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**APPENDIX N1**

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**HYDROGEN AND METHANE MONITORING PLAN**



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**APPENDIX N1**  
**HYDROGEN AND METHANE MONITORING PLAN**  
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1 **APPENDIX N1**

2 **VOLATILE ORGANIC COMPOUND MONITORING PLAN**

3 N1-1 Introduction

4 This Permit Attachment describes the monitoring plan for hydrogen and methane generated in  
5 Underground Hazardous Waste Disposal Units (**HWDUs**) 3 through 7, also referred to as Panels  
6 3 through 7.

7 Monitoring for hydrogen and methane in Panels 3 through 7 until final panel closure, unless an  
8 explosion-isolation wall is installed, may be an effective way to gather data to establish realistic  
9 gas generation rates. This plan includes the monitoring design, a description of sampling and  
10 analysis procedures, quality assurance (**QA**) objectives, and reporting activities.

11 N1-2 Parameters to be Analyzed and Monitoring Design

12 The Permittees will monitor for hydrogen and methane in filled Panels 3 through 7 until final  
13 panel closure, unless an explosion-isolation wall is installed. A “filled panel” is an Underground  
14 HWDU that will no longer receive waste for emplacement.

15 Monitoring of a filled panel will commence after installation of the following items in each filled  
16 panel:

- 17 • substantial barriers  
18 • bulkheads  
19 • five additional monitoring locations.

20 The substantial barriers serve to protect the waste from events such as ground movement or  
21 vehicle impacts. The substantial barrier will be constructed from available non-flammable  
22 materials such as mined salt (Figure N1-1).

23 The bulkheads (Figure N1-2) serves to block ventilation at the intake and exhaust of the filled  
24 panel and prevent personnel access. The bulkhead is constructed as a typical WIPP bulkhead  
25 with no access doors or panels. The bulkhead will consist of a steel member frame covered with  
26 galvanized sheet metal, and will not allow personnel access. Rubber conveyor belt will be used  
27 as a gasket to attach the steel frame to the salt, thereby providing an effective yet flexible  
28 blockage to ventilation air. Over time, it is possible that the bulkhead may be damaged by creep  
29 closure around it. If the damage is such as to indicate a possible loss of functionality, then the  
30 bulkhead will be repaired or an additional bulkhead will be constructed outside of the original  
31 one.

32 The existing VOC monitoring lines as specified in Attachment N, Section N-3a(2), “Sampling  
33 Locations for Disposal Room VOC Monitoring”, will be used for sample collection in each  
34 disposal room for Panels 3 through 7. The sample lines and their construction are shown in

1 Figure N1-3. In addition to the existing VOC monitoring lines, five more sampling locations will  
2 be used to monitor for hydrogen and methane. These additional locations include:

- 3 • the intake of room 1
- 4 • the waste side of the exhaust bulkhead,
- 5 • the accessible side of the exhaust bulkhead,
- 6 • the waste side of the intake bulkhead,
- 7 • the accessible side of the intake bulkhead.

8 These additional sampling locations (Figure N1-4) will use a single inlet sampling point placed  
9 near the back (roof) of the panel access drifts. This will maximize the sampling efficiency for  
10 these lighter compounds.

#### 11 N1-3 Sampling Frequency

12 Sampling frequency will vary depending upon the levels of hydrogen and methane that are  
13 detected.

- 14 • If monitored concentrations are at or below Action Level 1 as specified in Table IV.F.5.b,  
15 monitoring will be conducted monthly.
- 16 • If monitored concentrations exceed Action Level 1 as specified in Table IV.F.5.b,  
17 monitoring will be conducted weekly in the affected filled panel.

#### 18 N1-4 Sampling

19 Samples for hydrogen and methane will be collected using subatmospheric pressure grab  
20 sampling as described in Environmental Protection Agency (EPA) Compendium Method TO-15  
21 (EPA, 1999). The TO-15 sampling method uses passivated stainless-steel sample canisters to  
22 collect integrated air samples at each sample location. Flow rates and sampling duration may be  
23 modified as necessary to meet data quality objectives.

