GENERAL MOTORS CORPORATION
SHREVEPORT, LOUISIANA

EXPANSION ASSESSMENT II
PHASE II

JANUARY, 1991

PREPARED BY:

C-K ASSOCIATES, INC.
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SHREVEPORT, LOUISIANA 71105
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C-K ASSOCIATES' PROJECT NO. 12-455-1

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1.0 INTRODUCTION

General Motors Corporation's (General Motors) Assembly Plant is a large manufacturing facility located in Shreveport, Louisiana, western Caddo Parish (Figure 1). The plant assembles light duty trucks. The assembly plant occupies approximately 45 acres of a 440 acre site and employs about 2,700 people. Construction of the plant began in 1978 and was completed by 1981. A map of the facility is included as Figure 2 and an aerial photograph is included as Figure 3.

The plant receives its sub-assemblies and parts via railroad freight car and overland truck. The main processes that occur at the plant include: welding of steel sub-assemblies and parts into trucks and sheet-metal assemblies; washing and painting facilities (main hydrocarbon source); trim shop, where inside and outside hardware are assembled to the truck; chassis area, where the engine, axle, transmission and associated parts are assembled to the chassis frame; and the final assembly department that completes assembly operations for a finished truck. Other operations consist of final truck repairs, maintenance, cushion assembly, administrative offices, and other minor associated activities.

Phase II of Expansion Assessment II was initiated when laboratory data indicated the possible presence of 2-Hexanone in the soil at boring NO. 5 (B-5). B-5 is located within the southern portion of the Roll Test Booth Expansion Area (Expansion Area D) as shown on Figure 4. The objective of the Phase II investigation was to confirm the presence of 2-Hexanone in the soil in the vicinity of B-5 and to determine if present, its vertical distribution within the soil.

The findings of the previous assessment at Area D are found in the Expansion Assessment II Report, dated December 1990.

2.0 FIELD INVESTIGATION

Consistent with guidance provided by DEQ (Mr. Leon Waller), four soil borings were drilled within close proximity of B-5 in order to further investigate the possible presence of 2-Hexanone. The borings were placed in locations pre-determined by General Motors' environmental engineers in conjunction with DEQ Groundwater Protection personnel. Each of the four borings was drilled to a depth ranging from 32 to 35 feet below the ground surface. The soil borings are plotted on the Soil Boring Location Map included as Figure 4.

Soil samples were continuously collected with a Shelby tube to the completion depth of each boring. All soil samples and auger cuttings were visually inspected by the on-site hydrogeologist. Detailed boring logs were prepared which included sample numbers, sample depths, visual description of each sample, measured consistency, Unified Soil Classification System (USCS) descriptions, Organic Vapor Analyzer (OVA) measurements, and other pertinent information relative to the drilling operations. The completed soil boring logs are found in Appendix A.

Each soil sample collected was trimmed to remove the smear zone formed during sample acquisition. A portion of each sample was placed within a properly labeled Zip-Lock ^{R} bag for OVA analyses. The samples were then disaggregated and allowed to stabilize for approximately 15 minutes prior to scanning with the OVA. The OVA measurements were obtained by inserting the instrument probe into the opening of the Zip-Lock ^{R} bag. Following stabilization of the sample head space, the organic vapor concentrations were measured and recorded on the soil boring logs. A second series of OVA measurements were obtained with a light ends filter attached to the instrument probe. The second set of measurements were subtracted from the first set of measurements and the difference recorded on the soil boring logs as the adjusted values. This methodology eliminated the possibility of false high OVA measurements resulting from the presence of natural gas.

Soil samples were collected at five foot intervals for potential laboratory analyses. Samples collected at the shallowest intervals were analyzed first. If 2-Hexanone was detected at concentrations at or above the detection limit in a particular sample, a sample from the interval below it was analyzed. This selection process was continued until concentrations at or above the detection limit failed to be detected.

In order to minimize cross-contamination during sample preparation, each of the samples were handled with a clean pair of surgical gloves and placed on a clean sheet of aluminum foil. All sampling tools were washed with a laboratory grade cleaning compound and deionized water between sample collections.

3.0 EXPANSION AREA D (ROLL TEST BOOTH)

The Roll Test Booth Expansion Area will be used for the purpose of electronically testing assembled vehicles. The foundation for the expansion area will cover an area of 8,100 square feet and will be supported by five reinforced concrete pilings, each approximately 20 feet deep.

On December 10 and 11, 1990, C-K Associates conducted the Phase II assessment at the Roll Test Booth Expansion Area. The subsurface soils were assessed with soil borings B-9 through B-12 to depths of 32 to 35 feet (Figure 4). The soil borings encountered undifferentiated fill to a depth of four feet below the ground surface. Underlying the undifferentiated fill, silty clay was encountered to a depth of 13 to 14 feet. Below the silty clay a homogeneous hard clay with horizontally oriented fine grain sand and silt laminations was encountered. This unit was continuous to the completion depth of both borings. A saturated zone was encountered within each of the borings at a depth of 19 to 20 feet.

Soil samples were collected from each of the borings as described in Section 2.0 and were submitted to West-Paine Laboratories for 2-Hexanone analyses (SW-846, Method 8240). In addition to the submittal of the soil samples two field blanks were also submitted to the laboratory for 2-Hexanone analyses (EPA Method 624).

Field OVA analyses detected organic vapor concentrations ranging from 0 to 25 ppm in soil samples analyzed from one to eight feet below the surface. No measurable readings were recorded from samples collected below the depth of eight feet. The specific values are recorded on the soil boring logs found in Appendix A.

The laboratory analyses indicated the presence of 2-hexanone at B-9 and B-10. At B-9, 2-Hexanone was detected at a concentration of 0.24 mg/kg (Sample No. 901) in a sample collected from a depth of five feet and at a concentration of 0.21 mg/kg (Sample No. 902) in a sample collected from a depth of ten feet. At B-10, 2-Hexanone was detected at concentration of 0.09 mg/kg (Sample No. 1001) at a depth of five feet. The detection limit reported by the laboratory for the 2-Hexanone analyses was 0.05 mg/kg. The laboratory analyses are summarized on Table 1. Completed laboratory reports and chain of custody documentation are found in Appendix B.

Subsequent to attaining the completion depth of each boring, drilling equipment was retracted and the borehole was grouted up to the ground surface with a cement-bentonite slurry.

4.0 SUMMARY

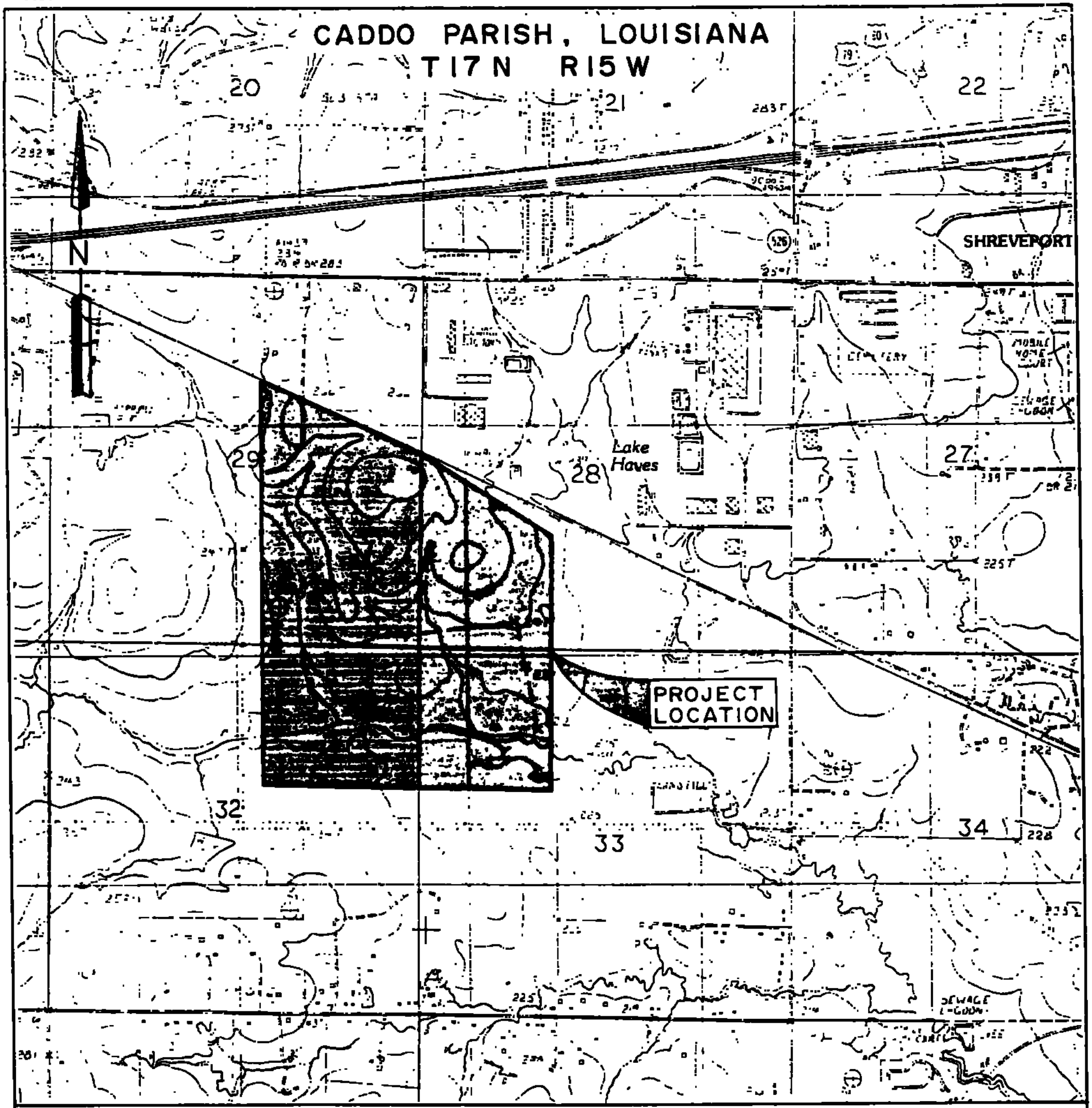
Phase II assessment activities conducted at Expansion Area D (Roll Test Booth) detected the presence of 2-Hexanone in soil samples collected at B-9 and B-10. The maximum depth in which 2-Hexanone was detected was ten feet below the ground surface.

From an analytical standpoint, the quantity of 2-hexanone found in sample no. 1001 is so close to the limit of detection, it should be discounted. Sample nos. 901 and 902 were found to contain a concentration of 2-hexanone at 4-5 times the detection limit used for this analysis. Due to the relatively low concentration of 2-hexanone in these samples and the limited occurrence, this compound may be a sampling or laboratory artifact.

Also, an Environmental Protection Agency document, "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses," February, 1988, may be cited. It states that no positive sample result should be reported unless the concentration of the compound in the sample exceeds five times the amount in any blank.

Further interpretation of the 2-hexanone analysis is included as correspondence found in Appendix C.

10684



2000 1000 0 2000 4000

SCALE- FEET

FIGURE 1

NOTE:

BASE MAP TAKEN FROM U.S.G.S. QUADRANGLE "GREENWOOD, LA.", DATED 1982, AT A SCALE OF 1:24,000.

PLANT BOUNDARIES SCALED FROM GM DRAWING "PLOT PLAN", PROJECT NO. 97101, DRAWING NO. SAP 003.

