Geosyntec consultants

134 N. LaSalle St, Suite 300
Chicago, Illinoi s 60602
PH 312.658.0500
FAX 312.658.0576
www.geosyntec.com

US EPA RECORDS CENTER REGION 5
451289

12 September 2008

Mr. Rick Lanham
Project Manager
Federal Site Remediation Section
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, Illinois 62794-9276

Subject: Response to Comments- Gas Well and Vent Construction Remedial Action Work Plan, MIG/DeWane Landfill Superfund Site Belvidere-Boone County, Illinois

Dear Mr. Lanham:

On behalf of BFINA, this letter presents a response to Illinois EPA comments dated 22 August 2008 on the "Gas Well and Vent Construction Remedial Action Work Plan" (RAWP). The comments are presented in normal font and the response is presented in Arial font.

1. Throughout the document, it is stated that the report was prepared for BFI North America (BFINA), although the cover of the document states, "Prepared for Allied Waste Industries". This should be clarified.

   The cover has been corrected.

2. The width-of-influence (WOI) for the passive gas trench design assumes that it extends an equivalent distance in both the upslope and downslope direction from the perforated pipe (which runs parallel to the toe of slope). Gas generated above slope from the pipe will move upslope; however, migration of gas downslope to the pipe will be limited. In addition, no information is provided in the submitted documents addressing the design of the gas trenches.

   Landfill gas migrates primarily by convection based upon: a) a concentration gradient and not based upon density because its density is almost the same as atmosphere, and b) based upon pressure gradients. Openings in the cover such as vents and wells represent a lower pressure and a lower concentration than under the cover. Therefore, gas will migrate to the trenches and vents because they represent a lower concentration and lower pressure.

Construction of the gas collection trenches is not included in the Gas Well and Vent Construction RAWP; preliminary design details are presented in the "Preliminary Remedial Design Report" (Geosyntec, April 2007) where the status of the trench design may be reviewed.

3. What is the basis for determining the locations for the dual-phase wells as compared to the locations for the gas vents (i.e., why was a particular location selected as the location for a dual-phase well)?

   The locations of the 17 passive vents were generally described in the Focused Feasibility Study (Clayton, 1999) as being on the crest of the landfill spaced at one per acre (considered a "rule of thumb" in the gas collection industry). However, the "Preliminary Remedial Design Report" (Geosyntec, 2007) identified that additional gas venting was required along the side slopes of the landfill to alleviate pressure build up. To account for the relatively high leachate level, evidenced by the leachate seeps near the edge of the landfill, the Preliminary Design identified that by locating the dual phase wells on top of the landfill the screen length for both gas and leachate removal is maximized compared to on the side slopes and especially near the perimeter of the landfill. Consequently, passive vents were placed along the side slopes and dual phase wells were placed on the crest of the landfill.

4. Section 3 proposes to install "40 new gas vents". Schedule 1 on Drawing No. 16 of 18 lists 41 "Passive Gas Vents". Clarify if 40 or 41 new gas vents will be installed.

   There is a total of 41 new gas vents to be installed; this has been clarified in the RAWP.

5. Section 3—Description of Work to be Completed—this section does not mention evaluating the thickness of cover topsoil or confirming the extent of waste which was discussed in comments 8 and 17, respectively of the July 16th Response to Comment letter from Geosyntec to IEPA. These activities should be included if there is a potential for this work to be done during this phase.

   The cover soil thickness will be recorded on the "Dual Phase Well and Gas Vent Construction Form" provided in Appendix D during construction of the wells and vents. A sentence has been added to Sections 4.1 and 4.2 to highlight this requirement.

6. Page 4-2, Section 4.1, Well Protection: The proposed use of a "Jersey barrier" is acceptable as a temporary barrier for protection of the well stick-ups. However, given the number of stick-ups over the landfill surface, there will also be a need for protection of the stick-ups during construction of the cover system.

The RAWP requires the protection to be left in place at the end of this phase of construction. The scope of work to complete the next phase of cover construction will include a requirement to protect the gas vents and wells during construction.

7. Section 4.1 describes the 17 Dual Phase Wells. The description speaks to a 24 inch minimum borehole that will be drilled up to a maximum diameter of 36 inches, although on Drawing 16 of 18, both notes numbered 5 (for details 1 and 2), the borehole is stated to be a maximum diameter of 30 inches. Standard landfill gas well drilling practice utilizes a 36 inch diameter bucket auger to drill well bores. This will provide for a large annular space for the stone pack to be placed around the well casing.

   In this revision, dual phase wells are specified to be drilled to a nominal diameter of 36 inches and gas vents to be drilled to a nominal diameter of 24 inches throughout the RAWP. The gas vent boreholes can be smaller than dual phase wells because the effectiveness of the gas vents to operate passively is governed by the diameter of the casing and length of screen, not the diameter of the borehole.

8. Section 4.1 calls for drilling the Dual Phase Wells "down to near the bottom of the waste". Taking this statement and comparing it with the details on Schedule 2 of Drawing No. 16 of 18, it can be seen that the boreholes will extend 12 – 28.5 feet below the anticipated leachate level. Although drilling beyond the leachate level is possible for distances of 10 feet or so, going to 20 and nearly 30 feet into leachate will cause problems with waste sloughing into the hole and could lead to collapse of the hole. Address how these conditions will be avoided or mitigated.

   Geosyntec's experience is that the boreholes can be drilled to the anticipated depths below the leachate level. Should drilling to deeper depths prove to be counter-productive, the boring may be terminated with the approval of BFINA at a more shallow depth to preserve the borehole; if this occurs, the leachate management objectives will be reviewed and changes will be made in the design, if required.

   Specific procedures have not been provided; there is a performance criterion that borehole stability will be required to be maintained by the Contractor.

9. Section 4.1 calls for the wells to be capable of being converted to active gas extraction wells in the future. The text states that an 8 inch casing in a 24 inch borehole is adequate to extract gas. However, under the design for the Vent Casings in Section 4.3, it is stated that the vents "are not designed to operate in an active gas extraction mode because the annular space seal is less than standard practice for an active gas extraction well...". Thus, a conflict exists between the 8 inch casings being adequate for active gas removal,

while the 6 inch casings, with a larger annular space are not. Standard industry practice for both types of wells should be followed with 36 inch bucket augured boreholes and either 6 inch or 8 inch casing that would be adequate for active gas extraction.

There is a difference between the dual phase wells that have to be able to initially operate passively and also be able to actively extract gas and leachate in the future, and gas vents that will always operate passively. The dual phase wells will be 8-inch diameter casing installed in 36-inch diameter boreholes. Although there is no standard for passive gas vents, the gas vents will be 6-inch diameter installed in 24-inch diameter boreholes. Geosyntec has installed 6-inch diameter passive gas vents at other sites. The RAWP has been revised to be consistent throughout.

10. In Section 4.1, under the subheading, Annular Space Seal, it is stated that the bentonite seal, "will extend from the elevation of the future geomembrane layer down to four feet below the geomembrane elevation". This is not possible for two reasons, 1) there is no geomembrane shown. Section 5.6 describes a clay cover system, and 2) the bentonite seal is only 3 feet in depth. The drawing shows that the seal would be trimmed by one foot when the "clay cover" (as described in Section 5.6) is installed and would then be only 2 feet in thickness. It is unsure how the adequate thickness and integrity of the seal would be maintained during clay capping and grading of the site.

    The design in the RAWP reflects the "Preliminary Remedial Design Report" that includes removal of approximately the top 12-inches of cover soil prior to installation of the geomembrane. Consequently, the gas well annular space seal will be installed from the existing ground surface down five feet. During the next phase of cover construction, to be completed by another contractor, the top foot will be removed leaving a four-foot deep annular seal prior to installation of the geomembrane.

    The bentonite seal has the ability to reseal itself when it becomes dehydrated; after the top foot of cover soil is removed and prior to installation of the geomembrane boot around the gas vent or well, the bentonite will be inspected and rehydrated, if necessary.

11. Page 4-3, Section 4.2, Gas Vents Design Criteria: These sections indicate that the gas vents will be installed to a depth approximately 2 feet below the estimated leachate level. It is likely that the leachate level will be different than the estimated level and that the elevation of the leachate will change over time. How will the actual completion depth of the gas vents be determined in the field?

    The intention is to extend the gas vents down to the leachate level but it is not a design criterion. If leachate is not identified during drilling, the vents will be installed to the

design depth leaving a screen length that is two feet longer than required by the design. If leachate is found to be at a higher elevation, the design will be checked after the well is installed to identify whether any modifications are required.

12. In Section 4.2, under the subheading, Annular Space Seal, for the gas vents, it is stated that the bentonite seal, "will extend from the elevation of the future geomembrane layer down to two feet below the geomembrane elevation". Although there is also no, "geomembrane layer" shown on the gas vent detail on Drawing 16 of 18, the depth of the bentonite seal would be as described, at a 2 foot finish depth. It is unsure how the adequate thickness and integrity of the seal would be maintained during clay capping and grading of the site.

    Similar to response to comment 10 regarding the gas wells, the annular seal will extend from the ground surface down three feet; the top foot will be removed during the next phase of construction leaving a two-foot deep seal.

13. Section 5.2 states that during construction, "the method of storage for equipment and materials will be the Contractor's decision." Guidelines should be established to direct the Contractor as to where and how materials should be stored and protected and as to how much material should be stored on site at any time.

    Some storage guidelines to the contractor have been provided in Section 5.2.

14. Sections 5.3 and 5.4 state that the drill rig must be capable of drilling a 24" diameter borehole but Sections 4.1 and 4.2 say the hole may be a large as 36". Please resolve this discrepancy.

    In this revision, changes have been made to clarify that the drill rig for the gas vents must be capable of drilling a 24-inch diameter borehole and the drill rig for the dual phase wells must be capable of drilling a 36-inch diameter borehole.

15. Section 5.6 states that, "It is estimated that approximately 100 cu yds of IDW may be derived from waste cuttings during drilling". If the drill depths shown in Schedules 1 and 2 on Drawing 16 of 18 are added, it would be seen that the unbulked cuttings would exceed 160 cubic yards in 24 inch boreholes and exceed 360 cubic yards in proper 36 inch boreholes. Moreover, with bulking of the removed material, it could exceed 200 cubic yards from 24 inch boreholes and exceed 400 cubic yards from proper 36 inch boreholes.

The estimated quantity of IDW has been recalculated to be 300 cy. This quantity is based on the depths shown on Schedules 1 and 2 and the diameter of the boreholes for gas vents and dual phase wells being 24 inches and 36 inches respectively. The RAWP has been revised to reflect current information.

16. Furthermore, IDW removed from the boreholes will be, for the most part, saturated with and discharging leachate as it is removed from the boreholes, since much of the drilling is proposed to take place below the leachate level within the landfill. No mention is made of a plan to handle and contain the liquid runoff from the IDW as it is stockpiled on the landfill adjacent to the boreholes and in other areas of the site. Runoff could easily contaminate surrounding vegetated surface soils if left uncontained. Although silt fencing is to be utilized, it would contain only solids in the runoff, and the contaminated liquid leachate would pass through such fencing.

    The RAWP currently leaves management of the liquids up to the Contractor with a prescription to avoid impacting any surface soil and to clean up any spills. . To address the comment further, additional details have been provided in the RAWP for containment of any leachate during drilling. To clarify, most of the drilling will not be below the leachate level because there will be 41 passive wells drilled with about 10% of the drilling below the leachate level and there will be 17 dual phase wells with 50% of the drilling below the leachate level

17. Section 5.6 makes no mention of the disposition of the soil, other than the topsoil, that will be removed from the trenches that will be used to bury the IDW. Well over 100 yards, and more probably, over 400 yards of bulked soil will be removed from the trenches and must be relocated. No mention is made of testing, stockpiling, moving, covering or removing this soil. Without proper precautions, this soil could easily become contaminated, or it could already be contaminated when it is excavated.

    First, the soil that will be removed is clay backfill, clay barrier, cover soil and topsoil placed during the interim remedial action in the early 1990s and was obtained from the borrow pit west of the site and is not expected to be contaminated. Regardless, the RAWP has been revised to clarify handling requirements for the soil that is to be excavated, stockpiled and stabilized by revegetation for later use during the final phase of remedial action construction.

    The RAWP has been revised to require observations by CQA Inspectors and a requirement to segregate potentially contaminated soils to avoid contact with existing surface cover soil that is to be used in the next phase of remedial action cover construction.

18. Page 8-1, Section 8.2, Construction Quality Assurance Inspections and Monitoring, Bullet No. 5: There would be value in continuing to use the constructed wells and vents to measure leachate levels on a periodic basis.

    The RAWP has been revised to indicate when leachate levels in the wells will be monitored.

19. Section 8.2 discusses construction QA and monitoring. In section 5.6 paragraph 7, ASTM testing of the clay cover material is described. This testing/monitoring must be part of the CQA Plan. Please add this to Section 8 where appropriate, starting with 8.2. Details that need to be included are where to sample, how often to sample, what field QC is required and the chain of custody for the samples. Make sure the laboratory designated to do the ASTM testing is identified in Section 8.3 and on the organizational chart. The testing appears to have been addressed in sections 8.3.7, 8.3.8 and 8.3.9.

    The soil testing and related information described in Section 5.6 has been added to Section 8.

20. Drawing 16 of 18: Two versions of this drawing were received. Although no indications of revisions were made, it is apparent that revisions had been made, as readily evidenced by the fact that, among other details, the titles of Schedule 1 and Schedule 2 were reversed. Thus, the latest received copy, with the corrected Schedule numbers, was used for this review.

    The second Drawing 16 was accompanied by a transmittal sheet instructing the recipient to discard the initial Drawing 16. The correct drawing was reviewed.

21. Drawing 16 of 18: Detail 1, Note 1 for the Passive Gas Vents, states, "Passive gas vents are not designed to be used for active gas extractive wells at anytime", although the annular space around the well casing is actually larger than that of the Dual Phase Wells that may be used for active extraction.

    The passive gas vent will be 6 inches in diameter and will be installed in the center of the 24-inch borehole. The annular space between the vent and the edge of the borehole will be 9 inches. The dual phase gas well will be 8 inches in diameter and will be installed in the center of the 36-inch borehole. The annular space between the well and the edge of the borehole will be 14 inches. Furthermore, passive gas vents will have 2-ft-thick bentonite seal and the dual phase gas wells will have 4-ft-thick bentonite seal. Because the seal of the gas vents will be relatively small, gas vents shall not be

used for active gas extraction wells at any time to avoid the potential for introducing atmospheric oxygen into the waste.

22. Drawing 16 of 18: Detail 1, Note 5 for the Passive Gas Vents, and Detail 2, Note 4 for the Dual Phase Wells state, "The maximum width of the drilled hole shall be 30 inches". Standard gas well drilling practices utilize a 36 inch bucket auger.

    The diameter of the borehole for the passive gas vent will be a minimum of 24 inches. A larger borehole is not required for the passive vents because the borehole is large enough to install the 6-inch diameter vent which is used in the design. This size of bucket auger will be utilized for this project to minimize the amount of IDW generation. The diameter of the dual phase gas wells will be 36 inches and therefore Note 4 on Detail 2 has been deleted.

23. Drawing 16 of 18: Detail 1, Note 9 for the Passive Gas Vents, and Detail 2, Note 8 for the Dual Phase Wells call for a "Hurricane turbine ventilator", and, "the Contractor shall provide a connection detail between the PVC pipe and turbine vent". Since turbine ventilators are not fabricated to match the outside diameter of Schedule 80 PVC, it would be wise for the connection detail to be developed and specified by the Engineer, as to attachment, adapter and sealing methods and seal materials. Further, according to the company's website, the turbine ventilator specified is not available in a size that would easily fit a 6 inch or an 8 inch pipe, so extensive adapter configuration would be necessary.

    Detail 5 for the connection has been provided on Drawing 16 of 18.

24. Drawing 16 of 18: Detail 1, Note 5 for the Passive Gas Vents, and Detail 2, Note 4 for the Dual Phase Wells specifies that, "the vent casing shall have a sample port to allow for periodic gas testing". The Engineer should specify the location for the port to ensure accurate gas sampling. The Engineer should also specify the type of port that will match those mating ports used by field sampling personnel. Plastic ports should be stabilized against UV degradation and exposure to landfill gas constituents.

    A sample port detail (see Detail 4) has been provided on Drawing 16 of 18.

25. Drawing 16 of 18: The "stick-up height" of the Passive Gas Vents and the Dual Phase Dual phase wells should be modified to 6 ft. This would allow for the 6 ft stick-up plus the 4 feet from the ground surface down to the top of the slotted casing to be fabricated from a single 10 foot section of pipe, minimizing waste and eliminating an extra joint on each well casing.

The stick up height is set to be 6-ft after the soil cover is completed. Geosyntec has specified that 2-1/2 ft of cover soil, including topsoil, is to be added over the geomembrane level, which is about 1 ft below current grade. To reach the final design level, a stick up height of 7-1/2 ft above the current ground surface will be required which will be 6 ft above the final grade. Consequently, no change in the design is required.

26. Drawing 16 of 18: Schedule 1 for the Passive Gas Vent System contains two vents identified as GV-41. It is assumed that the GV-41 listed between GV-13 and GV-15 should read, "GV-14".

    Drawing 16 has been corrected.

27. Drawing 9 of 17: This plan shows a number of "Leachate collection trenches". No details are provided for the construction of these trenches, materials of construction, width, depth or stone pack. Further, no details are supplied for the connections to the "Leachate Pipe Cleanout Risers and Gas Vents." Notes on the sheet indicate that details for these trenches are shown as "Details of Sheet 15", while Sheet 15 is not supplied.

    The leachate collection trenches will not be installed as part of the Gas Well and Vent Construction RAWP. They will be installed during the final cover remedial action. The details were presented on Drawing 15 as a part of the "Preliminary Remedial Design" (Geosyntec, April 2007) and will be finalized after receipt of comments from IEPA.

28. Drawing 9 of 17: If trench system as extensive as is shown on Sheet 9 of 17 is indeed to be installed, the design should include a plan for disposing of, or relocating the waste and soil that are removed from the trenches.

    The plan for disposing the excavated waste will be included in the RAWP for the final remedial action cover construction to be completed after the final design is approved.

Comments and Responses to Geosyntec's July 16, 2008 Gas Vents and Wells letter to the Illinois EPA.

1. In Item 3, IEPA requests "details addressing the methods for testing and sampling" the effectiveness of the gas vents. Mr. Seymour's response covers sampling of the vents, but does not address the issue of gas emissions through the landfill surface. It is recognized in the landfill gas control industry that gas pressure can build up under a landfill cap, causing instability of the clay cap and lead to fissuring and possible failure. Even though gas may be venting through the vents, this is not a guarantee that pressures beneath the

cap are being properly and totally relieved. Consideration should be given to conducting surface emissions testing (sweeping) wherein levels of methane emitted at the landfill surface are measured across the site. High levels of methane at areas on the surface would be indicative of pressure relieving through fissures in the cap. These measurements would identify these potential problem areas and help direct cap maintenance efforts.

This comment appears to be most appropriately addressed as a part of the cover system design and implemented after the final cover is installed. A long-term gas monitoring program will be included in the Operation and Maintenance Plan scheduled to be submitted in the pre-final remedial design to assess passive gas vent performance.

2. In Item 10, the possibility of the gas vents not being adequate to properly vent gas from the landfill is raised by IEPA. Mr. Seymour states that, in the event that the passive system is not adequate, the passive system "should be converted to an active system". Careful consideration should be given to quickly demonstrating that the passive system either works as expected, or it should be converted to an active system. The urgency of this determination is dictated by the design of the clay capping system and should be made before the cap is placed. The reason for this urgency is the fact that the clay cap is to be 2 feet thick. In order for an active landfill gas extraction system to operate properly, without freezing of condensate in system components and piping during Illinois winters, the piping must be placed a minimum of 3 feet below the finish grade of the landfill. Thus, installing landfill gas collection headers after the clay cap is installed would necessitate extensive penetration of the clay cap, compromising its efficiency and integrity.

   Geosyntec's comment regarding the assessment of the adequacy of the passive venting is directed to the time after the final cover is installed which will be many months after the gas wells and vents are installed.

   Geosyntec agrees that a general assessment of the effectiveness of the vents to vent landfill gas should be made immediately after construction. The following will be completed:

   a. measurement of liquid levels to assess whether leachate is blocking the screened interval that is expected to be used for venting;

   b. measurement of the methane levels emitting from the vent that would indicate landfill gas flow;

c. observation of the rotation of the turbines during differing weather conditions to assess whether landfill gas is causing rotation of the turbines due to venting; and,

d. measurement of methane, pressure, oxygen and carbon dioxide in gas probes around the landfill in accordance with Illinois Title 35 Part 811 Sections 311 and 312.

A further demonstration of the effectiveness of the venting system will be conducted after all layers of the cover are constructed. The demonstration will be described in the Operation and Maintenance Plan and Performance Standards Verification Plan to be submitted with the Pre-Final Remedial Design prescribing the long term monitoring program. Further, an RA Contingency Plan will be provided with the Pre-Final Remedial Design to address a condition where the monitoring indicates that the criteria in Illinois Administrative Code Title 35 Part 811 Sections 311 and 312 are exceeded.

If the gas system has to be converted to an active system, the collection piping will be installed within the soil cover above the geomembrane consistent with current landfill gas collection practice in the Midwest. It is not the current practice to excavate through the cover geomembrane when retrofitting gas systems and is not proposed for the Site. Precautions will be included to avoid freezing, again, consistent with current practice in the Midwest, for collection pipes in the soil cover.

3. Under the section entitled "PASSIVE GAS VENT AND DUAL PHASE GAS WELL LAYOUTS", in the subsection, "PROPOSED LAYOUT DESIGN", it is stated that "The borehole seals for the dual phase dual phase wells will extend four feet below the top of the final clay cover". This contradicts information discussed above in reviews of the report and the drawings.

   In the RAWP, the borehole seals for the dual phase wells are shown to extend four feet below the level of the geomembrane which will be welded to the well riser using a geomembrane "boot". The design criterion for sealing the dual phase wells is intended to be the level of the geomembrane, which is also the top of the "compacted" clay cover, not the "clay cover".

4. Under the section entitled "PASSIVE GAS VENT AND DUAL PHASE GAS WELL LAYOUTS", in the subsection, "ASSUMPTIONS/GIVEN", it is stated that 'There will be several perimeter passive leachate drainage trenches that will also passively vent gas". Although these trenches are shown on sheet 9 of 17, no details are provided.

The passive trenches will be installed during the final cover construction remedial action, to be initiated after approval of the final design. The remaining remedial design will be initiated after receipt of IEPA comments on the "Preliminary Remedial Design Report" (Geosyntec, April 2007).

Three copies of the revised RAWP are attached. Should you have any questions please contact me at (312) 416-3919 or (312) 658-0500 x 3919.

Sincerely,

John Seymour, PE
Associate

Attachments Gas Well and Vent Construction Remedial Action Work Plan

Copies to: Eric Ballenger; BFINA (1 copy)
Howard Caine; U.S. EPA (1 copy)
Lisa Harrison; CDM (1 copy)

RAWP

Prepared for

BFI Waste Systems North America (BFINA)
Hanover Park, Illinois 60133

GAS WELL AND VENT CONSTRUCTION REMEDIAL ACTION WORK PLAN

MIG/DeWANE LANDFILL SUPERFUND SITE BOONE COUNTY, BELVIDERE, ILLINOIS

0070050002- BOONE COUNTY ILD 980497788

Prepared by

GEOSYNTEC CONSULTANTS
134 N. LaSalle Street, Suite 300
Chicago, Illinois 60602

Project Number CHE8214
11 September 2008

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1. INTRODUCTION

1.1 Remedial Action Work Plan Overview

This Gas Well and Vent Construction Remedial Action Work Plan (RAWP) has been prepared by Geosyntec Consultants (Geosyntec) on behalf of BFI Waste Systems North America, Inc. (BFINA). The purpose of the RAWP is to facilitate the installation of landfill gas vents ("vents") and dual-phase leachate/gas wells ("wells") prior to constructing the rest of the remedy described in the Remedial Design/Remedial Action (RD/RA) Consent Decree (U.S. EPA, 2006). The intent of constructing the wells and vents in 2008 is to:

1) expedite venting of landfill gas to mitigate the presence of methane in GP-27, GP-28 and GP-30; and

2) shorten the construction schedule for remedial action construction work expected to occur in 2009 by completing some of the work in 2008.

This RAWP has been prepared in accordance with the 13 June 2008 letter from BFINA to Illinois Environmental Protection Agency (IEPA) providing a plan outlining the landfill gas and well installations and the 26 June 2008 BFINA response to Illinois EPA comments on the plan prepared by Geosyntec on behalf of BFINA.

This RAWP addresses the final design of the gas vents and wells, the remedial action (RA) construction, construction quality assurance (CQA), and health and safety. Upon Illinois Environmental Protection Agency (IEPA) approval of this RAWP, field work shall commence in accordance with the approved schedule.

This RAWP addresses the following:

- Section 2: Site Description and Background
- Section 3: Description of the Work to be Completed
- Section 4: Remedial Design
- Section 5: Remedial Construction Work Plan
- Section 6: Health and Safety
- Section 7: Schedule
- Section 8: Construction Quality Assurance
- Section 9: Project Management
- Section 10 Community Relations
- Section 11: References

1.2 Terms of Reference

This RAWP was prepared by John Seymour, P.E., and Burak Tanyu, PhD of Geosyntec. The RAWP was reviewed by Richard Berggreen, P.G., and the design was reviewed by John Hargrove, P.E., Brad Bodine, P.E., and Jay Beech, P.E., in accordance with Geosyntec's internal quality review process and the Remedial Design Work Plan.

2. PROJECT INFORMATION

2.1 Site Background

The Site operated as a landfill from 1969 until 1988. The Site received residential, municipal, commercial, and industrial wastes and is classified, based on United States Environmental Protection Agency (U.S. EPA) guidance, as a Type I landfill. A Type I landfill is a co-disposal facility where hazardous wastes are disposed of with municipal solid wastes. At one time, the Site had a landfill permit issued by the State of Illinois for the facility.

The Site was abandoned in 1988 by a former operator prior to achieving complete final closure. U.S. EPA placed the Site on the National Priorities List (NPL) in 1990. Throughout the 1990s, a number of activities were conducted by the MIG/DeWane Landfill Task Force (MLTF), the Potentially Responsible Party (PRP) group for the Site, including completion of Interim Remedial Measures (IRM) in 1992-1993. In the later 1990s, the remedial investigation (RI) and feasibility study (FS) were completed. Further, a landfill gas extraction trench was installed immediately west of the landfill and a landfill gas extraction well system was installed farther west along the eastern edge of the Wycliffe Estates Subdivision. Additional historical information from the mid-1990s through mid-2006 is included in the "Remedial Design Work Plan" (RDWP-Geosyntec, 2006).

In 2006, BFINA agreed to conduct the remedial design and remedial action. The RDWP was submitted in May 2006, revised and approved in September 2006. The RDWP described the design process, deliverables, and the requirements for a pre-design investigation. A predesign investigation was conducted in late 2006. A "Predesign Investigation Report" was submitted on 6 April 2007 followed by submittal of the "Preliminary Remedial Design Report" submitted on 25 April 2007.

The predesign investigation identified methane gas in several wells around the landfill perimeter. The presence of methane was addressed in the "Preliminary Remedial Design Report" by including the installation of additional gas vents around the side slopes of the landfill, and a combined passive gas venting trench and passive leachate drainage trench around portions of the perimeter of the landfill.

In a 13 June 2008 letter to Illinois EPA, BFINA proposed to install the gas wells and vents in 2008 and outlined a plan for their installation.[1] The Illinois EPA provided comments on the plan on 26 June 2008 and BFINA responded on 16 July 2008.

2.2 Site Description

The Site, also known as Boone Landfill, MIG Investment, DeWane Landfill, Bonus Landfill, or Kennedy Landfill, is located in Boone County, Illinois approximately 0.25 miles east of the City of Belvidere and 0.5 miles north of U.S Business Route 20 (Figure 2.1). The Site is located primarily in the south half of the southeastern quarter of Section 30, Township 44 North, Range 4 East. The Site is bounded on the north by the Union Pacific (formerly the Chicago and Northwestern) railroad tracks, and a Commonwealth Edison right-of-way. North of the railroad tracks is an agricultural field that extends to the Kishwaukee River.

Agricultural and commercial properties are located to the east and south of the Site. A soil borrow pit, used to provide soil for the Site's interim cap, is immediately adjacent ot the west of the Site. Farther west of the Site is a residential housing development known as the Wycliffe Estates subdivision.

The Site occupies an area of approximately 47 acres and rises to a height of approximately 55 ft above the surrounding terrain (Figure 2.2). The Site consists of a landfill and leachate surface impoundment. The surface impoundment was constructed to receive leachate from the eastern area of landfill operations through a gravity flow leachate collection system. A landfill gas extraction system, composed of two vents for passive gas removal, had been installed on the crest of the Site prior to the Site being abandoned in 1988 by M.I.G. Investments, Inc.

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[1] The installation of the passive gas venting/leachate drainage trenches is not proposed to be installed in 2008 because the leachate management system requires further design.

3. DESCRIPTION OF THE WORK TO BE COMPLETED

The RA construction work to be completed under this RAWP includes the following:

- final design of the wells and vents;
- contracting with a well drilling firm with experience installing wells in solid and hazardous waste landfills;
- installation of 17 new dual-phase wells;
- installation of 41 new gas vents;
- locating and closing of two gas vents that were reported to be in place but could not be found during the 2006 pre-design site investigation; and
- management of investigation derived waste (IDW).

4. REMEDIAL DESIGN

This section describes the design of the gas wells and vents. **Apppendix A** provides the final Remedial Design Drawings from the "Preliminary Remedial Design" applicable to the work that have been revised and finalized. **Appendix B** provides calculation packages for the final design of the wells and vents. **Appendix C** provides the Construction Health and Safety Plan (CHASP) for the work.

4.1 Dual Phase Wells Design Criteria

The following describes the final design of the dual phase wells.

Boreholes and Wells: The dual phase (gas and leachate) wells ("wells") are to be installed through the existing cover, through the unsaturated and saturated waste, down to near the bottom of the waste. Seventeen (17) wells are proposed to be installed and construction details (including the cover soil thickness) will be recorded on the well construction completion form contained in **Appendix D**. The bottoms of the well boreholes are designed to stop approximately five (5) feet above the estimated bottom of waste (per Drawing 2-6, Clayton, 1999) to avoid penetration of the clay at the bottom of the landfill.

The boreholes will be drilled to a diameter of 36-inches to provide a relatively large annular space for removal of gas and leachate. The borehole diameter will be restricted to a maximum diameter of 36 inches to avoid excessive drilling which could reduce borehole stability.

Well Casings: The casings for the wells will be installed to be operated in the passive gas venting mode. However, the well casings are designed to be able to be modified at a later date to include the mechanical equipment necessary to extract both leachate and gas, if necessary, based upon post-closure (after construction of the new cover system) monitoring results. To allow for sufficient space for the mechanical equipment, the casing is designed to be 8-inch diameter.

The well casings will be perforated to allow collection of both gas and leachate for a specified length of casing. The perforations will be located a specified distance below the geomembrane cover to avoid air (oxygen) intrusion should the system be converted to an active gas extraction system at a later date. The perforations shall have 3/8-inch wide, vertical slots approximately 8-inches long.

The well casing will be schedule 80 polyvinyl chloride (PVC). PVC has been found to be effective for normal solid waste landfill gas extraction operations. PVC would not be recommended for landfills that are generating heat in excess of allowances for PVC material specifications. However, high heat is not expected at the MIG/DeWane

Landfill because of the age of the waste (20 to 30 years old), and lack of field evidence of heat, such as steam or hot vapors emanating from the leachate wells and piezometers in the landfill and lack of snow cover during winter.

The stick up of the wells will be high enough to avoid a person from directly breathing the vapors. The height of stickup above the final cover shall be 6 ft, which is approximatley 7.5 ft above existing ground surface grade.

The casings will also be fitted with a "turbine vent" top that keeps out animals and spins to faciliate removal and dispersal of vapors. The turbine vents will be made of aluminum to reduce the potential for corrosion. The vent casing will have a sample port approximately 3-ft above final grade elevation to allow for periodic landfill gas testing.

Aggregate Filter Pack: Waste particles will be kept from entering the well by the use of an aggregate filter pack. The aggregate will be IDOT CA-1 without fines. Aggregate will not be a calcareous material susceptible to reduction in a relatively basic environment.

Annular Space Seal: The seal of the annular space around the well casing above the aggregate filter pack is designed to avoid air intrusion during active gas extraction. The seal will be made of a bentonite product, such as Hole Plug ™ manufactured by Baroid. Bentonite products have been shown to be effective and resilient as sealants at landfills because they have a very low hydraulic conductivity that minimizes air intrusion, are flexible to accommodate settlement, and will reseal if there is moisture loss and then reabsorption. The seal will extend from the elevation of the future geomembrane layer down to four feet below the geomembrane elevation.

Well Protection: Because the wells will be installed before the new cover system is constructed, the well casings will be protected above ground using temporary concrete barriers, such as a "Jersey barrier", a 3-ft diameter section of reinforced concrete pipe, or approved equivalent. The temporary barrier will be stabilized by gravity and will not be anchored into the cover system using a drilled pier or driven pile. The temporary barrier will be removed by the cover contractor to finish cover construction.

Summary of Well Design: **Table B-3-1** in **Appendix B** presents the dimensions/depths of the well features such as depths of boreholes, lengths of perforations, etc. based on the above design criteria. In the future, if the wells need to operate in an active mode, additional design and field modifications will be required.

4.2 Gas Vents Design Criteria

The following describes the final design of the gas vents.

Boreholes and Vents: The passive gas vents ("vents") are to be installed through the existing cover, through the unsaturated waste and down to approximately two feet below the estimated leachate level. Forty one (41) vents are proposed to be installed and construction details (including the cover soil thickness) will be recorded on the vent construction completion form contained in **Appendix D**. The vents will extend below the estimated leachate level to provide additional potential venting should the leachate level be lower than estimated.

The boreholes will be drilled to a minimum diameter of 24-inches to provide a relatively large annular space for removal of gas. The boreholes will be drilled up to a maximum diameter of 30 inches to avoid excessive drilling which could reduce borehole stability.

Vent Casings: The casings for the vents will be installed to be operated only in the passive gas venting mode. They are not designed to operate in an active gas extraction mode because the annular space seal is less than standard practice for an active gas extraction well and operation as an active system could lead to air (oxygen) intrusion and increase the potential to cause subsurface waste oxidation/combustion.

The vent casings shall be 6-inch diameter to be robust and to reduce flexibility with length. The vent casings will be perforated to allow venting of gas. The perforations shall have 3/8-inch wide vertical slots approximately 8-inches long.

The material for the casing will be schedule 80 polyvinyl chloride (PVC). PVC has been found to be effective for normal solid waste landfill gas extraction operations. PVC would not be recommended for landfills that are generating heat in excess of allowances for PVC material specifications. However, high heat is not expected at the MIG/DeWane Landfill because of the age of the waste (20 to 30 years old), and lack of field evidence of heat, such as steam or hot vapors emanating from the leachate wells and piezometers in the landfill and lack of snow cover during winter.

The stick up of the vents will be high enough to avoid a person from directly breathing the vapors. The height of stickup above the final cover shall be 6 ft, which is approximatley 7.5 ft above existing ground surface grade. The casings will also be fitted with a "turbine vent" top that keeps out animals and spins to faciliate removal and dispersal of vapors. The turbine vents will be made of aluminum to reduce the potential for corrosion. In the future, if the gas wells are required to be operated in an active mode, the turbine ventilators will have to be removed and the tops of each passive vent

will need to be sealed to avoid air intrusion. The vent casing will have a sample port approximately 3-ft above final grade to allow for periodic landfill gas testing.

Aggregate Filter Pack: Waste particles will be kept from entering the vent by the use of an aggregate filter pack. The aggregate will be IDOT CA-1 without fines. Aggregate will not be a calcareous material susceptible to reduction in a relatively basic environment.

Annular Space Seal: The seal of the annular space around the vent casing is designed to block potential surface water infiltration from the annular space and deter animal intrusion. The seal will be made of a bentonite product, such as Hole Plug ™ manufactured by Baroid. Bentonite products have been shown to be effective and resilient as sealants at landfills because they have a very low hydraulic conductivity that minimizes air intrusion, are flexible to accommodate settlement, and will reseal if there is moisture loss and then reabsorption. The seal will extend from the elevation of the future geomembrane layer down to two feet below the geomembrane elevation.

Vent Protection: Because the vents will be installed before the new cover system is constructed, the vent casings will be protected above ground using temporary concrete barriers, such as a "Jersey barrier", a 3-ft diameter section of reinforced concrete pipe, or approved equivalent. The temporary barrier will be stabilized by gravity and will not be anchored into the cover system using a drilled pier or driven pile. The temporary barrier will be removed by the cover contractor to finish cover construction.

Summary of Vent Design: **Table B-3-2** in **Appendix B** presents the dimensions/depths of the vent features such as depths of boreholes, lengths of perforations, etc. based on the above design criteria.

5. REMEDIAL CONSTRUCTION WORK PLAN

5.1 Overview

The construction work activities are summarized in this Section 5. Design details are addressed in Section 4 of this RAWP.

5.2 Contractor Selection and Mobilization

Request for bids (RFB) will be issued to three bidders. The bidders shall all have been prequalified for the work and will have worked for BFINA under standard terms and conditions. The RFB documents will include:

- Invitation to Bid
- Instructions to Bidders
- Description of the Work
- Bid Form
- Agreement
- Terms and Conditions
- Measurement and Payment Specification
- Remedial Action Work Plan

Bids will be received, evaluated and a Contractor will be selected by BFINA.

The Contractor will be asked to mobilize within three weeks of notification of award. The work will be conducted from a mobile field office which can include a trailer, sports utility vehicle or van.

Storage of materials and equipment may be in mobile trailers, semi-truck trailers, or other shelters/equipment suitable to protect the equipment and provide shelter for workers. Suitable equipment/shelters will be required to protect materials in accordance with manufacture's specifications and in accordance with specified project requirements. The Contractor shall choose the method of storage for equipment and materials based on the following requirements unless otherwise approved by BFINA or its designee:

- All materials shall be stored in accordance with manufacturer's storage requirements;

- Storage area(s) shall be easily accessible and shall not be located near any seeps;
- Storage area(s) shall not be located on slopes steeper than 10%; and
- Storage area(s) shall be clear of dual phase gas well, gas vent, leachate collection trench and future perforated gas pipes, and trench for IDW and shall not interfere with construction of these features.

5.3 Installation of Vents

The vents will be constructed on slopes ranging from 10 horizontal (H): 1 vertical (V) to 4H: 1V. Consequently, the area around the drilling location will need to be leveled by the Contractor using backfill, such as clay, from the site to provide a stable subgrade for drilling. Should additional support be necessary for the specific drilling equipment, the Contractor shall provide the support to maintain a stable subgrade for drilling.

If a leveling pad is to be constructed, the Contractor shall install silt fencing along the downstream perimeter in accordance with the Illinois Urban Manual Standard Drawings IL 620A and 620B to control erosion around the work area. The silt fencing shall be inspected weekly and modification and maintenance shall be completed and documented. After drilling, the leveling pad/work area will be spread with topsoil and vegetated with suitable grass seed and straw mulch.

The boreholes will be advanced using a drill rig capable of drilling a 24-inch diameter borehole without the addition of water or drilling mud to maintain borehole stability. Cuttings will be managed as investigation derived waste (IDW) in accordance with Section 5.6 of this RAWP.

5.4 Installation of Wells

The wells will be constructed on relatively flat (approximately 3%) slopes. Consequently, access to the drilling location is expected to be done without any additional support of the subgrade or addition of a roadway. Should additional support be necessary for the specific drilling equipment, the Contractor shall provide the support to maintain a stable subgrade for drilling.

The boreholes will be advanced using a drill rig capable of drilling a 36-inch diameter borehole without the addition of water or drilling mud to maintain borehole stability. Cuttings will be managed as IDW in accordance with Section 5.6 of this RAWP.

5.5 Abandonment of Old Gas Vents

Two gas vents are shown on Figure 4 contained in the "Construction Activities Interim Remedial Measures Final Construction Report", MIG/DeWane Landfill, Belvidere, Illinois, (Golder 1993). This figure is presented as **Figure B-1** in **Appendix B** of this RAWP. The Golder report states that the tops of the original vents were extended upward to above the IRM cover. However, these two vents could not be located during the existing conditions survey conducted in 2006 by Geosyntec. If the old vents exist, they could cause future damage to the geomembrane if the cover were to settle such that the vents puncutured the cover system. Consequently, additional work will be undertaken to locate and abandon the vents.

First, a field reconnaissance will be conducted to see if the vents are visible at the ground surface. If they are found their location will be located and put on the Existing Conditions Drawing 2A. If the vents are not found, the following will be completed.

- The "Final Feasibility Study" (Clayton, 1999) documents will be examined to locate the wells and also to identify whether they were previously abandoned and if so, the method of abandonment.
- If the old gas vents are found on the historical documents and they have not been abandoned, lay out the locations by land survey on the existing cover.
- Through the use of hand shovel excavation, attempt to locate the vents. If the vents are located, flag the locations using a 6-ft long wooden stake and locate by land survey or geographical positioning system (GPS).

Once the vents are located they will be abandoned/closed. The Contractor shall over drill the gas vents with the 24-inch diameter auger or bucket used to install the new gas vents and remove the top 6 ft of the gas vent casings. All cuttings will be managed as IDW in accordance with this RAWP.

The vent casing that remains in the subsurface will be backfilled with sand if it can be located. The open borehole above the remaining vent casing will be backfilled with soil to within three feet of the ground surface. The next 2.5 feet of the borehole shall be backfilled with Hole Plug ™ or equivalent bentonite seal installed in four lifts; each lift will be hydrated prior to placement of the subsequent lift. The top of the borehole will be covered with six inches of topsoil and vegetated.

The work will be documented on field forms used for the abandonment of wells.

5.6 Management of Investigation Derived Waste

Waste derived from the installation of the wells and vents will remain on site. It is estimated that approximately 300 cuyds of IDW may be derived from waste cuttings during drilling.

During drilling, the IDW will be collected and placed directly into skip buckets or rolloff containers at the drilling location and temporarily covered with a tarp at the end of the day. A containment berm or similar feature will be placed around the work area to contain any spillage of leachate. Any waste materials that are spilled will be cleaned up and put in the containers to avoid potential for contamination of the existing cover materials which are planned to be reused in the final cover system.

In prepartion for consolidation of the IDW below the existing cover, trenches will be excavated through the existing topsoil and 2-ft thick IRM cover and into the IRM clay soil backfill placed on the top of the landfill to fill in the depressions that existed before 1992. The topsoil and clay soil that will be removed were from off site and were not impacted from the waste at the site; consequently, the materials may be reused in the final cover.

The topsoil shall be segregated for later reuse. The subsequent underlying IRM clay fill shall also be segregated for later use to: 1) construct working pads to level the drill rigs on the side slopes, 2) reconstruct the IRM 2-ft thick, minimum, cover, or 3) stockpile for later use to construct the soil cover.

Should evidence of site impacts (staining, chemical odor, trash, sludge, etc.) be observed in the IRM clay fill, the impacted materials shall be segregated and covered with six inches of clean daily cover or tarp and sloped to drain. It shall be later incorporated into the IDW trenches along with IDW drill cuttings.

Trenches will be excavated to depths of 5 to 10 feet. The trenches shall not be located in areas where contaiminated soils were placed in 1992 as shown on **Figure B-1** in **Appendix B.** Borings completed on the top of the landfill in late 2006 confirmed the thickness of clay backfill on the top deck (the relatively flat area of the cover) of the landfill ranged from 13 to 19.5 ft as depicted on **Figure B-2**, which is the marked-up Drawing 2A "Existing Conditions"), included in **Appendix B**. Consequently, the waste below the existing clay cover and backfill soils should not be disturbed.

The accumulated waste will be periodically moved to the top of the landfill and put into one or more trenches. The side slopes of the trenches will be sloped back as necessary to maintain a safe trench excavation in accordance with OSHA.

The waste in the trench(es) will then be covered by the end of the day by a minimum of ½ ft of daily soil cover.

When the trench approaches capacity, the top of the waste will be covered by a minimum of a 2.5-ft thick final clay cover, 0.5 ft of topsoil and reseeded. The final clay cover over the waste will meet the design criteria of the IRM compacted clay barrier- a maximum hydraulic conductivity of 1×10^{-7} cm/sec. Prior to construction, the optimum moisture and moisture content of the clay to be used for the final clay cover shall be determined using ASTM D-698. A sample of the soil shall be compacted in the laboratory to 95% of the optimum dry density and from 0 to +3% of optimum moisture content and the hydraulic conductivity shall be measured in accordance with ASTM D 5084 to confirm the soil will meet the 1×10^{-7} cm/sec criterion. During construction, in-place density and water content of the final clay cover soil shall be measured in accordance with the CQA Plan as outlined in Section 8.

required because the soils used in the original IRM cover were already tested and will be reused.

The Contractor shall install silt fencing along the downstream perimeter of the work area in accordance with the Illinois Urban Manual Standard Drawings IL 620A and 620B to control erosion around the work area. The silt fencing shall be inspected weekly and modifications and maintenance shall be completed and documented. After backfilling and covering the area, the surface will be covered with topsoil and vegetated with suitable grass seed and straw mulch.

5.7 Surveying

The Contractor shall be responsible for all surveying to complete the work. The locations and constructed features of each installed vent and well, the location of IDW and overlying ground surface, the locations of the two abandoned vents, will be established by land surveying methods and requirements consistent with Section 7.5 of this RAWP. Record drawings shall be prepared by the Contractor to document all of the work and submitted to the CQA Certifying Engineer within 15 days after completion of the construction work.

5.8 Monthly Progress Reports

Monthly Progress Reports (MPRs) will be prepared by the BFINA Project Coordinator or designee. The MPRs will address the following:

- status of the work and progress to date;

- percentage of the work completed and status of the schedule;
- difficulties encountered and corrective actions to be taken;
- activities in progress;
- activities planned for the next reporting period;
- changes in key personnel; and
- community relations plan support activities.

The MPRs will be submitted to the following:

Ricky Lanham - Illinois Environmental Protection Agency (IEPA)
Howard Caine – U.S. EPA Remedial Project Manager
Lisa Harrison – CDM, consultant to IEPA
Eric Ballenger - BFINA (Allied Waste Industries)
Cash Out Generator Settling Defendants:
Steven Kohl (Warner Norcross & Judd)
John L. Greenthal
Kathleen McFadden (United Technologies Corporation)

A contact list is presented in included in the RDWP.

5.9 Construction Completion Report

The results of the pre-design field work will be presented in a "Construction Completion Report" that will include the following:

- summary of work;
- results of inspection, testing and monitoring;
- description of deviations, if any, from the RAWP;
- plan drawing showing the as built locations of the wells and vents;
- documentation such as well and vent completion reports and borehole logs;
- vent abandonment records;
- tabular summary of monitoring results; and
- certification statement by the CQA Certifying Engineer that the work was completed in accordance with the RAWP.

6. CONSTRUCTION HEALTH AND SAFETY

The Construction Health and Safety Plan (CHASP) in **Appendix C** provides the details of the health and safety practices for the work.