24 Sample lines shall be purged prior to sample collection.

#### 25 N1-5 Sampling Equipment

##### 26 N1-5a SUMMA<sup>®</sup> Canisters

27 Stainless-steel canisters with passivated or equivalent interior surfaces will be used to collect and  
28 store gas samples for hydrogen and methane analyses collected as part of the monitoring  
29 processes. These canisters will be cleaned and certified prior to their use in a manner similar to  
30 that described by Compendium Method TO-15 (EPA, 1999). The vacuum of certified clean  
31 canisters will be verified upon initiation of a sample cycle. Sampling will be conducted using  
32 subatmospheric pressure grab sampling techniques as described in TO-15.

1 N1-5b Sample Tubing

2 Treated stainless steel tubing shall be used as a sample path and treatment shall prevent the inner  
3 walls from absorbing contaminants.

4 Any loss of the ability to purge a sample line will be evaluated. The criteria used for evaluation  
5 are shown in Figure N1-5.

6 The Permittees will first suspect that a line is not useable when it is purged prior to sampling. If  
7 the line cannot be purged, then it will not be used for sampling unless the line is a bulkhead line  
8 that can be easily replaced. Replacement of bulkhead lines will occur before the next scheduled  
9 sample. Non-bulkhead lines will be evaluated by first determining if adjacent sampling lines are  
10 working. If the answer is no, then the previous sample from the failed line will be examined. If  
11 the previous sample was between the first and second action levels, then the explosion-isolation  
12 wall will be installed since without the ability to monitor it is unknown whether the area is  
13 approaching the second action level or decreasing. If the previous sample was below the first  
14 action level then continued sampling is acceptable without the lost sample.

15 If an adjacent line is working, the prior concentrations measured in that line will be evaluated to  
16 determine if it is statistically similar to the prior measurements from the lost line. If the prior  
17 sampling results are statistically similar, the lines can be grouped. Statistical similarity will be  
18 determined using the Student's "t" test to evaluate differences.

19 The magnitude of  $t$  will be compared to the critical  $t$  value from SW-846, Table 9-2 (EPA, 1996),  
20 for this statistical test.

21 If the lost line can be grouped with an adjacent line, no further action is necessary because the  
22 unmonitored area is considered to be represented by the adjacent areas. If the lost sample line  
23 cannot be grouped with an adjacent line, the previous concentration measurement will be  
24 compared to the Action Levels. If the concentration is below Action Level 1, monitoring will  
25 continue. If the concentration is between Action Level 1 and Action Level 2, the explosion-  
26 isolation wall will be installed in the panel.

27 N1-6 Sample Management

28 Sample containers shall be sealed and uniquely marked at the time of collection of the sample. A  
29 Request-for-Analysis Form shall be completed to identify the sample canister number(s), sample  
30 type, and type of analysis requested.

31 N1-7 Analytical Procedures

32 The samples will be analyzed using gas chromatography equipped with the appropriate detector  
33 under an established QA/quality control (QC) program. Analysis of samples shall be performed  
34 by a laboratory that the Permittees select and approve through established QA processes.

1 N1-8 Data Evaluation and Notifications

2 Analytical data from sampling events will be evaluated to determine whether the sample  
3 concentrations of flammable gases exceed the Action Levels.

4 If any Action Level is exceeded, notification will be made to NMED and the notification posted  
5 to the WIPP web page and accessed through the email notification system within 7 (seven)  
6 calendar days of obtaining validated analytical data.

7 If any sampling line loss occurs, notification will be made to NMED and the notification posted  
8 to the WIPP web page and accessed through the email notification system within 7 (seven)  
9 calendar days of learning of a sampling line loss. After the evaluation of the impact of sampling  
10 line loss as shown in Figure N1-5, notification will be made to NMED and the notification  
11 posted to the WIPP web page and accessed through the email notification system within 7  
12 (seven) calendar days of completing the sampling line loss evaluation.