NO.	REVISION	DATE	BY

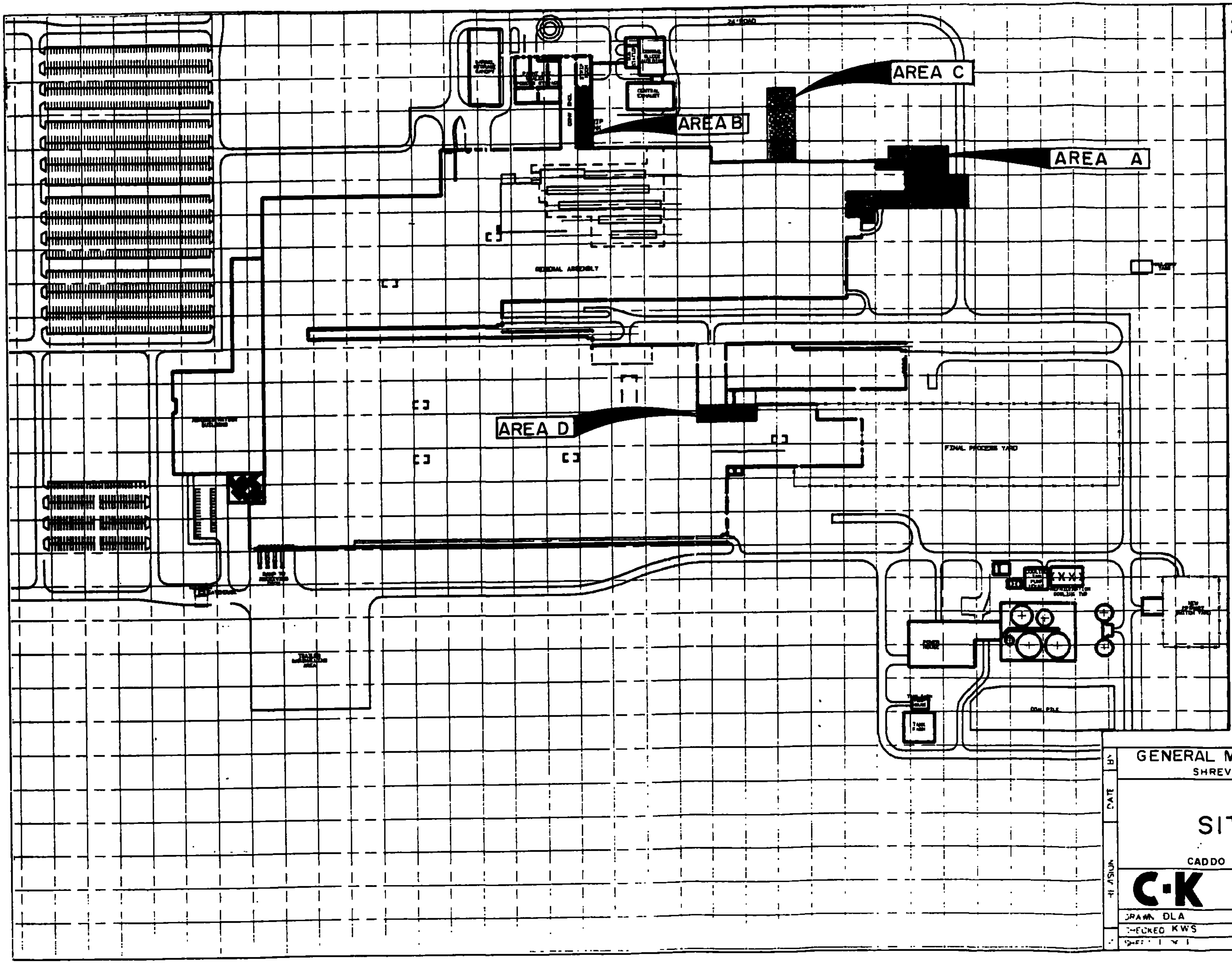
GENERAL MOTORS CORPORATION
SHREVEPORT, LOUISIANA

LOCATION MAP

CADDO PARISH, LOUISIANA

C·K ASSOCIATES, INC.
BATON ROUGE, LOUISIANA

DRAWN KWS	APPROVED SFM
CHECKED DRD	DATE DECEMBER 13, 1990
SHEET 1 OF 1	DWG. NO. A12-455-C4



LEGEND:

■ AREA OF PLANNED EXPANSION

NOTE:

BASE DRAWING TAKEN FROM G.M. CORPORATION "PLOT PLAN", DATED 3/18/89.

SCALE: 1" = 280' APPROXIMATE

FIGURE 2

GENERAL MOTORS CORPORATION
SHREVEPORT, LOUISIANA

SITE MAP

CADDO PARISH, LOUISIANA

C·K ASSOCIATES, INC.
BATON ROUGE, LOUISIANA

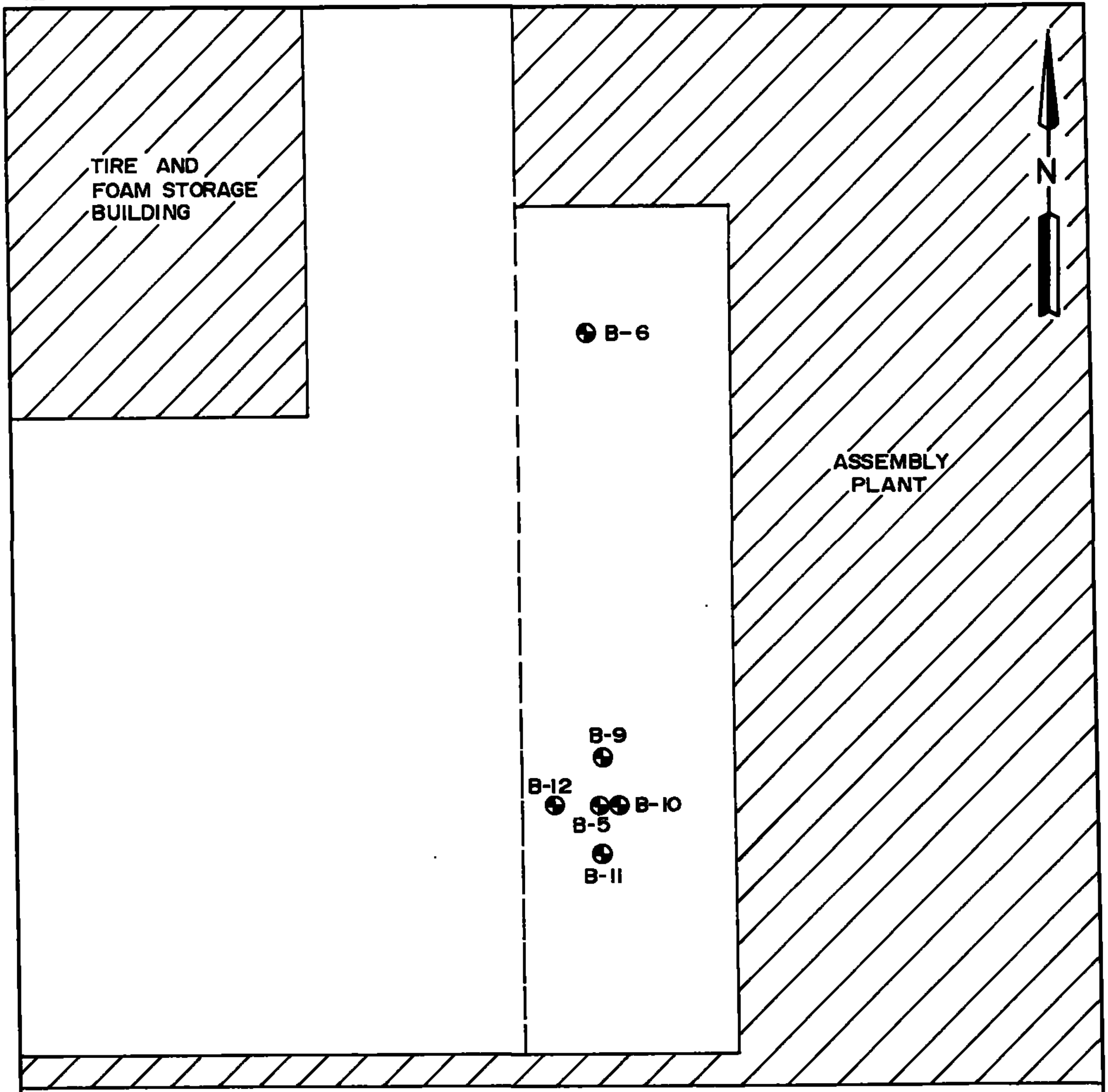
DRAWN DLA	APPROVED SFM
CHECKED KWS	DATE DECEMBER 13, 1990
SHEET 1 OF 1	DWG. NO. B12-455-02

REVISION	DATE	BY

Reference Sheet

REF+16493

06/18/99 1:19 PM



30 15 0 30

SCALE-FEET

1" = 30'

LEGEND:

------ LIMITS OF PLANNED EXPANSION

● B-5 SOIL BORING LOCATION

FIGURE 4

GENERAL MOTORS CORPORATION
SHREVEPORT, LOUISIANA

SOIL BORING LOCATION MAP
EXPANSION AREA D
CADDO PARISH, LOUISIANA

C-K ASSOCIATES, INC.
BATON ROUGE, LOUISIANA

DRAWN DLA	APPROVED SFM
CHECKED DE	DATE DECEMBER 13, 1990
SHEET 1 OF 1	DWG. NO. A 12-455-01

NO. REVISION DATE BY

APPENDIX A

SOIL BORING LOGS

C-K ASSOCIATES, INC.

SOIL BORING LOG

PROJECT NUMBER: 12-455-1	PROJECT NAME: General Motors Corporation	
BORING NUMBER: B-9	COORDINATES:	DATE STARTED: 12-10-90
ELEVATION:	GWL: DEPTH DATE/TIME	DATE COMPLETED: 12-10-90
C-K REPRESENTATIVE ON SITE: Brad Davis		
DRILLING METHODS: Hollow stem auger		PAGE 1 OF 2

DEPTH (FEET)	Recovery (%)	OVA (ppm)	Measured Consistency (TSF)	DESCRIPTION	USCS SYMBOL	REMARKS
0	30	10	4.0	Fill, red-brown, sandy clay	CL	Sample No. 900
	100	3	4.0			
5	90	0	4.0	Hard, light brown, silty clay Traces of organic material Iron oxide staining	CL	Sample No. 901
	90	0	>4.0			
10	80	0	4.0	Hard, gray-brown, silty clay, slickensided	CL	Sample No. 902
	90	0	3.5			
	90	0	>4.0			
15	90	0	4.0	Hard, gray-brown, clay, fine sand and silt laminations	CH	Sample No. 903
	80	0	>4.0			
20	90	0	1.0	Saturated zone at 19-20 feet		
	90	0	3.5			Sample No. 904
	90	0	4.0			
25	90	0	>4.0	Dark gray		Sample No. 905
	90	0	3.5			
	90	0	4.0			Sample No. 906

NOTES:

Laboratory samples were collected at 5-foot intervals

C-K ASSOCIATES, INC.

SOIL BORING LOG

PROJECT NUMBER: 12-455-1	**PROJECT NAME:** General Motors Corporation			
BORING NUMBER: B-9	**COORDINATES:**		**DATE STARTED:** 12-10-90	
ELEVATION:	**GWL: DEPTH**	**DATE/TIME**	**DATE COMPLETED:** 12-10-90	
C-K REPRESENTATIVE ON SITE: Brad Davis				
DRILLING METHODS: Hollow stem auger			**PAGE** 2	**OF** 2

DEPTH (FEET)	Recovery (90)	OVA (ppm)	Measured Consistency (TSF)	DESCRIPTION	USCS SYMBOL	REMARKS
30						
	90	0	4.0	Boring terminated at 32 feet		

NOTES:

C-K ASSOCIATES, INC.