In summary, the gas wells and vents will be installed by drilling through the landfill. However, the abandonment of the two gas vents should not require drilling in waste because they are located in the top deck area where the clay soil is deeper than the planned drilling depth.

Because the waste in the landfill was reported to be solid (municipal) and hazardous waste, the drilling of gas vent and well boreholes will be conducted using Level B (supplied air) personal protective equipment (PPE) to provide appropriate level of safety for personnel that accounts for the potential for encountering hazardous waste constituents. Air monitoring will be conducted during the drilling to monitor the breathing zone from both the borehole and from drill cuttings/waste area. Based on the monitoring results during drilling at each location, a decision will be made whether downgrading to Level C or D is appropriate at each location during well or vent installation.

Management of the cuttings (investigation derived waste = "IDW") will be conducted using appropriate PPE. In general, management of IDW will be to place the IDW into trenches excavated through the existing cover and within the soil backfill on the top deck of the landfill. The IDW will then be covered with daily cover and the IRM cover soil or tarps on a daily basis. At this time, it is expected that the management of IDW can be conducted using Level D PPE as the cuttings will be in the open atmosphere and the constituents of concern will not exceed health and safety criteria.

An exclusion zone will be created around each work (borehole or IDW management areas) location. Personal decontamination and removal of major contaminated materials from drilling equipment will occur at the exclusion zone at each location of drilling. Any spillage of IDW or potentially contaminated materials will be removed and placed into roll-off or other containers at the location of drilling and later managed as IDW.

Decontamination of equipment will be conducted at the existing ashpalt lined decontamination pad in the southwest area of the site. The decontamination liquids from the decontamination pad will be periodically removed and placed into the existing leachate pond on the east side of the site. Solids will be removed and managed as IDW.

7. SCHEDULE

The construction work is planned to begin in September and be completed by the end of November 2008. The Project Schedule is dependent upon receipt of comments and approvals from IEPA, BFINA responses, final approval and the schedule in the selected Contractor's bid.

Geosyntec has assumed a two (2) calendar week period to receive IEPA comments on deliverables and two (2) calendar weeks for BFINA to respond. The schedule will be periodically updated, as necessary.

The Construction Completion Report will be submitted to the IEPA for review and comment 45 days after completion of construction.

8. CONSTRUCTION QUALITY ASSURANCE

8.1 Purpose

This Section 8 provides a Construction Quality Assurance Plan (CQAP) that is appropriate for the scope of gas well and vent construction work. This CQAP establishes the quality-assurance monitoring and documentation procedures that will be used during construction of the wells and vents MIG/DeWane Landfill Superfund Site (Site).

The CQAP is a site-specific document which addresses the following: (i) monitoring and testing activities that will be performed during implementation of this portion of the remedy; (ii) CQA personnel responsibilities and authorities; and (iii) CQA meetings and documentation requirements.

The construction quality assurance (CQA) program set forth in this document shall be used by a third-party consultant, independent from the Contractor, to verify that the RA is constructed in accordance with the Final Design, and thus, achieves the applicable performance standards. Construction monitoring and documentation will be performed for installation of the wells and vents as described in this RAWP, including the Final Design documents included in this RAWP.

8.2 Construction Quality Assurance Inspections and Monitoring

The following construction inspections and monitoring will be conducted during the well and vent construction and the results will be incorporated into the Final Design of the landfill:

- record well/vent number, location, date started and date completed;
- record the borehole stratigraphy, including material characteristics and thicknesses of topsoil, clay cover soil, and subsoil, the general waste characterization and thickness;
- record the depth where water/leachate is first encountered during drilling and immediately after completion of drilling in each borehole;
- monitor methane concentrations at the top of the borehole at several depths, including at 5 ft, 10, ft, 20 ft and at borehole completion, using the methane monitoring equipment and procedures in **Appendix C**, Construction Health and Safety Plan;
- measure water/leachate levels in the constructed wells and vents approximately one day and one week after casing installation;

- observe the rotation of the turbines after completion of installation and at several occasions thereafter during differing weather conditions (such as calm, windy, hot and cold);
- measure methane, oxygen and carbon dioxide in the sample port approximately one day and one week after completion of installation;
- measure the gas probes around the landfill for methane, pressure, oxygen and carbon dioxide in accordance with Illinois Title 35 Part 811 Sections 311 and 312 one month after completion of installation and continuing on a quarterly basis.

Inspections of construction materials and depths for construction quality assurance will be as follows:

- well casing material details (diameter, schedule, length of perforations, end cap, joining method, etc.);
- dimensions of perforations and depths/lengths of perforated and solid casing;
- gravel pack description and depths;
- geotextile separator donut above the gravel pack;
- bentonite seal; and
- surface stickup, location of sample port and installation of the turbine ventilators.

The following construction inspections and monitoring will be conducted prior to and during excavation/construction of the IDW trenches and the results will be recorded:

- prior to construction of trenches, obtain one soil sample from the clay cover soil where the trench will be excavated and send to soils laboratory (following the selected laboratory's chain of custody procedure) to perform the following index and engineering property tests:
    - Sieve and hydrometer tests based on ASTM D422;
    - Atterberg limit test based on ASTM D4318;
    - Unified soil classification based on ASTM D2487;
    - Standard Proctor test based on ASTM D698; and
    - Hydraulic conductivity test based on ASTM D5084 at optimum moisture content and 95% maximum dry density.

- during excavation, observe soil excavation and: a) inform the Contractor when to stop excavation to avoid removal of the underlying waste, b) indicate to the Contractor those materials that are not suitable for reuse in the final cover, and c) observe stockpiling and later relocation of the soils back into the IDW trenches or revegetation of unused soil stockpiles.
- during construction of clay cover soil, the following protocol shall be followed:
    - clay cover soil shall be compacted to 95% of the optimum dry density and to 0 to +3% of optimum moisture content;
    - clay cover soil shall be placed in no more than 10-inch-thick lifts and lift thicknesses shall be determined by visual observation and compacted with a pad-foot compactor; and
    - in-place density and water content of the clay cover shall be measured at a minimum of one location per acre per lift in a location determined by the CQA personnel in accordance with ASTM D6938 (nuclear densitometer method).

Monitoring for health and safety purposes is described in the attached Construction Health and Safety Plan.

8.3 Project Personnel Responsibilities and Authorities

8.3.1 Organization of Personnel

The project organization chart for well and vent construction is provided in **Figure 8.1**. The duties, responsibilities, and authorities of the entities and personnel positions identified in these figures as they relate to the CQA program are described below.

As shown on **Figure 8.1**, in some cases the individual names and their affiliations of the project personnel are not identified. An updated project personnel organization chart that names the responsible individuals and their affiliation will be issued to Illinois EPA by BFINA after completion of the bidding process.

8.3.2 BFINA

BFINA will contract with the Contractor for implementation of the remedy, the CQA Consultant to implement the CQA program. BFINA has designated Eric Ballenger as the Project Coordinator to serve as the primary point of contact and to act as construction manager/Owner's representative during the project.

8.3.3 Regulatory Agencies

Regulatory agencies providing oversight for this project are the Illinois Environmental Protection Agency (IEPA), the lead agency, and the United States Environmental Protection Agency (U.S. EPA) Region V. Additionally, Illinois EPA has contracted with CDM to serve as their technical representative during implementation of the RA. These agencies and their designated representatives (identified on **Figure 8.1**) will provide regulatory oversight on this phase of the project. Project deliverables (e.g., progress reports, construction completion report, etc.) will be submitted to Illinois EPA and its technical representative and U.S. EPA to for their review and approval as described subsequently in this CQAP.

8.3.4 CQA Consultant

The CQA Consultant will be an independent, third-party engineering firm that contracts with BFINA to implement the CQA program described in this document. Specific responsibilities of the CQA personnel are described in the remainder of this section of the CQAP.

Geosyntec Consultants of Chicago, Illinois has been designated as the CQA Consultant.

8.3.5 Well and Vent Construction Contractor

The Well and Vent Construction Contractor ("Contractor") will be the company that contracts with BFINA to implement this construction phase of the project. The scope of the Contractor's activities is to construct and perform the work to satisfy the approved Final Design, as set forth in this RAWP. The Contractor shall be named after completion of a competitive bidding process.

8.3.6 CQA Certifying Engineer

The CQA Certifying Engineer will serve as the lead quality assurance official on the project. John Seymour, P.E., of Geosyntec Consultants of Chicago, Illinois has been designated as the CQA Certifying Engineer. As such, the CQA program will be directed and supervised by the CQA Certifying Engineer. Mr. Seymour will be directly accessible to BFINA and CQA personnel for technical direction during construction. The CQA Certifying Engineer is a registered Professional Engineer (Civil) in the State of Illinois. The responsibilities and duties of the CQA Certifying Engineer include the following:

- be familiar with the design calculations used to develop the Final Design;

- review conformance of material and construction to verify compliance with the intent of the requirements of the Final Design;
- be familiar with other site-specific documentation, including the Contractor's bid;
- conduct periodic site inspections;
- attend the meetings described in this CQAP;
- administer the CQA program (i.e., assign and manage CQA personnel, review field reports, and provide engineering review of CQA related issues);
- oversee the ongoing preparation of as-built drawings by the Contractor;
- review and approve the CQA Surveyor's work products; and
- preparation of the Construction Completion Report.

8.3.7 CQA Site Manager

The CQA Site Manager will report to the CQA Certifying Engineer and will supervise and direct the day-to-day CQA activities on the project. The CQA Site Manager will be provided by Geosyntec Consultants. The CQA Site Manager will interact on a frequent basis with the CQA Certifying Engineer and will have authority over the CQA personnel. The CQA Site Manager will also serve as the point of contact and oversee the work of the CQA Surveyor. The CQA Site Manager must have on-site field CQA work experience on previous landfill projects. The responsibilities and duties of the CQA Site Manager include the following:

- be familiar with the basic concepts used to develop the Final Design;
- evaluate the conformance of material and construction to verify compliance with the intent of the requirements of the Final Design;
- be familiar with other site-specific documentation, including the Contractor's bid;
- attend the meetings described in this CQAP;
- direct and supervise daily CQA activities (e.g., assign and manage CQA personnel, review field reports, and interact with the RA Contractor and the CQA Certifying Engineer on a frequent basis);

- coordinate and supervise preparation of CQA documentation by select CQA technicians, and maintain the on-site documentation in a neat and organized manner;
- coordinate with the CQA Soils Testing Laboratory;
- oversee the ongoing preparation of as-built drawings by the Contractor;
- review the CQA Surveyor's work products;
- prepare a daily activity report to document the work conducted; and
- assist in preparation of the Construction Completion Report.

The CQA Site Manager will be named prior to the preconstruction meeting.

8.3.8 Construction Quality Assurance Technician(s)

CQA Technicians will be responsible for on-site CQA activities. The CQA Technicians will be provided by Geosyntec Consultants. The general duties of CQA Technicians will include the following:

- be familiar with the CQA requirements for the project;
- perform daily CQA activities;
- attend CQA-related meetings discussed in this CQAP;
- verify the calibration and condition of on-site CQA and monitoring equipment;
- assign locations for testing and sampling;
- coordinate collection and shipping of laboratory test samples;
- prepare CQA daily field reports that include descriptions of the construction progress and any relevant observations;
- provide daily field reports and logs to the CQA Certifying Engineer upon request;
- report any unresolved deviations from the Final Design to the CQA Certifying Engineer;
- assist in preparing the Construction Completion Report;

- verify that erosion and sediment controls are in place and performing properly; and
- monitor management of IDW.

8.3.9 Soils Construction Quality Assurance Testing Laboratory

The Soils CQA Testing Laboratory will be a geotechnical testing laboratory firm that has experience in the physical testing of soils and is familiar with, and properly equipped to perform the geotechnical testing required by the CQAP. The Soils CQA Testing Laboratory may be a subcontractor to the CQA Consultant, or may be performed in-house by a laboratory-testing division of the CQA Consultant. Soils CQA Testing Laboratory personnel will report to the CQA Site Manager, who will direct the laboratory personnel on the CQA testing requirements (methods, workload, deadlines, test results, etc.).

8.3.10 Construction Quality Assurance Surveyor

A CQA Surveyor, contracted by the CQA Consultant will provide survey data to verify the Contractor's work and spot-verify as-built documentation. The CQA Surveyor will report directly to the CQA Certifying Engineer. Responsibilities of the CQA Surveyor will include spot-checking of locations of key features, and providing quality assurance of Record Drawings.

The duties of the CQA Surveyor are for verification and do not lessen the responsibility of the Contractor to provide his own surveying to layout, control, and document the work. The Contractor is required to meet the surveying and as-built drawing requirements.

8.4 Meetings

8.4.1 Pre-Construction Meeting

Prior to initiating construction activities at the site, requirements set forth in the Final Design for the project will be addressed in a Pre-Construction meeting. At a minimum, the meeting will be attended by the Contractor, the CQA Certifying Engineer, the CQA Surveyor, and representatives of BFINA. The meeting also may be attended by select CQA personnel and by Illinois EPA and U.S. EPA representatives.

The purpose of this meeting is to begin planning for coordination of tasks, to present the schedule and sequence of work, to discuss anticipated problems that might cause

difficulties and delays in construction, and present the procedures for clarifications and changes to the Final Design.

The Pre-Construction meeting should include discussion of the following activities:

- review the responsibilities of each party;
- confirm the lines of authority and communication, and update/finalize project personnel organization charts;
- distribute relevant documents to all parties;
- review critical design details of the project;
- address approved modifications to the CQAP;
- establish an understanding by the parties of the CQAP procedures;
- establish work area security and safety protocol in accordance with the Contractor's health and safety plan for RD/RA remedy;
- Confirm health and safety certification for all on-Site personnel;
- describe IDW waste management and soil borrow source locations;
- confirm the methods for documenting and reporting, and for distributing documents and reports; and
- confirm acceptance and approval process for task completion prior to schedule sequence advancement.

Items discussed during the Pre-Construction meeting will be documented by a person designated at the beginning of the meeting, and minutes will be distributed within 10 days of the meeting.

8.4.2 Progress Meetings

A bi-weekly progress meeting (via teleconference and/or at the site) will be held every two weeks during construction between the CQA Certifying Engineer, CQA Site Manager, the Contractor, and BFINA or its designee. Current progress, planned activities for the upcoming two weeks, and any new business or revisions to the work will be discussed at this meeting. The CQA Certifying Engineer will document in the meeting minutes any problems, decisions, or questions arising at this meeting. Any

matters requiring action which are raised in this meeting will be reported to the appropriate parties. Minutes of weekly progress meetings will be distributed to each party present at the meeting within five working days.

Daily progress meetings will be held between the CQA Site Manager and the Contractor prior to the start of work or following the completion of work. The purpose of these meetings will be to review the previous day's activities, review the upcoming day's activities and identify any needs or potential construction problems. Major items discussed during these meetings will be documented in the CQA personnel's daily field reports.

8.4.3 Problem or Work Deficiency Meetings

Special meetings will be held by the CQA Certifying Engineer when and if problems or deficiencies are present or judged likely to occur. At a minimum, these meetings will be attended by the Contractor, BFINA or its designee, and the CQA Certifying Engineer. The Designer will participate if needed. The purpose of these meetings will be to define and resolve the problem or work deficiency as follows:

- define and discuss the problem or deficiency;
- review alternative solutions; and
- implement an action plan to resolve the problem or deficiency.

Items discussed during these meetings will be documented by the CQA Certifying Engineer, and if deemed necessary by the CQA Certifying Engineer, minutes will be transmitted to affected parties.

8.4.4 Daily Health and Safety "Tailgate" Meetings

A tailgate meeting will be conducted prior to work each day to discuss the expected work to be conducted, identify any changes in procedures, review safety protocols and precautions specific to the work to be performed. The meeting will be documented in the daily report.

8.5 CQA Surveying

CQA surveying will be conducted on a periodic basis during construction to independently verify the work of the Contractor's Surveyor. The CQA Surveyor will be responsible for verifying select aspects of the Contractor's work, and for quality

assurance of the Contractor's Surveyor's Record Drawings for inclusion in the Construction Completion Report.

8.5.1 Surveying Personnel

CQA Surveying will be performed under the direct supervision of a registered Land Surveyor licensed in the State of Illinois. The survey crew will consist of the senior surveyor and as many surveying assistants as required to satisfactorily perform the work. Personnel will be experienced in all aspects of surveying, including detailed, accurate documentation and generation of Record Drawings.

8.5.2 Precision and Accuracy

The survey instruments used by the CQA Surveyor will be sufficiently precise and accurate to meet the needs of the project as defined in the Specifications. Survey instruments will be capable of reading to a precision of 0.01 ft and with a setting accuracy of 10 seconds. Calibration certificates for survey instruments will be submitted on request to the CQA Certifying Engineer prior to the initiating CQA surveying activities at the site.

It will be the responsibility of the CQA Site Manager to coordinate the CQA surveying work such that areas are promptly surveyed, interim results are reviewed, and approval is granted for the Contractor to proceed with subsequent work in the areas.

8.5.3 Surveying Documentation

Original field CQA survey notes and electronic data files will be retained by the Senior CQA Surveyor. Interim survey information will be provided to CQA personnel in tabular or electronic format at the end of each day of surveying or at the end of a given surveying task, as requested by CQA personnel. CQA personnel may also request that the CQA Surveyor periodically verify partial/draft record drawings for a given project component.

8.5.4 Record Drawings

The CQA Surveyor shall verify the following information on the Record Drawings, provided by the Contractor, for inclusion in the Construction Completion Report:

- locations and existing ground surface of all wells and vents constructed;
- depths and elevations of all materials (solid and slotted casing, aggregate, bentonite seals, sample ports, turbine vents, etc.) placed; and

- locations of the IDW and the cover grades;

The final Record Drawings will be submitted to the CQA Site Manager within 15 days of completion of the vent and wells installations. The CQA Surveyor shall then provide quality assurance on the Contractor's Record Drawing prior to inclusion into the Construction Completion Report.

8.6 CQA Documentation

The CQA Site Manager will provide a daily activities report. The report will include:

- weather;
- personnel and equipment on Site;
- activities conducted; and
- work hours;

The CQA Certifying Engineer will prepare a "Construction Completion Report". The report is described in Section 5 of this RAWP.

9. PROJECT MANAGEMENT

9.1 Project Construction Team - Roles & Responsibilties

The Project Remedial Action Team is depicted in the attached organization chart (Figure 8.1). The roles and responsibilities are summarized as follows:

IEPA Project Coordinator- Ricky Lanham. Mr. Lanham will be the primary point of contact representing the IEPA. Mr. Lanham will coordinate work with BFINA and its Supervising Contractor and coordinate work completed under the community relations plan. IEPA's Project Coordinator (and Alternate Project Coordinator) shall have the authority lawfully vested in a Remedial Project Manager (RPM) and an On-Scene Coordinator (OSC) by the National Contingency Plan, 40 C.F.R. Part 300. In addition, IEPA's Project Coordinator (or Alternate Project Coordinator) shall have authority, consistent with the National Contingency Plan, to halt any Work required by the CD and to take any necessary response action when s/he determines that conditions at the Site constitute an emergency situation or may present an immediate threat-to public health or welfare or the environment due to release or threatened release of Waste Material.[2] IEPA's Alternate Project Coordinator will be specified by IEPA.

BFINA Project Coordinator- BFINA. Eric Ballenger. Mr. Ballenger will be the primary point of contact representing BFINA. Eric Ballenger may designate certain aspects of the work to the Supervising Contractor. BFINA's Alternate Project Coordinator is Victoria Warren.

Contractor- The Contractor will be responsible for the completion of layout, construction work, as-built/record drawing, site security and health and safety. He will report directly to the BFINA Project Coordinator, Eric Ballenger, or his designee. The Contractor shall be named after completion of a competitive bidding process.

Supervising Contractor- Geosyntec Consultants. Geosyntec will be the principal contractor retained by BFINA to supervise and direct the implementation of the Remedial Design and Construction Quality Assurance Work under the CD. Geosyntec's project team is composed of the following key personnel:

> *Project Director* - Scott Luettich, PE. Mr. Luettich will provide overall project direction and support to Geosyntec's project team to evaluate the work is completed in accordance with technical requirements. With 20 years of

[2] The responsibilities of the IEPA Project Coordinator have been obtained from the RD/RA Consent Decree.

engineering experience, Mr. Luettich has completed innovative designs that have added value at several landfills and remedial action projects across the U.S. and in Illinois.

Project Manager - John Seymour, P.E. Mr. Seymour will be BFINA's and IEPA's primary point of contact. He is also the CQA Certifying Engineer. He will manage the project and provide monthly progress reporting to the IEPA in accordance with the SOW. Activities will include coordination of meetings with IEPA, preparation of meeting minutes, and participation in support of community relations. Mr. Seymour has managed five CERCLA RD/RA landfill sites in U.S. EPA Region V, including one in Illinois.

Design Manager - Burak Tanyu, PhD, will be the manager of the final design who will address questions in the field, as necessary. He has eight years experience in geotechnical engineering and five years design and construction engineering experience. He has provided design and field engineering for two landfills undergoing remediation and closure in Illinois. He will report to the CQA Certifying Engineer.

Construction Quality Assurance Site Manager - Rick Skowron is proposed to be the CQA Site Manager at this time. He has 12 years experience including construction oversight of installation of remedial systems at several sites. He is currently the manager of operation and maintenance of the soil gas extraction trench and gas monitoring at the MIG/DeWane Landfill Site. He will report to the CQA Certifying Engineer. If Mr. Skowron is not available for this work, the CQA Site Manager will be named prior to the preconstruction meeting.

9.2 Communications

Communications will include several methods as follows:

- progress meetings;
- monthly progress reports;
- telephone conversation records; and
- e-mail.

Written documentation of communications will be maintained in the project file for significant topics.

The project organization chart (**Figure 8.1**) delineates lines of communications.

9.3 Project Management Controls

Communications for team members will be primarily through the CQA Certifying Engineer, who is also the Geosyntec Project Manager, unless otherwise clarified during the design. Documentation shall be controlled by each person and maintained in central project files.

9.4 Document Control and File Requirements

Documents will be controlled by the Project Manager. Documents will be kept in final hard/paper copy and, as much as possible, electronically, in the project file. The hard copy file and electronic file will have the same folder/section numbering. Final documents issued by the Designer, will be stored in its original form (Microsoft Word, Excel, etc.) and as an image file using Adobe Acrobat. An outline of the project file system is presented in the RDWP.

Documents that are issued to parties outside of the CQA Certifying Engineering and the Designer that contain conclusions or recommendations will undergo a quality assurance or "peer" review. Tables, drawings, and calculations shall undergo a quality control check to ensure accuracy. Documentation of the quality assurance and quality control processes will be retained in the project file with the associated document.

10. COMMUNITY RELATIONS

The IEPA will be primarily responsible for community relations activities at the Site. The community relations program will be integrated closely with RA activities to assist with community understanding of actions being taken and to obtain community input during the RA.

BFINA and its Supervising Contractor/CQA Certifying Engineer will provide assistance to IEPA in its development and implemention of the community relations program. Specifically, BFINA requests to be an active member of the community relations program and volunteers to meet with the public before initiation of different elements of the RD. The community relations activities for the Site will include, but may not be limited to, the following:

1. preparation of a Community Relations Plan ("CRP") will be prepared based on interviews with community representatives and leaders by state agency staff. The CRP will describe the types of information to be provided to the public and outline the opportunities for community comment and input during the RD and RA. Deliverables, schedule, staffing, and budget requirements will be included in the CRP;
2. establishment and maintenance of a community information repository(s), one of which will house a copy of the administrative record;
3. preparation and dissemination of news releases, fact sheets, slide shows, exhibits, and other audio-visual materials designed to apprise the community of current or proposed activities;
4. development and upkeep of a mailing list that includes nearby and interested residents, public interest groups, and elected officials;
5. arrangements of briefings, press conferences, workshops, and public and other informal meetings;
6. analysis of community attitudes toward the proposed RD and RA;
7. assessment of the successes and failures of the community relations program to date; and
8. preparation of reports and participation in public meetings, project review meetings, and other meetings as necessary for the normal progress of the work.

Deliverables and the schedule for the submittal will be identified in the CRP. The CRP will be revised or amended as is determined to be necessary by the IEPA.

11. REFERENCES

"ASTM D 5084 Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter", ASTM, 2003.

"ASTM D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))", ASTM, 2007.

"Construction Activities Interim Remedial Measures Final Construction Report", MIG/DeWane Landfill, Belvidere, Illinois, Golder Associates, March 1993.

"Final Remedial Investigation Report, MIG/DeWane Landfill", Clayton Environmental Consultants, Inc., 11 July 1997.

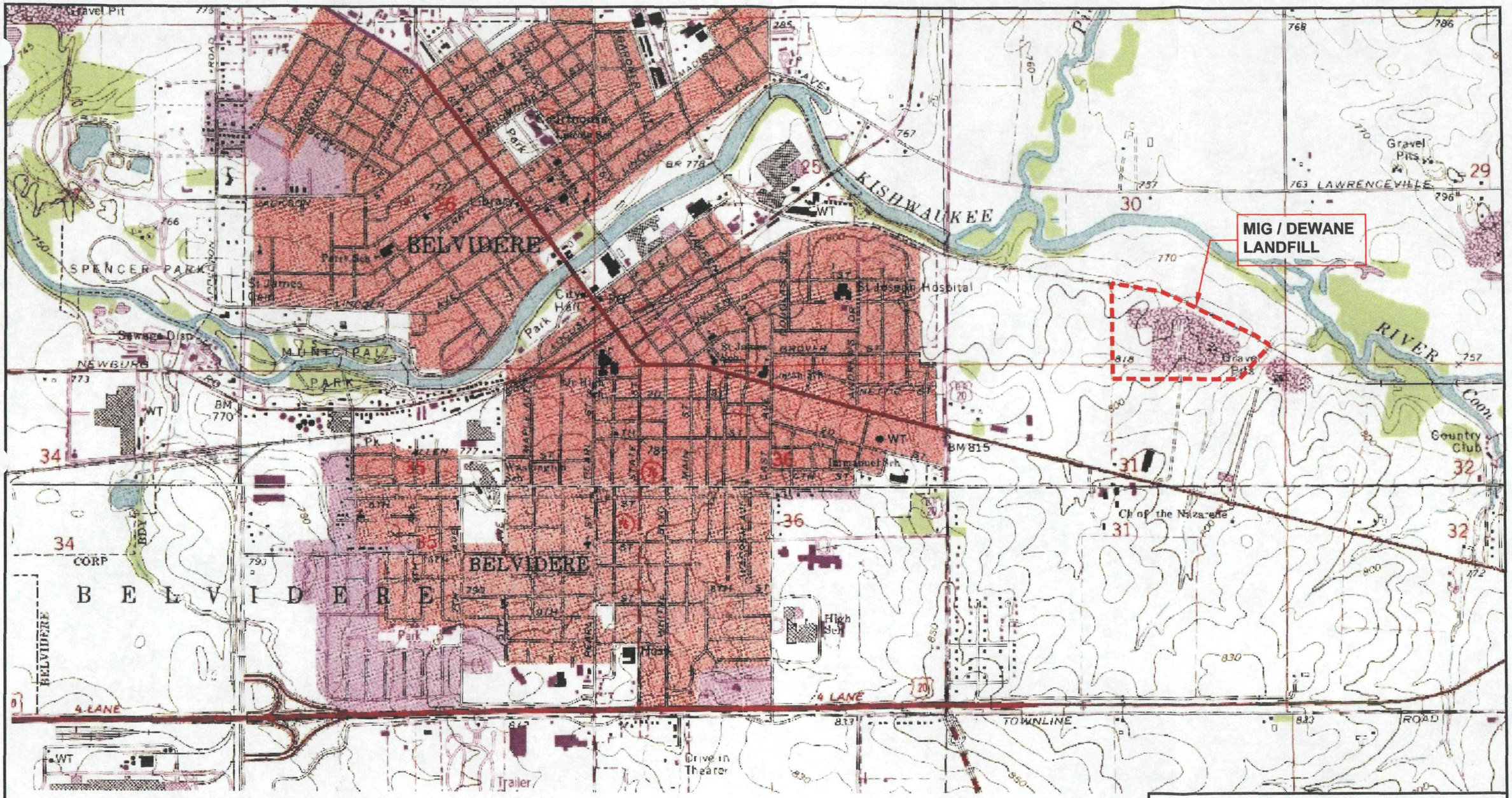
"Final Focused Feasibility Study", MIG/DeWane Landfill, Clayton Environmental Consultants, 1 February, 1999

"RD/RA Consent Decree", MIG/DeWane Landfill Superfund Site, U.S. Environmental Protection Agency, Entered in the U.S. District Court for the Northern District of Illinois, Western Division, 13 March 2006.

"Remedial Design Work Plan", MIG/DeWane Landfill Superfund Site, Geosyntec Consultants, 1 September 2006.

"Preliminary Remedial Design Report", MIG/DeWane Landfill Superfund Site, Geosyntec Consultants, 25 April 2007.

Figures

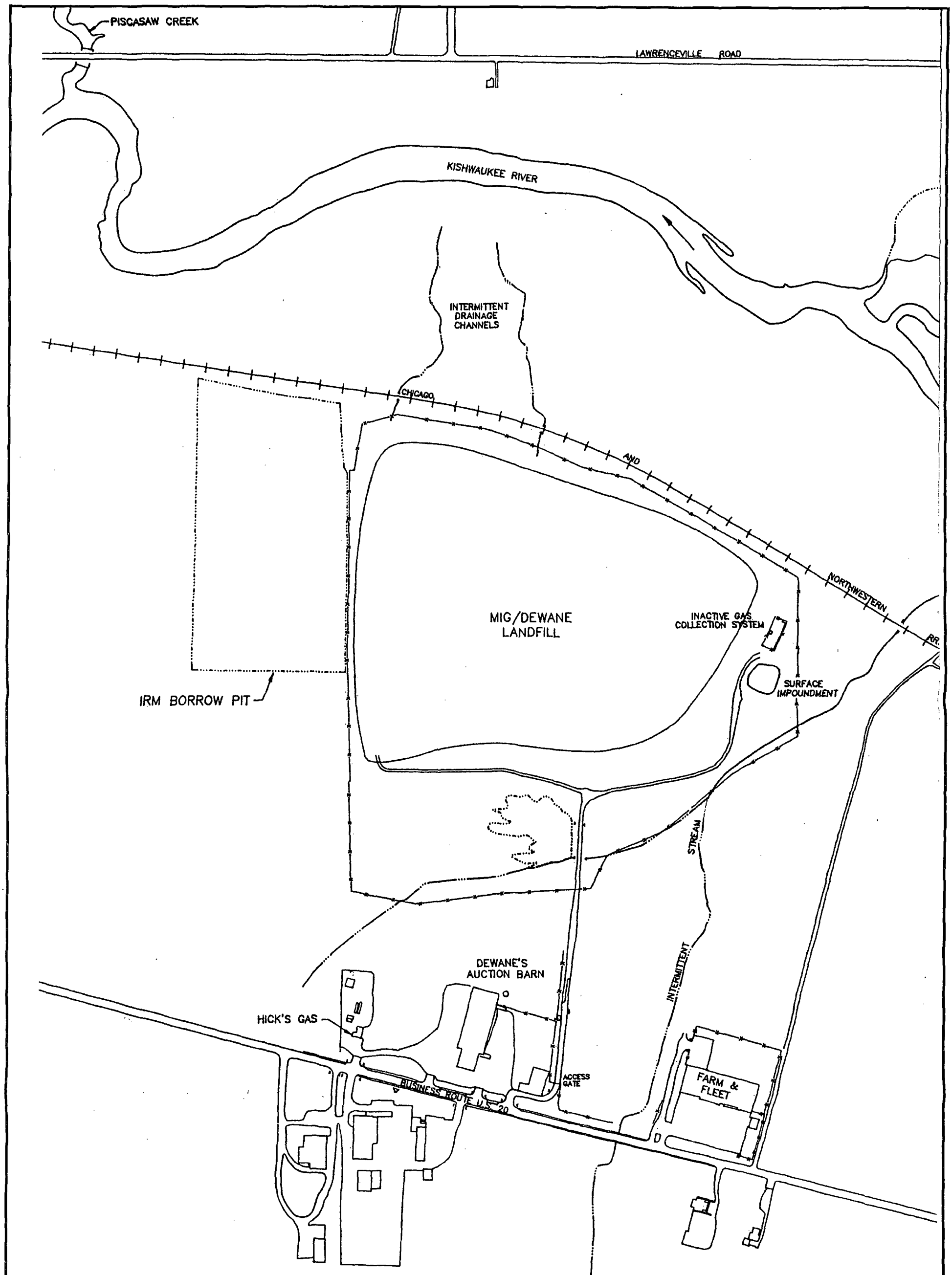


Geosyntec consultants

CHICAGO, ILLINOIS

CLIENT:	ALLIED WASTE INDUSTRIES		
PROJECT:	MIG/DEWANE LANDFILL BELVIDERE, ILLINIOS		
TITLE:	SITE LOCATION		
DRAWN BY:	RCO	CHECK BY:	JPS
PROJECT:	CHE8214	FILENAME:	8214-035
DATE:	25 JULY 2008	FIGURE NUMBER:	2-1

BASE MAP SOURCE: USGS 7.5 MINUTE QUADRANGLE MAPS BELVIDERE NORTH AND BELVIDERE SOUTH



BASE MAP SOURCE: FINAL FOCUSED FEASIBILITY STUDY, CLAYTON (1999)

Geosyntec consultants

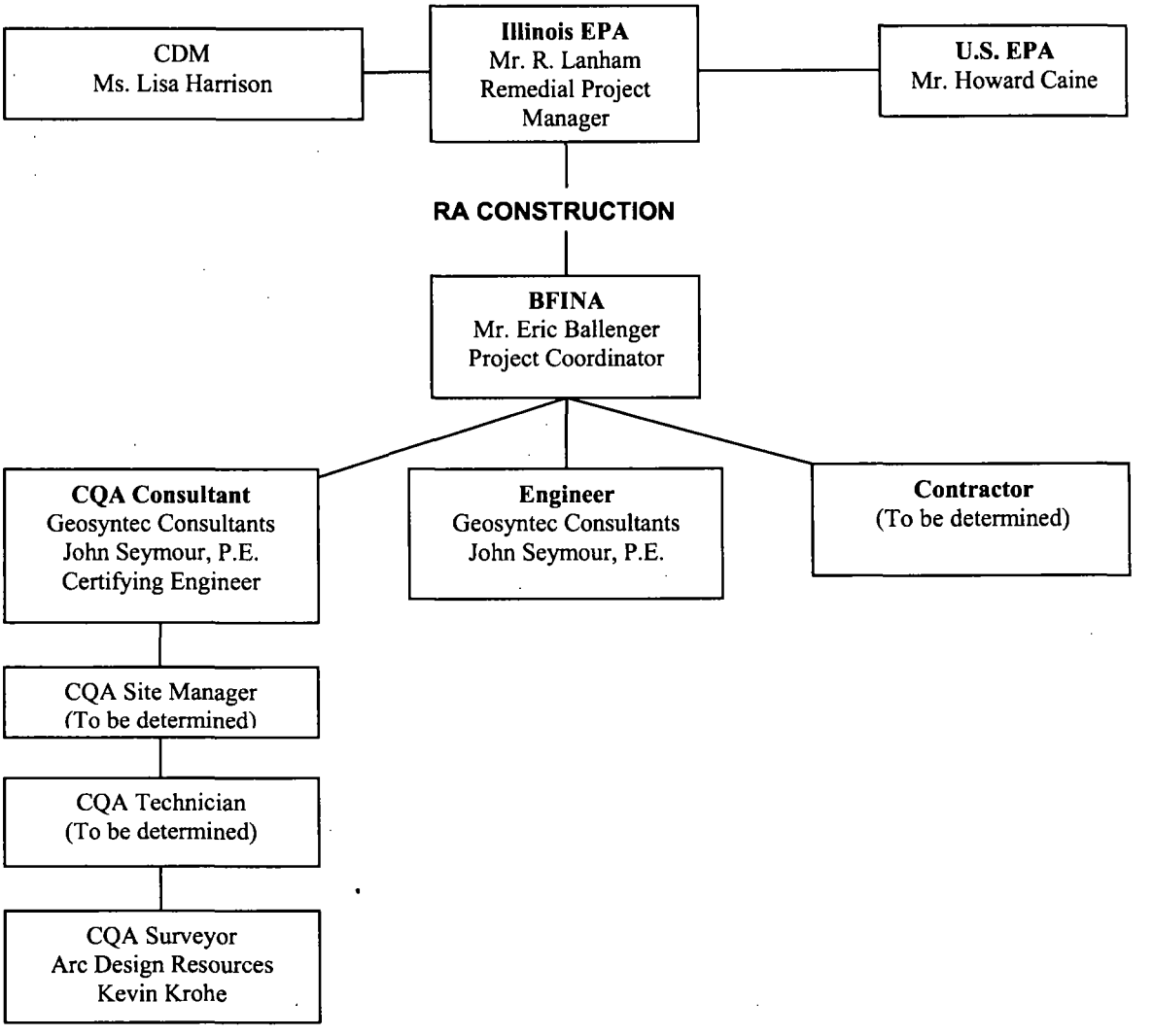
CHICAGO, ILLINOIS

CLIENT:	ALLIED WASTE INDUSTRIES
PROJECT:	MIG/DEWANE LANDFILL BELVIDERE, ILLINIOS
TITLE:	SITE PLAN

DRAWN BY:	RCO	CHECK BY:	JPS
PROJECT:	CHE8214	FILENAME:	8214-034
DATE:	08 MARCH 2007	FIGURE NUMBER:	2-2

Figure 8.1

Project Organization Chart
MIG/DeWane Landfill Superfund Site
Boone County, Belvidere, Illinois



Appendices

APPENDIX A

REMEDIAL DESIGN DRAWINGS:

Drawing 2A: Existing Site Conditions (Sheet 1 of 2)

Drawing 2B: Existing Site Conditions (Sheet 2 of 2)

Drawing 9: Leachate and Gas Collection System plan

Drawing 16: Landfill Gas System Details

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants

55 W. WACKER DRIVE, SUITE 1100
CHICAGO, ILLINOIS 60601 USA
PHONE: 312.658.0500

TITLE: EXISTING CONDITIONS

CLIENT: BFI WASTE SYSTEMS OF NORTH AMERICA, INC.

SITE: MIG/DEWANE LANDFILL
BELVIDERE, IL

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

DESIGN BY: L AVERILL	DATE: FEBRUARY 2007
DRAWN BY:	PROJECT NO.: CHE8214
CHECKED BY:	FILE: 8214-002
REVIEWED BY:	DRAWING NO.:
APPROVED BY:	2A OF 17

7 8

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants

55 W. WACKER DRIVE, SUITE 1100
CHICAGO, ILLINOIS 60601 USA
PHONE: 312.658.0500

TITLE: EXISTING CONDITIONS

CLIENT: BFI WASTE SYSTEMS OF NORTH AMERICA, INC.

SITE: MIG/DEWANE LANDFILL
BELVIDERE, IL

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

DESIGN BY: L AVERILL	DATE: FEBRUARY 2007
DRAWN BY:	PROJECT NO.: CHE8214
CHECKED BY:	FILE: 8214-002
REVIEWED BY:	DRAWING NO.:
APPROVED BY:	2B OF 17

7 8

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REV	DATE	DESCRIPTION	DRN	APP
A	21 JUL 08	REVISED GAS VENT AND WELL LOCATION	BT	JSP

Geosyntec consultants

55 W. WACKER DRIVE, SUITE 1100
CHICAGO, ILLINOIS 60601 USA
PHONE: 312.658.0500

TITLE: LEACHATE AND GAS COLLECTION SYSTEMS PLAN

CLIENT: BFI WASTE SYSTEMS OF NORTH AMERICA, INC.

SITE: MIG/DEWANE LANDFILL
BELVIDERE, IL

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

DESIGN BY:	BA & JPS	DATE:	APRIL 2007
DRAWN BY:	BM	PROJECT NO.:	CHE8214
CHECKED BY:	JPS & BT	FILE:	8214-009
REVIEWED BY:	JPS	DRAWING NO.:	9 OF 17
APPROVED BY:			

7 8

REV	DATE	DESCRIPTION	DRN	APP
1	03-SEPT-08	INCORPORATE AGENCY COMMENTS	DW	JPS

Geosyntec consultants

55 W. WACKER DRIVE, SUITE 1100
CHICAGO, ILLINOIS 60064 USA
PHONE: 312.658.0500

TITLE:

GAS MANAGEMENT SYSTEM DETAILS

PROJECT:

BFI WASTE SYSTEMS NORTH AMERICA, INC.

SITE:

MIG/DEWANE LANDFILL
BELVIDERE, IL

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

DESIGN BY:	BT	DATE:	JULY 2008
DRAWN BY:	DW	PROJECT NO.:	CHE8214
CHECKED BY:	JPS	FILE:	8214-009
REVIEWED BY:	JH	DRAWING NO.:	16 OF 18
APPROVED BY:	JPS		

S
N

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APPENDIX B

GAS WELL AND VENT LAYOUT DESIGN CALCULATIONS

B-1: Landfill Gas Passive Vent System Design Vents and Wells

B-2: Landfill Gas Passive Vent System Design- Trenches

B-3: Layout Tables:

Table B-3-1: Summary of Elevations for Dual Phase Gas System

Table B-3-2: Summary of Elevations for Passive Gas Vents

B-4: Design Figures:

Figure B-1: Location of Contaminated Soils Under Top Deck

Figure B-2: Depth of Clay Soils on Top Deck Area

B-1: Landfill Gas Passive Vent System Design
Vents and Wells

Geosyntec consultants

COMPUTATION COVER SHEET

Client: **BFINA** Project: **MIG/DeWane** Project/ Proposal No.: **CHE8214** Task No. **400/401A**

Title of Computations **Gas Vent and Well Layout**

Computations by:	Signature		7/16/2008
	Printed Name	Jordan Decker/J. Seymour	Date
	Title	Staff Scientist/Associate	15 July 2008
Assumptions and Procedures Checked by: (peer reviewer)	Signature	for Brad Bodine	
	Printed Name	Brad Bodine, PE	Date
	Title	Project Engineer	15 July 2008
Computations Checked by:	Signature		
	Printed Name	Burak F Tanyu, PhD	Date
	Title	Project Engineer	16 July 2008
Computations back checked by: (originator)	Signature	for Brad Bodine	
	Printed Name	Brad Bodine, PE	Date
	Title	Project Engineer	16 July 2008
Approved by: (pm or designate)	Signature		7/16/2008
	Printed Name	John Seymour, PE	Date
	Title	Associate	16 July 2008

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

PASSIVE GAS VENT AND DUAL PHASE GAS WELL LAYOUTS

PURPOSE

The purpose of this calculation package is to lay out the passive gas vents and dual phase gas wells to provide adequate venting of landfill gas to avoid gas pressure build up under the geomembrane cover that could lead to slope instability.

PROPOSED LAYOUT DESIGN

The basic concept of the layout design is to determine the corresponding radius of influence (ROI) at each proposed gas vent location and check that the assembled gas vent layout provides venting for the cover area.

The relevant calculations of the ROI are presented in calculation package titled "Landfill Gas Passive Vent System Design" in Appendix D of the "Preliminary Remedial Design Report" (Geosyntec, 2007), as revised in Technical Memorandum in 14 July 2008. In "Passive gas vent and dual phase gas well layout" calculation package (i.e., this package), the ROI is calculated at different slopes and lengths of perforated casing at a constant diameter for the passive gas vent and dual phase gas well. The calculated ROI for each gas vent varied based upon the cover slope, the gas generation rate, which is also a function of the thickness of unsaturated waste, length of perforated casing, the diameter of the vent, and waste permeability/conductivity to landfill gas. The calculated ROI are presented in the attached excerpted Tables 1 and 2 from the 2007 Geosyntec calculation package, as revised in 2008.

The basic elements of the design that are integrated with the passive gas vent and dual phase gas well layout are as follows:

- Passive gas vents will be a nominal 6-inch diameter casing;
- Dual phase gas wells will be a nominal 8-inch diameter casing;
- The top deck of the landfill will have a 3% slope;
- The side slopes of the landfill will vary from around 10% to nearly 25%;
- The borehole seals for the passive gas vents will extend two feet below the top of the final clay cover (the cover is a minimum of 2-ft thick on the top deck and 1-ft thick on the side slopes);
- The borehole seals for the dual phase gas wells will extend four feet below the top of the final clay cover (the cover is a minimum of 2-ft thick on the top deck and 1-ft thick on the side slopes);

- The length of perforated casing in the unsaturated waste will vary based upon the elevation of leachate and will range from about 2 to 20 ft long;
- The top of the passive gas vent perforated casing will begin 1-ft below the borehole seal;
- The bottom of the passive gas vent perforated casing will extend to 2 ft below the estimated depth of leachate;
- The top of the dual phase gas wells perforated casing will begin 2-ft below the borehole seal;
- The bottom of the dual phase gas well will extend down to 5 ft above the estimated bottom of the waste;
- There will be several perimeter passive leachate drainage trenches that will also passively vent gas;

ASSUMPTIONS/GIVEN

The given data and assumptions made for the layout design are as follows:

1. There will be several perimeter passive leachate drainage trenches that will also passively vent gas; an equivalent width of influence (WOI) of the linear gas vent trenches is calculated to be between 84 and 134 ft for side slopes between 25% and 15% respectively in accordance with 16 July 2008 calculation package titled "Landfill Gas Passive Trench System Design".
2. The ROIs that will be used for the layout are attached on Tables 1 and 2.
3. Hydraulic conductivity of the waste for transmission of landfill gas is the same as that measured in slug tests performed on leachate wells LP-1, LP-2, and LP-3.
4. Hydraulic conductivity (K_{sat}) values at LP-01 through LP-03 can be characterized based on the average values from the test results as summarized below

	Number of Tests	Average Hydraulic Conductivity (cm/s)
LP-01	2	1.4×10^{-3}
LP-02	2	5.1×10^{-4}
LP-03	2	2.0×10^{-3}

5. Leachate elevations can be estimated based on the November 2006 leachate measurements from leachate wells (LW) and leachate piezometers (LP). The estimated leachate elevations at LW and LPs are summarized below:

LW and LP[1]	Elevation of the Top of Casings (ft, msl)	Measured Leachate Depth (ft)	Leachate Elevations (ft, msl)
LW-01	845.21	30.51	814.70
LW-02	843.01	25.00	818.01
LP-01	806.15	2.90	803.25
LP-02	799.71	7.52	792.19
LP-03	800.49	5.63	794.86
LP-04	811.45	8.45	803.00

6. The waste is saturated from the ground surface elevation at the seeps shown on Design Drawing 2A "Existing Conditions" and sloped upward toward the crest of the landfill as shown on Figure A; the leachate elevations were obtained from water level measurements in leachate piezometers near the perimeter of the waste near seeps and near the crest of the landfill.
7. The existing ground surface contour elevations in Drawing 2A of the Preliminary 30% Design Drawings dated April 2007 can be used to estimate the approximate elevations of known leachate seeps (LS) as summarized below:

[1]Locations of LW and LP are shown on Drawing 2A of Preliminary 30% Design Drawings dated February 2007

ID	Ground Elevation (ft, msl)	Nearest Leachate Piezometer
LS-1	793	
LS-2	791	
LS-3	790	LP-2
LS-4	790	LP-2
LS-5	790	LP-2
LS-6	792	
LS-7	792	LP-3
LS-8	793	LP-3
LS-9	793	
LS-10	794	
LS-11	794	
LS-12	795	
LS-13	795	
LS-14	794	
LS-15	793	
LS-16	793	
LS-17	792	
LS-18	791	
LS-19	792	
LS-20	807	LP-4
LS-21	806	
LS-22	788.5	
LS-23	809	
LS-24	780	
LS-25	784	
LS-26	803	LP-1
LS-27	803	LP-1
LS-28	803	LP-1
LS-29	789	LP-1

8. Along much of the north, east and south sides of the landfill, there are seeps. The thickness of unsaturated waste was assumed to be 0 ft where there were seeps (i.e., LS locations). Around the remainder of the landfill perimeter, the 0-ft thickness contour was assumed to be at the edge of waste.