13 N1-9 References

14 U.S. Environmental Protection Agency (EPA), 1996. SW-846, *Test Methods for Evaluating*  
15 *Solid Waste, Physical/Chemical Methods*. 3rd Edition. Office of Solid Waste and Emergency  
16 Response, Washington, D.C.

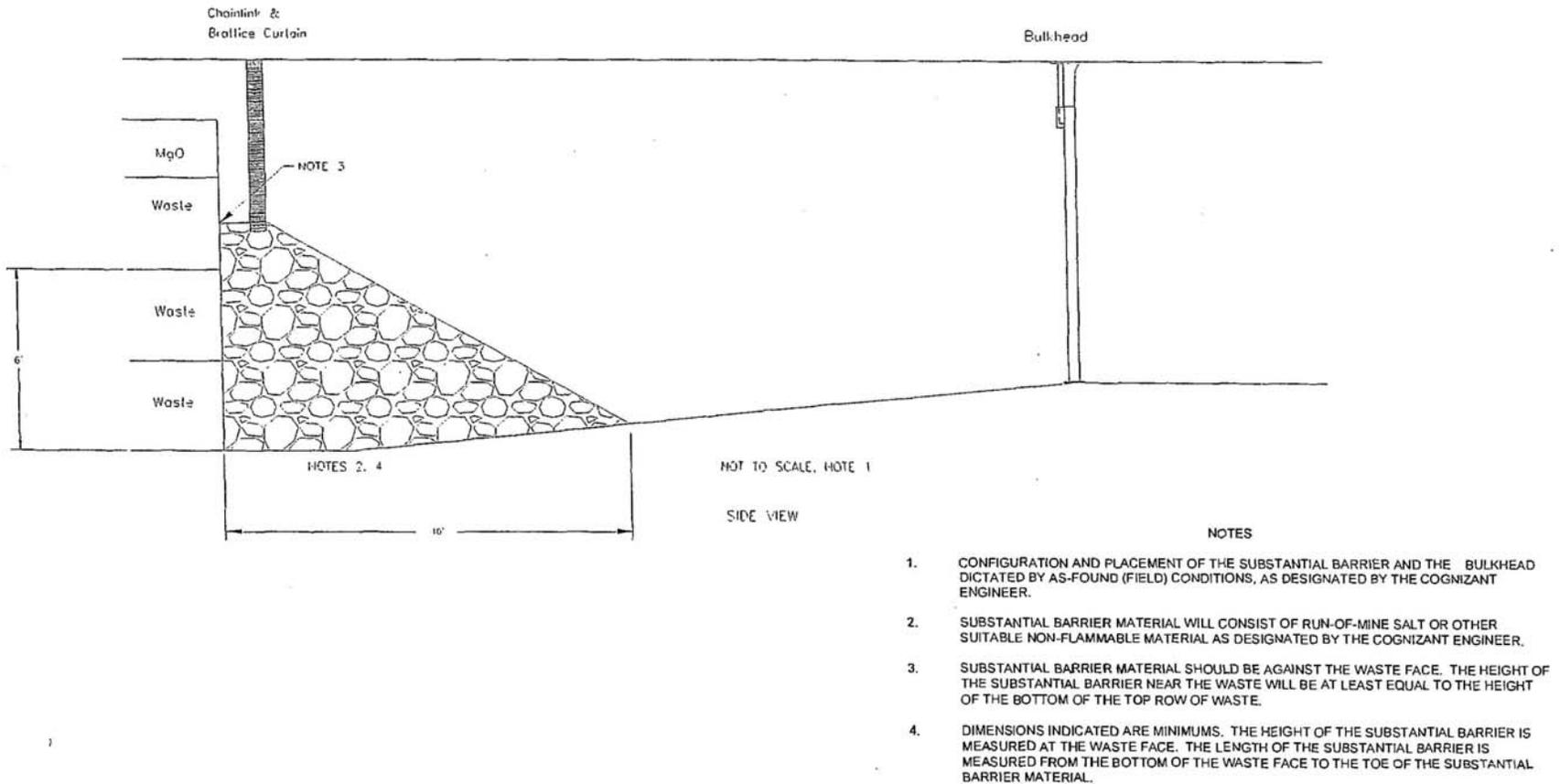
17 U.S. Environmental Protection Agency (EPA), 1999. *Compendium Method TO-15:*  
18 *Determination of Volatile Organic Compounds (VOCs) In Air Collected in Specially Prepared*  
19 *Canisters and Analyzed by Gas Chromatography/Mas Spectrometry*, EPA 625/R-96/010b.  
20 Center for Environmental Research Information, Office of Research and Development,  
21 Cincinnati, OH, January 1999.

