Appendix 6A

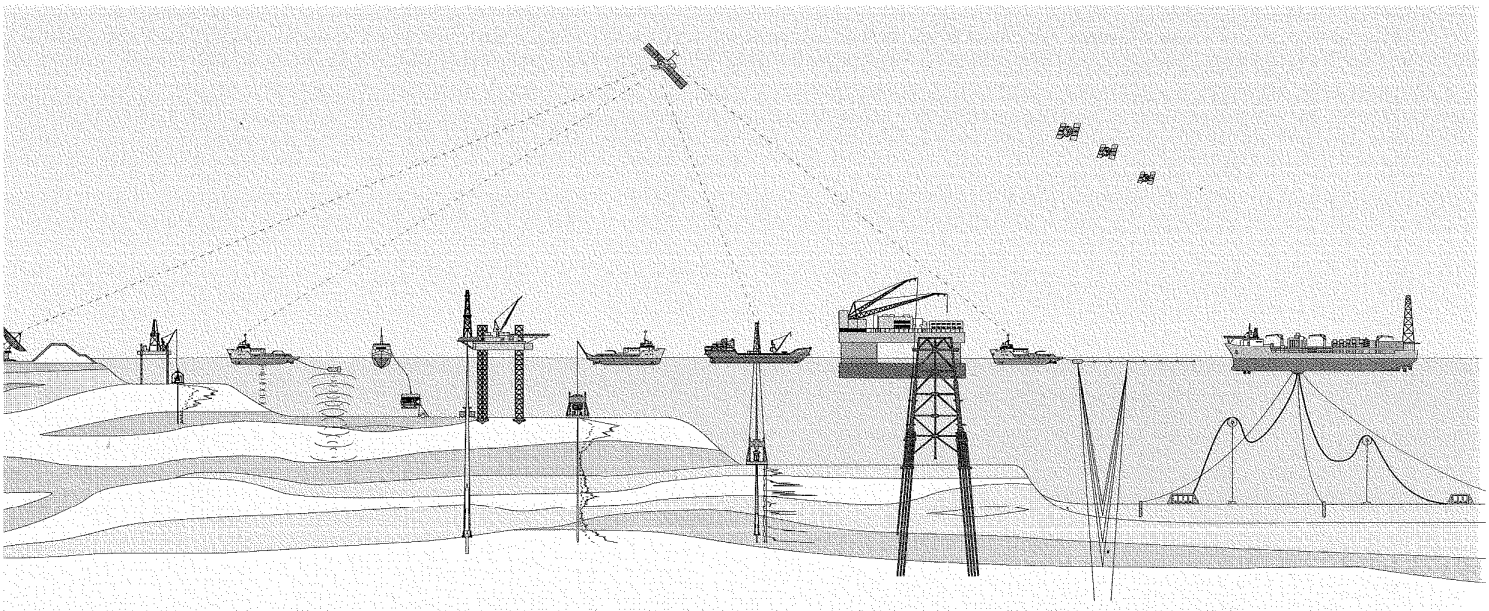
Ground Investigation Interpretative Report

FUGRO LIMITED

DEPARTMENT OF THE MARINE AND NATURAL RESOURCES

PROPOSED ROSSAVEEL HARBOUR DEVELOPMENT
ROSSAVEEL
Co. GALWAY

GROUND INVESTIGATION
INTERPRETATIVE REPORT



DEPARTMENT OF THE MARINE AND NATURAL RESOURCES

PROPOSED ROSSAVEEL HARBOUR DEVELOPMENT ROSSAVEEL Co. GALWAY

GROUND INVESTIGATION INTERPRETATIVE REPORT

REPORT NO : **14518-002(02)**

CLIENT : **Department of the Marine and Natural Resources**

ENGINEER : **Mott Macdonald**

CONFIDENTIAL

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EXECUTIVE SUMMARY

On behalf of the Department of the Marine and Natural Resources (the Client), acting on the instructions of both the Client and Mott Macdonald (Consulting Engineer), a geotechnical investigation has been performed at Rossaveel Harbour, Rossaveel, Co. Galway on the west coast of Ireland. At the time of this investigation the objective of the investigation was to determine ground conditions and obtain geotechnical data with respect to design of a combined dredge and build operation involving the construction of two quay structures. This report corresponds to the work performed at the above site.

The geotechnical fieldwork comprised a marine investigation carried out using the jack-up platform 'Skate 1'. The ground conditions were determined by eighty one boreholes advanced using cable tool percussive boring and wireline rotary coring techniques.

On completion of the fieldwork all soil and rock core samples scheduled for testing were taken to the UKAS accredited laboratory of Fugro Limited in Glasgow for testing.

This report comprises:

(i) A factual account of the fieldwork
(ii) General and detailed location plans
(iii) Comments on the encountered ground conditions

The detailed results of the ground investigation, including borehole logs, laboratory test results and core photographs are provided in the Final Factual Report by Fugro Limited dated 20th November 2001.

1. INTRODUCTION

1.1 GENERAL

Fugro Limited (Fugro) were instructed by the Department of the Marine and Natural Resources (the Client) to carry out a geotechnical investigation at Rossaveel Harbour, Co. Galway, Ireland. Mott Macdonald was appointed as Consulting Engineer to the Client for the contract and attended the first progress meeting on the 3rd August, 2001. The Consulting Engineer was responsible for administration of the contract from that date onwards

The Department of Marine and Natural Resources carried out the contract preparation and tendering. The number of boreholes, their locations and geotechnical requirements were specified in the contract and modified by both the Client and Consulting Engineer as the job progressed.

The objective of the investigation was to determine the ground conditions and obtain geotechnical data to be used in the design of a proposed dredge and build operation, involving the construction of two new quay facilities, within the existing harbour area and surrounding environs.

1.2 SCOPE OF WORK

The initial scope of the marine geotechnical fieldwork comprised sinking sixty-five boreholes in the existing harbour and surrounding area. The initial scope was extended by sixteen additional boreholes during the course of the investigation, taking the final total to eighty-one boreholes. Boreholes were initially advanced using cable percussive boring techniques. When further progress was not possible using this method, boreholes were continued using rotary coring techniques.

The marine fieldwork was carried out using the jack-up platform 'Skate 1' owned by Seacore Limited (Seacore) and operated in a joint venture between Seacore and Fugro.

Samples of soils were taken with in situ testing carried out where applicable in the cable percussive section of each borehole. Rock core samples were generally obtained in the rotary drill holes, with in situ testing being carried out in a few instances where deemed necessary.

1.3 SCOPE OF REPORT

The required scope of the report is provided in the Contract Documents for the Site Investigation at Rossaveel Harbour (Section 5, Schedule 1), prepared by the Department of the Marine and Natural Resources, April 2001 and includes

- A geographical appraisal of the lithology of the site.
- A summary of the ground conditions.
- A commentary on the influence on the proposed maritime structures and on dredging and reclamation of the acquired data.

1.4 SERVICE CONSTRAINTS

Appendix F, "Service Constraints", outlines the limitations of this report, in terms of a range of considerations including, but not limited to, its purpose, its scope, the data on which it is based, its use by Third Parties, possible future changes in design procedures and possible changes in the conditions at the site with time. The Appendix represents a clear exposition of the constraints, which apply to all reports issued by Fugro Limited. It should be noted that the Service Constraints do not in any way supersede the terms and conditions of the contract between Fugro Limited and the Client.

2. SITE DESCRIPTION AND REGIONAL GEOLOGY

2.1 GENERAL

The area under investigation is situated approximately 12 miles west of the town of Spiddal, which lies on the northern coastline at the mouth of Galway Bay, Co. Galway, Republic of Ireland.

The general site area comprises a natural coastal inlet, which forms an elongate channel running approximately NNE-SSW, with the existing Rossaveel Harbour complex lying on the eastern margins in the upper reaches of the channel. For convenience, it is considered appropriate herein to sub-divide the proposed development site into two approximate areas; the main channel and the existing harbour facility.

The main channel in the area under investigation is confined within the co-ordinates 224700mN to 225200mN and 95150mE to 95450mE (Irish National Grid), which encompass an area of approximately 0.15km^2. Here the channel is approximately 400m to 800m wide between its banks. To the south, the eastern bank is characterised by a small concrete slipway used for light leisure craft, with an access road and light steel framed industrial units adjacent. The northern portion of the eastern bank is dominated by a gently undulating topography of exposed bedrock, with sparse scrub and grass cover. The western bank of the main channel consists of a small marina with moorings for light pleasure craft, with gently to steeply undulating topography occupied by a number of generally isolated residential structures.

At the time of this investigation, the proposed development within the main channel area was scheduled to comprise a large dredging operation across the main investigation area, with the construction of an associated berthing quay and working platform, extending into the channel, from the southern area of the east bank.

The existing harbour area lies directly to the north east of the main channel area within a natural recess in the eastern shoreline. This natural feature has been engineered to accommodate berthing facilities for a wide range of commercial and leisure craft. At the time of this investigation, the harbour comprised two areas, a main rectangular quay used by commercial fishing vessels with an axis oriented approximately NE-SW and a smaller berthing quay to the east, primarily used by passenger ferries and small leisure craft. Several steel framed industrial units and concrete hardstanding generally occupy the surrounding area.

At the time of this investigation it was proposed to construct a new berthing facility along the eastern margin of the adjacent smaller quay. Access to this new facility is to be created by dredging an entrance corridor approximately 100m wide at the mouth of the

existing harbour complex, parallel to the existing NW-SE orientation of the main leading lights.

2.2 PUBLISHED GEOLOGY

2.2.1 Quaternary Geology

Connemara is characteristically an area of glacial erosion and not deposition, however, there is evidence of glacial material having been deposited in the site area in the form of large boulder size erratics and occasional glacial till (boulder clay).

2.2.2 Solid Geology

The solid geology is indicated to comprise rocks belonging to the Galway Granite Batholith, which are of Devonian age. There are two main types of granite indicated on the geological sheet, The Shannawona Granite and the Banded Zone Granite. The Shannawona Granite is indicated to outcrop in the main channel area and comprises a pale grey speckled pink monzogranite with pink megacrysts of K-feldspar and of greenish saussuritized plagioclase feldspar. The Banded Zone Granite is indicated to outcrop within the inner harbour area and comprises a pale grey speckled pink granodiorite mixed with a darker more mafic quartz diorite. Microdiorite enclaves are found through the granites, they possibly relate to early appinitic bodies, possibly dykes, which were engulfed by the granite, they occur most frequently in the Banded Zone.

There are a number of faults indicated on the geological sheet, one of which is thought to cut through the site, striking roughly Southeast - Northwest from the inner harbour area.

3. FIELDWORK

3.1 GENERAL

The geotechnical fieldwork was carried out during the period 14th July to 30th August 2001.

All fieldwork was directed on site by geotechnical engineers/engineering geologists from Fugro Ltd. at a manning level consistent with the degree of activity on site at the time. The work was carried out on a 24 hour working day, two twelve-hour shifts worked daily, seven days a week.

During the period of geotechnical fieldwork, all samples obtained were described by the Fugro shift engineer on site.

3.2 PLANT AND EQUIPMENT

All boreholes were performed from the jack-up platform 'Skate 1'. The platform consists of three pontoons linked together with four legs mounted externally on bearings to provide maximum stability. Each leg is 17m in length, giving a maximum working height of 14m from the underside of the platform to the seabed, depending on sea state, tides, and leg penetration. The platform was fitted with a 12.0 m high twin CRII drilling mast incorporating cable percussive boring facilities interchangeable with a rotary coring capability via a rooster box mounted Dando 250 high-speed power swivel. The platform is self propelled and driven by a single azimuthing thruster. An Equipment Data Sheet for this platform is presented in Appendix A.

3.3 DRILLING, SAMPLING AND IN SITU TESTING

All exploratory records are contained within Appendix B of the factual report.

3.3.1 Cable Percussive Boring

Cable percussive boring techniques were used in all of the boreholes to advance casing of 150mm diameter through soil and superficial material until no further progress was possible. Samples were recovered and in situ tests performed as per the specification and as directed by the Engineer's Representative.

3.3.2 Disturbed Samples

Bulk disturbed samples were taken at regular intervals during cable percussive boring. The samples were described and labelled on site before being transferred to the Fugro

Ltd laboratory. Small disturbed samples were also taken during boring for laboratory tests and as an aid to the production of borehole logs.

It should be noted that all samples were described 'as recovered' and at particular depths the recovered material may not have been wholly representative of the in situ material. The depth intervals for each sample are given on the borehole records in Appendix B. Where a single depth is shown, this is always the top of the sample.

3.3.3 Standard Penetration Tests

Standard Penetration Tests (SPTs) were carried out where appropriate in the boreholes to assess the relative density of the material encountered. The test procedures and equipment used were in accordance with British Standard 1377:1990. The material recovered in the split spoon was sealed in a polythene bag and retained as a disturbed sample.

The values of penetration resistance ('N' value) obtained are given on the borehole records in Appendix B of the factual report.

3.3.4 Rotary Coring

Rotary coring was employed at each marine location to advance the borehole into bedrock. A Geobor-S triple tube wireline system with seawater flush was used to obtain 102mm nominal diameter core samples. The equipment was driven by a Dando 250 rotary hydraulic power swivel incorporated within the drilling mast.

'Coreline', a transparent, semi-rigid plastic pipe which acts as a third inner tube was provided for nearly all core runs performed and most core samples were recovered within the 'Coreline' tube. On completion of each core run, the core samples were removed from the barrel, retained within the Coreline which was then capped, sealed, labelled and transferred to a wooden corebox.

Core was logged in detail and photographed on site by the shift engineer/geologist and selected samples were then transported to Fugro Ltd's Glasgow laboratory.

3.4 POSITION FIXING AND LEVELLING

Skate 1 was positioned using a Topcon GTS 4B Total Station established in relation to control stations and benchmarks provided by the client. Borehole co-ordinates and levels are presented in Appendix A of the factual report.

4. LOGGING AND LABORATORY TESTING

4.1 BOREHOLES

All samples obtained from the boreholes were described in accordance with British Standard 5930: 1999 on site by the Fugro engineer / geologist. These details were entered onto the daily site reports and later incorporated into the borehole logs. The borehole logs are presented in Appendix B of the factual report.

4.2 ROTARY CORE LOGGING AND PHOTOGRAPHY

Rock core from each of the boreholes were removed from their liner, photographed and described in detail using the methods outlined in BS 5930:1999. These detailed logs have been incorporated into the borehole logs.

Rock core photographs are presented in Appendix D of the factual report.

4.3 LABORATORY TESTING

A programme of laboratory testing on the soil and rock samples was scheduled by Mott MacDonald. The tests have been performed in accordance with BS1377 and ISRM Suggested Methods.

4.3.1 Laboratory Tests Performed

The following tests were carried out on the soil samples: -

1. Moisture Content
2. Plasticity Index
3. Bulk Density
4. Sieve Analysis
5. Hydrometer
6. Particle Density
7. Unconsolidated Undrained Triaxial Compression
8. Lab Vane Shear Test
9. Shear Box Test
10. One-Dimensional Consolidation

11. 2.5kg Compaction
12. Organic Matter Content
13. Sulphate Content / pH value
14. Chloride Content
15. Heavy Metal Analysis
16. PCB Analysis
17. TBT & DBT Analysis

The following tests were carried out on the rock samples: -

1. Uniaxial Compressive Strength Tests
2. Point Load Tests
3. Brazilian Indirect Tensile Strength

Results of the laboratory tests are presented in Appendix C of the factual report and further details are given on the appropriate plates. All test depths are related to the depth of the top of the sample below existing ground level.

5. QUALITY OF RESULTS AND USE OF DATA

The quality of the test results is believed to be generally good and representative of the in situ material.

It should be noted that the information given in this report is based solely on evaluations of the samples and in situ tests at each specific borehole location.

