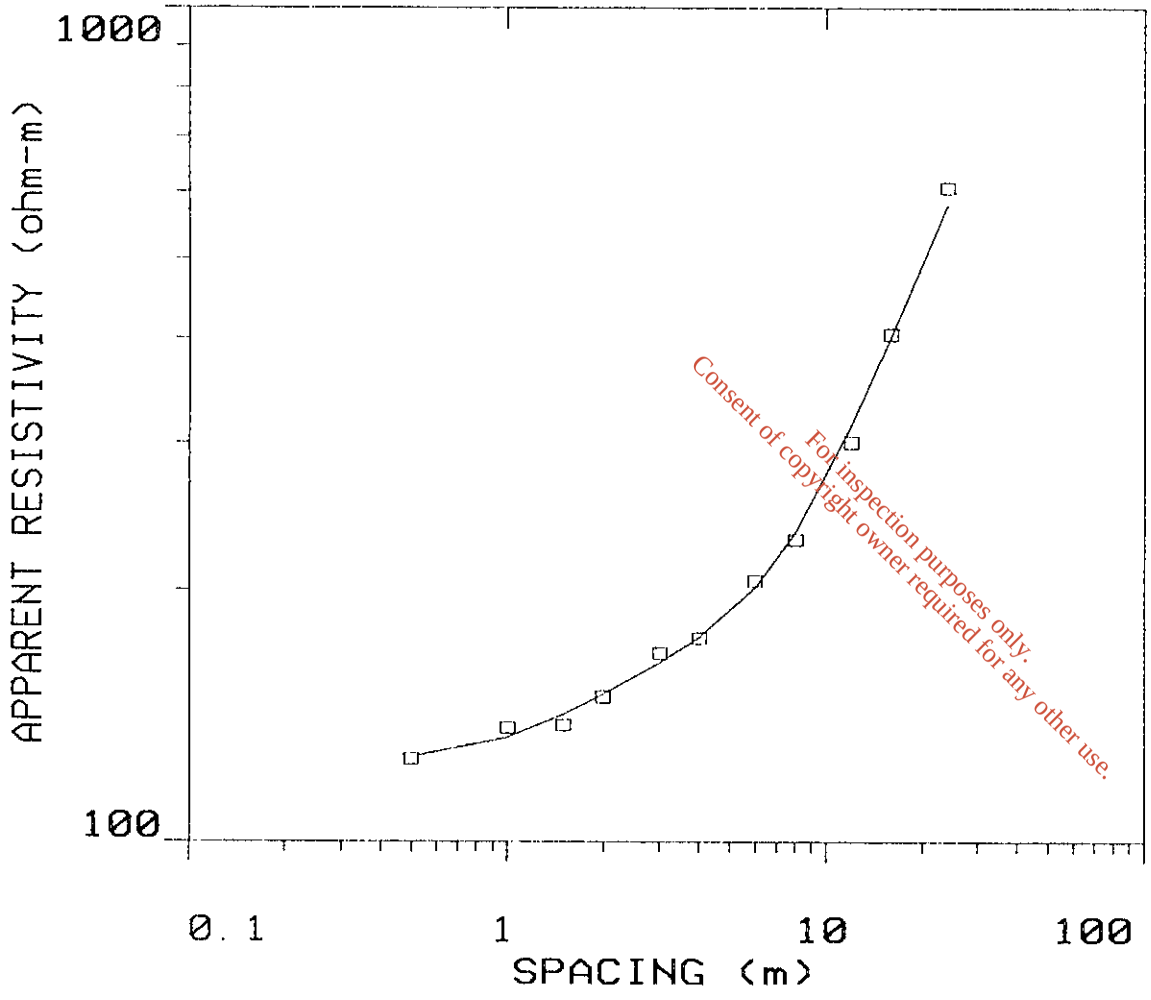


Plate: 13

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Date Set: MEAU-513 / Date: FEB. 2000	Azimuth: 360 DEG N
Equipment: ABEM/Geoscale / Sounding: 13	



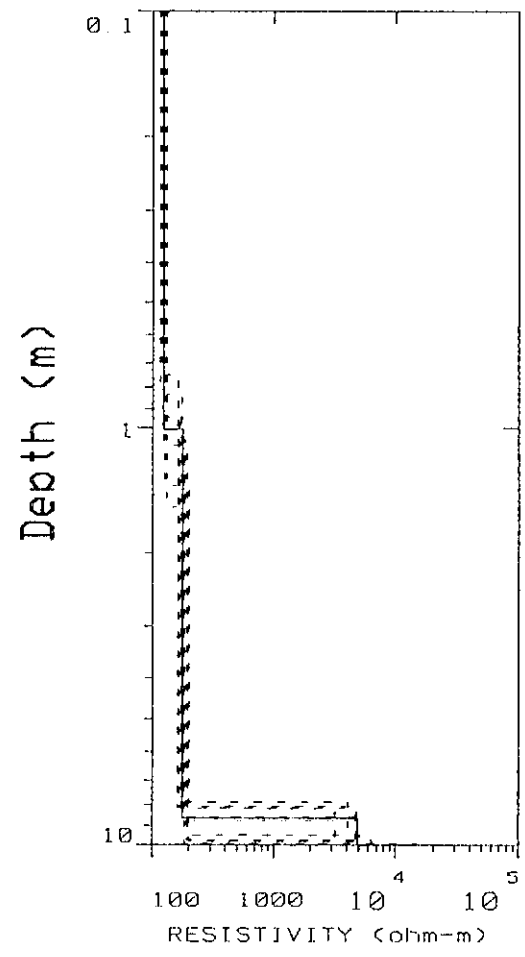
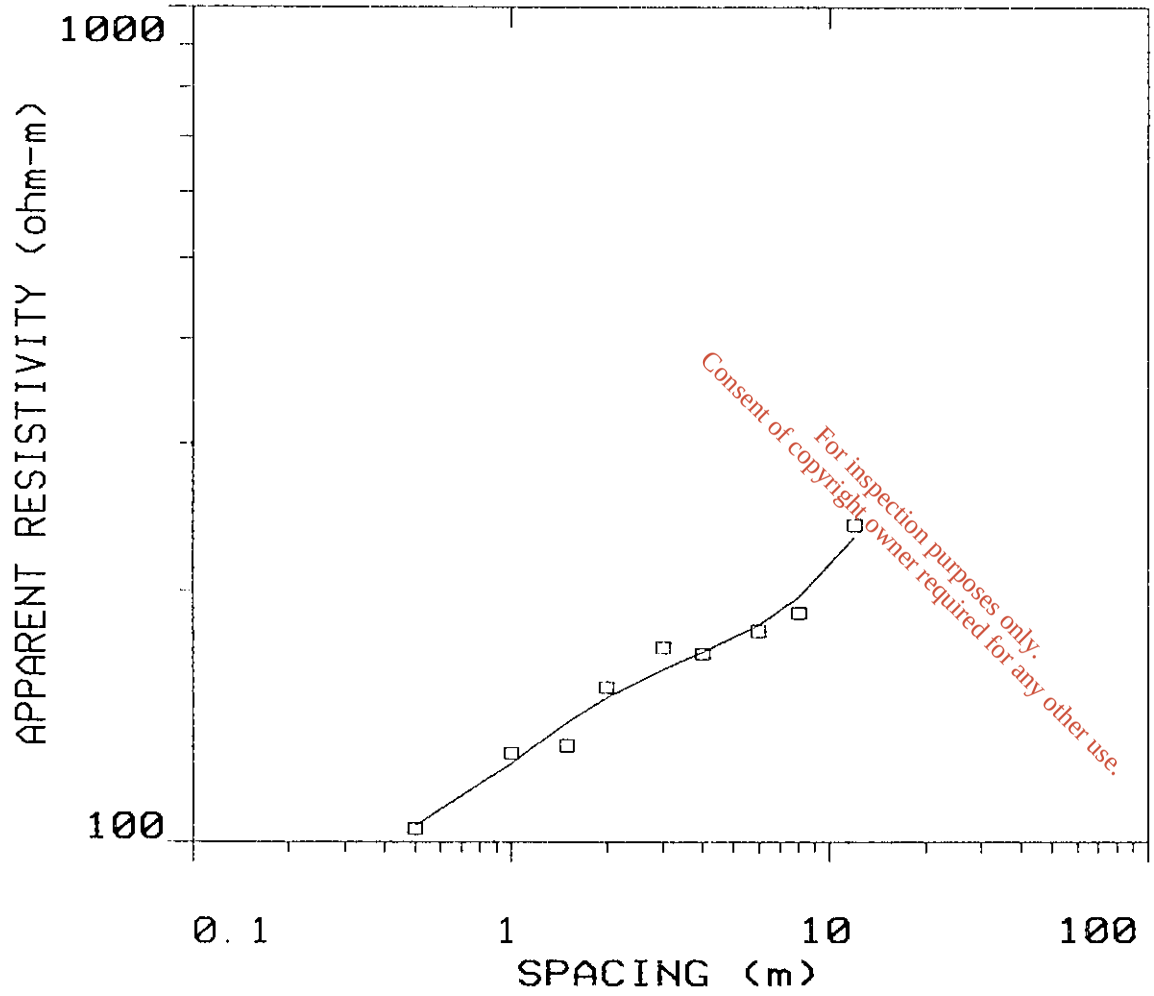


Plate: 14

FEHILY TIMONEY & CO	Depth to Bedrock Survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S14 / Date: FEB. 2000	
Equipment: RS20G/Gemini / Sounding: 14	Azimuth: 360 DEG N



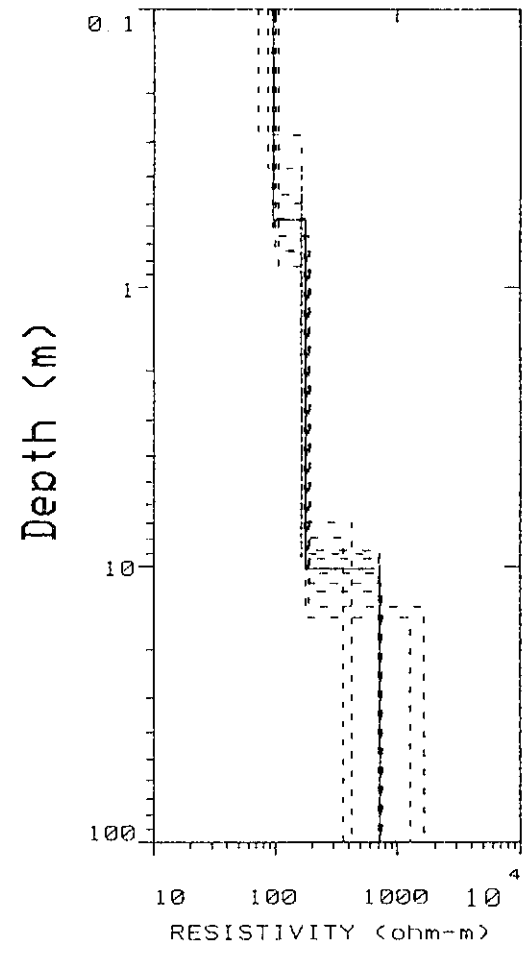
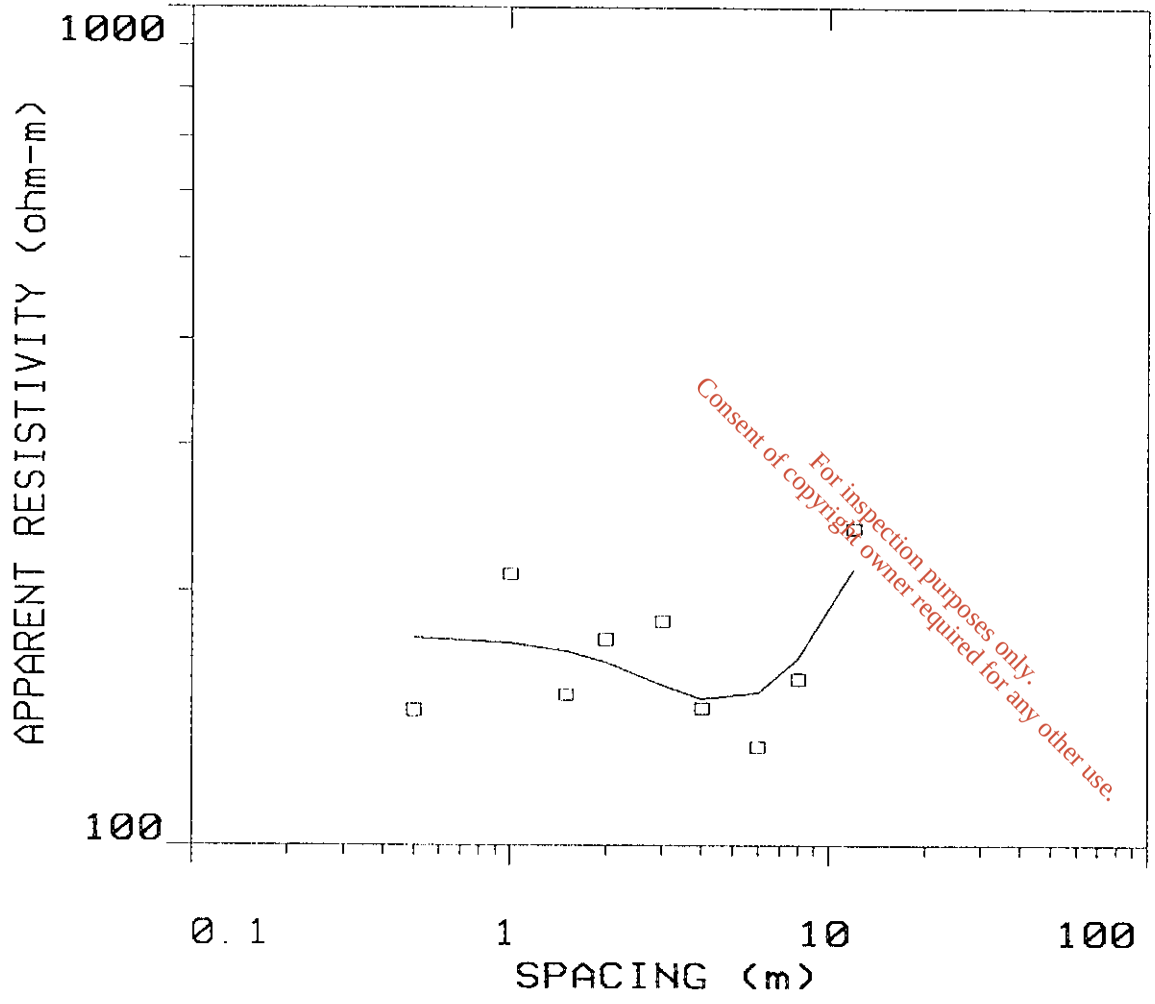