CALCULATIONS

The estimated thickness of unsaturated zone (i.e., cover soil and waste) is shown in thickness isopachs on Figure B.

The ROI for each gas vent is determined based on the slope of the final cover grades and the perforation length of the gas vents. The ROI used for each gas vent is summarized on Tables 3 and 4 for passive gas vent and dual phase gas well respectively and shown on Figure B.

For the purposes of ROI determinations, the slope of the final cover grades is assumed to be 3 on the top deck of the landfill or ranged from 15 to 25% on the side slopes. When compared to the actual slopes of the final cover grades, the slopes are always steeper than the actual slopes (See actual % slope values depicted on Figure B using AutoCADD). This results smaller ROI for the gas vents, which are considered to be conservative.

RESULTS

The details of the design parameters at each vent location are also presented on Tables 3 and 4. Figure B depicts a circle drawn at the ROI at each location demonstrating coverage for passive and dual phase venting. For the perimeter venting trench, the equivalent WOI was approximated to be 90 ft based on the final cover side slopes shown on Figure B. As depicted on Figure B, the WOI is running parallel to the trench, except at the ends where it forms a semi circle.

In several locations there are small areas where the ROI circles did not overlap. However, the Engineer has identified this as accept able because:

- The calculated final cover slopes that were used were larger than the actual slopes, yielding a more conservative (smaller) ROI circle.
- At the ROI circle radius there is gas venting and pressure relief equal to the relief necessary to yield a factor of safety of 1.5 for sliding. Consequently, immediately outside of the circle, the factor of safety is calculated to be a little less than 1.5 but will provide adequate stability (factor of safety > 1). Given other conservative assumptions (gas generation rate, use of steeper slopes for the calculations, the assumed interface friction angles were assumed to be at the geomembrane/clay subgrade interface when the gas will actually be conveyed through the waste below the clay subgrade), the Engineer has accepted the locations of the vents and wells.

The layout will have 17 dual phase wells and 41 passive gas vents along with several thousand lineal feet of passive venting trench with periodic vertical passive vents rising from the trenches to provide gas venting.

Table 1. Summary of Radius of Influence for Side Slope Area

Vent Perforation Length (ft)	Vent Dia (in.)	Slope Grade (%)	LFG Emission Rate (SCFM)	ROI (ft)	Vent Perforation Length (ft)	Vent Dia (in.)	Slope Grade (%)	LFG Emission Rate (SCFM)	ROI (ft)
4	6	15	302	76.2	4	8	15	302	78.2
6	6	15	302	91.7	6	8	15	302	94.0
8	6	15	302	104.6	8	8	15	302	107.2
10	6	15	302	115.9	10	8	15	302	118.7
12	6	15	302	126.0	12	8	15	302	129.0
14	6	15	302	135.2	14	8	15	302	138.4
16	6	15	302	143.8	16	8	15	302	147.2
18	6	15	302	151.8	18	8	15	302	155.4
20	6	15	302	159.4	20	8	15	302	163.1
22	6	15	302	166.6	22	8	15	302	170.4
24	6	15	302	173.4	24	8	15	302	177.3
26	6	15	302	179.9	26	8	15	302	184.0
28	6	15	302	186.2	28	8	15	302	190.4
30	6	15	302	192.2	30	8	15	302	196.5
4	6	20	302	64.0	4	8	20	302	65.8
6	6	20	302	77.0	6	8	20	302	79.0
8	6	20	302	87.8	8	8	20	302	90.1
10	6	20	302	97.3	10	8	20	302	99.7
12	6	20	302	105.8	12	8	20	302	108.4
14	6	20	302	113.5	14	8	20	302	116.3
16	6	20	302	120.7	16	8	20	302	123.6
18	6	20	302	127.4	18	8	20	302	130.5
20	6	20	302	133.8	20	8	20	302	136.9
22	6	20	302	139.8	22	8	20	302	143.0
24	6	20	302	145.5	24	8	20	302	148.9
26	6	20	302	150.9	26	8	20	302	154.4
28	6	20	302	156.2	28	8	20	302	159.8
30	6	20	302	161.2	30	8	20	302	164.9
4	6	25	302	48.5	4	8	25	302	49.9
6	6	25	302	58.3	6	8	25	302	59.9
8	6	25	302	66.5	8	8	25	302	68.3
10	6	25	302	73.6	10	8	25	302	75.5
12	6	25	302	80.0	12	8	25	302	82.1
14	6	25	302	85.8	14	8	25	302	88.0
16	6	25	302	91.2	16	8	25	302	93.5
18	6	25	302	96.3	18	8	25	302	98.7
20	6	25	302	101.1	20	8	25	302	103.6
22	6	25	302	105.6	22	8	25	302	108.2
24	6	25	302	109.9	24	8	25	302	112.6
26	6	25	302	114.0	26	8	25	302	116.8
28	6	25	302	117.9	28	8	25	302	120.8
30	6	25	302	121.7	30	8	25	302	124.7

Table 2. Summary of Radius of Influence for Top Deck Area

Vent Perforation Length (ft)	Vent Dia (in.)	Slope Grade (%)	LFG Emission Rate (SCFM)	ROI (ft)		Vent Perforation Length (ft)	Vent Dia (in.)	Slope Grade (%)	LFG Emission Rate (SCFM)	ROI (ft)
10	6	3	706	101.8		10	8	3	706	104.3
12	6	3	706	110.6		12	8	3	706	113.4
14	6	3	706	118.8		14	8	3	706	121.6
16	6	3	706	126.3		16	8	3	706	129.3
18	6	3	706	133.3		18	8	3	706	136.5
20	6	3	706	139.9		20	8	3	706	143.2
22	6	3	706	146.2		22	8	3	706	149.6
24	6	3	706	152.2		24	8	3	706	155.7
26	6	3	706	157.9		26	8	3	706	161.6
28	6	3	706	163.4		28	8	3	706	167.2
30	6	3	706	168.7		30	8	3	706	172.6
10	6	4	706	100.1		10	8	4	706	102.6
12	6	4	706	108.8		12	8	4	706	111.5
14	6	4	706	116.8		14	8	4	706	119.6
16	6	4	706	124.2		16	8	4	706	127.2
18	6	4	706	131.1		18	8	4	706	134.2
20	6	4	706	137.6		20	8	4	706	140.8
22	6	4	706	143.8		22	8	4	706	147.1
24	6	4	706	149.7		24	8	4	706	153.1
26	6	4	706	155.3		26	8	4	706	158.9
28	6	4	706	160.7		28	8	4	706	164.4
30	6	4	706	165.9		30	8	4	706	169.7

Table 3. Passive Gas Vent Systems

Well ID	Estimated Existing Ground Surface Elevation (ft)[1]	Estimated Leachate Level Below Ground Surface (ft)[2]	Length of perforation for Gas Collection (ft)[3]	ROI[4]
GV01	813.0	11.0	7.0	82.4
GV02	817.5	10.0	6.0	91.7
GV03	816.5	10.0	6.0	91.7
GV04	821.5	10.0	6.0	91.7
GV05	822.0	9.0	5.0	83.9
GV06	819.0	12.5	8.5	104.6
GV07	812.5	13.0	9.0	110.2
GV08	805.0	12.5	8.5	104.6
GV09	824.0	17.5	13.5	101.4
GV10	825.0	17.5	13.5	82.9
GV11	835.3	24.0	20.0	139.9
GV12	826.0	16.0	12.0	126.0
GV13	821.0	15.0	11.0	120.9
GV14	811.0	15.0	11.0	120.9
GV15	794.0	10.0	6.0	91.7
GV16	805.0	15.0	11.0	120.9
GV17	795.0	9.0	5.0	83.9
GV18	811.0	12.5	8.5	104.6
GV19	808.0	10.0	6.0	91.7
GV20	818.0	15.0	11.0	120.9
GV21	825.5	13.5	9.5	110.2
GV22	818.0	12.5	8.5	104.6
GV23	821.0	12.5	8.5	87.8
GV24	818.5	12.5	8.5	87.8
GV25	813.0	10.0	6.0	58.3
GV26	820.0	11.5	7.5	98.1
GV27	805.0	14.0	10.0	115.9
GV28	818.5	6.0	2.0	60.6
GV29	818.0	11.0	7.0	62.4
GV30	818.5	17.5	13.5	130.6
GV31	827.0	15.0	11.0	120.9
GV32	832.0	14.0	10.0	115.9
GV33	835.0	17.0	13.0	130.6
GV34	843.5	23.0	19.0	136.6
GV35	834.0	16.5	12.5	126.0
GV36	831.0	15.0	11.0	120.9
GV37	825.0	17.5	13.5	82.9
GV38	817.5	12.0	8.0	66.5
GV39	811.0	10.5	6.5	91.7
GV40	805.0	10.5	6.5	91.7
GV41	800.0	10.5	6.5	91.7

Notes:
[1]See Geosyntec's Drawing 2A titled "Existing conditions"
[2]See Figure B for leachate levels
[3]Length of perforations are determined by subtracting 4 ft (3 ft for bentonite pack and 1 ft for offset) from estimated leachate levels
[4]ROI stands for radius of influence

Table 4. Dual Phase Gas Well Systems

Well ID	Estimated Existing Ground Surface Elevation (ft)[1]	Estimated Leachate Level Below Ground Surface (ft)[2]	Length of perforation for Gas Collection (ft)[3]	ROI[4]
DP01	834.0	16.0	9.0	112.9
DP02	836.6	17.5	10.5	118.7
DP03	834.5	16.0	9.0	112.9
DP04	830.5	15.0	8.0	107.2
DP05	839.0	21.0	14.0	121.6
DP06	834.8	23.5	16.5	129.3
DP07	840.5	22.0	15.0	125.5
DP08	841.0	26.0	19.0	139.8
DP09	842.5	26.0	19.0	139.8
DP10	839.0	24.0	17.0	132.9
DP11	838.0	19.0	12.0	129.0
DP12	836.0	20.0	13.0	117.5
DP13	839.5	22.5	15.5	125.5
DP14	832.0	18.0	11.0	123.8
DP15	836.0	17.5	10.5	118.7
DP16	822.5	12.0	5.0	86.1
DP17	827.5	14.0	7.0	100.6

Notes:
[1]See Geosyntec's Drawing 2A titled "Existing conditions"
[2]See Figure B for leachate levels
[3]Length of perforations are determined by subtracting 7 ft (5 ft for bentonite pack and 2 ft for offset) from estimated leachate levels
[4]ROI stands for radius of influence

GEOSYNTEC CONSULTANTS

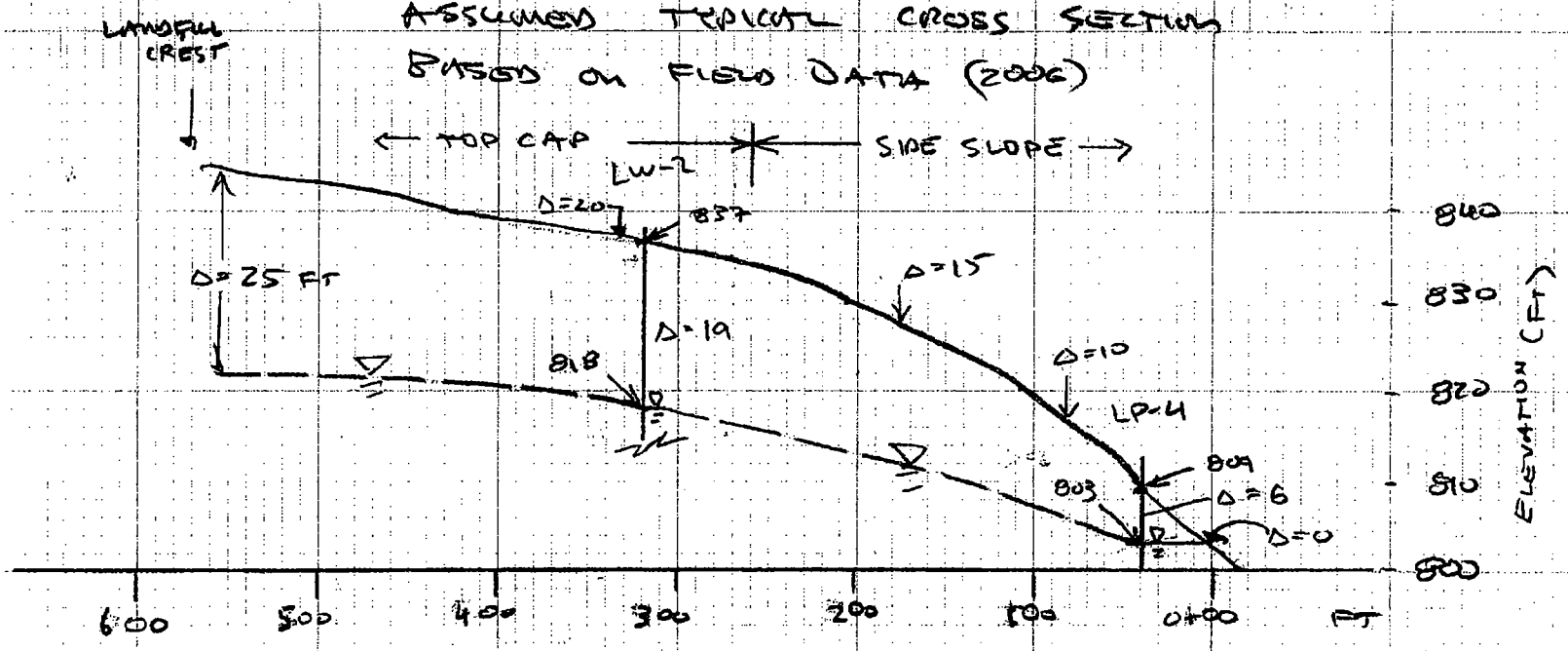
Written by: JSEYMOUR Date: 2/7/08 Reviewed by: _____ Date: __/__/__

Client: BFINA Project: MLG/DEWANEE Project/Proposal No. CHE824 Task No: 302

Page ____ of ____

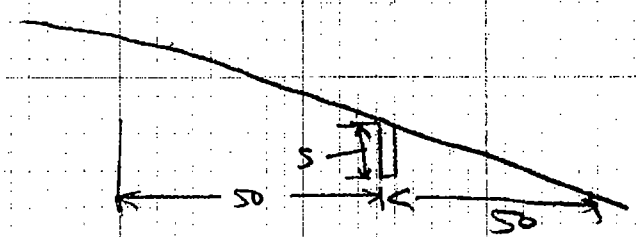
FIGURE A

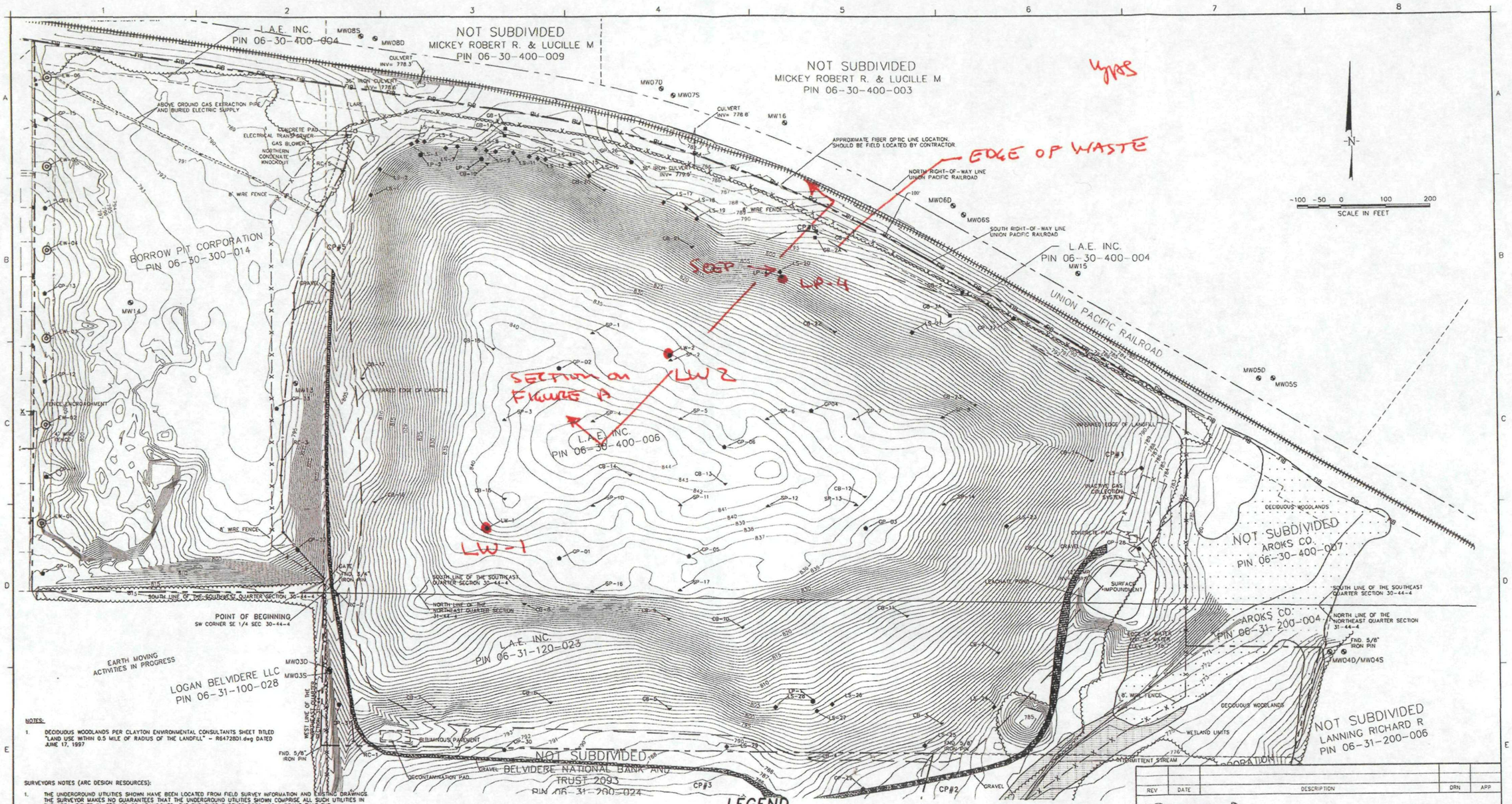
ASSUMED TYPICAL CROSS SECTION BASED ON FIELD DATA (2006)



DISTANCE FROM EDGE/SEEP (FT)	UNSATURATED THICKNESS (Δ = FT)
0	0
40	5
80	10
180	15
330	20
400~500	25

EFFECTIVE RADIUS OF INFLUENCE - DRAINAGE TRENCH





NOTES:

1. DECIDUOUS WOODLANDS PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "LAND USE WITHIN 0.5 MILE OF RADIUS OF THE LANDFILL" – R6472801.dwg DATED JUNE 17, 1997

SURVEYORS NOTES (ARC DESIGN RESOURCES):

1. THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN-SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH THE SURVEYOR DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.
2. BUILDINGS AND ROADWAYS ON BUSINESS ROUTE 20 AND BETHANY DRIVE HAVE NOT BEEN LOCATED IN THE FIELD.
3. WETLAND DELINEATION PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "LAND USE WITHIN 0.5 MILE OF RADIUS OF THE LANDFILL" – R6472801.dwg DATED JUNE 17, 1997
4. DECIDUOUS WOODLANDS PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "LAND USE WITHIN 0.5 MILE OF RADIUS OF THE LANDFILL" – R6472801.dwg DATED JUNE 17, 1997
5. INFERRED EDGE OF LANDFILL PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "CURRENT LANDFILL FEATURES" – F64730Y.DWG DATED SEPTEMBER 4, 1997
6. TOTAL AREA OF INSIDE INFERRED EDGE OF LANDFILL – 46.83 ACRES
7. TOTAL LINEAR FEET OF INFERRED EDGE OF LANDFILL – 5650' FEET
8. INGRESS AND EGRESS EASEMENT IN APPROXIMATE LOCATION OF ACCESS DRIVE. UNABLE TO ASCERTAIN DOCUMENTATION.
9. LEACHATE WELL (LW-1 & LW-2) WERE NOT FIELD LOCATED, LOCATION PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "CURRENT LANDFILL FEATURES" – F64730Y.DWG DATED SEPTEMBER 4, 1997
10. MONITORING WELLS WERE NOT FIELD LOCATED BY ARC DESIGN RESOURCES, LOCATION PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "SITE FEATURES MAP" – 99103JU.DWG DATED FEBRUARY 28, 2005

LEGEND

	Deciduous Tree		Existing Lot Line		Set 5/8" Pin	CP #1	Control Point #1
— X — X —	Site Fence Line		Inferred Edge of Landfill (See Note 6)		Found Monument	RC-1	Riser Column #1
	Tree Line	G	Underground Gas Line		Bollard		
	Utility Pole		Alignment of Gas Extraction Trench		Monitoring Well (See Note 10)	MW-01	Monitoring Well #1
	Light Pole		Wetland Identified in Remedial Investigation Report (Clayton Environmental Services, 1997)		Settlement Plate	SP-1	Settlement Plate #1
O/U	Overhead Utility Line		Deciduous Woodlands		Gas Probe	GP-01	Gas Probe #1
	Telephone Pedestal		Unimproved (Gravel & Dirt) Access Road		Cover Geoprobe Boring	CB-1	Cover Geoprobe Boring #1
	Metal End Section				Leachate Well	LW-1	Leachate Well #1
	Sign	U/E	Underground Electric Line		Extraction Well	EW-01	Extraction Well #1
	Property Line		Elevation Contour (ft, Mean Sea Level)		Historical Seep	LS-1	Historical Seep #1
FIB	Fiber Optic Line		Elevation Contour (5 ft, Mean Sea Level)		Leachate Piezometer	LP-1	Leachate Piezometer #1
	Existing Right-Of-Way Line		Section Line		Geoprobe Boring	GB-1	Geoprobe Boring #1

PRELIMINARY (30%) DESIGN DRAWINGS
NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants
55 W. WACKER DRIVE, SUITE 1100
CHICAGO, ILLINOIS 60601 USA
PHONE 312.658.0500

TITLE: EXISTING CONDITIONS

CLIENT: BFI WASTE SYSTEMS OF NORTH AMERICA, INC.

SITE: MIG/DEWANE LANDFILL
BELVIDERE, IL

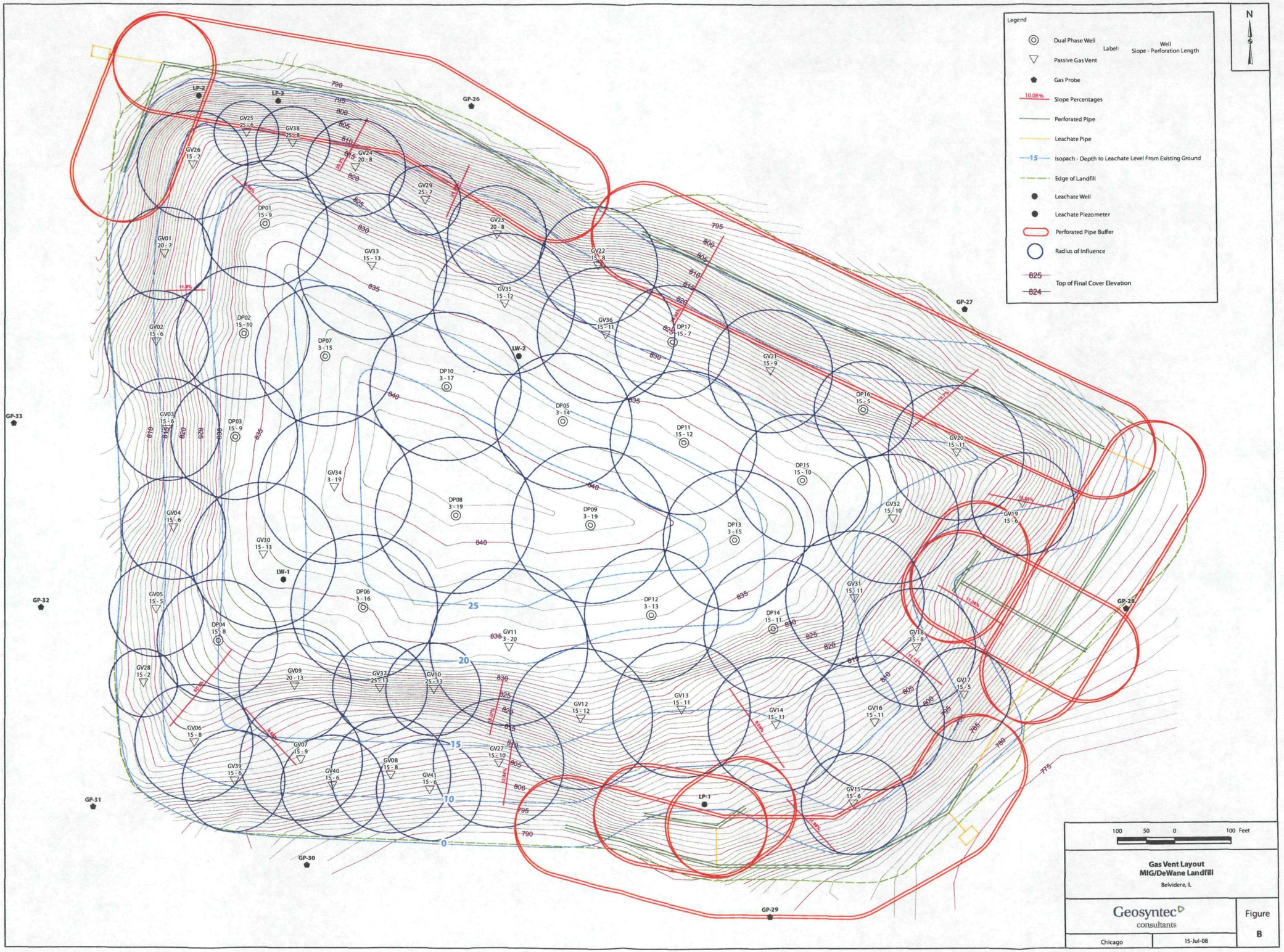
THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

DRAFT

DESIGN BY:	L AVERILL	DATE	FEBRUARY 2007
DRAWN BY:		PROJECT NO.:	CHE8214
CHECKED BY:		FILE:	8214-002
REVIEWED BY:		DRAWING NO.:	2A OF 17
APPROVED BY:			


Legend
Dual Phase Well
Passive Gas Vent
Gas Probe
Slope Percentages
Perforated Pipe
Leachate Pipe
Isopach - Depth to Leachate Level From Existing Ground
Edge of Landfill
Leachate Well
Leachate Piezometer
Perforated Pipe Buffer
Radius of Influence
Top of Final Cover Elevation
Label:
Well
Slope - Perforation Length
N
100 50 0 100 Feet
Gas Vent Layout
MIG/DeWane Landfill
Belvidere, IL
Geosyntec consultants
Chicago
15-Jul-08
Figure
B

B-2: Landfill Gas Passive Vent System Design- Trenches

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: BFINA **Project:** MIG/De Wane Landfill **Project/Proposal #:** CHE8214 **Task #:** ____

TITLE OF COMPUTATIONS LANDFILL GAS PASSIVE VENT SYSTEM DESIGN

COMPUTATIONS BY:
Signature: Cao Yiwen — DATE: 7.16.08
Printed Name and Title: Yiwen Cao, Project Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature: J.t. Beech — DATE: 16 July 2008
Printed Name and Title: Jay Beech, Principal

COMPUTATIONS CHECKED BY:
Signature: Cao Yiwen — DATE: 7.16.08
Printed Name and Title: Yiwen Cao, Project Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature: Cao Yiwen — DATE: 7.16.08
Printed Name and Title: Yiwen Cao, Project Engineer

APPROVED BY:
(PM or Designate)
Signature: J.t. Beech — DATE: 16 July 2008
Printed Name and Title: Jay Beech, Principal

APPROVAL NOTES: ____

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written By : Yiwen Cao Date: 7/15/08 Reviewed by: Jay Beech Date: 7/15/08

Client: BFINA Project: MIG/De Wane Landfill Project/Proposal No.: CHE8214-400 Task No.: 401

LANDFILL GAS PASSIVE TRENCH SYSTEM DESIGN

PURPOSE

The purpose of this analysis is to estimate the width of influence (WOI) for gravel-filled trench to be used at the MIG/De Wane Landfill located in Belvidere, Boone County, IL. The effects of the final cover slope on the trench WOI are assessed.

METHOD

Passive LFG Trench Design

The design of the passive landfill gas (LFG) pressure relief system using trench venting system is based on methodology developed by Thiel [1998]. The design methodology by Thiel considers slope stability analyses to estimate the maximum allowable gas pressure that results in an acceptable overall static factor of safety for a gas pressure relief system with a series of parallel trenches or strip drains at regular spacing.

The equations for estimating: (i) the gas pore pressure underneath final cover geomembrane; (ii) the intrinsic permeability of the gas collection and conveying layer (GCCL); (iii) the coefficient of permeability to LFG for GCCL; and (iv) the gas transmissivity of the GCCL are give below in Equations 1 through 4, respectively:

$$D = \sqrt{\frac{8u_{g-\max}\Psi_g}{\Phi_g \gamma_g}} \quad \text{.....Equation 1}$$

where: D = spacing between two parallel trenches = 2 times WOI (m);
$u_{g\text{-}max}$= maximum gas pore pressure acting on bottom of geomembrane (Pa);
Ψ_g = gas transmissivity of GCCL (e.g., soil, waste, or geosynthetic) ($m^3/s/m^2$);
Φ_g = gas flux from landfill surface ($m^3/s/m^2$); and
γ_g = unit weight of gas (N/m^3).

$$k_s = \frac{K_{water}\mu_w}{\rho_w g} \quad \text{.....Equation 2}$$

where: k_s = the intrinsic permeability of GCCL (m^2);
K_{water}= coefficient of permeability of GCCL to water (m/s);
μ_w = dynamic (absolute) viscosity of water ($N\text{-}s/m^2$)
ρ_w = unit density of water (kg/m^3); and
g = gravitational constant (m/s^2).

$$K_{gas} = \frac{k_s \rho_g g}{\mu_g} \quad \text{Equation 3}$$

where: K_{gas} = coefficient of permeability of GCCL to LFG (m/s);
ρ_g = unit density of LFG (kg/m^3); and
μ_g = dynamic (absolute) viscosity of gas (N-s/m^2).

$$\psi_g = K_{gas} t \quad \text{Equation 4}$$

where: t = the thickness of the GCCL (m).

The analysis is performed following the steps described below.

1. Estimate the coefficient of permeability to water for GCCL (K_{water}). If a geocomposite drainage layer (geotextile/geonet/geotextile) is used as a GCCL, an overall reduction factor may be applied to consider the reduction of the flow capacity due to various factors such as delayed intrusion, creep, and biological clogging etc.

2. Calculate the intrinsic permeability, k_s, of the GCCL using Equation 2.

3. Calculate the coefficient of permeability to LFG for the GCCL (K_{gas}) using Equation 3.

4. Calculate the LFG transmissivity of the GCCL using Equation 4.

5. Calculate the LFG flux, Φ_{gas}, by dividing the LFG average annual emission rate (AAER) for the whole landfill (defined as the total annual LFG volume generated during one year) by the footprint area of the landfill. If necessary, the LFG AAER may need to be adjusted for specific landfill areas where the waste thickness is different.

6. Calculate the maximum allowable LFG pressure, $u_{gas\text{-}allow}$, for the slope stability analysis with an acceptable factor of safety (e.g., 1.5).

7. Choose the maximum LFG pressure, $u_{gas\text{-}max}$ equal to $u_{gas\text{-}allow}$.

8. Calculate the spacing between two parallel trenches (D) using Equation 1. The WOI of the trench equals to half of the D.

LFG Emission Rate Adjustment for Waste Thickness

The methodology for the LFG emission rate adjustment for waste thickness was presented in detail in a calculation package titled "*Landfill Gas Passive Vent System Design*" (abbreviated as LFG Vent Package) and is not repeated here.

ANALYSIS SCENARIO

The analyses will be performed for the landfill side slope area since the gravel trench will be installed near the landfill perimeter. The final cover slope grades range from approximately 15% to 25% for the landfill side slope area. For the purpose of this calculation package, the analyses will be performed for three slope grades (15%, 20% and 25%) in the landfill side slope area.

GAS COLLECTION AND CONVEYING LAYER

The description of the gas collection and conveying layer was presented in detail in the LFG Vent Package and is not repeated here.

INPUT PARAMETERS

The input parameters for waste properties, LFG emission rate, and maximum LFG maximum pressure were presented in detail the LFG Vent Package. The results of each parameter are summarized below.

Waste Properties

The hydraulic conductivity of the waste is calculated to be 1.4 x 10^{-3} cm/s. The mass density of LFG was assumed to be 1.31 kg/m^3 or 1.31 g/cm^3, and the dynamic (absolute) viscosity of LFG was assumed to be 1.32 x 10^{-5} N-s/m^2.

LFG Emission Rate

The LFG emission rate for the landfill side slope area was estimated to be 302 SCFM.

Maximum Allowable LFG Pressure

Maximum allowable LFG pressures for different final cover slopes are summarized below.

- Slope = 15%, $u_{gas\text{-}allow}$ = 7.97 kN/m^2, or 32.0 in. water column (w.c.);
- Slope = 20%, $u_{gas\text{-}allow}$ = 5.45 kN/m^2, or 21.9 in. w.c.; and

- Slope = 25%, $u_{gas\text{-}allow}$ = 2.96 kN/m^2, or 11.9 in. w.c.

Gravel Trench Depth

The gravel trench used at the site is 5' deep. A 6-inch diameter ADS perforated pipe is installed 3" above the bottom of the gravel trench to collect leachate seeps from the waste. According to a calculation package titled "Leachate Collection System Analysis", the 6-inch ADS pipe has sufficient flow capacity to convey the estimated amount of leachate, and thus the leachate level in the trench is not expected to be higher than the top of the 6-inch ADS pipe (i.e., 9" above the bottom of the trench). It is conservatively assumed that the effective gravel trench depth for LFG conveying purpose is 2.5' deep to account for potential short-term leachate backup during peak rainfall event.

CALCULATIONS

A step by step hand calculations are shown in detail below for the landfill side slope area for the scenario where the final cover slope is 15%.

Estimate intrinsic permeability (k_s) of GCCL

- mass density of water, ρ_w = 1.0 g/cm^3
- gravitational constant g = 981 cm/s^2
- absolute viscosity of water, μ_w = 1.005E-3 Pa.sec
- $k_s = \dfrac{K_{water}\mu_w}{\rho_w g}$ = 1.4E-3 x 1.005E-3 / 1 / 981 x 10 = 1.43E-8 cm^2

Estimate k_{gas} of GCCL

- mass density of LFG, ρ_g = 1.31E-3 g/cm^3
- absolute viscosity of LFG, μ_g = 1.32E-5 Pa.sec
- $K_{gas} = \dfrac{k_s \rho_g g}{\mu_g}$ = 1.43E-8 / 1.32E-5 x 1.31E-3 x 981 / 10 = 1.40E-4 cm/s

Estimate Ψ_g of GCCL

- Thickness of GCCL, t = 2.5 ft = 762 mm
- $\psi_g = K_{gas} t$ =1.40E-4 x 762 / 10 = 1.07E-2 cm^2/s = 1.07E-6 m^2/s

Estimate LFG Flux for Landfill Side Slope Area

- LFG Emission Rate for Landfill Side Slope Area, ER_{side} = 302 SCFM = 8.54 m^3/min
- Landfill total cover area = 2,040,272 ft^2 = 189,548 m^2
- LFG Flux for landfill side slope area, Φ_g = 8.54 / 60 / 189,548 = 7.51E-7 $m^3/s/m^2$

Estimate WOI of LFG Trench

- The maximum allowable gas pressure for a 15% slope, $u_{gas\text{-}allow}$ = 7.97 kN/m^2 = 32.0 in. w.c.,
- The maximum gas pressure $u_{gas\text{-}max} = u_{gas\text{-}allow}$ = 7.97 kN/m^2 = 32.0 in. w.c.
- The unit weight of LFG, $\gamma_{gas} = \rho_g$ x g = 1.31E-3 x 981 x 0.001 / 0.01^2 = 12.85 N/m^2
- The spacing between LFG trench, $D = \sqrt{\frac{8u_{g-\max}\psi_g}{\Phi_g \gamma_g}}$ = SQRT(8 x 7.97E3 x 1.07E-6 / 7.51E-7 / 12.85) = 84 m, width of influence (WOI) = D / 2 = 84 / 2 = 42 m = 137.9 ft.

RESULTS

The WOI of LFG trench in the landfill side slope areas are summarized in Table 1 below.

Table 1. WOI of LFG Trench in Landfill Side Slope Area

SIDE SLOPE AREA

LFG Trench Depth (ft)	LFG Trench Effective Depth (ft)	Slope Grade (%)	LFG Emission Rate (SCFM)	D (ft)	WOI (ft)
5.0	**2.5**	**15**	**302**	**275.5**	**137.8**
5.0	**2.5**	**20**	**302**	**227.8**	**113.9**
5.0	**2.5**	**25**	**302**	**167.9**	**83.9**

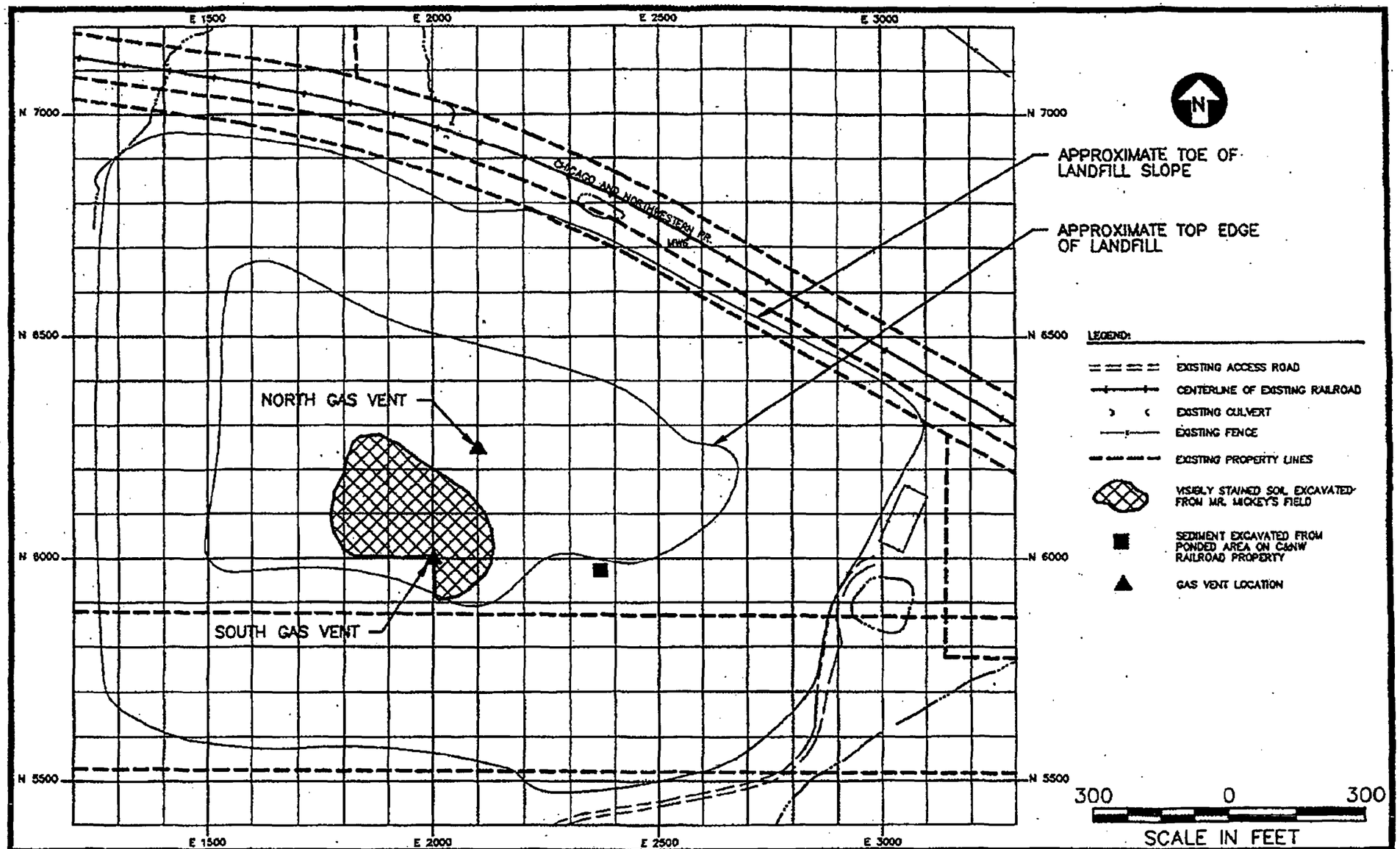
Vertical perforated LFG vents shall be installed along the entire length of the trench. The spacing between two adjacent LFG vents in the trench shall be no more than 100 ft.

REFERENCES

Thiel, R.S., *"Design Methodology For a Gas Pressure Relief Layer Below a Geomembrane Landfill Cover to Improve Slope Stability"*, Geosynthetics International, No. 6, Vol. 5, 1998.

USEPA, *Compilation of Air Pollutant Emission Factors,* "Section 2.4: Municipal Solid Waste Landfills", Document AP-42, Fifth Edition, Supplement E, November 1998.

B-3: Layout Tables



CLIENT/PROJECT						TITLE		
MLTF/MIG–DeWane/BELVIDERE			Golder Associates Chicago, Illinois			LOCATION ON LANDFILL WHERE OFFSITE SOILS WERE PLACED		
DRAWN KMK	CHECKED	REVIEWED	DATE 9/28/92	SCALE AS SHOWN	FILE NAME MAP	JOB NO. 903–8057	DWG NO. 103	FIGURE 4

FIGURE B-1

Predesign Investigation
Thickness of Clay
Cover (2006)

ypb

L.A.E. INC.
PIN 06-30-400-004

NOT SUBDIVIDED
MICKEY ROBERT R. & LUCILLE M
PIN 06-30-400-009

NOT SUBDIVIDED
MICKEY ROBERT R. & LUCILLE M
PIN 06-30-400-003

BORROW PIT CORPORATION
PIN 06-30-300-014

L.A.E. INC.
PIN 06-30-400-006

L.A.E. INC.
PIN 06-31-120-023

LOGAN BELVIDERE LLC
PIN 06-31-100-028

NOT SUBDIVIDED
BELVIDERE NATIONAL BANK AND TRUST 2093
PIN 06-31-200-024

NOT SUBDIVIDED
AROKS CO.
PIN 06-30-400-007

AROKS CO.
PIN 06-31-200-004

NOT SUBDIVIDED
LANNING RICHARD R
PIN 06-31-200-006

L.A.E. INC.
PIN 06-30-400-004

UNION PACIFIC RAILROAD

TOP CAP AREA

CB18: 19.5 ft
CB15: 14 ft
CB14: 19 ft
CB13: 19 ft
CB12: 14 ft
CB8: 13 ft

POINT OF BEGINNING
SW CORNER SE 1/4 SEC. 30-44-4

SCALE IN FEET: -100 -50 0 100 200

NOTES:

1. DECIDUOUS WOODLANDS PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "LAND USE WITHIN 0.5 MILE OF RADIUS OF THE LANDFILL" - R6472B01.dwg DATED JUNE 17, 1997
2. BUILDINGS AND ROADWAYS ON BUSINESS ROUTE 20 AND BETHANY DRIVE HAVE NOT BEEN LOCATED IN THE FIELD.
3. WETLAND DELINEATION PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "LAND USE WITHIN 0.5 MILE OF RADIUS OF THE LANDFILL" - R6472B01.dwg DATED JUNE 17, 1997
4. DECIDUOUS WOODLANDS PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "LAND USE WITHIN 0.5 MILE OF RADIUS OF THE LANDFILL" - R6472B01.dwg DATED JUNE 17, 1997
5. INFERRED EDGE OF LANDFILL PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "CURRENT LANDFILL FEATURES" - F6473OY.DWG DATED SEPTEMBER 4, 1997
6. TOTAL AREA OF INSIDE INFERRED EDGE OF LANDFILL - 46.83 ACRES
7. TOTAL LINEAR FEET OF INFERRED EDGE OF LANDFILL - 5650' FEET
8. INGRESS AND EGRESS EASEMENT IN APPROXIMATE LOCATION OF ACCESS DRIVE. UNABLE TO ASCERTAIN DOCUMENTATION.
9. LEACHATE WELL (LW-1 & LW-2) WERE NOT FIELD LOCATED, LOCATION PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "CURRENT LANDFILL FEATURES" - F6473OY.DWG DATED SEPTEMBER 4, 1997
10. MONITORING WELLS WERE NOT FIELD LOCATED BY ARC DESIGN RESOURCES, LOCATION PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "SITE FEATURES MAP" - 991033U.DWG DATED FEBRUARY 28, 2005

SURVEYORS NOTES (ARC DESIGN RESOURCES):

1. THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN-SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH THE SURVEYOR DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.
2. BUILDINGS AND ROADWAYS ON BUSINESS ROUTE 20 AND BETHANY DRIVE HAVE NOT BEEN LOCATED IN THE FIELD.
3. WETLAND DELINEATION PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "LAND USE WITHIN 0.5 MILE OF RADIUS OF THE LANDFILL" - R6472B01.dwg DATED JUNE 17, 1997
4. DECIDUOUS WOODLANDS PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "LAND USE WITHIN 0.5 MILE OF RADIUS OF THE LANDFILL" - R6472B01.dwg DATED JUNE 17, 1997
5. INFERRED EDGE OF LANDFILL PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "CURRENT LANDFILL FEATURES" - F6473OY.DWG DATED SEPTEMBER 4, 1997
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10. MONITORING WELLS WERE NOT FIELD LOCATED BY ARC DESIGN RESOURCES, LOCATION PER CLAYTON ENVIRONMENTAL CONSULTANTS SHEET TITLED "SITE FEATURES MAP" - 991033U.DWG DATED FEBRUARY 28, 2005

LEGEND

	Deciduous Tree		Existing Lot Line		Set 5/8" Pin	CP #1	Control Point #1
— X — X — X —	Site Fence Line		Inferred Edge of Landfill (See Note 6)		Found Monument	RC-1	Riser Column #1
	Tree Line	— G —	Underground Gas Line		Bollard		
	Utility Pole	— s — s —	Alignment of Gas Extraction Trench		Monitoring Well (See Note 10)	MW-01	Monitoring Well #1
	Light Pole		Wetland Identified in Remedial Investigation Report (Clayton Environmental Services, 1997)		Settlement Plate	SP-1	Settlement Plate #1
— O/U —	Overhead Utility Line		Deciduous Woodlands		Gas Probe	GP-01	Gas Probe #1
	Telephone Pedestal		Unimproved (Gravel & Dirt) Access Road		Cover Geoprobe Boring	CB-1	Cover Geoprobe Boring #1
	Metal End Section	— U/E —	Underground Electric Line		Leachate Well	LW-1	Leachate Well #1
	Sign		Elevation Contour (ft, Mean Sea Level)		Extraction Well	EW-01	Extraction Well #1
	Property Line		Elevation Contour (5 ft, Mean Sea Level)		Historical Seep	LS-1	Historical Seep #1
— FIB —	Fiber Optic Line		Section Line		Leachate Piezometer	LP-1	Leachate Piezometer #1
	Existing Right-Of-Way Line				Geoprobe Boring	GB-1	Geoprobe Boring #1

PRELIMINARY (30%) DESIGN DRAWINGS
NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants
55 W. WACKER DRIVE, SUITE 1100
CHICAGO, ILLINOIS 60601 USA
PHONE: 312.658.0500

TITLE: EXISTING CONDITIONS

CLIENT: BFI WASTE SYSTEMS OF NORTH AMERICA, INC.