6. GROUND CONDITIONS

6.1 SUMMARY OF STRATA

The strata as revealed by the site investigation generally confirmed the available published information. However, reference should be made to the exploratory hole records contained in Appendix B of the Factual Report for location specific information. In general the strata encountered can be summarised as follows: -

Description	Distribution	Depth to Base (m)	Thickness (m)
SAND/GRAVEL comprising mainly shell fragments	Predominantly in outer channel area, occasionally in the inner harbour	From 0.10 to 2.19	From 0.10 to 2.19
CLAY/SILT	Predominantly in the inner harbour area, occasionally in sheltered areas of the outer channel	From 0.22 to 6.40	From 0.22 to 6.40
ORGANIC CLAY/PEAT	Encountered in occasional boreholes in the inner harbour	From 2.76 to 8.92	From 0.00 to 2.52
GRAVEL/BOULDERS (Weathered Rock)	Encountered at various locations over entire investigation	From 0.35 to 14.00	From 0.25 to 4.07
BEDROCK (GRANITE)	Underlies entire investigation area	-	-

6.2 GENERAL

In general the geological strata encountered can be split into two broad engineering horizons; Superficial Deposits and Granite Bedrock. Each are summarised separately below.

6.3 SUPERFICIAL DEPOSITS

6.3.1 Sand/Gravel

Deposits of SAND and GRAVEL were encountered in fifty borehole positions predominantly in the outer channel area and occasionally in the inner harbour, at depths ranging from 0.00m to 3.30m below bed level (+0.14m to –9.08mCD); the maximum thickness recorded was 2.19m at BHE65.

The stratum generally consisted of a loose, locally dense, light brown grey slightly silty SAND & GRAVEL, composed almost entirely of shells and shell fragments. In the main channel area this horizon was generally found to be directly overlying Granite bedrock.

Six standard 2.5kg Compaction tests were carried out on appropriate samples of this material and gave optimum moisture content values ranging from 11.8% to 23.3% and maximum dry density values ranging from 1.41Mg/m^3 to 1.61Mg/m^3 . Occasionally the large gravel content precluded this test from being performed.

Six Particle Density tests gave values ranging from 2.29Mg/m^3 to 2.36Mg/m^3.

The results of a series of pH and Sulphate analysis gave pH values between 6.7 and 7.8 with total sulphate concentrations ranging from 0.08% to 0.41%.

The results of a series of Chloride analysis tests, using the acid extraction method, gave values of chloride content ranging from 0.01% to 0.20%.

The results of a series of Organic Matter analysis tests gave organic content values ranging from 0.4% to 2.4%.

The results of a series of Particle Size Distribution (PSD) tests gave the following results: -

	From	To	Average
Cobbles	0%	0%	0%
Gravel	10%	70%	38%
Sand	27%	88%	58%
Silt	0%	6%	2.7%
Clay	-	-	-

6.3.2 Clay/ Silt

Deposits representative of superficial clay were encountered in twenty-six boreholes, predominantly in the inner harbour area and occasionally in sheltered areas of the main channel, at bed level (from – 0.21m to –7.84mCD); the maximum thickness recorded was 6.40m at BHE3.

The superficial clay generally consisted of a very soft to soft grey/ dark grey slightly sandy slightly gravelly CLAY, the gravel comprised fine to medium angular shells and shell fragments. The clay often contained a high organic content with a moderately strong to strong organic odour frequently noted.

Ten Atterberg Limits and Moisture Content tests were carried out giving the following results, which are indicative of clay of a low to extremely high plasticity. The High moisture content noted may be a consequence of the high organic content.

Liquid Limit	28-139%
Plastic Limit	13-50%
Plasticity Index	15-87%
Moisture Content	19-105%

The results of eleven Undrained Triaxial Compression Tests on samples of recent alluvium gave average Undrained shear strength values ranging from 3.4kN/m^2 to 14.3kN/m^2.

The results of nine Laboratory Shear Vane tests gave average Undrained shear strength values ranging from 1.2kPa to 10.6kPa and average remould shear strength values ranging from 0.4kPa to 4.6kPa.

Four standard 2.5kg Compaction tests were carried out and gave optimum moisture content values ranging from 18.2% to 25.6% and maximum dry density values ranging from 1.27Mg/m^3 to 1.40Mg/m^3.

The results of seven One-Dimensional Consolidation Tests gave average values for coefficient of volume compressibility (m_v) between 1.763m^2/MN to 4.250m^2/MN indicative of a clay of very high compressibility.

The results of a series of Particle Density analysis gave particle density values ranging from 2.08mg/m^3 to 2.26mg/m^3.

The results of a series of Organic Matter analysis tests gave organic content values ranging from 0.6% to 9.5%.

The results of a series of pH and Sulphate analysis gave pH values between 6.1 and 7.4 with total sulphate concentrations ranging from 0.20% to 0.56% and water soluble concentrations ranging from 0.13% to 0.25%.

The results of a series of Chloride analysis tests, using the acid extraction method, gave values of chloride content ranging from 0.01% to 0.10%.

The results of a series of Particle Size Distribution (PSD) tests gave the following results: -

	From	To	Average
Cobbles	0%	0%	0%

Gravel	0%	29%	6.8%
Sand	2%	56%	9.5%
Silt	17%	86%	70.9%
Clay	4%	21%	11.2%

6.3.3 Organic Clay/ Peat

Deposits of ORGANIC CLAY with occasional discontinuous lenses of PEAT were encountered in borehole positions E1-3, 7 and 83 at depths ranging from 1.95m to 6.4m below bed level (-2.61m to –7.05mCD); the maximum thickness recorded was 2.52m at BHE2.

The peat lenses generally consisted of a firm to soft spongy fibrous brown slightly clayey to very clayey PEAT/ ORGANIC CLAY.

Two Atterberg Limits and Moisture Content tests were carried out on samples of organic clay giving the following results, which are indicative of clay of extremely high plasticity.

Liquid Limit	216-237%
Plastic Limit	107-128%
Plasticity Index	109%
Moisture Content	152-172%

The results of two Undrained Triaxial Compression Tests on samples of organic clay gave average Undrained shear strength values ranging from 6 kN/m^2 to 12 kN/m^2.

The results of a series of Particle Density analysis gave particle density values ranging from 2.13mg/m^3 to 2.24mg/m^3.

The results of an Organic Matter analysis test on a sample of organic clay gave an organic content value of 26.7%.

The results of a series of pH and Sulphate analysis gave pH values of 6.1 with total sulphate concentrations ranging from 0.32% to 0.44% and water soluble concentrations ranging from 0.20% to 0.23%.

6.4 GRANITE

The solid geology encountered is believed to represent rock belonging to the Galway Granite Batholith. The Granite bedrock was encountered to depth in the majority of borehole positions.

The granite was generally found to comprise two distinct engineering horizons;

(1) Completely to highly weathered GRANITE recovered as angular GRAVEL of granite with frequent cobbles and possible boulders.

(2) Strong to very strong fresh GRANITE.

6.4.1 Weathered Bedrock/ Possible Boulders

Deposits representative of completely weathered bedrock recovered as gravel were encountered in eighteen borehole positions spread over the entire investigation area at depths ranging from 0.00metres to 10.42metres below bed level (-0.90m to -11.07mCD), the maximum thickness recorded was 3.97metres at BHE 3.

The gravel deposit generally consisted of a dense to very dense grey brown fine to coarse angular GRAVEL of completely weathered granite, with some cobbles of granite.

The results of a series of Particle Size Distribution (PSD) tests gave the following results: -

	From	To	Average
Cobbles	0%	0%	0%
Gravel	56%	70%	63%
Sand	41%	27%	34%
Silt	3%	3%	3%
Clay	/	/	/

Possible Boulders were encountered at twenty-four positions spread over the entire investigation area at depths ranging from 0.00 metres to 8.92 metres below bed level (-0.20m to -9.57mCD), the maximum thickness recorded was 2.60metres at BHE 82.

The term Possible Boulder has been employed herein as it may be the case that some of the boulders were partially or almost entirely attached to the bedrock and thus a consequence of weathering as opposed to glacial transportation.

The Possible Boulders, which were of the same lithology as the underlying bedrock, were encountered during rotary coring and were not easily identified even after detailed logging of the samples had taken place. In some instances however, it was more obvious due to the nature of the material recovered being moderately weathered on the outer surfaces and in one occasion a void of 0.53m was encountered beneath a boulder (BHE 64).

6.4.2 Granite Bedrock

Granite Bedrock was proven in the majority of borehole positions with the exception of boreholes E17, 18, 20 and 83. E17 and 83 were terminated upon refusal during cable percussive boring at -10.16 and -4.55mCD respectively. Boreholes E18 and 20 were terminated upon reaching a specified target depth at the instruction of the on-site client representative, of -9.40 and -9.44mCD respectively.

Bedrock was encountered at levels ranging from -0.09m to -14.65mCD and generally comprised a strong to very strong light grey speckled pink and black massive coarse grained crystalline igneous rock GRANITE. However, within the harbour area the rock was very highly fractured and moderately strong to strong in a number of boreholes and may be associated with faulting as detailed on published geological sheets (see section 2.2.2). The fault is thought to strike roughly Southeast - Northwest originating from an area around borehole BHE3. A highly shattered corridor approximately twenty five metres wide, runs through the site and was encountered in boreholes BHE1, 2,3,81 and 82.

Reference should be made to the borehole logs within the factual report (No 14518-001) for TCR, SCR and RQD values.

A summary of laboratory rock strength test results is presented in Table 6.1

Rock strength test	Average (MPa)	Range (MPa)	Number ot Tests
Point Load	6.7	1.3 – 12.7	245
Unconfined Compressive Strength	100.5	52.9 – 185.7	25
Brazilian Tensile Strength	11.5	8.1 – 17.9	14

Table 6.1 – Summary of Rock Strength Test Results

7. ENGINEERING

At the time of the investigation the proposed harbour development comprised the construction of a new deepwater berth in the outer channel area and new ferry berths in the inner harbour. To facilitate these new developments it may be necessary to excavate large areas of the site to provide drafts of 8.00m in the outer channel and 4.00m in the inner harbour.

The materials encountered during the site investigation were assessed with regard to excavation and possible re-use

The superficial materials, where encountered, were either loose sand or gravel or very soft clay. It is thought that digging may excavate the superficial materials.

It is not thought that the superficial deposits will be suitable for re-use on the site. This is due to the composition (mainly shell fragments) of the sands and gravel as well as the high fines content. The clay is also highly compressible, very soft and with a moderately high organic content.

The bedrock was generally found to be fresh and strong to very strong with high RQD values and as such will require blasting to fracture and loosen prior to excavation.

There were localised areas on the site however, where weathered bedrock, highly fractured rock and possible boulders were encountered. Where this material is found ripping may be suitable, however these deposits were found randomly across the site and as such it may be difficult to determine their lateral extent.

With the exception of the highly weathered or highly fractured rock the majority of the granite bedrock will be suitable for re-use.

8. CONCLUSIONS

The strata encountered during the investigation generally confirmed the published information.

The site can be split into two geological areas (as shown on the attached plan):

(1) The inner harbour area
(2) The outer channel

The inner harbour area generally contained superficial deposits of soft clay and silt, with a maximum recorded thickness of up to 6.40metres, overlying bedrock, which was generally fresh with localised areas of moderate weathering. The area around the possible fault corridor contains highly fractured and moderately weathered rock.

The outer channel area generally contained an occasional thin covering of superficial deposits comprising carbonate sand and gravel, with a maximum thickness recorded of 2.19metres, overlying bedrock, which was fresh, to slightly weathered in the upper horizon.

The superficial materials, where encountered, will be suitable for digging.

The rock materials encountered within the inner harbour area are generally strong to very strong with local areas containing moderately strong highly fractured materials.

The rock materials encountered within the outer channel area are generally strong to very strong.

It is envisaged that the site areas containing strong to very strong material will require blasting to fracture and loosen the material prior to excavation. The localised areas containing moderately strong and highly fractured materials may be suitable for ripping.

It is thought that the fresh granite will be suitable for re-use but the superficial deposits and the highly weathered granite will not be suitable material for re-use.

A qualified contractor should appraise all of the data available and assess the suitability of the material to be excavated, for this purpose the majority of the rock cores have been retained at the site for future inspection. Consideration should be given to the presence of possible boulders over the entire site, with one possible void recorded beneath one boulder, as this may have an adverse affect on drilling, blasting and future excavation and dredging works.

9. REFERENCES

BRITISH STANDARD CODE OF PRACTICE, BS 1377:1990 (Parts 1 to 9) "Methods of Test for Soil for Engineering Purposes".

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APPENDIX A

PLANS AND GENERAL INFORMATION

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APPENDIX B

SERVICE CONSTRAINTS

SERVICE CONSTRAINTS

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1. This report and the assessment carried out in connection with the report (together the "Services") were compiled and carried out by Fugro Limited ("FL") for the Department of The Marine And Natural Resources (the "Client") in accordance with the terms of a contract between FL and the Client. The Services were performed by FL with the skill and care ordinarily exercised by a reasonable geotechnical specialist at the time the Services were performed. Further, and in particular, the Services were performed by FL taking into account the limits of the scope of works required by the Client, the time scale involved and the resources, including financial and manpower resources, agreed between FL and the Client.

2. Other than that expressly contained in paragraph 1 above, FL provides no other representation or warranty whether express or implied, in relation to the Services.

3. The Services were performed by FL exclusively for the purposes of the Client. FL is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, FL does not authorise, consent or condone any party other than the Client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and FL disclaims any liability to such party. Any such party would be well advised to seek independent advice from a competent geotechnical specialist and / or lawyer.

4. It is FL's understanding that this report is to be used for the purpose described in Section 1 - "Introduction" of this report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, and/or should the Client's proposed development or use of the site change (including in particular any change in any design and/or specification relating to the proposed use or development of the site), this report may no longer be valid or appropriate and any further use of or reliance upon the report in those circumstances by the Client without FL's review and advice shall be at the Client's sole and own risk. Should FL be requested, and FL agree, to review the report after the date hereof, FL shall be entitled to additional payment at the then existing rates or such other terms as may be agreed between FL and the Client.

5. The passage of time may result in changes (whether man-made or otherwise) in site conditions and changes in regulatory or other legal provisions, technology, methods of analysis, or economic conditions which could render the report inaccurate or unreliable. The information, recommendations and conclusions contained in this report should not be relied upon if any such changes have taken place or after a period of 2 years from

the date of this report or such other period as maybe expressly stated in the report, without the written agreement of FL. In the absence of such written agreement of FL, reliance on the report after any such changes have occurred or after the period of 2 years has expired shall be at the Client's own and sole risk. Should FL agree to review the report after the period of 2 years has expired, FL shall be entitled to additional payment at the then existing rates or such other terms as may be agreed between FL and the Client.

6. The observations, recommendations and conclusions in this report are based solely upon the Services which were provided pursuant to the contract between the Client and FL. FL has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the Client and FL. FL is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services.

7. Where the Services have involved FL's interpretation and/or other use of any information (including documentation or materials, analysis, recommendations and conclusions) provided by third parties (including independent testing and/or information services or laboratories) or the Client and upon which FL was reasonably entitled to rely or involved FL's observations of existing physical conditions of any site involved in the Services, then the Services clearly are limited by the accuracy of such information and the observations which were reasonably possible of the said site. Unless otherwise stated, FL was not authorised and did not attempt to independently verify the accuracy or completeness of such information, received from the Client or third parties during the performance of the Services. FL is not liable for any inaccuracies (including any incompleteness) in the said information, the discovery of which inaccuracies required the doing of any act including the gathering of any information which it was not reasonably possible for FL to do including the doing of any independent investigation of the information provided to FL save as otherwise provided in the terms of the contract between the Client and FL.

8. The soil and ground conditions information provided in the Services are based solely on evaluations of soil and ground condition samples and in-situ tests at determined sample test locations and elevations. That information cannot be extrapolated to any area or elevation outside those locations and elevations unless specifically so stated in the report. In the light of the information available to FL, the soil and ground conditions information are considered appropriate for use in relation to the geotechnical design and installation aspects of the structures addressed in the report, but they may not be appropriate for the design of other structures.