Plate: 15

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S15 / Date: FEB. 2000	
Equipment: ABEM/Geoarc / Sounding: 15	Azimuth: 360 deg. N



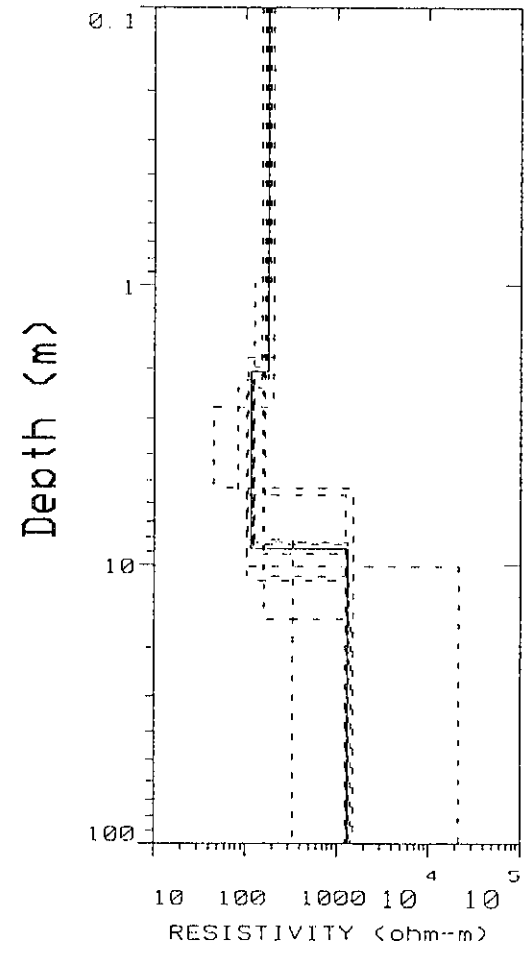
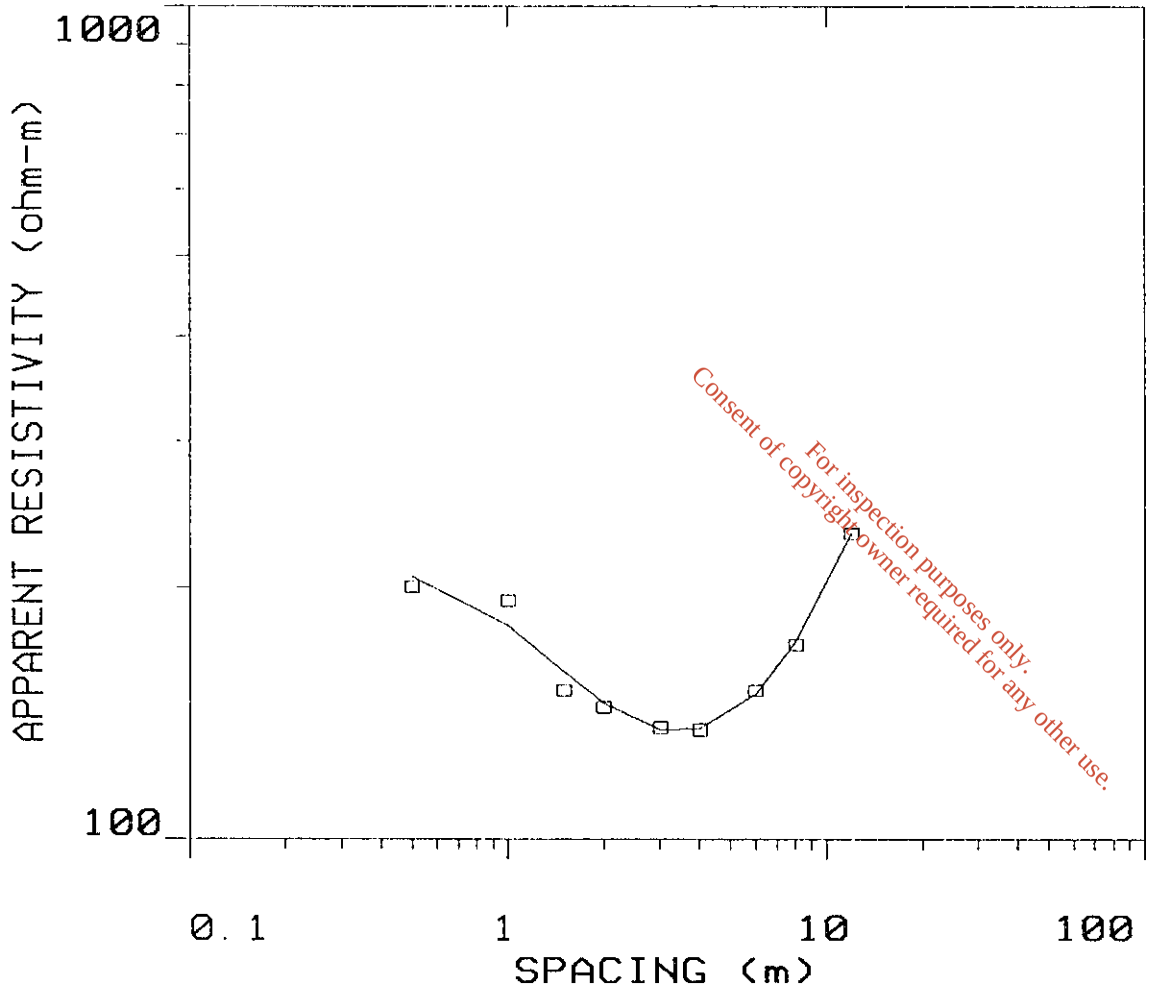


Plate: 16

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S16 / Date FEB. 2000	
Equipment: ABEM/Geonics / Sounding: 16	Azimuth: 360 DEG N



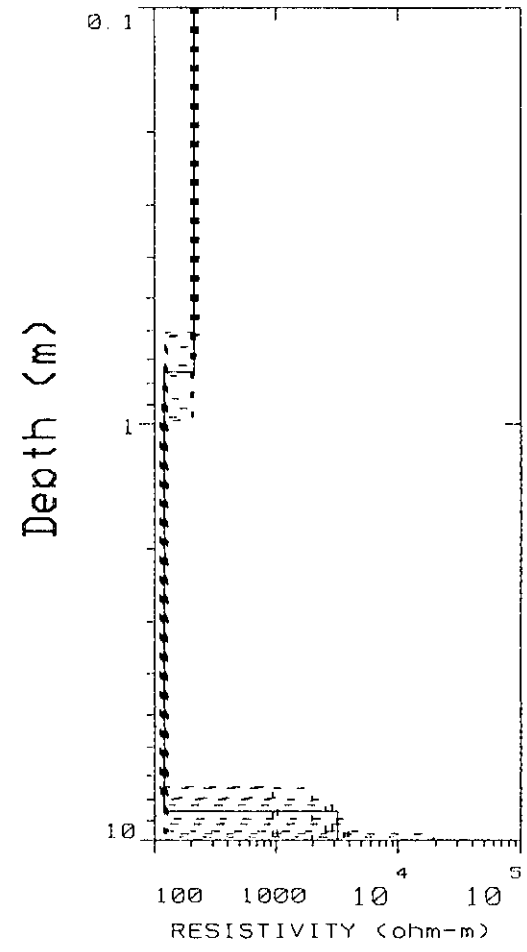
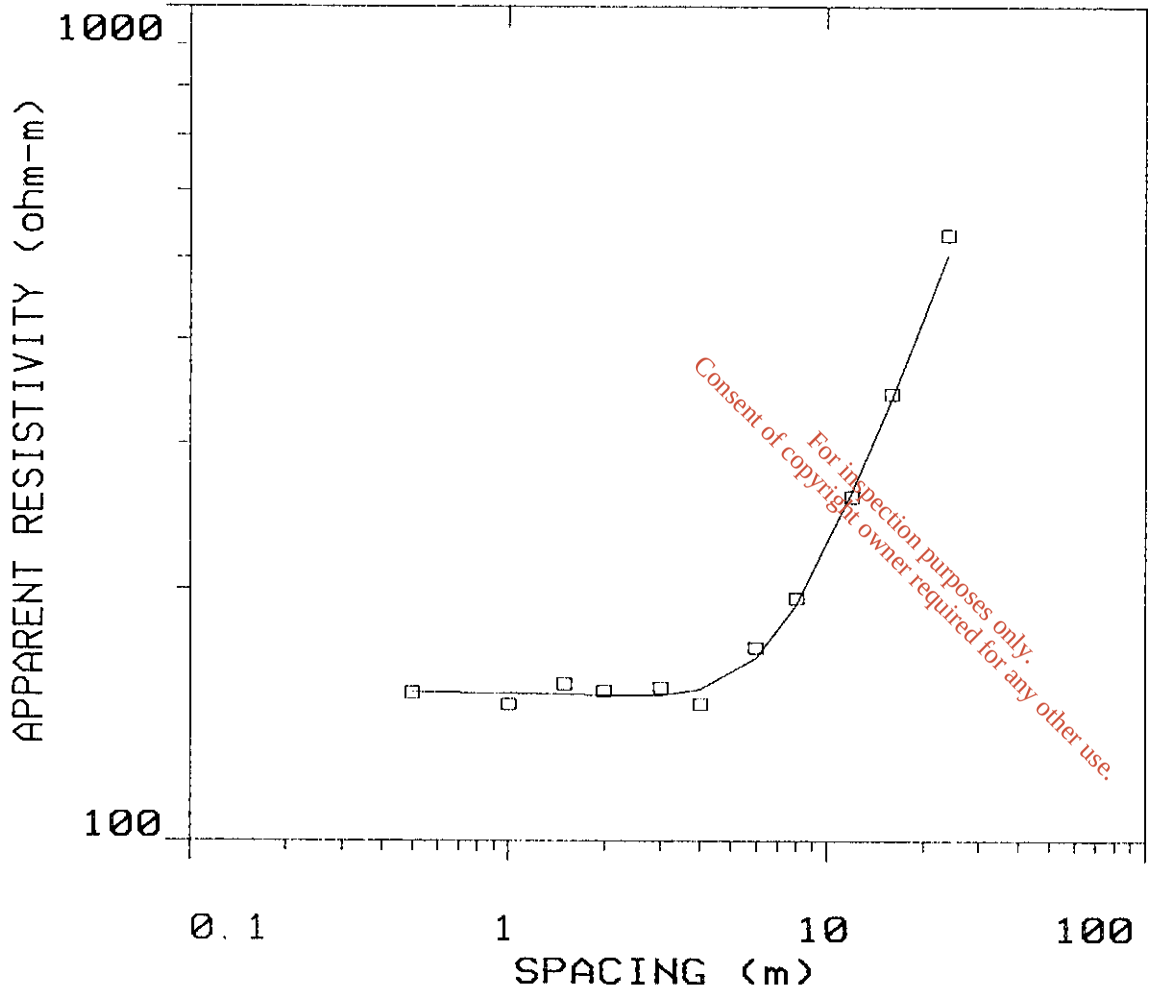


Plate: 17

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S17 / Date: FEB. 2000	
Equipment: IRIS/ABEM/Geoarc	Sounding: 17 / Azimuth: 360 deg. N



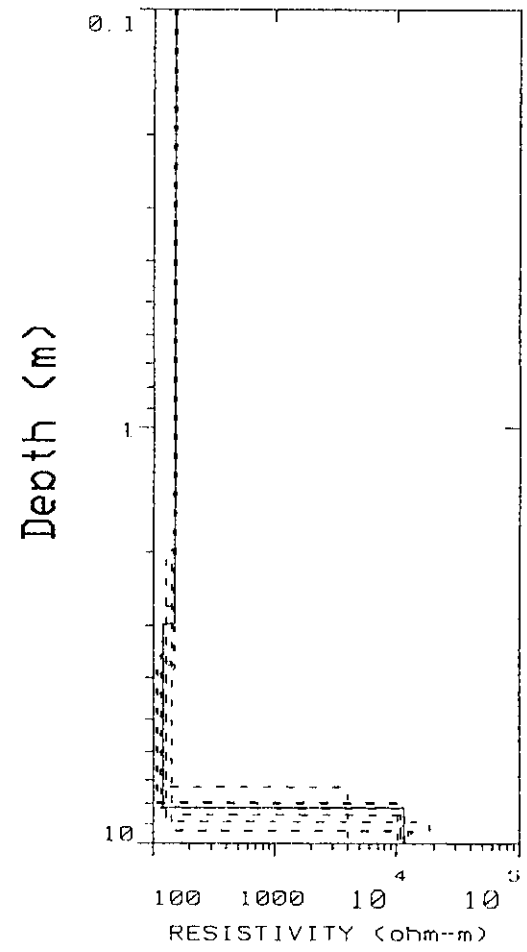
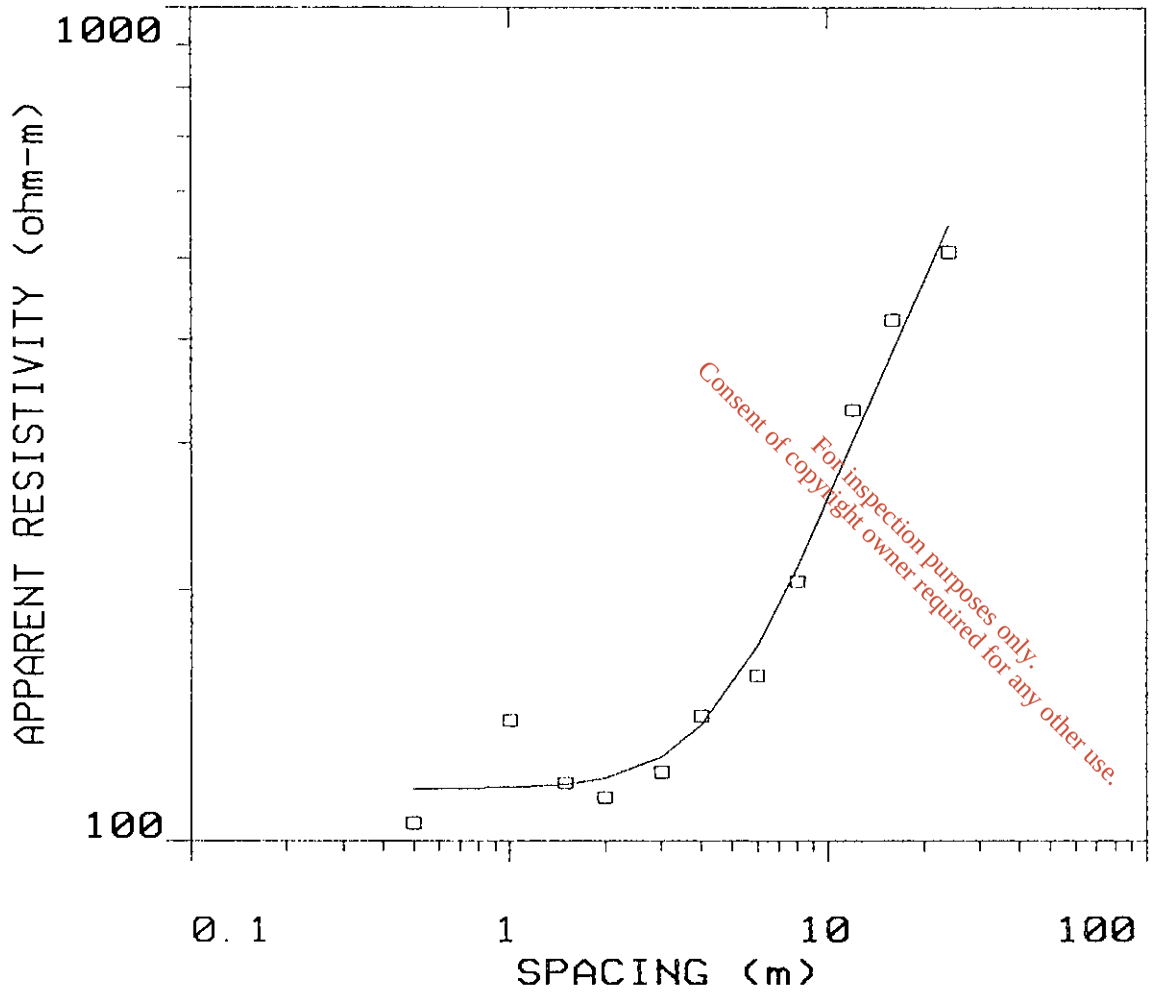