SOIL BORING LOG

PROJECT NUMBER: 12-455-1	**PROJECT NAME:** General Motors Corporation		
BORING NUMBER: B-10	**COORDINATES:**	**DATE STARTED:** 12-11-90	
ELEVATION:	**GWL: DEPTH**	**DATE/TIME**	**DATE COMPLETED:** 12-11-90
C-K REPRESENTATIVE ON SITE: Brad Davis			
DRILLING METHODS: Hollow stem auger		**PAGE** 1 **OF** 2	

DEPTH (FEET)	Recovery (%)	OVA (ppm)	Measured Consistency (TSF)	DESCRIPTION	USCS SYMBOL	REMARKS
0	50	10	4.0	Fill, red-brown, sandy clay	CL	Sample No. 1000
	60	0	>4.0			
5	70	2	4.0	Hard, light brown, silty clay Traces of organic material Iron oxide staining	CL	Sample No. 1001
	10	2	3.5			
	90	0	3.5			
10	90	0	>4.0	Hard, gray-brown, silty clay, slickensided	CL	Sample No. 1002
	90	0	>4.0			
15	80	0	>4.0	Hard, gray-brown, clay, fine sand and silt laminations	CH	Sample No. 1003
	90	0	>4.0			
	90	0	1.0			
20	90	0	>4.0	Saturated zone at 19-20 feet		Sample No. 1004
	90	0	4.0			
25	70	0	>4.0	Dark gray		Sample No. 1005
	80	0	>4.0			
	80	0	>4.0			Sample No. 1006

NOTES:

Laboratory samples were collected at 5-foot intervals

C-K ASSOCIATES, INC.

SOIL BORING LOG

PROJECT NUMBER: 12-455-1	PROJECT NAME: General Motors Corporation		
BORING NUMBER: B-10	COORDINATES:		DATE STARTED: 12-11-90
ELEVATION:	GWL: DEPTH	DATE/TIME	DATE COMPLETED: 12-11-90
C-K REPRESENTATIVE ON SITE: Brad Davis			
DRILLING METHODS: Hollow stem auger			PAGE 2 OF 2

DEPTH (FEET)	Recovery (90)	OVA (ppm)	Measured Consistency (TSF)	DESCRIPTION	USCS SYMBOL	REMARKS
30						
	90	0	>4.0			
	80	0	>4.0			
35				Boring terminated at 35 feet		Sample No. 1007

NOTES:

C-K ASSOCIATES, INC.

SOIL BORING LOG

PROJECT NUMBER: 12-455-1	PROJECT NAME: General Motors Corporation	
BORING NUMBER: B-11	COORDINATES:	DATE STARTED: 12-11-90
ELEVATION:	GWL: DEPTH DATE/TIME	DATE COMPLETED: 12-11-90
C-K REPRESENTATIVE ON SITE: Brad Davis		
DRILLING METHODS: Hollow stem auger		PAGE 1 OF 2

DEPTH (FEET)	Recovery (90)	OVA (ppm)	Measured Consistency (TSF)	DESCRIPTION	USCS SYMBOL	REMARKS
0	20	0	2.0	Fill, red-brown, sandy clay	CL	Sample No. 1100
	90	1	>4.0			
5	90	1	>4.0	Hard, light brown, silty clay Traces of organic material Iron oxide staining	CL	Sample No. 1101
	80	2	>4.0			
	90	0	>4.0	Hard, gray-brown, silty clay, slickensided	CL	
10	90	0	>4.0			Sample No. 1102
	90	0	>4.0			
15	90	0	4.0	Hard, gray-brown, clay, fine sand and silt laminations	CH	Sample No. 1103
	80	0	4.0			
	80	0	4.0	Saturated zone at 19-20 feet		
20	90	0	4.0			Sample No. 1104
	80	0	4.0			
25	80	0	>4.0	Dark gray		Sample No. 1105
	80	0	>4.0			
	90	0	4.0			Sample No. 1106

NOTES:

Laboratory samples were collected at 5-foot intervals.

C-K ASSOCIATES, INC.

SOIL BORING LOG

PROJECT NUMBER: 12-455-1	PROJECT NAME: General Motors Corporation	
BORING NUMBER: B-11	COORDINATES:	DATE STARTED: 12-11-90
ELEVATION:	GWL: DEPTH DATE/TIME	DATE COMPLETED: 12-11-90
C-K REPRESENTATIVE ON SITE: Brad Davis		
DRILLING METHODS: Hollow stem auger		PAGE 2 OF 2

DEPTH (FEET)	Recovery (90)	OVA (ppm)	Measured Consistency (TSF)	DESCRIPTION	USCS SYMBOL	REMARKS
30						
	90	0	4.0			
	90	0	4.0			
35				Boring terminated at 35 feet		Sample No. 1107

NOTES:

C-K ASSOCIATES, INC.

SOIL BORING LOG

PROJECT NUMBER: 12-455-1	**PROJECT NAME:** General Motors Corporation	
BORING NUMBER: B-12	**COORDINATES:**	**DATE STARTED:** 12-11-90
ELEVATION:	**GWL: DEPTH** **DATE/TIME**	**DATE COMPLETED:** 12-11-90
C-K REPRESENTATIVE ON SITE: Brad Davis		
DRILLING METHODS: Hollow stem auger		**PAGE** 1 **OF** 2

DEPTH (FEET)	Recovery (90)	OVA (ppm)	Measured Consistency (TSF)	DESCRIPTION	USCS SYMBOL	REMARKS
0	70	0	>4.0	Fill, red-brown, sandy clay	CL	Sample No. 1200
	90	25	2.5			
5	90	5	>4.0	Hard, light brown, silty clay Traces of organic material Iron oxide staining	CL	Sample No. 1201
	80	0	3.5			
	90	0	3.5			
10	90	0	>4.0	Hard, gray-brown, silty clay, slickensided	CL	Sample No. 1202
	90	0	4.0			
15	90	0	4.0	Hard, gray-brown, clay, fine sand and silt laminations	CH	Sample No. 1203
	90	0	4.0			
	90	0	>4.0	Saturated zone at 19-20 feet		
20	90	0	>4.0			Sample No. 1204
	90	0	4.0			
25	90	0	4.0	Dark gray		Sample No. 1205
	90	0	>4.0			
	90	0	4.0			Sample No. 1206

NOTES:

Laboratory samples were collected at 5-foot intervals.

C-K ASSOCIATES, INC.

SOIL BORING LOG

PROJECT NUMBER: 12-455-1	PROJECT NAME: General Motors Corporation	
BORING NUMBER: B-12	COORDINATES:	DATE STARTED: 12-11-90
ELEVATION:	GWL: DEPTH DATE/TIME	DATE COMPLETED: 12-11-90
C-K REPRESENTATIVE ON SITE: Brad Davis		
DRILLING METHODS: Hollow stem auger		PAGE 2 OF 2

DEPTH (FEET)	Recovery (90)	OVA (ppm)	Measured Consistency (TSF)	DESCRIPTION	USCS SYMBOL	REMARKS
30	90	0	4.0			
	90	0	4.0			
35				Boring terminated at 35 feet		Sample No. 1207

NOTES:

APPENDIX B

LABORATORY REPORTS

WEST-PAINE
Laboratories INC.
7979 GSRI AVE • BATON ROUGE, LA 70820

SAMPLE ANALYSES

for

C K Associates
17170 Perkins Road
Baton Rouge,   LA   70810

ATTENTION: Ms. Laurie Pierce

December 14, 1990

hal

19-3180

WEST-PAINE
Laboratories INC.
7979 GSRI AVE. • BATON ROUGE, LA 70820

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample receipt at West-Paine Laboratories, Inc. is documented for your designated sample(s). Chain-of-custody documentation, if provided, is included in this report. Sample analysis was in accordance with Environmental Protection Agency protocol.

A. <u>Test Methods for Evaluating Solid Waste</u>, SW-846, July 1982

Parameter	Method
2-Hexanone	8240

Documented results are shown on the following page(s).

Victor J. Blanchard, III
General Manager

nal

19-3180

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 900
Date Collected: 90/12/11 Time Collected: 13:35
Date Received: 90/12/12 Time Received: 09:19

Parameter (Units)	Results	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	<0.05	N/A	N/A	90/12/12 00:00 JAS

1,2-Dichloroethane-d_4:	87
Toluene-d_8:	101
4-Bromofluorobenzene:	80

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 901
Date Collected: 90/12/10 Time Collected: 10:50
Date Received: 90/12/11 Time Received: 09:01

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	0.24	N/A	N/A	90/12/11 00:00 JAS

1,2-Dichloroethane-d_4:	86
Toluene-d_8:	91
4-Bromofluorobenzene:	75

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 902
Date Collected: 90/12/10 Time Collected: 11:00
Date Received: 90/12/11 Time Received: 09:01

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	0.21	N/A	N/A	90/12/12 00:00 JAS

1,2-Dichloroethane-d_4:	102
Toluene-d_8:	122
4-Bromofluorobenzene:	94

WEST-PAINE
Laboratories INC.
7979 GSRI AVE. • BATON ROUGE, LA 70820

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 903
Date Collected: 90/12/10 Time Collected: 11:32
Date Received: 90/12/11 Time Received: 09:01

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/11 00:00 JAS

1,2-Dichloroethane-d_4:	95
Toluene-d_8:	100
4-Bromofluorobenzene:	79

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WEST·PAINE
Laboratories INC.
7979 GSRI AVE. • BATON ROUGE, LA 70820

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 904
Date Collected: 90/12/10   Time Collected: 13:01
Date Received: 90/12/11   Time Received: 09:01

Parameter (Units)	Results	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	*	N/A	N/A	90/12/11 00:00 JJB

NOTE: Unable to analyze sample. Neither internal standards nor surrogate standards could be recovered.

nal

19-3180

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 905
Date Collected: 90/12/10 Time Collected: 13:25
Date Received: 90/12/11 Time Received: 09:01

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/12 00:00 JAS

1,2-Dichloroethane-d_4: 94
Toluene-d_8: 92
4-Bromofluorobenzene: 67

WEST-PAINE
Laboratories INC.
7979 GSRI AVE. • BATON ROUGE, LA 70820

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 906
Date Collected: 90/12/10 Time Collected: 14:15
Date Received: 90/12/11 Time Received: 09:01

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/12 00:00 JAS

1,2-Dichloroethane-d_4: 88
Toluene-d_8: 85
4-Bromofluorobenzene: 59

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C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1000
Date Collected: 90/12/11 Time Collected: 13:40
Date Received: 90/12/12 Time Received: 09:19

Parameter (Units)	Results	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	<0.05	N/A	N/A	90/12/12 00:00 JJB

1,2-Dichloroethane-d4:	98
Toluene-d8:	100
4-Bromofluorobenzene:	75

nal

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1001
Date Collected: 90/12/11 Time Collected: 07:40
Date Received: 90/12/12 Time Received: 08:53

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	0.09	N/A	N/A	90/12/11 00:00 JAS

1,2-Dichloroethane-d_4:	88
Toluene-d_8:	93
4-Bromofluorobenzene:	79

WEST-PAINE Laboratories INC.
7979 GSRI AVE. • BATON ROUGE, LA 70820

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1002
Date Collected: 90/12/11 Time Collected: 07:50
Date Received: 90/12/12 Time Received: 08:53