SITE: MIG/DEWANE LANDFILL
BELVIDERE, IL

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION UNLESS SEALED

SIGNATURE

DATE

DRAFT

DESIGN BY:	L. AVERILL	DATE	FEBRUARY 2007
DRAWN BY:		PROJECT NO.:	CHE8214
CHECKED BY:		FILE:	8214-002
REVIEWED BY:		DRAWING NO.:	2A OF 17
APPROVED BY:			

FIGURE B-2

APPENDIX C

CONSTRUCTION HEALTH & SAFETY PLAN (CHASP)

BFI Waste Systems of North America, Inc.
Hanover Park, Illinois 60133

CONSTRUCTION HEALTH AND SAFETY PLAN

MIG/DeWane Landfill
Remedial Action Work Plan
Belvidere, Illinois

Prepared by

Geosyntec consultants

engineers | scientists | innovators

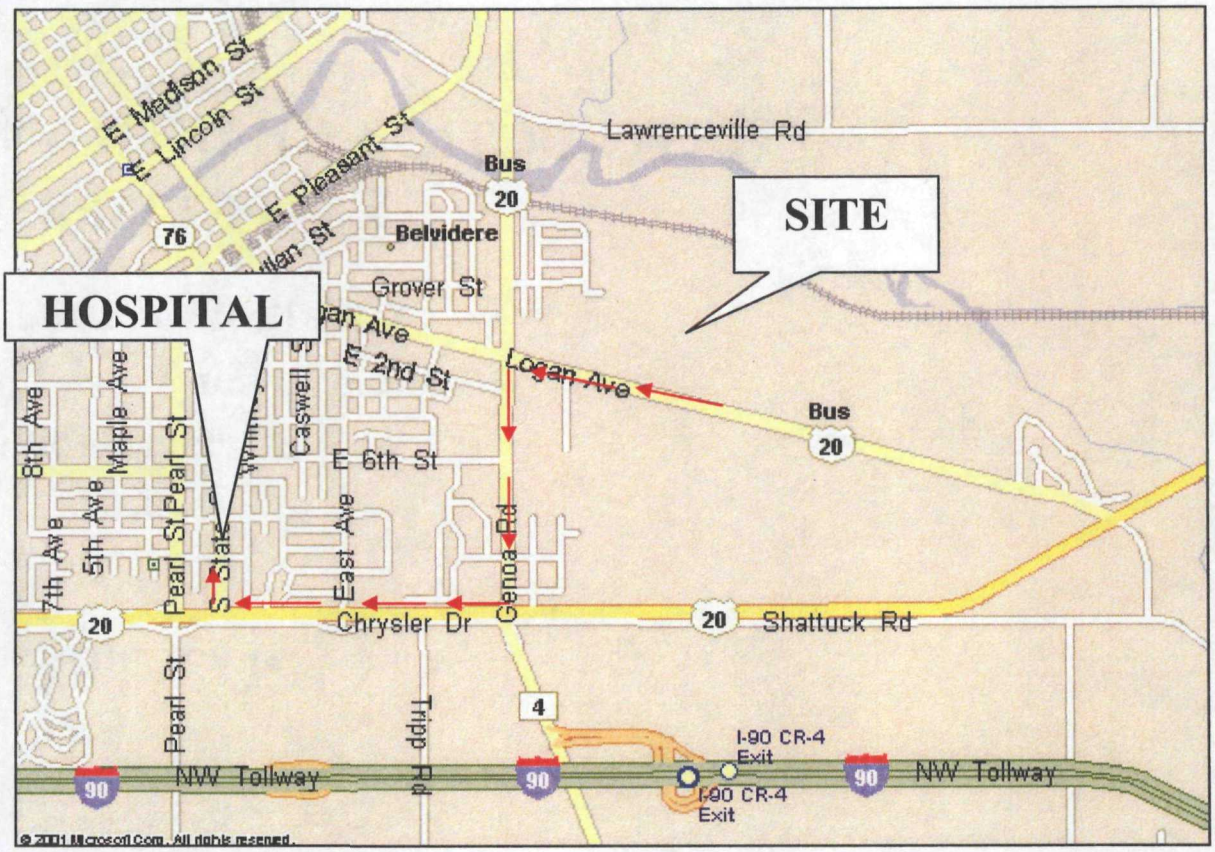
134 North La Salle Street, Suite 300
Chicago, Illinois 60602

Project Number: CHE8214

July 25, 2008

FIGURE 1A

ROUTE TO HOSPITAL



Hospital Name

Northwest Suburban Community Hospital
1625 S. State St.
Belvidere, IL 61008

Written Directions to Hospital from Site:

Exit the Site onto Logan Avenue and turn right (west onto Logan Avenue)
Turn Left at Genoa Road
Turn right at Chrysler Drive
Turn right at South State Street
Northwest Suburban Community Hospital is on your left

FIGURE 1B

ROUTE TO URGENT CARE FACILITY

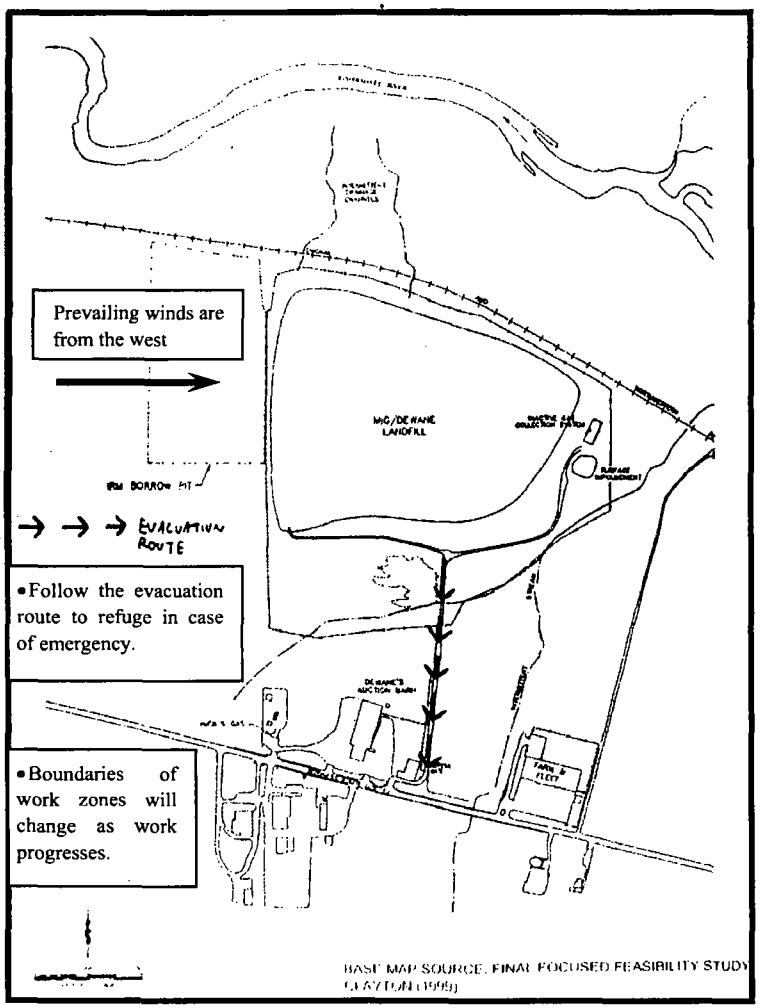
Physicians Immediate Care
(815) 544-0040
1663 Belvidere Road
Belvidere, Illinois 61008

Written Directions to Urgent Care Facility from Site:

Exit the Site onto Logan Avenue and turn right (west onto Logan Avenue)
Turn Left at Genoa Road
Physicians Immediate Care is on the right, across from the Wal-Mart

FIGURE 2

SITE MAP



WRITTEN DIRECTIONS TO SITE:

- From I-90 take the Belvidere-Genoa Road exit towards Genoa Road.
- Turn right on Genoa Road. Genoa Road becomes Belvidere Road (US-20-Bus).
- Turn right on Logan Avenue and continue for approximately 0.7 miles.
- Turn left onto an unnamed access road after DeWane's Auction Barn and before Farm and Fleet. Follow the access road through the gate to the site.

INSTRUCTIONS FOR INJURY RESPONSE

IF INJURY IS SERIOUS AND/OR LIFE THREATENING:

- Seek immediate medical attention at the hospital / emergency room listed in the Health and Safety Plan (HASP).

IF INJURY IS NON-LIFE THREATENING:

- Employee experiencing injury reports to the **highest ranking Geosyntec employee** at the site immediately. If the injured employee is on site alone or is the highest ranking employee, he/she is to contact his/her off-site **Supervisor** immediately. If employee is unable to contact his/her supervisor, he/she is to contact the **Project Manager (PM)**.

- The Supervisor/PM takes control of response and becomes the **"Primary Responder"** to the incident.

- The Primary Responder calls **Dale Prokopchak** immediately to discuss appropriate medical attention. If unable to contact Dale Prokopchak within fifteen minutes, **WorkCare** is to be contacted for direction on appropriate medical care.

- If the Primary Responder is the PM, he/she shall notify the employee's supervisor of the injury, and vice versa. Dale Prokopchak will notify the appropriate Environmental Health and Safety Coordinator (EHSC).

Dale Prokopchak
Office: 804-332-6376
Cell: 804-349-8067
Fax: 804-332-6732
dprokopchak@geosyntec.com

WorkCare
800-455-6155 Ext. 0

Emergency Response Contact Information

Contact	*Telephone Numbers*		*Date of Pre-Emergency Notification (if required)*
	Office	*Alternate (Type)*	
Fire Department	(815) 544-2242		
Police Department	(815) 544-2135	(815) 544-9626 (non-emergency)	
Hospital - *Northwest Suburban Community Hospital*	(815) 547-5441		
Director of Environment, Health & Safety – *Dale Prokopchak*	(804) 332-6376	(804) 349-8067 (Cell)	
Project Manager - *John Seymour*	(312) 416-3919	(313) 300-3245 (Cell)	
Environmental, Health & Safety Coordinator – *Kristi Kern*	(312) 416-3921	(651) 246-3688 (Cell)	
Principal- or Associate-in-Charge – *Scott Luettich*	(207) 782-2714 x127	(207) 446-0140 (Cell)	
Office Manager - *Susan Hill*	(630) 778-6122	(630) 330-8057 (Cell)	
EPA (if applicable) *Rich Lanham*	(217) 782-9881	N/A	
State Regulatory Agency (if applicable)	N/A	N/A	
Other -			

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Figure 2: Site Map (inside cover)

Instructions for Injury Response (form located after figures)
Emergency Response Contact Information (table located after figures)

Table 1: Key Personnel and Health & Safety Responsibilities
Table 2: Training / Medical Surveillance / Respirator Fit Test Records
Table 3: General Safe Work Practices
Table 4: Emergency Response Procedures

Appendix A: HASP Amendments
Appendix B: Weekly Health & Safety Inspection Checklist
Appendix C: Hazard Analysis and Hazard Mitigators
Appendix D: Constituents of Concern (COCs) and COC Fact Sheets
Appendix E: Air Monitoring Equipment, Frequency of Readings, and Action Guidelines per Task
Appendix F: Personal Protective Equipment per Task
Appendix G: Post-Incident Response Procedures and Forms
Appendix H: Material Safety Data Sheets

1. SIGNATURES

1.1 Preparers and Reviewers

This HASP, which must be maintained on site when field work is being performed, addresses the health and safety hazards of each phase of site operation, including the procedures and equipment required for worker protection. Only the Site Health and Safety Officer (SHSO) can change or amend this document, in agreement with the Environmental Health and Safety Coordinator (EHSC), and Project Manager. The SHSO must initial any change made to the HASP at the relevant section. Major amendments (e.g., changes in personal protective equipment, addition of tasks, etc.) must be documented in Section 3 and in Appendix A. This HASP must be reviewed and amended on an annual basis for projects lasting more than one year.

Prepared by:	_____	
	SHSO	Date
Reviewed by:	_____	
	EHSC	Date
Approved by:	_____	
	Project Manager	Date
Approved by: (as needed)	_____	
	Principal- or Associate-in-Charge	Date

Copy Cover Sheet to: EHSC

This HASP has been given to the following subcontractor(s) in accordance with the Occupational Safety and Health Administration (OSHA) HAZWOPER Standard, per Chapter 29 of Code of Federal Regulations (CFR), Subsection 1910.120.

Subcontractor: _____ Representative: _____ Date: _____

Subcontractor: _____ Representative: _____ Date: _____

Subcontractor: _____ Representative: _____ Date: _____

1.2 Site Workers

A pre-entry briefing conducted by the SHSO must be held prior to initiating the field work of this project. All sections of this HASP must be reviewed during this briefing. Any worker not in attendance at the initial meeting must be trained by the SHSO on the information covered in the pre-entry briefing.

Tailgate meetings must be held at the beginning of each day by the SHSO to discuss important health and safety issues concerning tasks to be performed during that shift. Topics discussed in the tailgate meetings must be documented in a daily field log.

Weekly site health and safety audits must be performed and documented by the SHSO for projects lasting more than one week.

After reading the HASP and attending a pre-entry briefing, Geosyntec employees must sign the following acknowledgment statement.

"I have read, understand, and agree with the information set forth in this HASP. I have also attended a pre-entry briefing. I agree to perform my work in accordance with this HASP."

Signature	Printed Name	Date

2. DISCLAIMER

This HASP was prepared in accordance with Geosyntec Consultants' Health and Safety Procedures for use by Geosyntec project staff. This plan complies with Geosyntec internal review procedures. Geosyntec does not endorse the use of this HASP by others. This document and its contents should not be used by firms other than Geosyntec or by persons other than Geosyntec employees without a thorough peer review by their health and safety managers. Should the work outlined in this HASP be executed by contractors other than Geosyntec, the HASP should be modified and reviewed to comply with such company's corporate health and safety procedures. In the event that a contractor other than Geosyntec executes this work, the contractor should complete independent analyses of hazards and mitigation measures, and should update all HASP tables, text, figures, and appendices prior to commencing work. Geosyntec assumes no responsibility for the accuracy, content, or health and safety of non-Geosyntec personnel during the implementation of the work in this HASP by other parties.

3. HASP AMENDMENTS

Over the course of this project, it is possible that the project-specific details and working conditions will change. This HASP shall be reviewed and amended as necessary to effectively describe the changing working conditions and to mitigate the potential health and safety issues that may arise during the project. Amendments to the HASP should be briefly described in the following spaces provided. The full text of the amendments should be provided in Appendix A.

AMENDMENT 1:

Date: _____ Project Manager: _____ EHSC: _____
Brief description of amendment:

_____

_____

AMENDMENT 2:

Date: _____ Project Manager: _____ EHSC: _____
Brief description of amendment:

_____

_____

4. SITE/TASK DESCRIPTION

The following is a brief description of the site, including information as to the location, approximate size, previous usage, and current usage. A description of the tasks to be performed is also presented.

- Site Location: MIG/DeWane Landfill, Belvidere, Illinois
- Approximate Size of Site: 47 acres (approx.)
- Previous Site Usage: Type I (hazardous and solid waste) landfill
- Current Site Usage: Closed Type I (hazardous and solid waste) landfill
- Tasks for this project include:

Task 1: Ground Topographical Survey

Task 2: Gas Vent Installation

Task 3: Dual Phase (Leachate and Gas) Well Installation

Task 4: Investigation Derived Waste (IDW) Handling

Task 5: Gas Monitoring

Task 6: Grass Mowing

Task 7:

Task 8:

- Description of Surrounding Property/Population:

North	Commonwealth Edison (ComEd) electrical transmission Corridor and Railroad R.O.W.	East	Woodland and meadowland
South	Agricultural fields	West	Residential (Wycliffe Estates subdivision)

5. KEY PERSONNEL AND HEALTH AND SAFETY RESPONSIBILITIES

Table 1 lists project personnel and their responsibilities in regard to health and safety concerns on this project.

6. WORKER TRAINING

Table 2 presents the training and medical monitoring that project personnel have received in accordance with the company Environmental, Health, and Safety (EH&S) Training Program. Pre-entry briefings and daily tailgate meetings shall also be conducted to facilitate site-specific training.

7. MAPS AND SITE CONTROL

7.1 Routes to Hospital and Urgent Care Facility

A hospital and an urgent care facility near the site have been identified. Figure 1A presents the route to the hospital, for emergency care. Figure 1B presents the route to an urgent care facility, for non-emergency care. Both figures also include the facility name, phone number, and written directions from the site. The figures are included after the cover page of this HASP.

7.2 Site Map

A site map is presented on Figure 2, located inside the cover of this HASP. The site map is intended to show the location of the work zone(s), to provide on-site orientation, and to delineate evacuation routes. Changes may be made to the site map by the SHSO based on changing site conditions. The site map should be accessible in the work area.

7.3 Buddy System

The buddy system is required for all tasks. The buddy system includes maintaining regular contact with onsite Geosyntec personnel, clients, and/or contractors to periodically check on the condition of site workers. In situations when only one employee is performing field work, on-site personnel must have appropriate communication devices on his/her persons at all times and shall maintain contact with off-site personnel. The field worker must communicate with off-site personnel, at a minimum, of three times daily: (1) upon arriving at the site; (2) midway through the work day; and (3) upon departing from site.

7.4 Controlled Work Zones

APPLIES TO TASK: ☒① ☒② ☒③ ☒④ ☐⑤ ☐⑥ ☐⑦ ☐⑧ ☐ Not Applicable

Three controlled work zones, including an Exclusion Zone, a Contaminant Reduction Zone (CRZ), and a Support Zone, are required for the task(s) indicated above. The Exclusion Zone is defined as the area on site where contamination is suspected and tasks are to be performed. The CRZ is defined as the area where equipment and workers are to be decontaminated as they leave the Exclusion Zone. The Support Zone is defined as the command area and may serve as a staging and storage area for supplies. The location and extent of the work zones may be modified as necessary as site investigation information becomes available. For sites that do not require the three controlled work zones, the area(s) where work is to be performed shall be called the Work Zone.

The boundaries of the Exclusion Zone, CRZ, and Support Zone or the Work Zone shall be marked using one of the following methods:

- ☒ Warning tape
- ☒ Traffic cones
- ☒ Signs
- ☒ Fence
- ☐ Other: _____

7.5 Site Access

Access to the site must be controlled using the following method:

- ☒ Sign in/Sign out log
- ☐ Guard
- ☐ Identification badges
- ☐ Check in with SHSO
- ☐ Other: _____

7.6 Visitors

Visitors to the site may need to be continually escorted for safety purposes. Geosyntec employees must not be allowed into the CRZ or Exclusion Zone or the Work Zone until they have received the proper personal protective equipment (PPE) and they have read, understand, and meet the requirements outlined in this HASP. Other visitors under Geosyntec's direction (subcontractors, etc.) may review this HASP for site familiarity, but they are ultimately responsible for their own health and safety (see disclaimer in Section 1).

7.7 Safe Work Practices

General Safe Work Practices that must be implemented during work activities at this site are listed in Table 3.

7.8 Inspections

SHSO will conduct weekly health and safety inspections. The inspections must be documented using the Weekly Health & Safety Inspection Checklist included in Appendix B. The Weekly Health & Safety Inspection Checklist should be kept on file at the project site.

8. HAZARD ANALYSIS AND MITIGATORS

Site specific hazards have been identified through hazard analysis. Hazard analysis included a review of chemical, physical, and biological hazards. The analysis also identified health and safety hazard mitigators needed to protect workers, which are presented in Appendix C.

8.1 Chemical Hazards

Potential exposure pathways to chemical health hazard agents include inhalation, dermal exposure, and/or ingestion. To effectively manage risk to exposure, constituents of concern (COCs) have been identified. Potential exposure to these COCs will be mitigated through engineering, administrative, and/or PPE controls. The COCs are documented and/or suspected materials present based on previous operations/activities. The identified COCs for this project are listed in Appendix D with appropriate hazard information, including signs of exposure. Hazard Mitigators, which include control measures and methods to minimize exposure, are presented in Appendix C. Also, airborne levels of COCs may be estimated or measured to evaluate levels of PPE that will be required for individual tasks. The type(s) of air monitoring to be performed are discussed in Section 9.

8.2 Physical Hazards

Physical hazards due to the tasks to be performed (e.g., crushing and pinching due to drilling, etc.) and due to the site setting and condition (e.g., slips, trips, or falls due to uneven terrain, etc.) were analyzed. Hazard mitigators for each physical hazard identified are presented in Appendix C. These hazard mitigators must be implemented for each task in which they are applicable, as summarized in the table in Appendix C.

8.3 Biological Hazards

Biological hazards (e.g., allergic reactions to poisonous plants or insects indigenous to the area, etc.) associated with tasks to be performed were analyzed. Hazard mitigators for each biological hazard identified are presented in Appendix C. These hazard mitigators must be implemented for each task in which they are applicable, as summarized in the table in Appendix C.

9. AIR MONITORING

APPLIES TO TASK: ☐① ☒② ☒③ ☒④ ☒⑤ ☐⑥ ☐⑦ ☐⑧ ☐ Not Applicable

Air monitoring will be performed to evaluate airborne exposure levels associated with the COCs on site. Hazardous conditions may include concentrations that may cause acute or chronic illness, potential oxygen deficient environments, or potential explosive environments. Air monitoring may also be performed to evaluate the adequacy of engineering, administrative, and/or PPE controls. Air monitoring may be "real-time" (e.g., the instrument provides immediate results at the project), using multi-gas meters, photoionization detectors (PIDs), or colorimetric tubes. "Non-real-time" monitoring may also be performed by collecting samples and forwarding to a laboratory for analysis and quantification.

The type(s) of air monitoring equipment required to evaluate COCs is outlined in Appendix E. **Monitoring equipment must be calibrated daily in accordance with the manufacturer's requirements.** Calibration results and air monitoring measurements must be documented. Based on the results noted and site activities or scope of work changes, the frequency of air monitoring may be adjusted on site by the SHSO with the consent of the Project Manager and communication with the EHSC.

10. PERSONAL PROTECTIVE EQUIPMENT

The levels of PPE required for each task are presented in Appendix F. Required equipment and types of protective clothing materials, as well as an indication of the initial level of protection to be utilized, are listed. The level of protection may be upgraded or downgraded by the SHSO according to mitigation measures required in Appendix C or according to action guidelines provided in Appendix E. The PPE levels that are implemented must be documented in a daily field log.

If respirators are worn, workers must abide by the company's Respiratory Protection Program in accordance with 29 CFR §1910.134. Table 2 provides a record of the last fit test for each site worker that may be required to wear a respirator. Fit tests are valid for a period of one year. Persons with facial hair that may interfere with the respirator seal may not wear respirators.

11. DECONTAMINATION

In an emergency, the primary concern is to prevent the loss of life or serious injury to personnel. Medical treatment will take precedence over decontamination in the event of a life threatening and/or serious injury/illness. Personnel will perform decontamination in designated and identified areas upon leaving "hot zones" where the potential exists for exposure to hazardous chemical, biological, or environmental conditions.

Decontamination of personnel in Level D (modified) will consist of removal and disposal of coveralls, disposable boots, and gloves, (if applicable).

Decontamination of personnel in Level D will consist of at a minimum:

- removal and cleaning/disposal of boot covers, coveralls, and outer gloves;
- washing of boots or other non-disposable PPE (e.g., hard hat, safety glasses/goggles, etc.) suspected of being contaminated using a soap solution followed by a water rinse; and
- removal and disposal of inner gloves.

Decontamination of personnel in Level B PPE, if applicable, will consist, at a minimum, of:

- removal and cleaning/disposal of boot covers, coveralls, and outer gloves;
- removal, cleaning, and storage of respiratory protection;
- washing of boots or other non-disposable PPE (e.g., hard hat, safety glasses/goggles, etc.) suspected of being contaminated using a soap solution followed by a water rinse; and
- removal and disposal of inner gloves.

Wash solutions and PPE will be managed on site in the existing leachate pond and the trenches designated for IDW, respectively. Hand tools and sampling equipment shall be decontaminated as needed by washing in decontamination basins with appropriate solutions.

Heavy equipment such as drill rigs, dozers, end loaders, etc., shall be decontaminated in accordance with the following:

- gross contamination shall be removed at the work location by use of shovels and brushes and will be collected in containers such as skip buckets or roll off containers and periodically moved to the location where investigation generated waste (IDW) will be located under the cover and unloaded into the trench;

- all IDW spillage and any visibly impacted soils below/around the spillage shall be removed and managed as IDW;

- heavy equipment shall be decontaminated in the existing asphalt lined decontamination pit in the southwest area of the site using pressure washers, brushes and non-phosphate soap, such as Alconox;

- all decontamination wash water shall be collected, contained and periodically placed in the existing on site leachate pond at the east end of the site;

- decontamination personnel shall wear Level D PPE and shall upgrade to Level B should organic vapors exceed health and safety criteria;

12. EMERGENCY PREPAREDNESS AND RESPONSE

A table presenting a list of contacts and telephone numbers for the applicable local off-site emergency responders is provided inside the front cover of this HASP (after figures). If the nature of the site work and COCs requires that off-site responders be notified before work begins on this project, the date that the pre-notification was made is presented in the table.

The following emergency response equipment is required for this project:

- ☒ Fire Extinguisher (Type ABC)
- ☒ Eyewash bottle
- ☒ First Aid Kit
- ☐ Other: _____

In the event that an on-site emergency develops, the procedures delineated in Table 4 are to be followed immediately. In addition, the instructions for reporting the incident presented in Appendix G shall be followed. Appendix G also includes forms that must be provided to the physician(s) giving care to a potentially injured or ill employee.

13. CONFINED SPACE ENTRY

☐ APPLICABLE ☒ NOT APPLICABLE

The task(s) for this project involve confined-space entry. Workers must abide by the company's Confined Space Entry Program [29 CFR §1910.120(j)].

14. SPILL CONTAINMENT

☐ APPLICABLE ☒ NOT APPLICABLE

The task(s) for this project involve handling of drums and/or containers that contain stored chemicals and/or wastes associated with sampling, excavation, transportation, etc. Workers must implement the hazard mitigating procedures for drum/container handling presented in Appendix C.

15. CHEMICAL HAZARD COMMUNICATION LABELING

☒ APPLICABLE ☐ NOT APPLICABLE

The following procedures must be followed for chemicals brought onto the site by Geosyntec personnel (i.e., decontamination solution, sampling preservatives, etc.) while performing the tasks of this project:

- Labels on primary chemical containers must not be defaced.
- Chemical containers must be stored in appropriate storage containers.
- Secondary containers and storage cabinets must be correctly and clearly labeled using the Hazardous Materials Identification System (HMIS).
- Chemicals incompatible with each other must not be stored together.
- Workers must receive training on the chemical hazards.
- Material Safety Data Sheets (MSDSs) for the chemical must be included in Appendix H.

When chemicals are used on site, workers must abide by Geosyntec's Hazard Communication Program.

Table 1

Key Personnel and Health & Safety Responsibilities

Principal-in-Charge or Associate-in-Charge Scott Luettich	*Project Manager (PM)* John Seymour	*Site Health & Safety Officer (SHSO)* Rich Skowron	*Project Personnel* Refer to Table 2	*Environmental, Health & Safety Coordinator (EHSC)* Kristi Kern
• Approve this HASP and amendments, if any. • Verify that elements of this HASP are implemented.	• Approve this HASP and amendments, if any. • Monitor the field logbooks for health and safety work practices employed. • Coordinate with SHSO so that emergency response procedures are implemented. • Verify that corrective actions are implemented. • Verify and document that personnel receive this plan and are aware of its provisions and potential hazards associated with site operations, and that they are instructed in safe work practices and familiar with emergency response procedures. • Provide for appropriate monitoring, personal protective equipment, and decontamination materials.	• Prepare and implement project HASP and amendments, if any, and report to the Project Manager for action if any deviations from the anticipated conditions exist and authorize the cessation of work if necessary. • Verify that site personnel meet the training and medical requirements. • Conduct pre-entry briefing and daily tailgate safety meetings. • Verify that all monitoring equipment and personal protective equipment is operating correctly according to manufacturer's instructions and such equipment is utilized by on-site personnel. Calibrate or verify calibration of all monitoring equipment and record results. • Verify that decontamination procedures are being implemented. • Implement site emergency response and follow-up procedures. • Notify the EHSC in the event an emergency occurs. • Perform weekly inspections.	• Provide verification of required health and safety training and medical surveillance prior to arriving at the site. • Notify the SHSO of any special medical conditions (e.g., allergies). • Attend pre-entry briefings and daily tailgate safety meetings. • Immediately report any accidents and/or unsafe conditions to the SHSO. • Be familiar with and abide by the HASP. • Be ultimately responsible for his or her own safety.	• Review and audit HASP and amendments. • Maintain a copy of the cover sheet of each completed HASP. • Notify Director of Environment, Health & Safety in the event an emergency occurs. • Assist with the implementation of the corporate health and safety program. • Consult on health and safety issues.

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Table 2

Training / Medical Surveillance / Respirator Fit Test Records

Employee name	Category	Initial 40 Hour	Initial 24 Hour	Annual 8 Hour Refresher	8 Hour Supervisor	CPR	First Aid	Medical Surveillance	Annual Respirator Fit Test	Other
BODINE, DANIEL G	II	3/1/1989		1/17/2008	12/1/1996	1/11/2007	1/11/2007	3/5/2007	4/29/2008	10/30/2002
DECKER, JORDAN	II	11/2/2007		1/21/2008		5/23/2007	5/23/2007	11/14/2007		
KERN, KRISTI	II	7/14/2006		1/17/2008	1/5/2007	3/20/2007	8/16/2006	7/17/2007		
SEYMOUR, JOHN P	II	12/14/1985		1/17/2008	8/29/1997	2/25/2006	2/7/2006	3/21/2007		
SKOWRON, RICK	II	7/24/2003		9/21/2007		12/19/2007	12/19/2007	9/11/2007	4/29/2008	
TANYU, BURAK	II	9/19/2003		1/17/2008	12/7/2004	3/20/2007	2/7/2006	9/21/2007		4/29/2004
ZOLP, DAVID	I	9/8/2003		1/21/2008	12/15/2000	3/18/2008	3/18/2008	12/18/2007		

Footnotes:

1 CPR Refresher: every year; First Aid Refresher: every three years.

2 Annual Medical Surveillance for EH&S Category I, Biannual Medical Surveillance for EH&S Categories II & III.

3 For EH&S Categories I & II Only.

4 Could Include task-specific training, project-specific training, or project-specific medial surveillance.

Table 3

General Safe Work Practices

- Minimize contact with impacted materials. Do not place equipment on the ground. Do not sit or kneel on potentially contaminated surfaces.
- Smoking, eating, or drinking after entering the work zone and before decontamination is not allowed. Employees who are suspected of being under the influence of illegal drugs or alcohol will be removed from the site. Workers taking prescribed medication that may cause drowsiness shall not operate heavy equipment and are prohibited from performing tasks where Level C, B, or A personal protective equipment is required.
- Practice good housekeeping. Keep everything orderly and out of potentially harmful situations.
- Use of contact lenses may not be allowed under certain hazardous working conditions.
- The following conditions must be observed when operating a motor vehicle.
  - Wearing of seat belts is mandatory
  - The use of headlights is mandatory during periods of rain, fog, or other adverse weather conditions
  - A backup warning system or use of vehicle horn is mandatory when the vehicle is engaged in a backward motion
  - All posted traffic signs and directions from flagmen must be observed
  - Equipment and/or samples transported in vehicles must be secured from movement
  - The use of vehicles acquired by Geosyntec by non-Geosyntec personnel is prohibited
- In an unknown situation, always assume the worst reasonable conditions
- Be observant of your immediate surroundings and the surroundings of others. It is a team effort to notice and warn of dangerous situations. Withdrawal from a hazardous situation to reassess procedures is the preferred course of action.
- Conflicting situations may arise concerning safety requirements and working conditions. These must be addressed and resolved rapidly by the SHSO and PM to relieve any motivations or pressures to circumvent established safety policies.
- Unauthorized breaches of specified safety protocol must not be allowed. Workers unwilling or unable to comply with the established procedures must be discharged.

Table 4

Emergency Response Procedures

- The SHSO (or alternate) should be immediately notified via the on-site communication system. The SHSO assumes control of the emergency response.
- If applicable, the SHSO must notify off-site emergency responders (i.e., fire department, hospital, police department, etc.) and must inform the response team of the nature and location of the emergency on site.
- If applicable, the SHSO calls for evacuation of the site. Site workers should move to their respective refuge stations using the evacuation routes provided on the Site Map.
- For small fires, flames should be extinguished using the fire extinguisher. Large fires should be handled by the local fire department.
- If chemicals are accidentally splashed into eyes or onto skin, use eyewash and/or shower.
- If a worker is injured, first aid shall be administered by workers certified in first aid.
- After an incident has occurred, the instruction for incident reporting presented in Appendix G must be followed.

Note that EMERGENCY RESPONSE PROCEDURES are separate from instructions for injury response and reporting, located elsewhere in this HASP.

Appendix A

HASP Amendments

Discuss details of amendments to this HASP here. Include amendment number, date, and details of amendments.

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Appendix B

Weekly Health & Safety Inspection Checklist

Project: _____ Date: _____

Inspected by: _____

Category	*Observations/Corrective Actions (N/A, if Not Applicable)*
Pre-entry briefing records are current	
Tailgate meeting records are current	
Training/medical surveillance/respiratory protection records are current	
Site map is posted	
Buddy system is implemented	
Work zones are identified	
Site access is controlled	
Visitors are being escorted	
On-site/off-site communications are in working order	
Safe work practices are being implemented	
Any additional hazards incurred?	
Air monitoring equipment is in working condition	
Air monitoring records are being recorded in field logbook	
Air monitoring calibration records are being recorded in field logbook	
PPE storage area is neat and organized	
Standard operating procedures are being implemented	
Housekeeping at decontamination zone is appropriate	
Decontamination procedures are being implemented	
Emergency response equipment is in working condition	
Route to hospital is posted	
Confined space entry program is being implemented	
Spill containment equipment is available	
Chemical inventory is up to date	
Material safety data sheets are available	
Primary and secondary containers are properly labeled	
Housekeeping at the chemical storage area is appropriate	

Appendix C

Hazard Analysis and Hazard Mitigators

	Ground Topographical Survey	Gas Vent Installation	Dual Phase Well Installation	IDW Handling	Gas Monitoring	Grass Mowing		
TASK #	①	②	③	④	⑤	⑥	⑦	⑧
I. Chemical Hazards								
Fire		X	X	X	X			
Permanganate Handling								
Reactivity								
Skin absorption			X	X				
II. Physical Hazards								
Bioaugmentation Culture Handling								
Chainsaw								
Compressed Gas Cylinder					X			
Downhole Logging		X	X					
Drilling (including Indoor)		X	X					
Drum and Container Handling				X				
Electrocution								
Excavation/Trenching				X				
Eye Injury	X	X	X	X	X	X		
Fall Protection	X	X	X	X	X			
Flash flood								
Hand/Foot Injury	X	X	X	X	X	X		
Heat Stress	X	X	X	X	X	X		
Heavy Equipment		X	X	X	X	X		
Knives / Blades					X	X		
Lifting Heavy Loads		X	X	X	X	X		

	Ground Topographical Survey	Gas Vent Installation	Dual Phase Well Installation	IDW Handling	Gas Monitoring	Grass Mowing		
TASK #	①	②	③	④	⑤	⑥	⑦	⑧
Loud Noise		X	X	X	X	X		
Portable Power/Hand Tool	X	X	X	X	X	X		
Slips, Trips, and Falls	X	X	X	X	X	X		
Truck Crane		X	X					
Urban Environments								
Utility Protection								
Welding and Cutting								
Other:								
III. Biological Hazards								
Allergic Reaction to Poisonous Plants	X	X	X	X	X	X		
Dogs								
Insects / Vermin / Snakes	X	X	X	X	X	X		
Medical Waste								
Stinging Insects	X	X	X	X	X	X		
Other:								

An X in a box indicates that the listed hazard is applicable to the respective task. The appropriate Hazard Mitigators are presented in this Appendix.

FIRE

- Know fire prevention procedures, fire-fighting techniques and essential precautions to prevent injury.
- Do not stop to get anything out of a building or area if evacuation is required. JUST GET OUT - and assemble in the predetermined evacuation assembly points.
- There are 3 elements to starting a fire: a fuel source, an oxygen source and a point of ignition.
- Know how and when to use different types of fire extinguishers.
- Keep all fire extinguishers in workable condition and accessible at all times. Access to or visibility of extinguishers shall not be obstructed.
- Control static electricity (e.g., ground equipment)
- Remove only the minimum required supply of paints, solvents, or other flammables from storage. At no time shall the quantity removed exceed one day's working supply.
- Do not allow combustible products of rubbish, waste or other residues to accumulate. Oil soaked rags and material subject to spontaneous combustion shall only be stored in non-combustible containers with self-closing lids.
- Do not store gasoline, flammable solvents, and liquids inside a building unless the structure has been approved for flammable storage containers. Only OSHA-approved storage cabinets shall be used for all flammable liquids, paints or solvents.
- Flammable liquids shall be stored in locations that will not interfere with evacuation of the area in case of a fire.
- Do not permit smoking, striking of matches, or other sources of ignition outside of designated "SMOKING" areas.
- Discard cigarette butts, matches or other similar materials in non-combustible containers.

SKIN ABSORPTION

- Be aware of chemicals of concern that can directly injure (corrode, burn, dehydrate) the skin or that can be absorbed into the bloodstream and subsequently transported to other organs from dust, liquid or vapor sources.
- Know that skin absorption is enhanced by abrasions, cuts, heat, and moisture.
- Do not wear contact lenses in contaminated atmospheres (since they may trap chemicals against the eye surface). The eye is particularly vulnerable because airborne chemicals can dissolve in its moist surface and be carried to the rest of the body through the bloodstream (capillaries are very close to the surface of the eye).
- Keep hands away from face.
- Minimize contact with liquid and solid chemicals.
- Wear protective clothing (e.g., suits and gloves) as specified by the Site Specific Health and Safety Plan.

COMPRESSED GAS CYLINDER

- Keep cylinder valve caps screwed on at all times when regulators and gauges are not attached to the cylinder and when the cylinder is being moved.
- Do not use force to remove valve cap if stuck.
- Protect cylinders from cuts and abrasions.
- Use extreme care not to drop cylinders.
- Secure cylinders in an upright position using chains or other approved restraints.
- Do not use cylinders for rollers or support.
- Do not tamper with cylinder valves or safety devices.
- Do not lift cylinders using the protective valve caps.
- Do not substitute oxygen for compressed air.
- Store all oxygen cylinders at least 20 feet from all fuel gas cylinders and gasoline or diesel storage tanks.
- Keep cylinders away from exposure to open flame.
- Do not use oil or grease on oxygen cylinders or regulator connections to avoid an explosion.
- All cylinders must be labeled and indicate when they have been emptied.
- Check all valves and fittings on a cylinder for leaks with each use. If leakage is found, place a tag on the cylinder indicting the defect, and report it to the SHSO.
- Leak test all connections using soap solution where possible.
- Be certain that the second stage of the regulator is closed, after attaching the regulator to the cylinder, but before opening the cylinder valve.
- Stand to one side of the regulator gauge while you slowly open the cylinder valve 1/4 of a turn.
- Keep wrench on the valve stem of an acetylene cylinder when in use.
- Close the cylinder valve and bleed the pressure off hoses on cylinders when not in use.
- Use a cylinder cart to transport cylinders distances greater than 2 feet.

DRILLING

- All members of the drilling crews shall be trained in the standard operating safety features and procedures to be utilized during operation, inspection, and maintenance of the equipment.
- Wear hard hats, steel toed boots, hearing protection and safety glasses at all times when performing drilling operations.
- Conduct a survey, prior to bringing drilling equipment to the job site, to identify overhead electrical hazards, potential subsurface hazards, and terrain hazard. Once on site, before drilling equipment is moved, the travel route shall again be visually surveyed for overhead and terrain hazards. Document possible hazards and communicate them to the drilling crew.
- Use only drilling equipment equipped with two easily-accessible emergency shutdown devices, one for the operator and one for the helper. Shutdown devices should be tested at the beginning of each day.
- Do not transport drilling equipment with the mast in the upward position.
- Extend outriggers per the manufacturer's specifications.
- Monitor weather conditions. Operations shall cease during electrical storms or when electrical storms are imminent.
- Wearing of loose clothing (e.g., open shirts, hooded sweatshirts, etc) is not permitted.
- When appropriate use auger guides on hard surfaces.
- Verbally alert employees and visually ensure employees are clear from dangerous parts of equipment prior to starting or engaging equipment.
- Channel the discharge of drilling fluids away from the work area to prevent the ponding of water.
- Use hoists only for their designed intent. Hoists shall not be loaded beyond their rated capacity. Steps shall be taken to prevent two-blocking of hoists (the condition when the lower load block or hook assembly comes in contact with the upper load block, or when the load block comes in contact with the boom tip).Follow the equipment manufacturer's procedures if ropes become caught in, or objects are pulled into a cathead.
- Do not run or rotate drill rods through rod slipping devices. No more than 5 feet of drill rod column shall be hoisted above the top of the drill mast. Drill rod tool joints shall not be made up, tightened, or loosened while the rod column is supported by a rod slipping device.
- Control dust using dust suppression techniques.
- Clean augers, drill casing, or drill rod only when the rotating mechanism is in neutral and the pipe is stationary is stopped.

- Cap and flag open boreholes; open excavations shall be barricaded.
- Keep all hand tools used during drilling operations clean and in good working condition.
- Check fire extinguishers and notify all onsite personnel to their whereabouts.
- Check cables for frays and hydraulic hoses for leaks daily.
- In situations where ambient water level may be above top of well screen, during well construction, ensure that well casing is vented to prevent air pressure build-up in blank casing above screen.

DRUM AND CONTAINER HANDLING

- Only trained personnel should open drums containing unknown materials.
- Bulging drums or containers are an indication of pressure build-up. Open all drums or bungs extremely slowly to determine the presence of vapors or pressure inside the drum. If the possibility of fire or explosion exists, a protective shield should be used and/or remote opening devices. Employees not directly involved with opening a container shall be kept a safe distance away.
- Use only drums and containers that meet the appropriate DOT, OSHA, and EPA regulations.
- Utilize drum/container handling equipment whenever possible. The equipment should have a sufficiently rated load capacity and should be able to operate smoothly on the available surface.
- Label and identify drums and containers when moved to the staging areas to safely identify and classify their contents. Segregate incompatible drums.
- Inspect the integrity of the drum container before moving. Any drum or container lacking integrity shall be placed within an over pack container.
- Staging areas require adequate escape routes. Staging area should provide secondary containment for all moved drums.
- Employees must be warned of the potential hazards associated with the contents of containers or drums prior to moving said containers or drums.
- Organize site operation to minimize the amount of drum or container movement. Have a clear view of the available pathway when moving drums. If needed, an additional person should be available to provide guidance.
- Never stand on drums or containers.
- Use non-sparking tools and appropriate grounding and bonding equipment.
- Appropriate fire extinguishing equipment must be onsite at all times during drum handling.
- Spill control equipment shall be onsite in areas where spills ruptures or leaks may occur.

EXCAVATION/TRENCHING

Prior to Excavation

- Confirm that an OSHA competent person is available. An OSHA competent person is someone with enough training to identify soil types and other excavation hazards and authority to take prompt corrective actions.
- Check for the presence of underground and aboveground utilities before conducting any intrusive work. Support, protect or remove utility lines as appropriate.
- Implement the Geosyntec Confined Space Entry Program if employees are to enter excavations or trenches of 4 feet deep or deeper (regardless of width).
- Remove or brace trees, boulders, etc., adjacent to the work area that could fall into the work area before intrusive begins.
- Underpin all nearby existing structures to ensure their stability before excavating below the level of the base of the footing of any foundation or retaining wall.

During Excavation

- Wear hard hats, safety boots and reflective vests.
- Use flagmen or warning devices for all mobile equipment using reverse and forward motion
- Adequately slope or shore all sides of excavations/trenches 5 feet or more in depth (depending on local regulations) before allowing anyone to enter them (see below).
- Store and retain all equipment/material and excavated soil/rock/waste (spoil(s)) at least 2 feet or more from the edge of the excavation/trench.
- Use diversion ditches or dikes to prevent water from entering an excavation, and to provide adequate drainage of the area adjacent to the excavation. Prevent water from accumulating in an excavation.
- Install substantial stop logs or barricades when mobile equipment is used or allowed adjacent to excavations.
- Provide a walkway or bridge with standard guardrails where employees or equipment are required or permitted to cross over excavations.
- Ladders used for ingress/egress should extend a minimum of 3' above ground surface, be secured, and be located so as to require no more than 25 feet of lateral travel for workers in the trench or excavation.
- Avoid standing on top of trench/excavation while personnel are below, in the trench.

- Examine all excavation work areas and faces for unsafe conditions at least at the beginning of each shift and especially after blasting, a rain, a freeze or a thaw. If unsafe conditions are found, all work in that immediate area shall cease until the necessary
- If it is necessary to place or operate trucks, materials or other heavy objects on a level above and near an excavation, pile, shore, and/or brace sides of excavations to resist the extra pressure due to such superimposed loads.

Shoring an Excavation

- Place cross braces or trench jacks in a true horizontal position, space vertically and secure to prevent sliding, falling or kickouts.
- Use portable trench boxes or sliding trench shields, if needed, in place of a shoring system or sloping.
- Support systems shall be planned and designed by a qualified professional engineer when the excavation is in excess of 20 feet in depth, adjacent to structures or improvement, or subject to vibration or ground water.
- Removal and backfilling of trench supports must slowly progress together from the bottom of the trench. Jacks or braces shall be released slowly and in unstable soil, ropes shall be used to pull out the jacks or braces from above after employees have cleared the trench.
- Stability of an excavation left open for a long period of time(i.e. more than a few days) should be evaluated by a professional engineer to assess if slopes, bracing measures, etc. need to be modified.
- Start backfilling trench before removing braces in case of Type C soils.
- Put up barricades – flagging tape, fencing to prevent falls into the excavation.
- Cover or secure trench/excavation if left open overnight.

Sloping an excavation

- Excavate to at least the OSHA minimum required angle ratio according to soil classification identified except for areas where solid rock allows for line drilling or pre-splitting.
- Flatten the angle of repose when an excavation has water conditions, silty materials, loose boulders, and areas where erosion, deep frost action and slide planes appear.