APPENDIX C

LABORATORY TEST RESULTS

	Plate
SOIL	
Moisture Content	C1 to C3 inclusive
Plasticity Index	C4 to C6 inclusive
Sieve Analysis / Hydrometer	C7 to C45 inclusive
Particle Density	C46
Unconsolidated Undrained Triaxial Compression	C47 to C57 inclusive
Lab Vane Shear Test	C58
Shear Box Test	C59 to C62 inclusive
One-Dimensional Consolidation	C63 to C90 inclusive
2.5kg Compaction	C91 to C105 inclusive
Organic Matter Content	C106 & C107
Sulphate Content / pH value	C108 & C109
Chloride Content	C110 & C111
ROCK	
Uniaxial Compressive Strength	C112 to C120 inclusive
Point Load Index	C121 to C128 inclusive
Brazilian Indirect Tensile Strength	C129 to C133 inclusive
CONTAMINATION TESTING	
Heavy Metal Analysis	16 pages
PCB Analysis	
TBT & DBT Analysis	1 page
Organochlorine Pesticide Analysis	17 pages
PCB, Cadmium and Mercury Retests	3 pages

AMENDMENT CONTROL PAGE

All pages of this report are at Issue 02 with the exception of those pages listed below:

Section	Page No.	Issue No.	Nature of Change
Appendix C		3	Additional contamination testing (Organochlorine Pesticides) 17 Pages
Appendix C		3	Retest contamination tests (PCB, Cadmium & Mercury) 3 pages

Note: The issue status is given on the bottom left of each page, which contains the Report No. and the Page Issue status, in the format **Report No. 14518-001(02),** where **14518** is the **Report Number** and **(02)** is the **Page Issue Status.**

ALcontrol Geochem

Chester Street,
Chester CH4 8RD
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email: mkt@geochem.com

CERTIFICATE OF ANALYSIS

Client: Fugro Environmental

1 Queenslie Court
Summerlee Street
Glasgow

G33 4DB

Attention: Gordan McKeown

Date: 18 January, 2002

Our Reference: 01/12540/02/01

Your Reference:

Location: Not Specified

A total of 10 samples were received for analysis on Friday, 21 December 2001. Accredited laboratory tests are defined in the log sheet, but opinions, interpretations and on-site data expressed herein are outside the scope of UKAS accreditation. We are pleased to enclose our final report, it was a pleasure to be of service to you, and we look forward to our continuing association.

Signed

Hazel Davidson
Deputy General Manager
Analytical Services

Compiled By

Janet Place

ALcontrol Geochem
TEST SCHEDULE

JOB NUMBER : 01/12540/02
CLIENT : Fugro Environmental
CONTACT : Gordan McKeown
DATE OF RECEIPT : 21/12/01
LOCATION : Not Specified

BATCH NUMBER : 1
CLIENT REF/CODE :
ORDER NUMBER : H5231
TURNAROUND : 10 days

Numeric values indicate additional scheduling

* indicates test subcontracted

		UKAS Accredited ?			
Sample Number	Sample Identity	P / V	Depth	Sample Type	Pests - Org Cl
1	E1	TUB	0.00	SOIL	X
2	E3	TUB	1.20	SOIL	X
3	E5	TUB	0.00	SOIL	X
4	E6	TUB	0.00	SOIL	X
5	E7	TUB	0.00	SOIL	X
6	E7	TUB	0.00	SOIL	X
7	E18	TUB	1.45	SOIL	X
8	E45	TUB	0.00	SOIL	X
9	E61	TUB	0.00	SOIL	X
10	E66	TUB	0.00	SOIL	X
		Total Number of Tests			10

Checked By

Name : Sheila Clayton

Printed : 21/12/01 12:42:41

Organochlorine Pesticides

Sample Identity - 12540-001/E1 0
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
Total		<1

Organochlorine Pesticides

Sample Identity - 12540-002/E3 1.2
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
	Total	<1

Organochlorine Pesticides

Sample Identity - 12540-003/E5 0
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
	Total	<1

Organochlorine Pesticides

Sample Identity - 12540-004/E6 0
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
	Total	<1

Organochlorine Pesticides

Sample Identity - 12540-005/E7 0
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
	Total	<1

Organochlorine Pesticides

Sample Identity - 12540-006/E7 0
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
	Total	<1

Organochlorine Pesticides

Sample Identity - 12540-006/E7 0 + Spike
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	545
1582-09-8	Trifluralin	691
319-84-6	alpha-HCH(Lindane)	512
118-74-1	Hexachlorobenzene	524
319-85-7	beta-HCH (Lindane)	499
58-89-9	gamma-HCH(Lindane)	479
82-68-8	Quintozene (PCNB)	493
2303-17-5	Triallate	513
1897-45-6	Chlorothalonil	341
76-44-8	Heptachlor	473
309-00-2	Aldrin	555
43121-43-3	Triadimefon	553
40487-42-1	Pendimethalin	610
1024-57-3	Heptachlor Epoxide	523
3424-82-6	o,p'-DDE	547
959-98-8	Endosulfan I	552
72-55-9	p,p'-DDE	541
60-57-1	Dieldrin	507
72-54-8	p,p'-TDE(DDD)	590
72-20-8	Endrin	535
33213-65-9	Endosulfan II	510
53-19-0	o,p'-TDE	651
789-02-6	o,p'-DDT	168
50-29-3	p,p'-DDT	123
1031-07-8	Endosulfan Sulphate	509
	o,p'-Methoxychlor	185
72-43-5	p,p'-Methoxychlor	131
52645-53-1	Permethrin	667
Total		13,525

Organochlorine Pesticides

Sample Identity - 12540-007/E18 1.45
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
Total		<1

Organochlorine Pesticides

Sample Identity - 12540-008/E45 0
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
	Total	<1

Organochlorine Pesticides

Sample Identity - 12450-009/E61 0
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
Total		<1

Organochlorine Pesticides

Sample Identity - 12540-010/E66 0
Client / Sample matrix - Fugro Environmental / Soil
Units - µg/kg

CAS Number	Compound	Concentration
117-18-0	Tecnazene	<1
1582-09-8	Trifluralin	<1
319-84-6	alpha-HCH(Lindane)	<1
118-74-1	Hexachlorobenzene	<1
319-85-7	beta-HCH (Lindane)	<1
58-89-9	gamma-HCH(Lindane)	<1
82-68-8	Quintozene (PCNB)	<1
2303-17-5	Triallate	<1
1897-45-6	Chlorothalonil	<1
76-44-8	Heptachlor	<1
309-00-2	Aldrin	<1
43121-43-3	Triadimefon	<1
40487-42-1	Pendimethalin	<1
1024-57-3	Heptachlor Epoxide	<1
3424-82-6	o,p'-DDE	<1
959-98-8	Endosulfan I	<1
72-55-9	p,p'-DDE	<1
60-57-1	Dieldrin	<1
72-54-8	p,p'-TDE(DDD)	<1
72-20-8	Endrin	<1
33213-65-9	Endosulfan II	<1
53-19-0	o,p'-TDE	<1
789-02-6	o,p'-DDT	<1
50-29-3	p,p'-DDT	<1
1031-07-8	Endosulfan Sulphate	<1
	o,p'-Methoxychlor	<1
72-43-5	p,p'-Methoxychlor	<1
52645-53-1	Permethrin	<1
Total		<1

UKAS ACCREDITED TEST METHODS

METHOD No	METHOD TITLE	UNITS
TM002	Determination of pH in soil using the HANNAH H1931402 Micro Processor pH meter	pH
TM004	Solvent extraction of soil	mg/kg
TM009	Class separation of hydrocarbons by thin layer chromatography (using Iatroscan)	mg/l mg/kg
TM015	Kone Analyser - Operator's Guide	N/A
TM018	Determination of Loss on Ignition in soils	% w/w
TM019	Determination of anions using ion chromatography	mg/l
TM021	The determination of total dissolved solids in waters.	mg/l
TM022	The determination of total suspended solids in waters	mg/l
TM023	The determination of pH in water samples using the 3040 ion analyser	pH
TM024	Determination of Exchangeable Ammonium in soil samples	mgNH_4/kg
TM027	Determination of phenol as C_6H_5 OH using the Dr Lange photometer	mg/l mg/kg
TM028	Determination of chemical oxygen demand (COD) using the Hach COD reactor system	mgO /l
TM036	Determination of electrical conductivity using the Ciba Corning meter	$mScm^{-1}$
TM043	Determination of alkalinity in aqueous samples	mg/l mg/kg
TM045	Determination of BOD_5 (ATU) using the Ciba Corning Oxygen Meter	mg/l
TM049	Leco CS444 – Operator's Guide	N/A
TM050	Determination using the Leco CS444 Total Organic Carbon	%
TM053	Determination of Bulk Gas Composition (Suite 1)	% v/v

UKAS ACCREDITED TEST METHODS

METHOD No	METHOD TITLE	UNITS
TM055	GC-MS Engine determination of polynuclear aromatic hydrocarbons in oil based mud by mass selective detection	µg/l mg/kg
TM056	Hydrocarbon analysis using the THA	
TM057	Determination of saturates by gas chromatography	µg/l µg/kg mg/l mg/kg
TM059	Determination of whole oil by gas chromatography	N/A
TM060	Analysis of drilling cuttings	µg/l % wt
TM061	Determination of total petroleum hydrocarbons by gas chromatography	µg/l µg/kg mg/l mg/kg
TM062	Determination of phenols by HPLC	mg/l mg/kg
TM063	Analysis of BTEX hydrocarbons by GC-MSD/Tekmar	µg/l
TM064	Analysis of volatile hydrocarbons by GC-MS/Tekmar	µg/l
TM065	Preparation of Standard Solutions for Calibration Quality Control of Emission Spectrometers	N/A
TM066	Analysis of acid digested samples by Inductively Coupled Plasma - general operation	N/A
TM067	Total (Acid-Soluble) sulphate determination in soils using Leco CS444	%
TM068	Total sulphur determination using Leco CS444	%
TM070	Determination of total polychlorinated biphenyls (PCB's)	µg/l µg/kg mg/l mg/kg
TM071	Determination of acid /base neutrals by GCMS	µg/l mg/kg
TM072	Determination of phenols by GCMS	µg/l mg/kg
TM073	Determination of organochlorine and organophosphorous pesticides by GCMS	µg/l mg/kg
TM074	Determination of polynuclear aromatic hydrocarbons (PAH) by GC-MS	µg/l µg/kg mg/l mg/kg

UKAS ACCREDITED TEST METHODS

METHOD No	METHOD TITLE	UNITS
TM078	Solid phase extraction of waters	mg/l
TM083	Determination of Sodium and Potassium by Flame Photometer	mg/l mg/kg
TM084	Analysis of aqueous samples for phenol – using the Alliance distillation instrument	mg/l
TM085	Analysis of water samples for sulphate using the Dionex ion chromatograph	mgSO_4^{2-} /l
TM087	Measurement of semi- and non-volatile petroleum hydrocarbons in soil or water samples by infra-red spectroscopy	mg/l mg/kg
TM089	Determination of Gasoline Range Organic Hydrocarbons (GRO) and BTEX(MTBE) compounds by Headspace GC-FID	µg/l µg/kg mg/l mg/kg
TM090	Determination of total organic carbon/total organic carbon in water and waste water	mgC/l
TM097	Determination of Chloride using the Kone Analyser	mg Cl /l mg Cl /kg
TM098	Determination of Sulphate using the Kone Analysers	mg SO_4^{2-} /l
TM099	Determination of Ammonium in water samples and cation exchange capacity in soil samples using the Kone Analyser	mg NH_4-N/l
TM100	Determination of Phosphate using the Kone Analyser	mg PO_4 /l
TM101	Determination of Sulphide in water samples using the Kone Analyser	mg S^{2-} /l
TM102	Determination of Nitrate using the Kone Analyser	mg NO_3 /l
TM103	Determination of Nitrite using the Kone Analyser	mg NO_2 /l
TM104	Determination of Fluoride using the Kone Analyser	mg F /l
TM107	The determination of Chemical Oxygen Demand using the COD Dr Lange Kit	mg O /l

UKAS ACCREDITED TEST METHODS

METHOD No	METHOD TITLE	UNITS
TM108	Determination of Thiocyanate by Colourmetric Spectroscopic Analysis	mg SCN /l mg SCN /kg
TM109	Total Carbon Determination using LECO CS444	%
TM112	Determination of S1 & S2 compounds by Pyrolysis -Gas Chromatography.	Area %
TM113	Determination of Total Cyanide by Steam Distillation	mg CN^- /l mg CN^- /kg
TM114	Determination of Aromatics by Gas Chromatography	N/A
TM116	Preparation & Analysis of Volatile Hydrocarbons by Headspace GC-MSD/HP7694 Headspace Autosampler	µg/l µg/kg
TM 127	The determination of Trace Level Mercury in Aqueous Media and soil extracts by Atomic Absorption Spectroscopy	µg/l
TM 128	The determination of Ultra-Trace Level Arsenic and Selenium in aqueous Media and soil extracts by Hydride Generation Atomic Absorption Spectrophotometry	µg/l

Scientific Analysis Laboratories

Report Number:	S10781
Date of Report:	24-Dec-2001
Client :	Fugro Limited 1 Queenslie court Summerlee Street Queenslie Glasgow G33 4DB
Client Contact:	R J Mooney
Client Reference:	OFL/980/RJM
Order Number:	none supplied
Date Job Received at SAL:	13-Dec-2001
Date Analysis Started:	13-Dec-2001

The results reported relate to samples received at the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory

Key to symbols used in this report:
W: Analysis was performed within the SAL group of UKAS accredited laboratories
S: Analysis was subcontracted to a laboratory that holds UKAS accreditation
C: Analysis was subcontracted
N: Analysis is not UKAS accredited
U: Analysis is UKAS accredited

Report written by and authorised by: P. Geri
Laboratory Supervisor

Report checked by: D. Barrett
Technician

UKAS TESTING
1977

Report Number: S10781
Client Reference: OFL/980/RJM

SAL Ref.	S10781/001	S10781/002	S10781/003	S10781/004	S10781/005
Client Ref.	E1	E3	E5	E6	E7
	B3 @ 0.00M	P8 @ 4.90M	B2 @ 0.00M	B9 @ 4.00M	U16 @ 1.50M
Type	Soil	Soil	Soil	Soil	Soil

Determinand	Method	Units	LOD	Symbol					
Trichloro, BZ# 28	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	<0.1
Tetrachloro, BZ# 52	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	<0.1
Pentachloro, BZ# 101	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	<0.1
Pentachloro, BZ#118	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachloro, BZ# 153	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachloro, BZ# 138	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachloro, BZ# 180	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	AAS	mgkg	0.1	WN	<0.1	<0.1	<0.1	<0.1	<0.1
Mercury	AAS	mgkg	0.05	WN	<0.05	<0.05	<0.05	<0.05	<0.05

RM :- In house reference soil, certified against BCR CRM 536.

Report Number: S10781
Client Reference: OFL/980/RJM

SAL Ref.	S10781/006	S10781/007	S10781/008	S10781/009	RM	RM
Client Ref.	E18	E45	E61	E66	Expected	Actual
	D7 @ 4.45M	B1 @ 0.00M	B1 @ 0.00M	B1 @ 0.00M		
Type	Soil	Soil	Soil	Soil	Soil	Soil

Determinand	Method	Units	LOD	Symbol						
Trichloro, BZ# 28	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	110	120
Tetrachloro, BZ# 52	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	45	64
Pentachloro, BZ# 101	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	23	26
Pentachloro, BZ#118	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	15	14
Hexachloro, BZ# 153	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	38	48
Hexachloro, BZ# 138	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	28	42
Heptachloro, BZ# 180	GC/MS	ug/kg	0.1	WU	<0.1	<0.1	<0.1	<0.1	49	47

Cadmium	AAS	mgkg	0.1	WN	<0.1	<0.1	<0.1	<0.1
Mercury	AAS	mgkg	0.05	WN	<0.05	<0.05	<0.05	<0.05

RM :- In house reference soil, certified against BCR CRM 536.