Plate: 18

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S18 / Date: FEB. 2008	
Equipment: ABEM SAS/Terrameter	Sounding: 18 / Azimuth: 360 deg. N



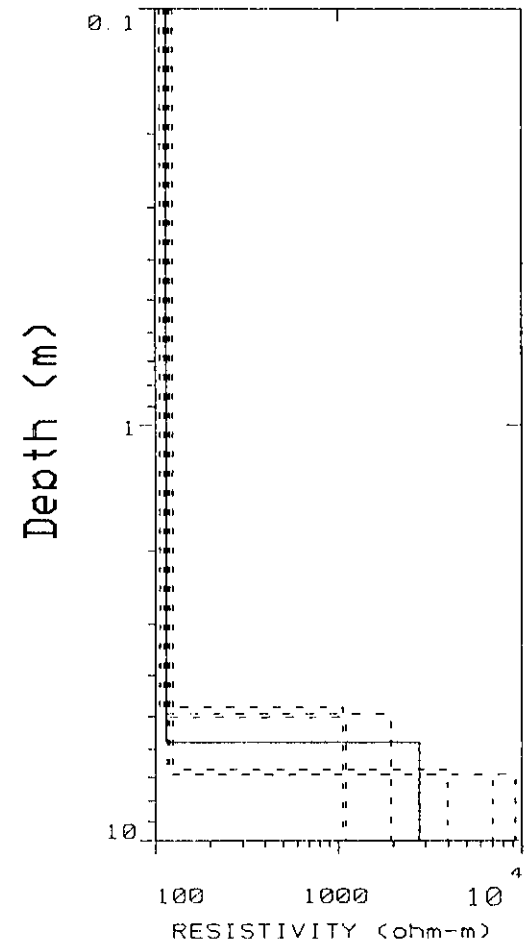
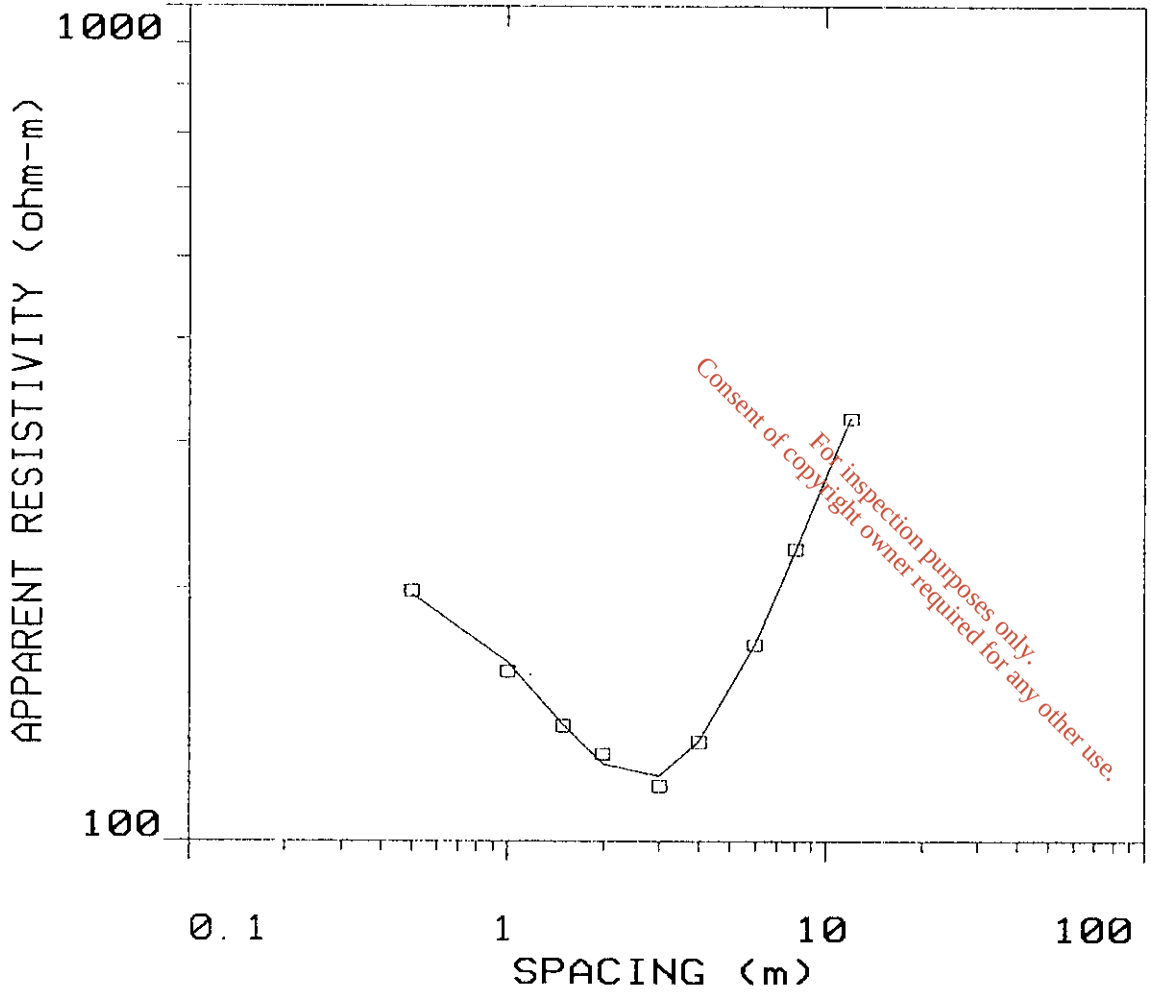


Plate: 19

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-519 / Date: FEB. 2000	Azimuth: 360 deg. N
Equipment: [illegible] / Sounding: 19	



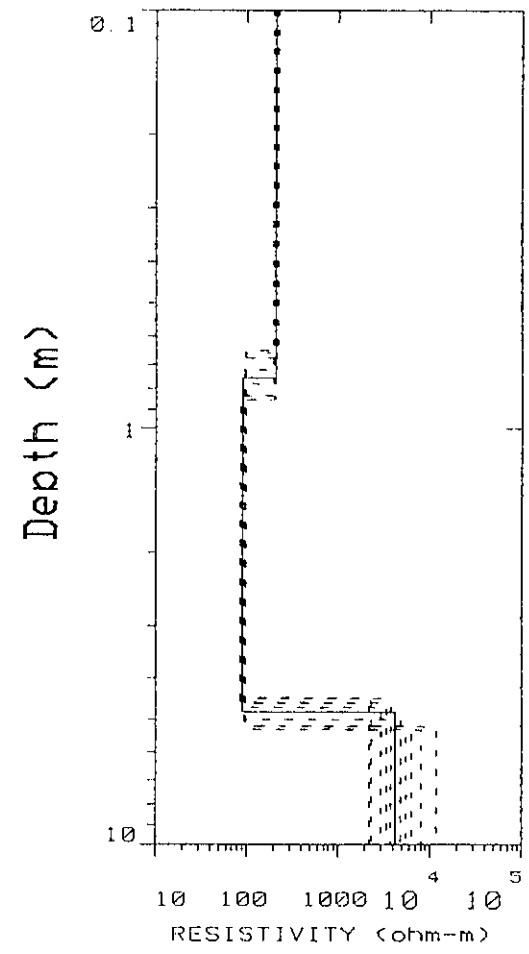
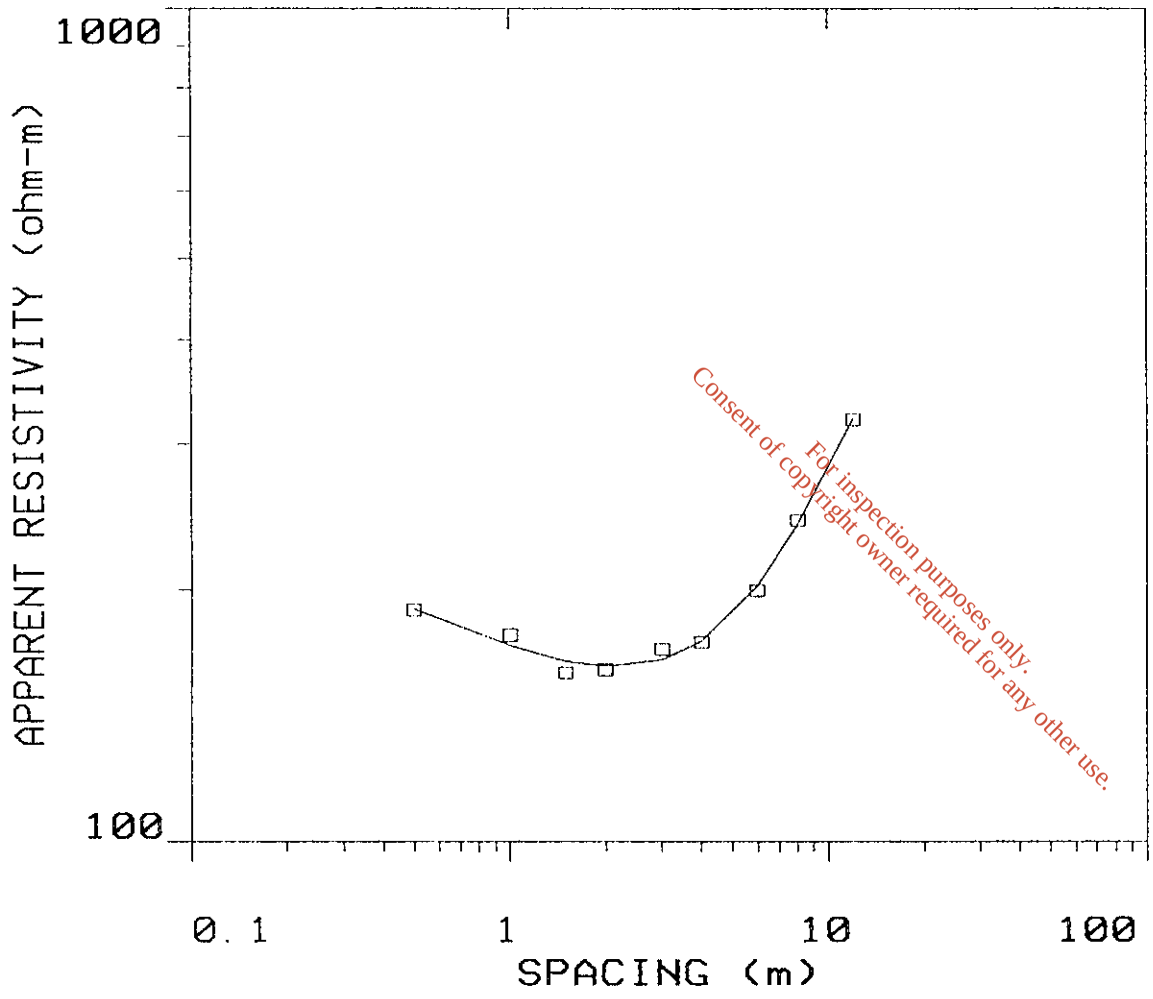


Plate: 20

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S20 / Date: FEB. 2000	
Equipment: MS20S/Geoarc	Sounding: 20 / Azimuth: 360 deg. N