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**FIGURES**

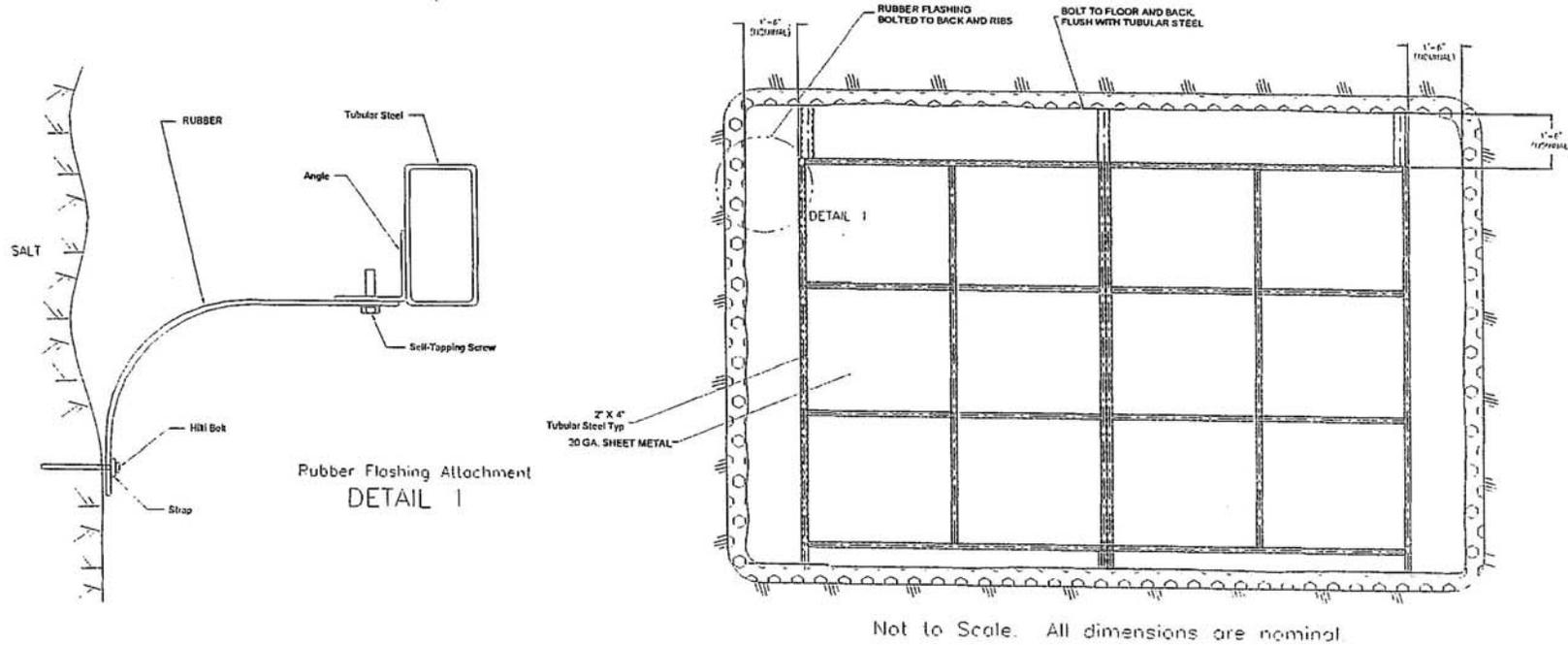
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