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/11 00:00 JAS

1,2-Dichloroethane-d_4:	83
Toluene-d_8:	88
4-Bromofluorobenzene:	68

WEST-PAINE
Laboratories INC.
7979 GSRI AVE. • BATON ROUGE, LA 70820

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1003
Date Collected: 90/12/11 Time Collected: 08:13
Date Received: 90/12/12 Time Received: 08:53

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/11 00:00 JAS

1,2-Dichloroethane-d_4:	90
Toluene-d_8:	90
4-Bromofluorobenzene:	68

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1100
Date Collected: 90/12/11 Time Collected: 09:40
Date Received: 90/12/12 Time Received: 08:53

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/12 00:00 JAS

1,2-Dichloroethane-d_4:	84
Toluene-d_8:	105
4-Bromofluorobenzene:	83

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1101
Date Collected: 90/12/11 Time Collected: 09:55
Date Received: 90/12/12 Time Received: 08:53

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/11 00:00 JAS

1,2-Dichloroethane-d_4:	83
Toluene-d_8:	91
4-Bromofluorobenzene:	67

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1102
Date Collected: 90/12/11 Time Collected: 10:05
Date Received: 90/12/12 Time Received: 08:53

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/11 00:00 JAS

1,2-Dichloroethane-d_4:	82
Toluene-d_8:	91
4-Bromofluorobenzene:	67

WEST-PAINE
Laboratories INC.
7979 GSRI AVE • BATON ROUGE, LA 70820

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1108
Date Collected: 90/12/11 Time Collected: 11:00
Date Received: 90/12/11 Time Received: 09:01

Parameter (Units)	Results	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (ug/L)	<50	N/A	N/A	90/12/13 00:00 JAS

1,2-Dichloroethane-d_4:	97
Toluene-d_8:	98
4-Bromofluorobenzene:	83

nal

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1200
Date Collected: 90/12/11 Time Collected: 12:12
Date Received: 90/12/12 Time Received: 09:19

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/12 00:00 JAS

1,2-Dichloroethane-d_4:	88
Toluene-d_8:	106
4-Bromofluorobenzene:	80

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1201
Date Collected: 90/12/11 Time Collected: 12:20
Date Received: 90/12/12 Time Received: 09:19

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/12 00:00 JAS

1,2-Dichloroethane-d_4: 84
Toluene-d_8: 105
4-Bromofluorobenzene: 79

WEST-PAINE
Laboratories INC.
7979 GSRI AVE. • BATON ROUGE, LA 70820

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1202
Date Collected: 90/12/11 Time Collected: 12:26
Date Received: 90/12/12 Time Received: 09:19

Parameter (Unit)	Result	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (mg/kg)	< 0.05	N/A	N/A	90/12/12 00:00 JAS

1,2-Dichloroethane-d_4:	75
Toluene-d_8:	94
4-Bromofluorobenzene:	69

WEST-PAINE
Laboratories INC.
7979 GSRI AVE • BATON ROUGE, LA 70820

C K Associates
Baton Rouge, LA 70810
December 14, 1990

Sample Source: 1400
Date Collected: 90/12/11 Time Collected: 13:50
Date Received: 90/12/12 Time Received: 09:19

Parameter (Units)	Results	Percent Recovery	Quality Assurance Actual/Found	Date/Time Analyst
2-Hexanone (ug/L)	.<50	N/A	N/A	90/12/13 00:00 JAS

1,2-Dichloroethane-d_4: 87
Toluene-d_8: 92
4-Bromofluorobenzene: 78

nal

WEST·PAINE
Laboratories INC.
7979 GSRI AVE. • BATON ROUGE, LA 70820

VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

(SOIL)

Sample No: 900719-0001 Level:(low/med): low

COMPOUND	SPIKE ADDED (ug/kg)	SAMPLE CONCENTRATION (ug/kg)	MS CONCENTRATION (ug/kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	2425	<100	2021	83	59-172
Trichloroethene	2425	<100	2238	91	62-137
Benzene	2425	<100	2278	94	66-142
Toluene	2425	<100	2472	102	59-139
Chlorobenzene	2425	<100	2443	101	60-133

COMPOUND	SPIKE ADDED (ug/kg)	MSD CONCENTRATION (ug/kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene					22	59-172
Trichloroethene					24	62-137
Benzene					21	66-142
Toluene					21	59-139
Chlorobenzene					21	60-133

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: _____ out of _____ outside limits
Spike Recovery: 0 out of 5 outside limits

COMMENTS: VOSLO-016

WEST·PAINE
Laboratories INC.
7979 GSRI AVE • BATON ROUGE, LA 70820

VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

(WATER)

Sample No: 901128-0009 Level:(low/med): low

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	250	<10	268.93	108	61-145
Trichloroethene	250	<10	229.69	92	71-120
Benzene	250	<10	233.78	94	75-130
Toluene	250	<10	254.19	102	76-125
Chlorobenzene	250	<10	240.77	96	76-127

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene					14	61-145
Trichloroethene					14	71-120
Benzene					13	75-130
Toluene					13	76-125
Chlorobenzene					11	76-127

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD:_____out of_____outside limits
Spike Recovery: 0 out of 5 outside limits

COMMENTS: VOWLO-059

ASSOCIATES · INC

C-K ASSOCIATES, INC.

Page 1 of 1

CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD

CLIENT: General Motors Corp.
P.O. NUMBER:
SAMPLED BY: Brad Davis
PROJECT NO.: 12-455-1
LABORATORY *: West-Paine
DATE: 12-10-90

	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	NO. OF CONTAINERS	PRESERVATIVE	ANALYSES AND INSTRUCTIONS
.1	901	12-10-90	1050	Soil	1	None	2-Hexanone
.2	902	12-10-90	1100	Soil	1	None	2-Hexanone
.3	903	12-10-90	1132	Soil	1	None	2-Hexanone
.4	904	12-10-90	1301	Soil	1	None	2-Hexanone
.5	905	12-10-90	1325	Soil	1	None	2-Hexanone
.6	906	12-10-90	1415	Soil	1	None	2-Hexanone
							*All samples were placed within
							a ice chest maintained at
							a temp. of < 4°C.

Relinquished by: (Signature) Brad Davis	Date 12-10-90	Time 1600	Received by: (Signature) Patsy N Frances	Date 12/10/90	Time 1600
Relinquished by: (Signature) Patsy N Frances	Date 12-10-90	Time 1700	Received by: (Signature)	Date	Time
Collection witnessed by: (Signature, If Required)	Date	Time	Method of Shipment: Greyhound Express		Date 12-10-90
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date 901211	Time 0900

* Please send results and invoice to the attention of Brad Davis in our ☐ Baton Rouge, ☐ Lake Charles, ☒ Shreveport office.

C K ASSOCIATES · INC

C - K ASSOCIATES, INC.

CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD

Page 1 of 2

CLIENT: General Motors Corp.
P.O. NUMBER:
SAMPLED BY: Brad Davis
PROJECT NO.: 12-455-1
LABORATORY*: West-Paine
DATE: 12-11-90

	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	NO. OF CONTAINERS	PRESERVATIVE	ANALYSES AND INSTRUCTIONS
130	1001	12-11-90	0740	Soil	1	None	2- Hexanone
131	1002	12-11-90	0750	Soil	1	None	2- Hexanone
132	1003	12-11-90	0813	Soil	1	None	2- Hexanone
133	1004	12-11-90	0820	Soil	1	None	2- Hexanone
134	1005	12-11-90	0830 ~~[illegible]~~	Soil	1	None	2- Hexanone
135	1006	12-11-90	0840 ~~[illegible]~~	Soil	1	None	2- Hexanone
136	1007	12-11-90	0850	Soil	1	None	2- Hexanone
Hold 137	1100	12-11-90	0940	Soil	1	None	2- Hexanone
138	1101	12-11-90	0955	Soil	1	None	2- Hexanone
139	1102	12-11-90	1005	Soil	1	None	2- Hexanone
140	1103	12-11-90	1020	Soil	1	None	2- Hexanone
141	1104	12-11-90	1028	Soil	1	None	2- Hexanone

	Date	Time		Date	Time
Relinquished by: (Signature) Brad Davis	12-11-90	1208	Received by: (Signature) W. A. Sniffen	12-11-90	1208
Relinquished by: (Signature) W. A. Sniffen	12-11-90	12:38	Received by: (Signature)		
Collection witnessed by: (Signature, if Required) Charles Ray [illegible]	12-11-90	1209	Method of Shipment: Greyhound Express	12-11-90	
Relinquished by: (Signature)			Received for Laboratory by: (Signature) Darrell [illegible]	12-12-90	0800

* Please send results and invoice to the attention of Brad Davis in our ☐ Baton Rouge, ☐ Lake Charles, ☒ Shreveport office.

C-K ASSOCIATES · INC

C - K ASSOCIATES, INC.

CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD

Page 2 of 2

CLIENT: General Motors Corp

P.O. NUMBER:

SAMPLED BY: Brad Davis

PROJECT NO.: 12-455-1

LABORATORY *: West-Paine

DATE: 12-11-90

SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	NO. OF CONTAINERS	PRESERVATIVE	ANALYSES AND INSTRUCTIONS
.142 1105	12-11-90 ~~1033~~	1033	Soil	1	None	2- Hexanone
.143 1106	12-11-90 ~~1040~~	1040	Soil	1	None	2- Hexanone
.144 1107	12-11-90 ~~1050~~	1050	Soil	1	None	2- Hexanone
.142 1108	12-11-90	1100	Water	1	Sodium Thiosulfate	2-Hexanone

Relinquished by: (Signature)	Date 12-11-90	Time 1208	Received by: (Signature) W.A. Sniffen	Date 12-11-90	Time 1208
Relinquished by: (Signature) W.A. Sniffen	Date 12-11-90	Time 12:38	Received by: (Signature)	Date	Time
Collection witnessed by: (Signature, if Required)	Date 12-11-90	Time 1209	Method of Shipment: Greyhound L' Express		Date 12-11-90
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date 12-12-90	Time 0800

• Please send results and invoice to the attention of Brad Davis in our ☐ Baton Rouge, ☐ Lake Charles, ☒ Shreveport office.

C-K [redacted]
ASSOCIATES · INC

C-K ASSOCIATES, INC.
CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD

Page 1 of 1

CLIENT: General Motors Corp.
P.O. NUMBER:
SAMPLED BY: Brad Davis
PROJECT NO.: 12-455-1
LABORATORY *: West-Paine
DATE: 12-11-90

	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	NO. OF CONTAINERS	PRESERVATIVE	ANALYSES AND INSTRUCTIONS
7	1200	12-11-90	1212	Soil	1	None	2- Hexanone
8	1201	12-11-90	1220	Soil	1	None	2- Hexanone
9	1202	12-11-90	1226	Soil	1	None	2- Hexanone
10	1203	12-11-90	1239	Soil	1	None	2- Hexanone
11	1204	12-11-90	1244	Soil	1	None	2- Hexanone
12	1205	12-11-90	1252	Soil	1	None	2- Hexanone
13	1206	12-11-90	1300	Soil	1	None	2- Hexanone
14	1207	12-11-90	1308	Soil	1	None	2- Hexanone
15	0900	12-11-90	1335	Soil	1	None	2- Hexanone
16	1000	12-11-90	1340	Soil	1	None	2- Hexanone
17	1400	12-11-90	1350	Water	2	Sodium Thiosulfate	2- Hexanone *All samples were placed w/in an ice chest
							w/ an internal temp <4°C.