APPENDIX

APPENDIX

1. Results are expressed as mg/Kg dry weight unless otherwise stated, excluding analyses in (2) below.
2. Leach tests, cyanide, phenols by MS, hexavalent chrome, flash point, acid soluble sulphides, TPH by IR and volatiles are performed on wet soil as received, and results are expressed as mg/Kg of wet soil or mg/l of leachate of specified leach test. Ammoniacal nitrogen and total phenols by HPLC are performed on wet sample but are then re-calculated and expressed as mg/kg of dry soil.
3. ICP metals results are analysed using a screening program and the data is accurate to within 20%.
4. The majority of analyses are run to an accuracy of 10%, but this may be improved upon if legally defensible data is required.
5. Every fifth sample is run in duplicate, but not reported, as part of our internal QC procedure.
6. A sub sample of all samples received will be retained free of charge for two months for soils and one month for waters (sample size permitting), but may then be discarded unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage.
7. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.
8. Please note that we take no responsibility for any test performed by sub-contractors (marked with an asterisk).
9. Asbestos screen is done in-house on soils and if no fibres are found will be reported as NFP-no fibres present. If asbestos is detected then identification & quantification is carried out by a sub-contractor. If a sample is suspected of containing asbestos then drying & crushing will be suspended on that sample until the asbestos result is known. If asbestos is present then no analysis requiring dry sample will be undertaken.
10. NDP-No determination possible due to insufficient/unsuitable sample.

Quantitation Report (QT Reviewed)

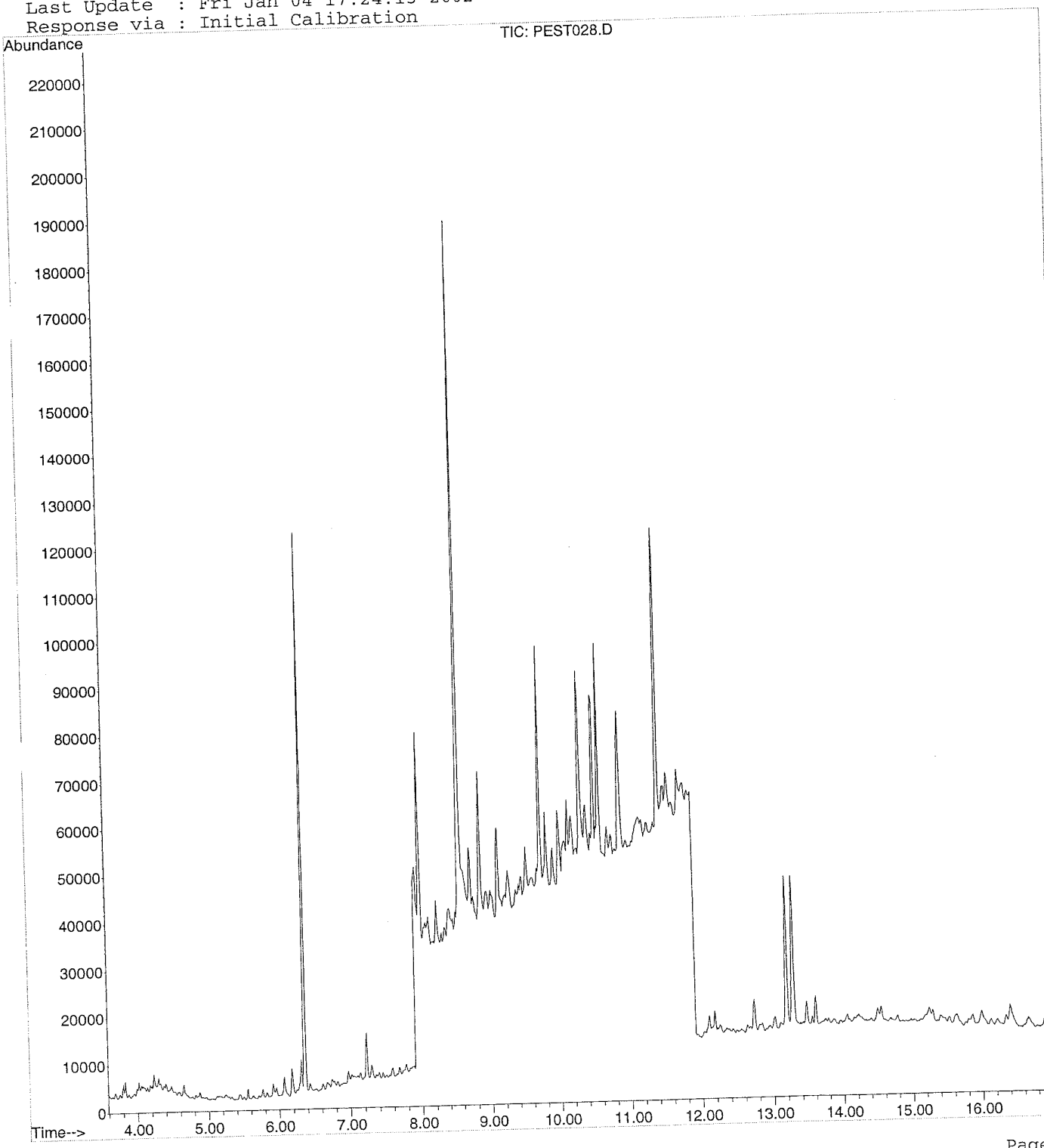
Data File : C:\MSDCHEM\1\DATA\010302\PEST028.D
Acq On : 4 Jan 2002 20:09
Sample : 12540-001/E1 0
Misc : Fugro Environmental / Soil

Vial: 28
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 9.71
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 7 9:40 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Fri Jan 04 17:24:13 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

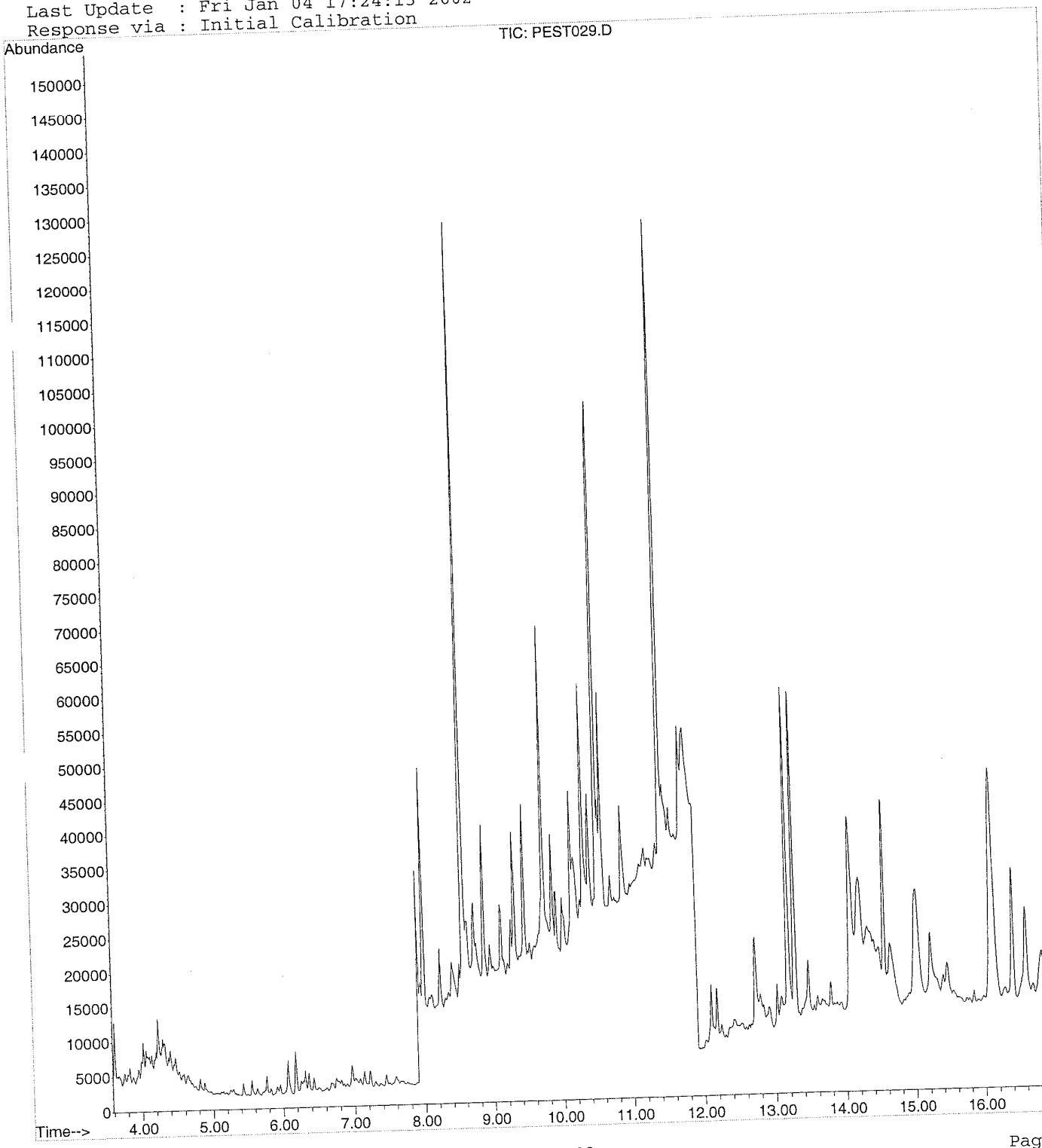
Data File : C:\MSDCHEM\1\DATA\010302\PEST029.D
Acq On : 4 Jan 2002 20:33
Sample : 12540-002/E3 1.2
Misc : Fugro Environmental / Soil

Vial: 29
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 10.31
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 7 9:44 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Fri Jan 04 17:24:13 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

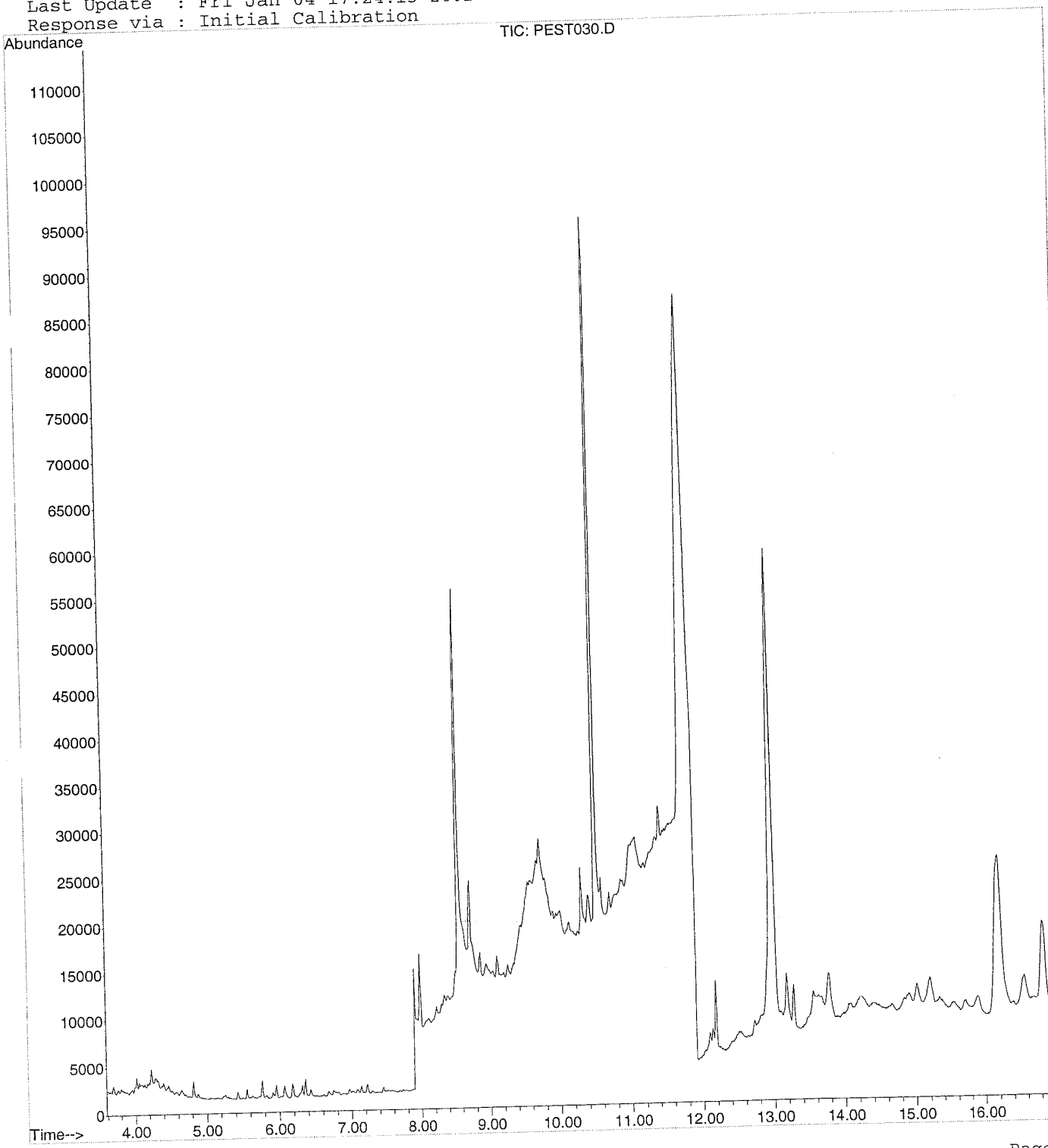
Data File : C:\MSDCHEM\1\DATA\010302\PEST030.D
Acq On : 4 Jan 2002 20:57
Sample : 12540-003/E5 0
Misc : Fugro Environmental / Soil

Vial: 30
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 10.20
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 7 10:00 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Fri Jan 04 17:24:13 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

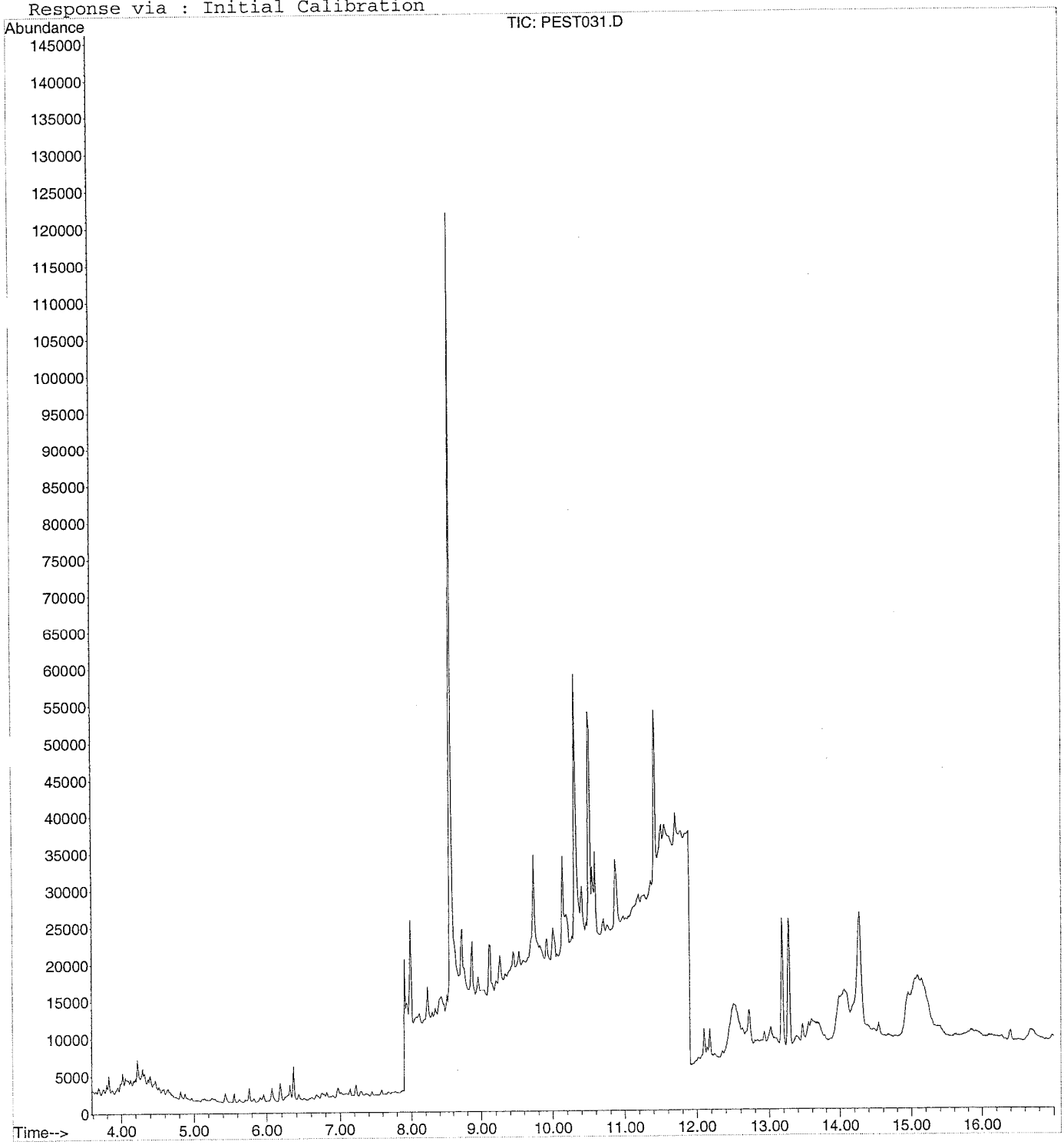
Data File : C:\MSDCHEM\1\DATA\010302\PEST031.D
Acq On : 4 Jan 2002 21:21
Sample : 12540-004/E6 0
Misc : Fugro Environmental / Soil