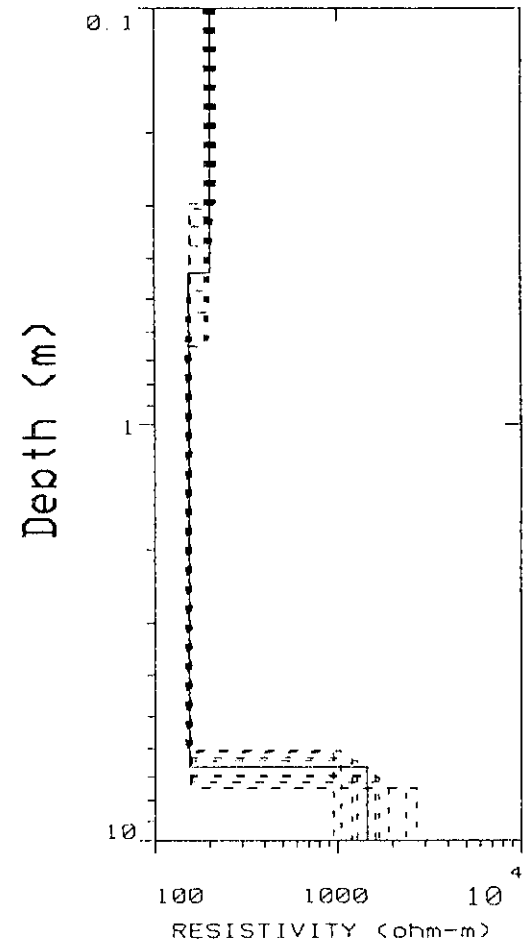
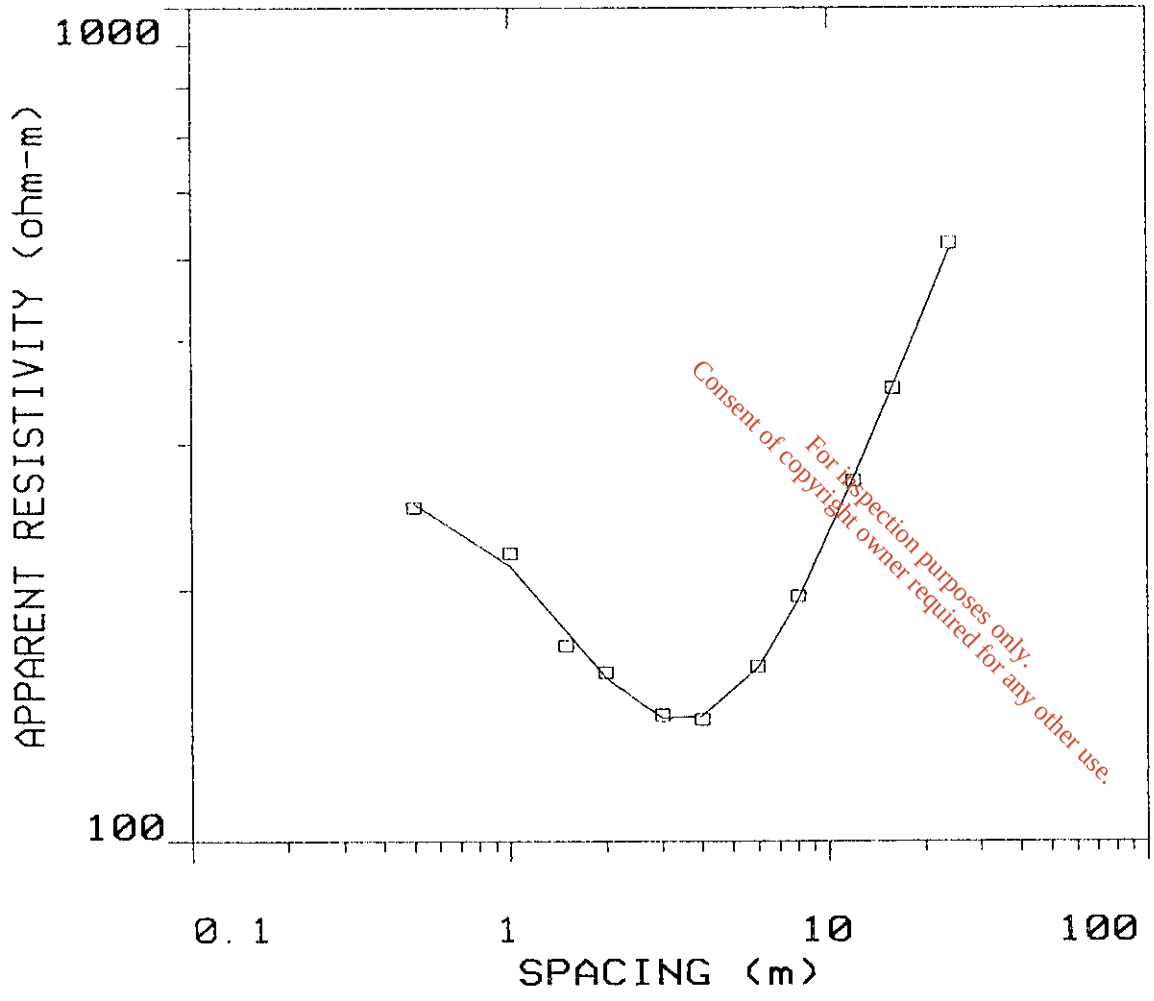


Plate: 21

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S21 / Date: FEB. 2000	
Equipment: ABEM/Geoarc / Sounding: 21	Azimuth: 360 deg. N



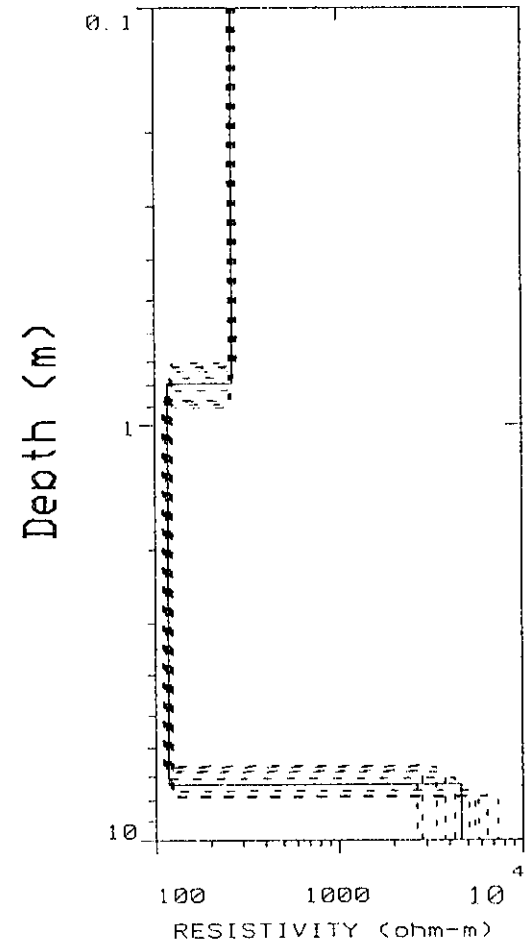
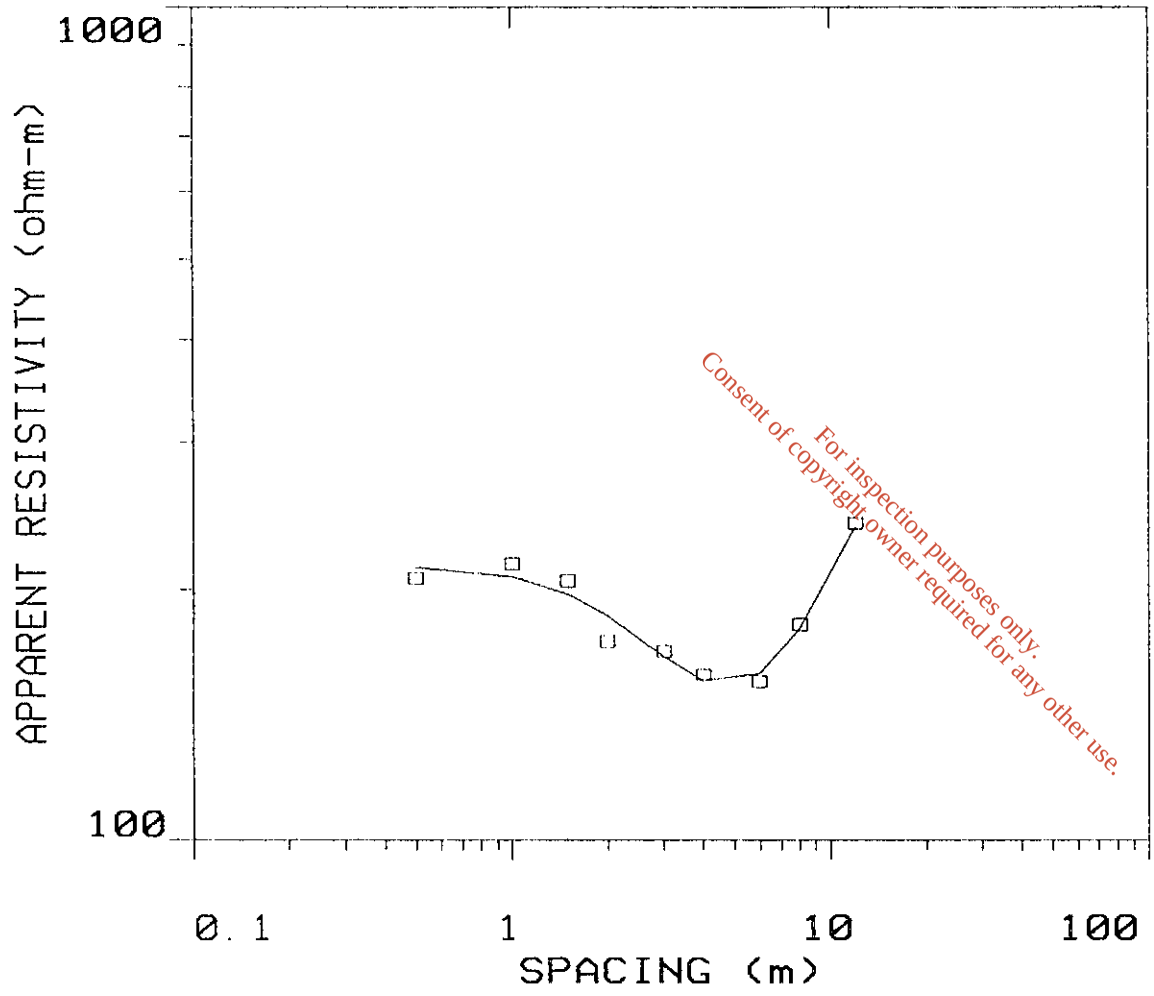


Plate: 22

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set. BEAU-S22 / Date. FEB. 2000	
Equipment. ABEM/Geoarc	Sounding. 22 / Azimuth. 360 deg. N



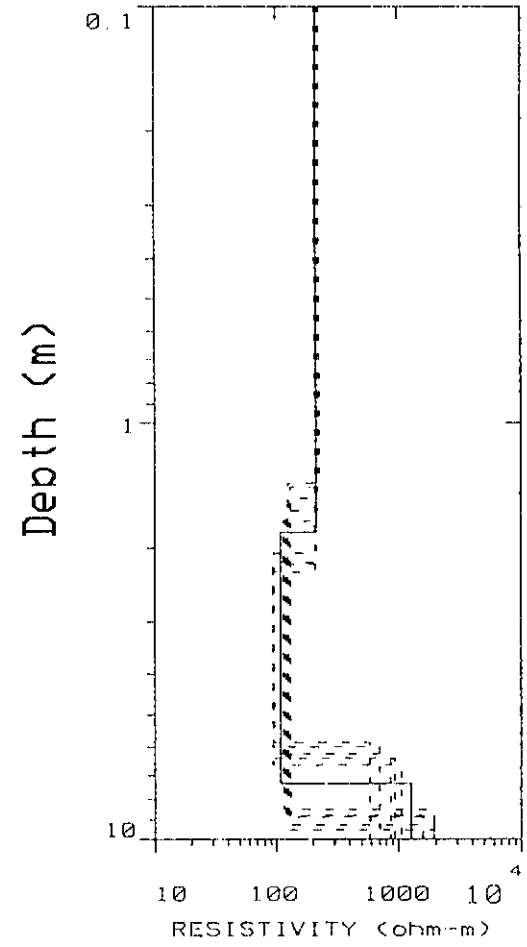
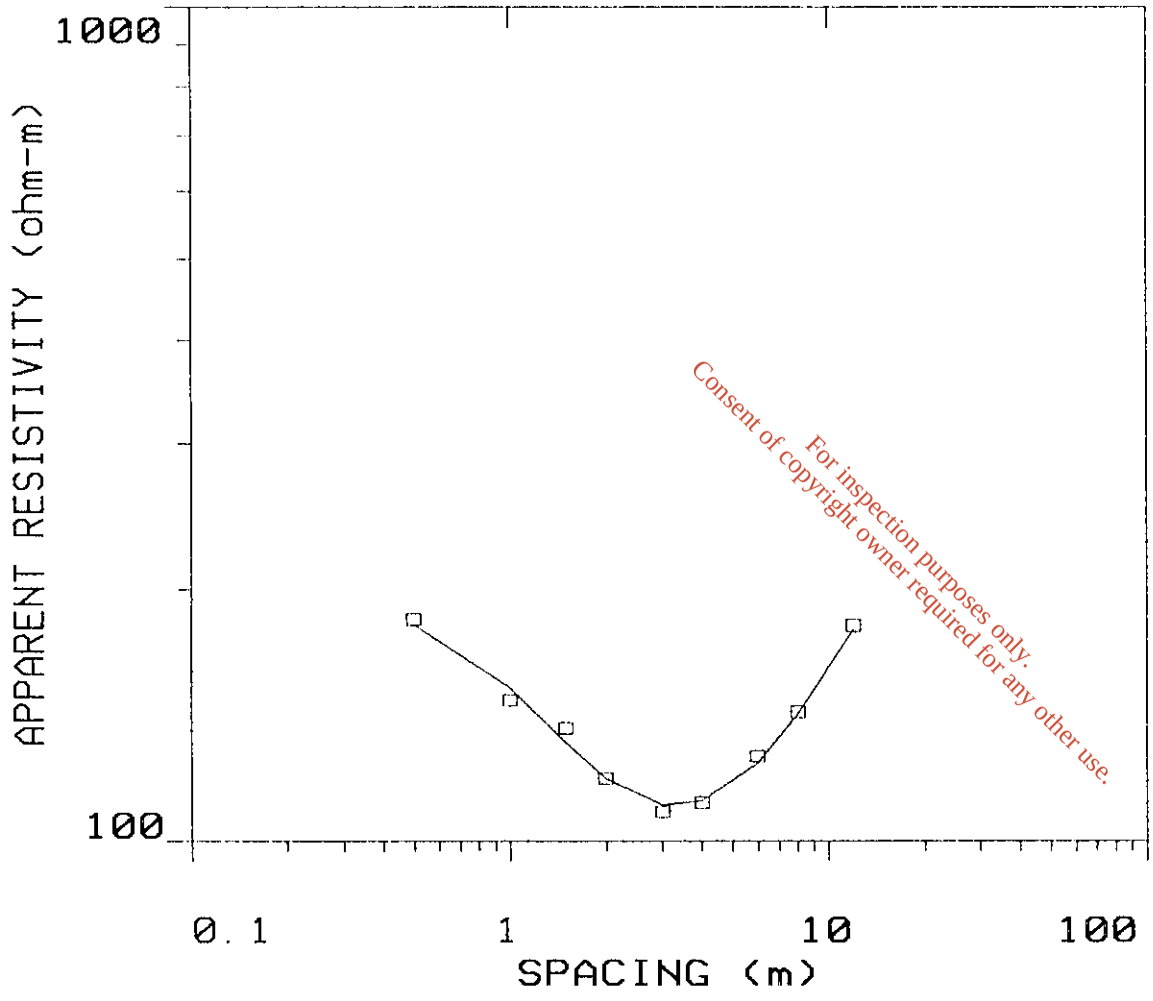