	Date	Time		Date	Time
Relinquished by: (Signature)	12-11-90	4:00 pm	Received by: (Signature)		
Relinquished by: (Signature)			Received by: (Signature)		
Collection witnessed by: (Signature, if required)	12-11-90	15:15 pm	Method of Shipment: Greyhound Express		12-11-90
Relinquished by: (Signature)			Received for Laboratory by: (Signature)	12-12-90	0800

* Please send results and invoice to the attention of Brad Davis in our ☐ Baton Rouge, ☐ Lake Charles, ☒ Shreveport office.

APPENDIX C

CORRESPONDENCE

C-K
ASSOCIATES · INC
BATON ROUGE, LOUISIANA

December 21, 1990

General Motors Corporation
Truck and Bus Manufacturing Division
Shreveport Plant
P. O. Box 30011
Shreveport, Louisiana 71130
Attn: Mr. H. Olin Desonier

Ref: West-Paine Laboratories, Inc.,
Soil Analysis of December 14, 1990;
C-K Associates' Project No. 12-455-2

Dear Mr. Desonier:

The referenced soil samples were analyzed for 2-hexanone by Method 8240, "Test Methods for Evaluating Solid Waste," SW-846, July, 1982. This compound was detected in the following samples:

Boring No.	Sample No.	Sample Depth (ft)	2-Hexanone (mg/kg)	Detection Limit (mg/kg)
B-9	901	5	0.24	0.05
B-9	902	10	0.21	0.05
B-10	1001	5	0.09	0.05

From an analytical standpoint, the quantity of 2-hexanone found in sample no. 1001 is so close to the limit of detection, it should be discounted. Sample nos. 901 and 902 were found to contain a concentration of 2-hexanone at 4-5 times the detection limit used for this analysis. Due to the relatively low concentration of 2-hexanone in these samples and the limited occurrence, this compound may be a sampling or laboratory artifact.

Also, an Environmental Protection Agency document, "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses," February, 1988, may be cited. It states that no positive sample result should be reported unless the concentration of the compound in the sample exceeds five times the amount in any blank.

Please contact me if you have any questions.

Very truly yours,
C-K Associates, Inc.

Linda H. Grande

Linda H. Grande, Ph.D.
Environmental Specialist

LG/jn

cc: Mr. Bill Corbin

Truck & Bus Group

Truck & Bus Group
General Motors Corporation
31 Judson Street
Pontiac, Michigan 48058

December 19, 1990

Certified Mail # P 094 288 267
Delivered by FAX # 504 342 6316

Mr. Leon Waller,
Groundwater Protection Division,
Louisiana Department of Environmental Quality
P.O. Box 44272
Baton Rouge, LA 70804

RE: Interpretation of Analyses Results in 2nd Tier of 2-hexanone analyses in GM Shreveport Assembly Facility Expansion Investigation

Dear Mr. Waller,

This letter provides information on additional borings performed at the GM Truck & Bus area "D" (attachment I). This area is part of the facility expansion slated to begin in September, 1991.

During Phase I of the Expansion Investigation, a composite boring located in area D showed a barely detectable level of 2-hexanone. Additional borings and analyses were performed as a second tier to determine if any contamination of the soil was present. The borings were spaced around the original composite boring (B-5) in order to "bracket" a possible pocket of contamination. The additional borings were analyzed at 2' and 5' intervals. Also, a new discrete boring (B-10) was made directly adjacent to the composite boring to verify the analyses results and more specifically quantify possible soil contamination.

All discrete borings showed below detection limits for all compounds tested except for insignificant levels of 2-hexanone (attachment II). GM believes these levels are insignificant for the reasons discussed in attachment III.

Based upon the results of the completed Expansion Assessment, we believe that LDEQ-AQD should be allowed to proceed with the issuance of the air variances and our air permit.

If you have any questions, please call me (313) 456 6915.

Sincerely,

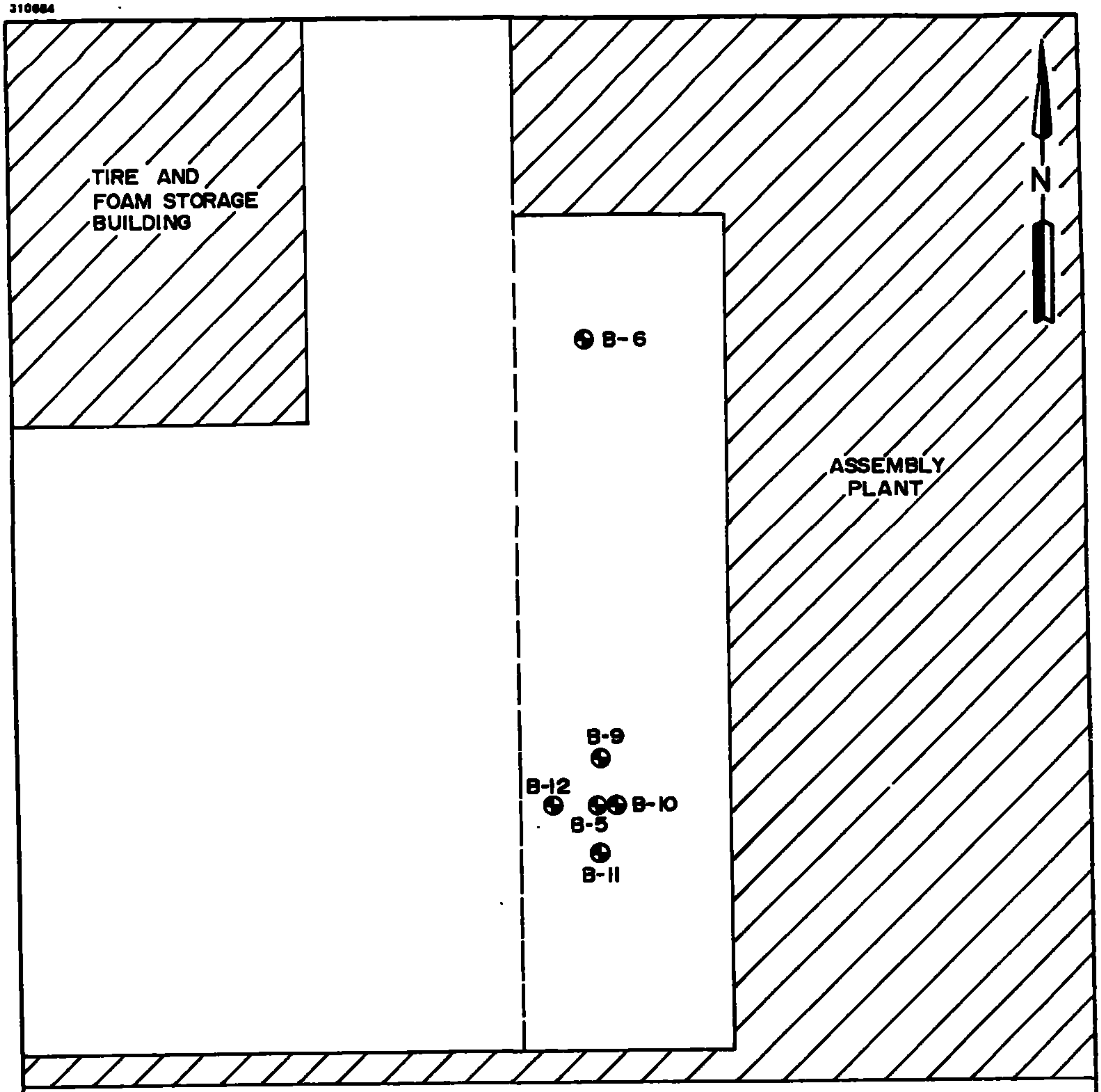
J. B. Nachtman,
Sr Environmental Engineer,
Truck & Bus Group, General
Motors Corporation

cc.

B. Davis, C-K Associates, Inc.
O. Desonier, GM T&B Shreveport
D. Dosher-Collard, LDEQ-AQD

Attach. I

310684



30 15 0 30

SCALE-FEET

1" = 30'

LEGEND:

------ LIMITS OF PLANNED EXPANSION

● B-5 SOIL BORING LOCATION

FIGURE 4

GENERAL MOTORS CORPORATION
SHREVEPORT, LOUISIANA
EXPANSION ASSESSMENT II

SOIL BORING LOCATION MAP
EXPANSION AREA D

CADDO PARISH, LOUISIANA

C-K ASSOCIATES, INC.
BATON ROUGE, LOUISIANA

BY
DATE
REVISION
NO.

DRAWN DLA	APPROVED SFM
CHECKED DE	DATE DECEMBER 13, 1990
SHEET 1 OF 1	DWG. NO. A 12-455-01

Attach. II

GENERAL MOTORS CORPORATION
TABLE 1
SOIL ANALYSIS

Boring No.	Sample No.	Sample Depth (ft)	2-Hexanone (mg/kg)	Detection Limit mg/kg
B-9	900	2	<0.05	0.05
B-9	901	5	0.24	0.05
B-9	902	10	0.21	0.05
B-9	903	15	<0.05	0.05
B-9	904	20	<0.05	0.05
B-9	905	25	<0.05	0.05
B-9	906	30	<0.05	0.05
B-10	1000	2	----	----
B-10	1001	5	0.09	0.05
B-10	1002	10	<0.05	0.05
B-10	1003	15	<0.05	0.05
B-11	1100	2	<0.05	0.05
B-11	1101	5	<0.05	0.05
B-11	1102	10	<0.05	0.05
B-12	1200	2	<0.05	0.05
B-12	1201	5	<0.05	0.05
B-12	1202	10	<0.05	0.05

FIELD BLANKS

Sample Number	2-Hexanone (ug/L)	Detection Limit (ug/L)
1108	<50	<50
1400	<50	<50

Attachment III

RATIONAL FOR INTERPRETATION OF 2-HEXANONE ANALYSES

The rational for interpreting the level of 2-hexanone as insignificant is summarized below. Since each analyses point is a discrete sample, each concentration value can be assessed individually. As such, 3 out of 16 analyses showed values above the method detection limit (attachment II). One value, .09 mg/kg, we agreed can be disregarded outright as it is 4/100ths of a part per million (parts per million - ppm) above the detection limit. However, two analyses results showed .24 and .21 ppm in B-9;5' and B-9;10' respectively. How do we interpret these test results?

GM Truck & Bus believes that these two test results lie in the, "region of less-certain quantitation" as specified by the American Chemical Society and U.S. EPA. The basis for this conclusion is summarized as follows.

The U.S. EPA Office of Water addressed variability in low-level, near detection limit organic analyses results during the Thirteenth Annual Conference on Analyses of Pollutants of the Environment, held in Norfolk VA., on May 9-10, 1990 (please see attachment IV, Quantitation/ Detection Limits for the Analyses of Environmental Samples). This presentation demonstrates EPA's view that analyses results that fall within 5 and 10 standard deviations from the Method Detection Limit (MDL) should be disregarded. The 10 standard deviation limit is also described as the Practical Quantitation Limit (PQL) and is considered a stringent standard to meet by most CERCLA (Superfund) contract laboratories.

The EPA uses PQLs which are recommended for volatile organic chemicals when it proposes MCLs for drinking water. Please note that our sampling matrix is soil, which is a more difficult matrix to quantify. The agency states that: "setting the PQLs in a range between 5 and 10 times the MDL achieved by the best laboratories is a fair expectation for most state and commercial laboratories" (50 FR 46907). The performance evaluations made by EPA showed that 80% of the labs could measure within ±40% of the true concentration. Therefore, even at the PQLs (10x the MDL), over 20% of the "good" labs would not be expected to obtain results within the ±40% of the specific component! At concentrations levels below the

PQL, performance of even the best of "good" contract laboratories deteriorated rapidly (see attachment IV).