Vial: 31
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 10.34
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 7 10:03 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Fri Jan 04 17:24:13 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

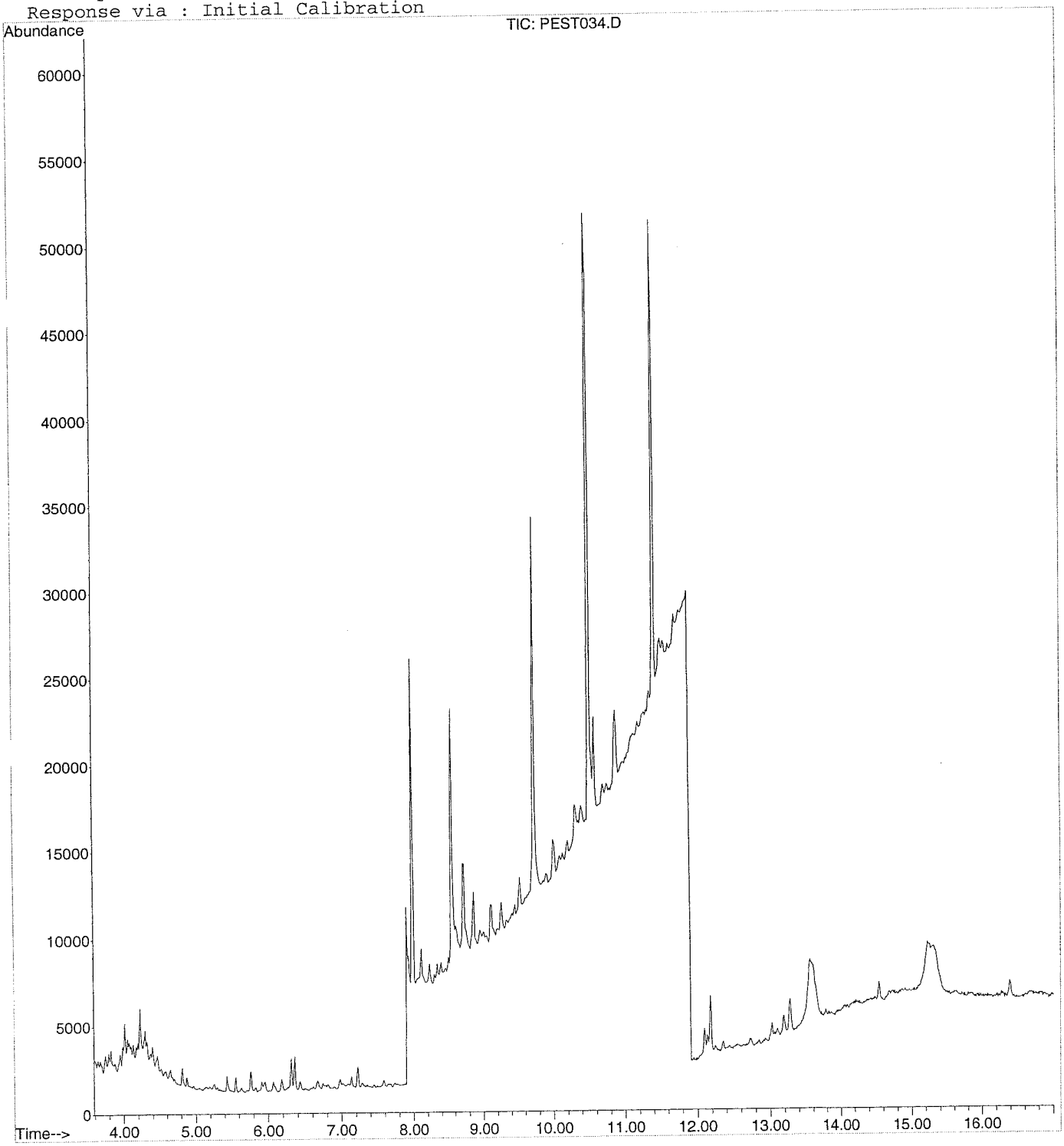
Data File : C:\MSDCHEM\1\DATA\010302\PEST034.D
Acq On : 4 Jan 2002 22:34
Sample : 12540-005/E7 0
Misc : Fugro Environmental / Soil

Vial: 34
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 10.30
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 7 10:05 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Fri Jan 04 17:24:13 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

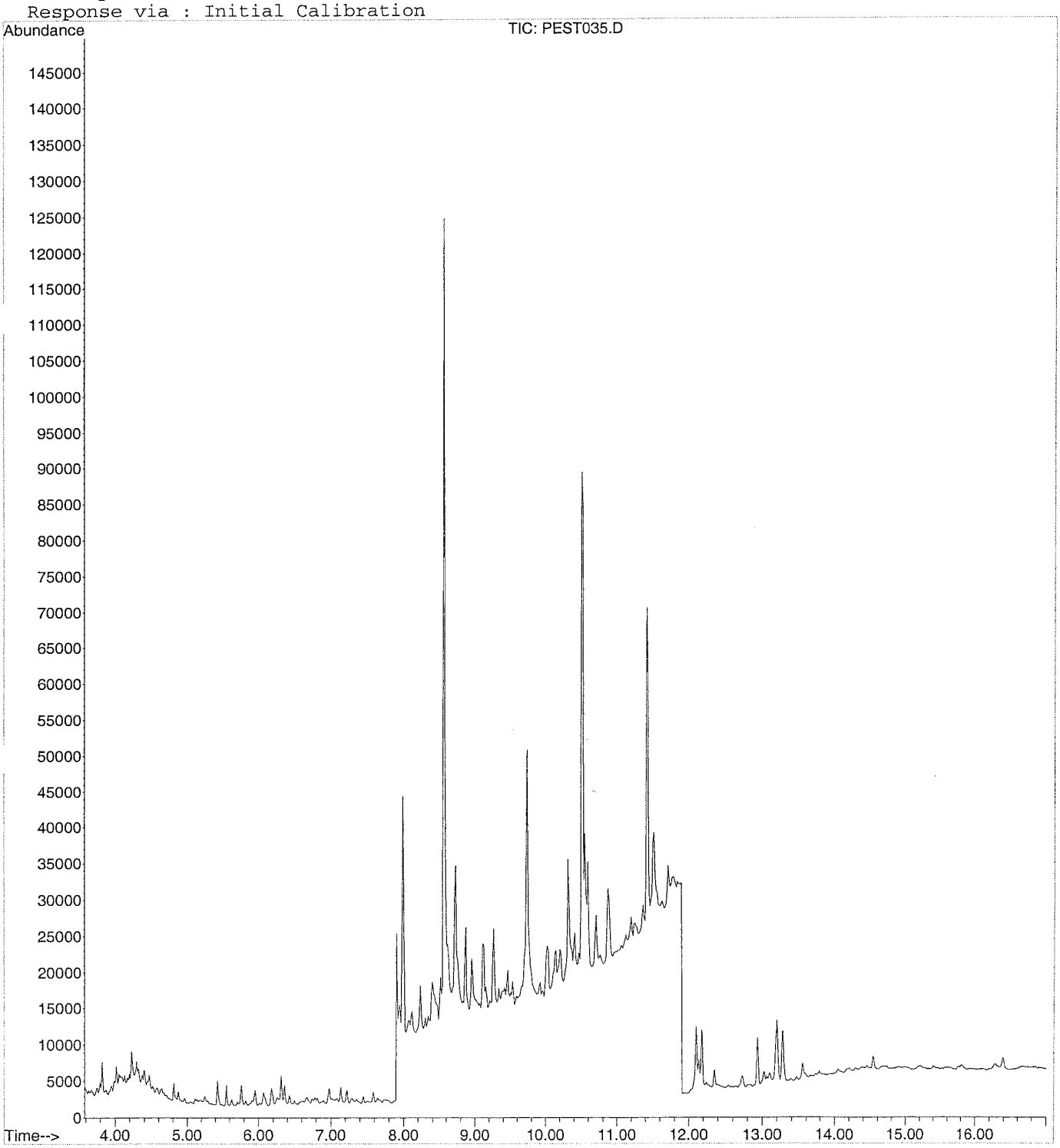
Data File : C:\MSDCHEM\1\DATA\010302\PEST035.D
Acq On : 4 Jan 2002 22:58
Sample : 12540-006/E7 0
Misc : Fugro Environmental / Soil

Vial: 35
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 10.24
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 7 10:37 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Fri Jan 04 17:24:13 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

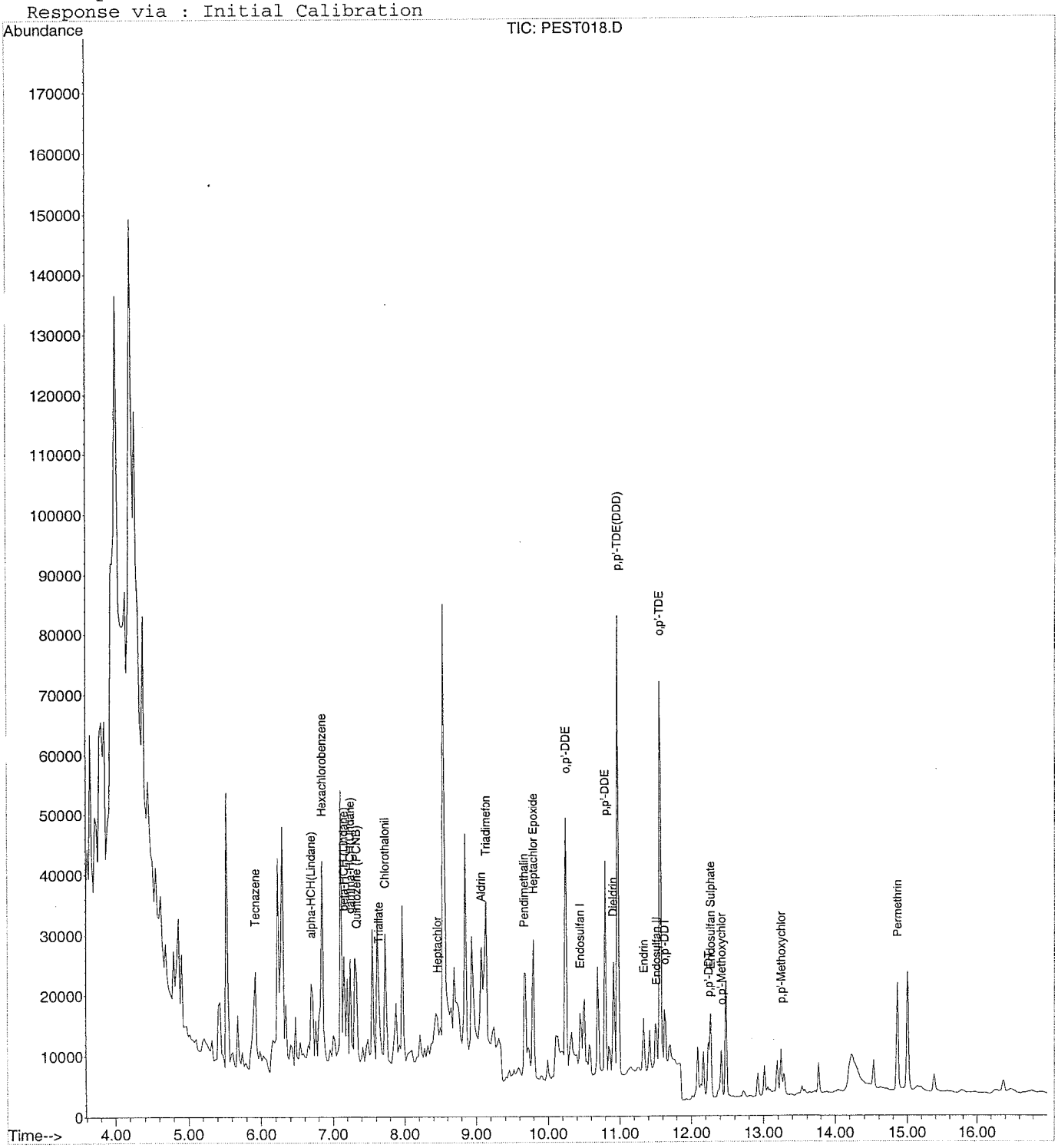
Data File : C:\MSDCHEM\1\DATA\011602\PEST018.D
Acq On : 17 Jan 2002 2:05
Sample : 12540-006/E7 0 + Spike
Misc : Fugro Environmental / Soil

Vial: 18
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 1.00
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 17 10:07 2002

Quant Results File: ORGANOCL.RES

Method : C:\MSDCHEM\1\METHODS\ORGANOCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Thu Jan 17 10:03:10 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

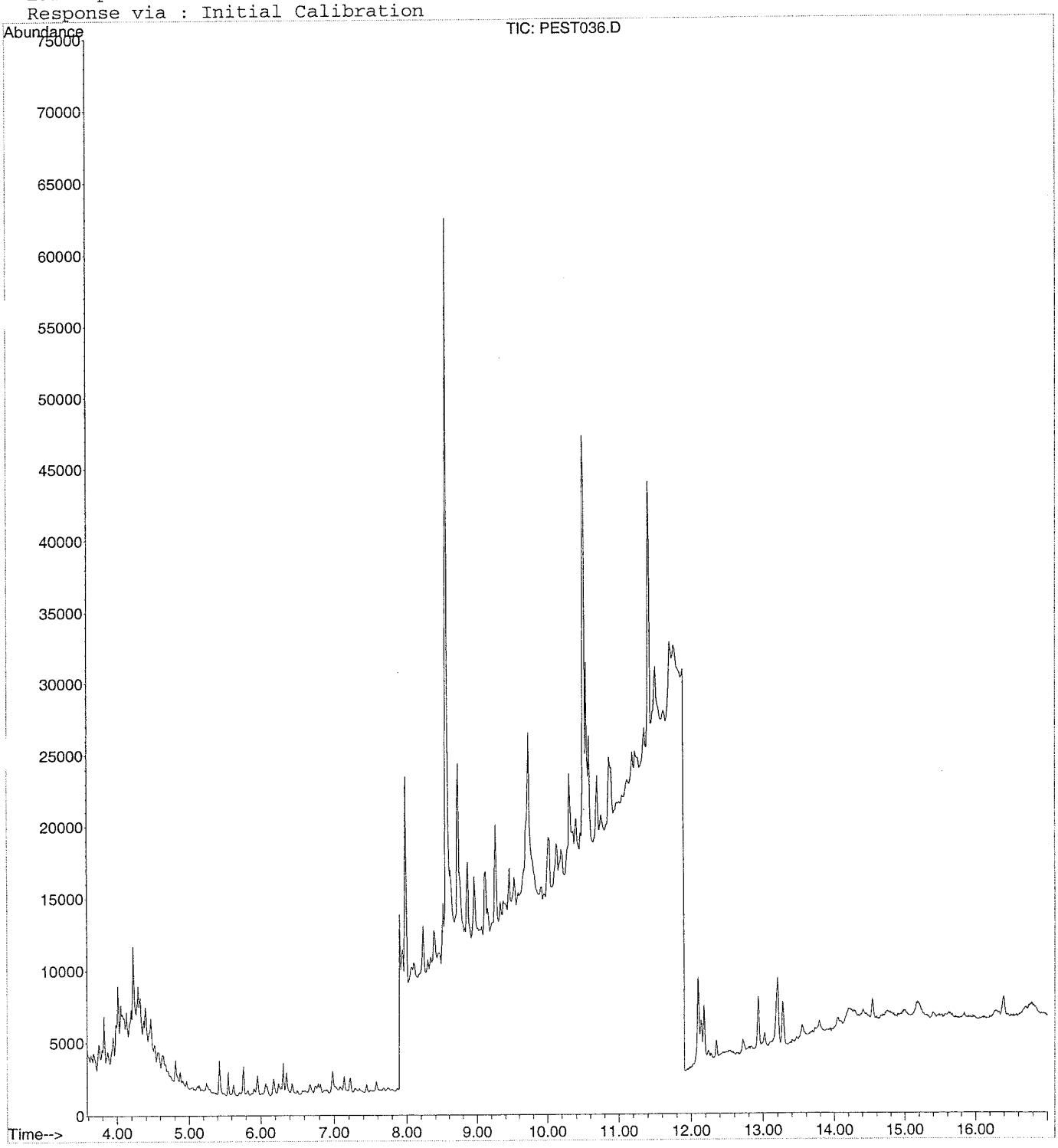
Data File : C:\MSDCHEM\1\DATA\010302\PEST036.D
Acq On : 4 Jan 2002 23:22
Sample : 12540-007/E18 1.45
Misc : Fugro Environmental / Soil