Plate: 23

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: ACAU-S23 / Date: FEB. 2000	
Equipment: ABEM/Geoarc	Sounding: 23 / Azimuth: 360 deg. N



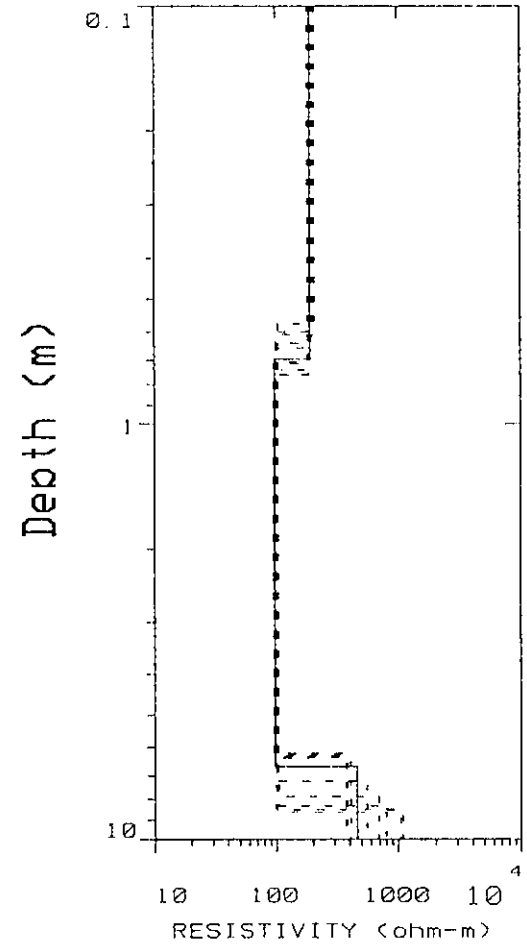
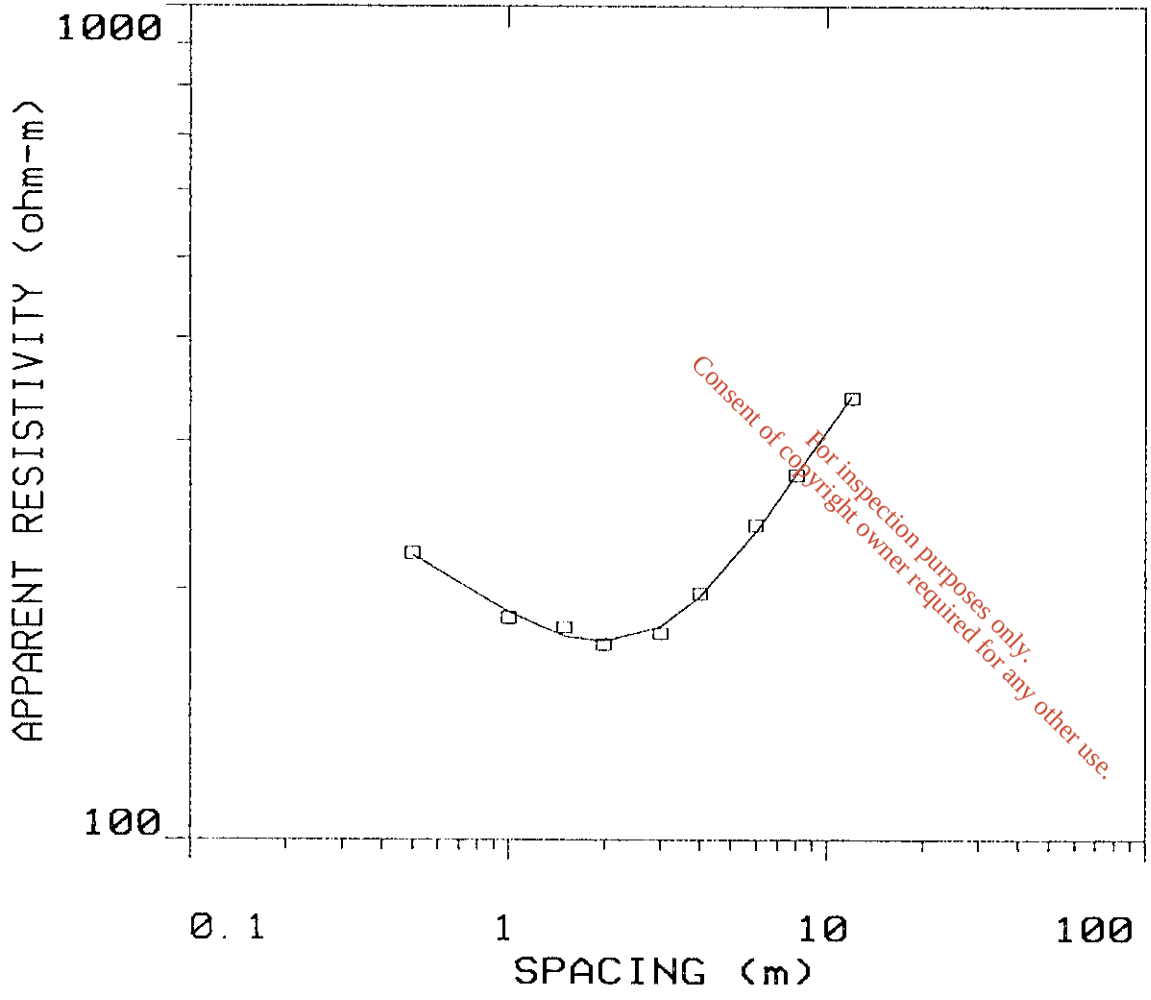


Plate: 24

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S24 / Date: FEB. 2000	
Equipment: [illegible] / Sounding: 24	Azimuth: 360 deg. N



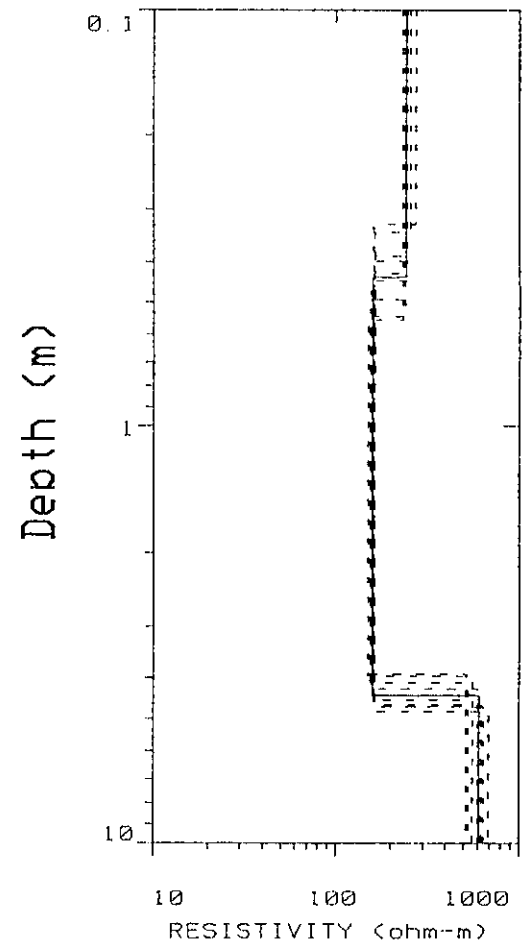
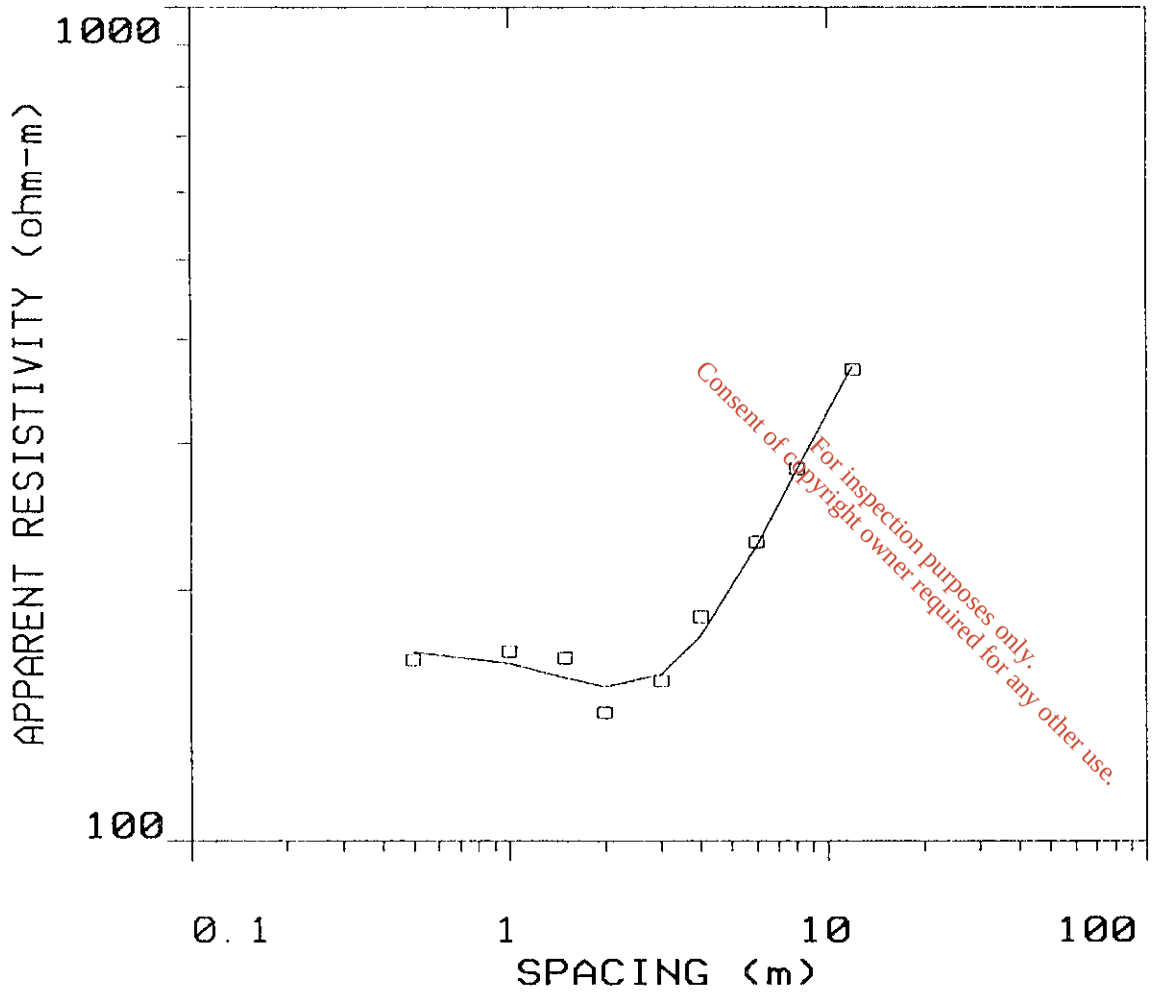


Plate: 25

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S25 / Date: FEB, 2000	
Equipment: RS20G/Geoscite / Sounding: 25	Azimuth: 360 deg. N