Also, the US EPA in the Hazardous Site Evaluation Division published a guidance document on February 1, 1988, called the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (a copy of which was given to you in our meeting of December 17, 1990). This document, essentially an EPA SOP (Standard Operating Procedure) is used by EPA for general guidance in the technical interpretation of organic analytical test data. These guidelines recommend that if a sample result is greater than the Contract Required Quantitation Limit (CRQL), but is less than 5x the blank result (10x for some volatiles such as 2-butanone), the sample results would be qualified as non-detects (Please refer to page 13, regarding, "Blank Qualification Guidelines").

Applying these EPA guidelines to the two data points in question, the 5x rule would apply to the compound 2-hexanone.

	5x Rule
Blank Result	50 ug/L
CRQL	10 ug/Kg
Sample Result	240 ug/Kg
Qualified Sample Result	240 U ug/Kg

Using the 5x rule, sample results less than 250 (or 5 x 50) would be qualified as non-detects. The designation "U" means that the material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit. The CRQL of 10 ug/Kg was taken from the US Contract Lab Program Scope of Work for Multi-Media/Multi-Concentrations, revised 8/87 (attachment V).

Please note the blanks used in this qualification are water blanks. The sample matrix is soil. This adds an additional safety factor in the analyses, as the blank result is biased downward, although the amount of bias cannot be quantified with this data.

Attach IV

QUANTITATION/DETECTION LIMITS
FOR THE ANALYSIS OF ENVIRONMENTAL SAMPLES

I. INTRODUCTION

Analytical technology continues its unrelenting pace to develop methodology to lower the concentration limits at which the analytes can be measured. Picogram (10^{-12} grams) quantities are commonly reported as new detector systems for gas and liquid chromatography are developed. Advances in mass spectrometry are leading to lower levels of quantitation. For example, ion trap mass spectrometers and inductively coupled plasma-mass spectrometry (ICP-MS) are some highly sensitive techniques, which are becoming more commonly used for organic and elemental determinations respectively and capable of detecting subnanogram ($<10^{-9}$ gram) quantities. The statement following depicts the situation that we are encountering:

> "... the number of compounds detected in a sample of water is related to the detection level. As the detection level decreases an order of magnitude, the number of compounds detected increased an order of magnitude. Based on the number of compounds detected by current methods, one would expect to find every known compound at a concentration of 10^{-12} g/L or higher." - Dr. William T. Donaldson (EPA Athens Laboratory)

As the regulated community is required to perform within the level of increasingly restrictive compliance limits, the analytical chemist must emphasize to the public that all measurement data have an associated uncertainty interval(1). This information becomes critical as measurements are made approaching the lowest analytical capability of a given procedure.

IV. PRACTICAL QUANTITATION LIMITS (PQL) AS A MEANS OF IDENTIFYING MEASUREABLE CONCENTRATIONS

Many observations for organic toxic pollutants are below the MDLs, thus creating difficulties in developing effluent limitations guidelines and permit limits. In such instances where analytical and effluent variability cannot be determined, only those concentrations above quantifiable levels (17) should be considered. It should also be recognized that there is a fundamental difference between detection and quantitation limits. Unfortunately these terms are too often misused as being synonymous. EPA has developed a method for establishing such quantifiable numerical limits for its proposed drinking water standards (50 FR 46902) and for its proposed organic toxicity characteristic (51 FR 21652), designated as the practical quantitation limit (PQL). EPA has developed this concept of a PQL for specific analytical methods and lists of chemicals.

A. RECOMMENDED PRACTICAL QUANTITATION LIMITS COMPARED TO METHOD DETECTION LIMITS

The EPA used PQLs which are recommended as 10 times the MDL for selected volatile organic chemicals when it proposed MCLs for drinking water. The Agency states that: "setting the PQLs in a range between 5 and 10 times the MDL achieved by the best laboratories is a fair expectation for most state and commercial laboratories" (50 FR 46907). At the PQLs chosen by EPA for this rulemaking, its performance evaluation studies indicate that 80% of the EPA and State laboratories in its water program evaluation studies could measure within ±40% of the true concentration. This was the basis for setting the PQL at 10 times the MDL. This is not a very high standard of performance as admitted by the Agency in the preamble to this proposed regulation. Thus, even at the PQLs, over 20% of the "good" laboratories would not be expected to obtain results within ±40% of the concentration of a specific component. At concentration levels below PQL, performance of even the best of "good" laboratories deteriorates rapidly.

B. PRACTICAL QUANTITATION LIMITS IN REAL MATRIX SAMPLES REFLECT EFFECT OF MATRIX INTERFERENCE

A recent presentation(12) described a study evaluating Method 8020, which is a gas/liquid chromatography procedure in SW-846 "Test Methods for Evaluating Solid Wastes, Physical Chemical Methods" for the determination of low concentrations of toluene, benzene, and xylenes in real matrix groundwater samples. The round robin study involved 20 commercial laboratories. Method 8020 lists the practical quantification limits for all three compounds as 2.0 μg/L. The PQLs derived from results achieved by the laboratories in this study are much higher. The PQLs at which 80% of the laboratories could achieve a recovery within ±40% of a true value from this study are 7.5 μg/L for benzene, >20 μg/L for toluene, and 18.5 μg/L for total xylenes. It is clear that the Method 8020 published PQLs are seriously underestimated when applied to this groundwater matrix and for these 20 laboratories.

V. PROPER TREATMENT OF THE DATA CAN AVOID MISREPRESENTATION OF THE FACTS

A. RULES FOR THE USE OF SIGNIFICANT NUMBERS

Despite the wide attention given to numbers for quantitative and qualitative limits the improper use of rules for use of significant numbers goes virtually unnoticed. As measurements are required more and more frequently to be made at decreasing concentrations, the relative analytical variability and uncertainty can increase substantially and the need to understand and recognize significant data is essential. Horwitz et al (22) reviewed data from over 50 independent Association of Official Analytical Chemists (AOAC) interlaboratory collaborative programs covering numerous AOAC drug and pesticide studies. The analytical methods covered were chromatography, atomic absorption spectrometry, absorption spectrometry, polarography, and biossay. In Figure 1 the % variation is expressed as powers of 2 with the mean concentration expressed as powers of 10. A convenient reference point is that at 1 ppm the variation is 16%. The % variation was found to double for each decrease of concentration by 2 orders of magnitude. It is important to note that this curve is independent of the analyte or analytical technique that was used to make the measurements. These relationships should also apply to environmental levels of measurement as well.

Analytical chemists must always emphasize to the users of the data that the single most important characteristic of any result obtained from one or more analytical measurements is an adequate statement of its uncertainty interval. Often in legal judgments there is an attempt to dispense with uncertainty and try to obtain unequivocal statements; therefore, an uncertainty interval must be clearly defined in cases involving litigation and/or enforcement proceedings. Otherwise, a value of 1.001 without a specified uncertainty, for example, may be viewed as legally exceeding a permissible level of 1(7).

The analytical inclusion of only significant numbers is vital to the accurate interpretation of data. Scientific personnel are not exempted from the tendency to retain all values, no matter how divergent or suspect they may be. One of the principles of handling the data of physical and chemical measurements is that a numerical result by itself should give an approximate idea of the precision of the value as indicated by the number of significant figures used in expressing the value. An inaccurate representation of significant figures may give one an impression nearly as erroneous as from an inaccurate value. Misuse of significant figures can cause reporting violations when indeed the measured value does not exceed the limit. Adherence to proper expression of significant numbers is especially important when permit limits are near the limit of quantitation for the procedure and its relative uncertainties are large.

The number of significant figures reported as a result of a scientific measurement depends on establishing previously the relative precision with which the measurement can be made as shown in Table II(11). In considering the proper use of significant figures for regulatory reporting, it is imperative that significant figures start at the laboratory bench and be adhered to by anyone who further treats or handles the data. Otherwise, false conclusions and misunderstanding will develop and possibly lead to serious consequences.

Several observations can be made regarding the probability distribution shown in Figure 3.

Observation #1: Only a small percentage of the total analyses may give the best estimate of the true value.

Observation #2: One-half the measurements are above the mean and one-half of the measurements are below the mean. Therefore, if the mean is some effluent trigger concentration above which a plant would be violating its permit, the plant would be failing one-half the time, if these data were treated as having no uncertainty.

Observation #3: The measured concentrations shown in Figure 3, 99.7% of the reported values would fall between plus or minus 3σ of the mean concentration; therefore, it can be seen that the σ of a determination is a very fundamental property of a distribution which must be used in evaluating data which contains uncertainty.

B. THE APPLICATION TO REGULATORY LIMITS

In order to translate this general probability distribution to real-world examples, Figures 4 through 7 were generated assuming different analytical uncertainty in the random errors. All figures were generated for the measurement of an effluent sample containing 100 μg/L of the target analyte. Figure 4 shows the distribution of measured concentrations when the analytical uncertainty produces a value of 1μg/L for σ; Figure 5 shows the distribution of measured concentrations when the analytical uncertainty produces a value of 10 μg/L for σ: Figure 6 shows the distribution of measured concentrations when the analytical uncertainty produces a value of 30 μg/L for σ; and Figure 7 shows the distribution of measured concentrations when the analytical uncertainty produces a value of 100 μg/L for σ. The probability distribution for the last case has been truncated at 0 μg/L since negative values of concentration are meaningless.

These four cases show clearly the impact of determinations which are carried out with different amounts of analytical uncertainty. Unfortunately, regulations are written as if data were being obtained with an uncertainty less than that shown in Figure 4. Permits which give a specific limit for a certain compound, fall into this category. However, the analytical data which are being obtained by a typical environmental laboratory for the analysis of reagent water are most likely analytical data obtained with the uncertainty shown in Figures 6 or 7. Figure 6 describes most analytical data obtained using EPA Methods 624 and 625 when the measured concentration is ten times higher than the method detection limit determined in reagent water. Figure 7 describes most analytical data obtained using EPA Methods 624 and 625 when the measured concentration is equal to the method detection limit which can be the case if the sample or sample extract must be diluted due to interfering substances. The concern is that the probability distribution summarized in Figure 6 is used by the Environmental Protection Agency to characterize data obtained by analytical laboratories for effluent analyses. However, these data represent a best case, since method detection limits for Methods 624 and 625 are derived from the analysis of reagent water. Reagent water data should not necessarily be used to determine the random error associated with all plant effluents which may contain relatively high levels of inorganic salts, and unregulated organic compounds which may interfere with these methods.

VII. RECOMMENDATIONS

There is a LOD or MDL which can be determined for every analyte in every matrix below which it is not possible to reliably ascertain that an analyte is present or absent. There is also a concentration range above the LOD or MDL where it is possible to qualitatively establish the presence of an analyte, but the concentration cannot be accurately and reliably quantified. It is also not practical to determine precisely the LOD or MDL for all analytes, in every matrix, and at all laboratories. All regulatory programs must recognize these facts. As a practical solution to this problem, every method should have published practical quantification limits (PQLs) which are at least media (water/soil) specific. Many of these PQLs have been published by media, and for most analytes these PQLs are representative of levels that can be achieved at most commercial laboratories. However, there should also be procedures for determining matrix specific detection and quantitation limits. Unfortunately it is not possible to analyze a large enough universe of matrices to establish generalized quantitation limits for comparison with regulatory levels. An approach must be established which will preserve the utility of published PQLs as guidance, while recognizing the significant number of compliance limits which are below their respective PQLs and thus require a variance procedure.