Soil Classification	Soil Classification Description	OSHA Minimum Requirements For Side Slopes
Soil Type A	Most stable: clay, silty clay and hardpan (resists penetration)	.75:1 (for one foot vertical rise, the trench wall must be cut back ¾')
Soil Type B	Medium stability: silt, sandy loam, medium clay and unstable dry rock	1:1 (each step has an equal horizontal and vertical rise; only cohesive Type B soils may be benched)
Soil Type C	Least stable: gravel, loamy sand, soft clay, submerged soil or dense, heavy unstable rock	1.5:1 (trench wall must be cut back 1-1/2' for 1' vertical rise; type C soil is not benched)

EYE INJURY

- Wear appropriate eye protection according to the task at hand.

HAZARD	TYPE OF PROTECTION
Impact	Safety glasses with side shield or vented safety goggles
Heat (Sparks)	Vented safety goggles or safety glasses with a face shield
Chemical	Hooded vented safety goggles or full-face respirator (if mild chemicals then safety glasses with side shield is acceptable)
Light Radiation	Tinted/reflective safety glasses or tinted/reflective face shield
Dust	Hooded vented safety goggles

- Apply anti-fog product to lens not previously treated.
- Minimize the amount of vapor or particulate matter generated, if possible.
- Avoid touching the face and eyes.
- Flush eyes with water for at least 15 minutes if chemicals do get into the eyes. If condition persists, seek medical attention.
- If dust or foreign objects are in your eyes, do not rub your eyes.
- If an object becomes embedded in the eye, do not attempt to remove. Lightly bandage your eyes, or both eyes, if possible and immediately seek medical attention.
- Do not wear contact lenses if chemical or dust hazard is present (e.g. decontamination or preservation chemicals used during sampling).
- Provide on-site training to workers before tasks at hand.
- If visitors enter area, stop work until they are properly protected.

FALL PROTECTION

- When workers could fall more than 15 feet doing structural wood framing or working on a tower crane. [1716.1(c)(1) and 4966(a)] Personal fall protection is used both to prevent workers from falling and to break falls.
- Fall protection is in place:

  - When workers could fall more than 6 feet placing or tying rebar. [1712(e)]

  - When workers could fall more than 7½ feet from the edge of a structure or through an opening. [1670(a)] When workers could fall more than 7½ feet from a platform, catwalk, walkway, scaffold, or sloped or roof surface steeper than 7:12. [1670(a)]

  - When workers could fall more than 15 feet doing most iron work (bolting steel, welding, etc.). [1710(g)(2)]

  - When workers could fall more than 20 feet doing roofing. [1730(b)]

  - When workers could fall more than 30 feet connecting structural steel beams. [1710(g)(1)]

- Guardrails are provided in the above locations where feasible. Otherwise, one or more of the following are used: personal fall arrest systems, personal fall restraint systems, positioning device systems, or safety nets. (Guardrails are covered in a separate Checklist.) [1670]
- The fall protection measures above are required but not used on the site because they are impractical or create a greater hazard than they prevent. In this case, there is a written Fall Protection Plan describing alternative measures that will be used. [1671.1(a)]
- Look where you walk to make certain your pathway is clear of hazards.
- Practice safe walking skills.
- Scaffolds/ladders: Both require pre-use inspection for integrity, with particular attention given to scaffold planking (secure and strong), levelness of erection, avoidance of power lines, and bolted pipe connections. Portable step ladders are exempt from fall protection
- Requirements when used properly, i.e. avoid using top step. Only fiberglass step ladders should be used. Extension ladders must extend 3 feet (3 rungs) above platform/work area, and must be placed on level surface, with tie-off at upper level.

HAND/FOOT INJURY

- Wear protective gloves as required in the Health and Safety Plan. Gloves should be chosen to suit the work being performed (e.g., chemical resistant gloves will be worn when handling chemicals or sampling for suspected chemicals).
- Steel-toed/steel-shanked safety boots must be worn whenever working around heavy objects (or as required by the HASP). Insulated and/or waterproof boots may also be warranted depending on weather conditions. Boots should be inspected periodically for signs of wear (e.g., cracks in rubber or along soles) and replaced as required.
- Durable footwear which provides adequate ankle support should be worn when working in rugged terrain.
- Use proper lifting techniques to avoid dropping heavy loads on hands and feet (refer to lifting heavy loads hazard mitigator)
- Be aware of moving machinery and heavy equipment in the work area and tuck away any loose clothing.

HEAT STRESS

Prevention:

- Drink plenty of hydrating fluids, such as Gatorade® or water. In high heat, a minimum of one gallon per day should be consumed. Fluid should be consumed frequently. Don't wait until thirsty.
- Provide cooling devices, when necessary, to aid natural body heat exchange during prolonged work or severe heat exposure. Devices include field showers, hose-down areas, shade umbrellas/tents, wide-brim hats, and cooling jackets, vests, or suits.
- If amenable to work conditions, wear light-colored, loose fitting, "breathable" clothing.
- Avoid prolonged periods of exposure. Take breaks as necessary. Higher heat exposure requires more frequent breaks.
- Be able to recognize the signs, symptoms and how to treat for heat stress. Signs, symptoms and treatment are listed below.

Signs and Symptoms:

- Mild heat stress - Decreased energy, slight loss of appetite, nausea, lightheadedness.
- Moderate heat stress - heavy sweating, thirst, faintness, headache, confusion.
- Severe heat stress (heat stroke) - Throbbing headache, confusion, irritability, rapid heartbeat, difficulty breathing, dry skin (no sweating), vomiting, diarrhea.

Treatment:

- Mild and Moderate heat stress - Take to cool place, drink cool (not cold) fluids, remove excess clothing, rest.
- Severe heat stress - Call 911 for an ambulance and get to a cool place, remove excess clothing and rest.
- Adjust work and rest schedules as needed. Establish a work regimen that will provide adequate rest periods for cooling down. This may require additional shifts of workers.
- Provide shelter or shaded areas (77o F is best) to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must equal the approximate amount of water lost in sweat. Workers are encouraged to drink more than the amount required to satisfy thirst (recommend water and sport drinks, not coffee or soda), because thirst is not an adequate indicator of adequate salt and fluid replacement.
- Remove impermeable protective garments during rest periods.
- Do not assign other tasks to personnel during rest periods.

HEAVY EQUIPMENT

Working around Heavy Equipment

- Yield to heavy equipment.
- Listen for warning signals on heavy equipment.
- Perform a visual inspection and walk around parked heavy equipment before moving to assure that equipment is in good condition and that there are no personnel on the ground that could be injured or objects that could be damaged by vehicle movement.
- Wear hearing protection if required.
- Wear traffic vests for increased visibility.
- Maintain eye contact with the heavy equipment operator when working near equipment.
- Be aware of changes in sound of equipment which may indicate a change in direction.

Heavy Equipment Operators

- use hand rails and footholds when mounting and dismounting equipment,
- Brakes, steering, clutches and controls shall be tested.
- Pay attention to workers on the ground who may be in the path and provide warning prior to moving the equipment.
- Permit no one to ride on, or in, heavy equipment. This includes any portion of a backhoe, bulldozer, forklift or the back of a pickup truck, except in locations specifically designed for passenger use and approved by the SHSO.
- Keep haulage vehicles under positive control at all times while operating. Vehicles shall be kept in gear when descending grades.
- Do not use heavy equipment on slopes with steepness exceeding 3H:1V unless operations are consistent with manufacturer's recommendations (if the Owner's Manual is not with the equipment or does not specify slope operating procedures, see the SHSO).
- Operate equipment with booms, blades, buckets, beds, etc., lowered or in a stable position while on slopes. Safety cables tethered to appropriate anchors shall be used for equipment working on steep slopes, where appropriate.
- Suspend in slings or support by hoists or jacks heavy equipment in need of repair. The equipment must also be blocked or cribbed before working underneath.
- Shut off motors, do not allow smoking, and use proper dispensing equipment when refueling gasoline-operated equipment to prevent fire hazards.
- Lower hydraulic systems (e.g., blades, etc.) to the ground, set brakes, and shut down equipment if malfunction occurs.
- Use rollover protection and seat belts.

KNIVES / BLADES

- Always wear proper protective equipment. This should include:

  - heavy-duty leather gloves,

  - steel-toed boots with non-slip soles, and

  - hardhat and eye protection.

- Check the work area and make sure that:

  - the ground is free of obstacles such as rocks, stumps, holes, and wet or otherwise slippery conditions.

  - you can get a firm footing on the ground.

- Route cords, hoses, and cables supplying power to portable power tools to prevent tripping hazards.
- Protect tools from corrosion damage.
- Keep tools free of accumulated dirt and unnecessary oil or grease.
- Worn, damaged or dull blades should be sharpened or replaced as necessary.

LIFTING HEAVY LOADS

- Proper lifting techniques include:

  - *Feet* - Feet should be parted, with one foot alongside the object being lifted and one behind. Feet should be comfortably spread to give greater stability. The rear foot should be in position for the upward thrust of the lift.

  - *Back* - Use the sit-down position and keep the back straight, but remember that "straight" does not mean "vertical". A straight back keeps the spine, back muscles, and organs of the body in correct alignment. It minimizes the compression of the abdomen that can cause a hernia.

  - *Arms and Elbows* - The load should be drawn close to the body, and the arms and elbows should be tucked in. When the arms are held away from the body, they lose much of their strength and power. Keeping the arms tucked in also helps keep body weight centered.

  - *Palm* - The palm grip is one of the most important elements of lifting. The fingers and the hand are extended around the object to be lifted. Use the full palm; fingers alone have very little power.

  - *Chin* - Tuck in the chin so the neck and head continue the straight back line. Keep the spine straight and firm.

  - *Body Weight* - Position the body so its weight is centered over the feet. This provides a more powerful line of thrust and assures better balance. Start the lift with a thrust of the rear foot. Shift hand positions so the object can be boosted after knees are bent. Straighten knees as object is lifted or shifted to the shoulders. To change direction, lift the object to a carrying position, and turn the entire body, including the feet. Do not twist your body. In repetitive work, both the person and the material should be positioned so that the worker will not have to twist his body when moving the material. If the object is too heavy to be handled by one person, get help.

- Limit continuous lifting of weights to 50 pounds or the maximum allowed by the client whichever is less. Lifts of heavier weights are permitted on an interim basis. Help shall be obtained for lifting of loads greater than 50 pounds or the maximum allowed by the client whichever is less. Mechanical equipment should be used on heavy materials when possible. If mechanical assistance is not available, adequate manpower to maintain the 50-pound limit per employee will be required.

- Do not lift more weight than can be handled comfortably, regardless of load weight. If necessary, help should be requested to lift a load so that the lifting is comfortable.
- Use drum dollies when moving drums or barrels.
- Inspect objects for grease or slippery substances before they are lifted to ensure that the object will not slip.
- Do not carry long, bulky or heavy objects without first verifying that the way is clear and that vision is unobstructed. This ensures that other persons or objects will not be struck by the load.
- Do not carry loads that cannot be seen over or around.
- Exercise caution when lifting above the chest level.
- Make sure workers are physically suited for the job before assigning jobs requiring heavy and/or frequent lifting. A person's lifting ability is not necessarily indicated by his height or weight.
- Before lifting an object, consideration should be given to how the object will be set down without pinching or crushing hands or fingers. For example, to place an object on a bench or table, the object should be set on the edge and pushed far enough onto the support so it will not fall. The object can then be released gradually as it is set down, and pushed in place with the hands and body from in front of the object.
- When two or more people are handling the same object, one should "call the signals". All the persons on the lift should know who this person is and should warn him if anyone in the crew is about to relax his grip.

LOUD NOISE

- Wear hearing protection in areas with constant or loud noise.
- Know the effects of noise, including:
  - Workers being startled, annoyed, or distracted.
  - Physical damage to the ear, pain, and temporary and/or permanent hearing loss.
  - Communication interference that may increase potential hazards due to the inability to warn of danger and proper safety precautions to be taken.
- Implement the company Hearing Conservation Program when noise exposures equal or exceed an 8-hour, time-weighed average (TWA) sound level of 85 decibels on the A-weighed scale (dB).
- Utilize feasible administrative or engineering controls if workers are subjected to noise exceeding an 8-hour TWA sound level of 90 dB.

PORTABLE POWER/HAND TOOL

- Read instruction manual for the safe operation of any portable power tool.
- Route cords, hoses, and cables to prevent tripping hazards or contact with equipment.
- Avoid abusing the power supply lines of portable equipment. Excessive scraping, kicking, stretching, and exposure to grease and oils will damage lines or cause them to fail prematurely, and possibly injure the operator or fellow workers.
- Inspect cords, hoses, and cables for wear or deterioration.
- Do not use electrically powered tools near flammable materials or explosive atmosphere, unless they are of the explosion-proof type meeting the National Electrical Code for potentially explosive work areas. Employees operating the equipment should be aware of sparks and or metal fragments when using this equipment.
- Ground-check portable electric power tools with metal cases initially and quarterly. At no time will electrical power equipment be operated without proper grounding. All electrical cords and cables, including extension cords, shall include a third wire ground.
- Prohibit operations of electric tools in wet or damp areas.
- Size cords adequately for length and the electrical demand of the tool. Otherwise, they may cause a fire hazard.
- Limit use of tools to the purpose for which the tool is intended (e.g., wrenches will not be used as hammers). Defective tools (e.g., with mushroomed heads or split or defective handles) shall not be used.
- Keep tools free of accumulated dirt and unnecessary oil or grease. Moving and adjustable parts shall be lubricated frequently to prevent wear and misalignment.
- Replace or repair damaged or worn tools promptly. Temporary or makeshift repairs are prohibited. At the discretion of the supervisor, discard all tools that cannot be repaired safely. Supervisors shall decide when to discard a tool.
- Store tools in suitable boxes or containers. Loose tools shall not be stored on ledges or where they might fall. Tools shall be picked up when a job is completed and not be allowed to accumulate in the work area. Store all tools in a safe place.
- Do not use conducting (i.e., metal) tools around electrical facilities. Insulated tools, approved for electrical work, shall be tested frequently for proper insulation.
- Select the correct size and type of wrench for each job. Wrench handles shall not be extended with a pipe or cheater because the jaws will spread.
- Repair mushroomed punch, drift and chisel heads. Mushroomed heads represent crystallized metal that will break and fly off when struck.
- Wear eye protection at all times.

SLIPS, TRIPS, AND FALLS

- Wear the proper foot wear and clothing for the task at hand.
- Pay attention to the work environment and become aware of all equipment and vehicles active onsite and use caution when moving about.
- Use caution when walking on sloped areas (especially geosynthetics), particularly when moisture is present. Use caution when walking on soft or uneven surfaces; e.g., marsh areas. Watch for icy conditions in cold weather.
- Follow the established designated safe paths for travel and keep these areas free from debris. Avoid steep or slippery slopes and paths near operation vehicles and equipment.
- Follow good housekeeping procedures. Never assume that someone else will clean up a spill or put away an object.
- Remove or clearly mark objects that pose tripping hazards.
- Prevent water accumulation where practicable.
- Cables and/or wiring should be taped down, when possible. Locate cables and/or wiring out of the commonly used areas.
- Mark or repair any opening or hole in the floor.
- Carry objects in a manner that allows you to see in the area you are moving in. Do not carry objects that are too large or bulky. Do not carry more weight than you can balance and keep stable. Understand that PPE can reduce or limit your field of vision and mobility.
- Use the proper ladder for the task at hand and do not exceed the recommended height. Do not use the top two rungs of a ladder. Ensure a flat and stable footing for the placement of a ladder. Utilize the buddy system to help secure the ladder. When working over 6 ft., utilize fall prevention measures. Obey height and weight guidelines and/or rules.
- Use the handrail when using stairs. Be aware of stairway blockages.
- If conditions even slightly resemble an unsafe environment, do not make any assumptions that the integrity of a workplace is intact.
- Never jump over or into a trench or excavation.
- Walk; do not run.
- Maintain proper lighting so obstacles are clearly visible

TRUCK CRANES

Working with Cargo Bed Mounted Truck Crane

- Make sure vehicle is in park with the parking brake on.
- Truck should be parked on as level of a surface as possible.
- Make sure the control unit connectors are plugged into their proper plug locations.
- Check the crane for proper support pin placements and that the crane unit is secured properly.
- When lowering or raising the cable, make sure hands and clothing are away from the pulleys and winch mechanism.
- Maintain eye contact with the crane operator when working near equipment.
- Be aware of changes in sound of equipment which may indicate a change in direction or fatigue with equipment.
- Hand signals may be needed to communicate with crane operator in areas with loud noise.

Lifting Loads with Cargo Bed Mounted Truck Crane

- Respect the load capabilities of the unit at all times. Capacity is 500 Lbs for trucks with GVWR of 8800 pounds or less and 750 Lbs for trucks with GVWR of 8800 pounds or greater. (GVWR specifications of trucks can be found on sticker located on the driver side door jam).
- Make sure the load is secured correctly to the crane cable.
- Make sure the load that will be lifted in not secured, bolted down, or attached in anyway before lifting.
- Equipment used to secure load to the truck crane should be properly rated for the load being lifted.
- Know the weight of the load being lifted, and make sure it falls under the maximum lift load of the crane.
- Do not put any part of body under the crane boom or lifted loads at any time.
- Load lifting should be as close to vertical (plumb) as possible. Be aware of swinging loads once lifted.
- Lift and drop load at a safe rate of speed.
- When rotating the load, make sure that the pathway way is clear of equipment and personnel.
- Do not stand between crane cable and truck at any time.

Appendix E

Air Monitoring Equipment, Frequency of Readings, and Action Guidelines per Task

Applies to Task: ☐ ① ☒ ② ☒ ③ ☒ ④ ☒ ⑤ ☐ ⑥ ☐ ⑦ ☐ ⑧

☒ *Explosimeter*

Brand/Model No.: GEM-500 or higher model
Monitoring Frequency: At potential sources prior to initiating work and periodically during work.

Source Reading (% LEL)	Action
1 to 10	Continue with caution.
Greater than 10	Stop work. Evacuate the area. If upon return, if concentration still exceeds 10% LEL, ventilate until concentration is back to <10% LEL.

Note: This is applicable only in the breathing zone, elsewhere may be higher.

☐ *Oxygen Meter*

Brand/Model No.: GEM-500 or higher model
Monitoring Frequency:_At potential sources prior to initiating work and periodically during work.

Reading (%)	Action
Less than 19.5	Stop work. Evacuate the area.
19.5 to 23.5	Continue to work with caution.
Greater than 23.5	Stop work. Evacuate the area.

Note: Upgrade to Level B after cause of high or low oxygen are understood.

☒ *Photoionization Detector*

Brand/Model No.: MiniRAE Plus, 11.7eV lamp
Monitoring Frequency: At potential sources prior to initiating work and periodically during work.

Breathing Zone Reading (ppm)	Action
0 to 5	Level D PPE
Greater than 5	Stop work. Evacuate the area. If upon return, levels still exceed 5 ppm, Level B PPE must be acquired and worn by trained personnel.

Note: Vinyl chloride has the lowest threshold of the COCs listed in Appendix D. Action level was set based on this COC.

☐ *Flame Ionization Detector*

Brand/Model No.: _____
Monitoring Frequency: ___

Breathing Zone Reading (ppm)	Action
____ to ____	Level D PPE
____ to ____	Level C PPE
Greater than _____	Stop work. Evacuate the area. If upon return, levels still exceed ___, stop work and implement engineering controls.

Note: _____

☒ *Chemical Detector Tube*

Brand/Model No.: Draeger-Tubes, Vinyl Chloride (Vinyl Chloride 0.5/b), Benzene (Benzene 5/a)
Monitoring Frequency: At potential sources prior to initiating work and periodically during work.

Breathing Zone Reading (ppm)	Action
0 to 1 (VC); 10 (B)	Level D PPE
Greater than 1 (VC); 10 (B)	Stop work. Evacuate the area. If upon return, levels still exceed 1 (VC) or 10(B) ppm, Level B PPE must be acquired and worn by trained personnel.

Note: _____

☐ *Other*

Brand/Model No.:_____
Monitoring Frequency: ___

Breathing Zone Reading	Action
____ to ____	Level D PPE
____ to ____	Level C PPE
Greater than _____	Stop work. Evacuate the area. If upon return, levels still exceed _____

Note: _____

ALLERGIC REACTION TO POISONOUS PLANTS

- Be able to recognize and identify poisonous plants indigenous to the site location (e.g., poison ivy, poison oak, poison sumac). For example, poison Ivy plants have three leaves arranged at the end of each stem. Two secondary leaves are attached opposite one another and directly to the stem at their base. The primary leaf is attached to the end of the stem. The leaves often, but NOT ALWAYS, have a shiny appearance. See photos below.

- Poison Ivy often appears as ground cover at the edge of wooded areas and along trails within fields and woods. It may also appear growing from a vine wrapped around trees.
- Avoid or remove poisonous plants where practicable. Wear appropriate protective clothing (e.g., gloves, long-sleeved shirts) as required.
- One can become sensitized (like a latex allergy) though immune for several years at the beginning.
- If you come in contact with the plant, the plant's oil will be transferred onto your skin and clothing. The best way to manage the oil is to wash skin with cool water and soap (preferably 5% tincture of green soap available at CVS). If soap and water is unavailable, thorough (2-3 minutes) rinsing with cold water may help (not warm...want to keep those pores closed!)
- The lag time between exposure and symptoms can be quite long like several days.
- If you are in the field, blot the area with an alcohol patch and follow by washing as soon as possible. Calamine lotion, Tecnu, yellow laundry soap, or Colloidal oatmeal (Aveeno®) baths provide relief from itching and rashes. More information about Tecnu can be found at http://www.teclabsinc.com/.
- If you have to pass through heavy ivy growth, be sure to carefully handle your field cloths when you return. Your shoe laces will always get you if you are not careful. The oil can last on clothing for a few weeks, so wash frequently.
- For additional information, please see http://poisonivy.aesir.com/

INSECT / VERMIN / SNAKES

- Be able to recognize insects/vermin/snakes indigenous to the site location and habitats. Learn the indigenous dangerous species (e.g., spiders, snakes, ticks) prior to entering the field and know the first aid treatments.
- Poisonous venomous snakes swim on top of the water, non-poisonous venomous snakes swim with only their heads above water.
- Advise the SHSO if you have allergies to any insects prior to engaging in any field activities.
- Include the following preventative measures as necessary: wear light-colored clothing, keep clothing buttoned, tuck pant legs into socks, keep shirt tails tucked in, boots, hoods, netting, gloves, masks, insect repellants or other personal protection.
- Snake bite kits are commercially available and should be carried by field personnel when working where poisonous snakes exist. In the case of a snake bite, keep the patient calm, restrict activity and immobilize the bite area (do not elevate), and immediately obtain medical attention.
- Report any bites or stings to the SHSO and seek medical attention immediately.

STINGING INSECTS

- Be aware of potential hive/nest locations, which may include culverts, drainage pipes, junk piles, or dense shrubbery.
- Advise the SHSO if you are allergic to stinging insects prior to engaging in any field activities.
- Include the following controls:
  - Do not agitate stinging insects or disrupt their hive/nest.
  - Keep the area quiet and calm.
  - Wear light-colored clothes.
  - Avoid wearing perfumes, hair spray, or scented lotions in the wilderness.
- If attacked:
  - Do not scream or wave arms.
  - Cover your face with your hands.
  - Run for shelter in a building or vehicle. Do not seek shelter in water.
  - Remove stingers as quickly as possible to lessen the amount of venom entering the body. Remove the stinger by raking your fingernail across it. Don't pinch or pull the stinger out. Put ice on the sting to reduce the swelling.
- Report any stings to the SHSO and seek first aid or emergency medical care immediately if stung several times.

Appendix D

Constituents of Concern (COCs)

Constituent[1]	*Medium*[2]	*Maximum Concentration*[3]
Methylene chloride	Liquid	3.200 mg/L
Acetone	Liquid	17 mg/L
Benzene	Liquid	0.170 mg/L
Tetrachloroethene	Liquid	0.420 mg/L
Trichloroethene	Liquid	0.340 mg/L
Phenol	Liquid	7.100 mg/L
Antimony	Liquid	0.494 mg/L
Chromium	Liquid	1.97 mg/L
Lead	Liquid	11.9 mg/L
Mercury	Liquid	0.167 mg/L
Methylene chloride	Gas	0.640 ppm
Acetone	Gas	1.600 ppm
1,1-Dichloroethane	Gas	2.800 ppm
2-Butane	Gas	1.200 ppm
Benzene	Gas	0.330 ppm
Tetrachloroethene	Gas	0.089 ppm
Toluene	Gas	20.000+ ppm
Ethylbenzene	Gas	5.500 ppm
Xylenes (total)	Gas	13.000 ppm

Vinyl chloride	Gas	0.700 ppm
1,1,1-trichloroethane	Gas	0.841 ppm
Trichloroethene	Gas	0.360 ppm
Chlorobenzene	Gas	0.640 ppm
Methane	Gas	50%
Hydrogen sulfide	Gas	Unknown[4]
Arsenic	Solid	9.2 mg/kg

Footnotes:

1 Constituents that are included on this list have either been detected at the site at concentrations that may cause potential dermal, ingestion, or inhalation hazards, or the constituent is suspected to potentially be present at elevated concentrations but no analytical data are available.

2 Type of medium (i.e. soil, water, sludge, etc.).

3 Maximum concentration previously detected for the constituent based on historic data (if available). Liquid concentrations are presented in milligrams of constituent per liter of solution (ug/l). Solids concentrations are presented in milligrams of constituent per kilogram of soil (mg/kg). Soil gas and/or ambient air concentrations are reported in milligrams of constituent per cubic meter of gas/air (mg/m^3).

4 Presence expected as a waste decomposition byproduct.

MSDS Number: **T4914** * * * * * *Effective Date: **02/16/06*** * * * * *Supercedes: **05/08/03***

MSDS **Material Safety Data Sheet**

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

1,1,1-TRICHLOROETHANE

1. Product Identification

Synonyms: Methyl chloroform; trichloroethane; chloroetene
CAS No.: 71-55-6
Molecular Weight: 133.40
Chemical Formula: CH3CCl3
Product Codes: 9435, 9437, W509, W510

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methyl Chloroform	71-55-6	96 - 100%	Yes
Dioxane	123-91-1	< 3%	Yes
1,2-Epoxybutane	106-88-7	< 0.5%	Yes
Actual concentrations proprietary			

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, KIDNEYS, AND CARDIOVASCULAR SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. POSSIBLE CANCER HAZARD. CONTAINS DIOXANE WHICH MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Inhalation of vapors will irritate the respiratory tract. Affects the central nervous system. Symptoms include headache, dizziness, weakness, nausea. Higher levels of exposure (> 5000 ppm) can cause irregular heart beat, kidney and liver damage, fall in blood pressure, unconsciousness and even death.
Ingestion:
Harmful if swallowed. Symptoms similar to inhalation will occur along with nausea, vomiting. Aspiration of material into the lungs can cause chemical pneumonitis which can be fatal. If aspirated, may be rapidly absorbed through the lungs and result in injury to other body systems.
Skin Contact:
Causes mild irritation and redness, especially on prolonged contact. Repeated contact may cause drying or flaking of the skin.
Eye Contact:
Liquids and vapors cause irritation. Symptoms include tearing, redness, stinging, swelling.
Chronic Exposure:
Prolonged or repeated skin contact may cause dermatitis. Chronic exposure may affect the kidneys and liver. Dioxane is a suspected human carcinogen based on animal data.
Aggravation of Pre-existing Conditions:
Personnel with CNS, kidney, liver or heart disease may be more susceptible to the effects of this substance. Use of alcoholic beverages may aggravate symptoms.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:
Autoignition temperature: 500C (932F)
Flammable limits in air % by volume:
lel: 7.0; uel: 16.0
Vapors in containers can explode if subjected to high energy source.
Dioxane has a flash point below 16C (60F).
Explosion:
Can react with strong caustic, such as potash to form a flammable or explosive material. Air/vapor mixtures may explode when heated. Vapors can flow along surfaces to distant ignition source and flash back. Sealed containers may rupture when heated.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! Do not use aluminum, magnesium or zinc metal for storage container. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

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7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do not use aluminum equipment or storage containers. Contact with aluminum parts in a pressurized fluid system may cause violent reactions.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
350 ppm (TWA) for trichloroethane
100 ppm (TWA) skin for dioxane
-ACGIH Threshold Limit Value (TLV):
350 ppm (TWA), 450 ppm (STEL) for trichloroethane
20 ppm (TWA) skin, A3 - Animal Carcinogen for dioxane
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). This substance has questionable warning properties. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Viton is a recommended material for personal protective equipment.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Mild chloroform-like odor.
Solubility:
4,400 ppm in water @ 20C (68F)
Specific Gravity:
1.34 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
74C (165F)
Melting Point:
-32C (-26F)
Vapor Density (Air=1):
4.63
Vapor Pressure (mm Hg):
100 @ 20C (68F)
Evaporation Rate (BuAc=1):
12.8

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10. Stability and Reactivity

Stability:
Requires inhibitor content to prevent corrosion of metals. Slowly hydrolyzes in water to form hydrochloric and acetic acid.
Hazardous Decomposition Products:
May produce carbon monoxide, carbon dioxide, hydrogen chloride and phosgene when heated to decomposition. Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Hazardous polymerization can occur in contact with aluminum trichloride.
Incompatibilities:
Open flames, welding arcs, nitrogen tetroxide, oxygen, liquid oxygen, sodium, sodium hydroxide, and sodium-potassium alloy, strong alkalis, oxidizers, aluminum and other reactive metals.
Conditions to Avoid:
Insufficient inhibitor, incompatibles, heat, flame and ignition sources

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11. Toxicological Information

Oral rat LD50: 9600 mg/kg; inhalation rat LC50: 18000 ppm/4H; investigated as a mutagen, tumorigen, reproductive effector; irritation eye rabbit, Standard Draize, 2mg/24H severe.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methyl Chloroform (71-55-6)	No	No	3
Dioxane (123-91-1)	No	Yes	2B
1,2-Epoxybutane (106-88-7)	No	No	2B

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released to water, this material is expected to quickly evaporate. This material is not expected to significantly bioaccumulate. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released to the atmosphere, this material has an average global half-life of 6.0 - 6.9 years. When released into the air, this material may adversely affect the ozone layer.
Environmental Toxicity:
This material is expected to be slightly toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: 1,1,1-TRICHLOROETHANE
Hazard Class: 6.1
UN/NA: UN2831
Packing Group: III
Information reported for product/size: 20L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Methyl Chloroform (71-55-6)	Yes	Yes	Yes	Yes
Dioxane (123-91-1)	Yes	Yes	Yes	Yes
1,2-Epoxybutane (106-88-7)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methyl Chloroform (71-55-6)	Yes	Yes	No	Yes
Dioxane (123-91-1)	Yes	Yes	No	Yes
1,2-Epoxybutane (106-88-7)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methyl Chloroform (71-55-6)	No	No	Yes	No
Dioxane (123-91-1)	No	No	Yes	No
1,2-Epoxybutane (106-88-7)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methyl Chloroform (71-55-6)	1000	U226	No
Dioxane (123-91-1)	100	U108	No
1,2-Epoxybutane (106-88-7)	100	No	No

Chemical Weapons Convention: No TSCA 12(b): Yes CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 2[Z]
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **2** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH

SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, KIDNEYS, AND CARDIOVASCULAR SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. POSSIBLE CANCER HAZARD. CONTAINS DIOXANE WHICH MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.

Label Precautions:

Avoid breathing vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid contact with eyes, skin and clothing.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

CHEM SERVICE INC -- F13 1,1-DICHLOROETHANE -- 6550-00F037545

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MSDS Safety Information

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FSC: 6550
MSDS Date: 06/01/1989
MSDS Num: BWJHT
LIIN: 00F037545
Tech Review: 12/30/1994
Product ID: F13 1,1-DICHLOROETHANE
Responsible Party
Cage: 84898
Name: CHEM SERVICE INC
Address: 660 TOWER LN
Box: 3108
City: WEST CHESTER PA 19381-3108 US
Info Phone Number: 215-692-3026/800-452-9994
Emergency Phone Number: 215-692-3026/800-452-9994

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Preparer Co. when other than Responsible Party Co.

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Cage: 84898
Assigned Ind: N
Name: CHEM SERVICE INC
Box: 3108
City: WEST CHESTER PA 19381

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Contractor Summary

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Cage: 84898
Name: CHEM SERVICE INC
Box: 3108
City: WEST CHESTER PA 19381 US
Phone: 215-692-3026
Cage: 8Y898
Name: CHEM SERVICE, INC
Address: 660 TOWER LN
Box: 599
City: WEST CHESTER PA 19381 US
Phone: 610-692-3026, 610-692-3026

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Ingredients

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Cas: 75-34-3
RTECS #: KI0175000
Name: 1,1-DICHLOROETHANE (ETHYLIDINE CHLORIDE)
Other REC Limits: 200 PPM
OSHA PEL: 100 PPM
ACGIH TLV: 200 PPM
EPA Rpt Qty: 1000 LBS
DOT Rpt Qty: 1000 LBS
Ozone Depleting Chemical: N

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Health Hazards Data

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LD50 LC50 Mixture: ORAL LD50 (RAT/MOUSE): 725 MG/KG
Route Of Entry Inds - Inhalation: YES
Skin: YES
Ingestion: YES
Carcinogenicity Inds - NTP: NO

IARC: NO
OSHA: NO
Effects of Exposure: SKIN: RAPIDLY ABSORBED/HARMFUL/IRRITATION/ALLERGIC REACTION/SENSITIZATION. INHALATION: HARMFUL/RESPIRATORY TRACT IRRITATION/MUCOUS MEMBRANE IRRITATION. INGESTION: HARMFUL. EYES: IRRITATION. EXPOSURE C AN CAUSE LIVER/KIDNEY/NERVOUS SYSTEM INJURY, DELAYED ADVERSE HEALTH AFFECTS. NARCOTIC AT HIGH CONCENTRATIONS.
Explanation Of Carcinogenicity: NONE
Signs And Symptions Of Overexposure: IRRITATION, DISORIENTATION.
First Aid: EYES: FLUSH W/WATER FOR 15-20 MINS. SKIN: FLUSH W/WATER FOR 15-20 MINS. IF NOT BURNED, WASH W/SOAP & WATER. INHALATION: REMOVE TO FRESH AIR. GIVE CPR/OXYGEN IF NEEDED. KEEP WARM & QUIET. INGESTION: DO N'T INDUCE VOMITING/GIVE LIQUIDS IF UNCONSCIOUS/CONVULSIVE. IF VOMITING, WATCH CLOSELY FOR ANY AIRWAY OBSTRUCTION. OBTAIN MEDICAL ATTENTION IN ALL CASES.

Handling and Disposal

Spill Release Procedures: EVACUATE AREA. WEAR APPRORPRIATE OSHA REGULATED EQUIPMENT. VENTILATE AREA. ABSORB ON VERMICULITE/SIMILAR MATERIAL. SWEEP UP & PLACE IN APPROPRIATE CONTAINER/HOLD FOR DISPOSAL. WASH CONTAMINATED SURFAC ES TO REMOVE ANY RESIDUES.
Waste Disposal Methods: BURN IN A CHEMICAL INCINERATOR EQUIPPED W/AN AFTERBURNER & SCRUBBER IAW/FEDERAL, STATE & LOCAL REGULATIONS.
Handling And Storage Precautions: KEEP TIGHTLY CLOSED IN A COOL DRY PLACE. STORE ONLY W/COMPATIBLE CHEMICALS. FOR LABORATORY USE ONLY.
Other Precautions: AVOID CONTACT W/SKIN, EYES & CLOTHING. DON'T BREATH VAPORS. CONTACT LENSES SHOULDN'T BE WORN IN THE LABORATORY. ALL CHEMICALS SHOULD BE CONSIDERED HAZARDOUS. AVOID DIRECT PHYSICAL CONTACT.

Fire and Explosion Hazard Information

Flash Point Text: 23F
Lower Limits: 6
Upper Limits: 16
Extinguishing Media: CO2, DRY CHEMICAL POWDER. DON'T USE WATER.
Unusual Fire/Explosion Hazard: FLAMMABLE CHEMICAL.

Control Measures

Respiratory Protection: WEAR APPROPRIATE OSHA/MSHA APPROVED SAFETY EQUIPMENT.
Ventilation: CHEMICAL SHOULD BE HANDLED ONLY IN A HOOD.
Eye Protection: EYE SHIELDS
Work Hygienic Practices: REMOVE/LAUNDER CONTAMINATED CLOTHING BEFORE REUSE. READILY ABSORBED & RETAINED ON CLOTHING &/SHOES.

Physical/Chemical Properties

B.P. Text: 135.14F
M.P/F.P Text: -142.6F
Vapor Pres: 182
Vapor Density: 3.4
Solubility in Water: SLIGHT
Appearance and Odor: COLORLESS LIQUID W/FRUITY/PLEASANT ODOR.

Reactivity Data

Stability Indicator: YES
Stability Condition To Avoid: SENSITIVE TO HEAT.

Materials To Avoid: STRONG OXIDIZING AGENTS/BASES, CAUSTICS.
Hazardous Decomposition Products: TOXIC FUMES.
Hazardous Polymerization Indicator: NO

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Toxicological Information

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Ecological Information

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MSDS Transport Information

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Regulatory Information

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Other Information

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HAZCOM Label

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Product ID: F13 1,1-DICHLOROETHANE
Cage: 84898
Company Name: CHEM SERVICE INC
PO Box: 3108
City: WEST CHESTER PA
Zipcode: 19381 US
Health Emergency Phone: 215-692-3026/800-452-9994
Date Of Label Review: 12/16/1998
Label Date: 12/16/1998
Hazard And Precautions: SKIN: RAPIDLY ABSORBED/HARMFUL/IRRITATION/ALLERGIC REACTION/SENSITIZATION. INHALATION: HARMFUL/RESPIRATORY TRACT IRRITATION/MUCOUS MEMBRANE IRRITATION. INGESTION: HARMFUL. EYES: IRRITATION. EXPOSURE C AN CAUSE LIVER/KIDNEY/NERVOUS SYSTEM INJURY, DELAYED ADVERSE HEALTH AFFECTS. NARCOTIC AT HIGH CONCENTRATIONS. IRRITATION, DISORIENTATION.

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MSDS Number: **B6302** * * * * * *Effective Date: 11/10/05* * * * * *Supercedes: 02/18/03*

MSDS *Material Safety Data Sheet*

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

sec-BUTYL ALCOHOL

1. Product Identification

Synonyms: 2-Butanol; S-butyl alcohol; methyl ethyl carbinol; 1-methyl propanol
CAS No.: 78-92-2
Molecular Weight: 74.12
Chemical Formula: CH3CHOHCH2CH3
Product Codes:
J.T. Baker: D721
Mallinckrodt: 1821

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
sec-Butyl Alcohol	78-92-2	100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

Potential Health Effects

Inhalation:
Inhalation of concentrated vapors may cause headache, dizziness, and drowsiness. Causes irritation to the respiratory tract. Symptoms can include sore throat, cough.
Ingestion:
Ingestion may cause sore throat, headache, dizziness, and drowsiness.
Skin Contact:
Causes mild irritation. May cause allergic reaction in sensitive individuals.
Eye Contact:
Vapors may irritate the eyes; splashes will cause eye irritation with redness and pain.
Chronic Exposure:
Prolonged skin contact may result in drying and cracking of the skin.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or impaired liver, kidney, or pulmonary function may be more susceptible to the effects of this agent.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Give large amounts of water to drink. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Wash clothes before reuse. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:
Flash point: 24C (75F) CC
Autoignition temperature: 405C (761F)
Flammable limits in air % by volume:
lel: 1.7; uel: 9.8
Flammable liquid and vapor!

(uel @ 100C)
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, alcohol foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
150 ppm (TWA)
-ACGIH Threshold Limit Value (TLV):
100 ppm (TWA)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures

below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece respirator with organic vapor cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

Other Control Measures:
There is insufficient data in the published literature to assign complete numerical SAF-T-DATA* ratings and laboratory protective equipment for this product. Special precautions must be used in storage, use and handling. Protective equipment for laboratory bench use should be chosen using professional judgment based on the size and type of reaction or test to be conducted and the available ventilation, with overriding consideration to minimize contact with the chemical.

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Strong pleasant odor.

Solubility:
15g/100g water @ 20C (68F).

Density:
0.81 @ 20C/4C

pH:
No information found.

% Volatiles by volume @ 21C (70F):
100

Boiling Point:
94C (201F)

Melting Point:
-115C (-175F)

Vapor Density (Air=1):
2.6

Vapor Pressure (mm Hg):
13 @ 20C (68F)

Evaporation Rate (BuAc=1):

1.3

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Acids, acid chlorides, acid anhydrides, organic peroxides, chromium trioxide, oxidizing agents and halogens.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

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11. Toxicological Information

Oral rat LD50: 6480 mg/kg; Irritation data: eye, rabbit: 100mg/24H Moderate; Investigated as a reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
sec-Butyl Alcohol (78-92-2)	No	No	None

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12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material is not expected to significantly bioaccumulate. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of less than 3.0. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is not expected to be degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition. When released into the air, this material is expected to have a half-life between 1 and 10 days.

Environmental Toxicity:
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

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13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

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14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: BUTANOLS
Hazard Class: 3
UN/NA: UN1120
Packing Group: II
Information reported for product/size: 20L

International (Water, I.M.O.)

Proper Shipping Name: BUTANOLS
Hazard Class: 3
UN/NA: UN1120
Packing Group: II
Information reported for product/size: 20L

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
sec-Butyl Alcohol (78-92-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
sec-Butyl Alcohol (78-92-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
sec-Butyl Alcohol (78-92-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
sec-Butyl Alcohol (78-92-2)	No	No	Yes

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 3[Y]E
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.
Label Precautions:
No SAF-T-DATA Ratings have been developed for this product. Read and follow all warnings, precautions, instructions and other safety and handling information on the label and MSDS.
Keep away from heat, sparks and flame.
Keep container closed.
Use with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.
Avoid contact with eyes, skin and clothing.
Label First Aid:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. Call a physician if irritation develops or persists. If swallowed, give large amounts of water to drink. Never give anything by mouth to an unconscious person. Call a physician.
Product Use:
Laboratory Reagent.
Revision Information:

No Changes.

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

CONTAMINANT FACT SHEET - ACETONE

CAS Number:67-64-1	**Molecular Weight:58.1**	**Color: Colorless**	**Ionization Potential (eV): 8.76**	**Vapor Density (Air=1):NA**
Synonyms: Dimethyl ketone; Ketone propane; 2-Propanone	**Physical State: Liquid**	**Odor: Fragrant, mint-like**	**Henry's Constant: NA**	**Vapor Pressure: 180 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**
NFPA rating: 3 **HMIS rating: 3**	**NFPA rating: 0** **HMIS rating: 0**	**NFPA rating: 1** **HMIS rating: 1**
Flash Point(°F): 0 LEL(%): 2.5 UEL(%): 12.8 Fire Extinguishing Media: ☒ Dry Chemical ☒ Foam ☐ Water Spray ☒ CO_2 Fire Extinguisher: ☐ Class A ☐ Class B ☐ Class C ☐ Class D ☒ Class A/B/C DOT: ☒Flammable Liquid ☐Combustible Liquid	Incompatibilities: Oxidizers, acids DOT: ☐ Oxidizer ☐ Water Reactive	Odor Threshold (ppm): 3.6 - 653 IDLH (ppm): 2500 Signs/Symptoms of Acute Exposure: Irritation of eyes, nose, throat;headache;dizziness;centr al nervous system depression;derm atitis DOT: ☐ Poison

Source	TWA (ppm)	STEL (ppm)	C (ppm)
OSHA PELs	1000	NA	NA
ACGIH TLVs	500	50	NA

Carcinogenic:
OSHA: ☐ Yes ☒ Not listed

IARC: ☐ Group 1 ☐ Group 2A ☐ Group 2B ☐ Group 3 ☐ Group 4 ☒ Not listed

NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not listed

ACGIH: ☐ A1 ☐ A2 ☐ A3 ☒ A4 ☐ A5 ☐ Not listed

Skin Absorbable: ☐ Yes ☒ No
Skin Corrosive: ☐ Yes ☒ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☒ Explosimeter	Gastech GX-82	Methane
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/CH22901 (100-12000ppm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#300	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
☐Viton/North ☐Viton/Best ☒Silvershield/North ☒4H/Safety
☐Neoprene/Mapa ☐Neoprene/Ans.Ed. ☐Neoprene/BestUltraflex ☐ Neoprene/BestNeo.(30min)
☐PVC/Ans.Ed. ☐PVC/BestHustler ☐Nitrile/LabSafe. ☐Nitrile/Ans.Ed.
☒Butyl/North ☐PVA/Ans.Ed. ☐Other

Suit Type (Breakthrough >1hr unless noted): ☐Tyvek ☐ Tyvek QC ☐Tyvek/Saranex(15 min) ☒Tychem500 ☒Tychem 9400 ☐Tychem10,000 ☐Other

Respiratory Protection

☒Air Purifying ☐Air Supplied Only | Maximum Use Concentration (ppm): Half mask: 1000 ppm Full face: 1000 ppm

Notes:
Prepared by: Sherry Hall Date: 29 September 1997 Revised 20 February 2002

MSDS Number: **A7152** * * * * * *Effective Date: **08/02/00*** * * * * *Supercedes: **09/08/97***

MSDS **Material Safety Data Sheet**

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

Antimony

1. Product Identification

Synonyms: Stibium, C.I. 77050
CAS No.: 7440-36-0
Molecular Weight: 121.75
Chemical Formula: Sb
Product Codes: 0848

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Antimony	7440-36-0	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! MAY BE FATAL IF INHALED. CAUSES IRRITATION.
TARGET ORGAN(S): Respiratory system, cardiovascular system, eyes, skin.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 1 - Slight
Reactivity Rating: 2 - Moderate
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Is harmful may be fatal.
Ingestion:
None identified.
Skin Contact:
Prolonged contact may cause dermatitis.
Eye Contact:
None identified.
Chronic Exposure:
Kidney damage, liver damage.
Aggravation of Pre-existing Conditions:
No information found.

---

4. First Aid Measures

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential.
Ingestion:
If large amounts were swallowed, give water to drink and get medical advice.
Skin Contact:
In case of contact, flush skin with water.
Eye Contact:
In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

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5. Fire Fighting Measures

Fire:
Not expected to be a fire hazard.
Explosion:
Can be an explosion hazard, especially when heated.
Fire Extinguishing Media:

Use extinguishing media appropriate for surrounding fire.
Special Information:
No information found.

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6. Accidental Release Measures

Wear self-contained breathing apparatus and full protective clothing. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

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7. Handling and Storage

Keep container tightly closed. Store in secure poison area. Keep product out of light. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
0.5 mg/m3 (TWA)

-ACGIH Threshold Limit Value (TLV):
0.5 mg/m3 (TWA)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to the substance is apparent, consult an industrial hygienist. For emergencies, or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Silvery-white metal.
Odor:
No information found.
Solubility:
Negligible (< 0.1%)
Specific Gravity:
6.68
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
1635C (2975F)
Melting Point:
630C (1166F)
Vapor Density (Air=1):
4.2
Vapor Pressure (mm Hg):
Not applicable.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
No information found.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents, strong acids, halogen acids, chlorine, fluorine.
Conditions to Avoid:
Heat, Light.