Vial: 36
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 10.07
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 7 10:53 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Fri Jan 04 17:24:13 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

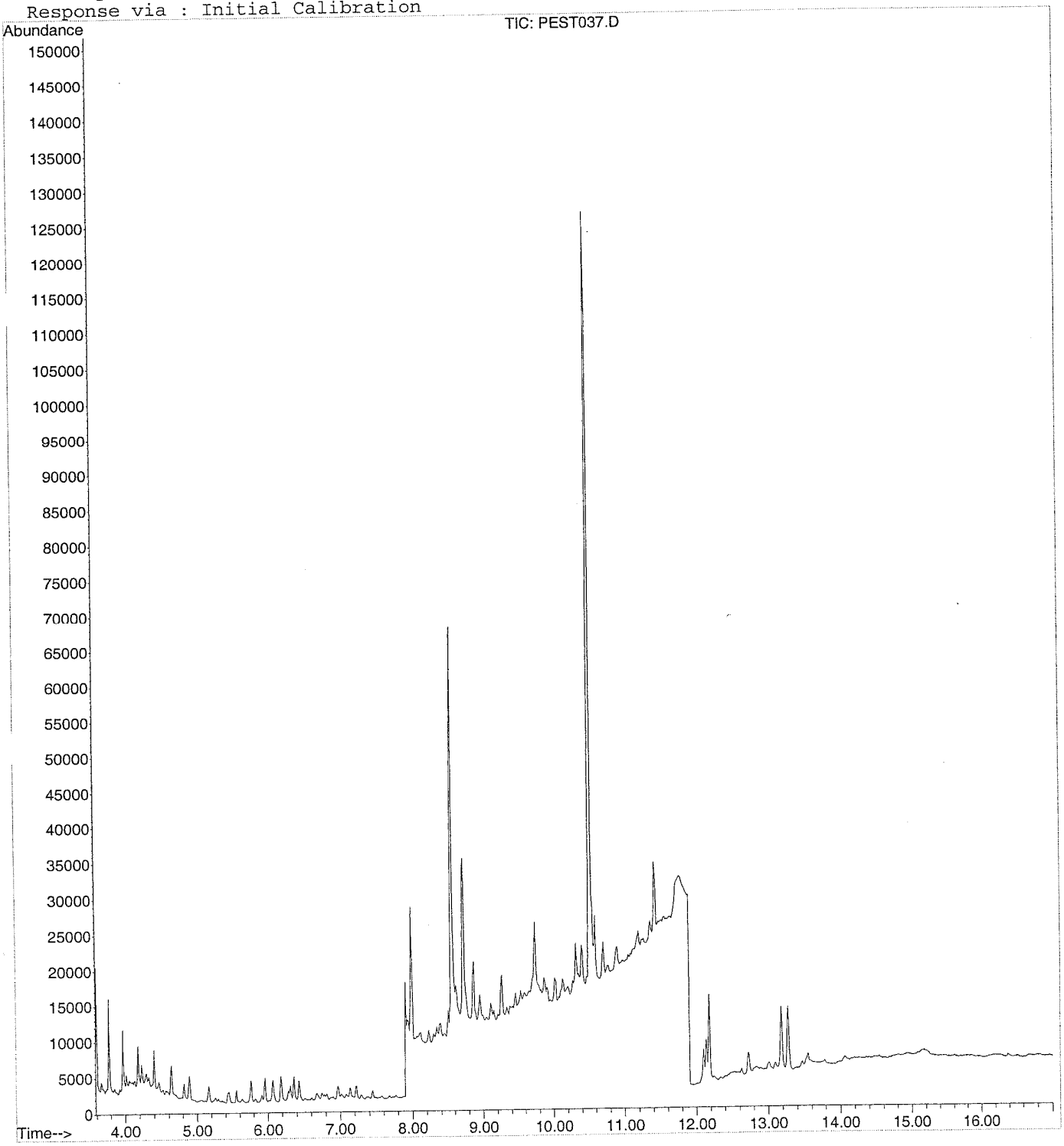
Data File : C:\MSDCHEM\1\DATA\010302\PEST037.D
Acq On : 4 Jan 2002 23:46
Sample : 12540-008/E45 0
Misc : Fugro Environmental / Soil

Vial: 37
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 10.34
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 7 10:58 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Fri Jan 04 17:24:13 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

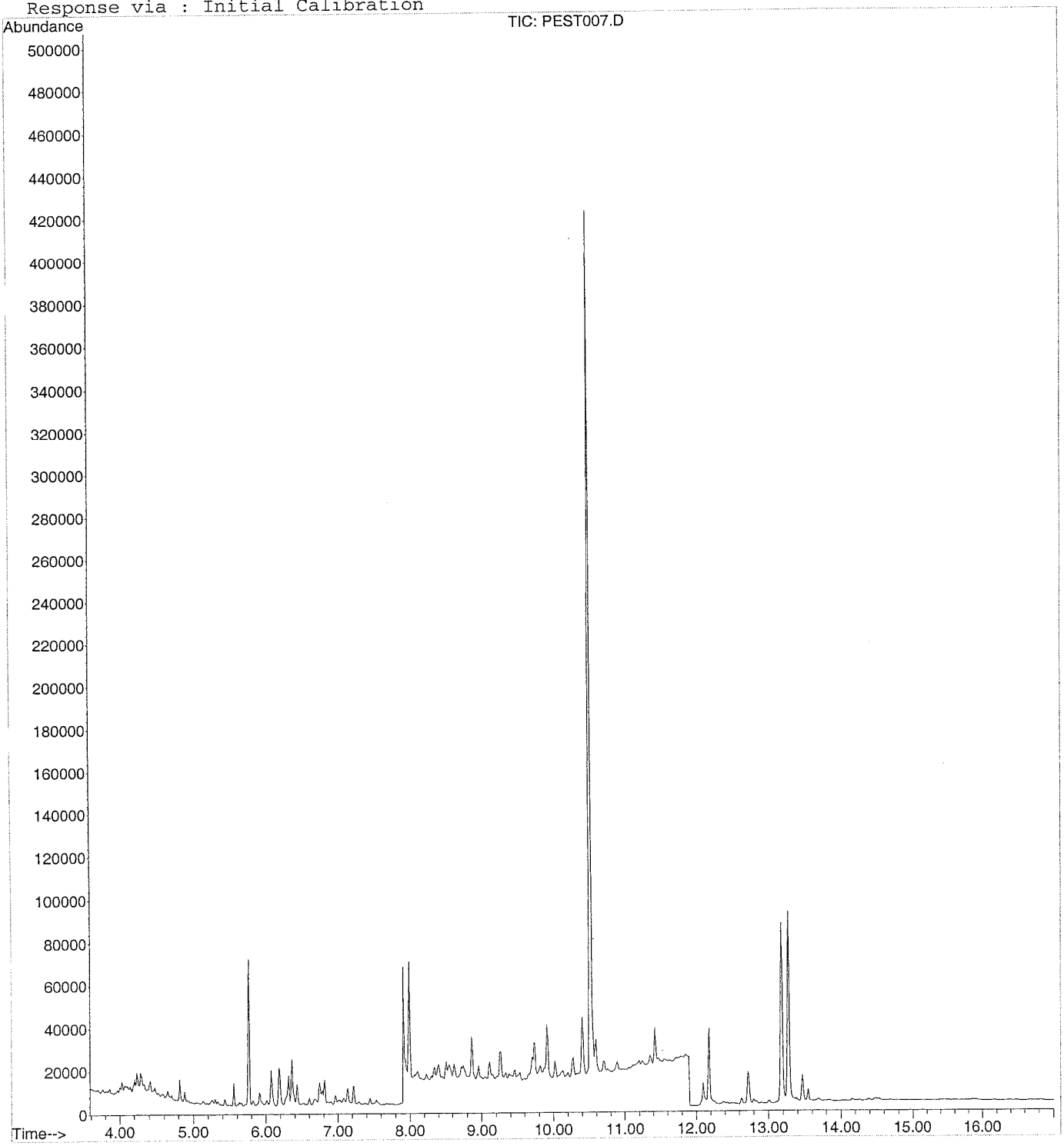
Data File : C:\MSDCHEM\1\DATA\010602\PEST007.D
Acq On : 6 Jan 2002 15:42
Sample : 12450-009/E61 0
Misc : Fugro Environmental / Soil

Vial: 7
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 0.20
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 9 9:38 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Wed Jan 09 09:27:08 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

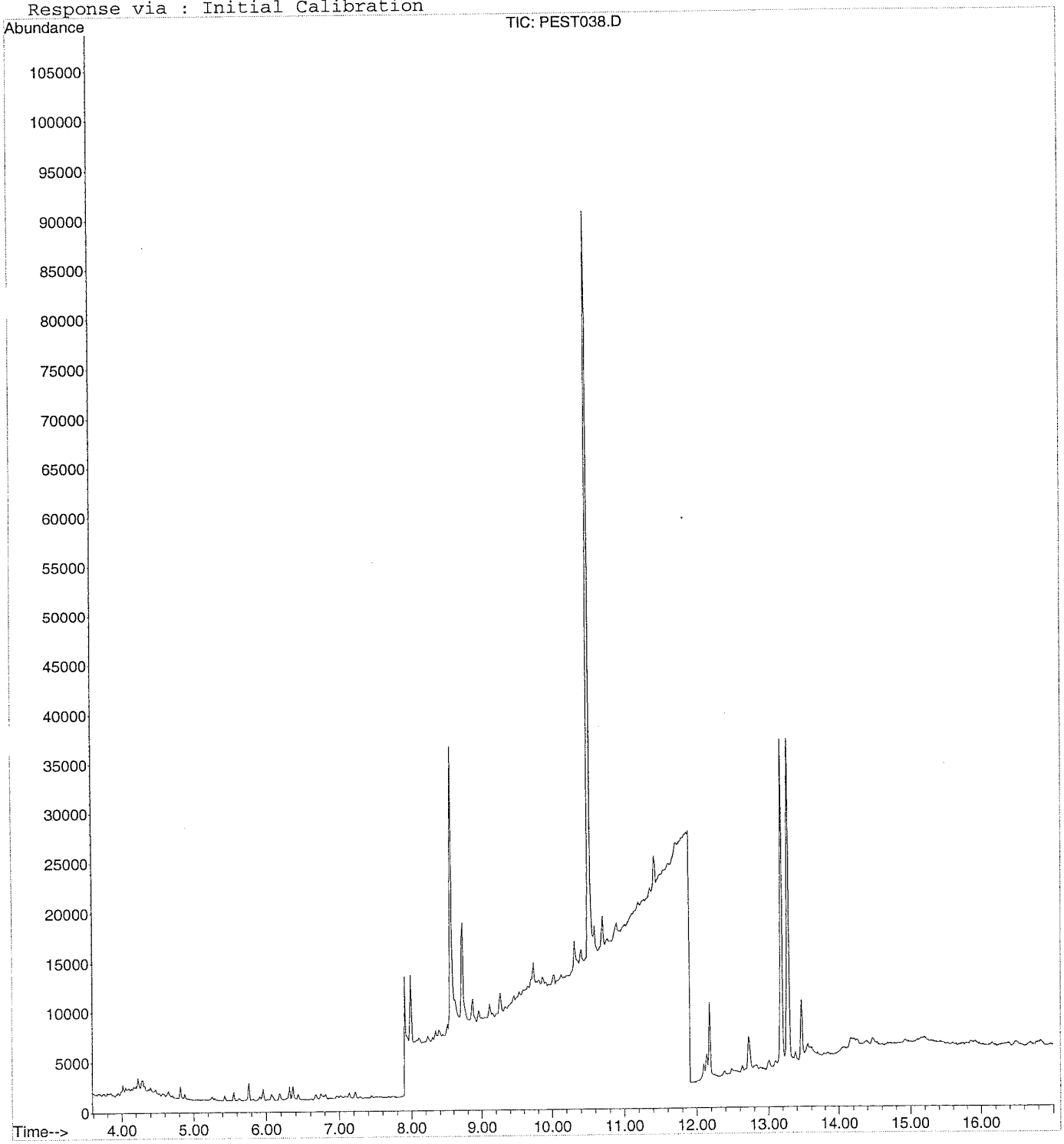
Data File : C:\MSDCHEM\1\DATA\010302\PEST038.D
Acq On : 5 Jan 2002 00:10
Sample : 12540-010/E66 0
Misc : Fugro Environmental / Soil

Vial: 38
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 10.20
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 7 11:02 2002

Quant Results File: PESTCL.RES

Method : C:\MSDCHEM\1\METHODS\PESTCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Fri Jan 04 17:24:13 2002
Response via : Initial Calibration



Organochlorine Pesticides

Sample Identity - 0.05ppm OCP
Client / Sample matrix - OCP / Water
Units - ng/l

CAS Number	Compound	Concentration
117-18-0	Tecnazene	38,330
1582-09-8	Trifluralin	32,375
319-84-6	alpha-HCH(Lindane)	46,330
118-74-1	Hexachlorobenzene	41,731
319-85-7	beta-HCH (Lindane)	36,114
58-89-9	gamma-HCH(Lindane)	44,560
82-68-8	Quintozene (PCNB)	37,020
2303-17-5	Triallate	39,023
1897-45-6	Chlorothalonil	35,529
76-44-8	Heptachlor	39,040
309-00-2	Aldrin	46,480
43121-43-3	Triadimefon	52,466
40487-42-1	Pendimethalin	29,930
1024-57-3	Heptachlor Epoxide	39,670
3424-82-6	o,p'-DDE	40,416
959-98-8	Endosulfan I	44,561
72-55-9	p,p'-DDE	37,851
60-57-1	Dieldrin	39,125
72-54-8	p,p'-TDE(DDD)	37,888
72-20-8	Endrin	35,800
33213-65-9	Endosulfan II	38,676
53-19-0	o,p'-TDE	36,445
789-02-6	o,p'-DDT	31,518
50-29-3	p,p'-DDT	24,278
1031-07-8	Endosulfan Sulphate	54,664
	o,p'-Methoxychlor	27,225
72-43-5	p,p'-Methoxychlor	21,710
52645-53-1	Permethrin	40,342
Total		1,069,096

Quantitation Report (QT Reviewed)