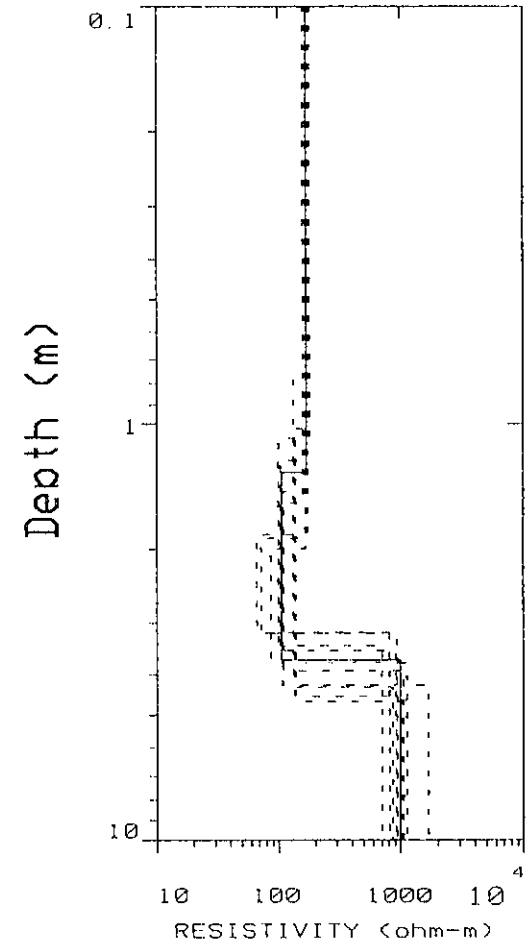
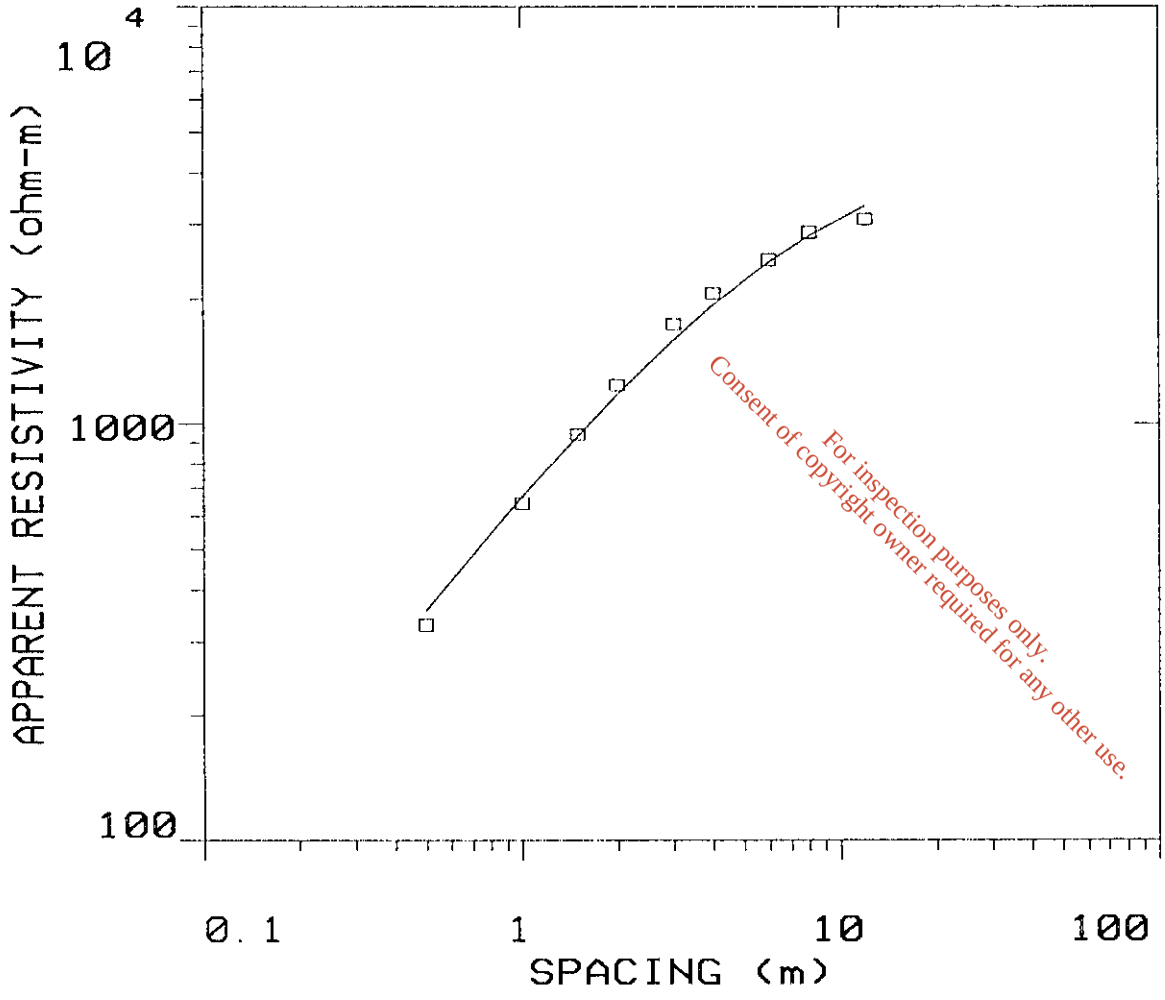


Plate: 26

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S26 / Date: FEB, 2000	
Equipment: [illegible] / Sounding: 26	Azimuth: 360 deg. N



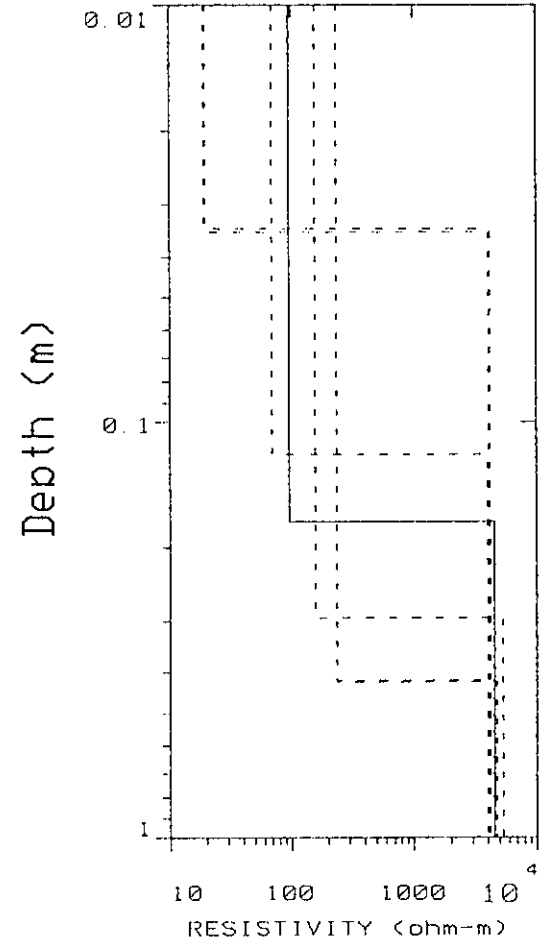
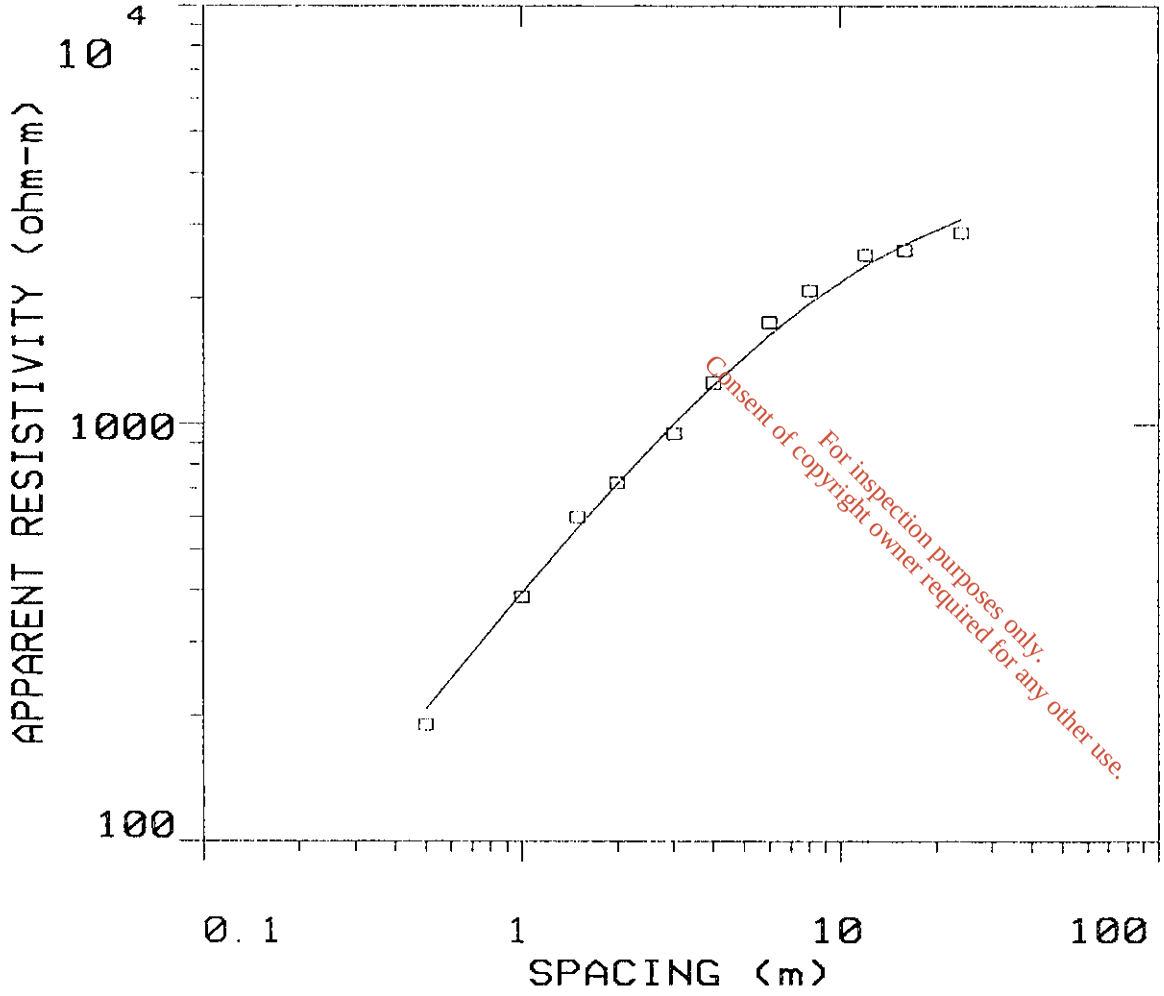


Plate: 27

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S27 / Date: FEB. 2000	
Equipment: ABEM/Germany / Sounding: 27	Azimuth: 360 deg. N



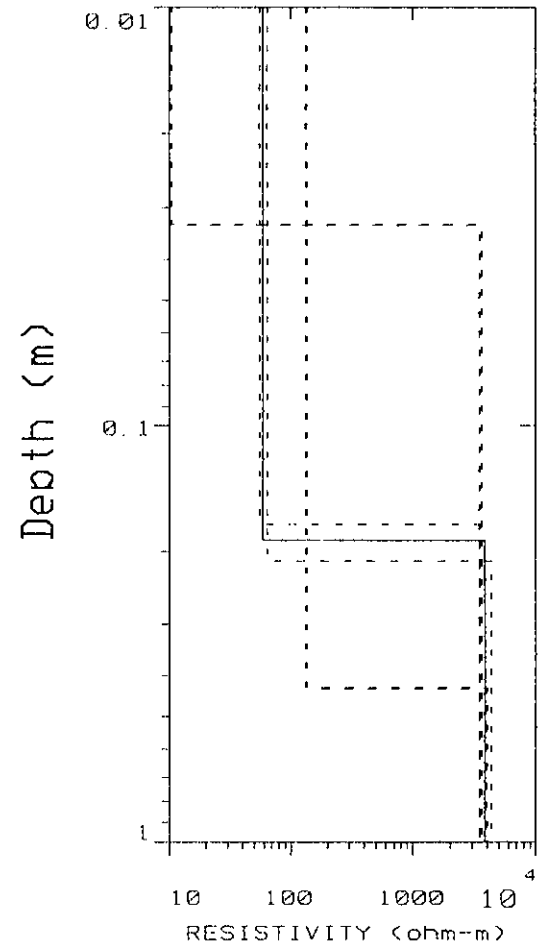
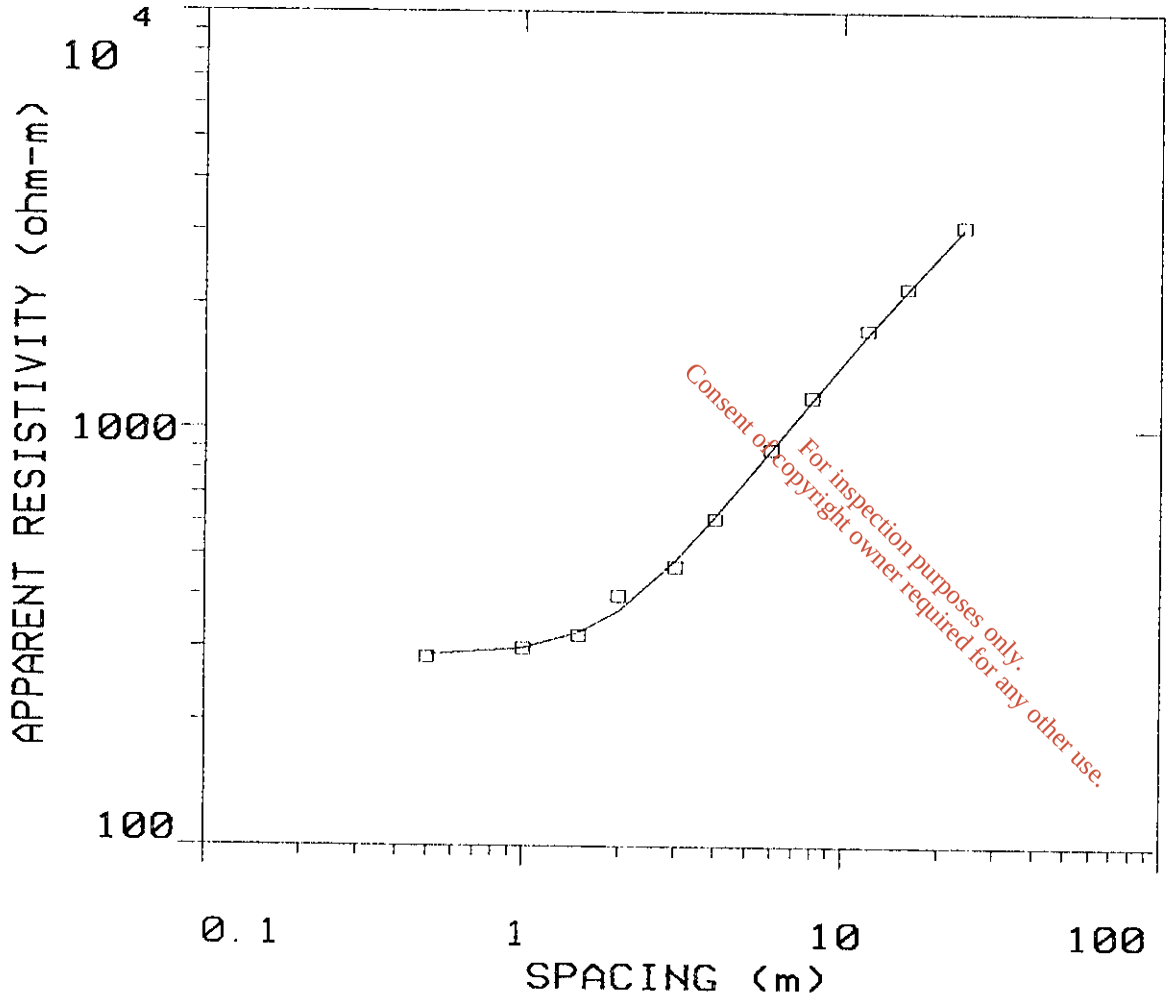


Plate: 28

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: DCAU-5201 / Date: FEB, 2000	
Equipment: ABEM/Terrameter / Sounding: 28	Azimuth: 360 deg. N