11. Toxicological Information

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--------\Cancer Lists\-------------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
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Antimony (7440-36-0)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Antimony (7440-36-0)	Yes	Yes	No	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Antimony (7440-36-0)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Antimony (7440-36-0)	No	No	Yes	Antimony com

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)

Antimony (7440-36-0)	5000	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

Label Hazard Warning:
POISON! DANGER! MAY BE FATAL IF INHALED. CAUSES IRRITATION. TARGET ORGAN(S): Respiratory system, cardiovascular system, eyes, skin.
Label Precautions:
Avoid contact with eyes, skin, clothing.
Do not breathe dust. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.
Label First Aid:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse.
Product Use:
Laboratory Reagent.
Revision Information:
No changes.
Disclaimer:
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

CONTAMINANT FACT SHEET - ARSENIC

CAS Number:7440-38-2	**Molecular Weight: 74.92**	**Color: silvery to black**	**Ionization Potential (eV): NA**	**Vapor Density (Air=1):NA**
Synonyms: Arsenic metal; Arsenia	**Physical State: solid**	**Odor: odorless**	**Henry's Constant: NA {(atm xm^3)/mol}**	**Vapor Pressure: 1 (mm Hg at 20°C)**

Fire Hazard	**NFPA rating: 3** **HMIS rating: 2**	**Reactivity Hazard**	**NFPA rating: 2** **HMIS rating: 2**	**Health Hazard**	**NFPA rating: 3** **HMIS rating: 3**

Flash Point(°F): NA
LEL(%): NA UEL(%): NA

Fire Extinguishing Media:
- ☒ Dry Chemical
- ☒ Foam
- ☒ Water Spray
- ☒ CO_2

Fire Extinguisher:
- ☐ Class A
- ☐ Class B
- ☐ Class C
- ☐ Class D
- ☒ Class A/B/C

DOT: ☐ Flammable Gas
☐ Combustible Liquid

Incompatibilities: Bromates, peroxides, chlorates, isodates, lithium, silver nitrate, potassium nitrate, potassium permanganate, chromium (VI) oxide; halogens; bromine azide; pulladium; dirubidium acetylide; zinc; and platinum

DOT: ☐ Oxidizer
☐ Water Reactive

Odor Threshold (ppm): NA

IDLH (mg/m^3): 500 mg/m^3

Source	TWA (mg/m^3)	STEL (mg/m^3)	C (mg/m^3)
OSHA PELs	0.5* 0.01*	NA	NA
ACGIH TLVs	0.01	NA	NA

* = Or ganic Compounds
* = I norganic Compounds

Signs/Symptoms of Acute Exposure: Inhalation may cause conjunctivitis;eyelid edem a;nasal irritation; coughing;chest pain;inflam ation of the mouth.

DOT: ☒ Poison

Carcinogenic:
OSHA: ☒ Yes ☐ Not listed

IARC: ☒ Group 1 ☐ Group 2A ☐ Group 2B ☐ Group 3 ☐ Group 4 ☐ Not listed

NTP: ☒ Known ☐ Anticipated ☐ Process ☐ Not listed

ACGIH: ☒ A1 ☐ A2 ☐ A3 ☐ A4 ☐ A5 ☐ Not listed

Skin Absorbable: ☐ Yes ☒ No
Skin Corrosive: ☐ Yes ☒ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter	Gastech GX-82	Methane
☐ PID	MiniRAE	Isobutylene
☐ FID	Foxboro OVA	Methane
☐ Colorometric Tubes	Drager	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor	NA	NA
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
- ☒ Viton/North
- ☒ Viton/Best
- ☒ Silvershield/North
- ☒ 4H/Safety
- ☒ Neoprene/Mapa
- ☒ Neoprene/Ans.Ed.
- ☒ Neoprene/BestUltraflex
- ☒ Neoprene/BestNeo.
- ☒ PVC/Ans.Ed.
- ☒ PVC/BestHustler
- ☒ Nitrile/LabSafe.
- ☒ Nitrile/Ans.Ed.
- ☒ Butyl/North
- ☒ PVA/Ans.Ed.
- ☐ Other

Suit Type (Breakthrough >1hr unless noted): ☒ Tyvek ☒ Tyvek Q ☒ Tyvek/Saranex ☒ Tychem500 ☒ Tychem 9400 ☒ Tychem10,000 ☐ Other

Respiratory Protection

☒ Air Purifying ☐ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: HEPA Full face: HEPA

Notes:
Prepared by: Sherry Hall Date: 16 January 1997 Rev. 28 January 2002

CONTAMINANT FACT SHEET - BENZENE

CAS Number:71-43-2	**Molecular Weight: 78.1**	**Color: Colorless to Lt. Yellow**	**Ionization Potential (eV): 9.24**	**Vapor Density (Air=1):2.7**
Synonyms: Benzol; Phenyl hydride	**Physical State: Liquid**	**Odor: Aromatic**	**Henry's Constant: 0.23**	**Vapor Pressure: 75 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**
NFPA rating: 3 **HMIS rating: 3**	**NFPA rating: 0** **HMIS rating: 0**	**NFPA rating: 2** **HMIS rating: 3**

Flash Point(°F): 12
LEL(%): 1.2 UEL(%): 7.8

Fire Extinguishing Media:
- ☒ Dry Chemical ☒ Foam
- ☐ Water Spray ☒ CO_2

Fire Extinguisher:
- ☐ Class A ☐ Class B
- ☐ Class C ☐ Class D
- ☒ Class A/B/C

DOT: ☒ Flammable Liquid
☐ Combustible Liquid

Incompatibilities: Strong oxidizers; m any fluorides & perchlorates;nitr ic acid

DOT: ☐ Oxidizer
☐ Water Reactive

Odor Threshold (ppm): 34-114

IDLH (ppm): 500

Source	TWA (ppm)	STEL (ppm)	C (ppm)
OSHA PELs	1*	5*	NA
ACGIH TLVs	.5	2.5	NA

*T able Z-2 for exclusions in 29CFR 1910, 1028

Signs/Symptoms of Acute Exposure: Irritation of eyes, skin, nose, & respiratory system;giddiness;headache; nausea;stagger ed gait

DOT: ☐ Poison

Carcinogenic:
OSHA: ☒ Yes ☐ Not listed

IARC: ☒ Group 1 ☐ Group 2A ☐ Group 2B ☐ Group 3 ☐ Group 4 ☐ Not listed

NTP: ☒ Known ☐ Anticipated ☐ Process ☐ Not listed

ACGIH: ☒ A1 ☐ A2 ☐ A3 ☐ A4 ☐ A5 ☐ Not listed

Skin Absorbable: ☒ Yes ☐ No
Skin Corrosive: ☐ Yes ☒ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☒ Explosimeter	GasTech GX-82	Methane
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA 128	Methane
☒ Colorometric Tubes	Drager/628561(0.5-10ppm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#500	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
- ☒ Viton/North
- ☐ Viton/Best
- ☒ Silvershield/North
- ☒ 4H/Safety
- ☐ Neoprene/Mapa
- ☐ Neoprene/Ans.Ed.
- ☐ Neoprene/BestUltraflex
- ☐ Neoprene/BestNeo.
- ☐ PVC/Ans.Ed.
- ☐ PVC/BestHustler
- ☒ Nitrile/LabSafe.(2in in)
- ☐ Nitrile/Ans.Ed.
- ☒ Butyl/North (31min)
- ☐ PVA/Ans.Ed.
- ☐ Other

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek QC ☐ Tyvek/Saranex ☒ Tychem 500 (49min) ☒ Tychem 9400 ☐ Tychem 10,000 ☐ Other

Respiratory Protection

☒ Air Purifying ☐ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: 10 Full face: 50

Notes: Poor warning but OSHA allows Air Purifying Respirators
Prepared by: Sherry Hall Date: 16 January 1997 Rev. 24 January 2002

CONTAMINANT FACT SHEET - CHLOROBENZENE

CAS Number:108-90-7	**Molecular Weight: 112.6**	**Color: Colorless**	**Ionization Potential (eV): 9.07**	**Vapor Density (Air=1):3.88**
Synonyms: Benzene chloride; Chlorobenzyl; MCB; Phenylchoride	**Physical State: Liquid**	**Odor: Almond-like**	**Henry's Constant: 0.15**	**Vapor Pressure: 9 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**
NFPA rating: 3 **HMIS rating: 3**	**NFPA rating: 0** **HMIS rating: 0**	**NFPA rating: 2** **HMIS rating: 2**

Flash Point(°F): 82
LEL(%): 1.3 UEL(%): 9.6

Fire Extinguishing Media:
- ☒ Dry Chemical
- ☒ Foam
- ☐ Water Spray
- ☒ CO_2

Fire Extinguisher:
- ☐ Class A
- ☐ Class B
- ☐ Class C
- ☐ Class D
- ☒ Class A/B/C

DOT: ☒ Flammable Liquid
☐ Combustible Liquid

Incompatibilities: Strong oxidizers

DOT: ☐ Oxidizer
☐ Water Reactive

Odor Threshold (ppm): 1.3

IDLH (ppm): 1000

Source	TWA (ppm)	STEL (ppm)	C (ppm)
OSHA PELs	5	NA	NA
ACGIH TLVs	10	NA	NA

Signs/Symptoms of Acute Exposure: Irritation of eyes, skin and nose;dr owsiness;incoor dination;CNS depression

DOT: ☐ Poison

Carcinogenic:
OSHA: ☐ Yes ☒ Not listed

IARC: ☐ Group 1 ☐ Group 2A ☐ Group 2B ☐ Group 3 ☐ Group 4 ☒ Not listed

NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not listed

ACGIH: ☐ A1 ☐ A2 ☒ A3 ☐ A4 ☐ A5 ☐ Not listed

Skin Absorbable: ☐ Yes ☒ No
Skin Corrosive: ☐ Yes ☒ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter		
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/67 28681(5-200ppm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#003	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
- ☐ Viton/North
- ☐ Viton/Best
- ☐ Silvershield/North
- ☐ 4H/Safety
- ☐ Neoprene/Mapa
- ☐ Neoprene/Ans.Ed.
- ☐ Neoprene/BestUltraflex
- ☐ Neoprene/BestNeo.(30min)
- ☐ PVC/Ans.Ed.
- ☐ PVC/BestHustler
- ☐ Nitrile/LabSafe.
- ☐ Nitrile/Ans.Ed.
- ☐ Butyl/North
- ☐ PVA/Ans.Ed.
- ☒ Other

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek QC ☐ Tyvek/Saranex ☐ Tychem500 ☒ Tychem 9400 ☒ Tychem 10,000 ☐ Other

Respiratory Protection

☒ Air Purifying ☐ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: 100 ppm Full face: 500 ppm

Notes:
Prepared by: Sheri Hall Date: 16 January 1997 Rev. 26 February 2002

CONTAMINANT FACT SHEET - CHROMIUM

CAS Number:7440-47-3	**Molecular Weight:52.0**	**Color: Blue-white**	**Ionization Potential (eV): NA**	**Vapor Density (Air=1):1.79**
Synonyms: Chromium metal; Chrome	**Physical State: Solid**	**Odor: Odorless**	**Henry's Constant: NA**	**Vapor Pressure: 0 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**
NFPA rating: 1 **HMIS rating: 1**	**NFPA rating: 1** **HMIS rating: 1**	**NFPA rating: 2** **HMIS rating: 2**

Flash Point(°F): NA
LEL(%): NA UEL(%): NA

Fire Extinguishing Media:
- ☒ Dry Chemical
- ☐ Foam
- ☐ Water Spray
- ☐ CO_2

Fire Extinguisher:
- ☐ Class A
- ☐ Class B
- ☐ Class C
- ☐ Class D
- ☒ Class A/B/C

DOT: ☐ Flammable Liquid
☐ Combustible Liquid

Incompatibilities: Strong oxidizers (such as hydrogen peroxide); alkalis

DOT: ☐ Oxidizer
☐ Water Reactive

Odor Threshold (ppm): NA

IDLH (mg/m^3): 250

Source	TWA (mg/m^3)	STEL (mg/m^3)	C (mg/m^3)
OSHA PELs	1	NA	NA
ACGIH TLVs	0.5	NA	NA

Signs/Symptoms of Acute Exposure: Irritation of eyes & kin

DOT: ☐ Poison

Carcinogenic:
OSHA: ☐ Yes ☒ Not listed

IARC: ☐ Group 1 ☐ Group 2A ☐ Group 2B ☒ Group 3 ☐ Group 4 ☐ Not listed

NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not listed

ACGIH: ☐ A1 ☐ A2 ☐ A3 ☒ A4 ☐ A5 ☐ Not listed

Skin Absorbable: ☐ Yes ☒ No
Skin Corrosive: ☐ Yes ☒ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter		
☐ PID		
☐ FID		
☐ Colorometric Tubes		
☐ Chemical Monitor ☒ Dust Monitor	MIE MiniRam	Factory calib. w/ AZ road dust
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH6024	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
- ☒ Viton/North
- ☒ Viton/Best
- ☒ Silvershield/North
- ☒ 4H/Safety
- ☒ Neoprene/Mapa
- ☒ Neoprene/Ans.Ed.
- ☒ Neoprene/BestUltraflex
- ☒ Neoprene/BestNeo.(30min)
- ☒ PVC/Ans.Ed.
- ☒ PVC/BestHustler
- ☒ Nitrile/LabSafe.
- ☒ Nitrile/Ans.Ed.
- ☒ Butyl/North
- ☒ PVA/Ans.Ed.
- ☐ Other

Suit Type (Breakthrough >1hr unless noted): ☒ Tyvek ☒ Tyvek QC ☒ Tyvek/Saranex ☒ Tychem 500 ☒ Tychem 9400 ☒ Tychem 10,000 ☐ Other

Respiratory Protection

☒ Air Purifying ☐ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: HEPA Full face: HEPA

Notes: Chromium dust suspended in carbon dioxide is ignitable & explosive when heated.
Prepared by: Sherry Hall Date: 16 January 1997 Rev. 28 January 2002

CONTAMINANT FACT SHEET - ETHYLBENZENE

CAS Number:100-41-4	**Molecular Weight:106.2**	**Color: Colorless**	**Ionization Potential (eV): 8.76**	**Vapor Density (Air=1):3.66**
Synonyms: Ethylbenzol; Phenylethane	**Physical State: Liquid**	**Odor: Aromatic**	**Henry's Constant: 0.38 {(atm ×m³)/mol}**	**Vapor Pressure: 7 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**
NFPA rating: 3 **HMIS rating: 3**	**NFPA rating: 0** **HMIS rating: 0**	**NFPA rating: 2** **HMIS rating: 2**

Flash Point(°F): 8.6
LEL(%): 0.8 UEL(%): 6.7

Fire Extinguishing Media:
☒ Dry Chemical ☒ Foam
☐ Water Spray ☒ CO_2

Fire Extinguisher:
☐ Class A ☐ Class B
☐ Class C ☐ Class D
☒ Class A/B/C

DOT: ☒ Flammable Liquid
☐ Combustible Liquid

Incompatibilities: Strong oxidizers

DOT: ☐ Oxidizer
☐ Water Reactive

Odor Threshold (ppm): 0.092-0.60

IDLH (ppm): 800

Source	TWA (ppm)	STEL (ppm)	C (ppm)
OSHA PELs	100	NA	NA
ACGIH TLVs	100	125	NA

Signs/Symptoms of Acute Exposure: Irritation of eyes, skin and mucous membranes;headaches;derm atitis; narcosis;com a

DOT: ☐ Poison

Carcinogenic:
OSHA: ☐ Yes ☒ Not listed

IARC: ☐ Group 1 ☐ Group 2A
☒ Group 2B ☐ Group 3
☐ Group 4 ☐ Not listed

NTP: ☐ Known ☐ Anticipated
☐ Process ☒ Not listed

ACGIH: ☐ A1 ☐ A2
☐ A3 ☐ A4
☐ A5 ☒ Not listed

Skin Absorbable: ☐ Yes ☒ No
Skin Corrosive: ☐ Yes ☒ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☒ Explosimeter	Gastech GX-82	Methane
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/16728351 (30-600ppm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☒ Collection Medium/Sampling Pump	Gilian Pump/N105H#501	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
☐ Viton/North ☐ Viton/Best ☐ Silvershield/North ☐ 4H/Safety
☐ Neoprene/Mapa ☐ Neoprene/Ans.Ed. ☐ Neoprene/BestUltraflex ☐ Neoprene/BestNeo.(30min)
☐ PVC/Ans.Ed. ☐ PVC/BestHustler ☐ Nitrile/LabSafe. ☐ Nitrile/Ans.Ed.
☐ Butyl/North ☐ PVA/Ans.Ed. ☒ Other

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek QC ☐ Tyvek/Saranex(45 min) ☒ Tychem500 ☒ Tychem 9400 ☐ Tychem10,000 ☐ Other

Respiratory Protection

☒ Air Purifying ☐ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: 800 ppm Full face: 800 ppm

Notes:
Prepared by: Sherry Hall Date: 16 January 1997 Rev. 4 March 2002

CONTAMINANT FACT SHEET - *HYDROGEN SULFIDE*

CAS Number:7783-06-4	**Molecular Weight:34.1**	**Color: Colorless**	**Ionization Potential (eV): 10.46**	**Vapor Density (Air=1):1.175**
Synonyms: Hydrosulfuric acid; Sewer gas; Sulfuretted hydrogen	**Physical State: Gas**	**Odor: Strong odor of rotten eggs**	**Henry's Constant: NA {(atm ×m^3)/mol}**	**Vapor Pressure: 17.6 (atm)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**	
NFPA rating: 4 **HMIS rating: 4**	**NFPA rating: 0** **HMIS rating: 0**		**NFPA rating: 3** **HMIS rating: 3**
Flash Point(°F): NA LEL(%): 4% UEL(%): 44% Fire Extinguishing Media: ☐ Dry Chemical ☒ Foam ☒ Water Spray ☐ CO_2 Fire Extinguisher: ☐ Class A ☐ Class B ☐ Class C ☐ Class D ☒ Class A/B/C DOT: ☒Flammable Gas ☐Combustible Liquid	Incompatibilities: Strong oxidizers; str ong nitric acid;m etals DOT: ☐ Oxidizer ☐ Water Reactive	Odor Threshold (ppm): 0.0005-0.13 IDLH (ppm): 100-300 Source / TWA (ppm) / STEL (ppm) / C (ppm) OSHA PELs: NA / NA / 20, 50* ACGIH TLVs: (10)* / (15)* / NA * 10-m in peak;once per 8-hr shift ( ) = Intended to be changed to 5 ppm in 2003.. Signs/Symptoms of Acute Exposure: Irritation of eyes, respiratory system;apnea;com a;convulsions; conjunctivitis;eye pain;dizziness;headache; irritability See Notes below DOT: ☐ Poison	Carcinogenic: OSHA: ☐ Yes ☒ Not anticipated IARC: ☐ Group 1 ☐ Group 2A ☐ Group 2B ☐ Group 3 ☐ Group 4 ☒ No NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not anticipated ACGIH: ☐ A1 ☐ A2 ☐ A3 ☐ A4 ☐ A5 ☒ Not anticipated Skin Absorbable: ☐ Yes ☒ No Skin Corrosive: ☐ Yes ☒ No DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter	Gastech GX-82	Methane
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/8101831 (1-200 ppm)	Check pump for leaks
☒ Chemical Monitor ☐ Dust Monitor	Many available	See owner's manual
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH6013	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):				
	☐Viton/North	☐Viton/Best	☐Silvershield/North	☐4H/Safety
	☐Neoprene/Mapa	☐Néoprène/Ans.Ed.	☐Neoprene/BestUltraflex	☐ Neoprene/BestNeo.(30min)
	☐PVC/Ans.Ed.	☐PVC/BestHustler	☐Nitrile/LabSafe.	☐Nitrile/Ans.Ed.
	☐Butyl/North	☐PVA/Ans.Ed.	☒Other	

Suit Type (Breakthrough >1hr unless noted): ☐Tyvek ☐ Tyvek QC ☐Tyvek/Saranex ☒Tychem 500 ☒Tychem 9400 ☐Tychem10,000 ☒Other

Respiratory Protection

☐Air Purifying	☒Air Supplied Only	Maximum Use Concentration (ppm): Half mask: NA Full face: NA

Notes: Causes olfactory fatigue and can not be relied upon to warn of continuous hydrogen sulfide presence

Prepared by: Sherry Hall Date: 10 October 1997 Rev. 27 March 2004

CONTAMINANT FACT SHEET - LEAD (INORGANIC)

CAS Number:7439-92-1	**Molecular Weight:207.2**	**Color: Gray**	**Ionization Potential (eV): NA**	**Vapor Density (Air=1):NA**
Synonyms: Lead Metal; Plumbum	**Physical State: Solid**	**Odor: Odorless**	**Henry's Constant: NA**	**Vapor Pressure: 1.77 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**	
NFPA rating: 1 **HMIS rating: 1**	**NFPA rating: 0** **HMIS rating: 0**		**NFPA rating: 3** **HMIS rating: 3**
Flash Point(°F): NA LEL(%): NA UEL(%): NA Fire Extinguishing Media: ☒ Dry Chemical ☒ Foam ☒ Water Spray ☒ CO_2 Fire Extinguisher: ☐ Class A ☐ Class B ☐ Class C ☐ Class D ☒ Class A/B/C DOT: ☐Flammable Liquid ☐Combustible Liquid	Incompatibilities: Strong oxidizers; hydrogen peroxide;acids DOT: ☐ Oxidizer ☐ Water Reactive	Odor Threshold (ppm): NA IDLH (mg/m^3): 100 See 29 CFR 1910. 1025 Signs/Symptoms of Acute Exposure: Weakness; lassitude;insomnia;facial pallor;pale eyes;anorexia; constipation;abdominal pain;colic;anemia;gingival lead line;tremors;irritated eyes DOT: ☐ Poison	Carcinogenic: OSHA: ☐ Yes ☒ Not listed IARC: ☐ Group 1 ☐ Group 2A ☒ Group 2B ☐ Group 3 ☐ Group 4 ☐ Not listed NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not listed ACGIH: ☐ A1 ☐ A2 ☒ A3 ☐ A4 ☐ A5 ☐ Not listed Skin Absorbable: ☐ Yes ☒ No Skin Corrosive: ☐ Yes ☒ No DOT: ☐ Corrosive

Source	TWA (mg/m^3)	STEL (mg/m^3)	C (mg/m^3)
OSHA PELs	0.05*	NA	NA
ACGIH TLVs	0.05	NA	NA

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter		
☐ PID		
☐ FID		
☐ Colorometric Tubes		
☐ Chemical Monitor ☒ Dust Monitor	MIE MiniRam	Factory calib. w/ AZ road dust
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH982	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
☒Viton/North ☒Viton/Best ☒Silvershield/North ☒4H/Safety
☒Neoprene/Mapa ☒Neoprene/Ans.Ed. ☒Neoprene/BestUltraflex ☒ Neoprene/BestNeo.(30min)
☒PVC/Ans.Ed. ☒PVC/BestHustler ☒Nitrile/LabSafe. ☒Nitrile/Ans.Ed.
☒Butyl/North ☒PVA/Ans.Ed. ☐Other

Suit Type (Breakthrough >1hr unless noted): ☒Tyvek ☒ Tyvek QC ☒Tyvek/Saranex ☒Tychem 500 ☒Tychem 9400 ☒Tychem 10,000 ☐Other

Respiratory Protection

☒Air Purifying ☐Air Supplied Only | Maximum Use Concentration (ppm): Half mask: HEPA Full face: HEPA

Notes: ACGIH TLV-TWA: 0.002 mg/m3 respirable fraction;Powder is pyrophoric.

Prepared by: Sherry Hall Date: 16 January 1997 Rev. 29 January 2002

CONTAMINANT FACT SHEET - MERCURY

CAS Number:7439-97-6	**Molecular Weight:200.6**	**Color: Silver**	**Ionization Potential (eV): NA**	**Vapor Density (Air=1):NA**
Synonyms: Colloidal mercury; Metallic mercury; Quicksilver	**Physical State: Liquid**	**Odor: Odorless**	**Henry's Constant: 0.23**	**Vapor Pressure: 0.0012 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**
NFPA rating: 0 **HMIS rating: 0**	**NFPA rating: 0** **HMIS rating: 0**	**NFPA rating: 4** **HMIS rating: 4**

Flash Point(°F): NA
LEL(%): NA UEL(%): NA

Fire Extinguishing Media:
- ☒ Dry Chemical
- ☒ Foam
- ☒ Water Spray
- ☒ CO_2

Fire Extinguisher:
- ☐ Class A
- ☐ Class B
- ☐ Class C
- ☐ Class D
- ☒ Class A/B/C

DOT: ☐ Flammable Liquid
☐ Combustible Liquid

Incompatibilities: Acetylene;am monia; chlorine dioxide;azides;calcium ;sodium carbide;lithium ; rubidium;copper

DOT: ☐ Oxidizer
☐ Water Reactive

Odor Threshold (ppm): NA

IDLH (mg/m^3): 10

Source	TWA (mg/m^3)	STEL (mg/m^3)	C (mg/m^3)
OSHA PELs	NA	NA	0.1
ACGIH TLVs	0.025	NA	NA

Signs/Symptoms of Acute Exposure: Irritation of eyes & skin;cough;chest pain;dy spnea;bronchitis; pneuitis;trem or;insom nia;irritability;headache; fatigue;weakness;stom atitis;salivation

DOT: ☐ Poison

Carcinogenic:
OSHA: ☐ Yes ☒ Not listed

IARC: ☐ Group 1 ☐ Group 2A ☐ Group 2B ☒ Group 3 ☐ Group 4 ☐ Not listed

NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not listed

ACGIH: ☐ A1 ☐ A2 ☐ A3 ☒ A4 ☐ A5 ☐ Not listed

Skin Absorbable: ☒ Yes ☐ No
Skin Corrosive: ☒ Yes ☐ No

DOT: ☒ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter		
☐ PID		
☐ FID		
☒ Colorometric Tubes	Drager/CH23101(0.1-2mg/m3)	Check pump for leaks
☒ Chemical Monitor ☐ Dust Monitor	Jerome Mercury Vapor Analyzer	Factory calibrated;r egenerate cell
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH6009	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
- ☒ Viton/North
- ☒ Viton/Best
- ☒ Silvershield/North
- ☒ 4H/Safety
- ☒ Neoprene/Mapa
- ☒ Neoprene/Ans.Ed.
- ☒ Neoprene/BestUltraflex
- ☒ Neoprene/BestNeo.
- ☒ PVC/Ans.Ed.
- ☒ PVC/BestHustler
- ☒ Nitrile/LabSafe.
- ☒ Nitrile/Ans.Ed.
- ☒ Butyl/North
- ☒ PVA/Ans.Ed.
- ☐ Other

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek QC ☒ Tyvek/Saranex ☐ Tychem500 ☒ Tychem9400 ☐ Tychem 10,000 ☐ Other

Respiratory Protection

☒ Air Purifying ☐ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: See note Full face: See note

Notes: Use only NIOSH-approved cartridges for mercury with end-of-service indicator; Glove T ype/Brand Information Not Available;
Prepared by: Sherry Hall Date: 16 January 1997 Rev. 22 January 2002

CONTAMINANT FACT SHEET - METHANE

CAS Number:0074-82-8	**Molecular Weight: 16**	**Color: Colorless**	**Ionization Potential (eV): 12.51**	**Vapor Density (Air=1):0.544 @ 32F**
Synonyms: Fire damp; marsh gas; Methyl hydride	**Physical State: Gas**	**Odor: Odorless; Commercially, mercaptans added produce rotten egg odor**	**Henry's Constant: NA**	**Vapor Pressure: NA (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**	
NFPA rating: 4 **HMIS rating: 4**	**NFPA rating: 0** **HMIS rating: 0**		**NFPA rating: 1** **HMIS rating: 1**
Flash Point(°F): -213 LEL(%): 5 UEL(%): 15 Fire Extinguishing Media: *See Note* ☐ Dry Chemical ☐ Foam ☐ Water Spray ☐ CO_2 Fire Extinguisher: ☐ Class A ☐ Class B ☐ Class C ☐ Class D ☐ Class A/B/C DOT: ☒ Flammable Gas ☐ Combustible Liquid	Incompatibilities: Bromine pentafluoride; chlorine; chlor ine dioxide; nitr ogen trifluoride;liquid oxy gen;oxy gen difluoride DOT: ☐ Oxidizer ☐ Water Reactive	Odor Threshold (ppm): NA IDLH (ppm): NA Source / TWA (ppm) / STEL (ppm) / C (ppm) OSHA PELs* / NA / NA / NA ACGIH TLVs* / NA / NA / NA Sim ple asphyxiant Signs/Symptoms of Acute Exposure: Simple asphyxiant;r apid respir.; air hunger; diminish. mental alert.;im pair. musc. coord.;faulty judge. ; rapid fatigue; emotion. instabil.;nausea;convul. ; coma;death DOT: ☐ Poison	Carcinogenic: OSHA: ☐ Yes ☒ Not listed IARC: ☐ Group 1 ☐ Group 2A ☐ Group 2B ☐ Group 3 ☐ Group 4 ☒ Not listed NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not listed ACGIH: ☐ A1 ☐ A2 ☐ A3 ☐ A4 ☐ A5 ☒ Not listed Skin Absorbable: ☐ Yes ☒ No Skin Corrosive: ☒ Yes ☐ No (as liquid) DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☒ Explosimeter	GasTech	Methane
☐ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☐ Colorometric Tubes	Drager	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☐ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted): ☐ Viton/North ☐ Viton/Best ☐ Silvershield/North ☐ 4H/Safety ☐ Neoprene/Mapa ☐ Neoprene/Ans.Ed. ☐ Neoprene/BestUltraflex ☐ Neoprene/BestNeo.(30min) ☐ PVC/Ans.Ed. ☐ PVC/BestHustler ☐ Nitrile/LabSafe. ☐ Nitrile/Ans.Ed. ☐ Butyl/North ☐ PVA/Ans.Ed. ☒ Other

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek QC ☐ Tyvek/Saranex ☐ Tychem500 ☐ Tychem 9400 ☐ Tychem 10,000 ☒ Other

Respiratory Protection

☐ Air Purifying ☒ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: NA Full face: NA

Notes: To treat fire, shut off source.

Prepared by: Sherry Hall Date: 23 June 1997 Rev. March 5, 2002

CONTAMINANT FACT SHEET - METHYLENE CHLORIDE

CAS Number:75-09-2	**Molecular Weight: 84.9**	**Color: Colorless**	**Ionization Potential (eV): 11.32**	**Vapor Density (Air=1):2.93**
Synonyms: Dichloromethane; Methylene dichloride	**Physical State: Liquid**	**Odor: Chloroform-like**	**Henry's Constant: 0.12**	**Vapor Pressure: 350 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**	
NFPA rating: 1 **HMIS rating: 1**	**NFPA rating: 0** **HMIS rating: 0**		**NFPA rating: 2** **HMIS rating: 2**
Flash Point(°F): NA LEL(%): 13 UEL(%): 23 Fire Extinguishing Media: ☒ Dry Chemical ☒ Foam ☒ Water Spray ☒ CO_2 Fire Extinguisher: ☐ Class A ☐ Class B ☐ Class C ☐ Class D ☒ Class A/B/C DOT: ☐ Flammable Liquid ☐ Combustible Liquid	Incompatibilities: Strong oxidizers;caustics; chemically active metals such as aluminum, magnesium, potassium & sodium; concentrated nitric acid DOT: ☐ Oxidizer ☐ Water Reactive	Odor Threshold (ppm): 160 IDLH (ppm): 2300 See 29 CFR 1910.1052 Signs/Symptoms of Acute Exposure: Irritation of eyes &skin;fatigue;weakness;sleepiness;light-headed; numb tingling limbs;nausea DOT: ☐ Poison	Carcinogenic: OSHA: ☒ Yes ☐ Not listed IARC: ☐ Group 1 ☐ Group 2A ☒ Group 2B ☐ Group 3 ☐ Group 4 ☐ Not listed NTP: ☐ Known ☒ Anticipated ☐ Known ☐ Not listed ACGIH: ☐ A1 ☐ A2 ☒ A3 ☐ A4 ☐ A5 ☐ Not listed Skin Absorbable: ☐ Yes ☒ No Skin Corrosive: ☐ Yes ☒ No DOT: ☐ Corrosive

Source	TWA (ppm)	STEL (ppm)	C (ppm)
OSHA PELs	25	125	NA
ACGIH TLVs	50	NA	NA

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter		
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/624601(50-2000ppm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#005	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):				
	☒ Viton/North (1hr)	☒ Viton/Best (113min)	☒ Silvershield/North	☒ 4H/Safety
	☐ Neoprene/Mapa	☐ Neoprene/Ans.Ed.	☐ Neoprene/BestUltraflex	☐ Neoprene/BestNeo.(30min)
	☐ PVC/Ans.Ed.	☐ PVC/BestHustler	☐ Nitrile/LabSafe.	☐ Nitrile/Ans.Ed.
	☐ Butyl/North	☐ PVA/Ans.Ed.	☐ Other	

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek QC ☐ Tyvek/Saranex ☐ Tychem 500 ☒ Tychem 9400 ☒ Tychem 10,000 ☐ Other

Respiratory Protection

☐ Air Purifying ☒ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: NA Full face: NA

Notes: * = 2000 ppm 5 min. peak in any 2 hours

Prepared by: Sherry Hall Date: 16 January 1997 Rev. 30 January 2002

CONTAMINANT FACT SHEET - PHENOL

CAS Number:108-95-2 | **Molecular Weight: 94.1** | **Color: Colorless to light pink** | **Ionization Potential (eV): 8.50** | **Vapor Density (Air=1):3.24**

Synonyms: Carbonic acid; Hydroxybenzene; Monohydroxybenzene; Phenol alcohol; Phenyl hydroxide | **Physical State: Solid** | **Odor: Acrid** | **Henry's Constant:** | **Vapor Pressure: 0.4 (mmHg@20C)**

Fire Hazard — **NFPA rating: 2** **HMIS rating: 2**

Flash Point(°F): 15
LEL(%): 1.8 UEL(%): 8.6

Fire Extinguishing Media:
- ☒ Dry Chemical
- ☒ Foam
- ☐ Water Spray
- ☒ CO_2

Fire Extinguisher:
- ☐ Class A
- ☐ Class B
- ☐ Class C
- ☐ Class D
- ☒ Class A/B/C

DOT: ☐ Flammable Liquid
☐ Combustible Liquid

Reactivity Hazard — **NFPA rating: 0** **HMIS rating: 0**

Incompatibilities: Strong ocidizers; Calcium hypochlorite;alum inum chloride;acids

DOT: ☐ Oxidizer
☐ Water Reactive

Health Hazard — **NFPA rating: 3** **HMIS rating: 3**

Odor Threshold (ppm): 0.06

IDLH (ppm): 250

Source	TWA (ppm)	STEL (ppm)	C (ppm)
OSHA PELs	5	NA	NA
ACGIH TLVs	5	NA	NA

Signs/Symptoms of Acute Exposure: Irritaion of eyes, nose & throat;anoxer ia;low weight;weakness;m uscle ache;skin burns;derm atitis

DOT: ☐ Poison

Carcinogenic:
OSHA: ☐ Yes ☒ Not listed

IARC: ☐ Group 1 ☐ Group 2A ☐ Group 2B ☒ Group 3 ☐ Group 4 ☐ Not listed

NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not listed

ACGIH: ☐ A1 ☐ A2 ☐ A3 ☒ A4 ☐ A5 ☐ Not listed

Skin Absorbable: ☒ Yes ☐ No
Skin Corrosive: ☒ Yes ☐ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter	GasTech GX-82	Methane
☐ PID	MiniRAE	Isobutylene
☐ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/8101641 (1-20 ppm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☒ Collection Medium/Sampling Pump	Gilian Pump/OSHA82	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
- ☒ Viton/North
- ☐ Viton/Best
- ☒ Silvershield/North
- ☐ 4H/Safety
- ☒ Neoprene/Mapa
- ☒ Neoprene/Ans.Ed.
- ☒ Neoprene/BestUltraflex
- ☒ Neoprene/BestNeo.
- ☒ PVC/Ans.Ed.
- ☒ PVC/BestHustler
- ☒ Nitrile/LabSafe.(2in in)
- ☐ Nitrile/Ans.Ed.
- ☒ Butyl/North (31min)
- ☐ PVA/Ans.Ed.
- ☐ Other

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek QC ☒ Tyvek/Saranex ☐ Tychem 500 (49min) ☒ Tychem 9400 ☒ Tychem 10,000 ☐ Other

Respiratory Protection

☒ Air Purifying ☐ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: 50 Full face: 250

Notes:
Prepared by: Sherry Hall Date: 13 October 1997 31 January 2002

CONTAMINANT FACT SHEET – TETRACHLOROETHYLENE

CAS Number:127-18-4	**Molecular Weight:165.8**	**Color: Colorless to pale yellow**	**Ionization Potential (eV): 9.32**	**Vapor Density (Air=1): 5.85**
Synonyms: Tetrachloroethylene; Perchlorethylene; Perk	**Physical State: Liquid**	**Odor: Mild chloroform-like**	**Henry's Constant: NA {(atm ×m^3)/mol}**	**Vapor Pressure: 2.11 @ 22C (atm)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**	
NFPA rating: 0 **HMIS rating: 0**	**NFPA rating: 0** **HMIS rating: 0**		**NFPA rating: 2** **HMIS rating: 2**
Flash Point(°F): Nonflammable LEL(%): 1.8% UEL(%): 11.5% Fire Extinguishing Media: ☐ Dry Chemical ☐ Foam ☐ Water Spray ☐ CO_2 Fire Extinguisher: ☐ Class A ☐ Class B ☐ Class C ☐ Class D ☐ Class A/B/C DOT: ☐ Flammable Gas ☐ Combustible Liquid	Incompatibilities: Strong oxiders;chem ically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash DOT: ☐ Oxidizer ☐ Water Reactive	Odor Threshold (ppm): 47 IDLH (ppm): 150 Source / TWA (ppm) / STEL (ppm) / C (ppm) OSHA PELs: 100 / NA ACGIH TLVs: 200,300* / 25 / 100 / NA 5 m in. peak in any 3 hours Signs/Symptoms of Acute Exposure: Irritation of the eyes, nose, throat;nausea;f lush face, neck;vertigo; dizziness;incorehent;headache DOT: ☒ Poison, Harmful	Carcinogenic: OSHA: ☐ Yes ☒ Not listed IARC: ☐ Group 1 ☒ Group 2A ☐ Group 2B ☐ Group 3 ☐ Group 4 ☐ Not listed NTP: ☐ Known ☒ Anticipated ☐ Process ☐ Not listed ACGIH: ☐ A1 ☐ A2 ☒ A3 ☐ A4 ☐ A5 ☐ Not listed Skin Absorbable: ☐ Yes ☒ No Skin Corrosive: ☐ Yes ☒ No DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☒ Explosimeter	Gastech GX-82	Methane
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/8101501(2-300 ppm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor	NA	NA
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#003	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted): ☒ Viton/North ☐ Viton/Best ☐ Silvershield/North ☐ 4H/Safety ☐ Neoprene/Mapa 28min ☐ Neoprene/Ans.Ed. ☐ Neoprene/BestUltraflex40min ☐ Neoprene/BestNeo.(30min) ☐ PVC/Ans.Ed. ☐ PVC/BestHustler ☐ Nitrile/LabSafe. ☐ Nitrile/Ans.Ed. ☐ Butyl/North ☒ PVA/Ans.Ed. ☐ Other

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek Q ☐ Tyvek/Saranex ☐ Tychem500 ☐ Tychem 9400 ☐ Tychem10,000 ☐ Other

Respiratory Protection

☐ Air Purifying ☒ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: NA Full face: NA

Notes: Noncombustible liquid, but decomposes in a fire to hydrogen chloride and phosgene

Prepared by: Sherry Hall Date: 10 October 1997 Rev. 30 January 2002

CONTAMINANT FACT SHEET - TOLUENE

CAS Number:108-88-3	**Molecular Weight: 92.1**	**Color: Colorless**	**Ionization Potential (eV): 8.82**	**Vapor Density (Air=1):318**
Synonyms: Methyl benzene, Methyl benzol	**Physical State: Liquid**	**Odor: Sweet, pungent, aromatic**	**Henry's Constant: 0.27**	**Vapor Pressure: 21 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**
NFPA rating: 3 **HMIS rating: 3**	**NFPA rating: 0** **HMIS rating: 0**	**NFPA rating: 2** **HMIS rating: 2**
Flash Point(°F): 40 LEL(%): 1.1 UEL(%): 7.1 Fire Extinguishing Media: ☒ Dry Chemical ☒ Foam ☐ Water Spray ☒ CO_2 Fire Extinguisher: ☐ Class A ☐ Class B ☐ Class C ☐ Class D ☒ Class A/B/C DOT: ☒Flammable Liquid ☐Combustible Liquid	Incompatibilities: Strong oxidizers DOT: ☐ Oxidizer ☐ Water Reactive	Odor Threshold (ppm): 0.16-37 IDLH (ppm): 500 Signs/Symptoms of Acute Exposure: Irritation of the eyes & nose;fatique;wea kness;confusion;ar chona; dizziness;headache;derm atitis. DOT: ☐ Poison

Source	TWA (ppm)	STEL (ppm)	C (ppm)
OSHA PELs	200	NA	300*
ACGIH TLVs	50	NA	NA

*500 ppm - 10-min. peak per 8-hr. shift

Carcinogenic:
OSHA: ☐ Yes ☒ Not listed

IARC: ☐ Group 1 ☐ Group 2A ☐ Group 2B ☒ Group 3 ☐ Group 4 ☐ Not listed

NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not listed

ACGIH: ☐ A1 ☐ A2 ☐ A3 ☒ A4 ☐ A5 ☐ Not listed

Skin Absorbable: ☒ Yes ☐ No
Skin Corrosive: ☐ Yes ☒ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☒ Explosimeter	GasTech GX-82	Methane
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/CH23001(5-500ppm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#500	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
☒Viton/North ☐Viton/Best ☒Silvershield/North ☒4H/Safety
☐Neoprene/Mapa ☐Neoprene/Ans.Ed. ☐Neoprene/BestUltraflex ☒ Neoprene/BestNeo.(25min)
☐PVC/Ans.Ed. ☒PVC/BestHustler (9min) ☒Nitrile/LabSafe.(28min) ☐Nitrile/Ans.Ed.
☒Butyl/North ☐PVA/Ans.Ed. ☐Other

Suit Type (Breakthrough >1hr unless noted): ☐Tyvek ☐ Tyvek Q ☐Tyvek/Saranex ☒Tychem 500 ☒Tychem 9400 ☒Tychem 10,000 ☐Other

Respiratory Protection

☒Air Purifying ☐Air Supplied Only | Maximum Use Concentration (ppm): Half mask: 250 Full face: 250

Notes:
Prepared by: Sherry Hall Date: 16 January 1997 Rev. 31 January 2002

CONTAMINANT FACT SHEET - TRICHLOROETHENE

CAS Number:79-01-6	**Molecular Weight: 131.4**	**Color: Colorless**	**Ionization Potential (eV): 9.45**	**Vapor Density (Air=1):4.54**
Synonyms: Trichloroethylene; TCE	**Physical State: Liquid**	**Odor: Chloroform-like**	**Henry's Constant: 0.50**	**Vapor Pressure: 58 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**
NFPA rating: 2 **HMIS rating: 2**	**NFPA rating: 0** **HMIS rating: 0**	**NFPA rating: 2** **HMIS rating: 2**

Flash Point(°F): 90
LEL(%): 8 UEL(%): 10.5

Fire Extinguishing Media:
- ☒ Dry Chemical
- ☒ Foam
- ☐ Water Spray
- ☒ CO_2

Fire Extinguisher:
- ☐ Class A
- ☐ Class B
- ☐ Class C
- ☐ Class D
- ☒ Class A/B/C

DOT: ☐ Flammable Liquid
☐ Combustible Liquid

Incompatibilities: Strong caustics;alkalis; chemically active metals (such as barium, lithium, sodium, magnesium, titanium and beryllium

DOT: ☐ Oxidizer
☐ Water Reactive

Odor Threshold (ppm): 82

IDLH (ppm): 1000

Source	TWA (ppm)	STEL (ppm)	C (ppm)
OSHA PELs	100	NA	200, 300*
ACGIH TLVs	50	100	NA

5- Min peak in any two hours.