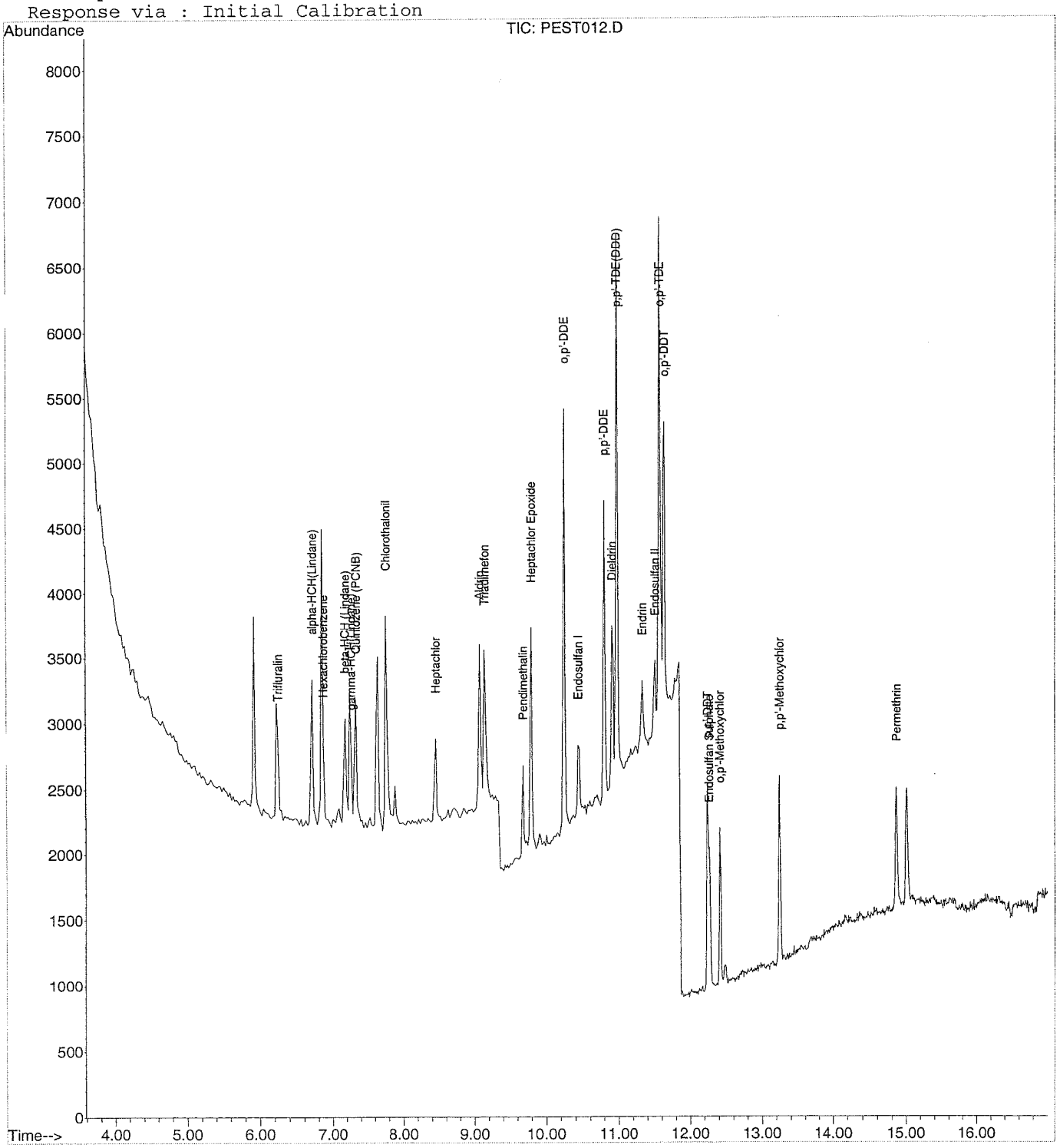
Data File : C:\MSDCHEM\1\DATA\011602\PEST012.D
Acq On : 16 Jan 2002 23:39
Sample : 0.05ppm OCP
Misc : OCP / Water

Vial: 12
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 1.00
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 17 9:59 2002

Quant Results File: ORGANOCL.RES

Method : C:\MSDCHEM\1\METHODS\ORGANOCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Thu Jan 17 10:03:10 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

Data File : C:\MSDCHEM\1\DATA\011602\PEST012.D Vial: 12
Acq On : 16 Jan 2002 23:39 Operator: ALcontrol Geochem
Sample : 0.05ppm OCP Inst : 01A MSD59
Misc : OCP / Water Multiplr: 1.00
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 17 09:58:14 2002 Quant Results File: ORGANOCL.RES

Quant Method : C:\MSDCHEM\1\METHODS\ORGANOCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Thu Jan 17 09:51:06 2002
Response via : Initial Calibration
DataAcq Meth : ORGANOCL

Internal Standards	R.T.	QIon	Response	Conc	Units		Dev(Min)
Target Compounds							Qvalue
1) Tecnazene	5.93	261	4409	0.04	ppm	#	85
2) Trifluralin	6.25	306	8848	0.03	ppm		96
3) alpha-HCH(Lindane)	6.72	183	8851	0.05	ppm		95
4) Hexachlorobenzene	6.86	284	24970	0.04	ppm		97
5) beta-HCH (Lindane)	7.19	181	5923	0.04	ppm	#	46
6) gamma-HCH(Lindane)	7.26	183	8390	0.04	ppm		97
7) Quintozene (PCNB)	7.34	295	3283	0.04	ppm		91
8) Triallate	7.65	268	9320	0.04	ppm		92
9) Chlorothalonil	7.75	266	16504m	0.04	ppm		
10) Heptachlor	8.46	100	4972	0.04	ppm	#	87
11) Aldrin	9.07	66	5585m	0.05	ppm		
12) Triadimefon	9.14	208	14387m	0.05	ppm		
13) Pendimethalin	9.69	252	9723m	0.03	ppm		
14) Heptachlor Epoxide	9.81	353	9116	0.04	ppm	#	43
15) o,p'-DDE	10.26	246	27603	0.04	ppm		99
16) Endosulfan I	10.45	195	2300m	0.04	ppm		
17) p,p'-DDE	10.81	246	19056	0.04	ppm		96
18) Dieldrin	10.92	79	8228	0.04	ppm		93
19) p,p'-TDE(DDD)	10.99	235	33519	0.04	ppm		96
20) Endrin	11.34	263	1873	0.04	ppm	#	1
21) Endosulfan II	11.52	337	596m	0.04	ppm		
22) o,p'-TDE	11.58	235	31466	0.04	ppm		98
23) o,p'-DDT	11.65	235	21203m	0.03	ppm		
24) p,p'-DDT	12.25	235	15211	0.02	ppm		87
25) Endosulfan Sulphate	12.28	272	8139m	0.05	ppm		
26) o,p'-Methoxychlor	12.42	227	14756	0.03	ppm		98
27) p,p'-Methoxychlor	13.25	227	20938	0.02	ppm		98
28) Permethrin	14.87	183	16352	0.04	ppm	#	88

(#) = qualifier out of range (m) = manual integration

Organochlorine Pesticides

Sample Identity - 0.10ppm OCP
Client / Sample matrix - OCP / Water
Units - ng/l

CAS Number	Compound	Concentration
117-18-0	Tecnazene	93,478
1582-09-8	Trifluralin	77,359
319-84-6	alpha-HCH(Lindane)	101,394
118-74-1	Hexachlorobenzene	98,173
319-85-7	beta-HCH (Lindane)	88,157
58-89-9	gamma-HCH(Lindane)	100,348
82-68-8	Quintozene (PCNB)	89,452
2303-17-5	Triallate	91,580
1897-45-6	Chlorothalonil	88,081
76-44-8	Heptachlor	92,551
309-00-2	Aldrin	92,157
43121-43-3	Triadimefon	112,760
40487-42-1	Pendimethalin	68,999
1024-57-3	Heptachlor Epoxide	96,871
3424-82-6	o,p'-DDE	98,176
959-98-8	Endosulfan I	98,507
72-55-9	p,p'-DDE	92,137
60-57-1	Dieldrin	93,049
72-54-8	p,p'-TDE(DDD)	93,236
72-20-8	Endrin	92,639
33213-65-9	Endosulfan II	93,446
53-19-0	o,p'-TDE	90,498
789-02-6	o,p'-DDT	90,667
50-29-3	p,p'-DDT	66,741
1031-07-8	Endosulfan Sulphate	101,748
	o,p'-Methoxychlo	68,193
72-43-5	p,p'-Methoxychlo	60,368
52645-53-1	Permethrin	86,014
	Total	2,516,780

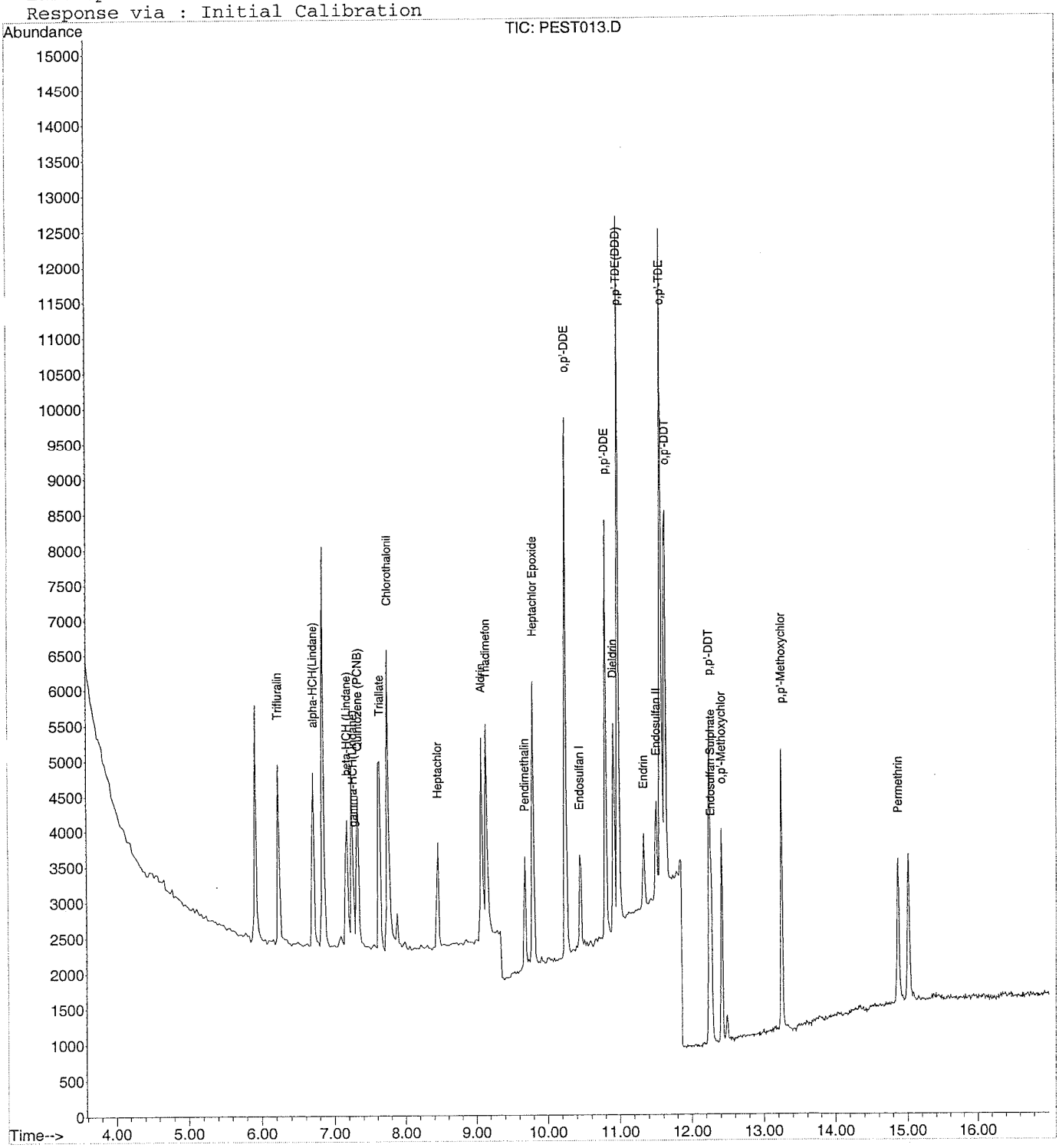
Data File : C:\MSDCHEM\1\DATA\011602\PEST013.D
Acq On : 17 Jan 2002 00:04
Sample : 0.10ppm OCP
Misc : OCP / Water

Vial: 13
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 1.00
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 17 10:00 2002

Quant Results File: ORGANOCL.RES

Method : C:\MSDCHEM\1\METHODS\ORGANOCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Thu Jan 17 10:03:10 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

Data File : C:\MSDCHEM\1\DATA\011602\PEST013.D
Acq On : 17 Jan 2002 00:04
Sample : 0.10ppm OCP
Misc : OCP / Water

Vial: 13
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 1.00
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 17 09:59:52 2002

Quant Results File: ORGANOCL.RES

Quant Method : C:\MSDCHEM\1\METHODS\ORGANOCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Thu Jan 17 09:59:45 2002
Response via : Initial Calibration
DataAcq Meth : ORGANOCL

Internal Standards	R.T.	QIon	Response	Conc	Units		Dev(Min)
Target Compounds							Qvalue
1) Tecnazene	5.93	261	10752	0.09	ppm	#	96
2) Trifluralin	6.23	306	21142m	0.08	ppm		
3) alpha-HCH(Lindane)	6.72	183	19372	0.10	ppm		98
4) Hexachlorobenzene	6.86	284	58743	0.10	ppm		95
5) beta-HCH (Lindane)	7.18	181	14459	0.09	ppm		98
6) gamma-HCH(Lindane)	7.26	183	18894	0.10	ppm		100
7) Quintozene (PCNB)	7.34	295	7933	0.09	ppm		93
8) Triallate	7.65	268	21873	0.09	ppm		96
9) Chlorothalonil	7.75	266	40919m	0.09	ppm		
10) Heptachlor	8.46	100	11788	0.09	ppm		96
11) Aldrin	9.07	66	11077m	0.09	ppm		
12) Triadimefon	9.14	208	30885m	0.11	ppm		
13) Pendimethalin	9.69	252	22419	0.07	ppm	#	1
14) Heptachlor Epoxide	9.80	353	22261	0.10	ppm		96
15) o,p'-DDE	10.26	246	67050	0.10	ppm		98
16) Endosulfan I	10.45	195	5086m	0.10	ppm		
17) p,p'-DDE	10.81	246	46386	0.09	ppm		100
18) Dieldrin	10.92	79	19568	0.09	ppm		96
19) p,p'-TDE(DDD)	10.99	235	82484	0.09	ppm		99
20) Endrin	11.34	263	4845	0.09	ppm	#	77
21) Endosulfan II	11.52	337	1441m	0.09	ppm		
22) o,p'-TDE	11.59	235	78133	0.09	ppm		99
23) o,p'-DDT	11.65	235	60994m	0.09	ppm		
24) p,p'-DDT	12.25	235	41815	0.07	ppm		96
25) Endosulfan Sulphate	12.28	272	15155	0.10	ppm	#	70
26) o,p'-Methoxychlor	12.42	227	36961	0.07	ppm		99
27) p,p'-Methoxychlor	13.25	227	58222	0.06	ppm		100
28) Permethrin	14.87	183	34866	0.09	ppm	#	93

(#) = qualifier out of range (m) = manual integration

Organochlorine Pesticides

Sample Identity - 0.50ppm OCP
Client / Sample matrix - OCP / Water
Units - ng/l

CAS Number	Compound	Concentration
117-18-0	Tecnazene	488,677
1582-09-8	Trifluralin	465,470
319-84-6	alpha-HCH(Lindane)	544,731
118-74-1	Hexachlorobenzene	513,824
319-85-7	beta-HCH (Lindane)	514,540
58-89-9	gamma-HCH(Lindane)	514,767
82-68-8	Quintozene (PCNB)	507,692
2303-17-5	Triallate	521,541
1897-45-6	Chlorothalonil	492,718
76-44-8	Heptachlor	506,562
309-00-2	Aldrin	543,767
43121-43-3	Triadimefon	504,328
40487-42-1	Pendimethalin	454,219
1024-57-3	Heptachlor Epoxide	522,578
3424-82-6	o,p'-DDE	500,143
959-98-8	Endosulfan I	492,843
72-55-9	p,p'-DDE	498,726
60-57-1	Dieldrin	490,579
72-54-8	p,p'-TDE(DDD)	490,922
72-20-8	Endrin	472,656
33213-65-9	Endosulfan II	486,159
53-19-0	o,p'-TDE	483,509
789-02-6	o,p'-DDT	459,944
50-29-3	p,p'-DDT	469,792
1031-07-8	Endosulfan Sulphate	487,778
	o,p'-Methoxychlor	467,815
72-43-5	p,p'-Methoxychlor	461,794
52645-53-1	Permethrin	486,601
	Total	13,844,677