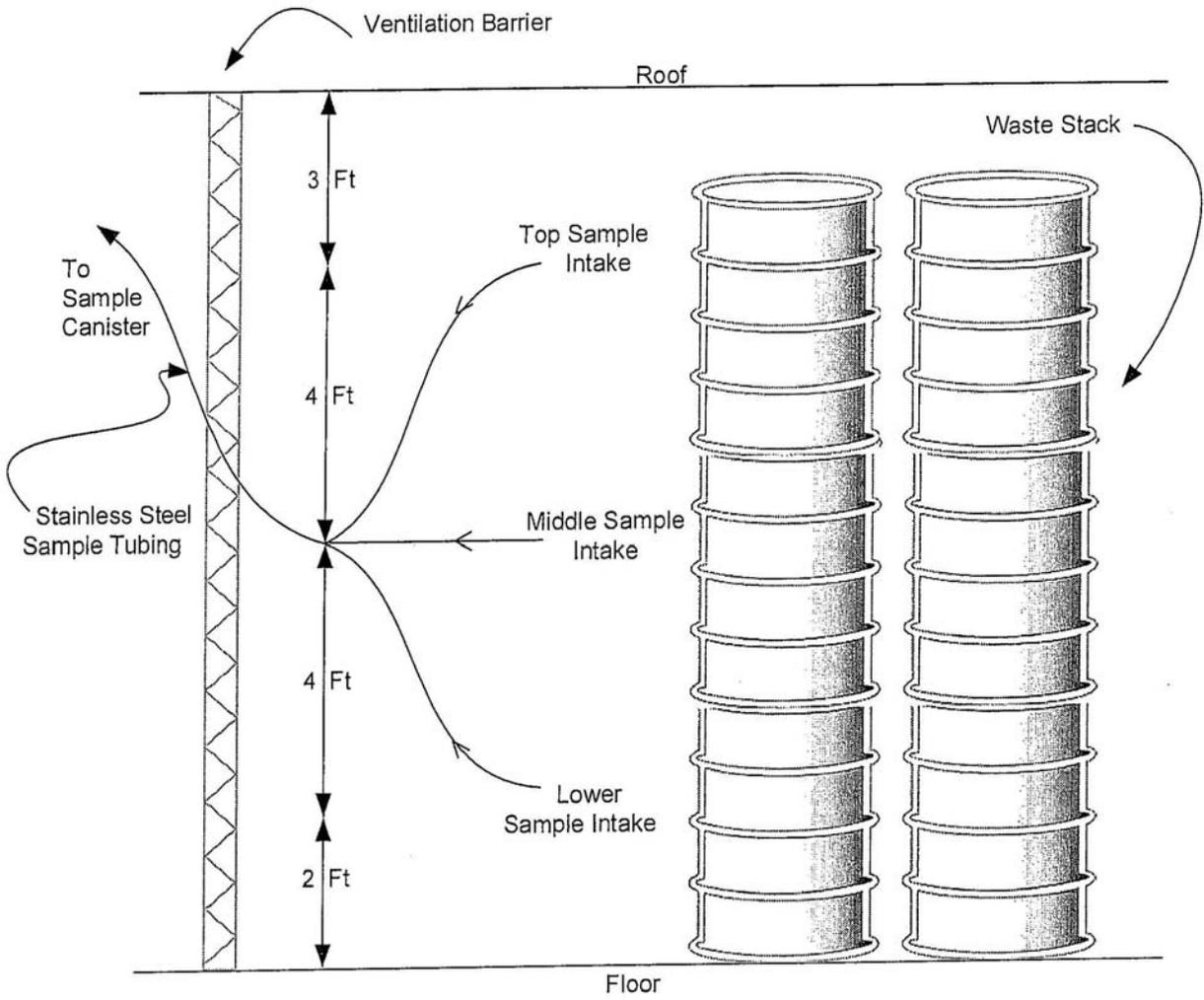
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Figure N1-1  
 Typical Substantial Barrier and Bulkhead