Signs/Symptoms of Acute Exposure: Irritation of eyes and skin;headache;ver tigo;visual distur bance; fatigue;giddiness;tr emor;sleepiness;nausea; vomiting;derm atitis

DOT: ☐ Poison

Carcinogenic:
OSHA: ☐ Yes ☒ Not listed

IARC: ☐ Group 1 ☒ Group 2A ☐ Group 2B ☐ Group 3 ☐ Group 4 ☐ Not listed

NTP: ☐ Known ☒ Anticipated ☐ Process ☐ Not listed

ACGIH: ☐ A1 ☐ A2 ☐ A3 ☐ A4 ☒ A5 ☐ Not listed

Skin Absorbable: ☐ Yes ☒ No
Skin Corrosive: ☐ Yes ☒ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter	Gastech GX-82	Methane
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/CH24401 (10-500pmm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#022	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
- ☒ Viton/North
- ☐ Viton/Best
- ☒ Silvershield/North
- ☒ 4H/Safety
- ☐ Neoprene/Mapa
- ☐ Neoprene/Ans.Ed.
- ☐ Neoprene/BestUltraflex
- ☐ Neoprene/BestNeo.(30min)
- ☐ PVC/Ans.Ed.
- ☐ PVC/BestHustler
- ☐ Nitrile/LabSafe.
- ☐ Nitrile/Ans.Ed.
- ☐ Butyl/North
- ☐ PVA/Ans.Ed.
- ☐ Other

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek Q ☐ Tyvek/Saranex ☐ Tychem 500 ☒ Tychem 9400 ☐ Other

Respiratory Protection

☐ Air Purifying ☒ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: NA Full face: NA

Notes:
Prepared by: Sherry Hall Date: 16 January 1997 Rev. 30 January 2002

CONTAMINANT FACT SHEET - XYLENE (MIXED ISOMERS)

CAS Number:varies w/ isomer	**Molecular Weight: 106.2**	**Color: Colorless**	**Ionization Potential (eV): 8.44**	**Vapor Density (Air=1):3.66**
Synonyms: o-xylene, p-xylene, m-xylene	**Physical State: Liquid**	**Odor: Aromatic**	**Henry's Constant: 0.17**	**Vapor Pressure: 7 (mmHg@20C)**

Fire Hazard	**Reactivity Hazard**	**Health Hazard**
NFPA rating: 3 **HMIS rating: NE**	**NFPA rating: 0** **HMIS rating: 0**	**NFPA rating: 2** **HMIS rating: 2**

Flash Point(°F): 81
LEL(%): 0.9 UEL(%): 6.7

Fire Extinguishing Media:
- ☒ Dry Chemical
- ☒ Foam
- ☐ Water Spray
- ☒ CO_2

Fire Extinguisher:
- ☐ Class A
- ☐ Class B
- ☐ Class C
- ☐ Class D
- ☒ Class A/B/C

DOT: ☒ Flammable Liquid
☐ Combustible Liquid

Incompatibilities: Strong oxidizers; strong acids

DOT: ☐ Oxidizer
☐ Water Reactive

Odor Threshold (ppm): 20

IDLH (ppm): 900

Source	TWA (ppm)	STEL (ppm)	C (ppm)
OSHA PELs	100	NA	NA
ACGIH TLVs	100	150	NA

Signs/Symptoms of Acute Exposure: Irritation of eyes, nose, & throat;dizziness;excitement;drowsiness; incoherence;staggering gait;cornea vacuolization; anorexia;nausea;vomiting;abdominal pain;dermatitis

DOT: ☐ Poison

Carcinogenic:
OSHA: ☐ Yes ☒ Not listed

IARC: ☐ Group 1 ☐ Group 2A ☐ Group 2B ☒ Group 3 ☐ Group 4 ☐ Not listed

NTP: ☐ Known ☐ Anticipated ☐ Process ☒ Not listed

ACGIH: ☐ A1 ☐ A2 ☐ A3 ☒ A4 ☐ A5 ☐ Not listed

Skin Absorbable: ☐ Yes ☒ No
Skin Corrosive: ☐ Yes ☒ No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☒ Explosimeter	GasTech GX-82	Methane
☒ PID	MiniRAE	Isobutylene
☒ FID	Foxboro OVA	Methane
☒ Colorometric Tubes	Drager/633161(10-400ppm)	Check pump for leaks
☐ Chemical Monitor ☐ Dust Monitor		
☒ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#501	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):
- ☒ Viton/North
- ☐ Viton/Best
- ☒ Silvershield/North
- ☒ 4H/Safety
- ☐ Neoprene/Mapa
- ☐ Neoprene/Ans.Ed.
- ☐ Neoprene/BestUltraflex
- ☒ Neoprene/BestNeo.(30min)
- ☐ PVC/Ans.Ed.
- ☐ PVC/BestHustler
- ☒ Nitrile/LabSafe.(92min)
- ☒ Nitrile/Ans.Ed. (50min)
- ☐ Butyl/North
- ☐ PVA/Ans.Ed.
- ☐ Other

Suit Type (Breakthrough >1hr unless noted): ☐ Tyvek ☐ Tyvek Q ☐ Tyvek/Saranex ☐ Tychem 500 ☒ Tychem 9400 ☒ Tychem 10,000 ☐ Other

Respiratory Protection

☒ Air Purifying ☐ Air Supplied Only | Maximum Use Concentration (ppm): Half mask: 900 Full face: 900

Notes: The most conservative values were chosen if values were given in the literature for all isomers.
Prepared by: Sherry Hall Date: 16 January 1997 31 January 2002

Appendix F

Personal Protective Equipment per Task

Level D for Task ④ (Investigation Derived Waste Handling)		*Modified Level D for Tasks* ① (Ground Topographical Survey) ⑤ (Gas Monitoring) & ⑥ (Grass Mowing)	
Equipment	***Material/Type***	***Equipment***	***Material/Type***
☒Protective clothing	Long pants and long sleeves	☒Protective clothing	Disposable Tyvek (or similar)
☒Outer gloves**		☒Outer gloves**	Required while drilling
☒Outer boots**		☒Outer boots**	
☒Hard hat	ANSI approved	☒Hard hat	ANSI approved
☒Safety glasses	ANSI approved with side shields	☒Safety glasses	ANSI approved with side shields
☒Hard-toed boots	Impact/puncture resistant	☒Hard-toed boots	Impact/puncture resistant
☒Hearing protection**	Must carry and use as necessary	☒Hearing protection**	Must carry and use as necessary
☒Face Shield**	In lieu of safety glasses	☐Face Shield**	
☐Other:		☐Other:	

** Optional as applicable

Appendix F (cont.)

Personal Protective Equipment per Task

Level C		*Level B* for Task* ② (Gas Vent Installation) & ③ (Dual Phase Well Installation)	
Equipment	***Material/Type***	***Equipment***	***Material/Type***
☐ Full-face air-purifying respirator	Cartridge Type:	☒SCBA (pressure demand)	Or air-line system
☒ Half-mask air-purifying respirator	Cartridge Type:	☒Air-line System (pressure demand)	Or SCBA system
☒Protective clothing	Disposable Tyvek (or similar)	☒Protective clothing	Disposable Tyvek (or similar)
☒Outer gloves	Disposable or washable	☒Outer gloves	
☐Inner gloves		☐Inner gloves	
☒Outer boots	Disposable or washable	☒Outer boots	
☒Hard hat	ANSI approved	☒Hard hat	ANSI approved
☒Safety glasses	ANSI approved with side shields	☒Hard-toed boots	Impact/puncture resistant
☒Hard-toed boots	Impact/puncture resistant	☒Hearing protection**	Must carry and use as necessary
☒Hearing protection	Must carry and use as necessary	☐Escape respirator**	
☐Other:		☒Safety "tag" rope**	
		☐Other:	

* For Tasks 2 and 3, holes shall be drilled in level B and downgrade to D based on air monitoring of breating air, if appropriate for well/vent construction

** Optional as applicable

Appendix G

Post-Incident Response Procedures and Forms

- **Instructions for Incident Reporting**
- **Letter to Medical Provider**
- **Physician Return-to-Work Authorization**

Instructions for Incident Reporting

After an incident involving a Geosyntec employee has been responded to, it must be appropriately reported according to the following procedure:

- Within 24 hours, the "Primary Responder" to an incident completes an **Incident Reporting Form - Manager**, located on the Geosyntec Environmental Health and Safety Sharepoint website under "What to Do in Case of an Incident".

- Within 48 hours, the employee must complete an **Incident Reporting Form – Employee** (also located at the EH&S website link).

- The Primary Responder forwards both Incident Reporting Forms within 48 hours to Dale Prokopchak for review, documentation, and corrective measure implementation into our case management program.

Dale Prokopchak
Office: 804-332-6376
Cell: 804-349-8067
Fax: 804-332-6732
dprokopchak@geosyntec.com

NOTE: Contractors are responsible for compliance with their company's own internal safety procedures regarding incident reporting. However, if a Geosyntec employee observes a contractor's incident, the employee shall document the incident in their field notes.

Geosyntec consultants

5901 Broken Sound Parkway, NW, Suite 300
Boca Raton, FL 33487-2775
PH 561.995.0900
FAX 561.922.1101
www.geosyntec.com

Dear Medical Provider:

On behalf of Geosyntec Consultants/MMI Engineering, you are authorized to evaluate and treat the above Geosyntec/MMI employee today for an alleged work-related injury or illness.

Employee Name: _____
Alleged Injury: _____
Date of Alleged Injury: _____
Date of Medical Evaluation: _____

Geosyntec/MMI strives to reduce OSHA recordables; therefore, ***please do not prescribe or dispense prescription medications if OTC medications if non-prescription strength can be used.*** It is our primary interest to ensure this employee returns to work full duty. If a full duty release is not possible, Geosyntec/MMI may be able to find light duty for the **employee**; ***unless it is unavoidable, please do not prescribe lost time.*** We would appreciate it if you would complete the attached form "Physical Status for Return to Work", or a similar form, to assist us in evaluating this employee's work capabilities.

- Please fax a copy of all medical paperwork and "Physical Status for Return to Work Form" to Dale Prokopchak at (804) 332-6732.
- Invoices and supporting medical records should be mailed to:

  Denise Emmanuelli
  Senior HR Representative
  Geosyntec Consultants
  5901 Broken Sound Parkway, NW, Suite 300
  Boca Raton, FL 33487
  Phone: 561.922.1112
  Fax: 561.922.1101

Thank you for your assistance.

Very truly yours,

Dale Prokopchak, CIH, CSP
Director of Environmental Health and Safety

Geosyntec consultants

PHYSICAL STATUS FOR RETURN TO WORK
PLEASE FAX COMPLETED FORM TO DALE PROKOPCHAK AT (804) 332-6732

Employee Name _____ Date of Injury/Illness _____

TO BE COMPLETED BY TREATING PHYSICIAN

Diagnosis _____

I saw and treated this patient on (date) _____ and:

__ Release the patient to full duty with no limitations on (date) _____

__ Patient may return to work with the following limitation on (date) _____ and may work an 8 hr. shift unless specified otherwise.

LIFTING CAPACITY

__ Occasional lifting (10 lbs. max.) and lifting and carrying occasionally. Walking and standing occasionally.

__ Occasional lifting (20 lbs. max.). Significant walking, standing; or sitting with pushing and pulling with arms or legs.

__ Occasional lifting (50 lbs. max.) with frequent lifting and/or carrying up to 25 pounds.

OTHER ACTIVITIES

		SINGLE DURATION					IN AN 8 HOUR DAY PATIENT MAY DO				
LIMITATION	NO LIMITATION	< 1/2 hr	1/2-1 hr	1-2 hr	2-4 hr	4-6 hr	1/2-1 hr	1-2 hr	2-4 hr	4-6 hr	6-8 hr
SIT											
STAND											
WALK											
USE RIGHT HAND											
USE LEFT HAND											

	NO LIMITATION	FREQUENTLY (31%-60%)	OCCASIONALLY (1%.-30%)	NEVER
BEND				
SQUAT				
CLIMB				
REACH OVERHEAD		WEIGHT LIMIT	WEIGHT LIMIT	
REACH SHOULDER		WEIGHT LIMIT	WEIGHT LIMIT	
PUSHING/PULLING		WEIGHT LIMIT	WEIGHT LIMIT	

Other instructions or limitations:

_____

_____

Estimated length of time of modified duty: _____

__ These restrictions are in effect until (date) _____ or until patient is reevaluated on (date) _____

__ Patient is totally incapacitated at this time. Patient will be reevaluated on (date) _____

Physician Signature _____ Date _____

ADDITIONAL NOTES:

Appendix H

Material Safety Data Sheets

Included in HASP	*Chemical*
☒	Acetone
☒	Alconox
☐	Ammonia
☒	Bentonite
☒	Diesel Fuel Oil No. 2-D
☒	Gasoline
☐	Helium
☐	*n*-Hexane
☒	Hydrochloric Acid
☐	Hydrogen
☒	Isobutylene Calibration Gas
☒	Isopropyl Alcohol
☐	KB-1
☒	Methane Calibration Gas
☒	Nitric Acid
☐	Permanganate
☒	Portland Cement
☒	Sulfuric Acid
☐	Other: _____

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2000-07

Acetone
MSDS 300
ACE4750

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Acetone **CAS Number:** 67-64-1
Chemical Formula: C_3H_6O
Structural Chemical Formula: CH_3COCH_3
Synonyms: ACETON; ACETONE; CHEVRON ACETONE; DIMETHYL KETONE; DIMETHYLFORMALDEHYDE; DIMETHYLKETAL; EPA PESTICIDE CHEMICAL CODE 004101; KETONE PROPANE; KETONE,DIMETHYL; BETA-KETOPROPANE; METHYL KETONE; 2-PROPANONE; PROPANONE; PYROACETIC ACID; PYROACETIC ETHER
General Use: Solvent for fats, oils, waxes, resins, rubber, plastics, lacquers.
Used in manufacture of methyl isobutyl ketone, mesityl oxide, acetic acid, diacetone alcohol, isoprene. Used in solvent extraction processes.
Solvent in the manufacture of explosives and rayon. Component of adhesives, glues, cleaning solvents, lacquer thinners, nail polish, paint removers.
Storing acetylene gas (takes up about 24 times its volume of the gas).
Purifying paraffin and biomedical hardening and dehydrating tissues.
Minor food additive, permitted in USA.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
acetone	67-64-1	95-99.5

OSHA PEL
TWA: 1000 ppm; 2400 mg/m^3.

NIOSH REL
TWA: 250 ppm; 590 mg/m^3.

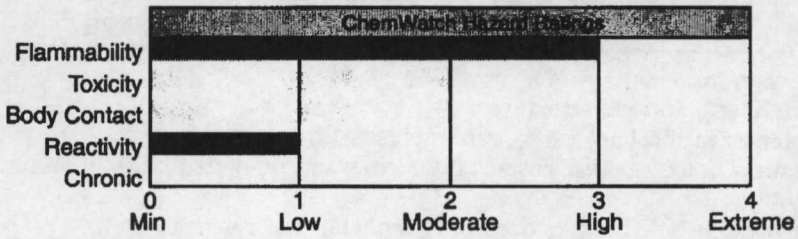
DFG (Germany) MAK
TWA: 500 ppm; 1200 mg/m^3.

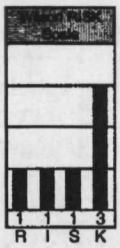
OSHA PEL Vacated 1989 Limits
TWA: 750 ppm; 1800 mg/m^3;
STEL: 1000 ppm; 2400 mg/m^3.

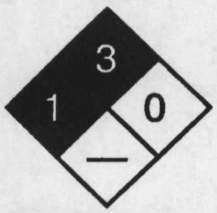
IDLH Level
2500 ppm; LEL.

ACGIH TLV
TWA: 750 ppm; 1780 mg/m^3;
STEL: 1000 ppm; 2380 mg/m^3.

Section 3 - Hazards Identification







Fire Diamond

ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, highly volatile liquid; sweet odor. Irritating. Also causes: muscle weakness, mental confusion, coma (high concentrations). Ingestion: GI irritation, kidney and liver damage, metabolic changes, coma. Chronic: dermatitis. Highly flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact, ingestion

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Target Organs: respiratory system, central nervous system (CNS), skin

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Exposure to ketone vapors may produce nose, throat and mucous membrane irritation. High concentrations of vapor may produce central nervous system depression characterized by headache, vertigo, loss of coordination, narcosis and cardiorespiratory failure. Some ketones produce neurological disorders (polyneuropathy) characterized by bilateral symmetrical paresthesia and muscle weakness primarily in the legs and arms.
Symptoms of exposure may include restlessness, headache, vomiting, stupor, low blood pressure and rapid and irregular pulse, eye and throat irritation, weakness of the legs, dizziness and lightheadedness.
Inhalation of high concentrations produces dryness of the mouth and throat, dizziness, nausea, incoordinated movements, loss of coordinated speech, drowsiness, and in extreme cases, coma.
Inhalation of acetone vapors over long periods causes irritation of the respiratory tract, coughing, headache. Acetone concentrations of 52200 ppm for 1 hour produced narcosis in rats and fatalities at 126600 ppm.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration.
The vapor is discomforting to the eyes.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is discomforting to the skin if exposure is prolonged and may cause drying of the skin, which may lead to dermatitis.
Toxic effects may result from skin absorption.
Open cuts, abraded or irritated skin should not be exposed to this material.
The material may accentuate any pre-existing skin condition.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is highly discomforting and mildly toxic if swallowed but may be harmful if swallowed in quantity.
Small amounts or low dose rates are regarded as practically non-harmful.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.
Workers exposed to 700 ppm acetone for 3 hours/day for 7-15 years showed inflammation of the respiratory tract, stomach and duodenum, attacks of giddiness and loss of strength. Exposure to acetone may enhance liver toxicity of chlorinated solvents.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.
Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water.
Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to acetone:
1.Symptoms of acetone exposure approximate ethanol intoxication.
2.About 20% is expired by the lungs and the rest is metabolized.
Alveolar air half-life is about 4 hours following two hour inhalation at levels near the Exposure Standard; in overdose, saturable metabolism and limited clearance, prolong the elimination half-life to 25-30 hours.
3.There are no know antidotes and treatment should involve the usual methods of decontamination followed by supportive care.

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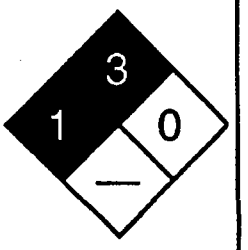
Section 5 - Fire-Fighting Measures

Flash Point: -20 °C
Autoignition Temperature: 465 °C
LEL: 2.15% v/v
UEL: 13% v/v
Extinguishing Media: Water spray or fog; alcohol stable foam.
Dry chemical powder.
Bromochlorodifluoromethane (BCF) (where regulations permit).
Carbon dioxide.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
PLEASE NOTE: 10% of acetone in water has a flash point below 20 deg. C.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Avoid breathing vapors and contact with skin and eyes.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Shut off all possible sources of ignition and increase ventilation.
Water spray or fog may be used to disperse vapor.
Stop leak if safe to do so. Contain spill with sand, earth or vermiculite.
Collect residues and place in flammable waste container.
Any electric cleaning equipment must be explosion proof.
Wash spill area with large quantities of water.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.

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DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer. Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
None required when handling small quantities. OTHERWISE: If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves or Butyl rubber gloves or Neoprene rubber gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >1000 to <2500 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 2500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: use ov (black) cartridge for nuisance(<1000)

Other: Overalls. Ensure that there is ready access to eye wash unit and Ensure there is ready access to an emergency shower.

Glove Selection Index:

BUTYL/NEOPRENE	A
PE/EVAL/PE	A
PVDC/PE/PVDC	A
BUTYL	A
SARANEX-23 2-PLY	B
TEFLON	B
SARANEX-23	C
CPE	C
HYPALON	C
NITRILE+PVC	C
PVA	C
VITON/NEOPRENE	C
NEOPRENE	C
PVC	C
NATURAL+NEOPRENE	C
NATURAL RUBBER	C
NITRILE	C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless, highly volatile, highly flammable liquid with characteristic sweet odor. Mixes in alcohol, ether, most hydrocarbons and oils.

Physical State: Liquid
Vapor Pressure (kPa): 24 at 20 °C
Vapor Density (Air=1): 2.0
Formula Weight: 58.08
Specific Gravity (H_2O=1, at 4 °C): 0.79 at 20 °C
Water Solubility: Miscible
Evaporation Rate: 11 (BuAc=1) VFast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 56.2 °C (133 °F) at 760 mm Hg
Freezing/Melting Point Range: -95.35 °C (-139.63 °F)
Volatile Component (% Vol): 100

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Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers, strong acids and strong alkalis.
Reacts violently with bromoform and chloroform in the presence of alkalies or in contact with alkaline surfaces.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (man) TD_{Lo}: 2857 mg/kg
Oral (rat) LD_{50}: 5800 mg/kg
Inhalation (human) TC_{Lo}: 500 ppm
Inhalation (man) TC_{Lo}: 12000 ppm/4 hr
Inhalation (man) TC_{Lo}: 10 mg/m^3/6 hr
Inhalation (rat) LC_{50}: 50100 mg/m^3/8 hr
Dermal (rabbit) LD_{50}: 20000 mg/kg

IRRITATION
Eye (human): 500 ppm - irritant
Eye (rabbit): 3.95 mg - SEVERE
Eye (rabbit): 20 mg/24 hr -moderate
Skin (rabbit): 395 mg (open) - mild
Skin (rabbit): 500 mg/24 hr - mild

See NIOSH, *RTECS* AL 3150000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on soil, it will both volatilize and leach into the ground and probably biodegrade. If released into water, it will probably biodegrade. It will also be lost due to volatilization (estimated half-life 20 hr from a model river). Bioconcentration in aquatic organisms and adsorption to sediment should not be significant. In the atmosphere, it will be lost by photolysis and reaction with photochemically produced hydroxyl radicals. Half-life estimates from these combined processes average 22 days and are shorter in summer and longer in winter. It will also be washed out by rain.
Ecotoxicity: LD_{100} Asellus aquaticus 3 ml/l (within 3 days of exposure) /Conditions of bioassay not specified; LC_{50} Mexican axolotl 20.0 mg/l/48 hr (3-4 weeks after hatching) /Conditions of bioassay not specified; TLm Mosquito fish 13,000 mg/l/24, 48, 96 hr /Conditions of bioassay not specified; LD_{100} Gammarus fossarum 10 ml/l (within 48 hr) /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 7,032 ppm/14 days /Conditions of bioassay not specified; LC_{50} Ring-necked pheasant oral greater than 40,000 ppm, in diet, age 10 days, (no mortality to 40,000 ppm); LC_{50} Salmo gairdneri (Rainbow trout) 5,540 mg/l/96 hr at 12 °C (95% confidence limit 4,740-6,330 mg/l), wt 1.0 g /static bioassay; LC_{50} Clawed toad 24.0 mg/l/48 hr (3-4 weeks after hatching) /Conditions of bioassay not specified; TLm Daphnia magna 10 mg/l/24, 48 hr /Conditions of bioassay not specified
Henry's Law Constant: 3.97 x10^{-5}
BCF: negligible
Biochemical Oxygen Demand (BOD): theoretical 122%, 5 days
Octanol/Water Partition Coefficient: log K_{OW} = -0.24

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ACETONE
Hazard Class: 3.1
ID No.: 1090
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U002 Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

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Section 16 - Other Information

Research Date: .....1999-11 **Review Date:** 2000-07

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CAS # 67-64-1

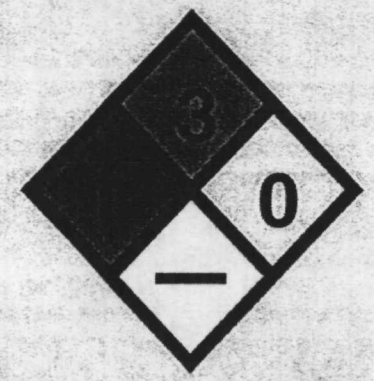
Danger! 1 3

Flammable

Acetone

dimethylformaldehyde; dimethylketal; dimethylketone; B-ketopropane; methyl ketone; propanone; pyroacetic acid

Colorless, highly volatile liquid; sweet odor. Irritating. Also Causes: muscle weakness, mental confusion, coma (high concentrations). Ingestion: GI irritation, kidney and liver damage, metabolic changes, coma. Chronic: dermatitis. Highly flammable.



Target Organs

3 9 10

Eyes, Skin, Respiratory System, Gastro intestinal, Nervous System

Personal Protective Equipment

8

Goggles, Gloves, Apron

Check to see is respirator required?

Emergency Procedures

First Aid

4

Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Do not induce vomiting. Contact physician immediately.

Fire

5

Flammable. Can form explosive mixtures in the air. Stop leak before extinguishment. Use dry chemical, carbon dioxide, water spray, or alcohol-resistant foam. Water may be ineffective.

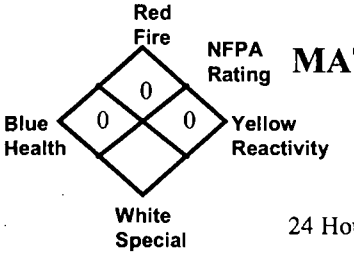
Spills & Leaks

6

Notify safety personnel, isolate and ventilate area. Shut off heat and ignition sources. Take up with inert material (earth, vermiculite). Cleanup personnel should protect against exposure.

Consult MSDS 0300 for more information

Alconox ®



MATERIAL SAFETY DATA SHEET

Alconox, Inc.
30 Glenn Street. Suite 309
White Plains, NY 10603

24 Hour Emergency Number – Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 1999
Chemical Family:	Anionic Powdered Detergent
Manufacturer Catalog Numbers for sizes	1104, 1125, 1150, 1101, 1103 and 1112

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO_2, foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO_2 on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

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MATERIAL SAFETY DATA SHEET

Ammonia, Standard 2000 ppm

Revision Issued: 08/02/2000 Supercedes: 07/06/1999 First Issued: 07/06/1999

Section I — Chemical Product and Company Identification

Product Name: Ammonia, Standard 2000 ppm

Synonyms:

None

Fisher Scientific
One Reagent Lane
Fairlawn, New Jersey 07410

(201) 796-7100
Chemtrec: (800) 424-9300

Section II — Composition/Information on Ingredients

Chemical Name	CAS Number	%	EINECS#
Water	7732-18-5	Balance	231-791-2
Ammonium Chloride	12125-02-9	0.626	235-186-4

Hazard Symbols: None listed

Risk Phrases: None listed

Section III — Hazard Identification

EMERGENCY OVERVIEW:

Not available.

POTENTIAL HEALTH EFFECTS:

Eyes: May cause eye irritation.

Skin: May cause skin irritation.

Ingestion: May cause irritation of the digestive tract.

Inhalation: May cause respiratory tract irritation.

Chronic: No information found.

Section IV — First Aid Measures

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

Skin:

Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse.

Ingestion:

Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.

Inhalation:

Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician:

None.

Section V — Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

Extinguishing Media:

Use extinguishing media most appropriate for the surrounding fire. Use water spray, dry chemical, carbon dioxide, or appropriate foam.

Section VI — Accidental Release Measures

General Information:

Use proper personal protective equipment as indicated in Section VIII.

Spills and/or Leaks:

Absorb spill with inert material (e.g., vermiculite, sand or earth), then place in suitable container. Clean up spills immediately, observing precautions in the Protective Equipment section. Provide ventilation.

Section VII — Handling and Storage

Handling:

Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.

Storage:

Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section VIII — Exposure Controls/Personal Protection

Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

Personal Protective Equipment:

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations ins 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

Section IX — Physical and Chemical Properties

Physical State:	Liquid	**pH:**	N/A
Appearance:	Clear, colorless.	**Vapor Pressure:**	N/A
Odor:	None reported	**Vapor Density:**	N/A
Viscosity:	N/A	**Evaporation Rate:**	N/A
Boiling Point/Range:	N/A	**Autoignition Temperature:**	N/A

Freezing/Melting Point:	N/A	**Explosion Limits, upper:**	N/A
Flash Point:	N/A	**Explosion Limits, lower:**	N/A
Decomposition Temperature:	N/A	**Specific Gravity/Density:**	N/A
Molecular Formula:	Mixture	**Molecular Weight:**	0
Solubility:	Soluble		

Section X — Stability and Reactivity

Chemical Stability:
Stable under normal temperatures and pressures.

Conditions to Avoid:
Incompatible materials, excess heat.

Incompatibilities with Other Materials:
Oxidizing agents.

Hazardous Decomposition Products:
Hydrogen chloride, irritating and toxic fumes and gases, ammonia and/or derivatives.

Hazardous Polymerization:
Has not been reported.

Section XI — Toxicological Information

RTECS#: CAS# 7732-18-5: ZC0110000

CAS# 12125-02-9: BP4550000

LD50/LC50:

CAS# 7732-18-5: Oral, rat: LD50 = >90 mL/kg.

CAS# 12125-02-9: Draize test, rabbit, eye: 500 mg/24H Mild; Draize test, rabbit, eye: 100 mg Severe; Oral, mouse: LD50 = 1300 mg/kg; Oral rat: LD50 = 1650 mg/kg.

Carcinogenicity:

Water: Not listed by ACGIH, IARC, NIOSH, NTP or OSHA.

Ammonium Chloride: Not listed by ACGIH, IARC, NIOSH, NTP or OSHA.

Epidemiology: No information available.

Teratogenicity: No information available.

Reproductive Effects: No information available.

Neurotoxicity: No information available.

Mutagenicity: No information available.

Other Studies: No data available.

Section XII — Ecological Information

No information available.

Section XIII — Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

Section XIV — Transport Information

US DOT: No information available.

Canadian TDG: No information available.

Section XV — Regulatory Information

U.S. FEDERAL

TSCA:

CAS# 7732-18-5 is listed on the TSCA inventory.

CAS# 12125-02-9 is listed on the TSCA inventory.

This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

CAS# 12125-02-9 is listed as a Hazardous Substance under the CWA.

None of the chemicals in this product are listed as Priority Pollutants under the CWA.

None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE:

Water is not present on state lists from CA, PA, MN, MA, FL, or NJ.
Ammonium chloride can be found on the following state right-to-know lists:

California
New Jersey
Florida
Pennsylvania
Minnesota
Massachusetts

California No Significant Risk Level:

None of the chemicals in this product are listed.

EUROPEAN/INTERNATIONAL REGULATIONS:

European Labeling in Accordance with EC Directives:

Hazard Symbols:	Not available.
Risk Phrases:	Not available.
Safety Phrases:	
S 28A:	After contact with skin, wash immediately with plenty of water.
S 36/37/39:	Wear suitable protective clothing, gloves and eye/face protection.
S 37:	Wear suitable gloves.
S 45:	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger Protection):

CAS# 7732-18-5:	No information available.
CAS# 12125-02-9:	1

United Kingdom Occupational Exposure Limits:

CAS# 12125-02-9:	OES-United Kingdom, TWA fume: 10 mg/m^3 TWA
CAS# 12125-02-9:	OES-United Kingdom, STEL fumr: 20 mg/m^3 STEL

Canada:

CAS# 7732-18-5:	Listed on Canada's DSL List.
CAS# 12125-02-9:	Listed on Canada's DSL List.
CAS# 7732-18-5:	Not listed on Canada's Ingredient Disclosure List.
CAS# 12125-02-9:	Not listed on Canada's Ingredient Disclosure List.

Exposure Limits:

CAS# 12125-02-9:

OEL-Arab Republic of Egypt:	TWA 10 mg/m^3 (fume)
OEL-Australia:	TWA 10 mg/m^3; STEL 20 mg/m^3 (fume)
OEL-Belgium:	TWA 10 mg/m^3; STEL 20 mg/m^3 (fume)
OEL-Denmark:	TWA 10 mg/m^3 (fume)
OEL-France:	TWA 10 mg/m^3 (fume)
OEL-The Netherlands:	TWA 10 mg/m^3 (fume)
OEL-Russia:	STEL 10 mg/m^3 (fume)
OEL-Switzerland:	TWA 6 mg/m^3 (fume)
OEL-United Kingdom:	TWA 10 mg/m^3; STEL 20 mg/m^3 (fume)
OEL in Bulgaria, Colombia, Jordan, Korea:	Check ACGIH TLV
OEL in New Zealand, Singapore, Vietnam:	Check ACGI TLV

Section XVI — Other Information

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use.

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International Chemical Safety Cards

BENTONITE

ICSC: 0384

BENTONITE
Wilkinite

CAS # 1302-78-9
RTECS # CT9450000
ICSC # 0384

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST!	
• INHALATION		Avoid inhalation of fine dust and mist.	
• SKIN		Protective gloves.	
• EYES		Safety spectacles.	
• INGESTION			

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting (extra personal protection: P1 filter respirator for inert particles).		

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0384

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

BENTONITE

ICSC: 0384

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** ODOURLESS GRANULES OR POWDER IN VARIABLE COLOUR. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** The substance is a weak base in suspension in water. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of dust. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may have effects on the lungs , resulting in silicosis due to the presence of crystalline silica (see ICSC # 0808).
PHYSICAL PROPERTIES	Relative density (water = 1): 2.5	Solubility in water: none
ENVIRONMENTAL DATA		

NOTES

Bentonites are aluminate silicate and can contain crystalline silica. The content varies widely from less than 1% to about 24%.

ADDITIONAL INFORMATION

ICSC: 0384 **BENTONITE**

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One Genium Plaza
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(518) 377-8854

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Diesel fuel oil no. 2-D
Chemical Formula: Unspecified or variable
CAS Number: 68334-30-5
Synonyms: automotive diesel oil; diesel fuel; diesel oil (medium); diesel oil no. 2; diesel oil (petroleum); diesel oils; diesel test fuel; fuels, diesel; no. 2 diesel oil; olej napeldowy III (Polish)
Derivation: Fuel oil may be a distilled fraction of petroleum, a residuum from refinery operations, a crude petroleum or a blend of two or more of these.
General Use: This medium viscosity residual fuel oil has both light and heavy grades, and is used in furnaces and boilers of utility and industrial power plants, ships, locomotives, and metallurgical operations.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* [73]

Section 2 - Composition / Information on Ingredients

Diesel fuel oil no. 2-D, ca 100% vol; diesel fuels consist primarily of aliphatic (64% vol), aromatic (35% vol), and olefinic (1-2% vol) hydrocarbons.
Trace Impurities: May contain sulfur (< 0.5), benzene (<100 ppm), and additives such as sulfurized esters.

OSHA PEL
As petroleum distillates
8-hr TWA: 500 ppm (2000 mg/m^3)

ACGIH TLV
As diesel fuel
Notice of impending change (1997):
TWA: 100 mg/m^3, *Skin*

NIOSH REL
As petroleum distillates
10-hr TWA: 350 mg/m^3
Ceiling (15 min): 1800 mg/m^3

IDLH Level
As petroleum distillates
1,100 ppm

DFG (Germany) MAK
None established

Section 3 - Hazards Identification

ANSI Signal Word: Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Diesel fuel oil no. 2-D is a brown, slightly viscous liquid with a kerosene-like odor. It is irritating to the skin and respiratory tract. Inhalation of mist or vapor may result in headache, nausea, vomiting, diarrhea, central nervous system (CNS) depression, tachycardia (rapid heart beat), cyanosis (blue coloration of skin due to oxygen deficiency), pulmonary edema (fluid in the lungs), and liver or kidney injury. Diesel fuel oil no. 2-D is an environmental hazard when spilled. When exposed to heat or flame, this flammable liquid is a fire hazard. When heated to decomposition, diesel fuel oil no. 2-D will emit acrid smoke and irritating vapors.

Wilson Risk Scale
R 1
I 2
S 2*
K 2
*Skin absorption

HMIS
H 1*
F 2
R 0
PPE†
*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin contact/absorption
Target Organs: Skin, CNS, cardiovascular system (CVS), respiratory system, liver, kidneys
Acute Effects
Inhalation: Euphoria, respiratory irritation, cardiac dysrhythmia, increased respiration rates, cyanosis, pulmonary edema, hemoptysis (spitting up blood from the respiratory tract), respiratory arrest, renal (kidney) and liver injury, and CNS toxicity can result from inhalation of diesel fuel oil no. 2-D mist or vapor.
Eye: Contact may result in irritation.
Skin: Contact may cause irritation, systemic effects (see Inhalation), and block the sebaceous (oil) glands, resulting in a rash of acne-like pimples and spots, usually on the arms and legs.
Ingestion: Gastrointestinal irritation, vomiting, diarrhea, and in severe cases, CNS depression progressing to coma and death and other systemic effects (see Inhalation) can result. Aspiration can result in transient CNS depression or excitement, hypoxia, infection, pneumatocele (abnormal cavities in lungs) formation, and chronic lung dysfunction.
Carcinogenicity: IARC lists occupational exposure in petroleum refining as Group 2A (Probable human carcinogen) and distillate light (diesel) fuels as Group 3 (Not classifiable as to carcinogenicity to humans). ACGIH lists a notice of impending change for diesel fuels as TLV-A3 (Animal carcinogen). NTP and OSHA do not list diesel fuel oil no. 2-D as a carcinogen.

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Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Prolonged or repeated skin contact causes dermatitis and possible systemic toxicity. Prolonged or repeated inhalation can cause CNS and peripheral nervous system damage.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain and/or irritation develops.

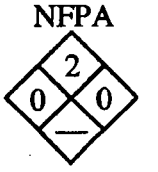
Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water followed by washing the exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Have the *conscious and alert* person drink 1 to 2 glasses of water. Contact a poison control center. Because of aspiration risk, *do not* induce vomiting unless the poison control center advises otherwise.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Gastric lavage is contraindicated due to aspiration risk. Instead, consider administration of charcoal or milk. If ingestion amount is large, gastric emptying in the alert patient can be accomplished through administration of Syrup of Ipecac. Treat overexposure symptomatically and supportively.

Section 5 - Fire-Fighting Measures



Flash Point: 100.4 °F (38 °C)

Flash Point Method: CC

Autoignition Temperature: 351-624 °F (177-329 °C)

LEL: 1.3% v/v

UEL: 75% v/v

Flammability Classification: OSHA Class II Combustible Liquid

Extinguishing Media: Use dry chemical, carbon dioxide, foam, low velocity water fog or spray. Use a smothering technique to extinguish fire. Water may be ineffective in putting out a fire involving diesel fuel oil no. 2-D, and a solid water stream may spread the flames; however, a water spray may be used to cool fire-exposed containers, and flush spills away from ignition sources.

Unusual Fire or Explosion Hazards: Vapor or mist can form explosive mixtures in air. In still air, the heavier-than-air vapors of diesel fuel oil no. 2-D from a large source may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire.

Hazardous Combustion Products: Heating diesel fuel oil no. 2-D to decomposition can produce acrid smoke and irritating vapors.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Ground all equipment used when handling this product. *Do not* touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A fire fighting foam may be used to suppress vapors. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Use clean non-sparking tools to collect absorbed material.

Small Spills: Absorb diesel fuel oil no. 2-D with vermiculite, earth, sand or similar material.

Large Spills

Containment: For large spills, consider downwind evacuation of at least 1000 ft (300 m). Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

Cleanup: Ground all equipment. Use non-sparking tools. Spills can be absorbed with materials such as peat, activated carbon, polyurethane foam, or straw. Sinking agents, gelling agents, dispersants, and mechanical systems can also be use to treat oil spills.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor or mist inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations to non-hazardous levels (see Sec. 2). Wear protective gloves (or use barrier cream), and clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use non-sparking tools to open and close containers.

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Storage Requirements: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Periodically inspect stored materials. Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.106) for Class II Combustible Liquid.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Enclose operations and/or provide local exhaust ventilation appropriately designed for flammable mist and vapor at the site of chemical release. Where possible, transfer diesel fuel oil no. 2-D from drums or other storage containers directly to process containers. Minimize sources of ignition in surrounding low-lying areas.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), use an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets. Wear protective eyeglasses, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance and Odor: Brown, slightly viscous; kerosene-like odor
Odor Threshold: 0.7 ppm
Vapor Pressure: < 0.1 mm Hg at 68 °F (20 °C)
Vapor Density (Air=1): > 6
Formula Weight: N/A

Specific Gravity (H_2O=1, at 4 °C): < 0.86
Water Solubility: Insoluble
Boiling Point: 340-676 °F (171-358 °C)
Freezing Point: -29.2 °F (-34 °C)
Viscosity: 1.9-4.1 centistoke at 104 °F (40 °C)
Surface Tension: 23-32 dynes/cm at 68 °F (20 °C)

Section 10 - Stability and Reactivity

Stability: Diesel fuel oil no. 2-D is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include strong oxidizing agents.

Conditions to Avoid: Exposure to heat and ignition sources.

Hazardous Decomposition Products: Thermal oxidative decomposition of diesel fuel oil no. 2-D can produce low molecular weight hydrocarbons, hydrocarbon derivatives, carbon oxides (CO_x), and sulfur oxides (SO_x).

Section 11- Toxicological Information

Toxicity Data:*

Acute Oral Effects:
Rat, oral, LD_{50}: 7500 mg/kg

Acute Dermal Effects:
Rabbit, skin, LD: > 5 mL/kg

Skin Effects:
Rabbit, skin, standard Draize test: 500 µL/24 hr, resulted in severe reaction.

Other Multiple Dose Toxicity Data:
Rat, inhalation: 2 g/m^3/6 hr/3 weeks, intermittently, resulted in changes in blood erythrocyte (RBC) count, and focal fibrosis (pneumonoconiosis) and other changes in the lung, thorax or respiration.
Rat, inhalation: 400 µg/m^3/16 hr/2.5 years, intermittently, caused other changes in the blood, and biochemical effects - transaminases.
Rabbit, skin: 80 mL/kg/12 days, continuously, resulted in other changes in the liver, kidney, ureter, and bladder, and death.

* See NIOSH, *RTECS* (HZ1800000), for additional toxicity data.

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Section 12 - Ecological Information

Ecotoxicity: Juvenile American shad, salt water TLm: 204 mg/L/24 hr; mallard duck, LD_{50}=20 mg/kg.

Environmental Fate: Diesel fuel oil no. 2-D will evaporate from water or soil. In surface water, it may partition from the water column to suspended sediments.

Environmental Degradation: Biodegradation may occur in soil and water.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Diesel fuel
Shipping Symbols: D
Hazard Class: 3
ID No.: NA1993
Packing Group: III
Label: None
Special Provisions (172.102): B1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 60 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: –

Section 15 - Regulatory Information

EPA Regulations:

Classified as RCRA Hazardous Waste (40 CFR 261.21): Characteristic of Ignitability
RCRA Hazardous Waste Number: D001
Listed as a CERCLA Hazardous Substance (40 CFR 302.4), Unlisted Hazardous Waste, Characteristic of Ignitability per RCRA Sec. 3001
CERCLA Final Reportable Quantity (RQ): 100 lb (45.4 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A, as petroleum distillates)

Section 16 - Other Information

References: 73, 103, 136, 190, 209, 222, 230, 231

Prepared By..... HM Spliethoff, MS
Industrial Hygiene Review..... PA Roy, MPH, CIH
Medical Review..... T Thoburn, MD, MPH

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CAS # 68334-30-5

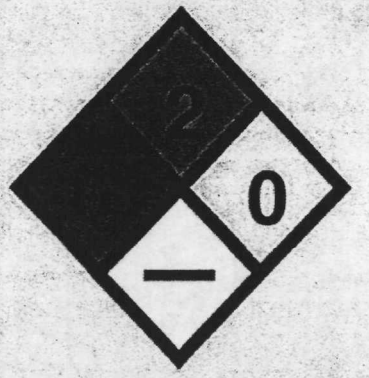
Warning! [1][3]

Flammable

Diesel Fuel Oil No. 2-D

diesel fuel

Brown, slightly viscous liquid; kerosene-like odor. Irritating to eyes/skin/respiratory tract. Also Causes: increased respiration rate, rapid heart beat, cyanosis; GI irritation, vomiting, diarrhea, CNS depression. Chronic Effects: dermatitis. Flammable.



Target Organs [3][9][10]

Skin | Respiratory System | Nervous System | Liver | Kidneys | Cardio-vascular

Personal Protective Equipment [8]

Goggles | Gloves | Apron

Check to see is respirator required

Emergency Procedures

First Aid [4]

Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush eyes with plenty of water. Thoroughly wash skin with soap and water. Ingestion: Do not induce vomiting. Consult physician.

Fire [5]

Flammable. Can form explosive mixtures in the air. Use water as fog, dry chemical, or carbon dioxide. Do not use water spray as it may scatter fire.

Spills & Leaks [6]

Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Shut off ignition sources. Absorb with inert material, such as sand or vermiculite. Cleanup crew should protect against exposure.

Consult **MSDS 0470** for more information

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2000-07

Hydrochloric Acid
MSDS 30
HYD2200

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Hydrochloric Acid **CAS Number:** 7647-01-0
Chemical Formula: ClH
Structural Chemical Formula: HCl
Synonyms: 4-D BOWL SANITIZER; ACIDE CHLORHYDRIQUE; ACIDO CLORHIDRICO; ACIDO CLORIDRICO; ANHYDROUS HYDROCHLORIC ACID; ANHYDROUS HYDROGEN CHLORIDE; AQUEOUS HYDROGEN CHLORIDE; BOWL CLEANER; CHLOORWATERSTOF; CHLOROHYDRIC ACID; CHLOROWODOR; CHLORURE D'HYDROGENE; CHLORURE D'HYDROGENE ANHYDRE; CHLORURO DE HIDROGENO; CHLORWASSERSTOFF; CLORURO DE HIDROGENO ANHIDRO; EMULSION BOWL CLEANER; EPA PESTICIDE CHEMICAL CODE 045901; HYDROCHLORIC ACID; HYDROCHLORIC ACID GAS; HYDROCHLORIDE; HYDROGEN CHLORIDE; HYDROGEN CHLORIDE (HCL); HYGEIA CREME MAGIC BOWL CLEANER; MURIATIC ACID; MURIATIC ACID); NOW SOUTH SAFTI-SOL BRAND CONCENTRATED BOWL CLEANSE WITHMAGIC ACTIO; PERCLEEN BOWL AND URINAL CLEANER; SPIRITS OF SALT; VARLEY'S OCEAN BLUE SCENTED TOILET BOWL CLEANER; VARLEY POLY-PAK BOWL CREME; WHITE EMULSION BOWL CLEANER; WUEST BOWL CLEANER SUPER CONCENTRATED
General Use: Hydrogen chloride is used to produce pharmaceutical hydrochlorides; vinyl chloride from acetylene; alkyl chlorides from olefins and arsenious chloride from arsenious oxide; electronic grade for etching semiconductor crystals. Used in the chlorination of rubber; in organic reactions involving isomerization, polymerization and alkylation; as a catalyst and condensing agent; for making chlorine where economical; in the separation of cotton from wool and cotton de-linting; as flux in the babbitt type of metal alloy; etching semi-conductor crystals.
Hydrochloric acid is used for pickling and heavy duty cleaning of metal parts; rust and scale removal. The production of chlorides; neutralizing bases; a laboratory reagent. For hydrolyzing starch and proteins in preparations for food. As a catalyst and solvent in organic synthesis. As "spirits of salts" for cleaning of lime and masonry from new brickwork. As flux or flux component for soldering; manufacture of "killed spirits".

Section 2 - Composition / Information on Ingredients

Name	CAS	%
hydrogen chloride	7647-01-0	> 99.0

OSHA PEL
STEL: 5 ppm; 7 mg/m^3.

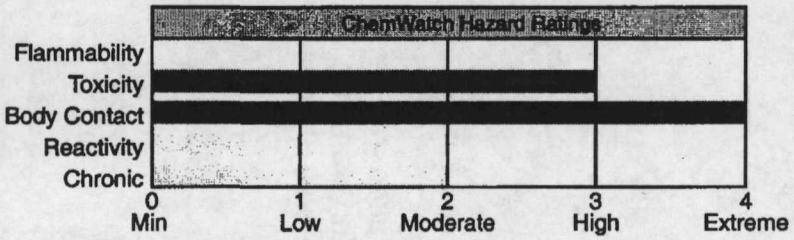
NIOSH REL
No data found.

DFG (Germany) MAK
TWA: 5 ppm; 7 mg/m^3.

ACGIH TLV
STEL: 5 ppm; 7.5 mg/m^3; Ceiling.

IDLH Level
50 ppm.

Section 3 - Hazards Identification



Fire Diamond

ANSI Signal Word
Danger!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas; characteristic suffocating, pungent odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Stored as compressed gas which may cause frostbite. Chronic: Repeated or prolonged exposure may cause erosion of teeth.

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Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact
Target Organs: eyes, skin, respiratory system, liver (in animals)
Acute Effects

Inhalation: The vapor is extremely discomforting to the upper respiratory tract, may cause severe mucous membrane damage and may be harmful if inhaled.
Inhalation of quantities of liquid mist may be extremely hazardous, even lethal due to spasm, extreme irritation of larynx and bronchi, chemical pneumonitis and pulmonary edema.
A single severe exposure may cause coughing and choking; bleeding of nose, inflammation and occasionally ulceration of the nose, throat and larynx. Fluid on the lungs followed by generalized lung damage may follow.
Breathing of vapor may aggravate asthma and inflammatory or fibrotic pulmonary disease.
High concentrations cause necrosis of the tracheal and bronchial epithelium, pulmonary edema, atelectasis and emphysema and damage to the pulmonary blood vessels and liver.
Inhalation hazard is increased at higher temperatures.
The vapor from heated material is extremely discomforting to the upper respiratory tract and lungs if inhaled.
Continued severe exposure can result in pulmonary edema and corrosion of tissues in the nose and throat.

Eye: Hydrogen Chloride: The vapor is extremely discomforting to the eyes and is capable of causing pain and severe conjunctivitis. Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Hydrochloric Acid: Eye contact is extremely painful and may cause rapid corneal damage. The liquid is extremely corrosive to the eyes and is capable of causing severe damage with loss of sight.
The vapor is highly discomforting and may be corrosive to the eyes. The vapor from heated material is extremely discomforting to the eyes.

Skin: The material is corrosive to the skin and may cause chemical burns.
Toxic effects may result from skin absorption. Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.
The vapor is discomforting to the skin.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is extremely corrosive if swallowed and is capable of causing burns to mouth, throat, esophagus, with extreme discomfort, pain and may be fatal if swallowed in quantity. Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic exposure may cause discoloration or erosion of the teeth, bleeding of the nose and gums; and ulceration of the nasal mucous membranes.
Repeated exposures of animals to concentrations of about 34 ppm produced no immediate toxic effects.
Workers exposed to hydrochloric acid suffered from gastritis and a number of cases of chronic bronchitis have also been reported.
Repeated or prolonged exposure to dilute solutions may cause dermatitis. Repeated exposure to low vapor concentrations can cause skin tenderness, bleeding of the nose and gums, chronic bronchitis, gastritis.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center. Rinse mouth out with plenty of water. Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to strong acids:
1.Airway problems may arise from laryngeal edema and inhalation exposure.
Treat with 100% oxygen initially.
2.Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.
3. Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.