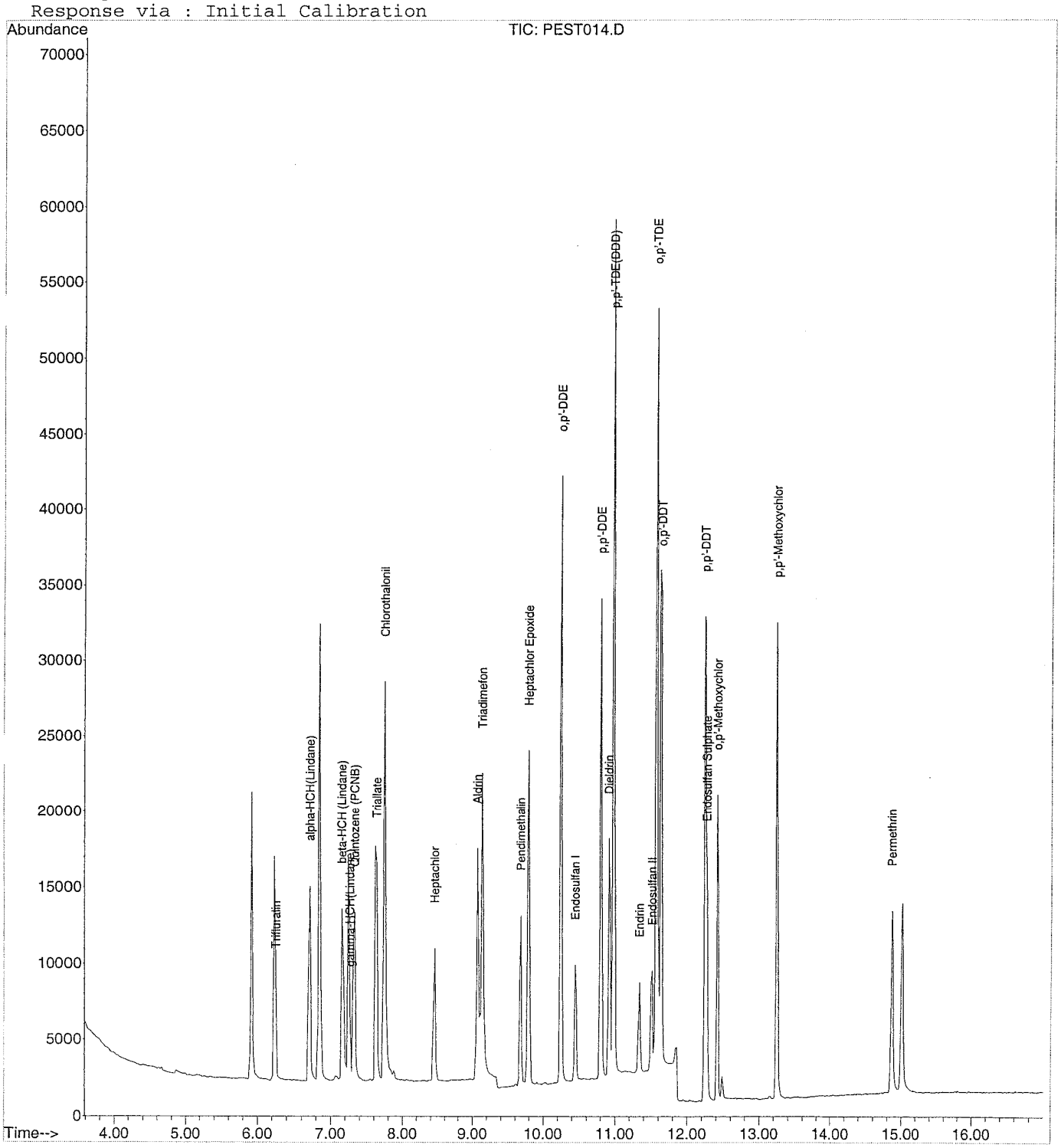
Data File : C:\MSDCHEM\1\DATA\011602\PEST014.D
Acq On : 17 Jan 2002 00:28
Sample : 0.50ppm OCP
Misc : OCP / Water

Vial: 14
Operator: ALcontrol Geochem
Inst : 01A MSD59
Multiplr: 1.00
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 17 10:01 2002

Quant Results File: ORGANOCL.RES

Method : C:\MSDCHEM\1\METHODS\ORGANOCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Thu Jan 17 10:03:10 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

Data File : C:\MSDCHEM\1\DATA\011602\PEST014.D Vial: 14
Acq On : 17 Jan 2002 00:28 Operator: ALcontrol Geochem
Sample : 0.50ppm OCP Inst : 01A MSD59
Misc : OCP / Water Multiplr: 1.00
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 17 09:26:52 2002 Quant Results File: ORGANOCL.RES

Quant Method : C:\MSDCHEM\1\METHODS\ORGANOCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Thu Jan 17 09:26:38 2002
Response via : Initial Calibration
DataAcq Meth : ORGANOCL

Internal Standards	R.T.	QIon	Response	Conc	Units		Dev(Min)
Target Compounds							Qvalue
1) Tecnazene	5.93	261	56517	0.49	ppm	#	95
2) Trifluralin	6.25	306	129319	0.47	ppm		97
3) alpha-HCH(Lindane)	6.72	183	102246	0.54	ppm		97
4) Hexachlorobenzene	6.86	284	305911	0.51	ppm		98
5) beta-HCH (Lindane)	7.16	181	84042m	0.51	ppm		
6) gamma-HCH(Lindane)	7.26	183	96371	0.51	ppm		99
7) Quintozene (PCNB)	7.34	295	44946	0.51	ppm		98
8) Triallate	7.65	268	123640	0.52	ppm		96
9) Chlorothalonil	7.76	266	229983	0.49	ppm		100
10) Heptachlor	8.46	100	64416	0.51	ppm		99
11) Aldrin	9.08	66	64282	0.54	ppm	#	92
12) Triadimefon	9.14	208	139914m	0.50	ppm		
13) Pendimethalin	9.69	252	151286m	0.45	ppm		
14) Heptachlor Epoxide	9.81	353	119028	0.52	ppm		98
15) o,p'-DDE	10.26	246	341739	0.50	ppm		99
16) Endosulfan I	10.45	195	25508	0.49	ppm		97
17) p,p'-DDE	10.81	246	251488	0.50	ppm		99
18) Dieldrin	10.92	79	103660	0.49	ppm		98
19) p,p'-TDE(DDD)	10.99	235	436333	0.49	ppm		100
20) Endrin	11.34	263	25017	0.47	ppm		94
21) Endosulfan II	11.52	337	6996	0.49	ppm	#	65
22) o,p'-TDE	11.58	235	420799	0.48	ppm		99
23) o,p'-DDT	11.64	235	315204	0.46	ppm		97
24) p,p'-DDT	12.24	235	301430m	0.47	ppm		
25) Endosulfan Sulphate	12.28	272	72984	0.49	ppm		98
26) o,p'-Methoxychlor	12.42	227	259214m	0.47	ppm		
27) p,p'-Methoxychlor	13.24	227	458760m	0.46	ppm		
28) Permethrin	14.87	183	198605	0.49	ppm		99

(#) = qualifier out of range (m) = manual integration

Organochlorine Pesticides

Sample Identity - 1ppm OCP
Client / Sample matrix - OCP / Water
Units - ng/l

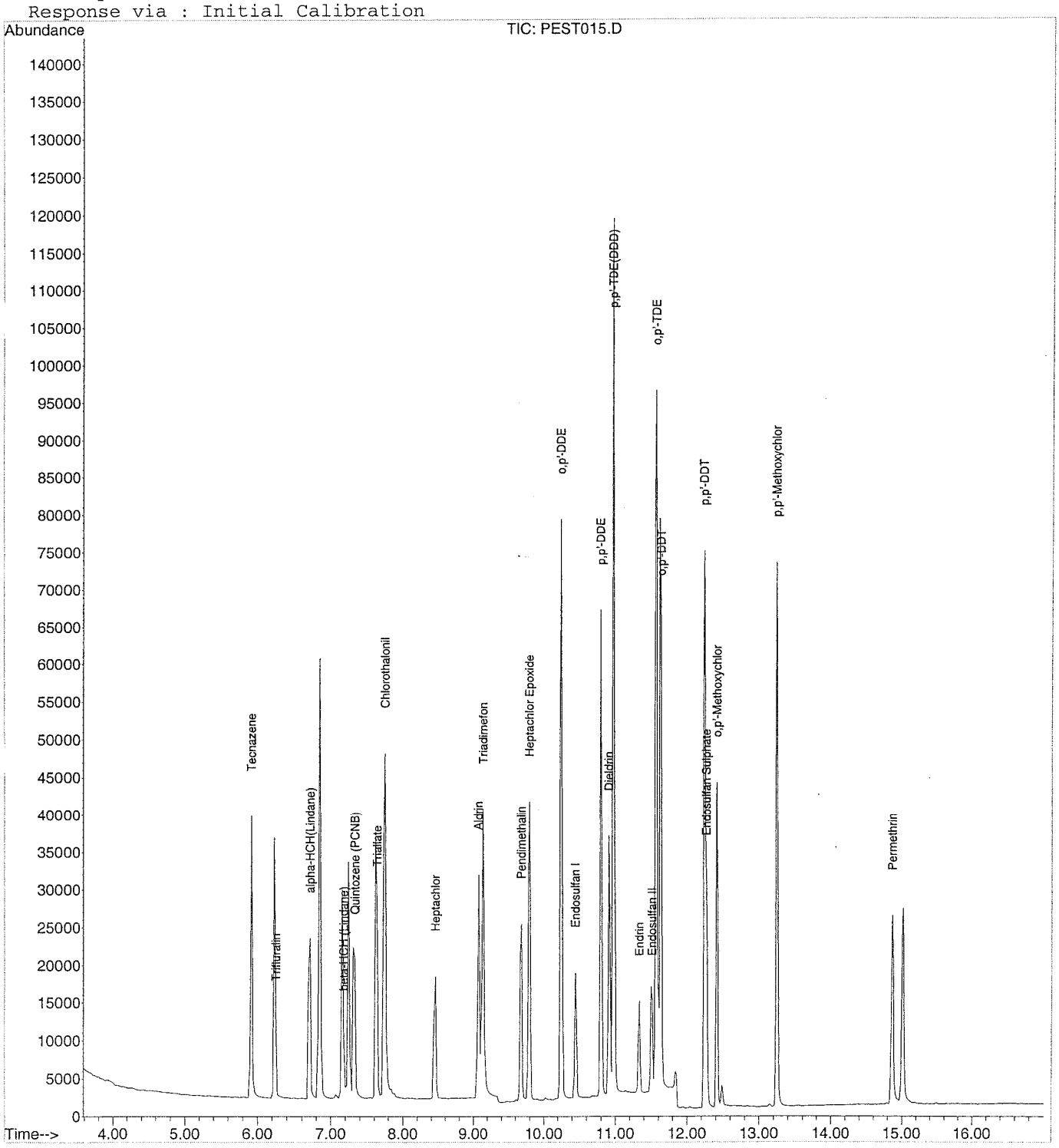
CAS Number	Compound	Concentration
117-18-0	Tecnazene	1,005,543
1582-09-8	Trifluralin	1,016,557
319-84-6	alpha-HCH(Lindane)	982,256
118-74-1	Hexachlorobenzene	994,975
319-85-7	beta-HCH (Lindane)	995,324
58-89-9	gamma-HCH(Lindane)	994,317
82-68-8	Quintozene (PCNB)	998,292
2303-17-5	Triallate	992,561
1897-45-6	Chlorothalonil	1,001,032
76-44-8	Heptachlor	997,527
309-00-2	Aldrin	981,177
43121-43-3	Triadimefon	1,034,191
40487-42-1	Pendimethalin	1,022,019
1024-57-3	Heptachlor Epoxide	991,702
3424-82-6	o,p'-DDE	1,000,472
959-98-8	Endosulfan I	1,003,203
72-55-9	p,p'-DDE	1,001,625
60-57-1	Dieldrin	1,004,778
72-54-8	p,p'-TDE(DDD)	1,004,674
72-20-8	Endrin	1,012,226
33213-65-9	Endosulfan II	955,606
53-19-0	o,p'-TDE	1,007,952
789-02-6	o,p'-DDT	1,017,801
50-29-3	p,p'-DDT	1,015,677
1031-07-8	Endosulfan Sulphate	1,004,585
	o,p'-Methoxychlor	1,016,579
72-43-5	p,p'-Methoxychlor	1,019,828
52645-53-1	Permethrin	1,006,547
	Total	28,079,025

Quantitation Report (QT Reviewed)

Data File : C:\MSDCHEM\1\DATA\011602\PEST015.D Vial: 15
Acq On : 17 Jan 2002 00:52 Operator: ALcontrol Geochem
Sample : 1ppm OCP Inst : 01A MSD59
Misc : OCP / Water Multiplr: 1.00
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 17 10:02 2002 Quant Results File: ORGANOCL.RES

Method : C:\MSDCHEM\1\METHODS\ORGANOCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Thu Jan 17 10:03:10 2002
Response via : Initial Calibration



Quantitation Report (QT Reviewed)

Data File : C:\MSDCHEM\1\DATA\011602\PEST015.D Vial: 15
Acq On : 17 Jan 2002 00:52 Operator: ALcontrol Geochem
Sample : 1ppm OCP Inst : 01A MSD59
Misc : OCP / Water Multiplr: 1.00
Sample Amount: 0.00

MS Integration Params: EVENTS.E
Quant Time: Jan 17 10:02:13 2002 Quant Results File: ORGANOCL.RES

Quant Method : C:\MSDCHEM\1\METHODS\ORGANOCL.M (Chemstation Integrator)
Title : Organochlorine Pesticides
Last Update : Thu Jan 17 10:02:06 2002
Response via : Initial Calibration
DataAcq Meth : ORGANOCL

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
Target Compounds						Qvalue
1) Tecnazene	5.93	261	115654	1.01	ppm	100
2) Trifluralin	6.25	306	277825	1.02	ppm	100
3) alpha-HCH(Lindane)	6.72	183	187661	0.98	ppm	100
4) Hexachlorobenzene	6.86	284	595361	0.99	ppm	100
5) beta-HCH (Lindane)	7.17	181	163270	1.00	ppm	100
6) gamma-HCH(Lindane)	7.26	183	187213	0.99	ppm	100
7) Quintozene (PCNB)	7.34	295	88530	1.00	ppm	100
8) Triallate	7.65	268	237067	0.99	ppm	100
9) Chlorothalonil	7.76	266	465171	1.00	ppm	100
10) Heptachlor	8.45	100	127050	1.00	ppm	100
11) Aldrin	9.08	66	117930	0.98	ppm	100
12) Triadimefon	9.15	208	287683	1.03	ppm	97
13) Pendimethalin	9.69	252	333069	1.02	ppm	100
14) Heptachlor Epoxide	9.80	353	227771	0.99	ppm	100
15) o,p'-DDE	10.26	246	683282	1.00	ppm	100
16) Endosulfan I	10.45	195	51757	1.00	ppm	100
17) p,p'-DDE	10.81	246	504261	1.00	ppm	100
18) Dieldrin	10.92	79	211302	1.00	ppm	100
19) p,p'-TDE(DDD)	10.99	235	888802	1.00	ppm	100
20) Endrin	11.34	263	52930	1.01	ppm	100
21) Endosulfan II	11.52	337	14749m	0.96	ppm	
22) o,p'-TDE	11.58	235	870302	1.01	ppm	100
23) o,p'-DDT	11.64	235	685310	1.02	ppm	100
24) p,p'-DDT	12.25	235	641410	1.02	ppm	100
25) Endosulfan Sulphate	12.28	272	149625	1.00	ppm	100
26) o,p'-Methoxychlor	12.42	227	554095	1.02	ppm	100
27) p,p'-Methoxychlor	13.25	227	993315	1.02	ppm	100
28) Permethrin	14.87	183	408004	1.01	ppm	100

(#) = qualifier out of range (m) = manual integration