If a laboratory determines that it can not meet published detection and quantitation limits in their sample matrix, they should be allowed to measure these levels using established procedures which include mandated QA/QC requirements. These levels would then be used as reporting limits. If the quantitation limit, so established, is above the regulatory level, the compound would be considered to be in compliance until such a time that a level above the quantitation limit is measured. This assumption of compliance would apply whether or not the quantitation limit were a published PQL or a measured quantitation limit. EPA would also determine the frequency that these published PQLs would be re-evaluated pending method and equipment improvement. In some cases the Agency has suggested that a facility may petition for such a variance (24).

We also recommend that the EPA establish uniformity among the various regulatory programs for the determination of the method detection limit. Although the definition is essentially the same, the number of replicates and blanks may be different, therefore, the calculation is effected. This can further compound the current state of confusion in understanding and applying quantitation and detection limits. The corresponding quantitation limit should be established at five to ten times the MDL or substantially higher as the matrix would dictate (19). The use of such factors, however, must be used with extreme care as the method variability may well be underestimated by most laboratories (17). EPA recognized this need for consistency in its Report to Congress in CWA Section 518. It was reported that analytical methods are sometimes unnecessarily different for similar sample matrices, target analytes and data quality objectives. The Agency should move to greater method uniformity and more consistency in the use of quantitation and detection limits and use the concepts in regulatory compliance situations.

18. USEPA "Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities, Interim Final Guidance" Office of Solid Waste Management Division, February, 1989, Section 8.

19. "Test Methods for Evaluating Solid Wastes, Physical/Chemical Method" Third Edition, 8010-10, USEPA Office of Solid Waste, Revision I, December, 1987.

20. Parr. J., K. Carlberg, and G. Ward, "Reporting of Low Level Data for U.S. Environmental Protection Agency Needs", Presented at: Third Chemical Congress of North America Symposium in Honor of W. E. Harris, June 8, 1988.

21. Method Detection Limits and Practical Quantitation Limits for Incinerator Ash Matrices-Interlaboratory Study. Prepared for the Office of Solid Waste, USEPA, Washington, D.C. Prepared by the Analytical Chemistry Committee, Hazardous Waste Treatment Council, December 22, 1989.

22. Horwitz, W., Anal. Chem., 1982, 54 (1), 67A - 76A

23. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories" EPA-600/4-79-019, Chapter 7, Environmental Monitoring and Support Laboratory, USEPA Office of Research and Development, Cincinnati, Ohio.

24. 54 Federal Register 26603, June 23, 1989.

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"... THE NUMBER OF COMPOUNDS DETECTED IN A SAMPLE OF WATER IS RELATED TO THE DETECTION LEVEL. AS THE DETECTION LEVEL DECREASES AN ORDER OF MAGNITUDE, THE NUMBER OF COMPOUNDS DETECTED INCREASED AN ORDER OF MAGNITUDE. BASED ON THE NUMBER OF COMPOUNDS DETECTED BY CURRENT METHODS, ONE WOULD EXPECT TO FIND EVERY KNOWN COMPOUND AT A CONCENTRATION OF 10^{-12} G/L OR HIGHER."

(1) Laboratories receive performance evaluation samples in which a limited number of concentrations are analyzed and the samples do not have matrix interferences as might actual samples;

(2) PQLs are based on EPA and State laboratory data which are considered to be representative of the best laboratories, but not all laboratories; and

(3) Samples are analyzed under controlled ideal testing conditions which may not be representative of routine practices.

For these reasons, the PQL represents a relative stringent target for routine performance. (52 Federal Register 25699).

COMPARISON OF REPORTABLE SIGNIFICANT FIGURES AS A FUNCTION OF RELATIVE PRECISION

Precision (%)	Significant Figures	Example	
		Calculated	Reported
±0.001 to ±0.01	5	54.8149	54.815
±0.01 to ±0.1	4	54.8149	54.81
±0.1 to ±1	3	54.8149	54.8
± 1 to ±10	2	54.8149	55
±10 to ±30	1	54.8149	5×10^1

Figure 3. Normal Curve of Random Error
(x in sigma-units from mean)