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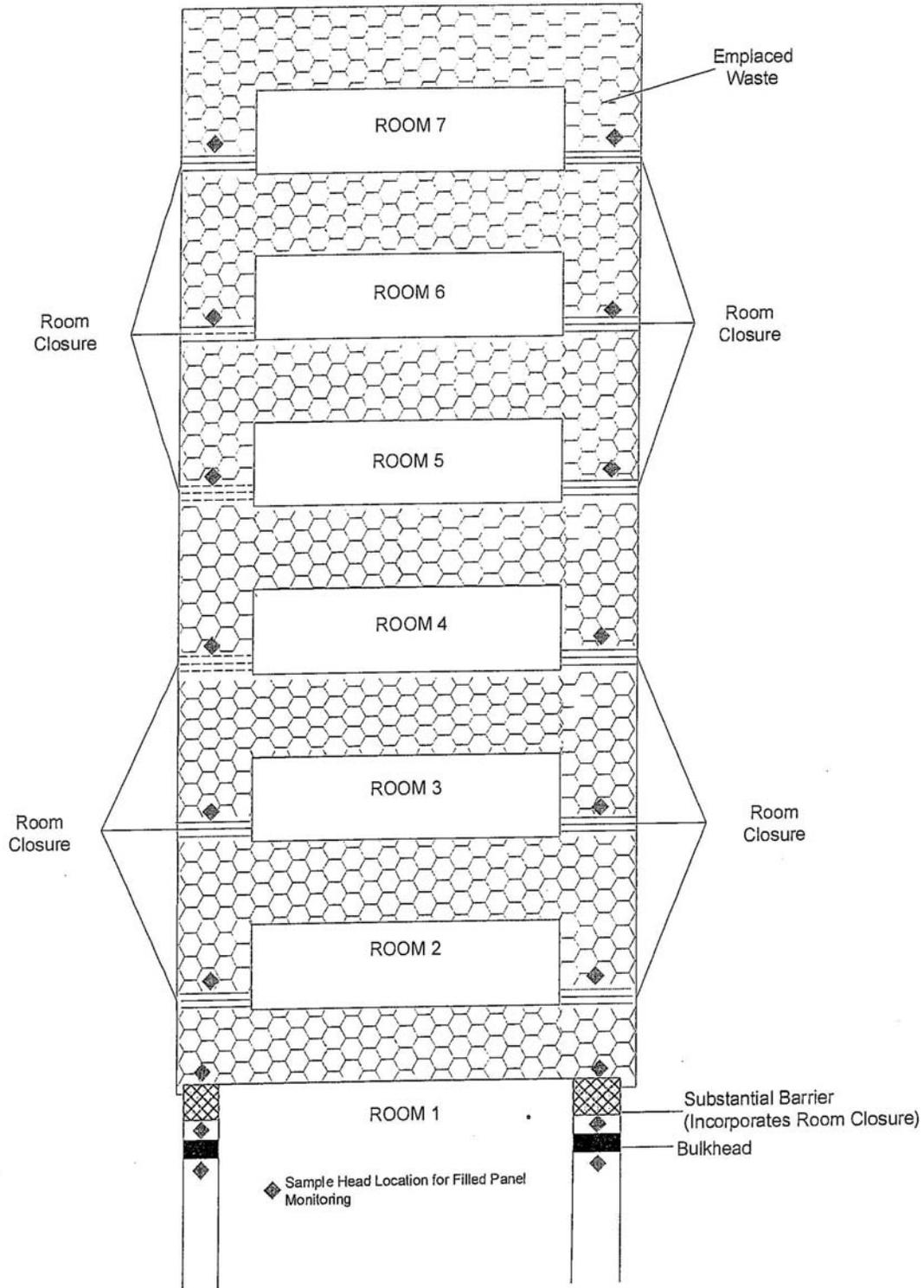
Figure N1-2  
Typical Bulkhead



(not to scale, all measurements approximate)