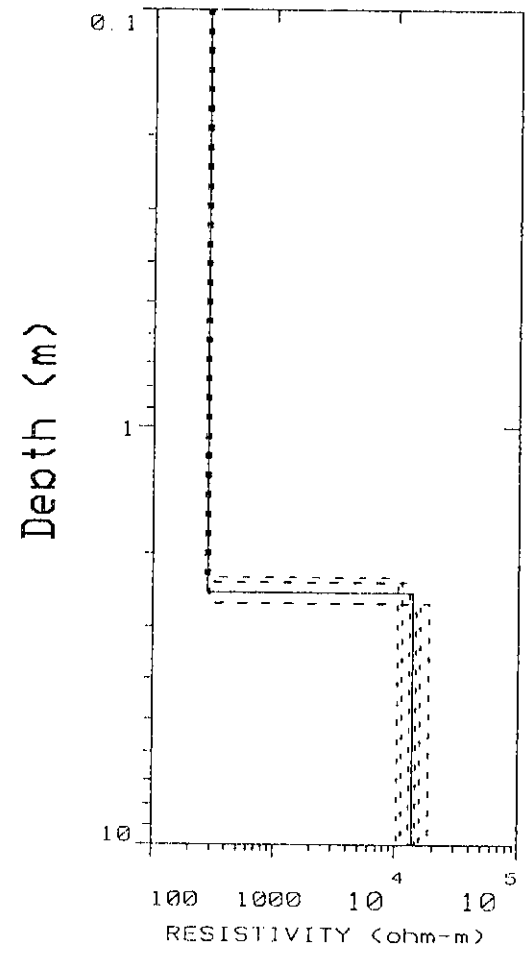
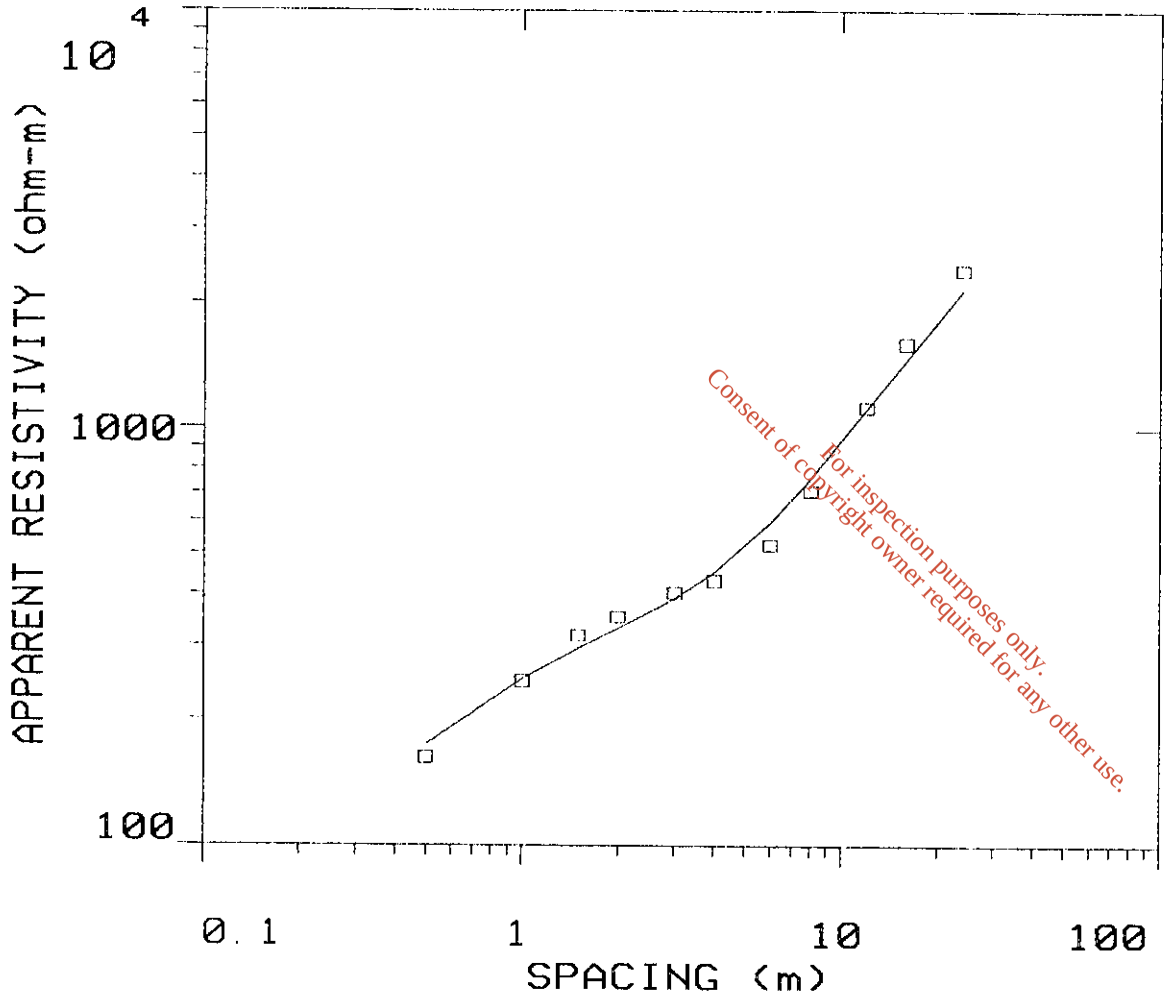


Plate: 29

FERILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S29 / Date: FEB. 2000	
Equipment: [illegible] / Sounding: 29	Azimuth: 360 deg. N



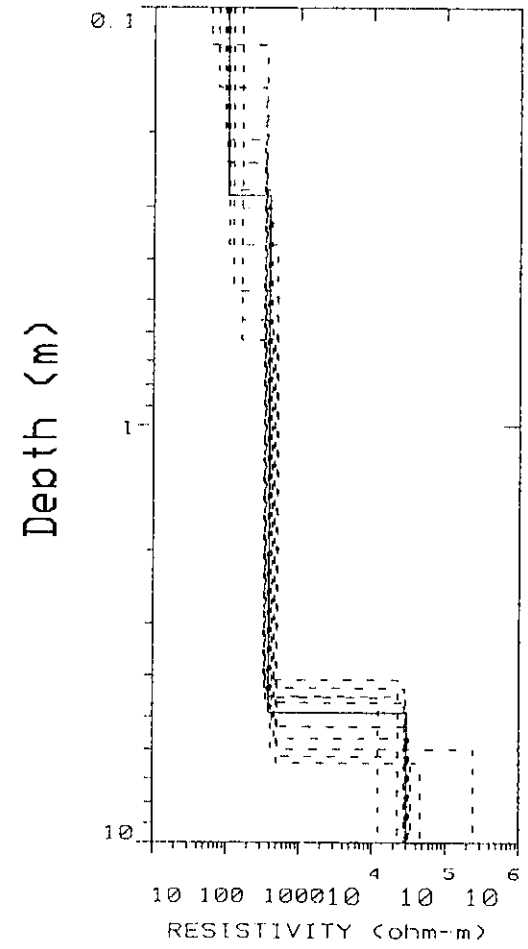
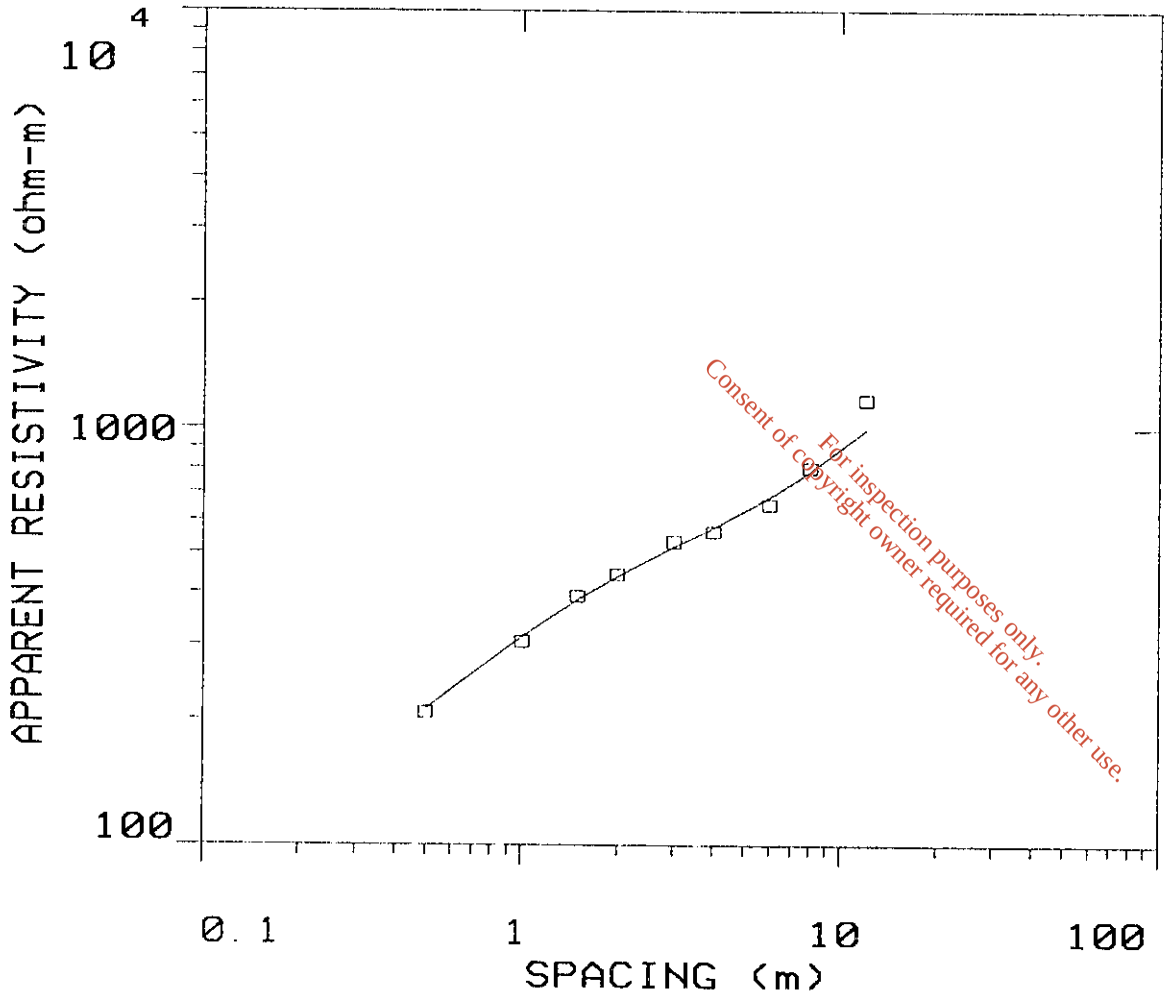


Plate: 30

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY
Data Set: BEAU-S30 / Date: FEB. 2000	CORK
Equipment: RS20A/Geoarc / Sounding: 30	Azimuth: 360 deg. N



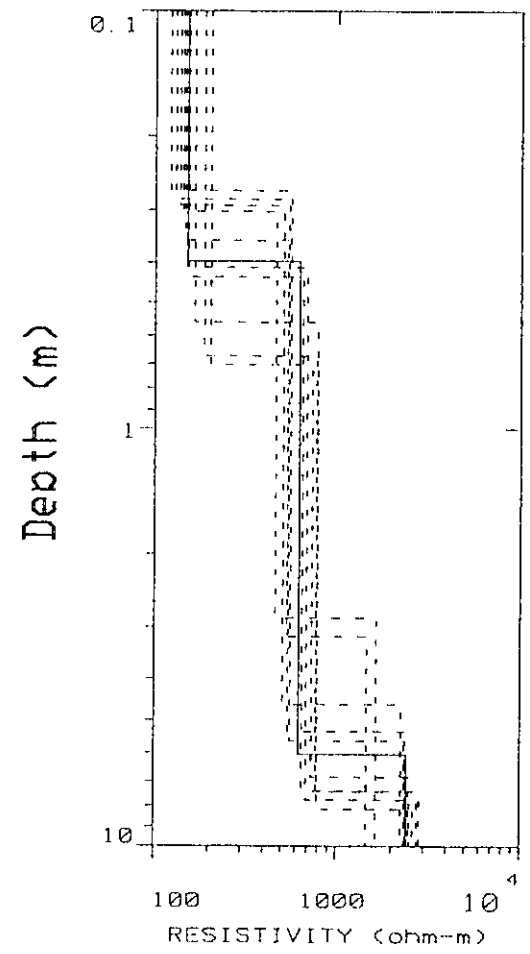
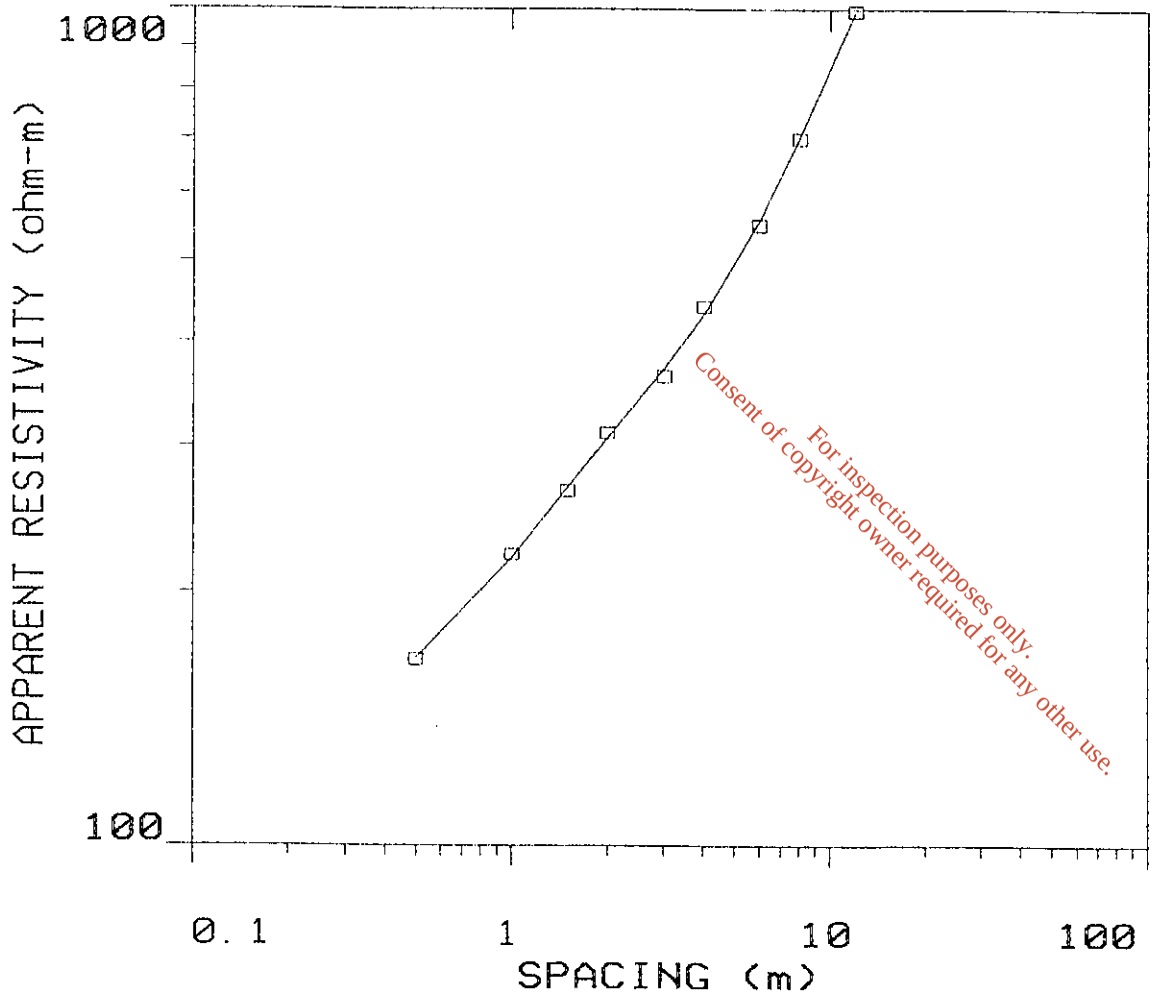