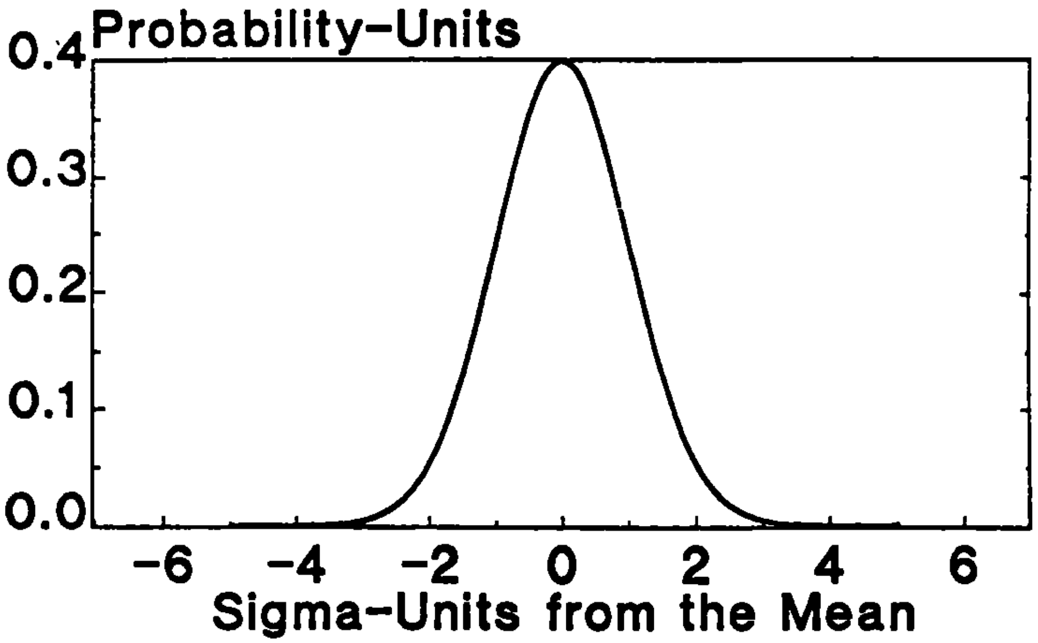


Figure 4. Normal Curve of Random Error
Mean = 100 ug/L; Sigma = 1 ug/L

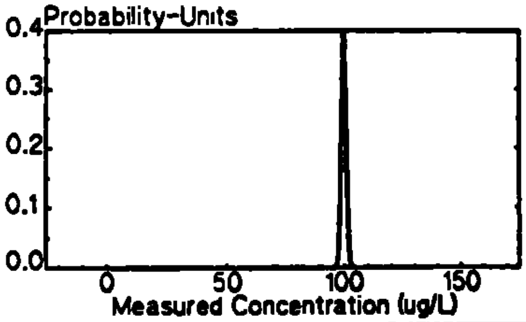


Figure 5. Normal Curve of Random Error
Mean = 100 ug/L; Sigma = 10 ug/L

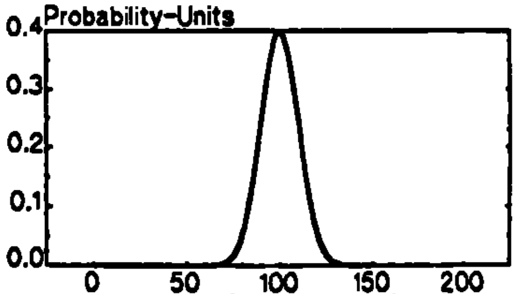


Figure 6. Normal Curve of Random Error
Mean = 100 ug/L; Sigma = 30 ug/L

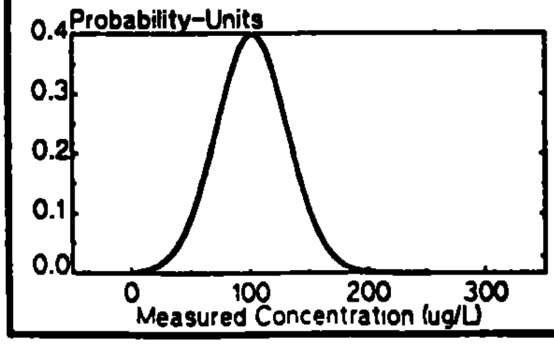


Figure 7. Normal Curve of Random Error
Mean = 100 ug/L; Sigma = 100 ug/L

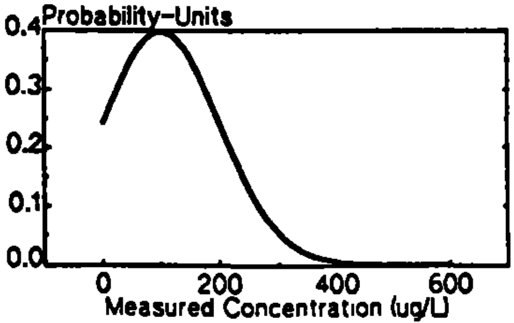


Figure 4. Normal Curve of Random Error
Mean = 100 ug/L; Sigma = 1 ug/L

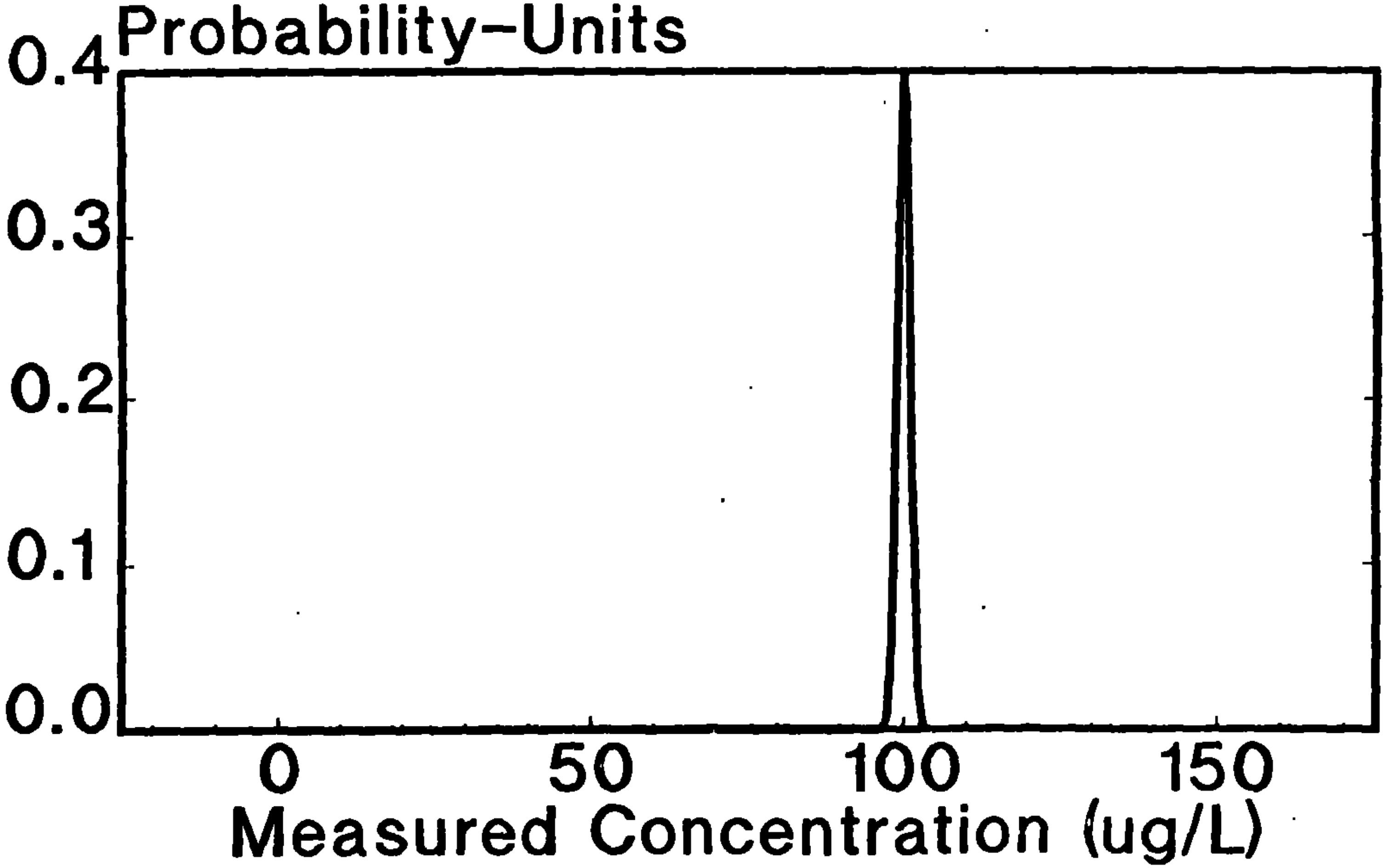
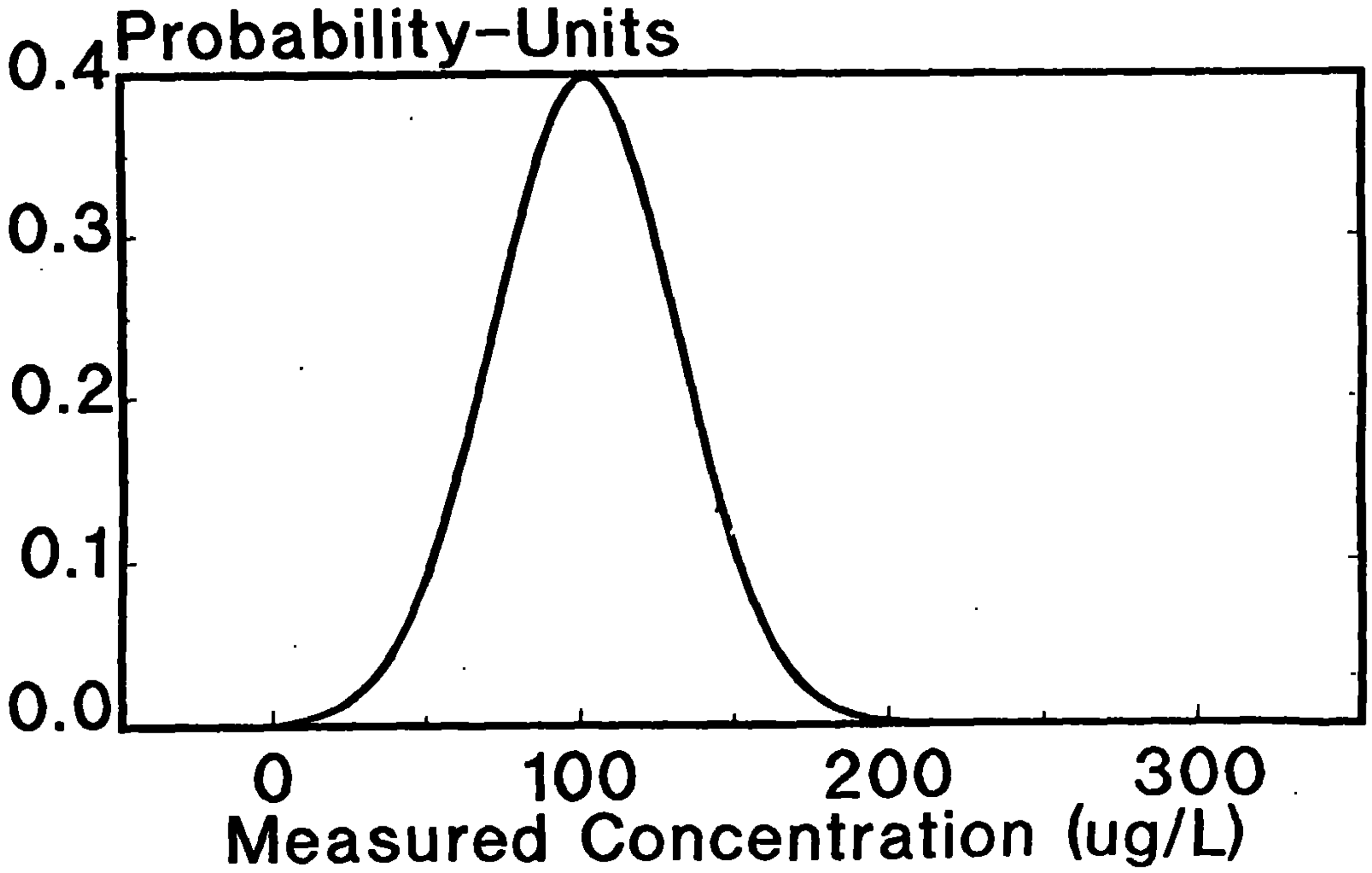


Figure 6. Normal Curve of Random Error
Mean = 100 ug/L; Sigma = 30 ug/L



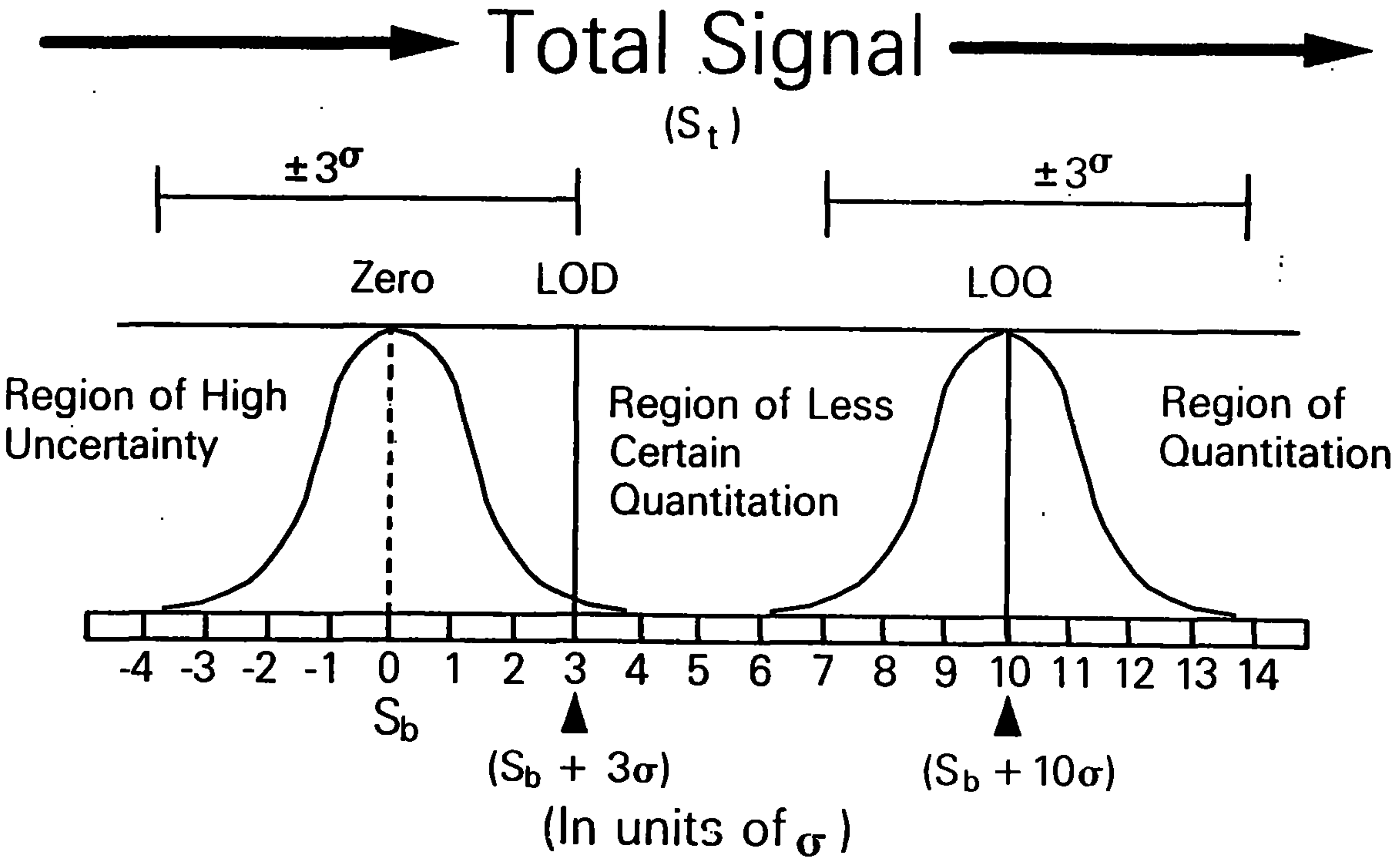


FIGURE 2, RELATIONSHIP OF LOD AND LOQ TO SIGNAL STRENGTH

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US Contract Lab Program Attach. V
Stmt of Work for multi-media
Multi-Conc.
Rev. 8/87

Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

Volatiles	CAS Number	Quantitation Limits**	
		Water ug/L	Low Soil/Sediment^a ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-34-3	5	5
10. 1,2-Dichloroethene (total)	540-59-0	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,2-Dichloropropane	78-87-5	5	5
19. cis-1,3-Dichloropropene	10061-01-5	5	5
20. Trichloroethene	79-01-6	5	5
21. Dibromochloromethane	124-48-1	5	5
22. 1,1,2-Trichloroethane	79-00-5	5	5
23. Benzene	71-43-2	5	5
24. trans-1,3-Dichloropropene	10061-02-6	5	5
25. Bromoform	75-25-2	5	5
[redacted]anone	108-10-1	10	10
27. 2-Hexanone	591-78-6	10	10
[redacted]ethene	127-18-4	5	5
29. Toluene	108-88-3	5	5
30. 1,1,2,2-Tetrachloroethane	79-34-5	5	5

(continued)

GENERAL MOTORS CORPORATION
TABLE 1
ANALYTICAL DATA

Boring No.	Sample No.	Sample Depth (ft)	2-Hexanone (mg/kg)	Detection Limit (mg/kg)
B-9	900	2	<0.05	0.05
B-9	901	5	0.24	0.05
B-9	902	10	0.21	0.05
B-9	903	15	<0.05	0.05
B-9	904	20	-----	-----
B-9	905	25	<0.05	0.05
B-9	906	30	<0.05	0.05
B-10	1000	2	<0.05	0.05
B-10	1001	5	0.09	0.05
B-10	1002	10	<0.05	0.05
B-10	1003	15	<0.05	0.05
B-11	1100	2	<0.05	0.05
B-11	1101	5	<0.05	0.05
B-11	1102	10	<0.05	0.05
B-12	1200	2	<0.05	0.05
B-12	1201	5	<0.05	0.05
B-12	1202	10	<0.05	0.05

FIELD BLANKS		
Sample No.	2-Hexanone (ug/L)	Detection Limit (ug/L)
1108	<50	<50
1400	<50	<50