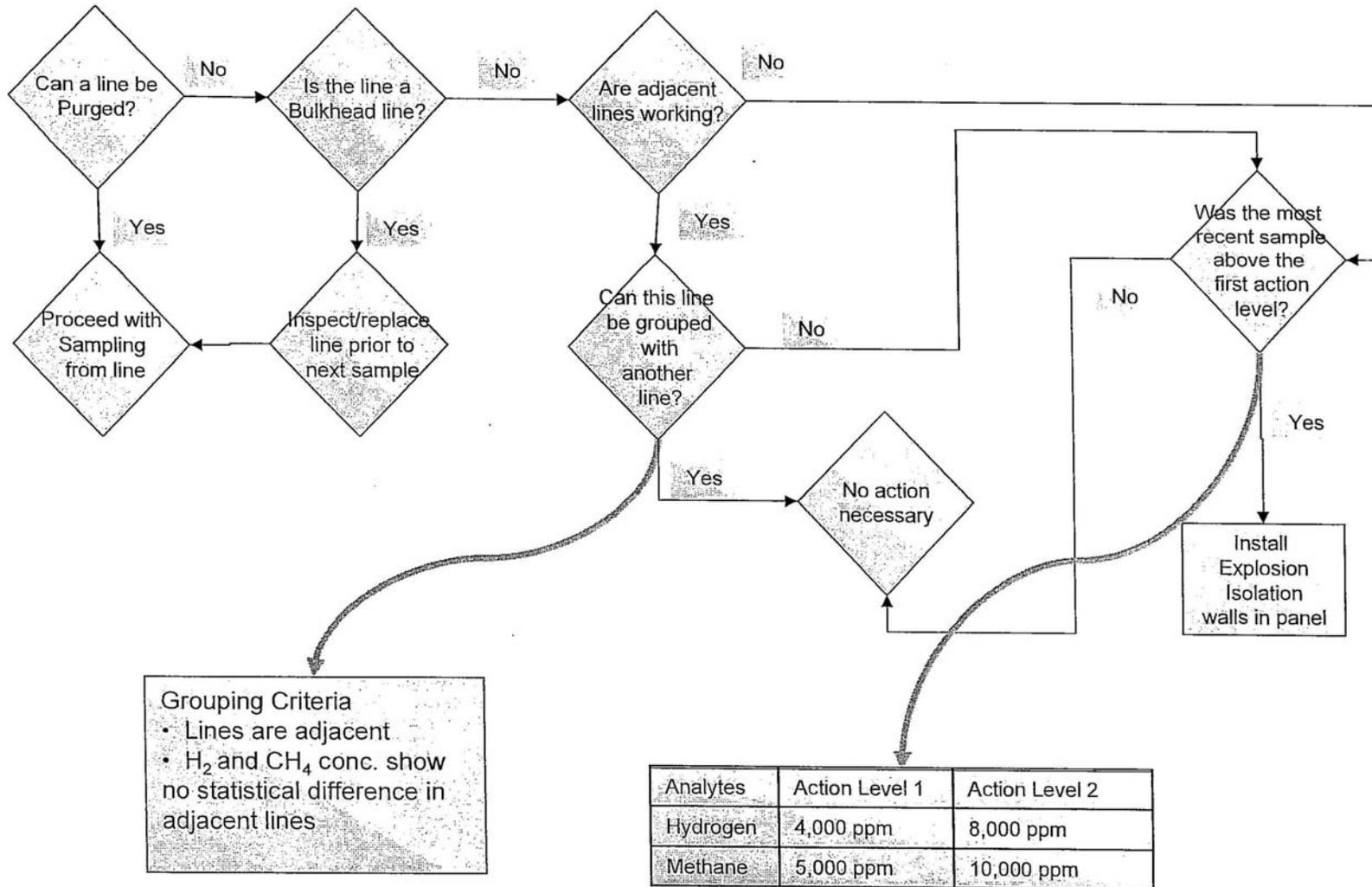
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Figure N1-3  
Typical Hydrogen and Methane Monitoring System



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Figure N1-4  
Typical Hydrogen and Methane Sampling Locations



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Figure N1-5  
 Logic Diagram for Evaluating Sample Line Loss