Plate: 31

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S31 / Date: FEB, 2000	
Equipment: PASI/Geoarc	Sounding: 31 / Azimuth: 360 deg. N



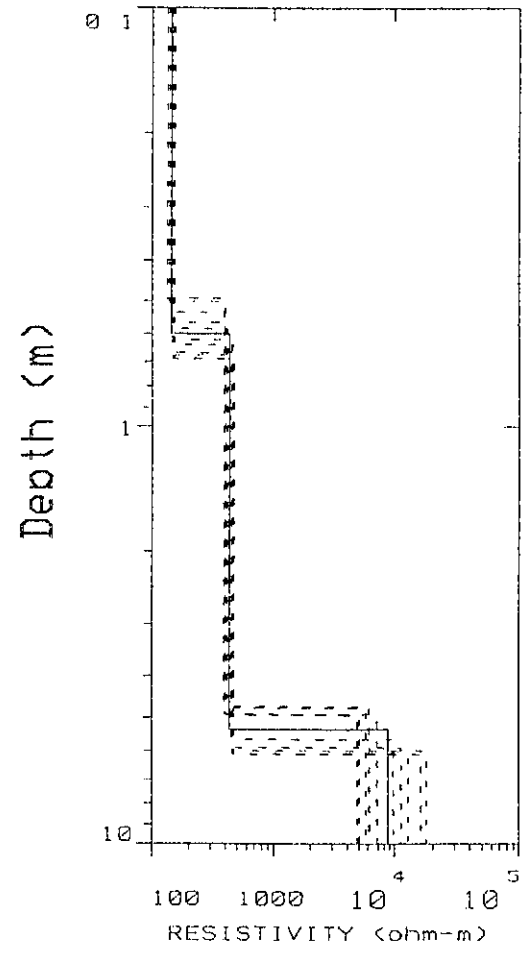


Plate: 32

FEHILY TIMONEY & CO	Depth to bedrock survey
GEOARC LTD.	BEAUMONT QUARRY CORK
Data Set: BEAU-S32 / Date: FEB, 2000	
Equipment: [illegible] / Sounding: 32	Azimuth: 360 deg. N

Appendix 5

The Status and Designation of Irish Mammal Species

Appendix 5 Conservation Status of Irish Mammals

The Irish Red Data Book of Vertebrates (Whilde, 1993) contains a list of mammal species that are threatened or extinct in Ireland as well as species that may be relatively common in this country but are considered of international conservation importance. Most Irish mammals are afforded protection under the 1976 Wildlife Act, Wildlife Amendment Act 2000 (and 1979 Bern Convention) although some are considered as quarry species e.g. Irish Hare. For instance, any action likely to impact on roost sites of Bats must be notified in advance to the Department of Environment, Heritage and Local Government.

All of the (then known) Irish bat species are Red Data Book species, with Whiskered Bat, *Myotis mystacinus* and Natterer's Bat, *Myotis nattereri* given an elevated threatened status. Neither of these latter species is known to occur in this part of Kerry. Hedgehog, Irish Hare, Pine Marten, Badger and Otter are all considered internationally important. Otters are also protected under international law as they are listed on the IUCN list of vulnerable species (United Nations, 1991).

Several Irish mammal species are included in Annex II of the EU Habitats Directive (92/43/EEC) Lesser Horseshoe Bats, *Rhinolophus hipposideros*, and Otter. The presence of these species of EU community interest requires the designation of a number of Special Areas of Conservation. Several species are also mentioned in Annex IV of the directive: animals of community interest in need of strict protection; e.g. Otter, Cetaceans and Bats. Annex V, details species of community interest whose 'taking' in the wild and exploitation may be subject to management measures. Annex V includes Pine Marten, and Irish Hare.

Appendix 6

Terrestrial Macroinvertebrates

Plate 8.1. Female cuckoo bumblebee, *Bombus rupestris*. Photograph taken at Beaumont Quarry August 2006

Plate 8.2. Six-spot Burnet Moth, *Zygaena filipendulae*. Photograph taken at Beaumont Quarry, August 2006

Appendix 7

Description of Habitat Types found in the vicinity of Beaumont Quarry

Habitat descriptions - as per Fossitt (2000).

Amenity grassland (improved) GA2
This type of grassland is improved, or species-poor, and is managed for purposes other than grass production. It includes amenity, recreational or landscaped grasslands, but excludes farmland. Most areas of amenity grassland have been reseeded and are regularly mown to maintain very short swards. Fertilisers and herbicides are often applied but there is rarely any grazing by livestock. The sward may comprise a variety of grasses, including some that also occur in **improved agricultural grassland - GA1**, but rye-grasses (*Lolium* spp.) are rarely abundant. Broadleaved herbs such as Daisy (*Bellis perennis*), Dandelion (*Taraxacum* spp.), clovers (*Trifolium* spp.) and plantains (*Plantago* spp.) are common. Amenity grassland is typically associated with lawns and other managed grassland areas in gardens, parks, grounds of various buildings or institutions, golf course fairways, grassy sports fields and race courses.

Dry meadows and grassy verges GS2
Dry meadows that are rarely fertilised or grazed, and are mown only once or twice a year for hay are now rare in Ireland. Most have been improved for agriculture and this type of grassland is now best represented on grassy roadside verges, on the margins of tilled fields, on railway embankments, in churchyards and cemeteries, and in some neglected fields or gardens. These areas are occasionally mown (or treated with herbicides in the case of some railway embankments) and there is little or no grazing or fertiliser application. This pattern of management produces grasslands with a high proportion of tall, coarse and tussocky grasses such as False Oat-grass (*Arrhenatherum elatius*) and Cock's-foot (*Dactylis glomerata*). Other grasses may include Yorkshire-fog (*Holcus lanatus*), Smooth Meadow-grass (*Poa pratensis*), Barren Brome (*Anisantha sterilis*) and Meadow Foxtail (*Alopecurus pratensis*). The broadleaved herb component is characterised by a range of species that either grow tall, such as Cow Parsley (*Anthriscus sylvestris*), Hogweed (*Heracleum sphondylium*), Goat's-beard (*Tragopogon pratensis*), Nettle (*Urtica dioica*) and Common Knapweed (*Centaurea nigra*), or climb the stems of others, as in the case of Bush Vetch (*Vicia sepium*) and Meadow Vetchling (*Lathyrus pratensis*). Grassy verges may support other smaller broadleaved herbs such as Pignut (*Conopodium majus*), Creeping Cinquefoil (*Potentilla reptans*) and clovers (*Trifolium* spp.).

Scattered trees and parkland WD5
This category can be used in situations where scattered trees, standing alone or in small clusters, cover less than 30% of the total area under consideration but are a prominent structural or visual feature of the habitat. This usually occurs in areas of cultivated grassland, particularly amenity areas. In the case of parkland or parks which originate from former planting and landscaping, the proportion of non-native trees is typically high.

Scrub WS1
This broad category includes areas that are dominated by at least 50% cover of shrubs, stunted trees or brambles. The canopy height is generally less than 5 m, or 4 m in the case of wetland areas. Scrub frequently develops as a precursor to woodland and is often found in inaccessible locations, or on abandoned or marginal farmland. In the absence of grazing and mowing, scrub can expand to replace grassland or heath vegetation. Trees are included as components of scrub if their growth is stunted as a result of exposure, poor soils or waterlogging. If tall trees are present, these should

have a scattered distribution and should not form a distinct canopy. This category does not include areas that are dominated by young or sapling trees (<5 or 4 m in height) or young conifer plantations.

Ornamental/non-native shrub WS3
This category should be used for areas that are dominated by ornamental and non-native shrubs. Most of these originate from planting and can be found in formal beds and borders in gardens, parks and other landscaped areas. It also includes areas where non-native shrubs have escaped and become naturalised in urban and rural situations. The range of possible non-native shrubs is extensive but some of the more common examples include Fuchsia (*Fuchsia magellanica*), Butterfly-bush (*Buddleja davidii*), Box (*Buxus sempervirens*), Snowberry (*Symphoricarpos albus*), Cotoneaster (*Cotoneaster* spp.), Rhododendron (*Rhododendron ponticum*) and Cherry Laurel (*Prunus laurocerasus*). Ornamental/non-native shrubs should not be recorded as a separate habitat where they occur in the understorey of woodlands.

Hedgerows WL1
Linear strips of shrubs, often with occasional trees, that typically form field or property boundaries. Most hedgerows originate from planting and many occur on raised banks of earth that are derived from the excavation of associated drainage ditches. Dimensions of hedgerows vary considerably, depending largely on management and composition, and are taken here as being mainly less than 5 m high and 4 m wide. When wider or taller than this, or dominated by trees, the habitat should be considered as a narrow strip of scrub or woodland, or as a **treeline - WL2**. Some hedgerows may be overgrown or fragmented if management has been neglected, but they should still be considered in this category unless they have changed beyond recognition. Linear strips of low scrub are included in this category if they occur as field boundaries.
Species composition varies with factors such as age, management, geology, soils and exposure. Hedgerows commonly support a high proportion of spinose plants such as Hawthorn (*Crataegus monogyna*), Blackthorn (*Prunus spinosa*), Gorse (*Ulex europaeus*), Holly (*Ilex aquifolium*), Dog-rose (*Rosa canina*) or Bramble (*Rubus fruticosus agg.*), in addition to many other native and non-native trees and shrubs including, for example, Ash (*Fraxinus excelsior*), Hazel (*Corylus avellana*), Beech (*Fagus sylvatica*), Elder (*Sambucus nigra*), elms (*Ulmus* spp.) and willows (*Salix* spp.). Some of these may occur as scattered tall trees. Fuchsia (*Fuchsia magellanica*), an introduced shrub, is a common component of hedgerows in parts of the south and west of Ireland. Hedgerows frequently support climbing plants such as Ivy (*Hedera helix*), Honeysuckle (*Lonicera periclymenum*), Hedge Bindweed (*Calystegia sepium*), Cleavers (*Galium aparine*) and Bush Vetch (*Vicia sepium*). Tall grasses, including False Brome (*Brachypodium sylvaticum*) and Hairy-brome (*Bromopsis ramosa*), ferns, and woodland herbs are characteristic.

Treelines WL2
A treeline is a narrow row or single line of trees that is greater than 5 m in height and typically occurs along field or property boundaries. This category includes tree-lined roads or avenues, narrow shelter belts with no more than a single line of trees, and overgrown hedgerows that are dominated by trees. Most treelines are planted and trees are often regularly spaced. They commonly comprise a high proportion of non-native species such as Beech (*Fagus sylvatica*), Horse Chestnut (*Aesculus hippocastanum*), Sycamore (*Acer pseudoplatanus*), limes (*Tilia* spp.), some poplars (*Populus* spp.) and conifers. Trees may occur on level ground or on banks of earth. The presence or absence of hedgerow or scrub at the base should be noted. If

treelines are greater than 4 m wide at the base they should be considered as narrow stretches of woodland.

Exposed calcareous rock ER2

This category is used for all natural and artificial exposures of calcareous bedrock and loose rock, and any other exposures of basic rock, with the exception of unstable scree and areas of rocky coastline. It occurs in upland and lowland areas and can include inland cliffs and crags, limestone pavement, and rock surfaces that are exposed by excavation. Note that active rock quarries with ongoing high levels of disturbance are excluded (See active **quarries and mines - ED4**). There may be some patchy cover of vegetation but the total area of bare rock, with or without lichen cover, should exceed 50% for inclusion in this category. Exposed calcareous rock may support small pockets of species-rich calcareous grassland, heath or scrub vegetation. North-facing limestone cliffs in montane areas can be important for rare plant species.

Limestone pavement is a notable inclusion in this category. It includes areas of level, gently-sloping or terraced limestone bedrock that are fissured, broken or weathered along natural joints and faults to produce classic 'clint and gryke' features. Areas of loose limestone rubble known as 'shattered pavement' are also included. Large expanses of bare rock are common and, where soil cover is absent, plants are usually restricted to fissures and other spaces between the rocks. Typical colonisers include ferns (particularly *Cystopteris fragilis and Asplenium* spp.), and woodland plants such as Honeysuckle (*Lonicera periclymenum*), Ivy (*Hedera helix*) and Sanicle (*Sanicula europaea*). Small pockets of dry calcareous grassland, heath or scrub vegetation are common in areas where there is sufficient soil cover. The diversity of plant species on limestone pavement is typically very high. Unique combinations of arctic-alpine species such as Mountain Avens (*Dryas octopetala*) and Spring Gentian (*Gentiana verna*) occur together with Atlantic-Mediterranean species such as Wild Madder (*Rubia peregrina*), Irish Orchid (*Neotinea maculata*) and Maidenhair Fern (*Adiantum capillus-veneris*) in the Burren, and other areas of limestone pavement.

Artificial underground habitats EU2

This category includes excavated underground passageways such as underground mine shafts (disused only) or wells, and rail or road tunnels. Underground archaeological features such as souterrains can also be considered here. Note that **active quarries and mines - ED4** are excluded. Artificial underground habitats are noted as possible refuges for wildlife, particularly bats.