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4.Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.

INGESTION:

1.Immediate dilution (milk or water) within 30 minutes post-ingestion is recommended.

2.Do not attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.

3.Be careful to avoid further vomiting since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.

4.Charcoal has no place in acid management.

5.Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:

1.Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.

2.Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:

1.Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. Do not use neutralizing agents or any other additives. Several liters of saline are required.

2.Cycloplegic drops (1% cyclopentolate for short-term use or 5% homatropine for longer term use), antibiotic drops, vasoconstrictive agents, or artificial tears may be indicated dependent on the severity of the injury.

3.Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

Section 5 - Fire-Fighting Measures

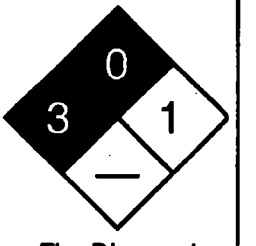
Flash Point: Nonflammable

Autoignition Temperature: Not applicable

LEL: Not applicable

UEL: Not applicable

Extinguishing Media: Water spray or fog; foam; Bromochlorodifluoromethane (BCF) (where regulations permit); Dry agent; Carbon dioxide.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Noncombustible liquid. Will not burn, but heat produces highly toxic fumes/vapors.

Heating may cause expansion or decomposition leading to violent rupture of containers.

Decomposes on heating and produces toxic fumes of hydrogen chloride. Decomposition may produce toxic fumes of chlorine.

Reacts with metals producing flammable/explosive hydrogen gas. Contact with moisture or water may generate heat causing ignition. Reacts vigorously with alkalis. Moderate fire hazard when in contact with reducing agents.

Fire Incompatibility: Reacts with metals producing flammable/explosive hydrogen gas.

Avoid reactions with metals, metal oxides, hydroxides, amines, carbonates, alkaline materials, acetic anhydride, cyanides, sulphides, sulphites, phosphides, acetylides, borides, carbides, silicides, vinyl acetate, formaldehyde and potassium permanganate, unsaturated organics, metal acetylides, sulphuric acid.

Note: Compatibility with plastics should be confirmed prior to use.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation. Cool fire-exposed containers with water spray from a protected location. If safe to do so, remove containers from path of fire. Equipment should be thoroughly decontaminated after use.

Water spray or fog may be used to disperse vapor. Do not approach cylinders suspected to be hot. If safe to do so, stop flow of gas.

Section 6 - Accidental Release Measures

Small Spills: DO NOT touch the spill material. Clean up all spills immediately. Wear fully protective PVC clothing and breathing apparatus. Contain and absorb spill with sand, earth, inert material or vermiculite. Use soda ash or slaked lime to neutralize. Collect residues and place in labeled plastic containers with vented lids. Clear area of personnel and move upwind. Avoid breathing vapors and contact with skin and eyes. Do not exert excessive pressure on valve; do not attempt to operate damaged valve. Water spray or fog may be used to disperse vapor.

Large Spills: Contact fire department and tell them location and nature of hazard. Clear area of personnel and move upwind. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation. Stop leak if safe to do so. Remove leaking cylinders to a safe place if possible. Release pressure under safe, controlled conditions by opening the valve. Do not exert excessive pressure on valve; do not attempt to operate damaged valve. Shut off all possible sources of ignition and increase ventilation.

Water spray or fog may be used to disperse vapor. Use soda ash or slaked lime to neutralize.

Collect and seal in labeled drums for disposal. Wash spill area with large quantities of water. If contamination of drains or waterways occurs, advise emergency services. After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing. DO NOT touch the spill material. Contain and absorb spill with sand, earth, inert material or vermiculite.

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DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist and vapor, breathing vapors and contact with skin and eyes.
Avoid physical damage to containers. Use in a well-ventilated area. Wear protective clothing and gloves when handling containers. Handle and open container with care.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material. When handling, DO NOT eat, drink or smoke. Always wash hands with soap and water after handling. Work clothes should be laundered separately. Use good occupational work practices. Observe manufacturer's storing and handling recommendations.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Local exhaust ventilation may be required for safe working, i.e. to keep exposures below required standards; otherwise, PPE is required.
Keep dry. Reacts violently with water.
Transport containers on a trolley. Avoid sources of heat. DO NOT transfer gas from one cylinder to another.
Recommended Storage Methods: Packaging as recommended by manufacturer. Check that containers are clearly labeled.
Cylinder. Ensure the use of equipment rated for cylinder pressure. Ensure the use of compatible materials of construction. Valve protection cap to be in place until cylinder is secured, connected. Cylinder must be properly secured either in use or in storage. Cylinder valve must be closed when not in use or when empty. Segregate full from empty cylinders. WARNING: Suckback into cylinder may result in rupture. Use back-flow preventive device in piping.
Hydrochloric acid: Packs of 2.5 litres or less require a child-resistant closure. Glass container or Plastic carboy or Polylined drum.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: If risk of overexposure exists, wear air supplied breathing apparatus. Provide adequate ventilation in warehouse or closed storage areas. Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
If risk of inhalation or overexposure exists, wear NIOSH-approved respirator or work in fume hood. Hydrogen chloride vapors will not be adequately absorbed by organic vapor respirators. [NSW D.I.R.]
Personal Protective Clothing/Equipment
Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Neoprene gloves; rubber gloves. Nitrile gloves.
Safety footwear. Rubber boots.
Hydrochloric acid: Barrier cream and Neoprene gloves or Elbow length PVC gloves. Nitrile gloves.
PVC boots or PVC safety gumboots.
Respiratory Protection:
Exposure Range >5 to <50 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 50 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: white
Other: Ensure there is ready access to a safety shower; Eyewash unit.
Acid-resistant overalls. Full protective suit. Operators should be trained in procedures for safe use of this material.
Glove Selection Index:

BUTYL	A
BUTYL/NEOPRENE	A
HYPALON	A
NEOPRENE	A
NEOPRENE/NATURAL	A
NITRILE+PVC	A
PE/EVAL/PE	A
SARANEX-23	A
VITON/NEOPRENE	A
PVC	A
NITRILE	A
NATURAL RUBBER	B
NATURAL+NEOPRENE	B

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

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NAT+NEOPR+NITRILE.....C

Section 9 - Physical and Chemical Properties

Appearance/General Info: Hydrogen chloride: Colorless, corrosive gas. Pungent suffocating odor. White fumes in moist air. Soluble in methanol, ethanol, ether and benzene.
Hydrochloric acid: Clear to light yellow (orange tint for inhibited grades) fuming corrosive liquid with sharp, suffocating odor.

Physical State: Hydrogen chloride: Compressed gas; Hydrochloric acid: Liquid
Vapor Pressure (kPa): < 24.8 at 25 °C
Vapor Density (Air=1): 1.268 at 20 °C
Formula Weight: 36.461
Specific Gravity (H_2O=1, at 4 °C): < 1.19 at 20 °C
Water Solubility: 56.1 g/100 cc hot water at 60 °C
Evaporation Rate: Slow

pH: Hydrochloric acid: < 1
Boiling Point Range: -85 °C (-121 °F)
Freezing/Melting Point Range: -114.44 °C (-173.992 °F)
Volatile Component (% Vol): 100
Decomposition Temperature (°C): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Decomposes in the presence of moisture to produce corrosive acid. May generate sufficient heat to ignite combustible materials. Presence of heat source and direct sunlight (ultra-violet radiation). Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.
Storage Incompatibilities: Hydrogen chloride: Segregate from most common metals and their alloys, alkalis, unsaturated organics, fluorine, metal carbides, metal acetylides, potassium permanganate and sulfuric acid. Compatibility with plastics should be confirmed prior to use.
Hydrochloric acid: Segregate from alkalies, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates. Avoid storage with metals, metal oxides, hydroxides, amines, carbonates, alkaline materials, acetic anhydride, cyanides, sulphides, sulphites, phosphides, acetylides, borides, carbides, silicides, vinyl acetate, formaldehyde and potassium permanganate. Reacts with zinc, brass, galvanized iron, aluminum, copper and copper alloys.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Inhalation (human) LC_{Lo}: 1300 ppm/30 m
Inhalation (human) LC_{Lo}: 3000 ppm/5 m
Inhalation (rat) LC_{50}: 3124 ppm/60 m
Inhalation (rat) LC_{50}: 4701 ppm/30 m
Oral (rat) LD_{50}: 900 mg/kg

IRRITATION
Eye (rabbit): 5 mg/30 s - mild

See NIOSH, *RTECS* MW 4025000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: TLm Gambusia affinis (mosquito fish) 282 ppm/96 hr (fresh water) /Conditions of bioassay not specified; Lethal Lepomis macrochirus (bluegill sunfish) 3.6 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Cockle 330 to 1,000 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Carassius auratus (goldfish) 178 mg/l (1 to 2 hr survival time) /Conditions of bioassay not specified; LC_{50} Shore crab 240 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Shrimp 100 to 330 ppm/48 hr (salt water) /Conditions of bioassay not specified; LC_{100} Trout 10 mg/l 24 hr /Conditions of bioassay not specified
Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options. Treat and neutralize at an effluent treatment plant. Bury residue in an authorized landfill. Decontaminate empty containers with a lime slurry. Return empty containers to supplier or bury empty containers at an authorized landfill.
Return empty cylinders to supplier.

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Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: HYDROGEN CHLORIDE, ANHYDROUS; HYDROCHLORIC ACID SOLUTION
Hazard Class: 2.3; 8
ID No.: 1050; 1789
Packing Group: None; II
Label: Poison Gas [2], Corrosive

Additional Shipping Information: MURIATIC ACID

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Listed 5,000 lb
TSCA: Listed

Section 16 - Other Information

Research Date:.....1999-11 **Review Date:** 2000-07

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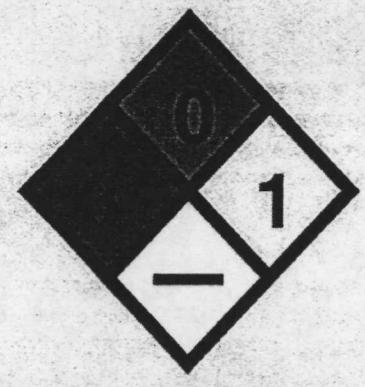
CAS # 7647-01-0 **Danger!** 1 3

Corrosive

Compressed Gas

Hydrogen Chloride

anhydrous hydrochloric acid



Colorless gas; characteristic suffocating, pungent odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Stored as compressed gas which may cause frostbite. Chronic: Repeated or prolonged exposure may cause erosion of teeth.

Target Organs

3 9 10

Eyes

Skin

Respiratory System

Teeth

Personal Protective Equipment

8

Goggles

Face Shield

Gloves

Full Suit

Boots

is respirator required?

Emergency Procedures

First Aid

4

Inhalation: Remove to fresh air and support breathing.
Eyes/Skin: Flush with flooding amounts of water for at least 15 minutes. Thoroughly wash skin with soap and water.
Ingestion: Unlikely. Contact physician immediately.

Fire

5

Noncombustible. Use agent suitable for surrounding fire. In presence of water, hydrogen chloride can react with certain metals such as iron to produce highly flammable and explosive hydrogen gas.

Spills & Leaks

6

Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Shut off ignition sources. Shut off gas. Otherwise, remove leaking cylinder to fume hood to empty. Tag as defective and return to supplier. Protect against exposure.

Consult MSDS 0030 for more information

AIR LIQUIDE

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: NON-FLAMMABLE GAS MIXTURE

Containing One or More of the Following Components in a Nitrogen Balance Gas: Oxygen 0-23.5%; Isobutylene, 0.0005-0.9%

SYNONYMS: Not Applicable
CHEMICAL FAMILY NAME: Not Applicable
FORMULA: Not Applicable
Document Number: 50054

Note: The Material Safety Data Sheet is for this gas mixture supplied in cylinders with 33 cubic feet (935 liters) or less gas capacity (DOT - 39 cylinders). This MSDS has been developed for various gas mixtures with the composition of components within the ranges listed in Section 2 (Composition and Information on Ingredients). Refer to the product label for information on the actual composition of the product.

PRODUCT USE:	Calibration of Monitoring and Research Equipment
SUPPLIER/MANUFACTURER'S NAME:	AIR LIQUIDE AMERICA CORPORATION
ADDRESS:	821 Chesapeake Drive Cambridge, MD 21613
EMERGENCY PHONE:	CHEMTREC: 1-800-424-9300
BUSINESS PHONE:	1-410-228-6400
General MSDS Information	1-713/868-0440
Fax on Demand:	1-800/231-1366

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
		-	ACGIH		OSHA			OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm	IDLH ppm	
Oxygen	7782-44-7	0 - 23.5%	There are no specific exposure limits for Oxygen.					
Isobutylene	115-11-7	0.0005 - 0.9%	There are no specific exposure limits for Isobutylene.					
Nitrogen	7727-37-9	Balance	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					

NE = Not Established. C = Ceiling Limit. See Section 16 for Definitions of Terms Used.

NOTE : All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This product is a colorless, odorless gas. Releases of this product may produce oxygen-deficient atmospheres (especially in confined spaces or other poorly-ventilated environments); individuals in such atmospheres may be asphyxiated. Isobutylene, a component of this gas mixture, may cause drowsiness and other central nervous system effects in high concentrations; however, due to its low concentration in this gas mixture, this is unlikely to occur.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this product is by inhalation.

INHALATION: Due to the small size of an individual cylinder of this product, no unusual health effects from over-exposure to the product are anticipated under routine circumstances of use. The chief health hazard associated with this gas mixture is when this product contains less than 19.5% Oxygen and is released in a small, poorly-ventilated area (i.e. an enclosed or confined space). Under this circumstance, an oxygen-deficient environment may occur. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur. The effects associated with various levels of oxygen are as follows:

CONCENTRATION OF OXYGEN	OBSERVED EFFECT
12-16% Oxygen:	Breathing and pulse rate increase, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea, vomiting, collapse, or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

HAZARDOUS MATERIAL INFORMATION SYSTEM

HEALTH	(BLUE)	1
FLAMMABILITY	(RED)	0
REACTIVITY	(YELLOW)	0
PROTECTIVE EQUIPMENT		B

EYES	RESPIRATORY	HANDS	BODY
See Section 8			

For routine industrial applications

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to this gas mixture may cause the following health effects:

ACUTE: Due to the small size of the individual cylinder of this product, no unusual health effects from exposure to the product are anticipated under routine circumstances of use. The most significant hazard associated with this gas mixture when it contains less than 19.5% oxygen is the potential for exposure to oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, ringing in ears, headaches, shortness of breath, wheezing, headache, dizziness, indigestion, nausea, unconsciousness, and death. The skin of a victim of over-exposure may have a blue color. Additionally, Isobutylene, a component of this gas mixture, may cause drowsiness or central nervous system effects in high concentrations; however, due to its low concentration in this gas mixture, this is unlikely to occur.

CHRONIC: There are currently no known adverse health effects associated with chronic exposure to this gas mixture.

TARGET ORGANS: Respiratory system.

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS PRODUCT WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus must be worn.

No unusual health effects are anticipated after exposure to this product, due to the small cylinder size. If any adverse symptom develops after over-exposure to this product, remove victim(s) to fresh air as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation if necessary.

4. FIRST-AID MEASURES (Continued)

Victim(s) who experience any adverse effect after over-exposure to this product must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Take a copy of the label and the MSDS to physician or other health professional with victim(s).

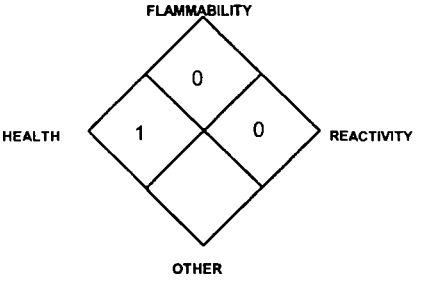
5. FIRE-FIGHTING MEASURES

FLASH POINT, (method): Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):
Lower (LEL): Not applicable.
Upper (UEL): Not applicable.

NFPA RATING



FIRE EXTINGUISHING MATERIALS: Non-flammable gas mixture. Use extinguishing media appropriate for surrounding fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas mixture is not flammable; however, containers, when involved in fire, may rupture or burst in the heat of the fire.

Explosion Sensitivity to Mechanical Impact: Not sensitive.
Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment.

6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Due to the small size and content of the cylinder, an accidental release of this product presents significantly less risk of an oxygen deficient environment and other safety hazards than a similar release from a larger cylinder. However, as with any chemical release, extreme caution must be used during emergency response procedures. In the event of a release in which the atmosphere is unknown, and in which other chemicals are potentially involved, evacuate immediate area. Such releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a leak, clear the affected area, protect people, and respond with trained personnel.

Allow the gas mixture to dissipate. If necessary, monitor the surrounding area (and the original area of the release) for oxygen. Oxygen levels must be above 19.5% before non-emergency personnel are allowed to re-enter area.

If leaking incidentally from the cylinder, contact your supplier.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES: Be aware of any signs of dizziness or fatigue, especially if work is done in a poorly-ventilated area; exposures to fatal concentrations of this product could occur without any significant warning symptoms, due to oxygen deficiency. Do not attempt to repair, adjust, or in any other way modify cylinders containing this gas mixture. If there is a malfunction or another type of operational problem, contact nearest distributor immediately.

STORAGE AND HANDLING PRACTICES: Cylinders should be firmly secured to prevent falling or being knocked-over. Cylinders must be protected from the environment, and preferably kept at room temperature (approximately 21°C; 70°F). Cylinders should be stored in dry, well-ventilated areas, away from sources of heat, ignition, and direct sunlight. Protect cylinders against physical damage.

Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. These cylinders are not refillable. **WARNING! Do not refill DOT 39 cylinders. To do so may cause personal injury or property damage.**

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: WARNING! Compressed gases can present significant safety hazards. During cylinder use, use equipment designed for these specific cylinders. Ensure all lines and equipment are rated for proper service pressure.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: No special ventilation systems or engineering controls are needed under normal circumstances of use. As with all chemicals, use this product in well-ventilated areas. If this product is used in a poorly-ventilated area, install automatic monitoring equipment to detect the levels of oxygen.

RESPIRATORY PROTECTION: No special respiratory protection is required under normal circumstances of use. Use supplied air respiratory protection if oxygen levels are below 19.5% or unknown during emergency response to a release of this product. If respiratory protection is required for emergency response to this product, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) or equivalent State standards.

EYE PROTECTION: Safety glasses.

HAND PROTECTION: No special protection is needed under normal circumstances of use.

BODY PROTECTION: No special protection is needed under normal circumstances of use.

9. PHYSICAL and CHEMICAL PROPERTIES

Unless otherwise specified, the following information is for Nitrogen, the main component of this gas mixture.

GAS DENSITY @ 32°F (0°C) and 1 atm: 0.072 lbs/ ft^3 (1.153 kg/m^3)
BOILING POINT: -195.8°C (-320.4 °F)
FREEZING/MELTING POINT @ 10 psig -210°C (-345.8°F)
SPECIFIC GRAVITY (air = 1) @ 70°F (21.1°C): 0.906 **pH**: Not applicable.
SOLUBILITY IN WATER vol/vol @ 32°F (0°C) and 1 atm: 0.023 **MOLECULAR WEIGHT:** 28.01
EVAPORATION RATE (nBuAc = 1): Not applicable. **EXPANSION RATIO**: Not applicable.
ODOR THRESHOLD: Not applicable. **SPECIFIC VOLUME (ft^3/lb)**: 13.8
VAPOR PRESSURE @ 70°F (21.1°C) psig: Not applicable.
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for this gas mixture.

APPEARANCE AND COLOR: This product is a colorless, odorless gas.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no unusual warning properties associated with a release of this product.

10. STABILITY and REACTIVITY

STABILITY: Normally stable in gaseous state.

DECOMPOSITION PRODUCTS: The thermal decomposition products of Isobutylene include carbon oxides. The other components of this gas mixture do not decompose, per se, but can react with other compounds in the heat of a fire.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Titanium will burn in Nitrogen (the main component of this product). Lithium reacts slowly with Nitrogen at ambient temperatures. A component of this product (Isobutylene) are also incompatible with strong oxidizers (i.e. chlorine, bromine pentafluoride, oxygen difluoride, and nitrogen trifluoride).

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicology data are available for the components of this product:

NITROGEN: There are no specific toxicology data for Nitrogen. Nitrogen is a simple asphyxiant, which acts to displace oxygen in the environment.

ISOBUTYLENE:
LC_{50} (inhalation, rat) = 620,000 mg/kg/4 hours
LC_{50} (inhalation, mouse) = 415,000 mg/kg

11. TOXICOLOGICAL INFORMATION (Continued)

SUSPECTED CANCER AGENT: The components of this gas mixture are not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, and IARC; therefore, they are not considered to be, nor suspected to be, cancer-causing agents by these agencies.

IRRITANCY OF PRODUCT: Not applicable.

SENSITIZATION TO THE PRODUCT: This gas mixture is not known to cause sensitization in humans.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this product and its components on the human reproductive system.

Mutagenicity: No mutagenicity effects have been described for this gas mixture.
Embryotoxcity: No embryotoxic effects have been described for this gas mixture.
Teratogenicity: No teratogenicity effects have been described for this gas mixture.
Reproductive Toxicity: No reproductive toxicity effects have been described for gas mixture.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions may be aggravated by over-exposure to the components of this product.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary; treat symptoms; eliminate exposure.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for the components of this gas mixture.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The components of this gas mixture occur naturally in the atmosphere. The gas will be dissipated rapidly in well-ventilated areas. The following environmental data are applicable to the components of this product.

OXYGEN: Water Solubility = 1 volume Oxygen/32 volumes water at 20°C. Log K_{ow} = -0.65
NITROGEN: Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C. 1.6 volumes Nitrogen/100 volumes water at 20°C.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plant and animal life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Cylinders with undesired residual product may be safely vented outdoors with the proper regulator. For further information, refer to Section 16 (Other Information).

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (Nitrogen, Oxygen)
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
PACKING GROUP: Not applicable.
DOT LABEL(S) REQUIRED: Non-Flammable Gas
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 126

MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).

14. TRANSPORTATION INFORMATION (Continued)

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.

Note: DOT 39 Cylinders ship in a strong outer carton (overpack). Pertinent shipping information goes on the outside of the overpack. DOT 39 Cylinders do not have transportation information on the cylinder itself.

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

15. REGULATORY INFORMATION

SARA REPORTING REQUIREMENTS: This product is subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

COMPONENT	SARA 302	SARA 304	SARA 313
Oxygen	NO	NO	NO
Nitrogen	NO	NO	NO
Isobutylene	NO	NO	NO

SARA THRESHOLD PLANNING QUANTITY: Not applicable.

TSCA INVENTORY STATUS: The components of this gas mixture are listed on the TSCA Inventory.

CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

OTHER U.S. FEDERAL REGULATIONS:

- No component of this product is subject to the requirements of CFR 29 1910.1000 (under the 1989 PELs).
- Isobutylene is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 10,000 pounds.
- The regulations of the Process Safety Management of Highly Hazardous Chemicals are not applicable (29 CFR 1910.119).
- This gas mixture does not contain any Class I or Class II ozone depleting chemicals (40 CFR Part 82).
- Nitrogen and Oxygen are not listed as Regulated Substances, per 40 CFR, Part 68, of the Risk Management for Chemical Releases. Isobutylene is listed under this regulation in Table 3 as Regulated Substances (Flammable Substances), in quantities of 10,000 lbs (4,553 kg) or greater.

OTHER CANADIAN REGULATIONS: This gas mixture is categorized as a Controlled Product, Hazard Class A, as per the Controlled Product Regulations.

STATE REGULATORY INFORMATION: The components of this gas mixture are covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: No.
California - Permissible Exposure Limits for Chemical Contaminants: Nitrogen.
Florida - Substance List: Oxygen, Isobutylene.
Illinois - Toxic Substance List: No.
Kansas - Section 302/313 List: No.
Massachusetts - Substance List: Oxygen, Isobutylene.
Michigan - Critical Materials Register: No.
Minnesota - List of Hazardous Substances: No.
Missouri - Employer Information/Toxic Substance List: No.
New Jersey - Right to Know Hazardous Substance List: Oxygen, Nitrogen, Isobutylene.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.
Pennsylvania - Hazardous Substance List: Oxygen, Nitrogen, Isobutylene.
Rhode Island - Hazardous Substance List: Oxygen, Nitrogen.
Texas - Hazardous Substance List: No.
West Virginia - Hazardous Substance List: No.
Wisconsin - Toxic and Hazardous Substances: : No.

CALIFORNIA PROPOSITION 65: No component of this product is on the California Proposition 65 lists.

16. OTHER INFORMATION

INFORMATION ABOUT DOT-39 NRC (Non-Refillable Cylinder) PRODUCTS

DOT 39 cylinders ship as hazardous materials when full. Once the cylinders are relieved of pressure (empty) they are not considered hazardous material or waste. Residual gas in this type of cylinder is not an issue because toxic gas mixtures are prohibited. Calibration gas mixtures typically packaged in these cylinders are Nonflammable n.o.s., UN 1956. A small percentage of calibration gases packaged in DOT 39 cylinders are flammable or oxidizing gas mixtures.

For disposal of used DOT-39 cylinders, it is acceptable to place them in a landfill if local laws permit. Their disposal is no different than that employed with other DOT containers such as spray paint cans, household aerosols, or disposable cylinders of propane (for camping, torch etc.). When feasible, we recommended recycling for scrap metal content. Air Liquide America will do this for any customer that wishes to return cylinders to us prepaid. All that is required is a phone call to make arrangements so we may anticipate arrival. Scrapping cylinders involves some preparation before the metal dealer may accept them. We perform this operation as a service to valued customers who want to participate.

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information about the handling of compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

P-1 *"Safe Handling of Compressed Gases in Containers"*
AV-1 *"Safe Handling and Storage of Compressed Gases"*
"Handbook of Compressed Gases"

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
9163 Chesapeake Drive, San Diego, CA 92123-1002
619/565-0302

Fax on Demand: 1-800/231-1366

AIR LIQUIDE

This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product. To the best of Air Liquide America Corporation's knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this product is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Isopropyl Alcohol **MSDS No. 324**

Date of Preparation: 9/85 Revision: A, 10/93

Section 1 - Chemical Product and Company Identification 42

Product/Chemical Name: Isopropyl Alcohol
Chemical Formula: $(CH_3)_2CHOH$
CAS No.: 67-63-0
Synonyms: Dimethyl carbinol, 2-hydroxypropane, IPA, Isohol, Lutosol, isopropanol, Petrohol, 2-propanol, *sec*-propyl alcohol, rubbing alcohol, Spectrar.
Derivation: Treating propylene with sulfuric acid and then hydrolyzing or direct hydration of propylene using superheated steam. Most commonly available as rubbing alcohol (70% IPA).
General Use: As a solvent for gums, shellac, and essential oils, chemical intermediate, dehydrating agent, vehicle for germicidal compounds, de-icing agent for liquid fuels; for denaturing ethyl alcohol, preserving pathological specimens; in extraction of alkaloids, quick-drying inks and oils, and an ingredient of skin lotions, cosmetics, window cleaner, liquid soaps, and pharmaceuticals.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Isopropyl alcohol, 100% vol. Most commonly sold as 70% isopropyl alcohol (rubbing alcohol).

OSHA PELs
8-hr TWA: 400 ppm (980 mg/m^3)
STEL: 500 ppm (1225 mg/m^3) *

ACGIH TLVs
TWA: 400 ppm (983 mg/m^3)
STEL: 500 ppm (1230 mg/m^3)

* Vacated 1989 Final Rule Limits

NIOSH REL
10-hr TWA: 400 ppm (980 mg/m^3)
STEL: 500 ppm (1225 mg/m^3)

IDLH Level
12,000 ppm

DFG (Germany) MAK
TWA: 400 ppm (980 mg/m^3)
Category II: Substances with systemic effects
Half-life: < 2 hr

Peak Exposure Limit: 800 ppm, 30 min. average value, 4/shift

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Isopropyl alcohol is a highly flammable, volatile liquid. It is considered more toxic than ethyl alcohol, but less toxic than methyl alcohol. Inhalation can cause irritation of the eyes and respiratory tract and central nervous system depression at high concentrations. Repeated skin contact may cause dermatitis. Systemic toxicity appears to occur mostly in cases of heavy ingestion or inhalation. There is recent evidence that skin absorption may be more likely to cause systemic effects than previously thought.

Wilson Risk Scale	
R	1
I	2
S	2*
K	3

*Skin absorption

HMIS	
H	1
F	3
R	0

PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin contact/absorption.
Target Organs: Eyes, skin, respiratory system.
Acute Effects
Inhalation: Vapor inhalation is irritating to the respiratory tract and can cause central nervous system depression at high concentrations. Volunteers exposed to 400 ppm for 3 to 5 min experienced mild eye and respiratory irritation. At 800 ppm, irritation was not severe, but most people found the air uncomfortable to breathe.
Eye: Exposure to the vapor or direct contact with the liquid causes irritation and possible corneal burns.
Skin: Some irritation may occur after prolonged exposure.
Ingestion: Accidental ingestions have provided the most information on isopropyl alcohol toxicity. Symptoms include nausea and vomiting, headache, facial flushing, dizziness, lowered blood pressure, mental depression, hallucinations and distorted perceptions, difficulty breathing, respiratory depression, stupor, unconsciousness, and coma. Kidney insufficiency including oliguria (reduced urine excretion), anuria (absent urine excretion), nitrogen retention, and edema (fluid build-up in tissues) may occur. One post-mortem examination in a case of heavy ingestion showed extensive hemorrhagic tracheobronchitis, broncho-pneumonia, and hemorrhagic pulmonary edema. Death can occur in 24 to 36 h post-ingestion due to respiratory paralysis.
Carcinogenicity: NTP and OSHA do not list isopropyl alcohol as a carcinogen. The IARC has studied IPA and has classified it as Class-3 (unclassifiable, inadequate human and animal evidence). There appears to be an association between the *manufacture* (strong acid process, rather than the alcohol itself) of isopropanol and parasinus cancer, but this may be due to the diisopropyl sulfate or isopropyl oil by-products.
Medical Conditions Aggravated by Long-Term Exposure: Dermatitis or respiratory or kidney disorders.
Chronic Effects: Repeated skin contact can cause drying of skin and delayed hypersensitivity reactions in some individuals.

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Other: Isopropyl alcohol is oxidized in the body to acetone where it is excreted by the lungs or kidneys. Some acetone may be further metabolized to acetate, formate, and finally carbon dioxide. Probable oral lethal dose is 240 mL.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. Vomiting may be contraindicated because of the rapid onset of central nervous system depression. Gastric lavage is preferred.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Diagnostic test: acetone in urine.

Section 5 - Fire Fighting Measures

Flash Point: 53 °F (12 °C)
Flash Point Method: CC
Burning Rate: 2.3 mm/min.
Autoignition Temperature: 750°F (399°C)
LEL: 2 % v/v
UEL: 12.7 % v/v at 200 °F
Flammability Classification: Class 1B Flammable Liquid
Extinguishing Media: Carbon dioxide, dry chemical, water *spray* (solid streams can spread fire), alcohol-resistant foam, or fog.
Unusual Fire or Explosion Hazards: Container may explode in heat of fire. Vapors may travel to an ignition source and flash back. Isopropyl alcohol poses an explosion hazard indoors, outdoors, and in sewers.
Hazardous Combustion Products: Carbon oxides and acrid smoke.
Fire-Fighting Instructions: If possible without risk, move container from fire area. Apply cooling water to container side until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. *Do not* release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Water spray may reduce vapor, but may not prevent ignition in closed spaces.
Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers.
Large Spills
Containment: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use non-sparking tools to open containers.
Storage Requirements: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec 10). Install electrical equipment of Class 1, Group D.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around IPA.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne levels below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin, kidneys, and respiratory system. Be extra cautious when using IPA concurrently with carbon tetrachloride because animal studies have shown it enhances carbon tetrachloride's toxicity.
Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Nitrile rubber (breakthrough time > 8 hr), Neoprene and Teflon (breakthrough time > 4 hr) are suitable materials for PPE. Do not use PVA, PVC or natural rubber (breakthrough time < 1 hr). Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

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Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use any powered, air purifying respirator with organic vapor cartridges or any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s). For < 10,000 ppm, use any supplied-air respirator (SAR) operated in continuous-flow mode. For < 12,000 ppm, use any air-purifying, full facepiece respirator (gas mask) with a chin-style, front-or back-mounted organic vapor canister or any SCBA or SAR with a full facepiece. For emergency or entrance into unknown concentrations, use any SCBA or SAR (with auxiliary SCBA) with a full facepiece and operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove isopropyl alcohol from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using isopropyl alcohol, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance and Odor: Colorless with a slight odor and bitter taste.
Odor Threshold: 22 ppm*
Vapor Pressure: 44 mm Hg at 25 °F (77 °C)
Saturated Vapor Density (Air = 1.2 kg/m^3, 0.075 lb/ft^3): 1.274 kg/m^3 or 0.080 lb/ft^3
Formula Weight: 60.09
Density (H_2O=1, at 4 °C): 0.78505 at 68°F (20 °C)
Water Solubility : > 10 %
Ionization Potential: 10.10 eV

Other Solubilities: Soluble in alcohol, ether, chloroform, and benzene. Insoluble in salt solutions.
Boiling Point: 180.5 °F (82.5 °C)
Freezing Point: -129.1 °F (-89.5 °C)
Viscosity: 2.1 cP at 77 °F (25 °C)
Refraction Index: 1.375 at 68 °F (20 °C)
Surface Tension: 20.8 dyne/cm at 77 °F (25 °C)
Critical Temperature: 455 °F (235 °C)
Critical Pressure: 47 atm
Octanol/Water Partition Coefficient: log Kow = 0.05

* References range from 1 to as high as 610 ppm.

Section 10 - Stability and Reactivity

Stability: Isopropyl alcohol is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization does not occur.

Chemical Incompatibilities: Include acetaldehyde, chlorine, ethylene oxide, acids and isocyanates, hydrogen + palladium, nitroform, oleum, phosgene, potassium *t*-butoxide, oxygen (forms unstable peroxides), trinitromethane, barium perchlorate, tetrafluoroborate, chromium trioxide, sodium dichromate + sulfuric acid, aluminum, aluminum triisopropoxide, and oxidizers. Will attack some forms of plastic, rubber, and coatings.

Conditions to Avoid: Exposure to heat, ignition sources, and incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of isopropyl alcohol can produce carbon oxides and acrid smoke.

Section 11- Toxicological Information

Toxicity Data:*

Eye Effects:
Rabbit, eye: 100 mg caused severe irritation.

Skin Effects:
Rabbit, skin: 500 mg caused mild irritation.

Reproductive:
Rat, inhalation: 3500 ppm/7 hr given from 1 to 19 days of pregnancy caused fetotoxicity.

Acute Oral Effects:
Human, oral, TD_{Lo}: 223 mg/kg caused hallucinations, distorted perceptions, lowered blood pressure, and a change in pulse rate.
Human, oral, LD_{Lo}: 3570 mg/kg caused coma, respiratory depression, nausea, and vomiting.
Rat, oral, LD_{50}: 5045 mg/kg caused a change in righting reflex, and somnolence (general depressed activity).

* See NIOSH, *RTECS* (NT8050000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Guppies (*Poecilia reticulata*) LC_{50} = 7,060 ppm/7 days; fathead minnow (*Pimephales promelas*) LC_{50} = 11,830 mg/L/1 hr. BOD = 133 %/5 days.

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Environmental Degradation: On soil, IPA will volatilize or leach into groundwater. Biodegradation is possible but rates are not found in available literature. It will volatilize (est. half-life = 5.4 days) or biodegrade in water. It is not expected to bioconcentrate in fish. In the air, it reacts with photochemically produced hydroxyl radicals with a half-life of one to several days. Because it is soluble, removal by rain, snow or other precipitation is possible.

Section 13 - Disposal Considerations

Disposal: Microbial degradation is possible by oxidizing isopropyl alcohol to acetone by members of the genus *Desulfovibrio*. Spray waste into incinerator (permit-approved facilities only) equipped with an afterburner and scrubber. Isopropyl alcohol can be settled out of water spills by salting with sodium chloride. Note: Salt may harm aquatic life, so weigh the benefits against possible harm before application. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Container Cleaning and Disposal: Triple rinse containers.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Isopropanol or isopropyl alcohol
Shipping Symbols: –
Hazard Class: 3
ID No.: UN1219
Packing Group: II
Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 5 L
b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: –

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste Number (40 CFR 261.21)
RCRA Hazardous Waste Classification (40 CFR 261.21): Characteristic of Ignitability
Listed (Unlisted Hazardous Waste, Characteristic of Ignitability) as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA, Sec. 3001
CERCLA Reportable Quantity (RQ), 100 lb (45.4 kg)
SARA 311/312 Codes: 1, 2, 3
Listed as a SARA Toxic Chemical (40 CFR 372.65); *only persons who manufacture by the strong acid process are subject; no supplier notification.*
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 73, 103, 124, 126, 127, 132, 136, 139, 148, 153, 159, 164, 167, 168, 176, 187

Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... PA Roy, MPH, CIH
Medical Review ..... T Thoburn, MD, MPH

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CAS # 67-63-0

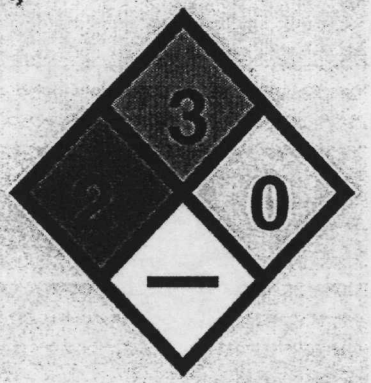
Warning! 1 3

Flammable

Isopropyl Alcohol

dimethyl carbinol; 2-hydroxypropane; IPA; isopropanol; rubbing alcohol

Colorless liquid; slight odor. Irritating to the eyes/skin/respiratory tract. Eye exposure may cause corneal burns. Also Causes: drowsiness, dizziness, and incoordination. Chronic: dermatitis. Flammable!



Target Organs

3 9 10

Eyes, Skin, Respiratory System, Nervous System, Kidneys

Personal Protective Equipment

8

Goggles, Gloves, Apron

Check to see is respirator required?

Emergency Procedures

First Aid

4

Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Do not induce vomiting! Consult physician.

Fire

5

Highly flammable. Can form explosive mixtures in the air. Use water as fog, dry chemical, carbon dioxide, or alcohol-resistant foam. Solid streams of water may spread fire.

Spills & Leaks

6

Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Shut off heat and ignition sources. Take up with inert material such as sand or vermiculite. Cleanup personnel should protect against exposure.

Consult MSDS 0324 for more information

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: METHANE IN ARGON/HELIUM/NITROGEN OR AIR GAS MIXTURE

TRADE NAMES: P-5; P-10 (Methane/Argon Mixture)

CHEMICAL FAMILY: Organic Hydrocarbon/Inert Gas or Air Mixture **PRODUCT USE:** Calibration Gas

MANUFACTURER

MATHESON TRI-GAS, INC.

959 ROUTE 46 EAST
PARSIPPANY, NJ 07054-0624
USA

Phone: 973/257-1100

EMERGENCY PHONE:

CHEMTREC DOMESTIC U.S.:	**1-800-424-9300**
CHEMTREC INTERNATIONAL:	**1-703-527-3887**
CANUTEC (CANADA):	**1-613-996-6666**

2. COMPOSITION and INFORMATION ON INGREDIENTS

(10,000 ppm = 1%)

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH-TLV		OSHA-STEL		NIOSH	OTHER
			TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	ppm
Methane	74-82-8	≤ 5.0 In Air ≤ 10.0 In Argon ≤ 12.0 In Helium ≤ 14.3 In Nitrogen	NIC = 1000	NE	NE	NE	NE	NE
The balance of this gas mixture consists of one of the following inert gases or Air.								
Air (compressed, atmospheric)	132259-10-0	Compressed air is a mixture of approximately 79% Nitrogen, approximately 21% Oxygen and other trace gases. No exposure limits are applicable to Air, Nitrogen or Oxygen.						
Argon	7440-37-1	There are no specific exposure limits for Argon. Argon is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.						
Helium	7440-59-7	There are no specific exposure limits for Helium. Helium is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.						
Nitrogen	7727-37-9	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.						

NIC = Notice of Intended Change. NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1998 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

See Section 16 for Definitions of Terms Used.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This is a colorless, odorless, non-flammable gas mixture. The main health hazard associated with releases of this gas mixture is asphyxiation by displacement of oxygen, as each component of this mixture is a simple asphyxiant. A cylinder rupture hazard exists when this gas mixture, which is under pressure, is subject to heat or flames.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this product is by inhalation.

INHALATION: High concentrations of this gas mixture can cause an oxygen-deficient environment, especially if released in a poorly-ventilated area (e.g., an enclosed or confined space). Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of overexposure, death may occur. The effects associated with various levels of oxygen are as follows:

CONCENTRATION OF OXYGEN	OBSERVED EFFECT
12-16% Oxygen:	Breathing and pulse rate increase, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea, vomiting, collapse, or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

CONTACT WITH SKIN or EYES: Contact with rapidly expanding gases (which are released under high pressure) may cause frostbite.

SKIN ABSORPTION: No component of this gas mixture presents a hazard of skin absorption.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: Over-exposure to this gas mixture may cause the following health effects:

ACUTE: The most significant hazard associated with this gas mixture is inhalation of oxygen-deficient atmospheres. Symptoms of oxygen deficiency include ringing in ears, headaches, shortness of breath, wheezing, dizziness, indigestion, and nausea. At high concentrations, unconsciousness or death may occur.

CHRONIC: Chronic exposure to oxygen-deficient atmospheres (below 18% oxygen in air) may affect the heart and nervous system.

TARGET ORGANS: ACUTE: Respiratory system. CHRONIC: Cardiac system, central nervous system.

HMIS RATING: HEALTH HAZARD = 0 FLAMMABILITY HAZARD= 0 PHYSICAL HAZARD = 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

4. FIRST-AID MEASURES

GENERAL INFORMATION: Remove to fresh air, as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. **Seek medical attention immediately**.

SKIN EXPOSURE: If release of this gas mixture has resulted in frostbite, warm affected area slowly. Seek immediate medical attention.

EYE EXPOSURE: If release of this gas mixture has affected the eyes, seek immediate medical attention.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing respiratory conditions may be aggravated by overexposure to this gas mixture.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

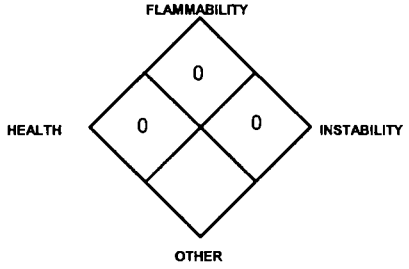
AUTOIGNITION TEMPERATURE: Not applicable

5. FIRE-FIGHTING MEASURES (Continued)

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.
Upper (UEL): Not applicable.

NFPA RATING



See Section 16 for Definition of Ratings

FIRE EXTINGUISHING MATERIALS: Use extinguishing materials appropriate for surrounding materials involved in the fire. Water spray should be used to cool fire-exposed containers.

UNUSUAL FIRE AND EXPLOSION HAZARD: This gas mixture does not burn; however, cylinders, when involved in a fire, may rupture or burst in the heat of the fire.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural fire fighters must wear Self-Contained Breathing Apparatus and full protective equipment. Immediately cool the cylinders with water spray from a maximum distance. When cool, move cylinders from fire area if this can be done without risk to firefighters.

6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used in the event of a significant release from a single cylinder. Call CHEMTREC (1-800-424-9300) for emergency assistance. Or if in Canada, call CANUTEC (613-996-6666).

Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there. Monitor the surrounding area for the level of Oxygen. The atmosphere must have at least 19.5 percent Oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES

Do not eat or drink while handling chemicals.

Be aware of all potential exposure symptoms; exposures to a fatal oxygen-deficient atmosphere could occur without any significant warning symptoms.

All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release.

Workers who handle this gas mixture should wear protective clothing, as listed in Section 8 (Exposure Controls and Personal Protection).

If ventilation controls are not adequate to provide sufficient oxygen content, proper respiratory protection equipment should be provided and workers using such equipment should be carefully trained in its operation and limitations.

Precautions must always be taken to prevent suck-back of foreign materials into the cylinder by using a check-valve, or vacuum break, since suck-back may cause dangerous pressure changes within the cylinder.

STORAGE AND HANDLING PRACTICES: Cylinders should be stored upright and be firmly secured to prevent falling or being knocked-over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Cylinders should be stored in dry, well-ventilated areas away from sources of heat or ignition. Do not allow the area where cylinders are stored to exceed 52°C (125°F).

7. HANDLING and USE (Continued)

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Compressed gases can present significant safety hazards. The following rules are applicable to work situations in which cylinders are being used.

Before Use: Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap (where provided) in-place until cylinder is ready for use.

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not use oils or grease on gas-handling fittings or equipment. Immediately contact the supplier if there are any difficulties associated with operating cylinder valve. Never insert an object (e.g wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing a leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Never strike an arc, on a compressed gas cylinder or make a cylinder part of and electric circuit.

After Use: Close main cylinder valve. Replace valve protection cap. Close valve after each use and when empty. Mark empty cylinders "EMPTY".

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Refer to current CGA Guidelines for information on protective practices during maintenance of contaminated equipment.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure compliance with exposure limits described in Section 2 (Composition and Information on Ingredients). Local exhaust ventilation is preferred, because it prevents dispersion of this gas mixture into the work place by eliminating it at its source. If appropriate, install automatic monitoring equipment to detect the level of Oxygen.

RESPIRATORY PROTECTION: Maintain the level Oxygen above 19.5% in the workplace. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent U.S. State standards and Canadian CSA Standard Z94.4-93. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998).

EYE PROTECTION: Splash goggles or safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133, or Canadian Standards.

HAND PROTECTION: Wear mechanically-resistant gloves when handling cylinders containing this gas mixture. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to the task. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee's feet may be exposed to electrical hazards, use foot protection, as described in U.S. OSHA 29 CFR.

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is for Air, a possible main component of this gas mixture:

GAS DENSITY: 0.07493 lb/cu ft (1.2 kg/m^3)
SPECIFIC GRAVITY (air = 1): 1
SOLUBILITY IN WATER: 0.0292
EXPANSION RATIO: Not applicable.
ODOR THRESHOLD: Not applicable.
VAPOR PRESSURE (psia): Not applicable.
EVAPORATION RATE (nBuAc = 1): Not applicable.
FREEZING POINT: -216.2°C (-357.2°F)
BOILING POINT(@ 1 atmos.): -194.3°C (-137.8°F)
SPECIFIC VOLUME (ft^3/lb): 13.346
MOLECULAR WEIGHT: 28.975
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for Argon, a possible main component of this gas mixture:

GAS DENSITY: 0.103 lb/cu ft (1.650 kg/m^3)
SPECIFIC GRAVITY (air = 1): 1.38
SOLUBILITY IN WATER: 0.056
EXPANSION RATIO: Not applicable.
ODOR THRESHOLD: Not applicable.
VAPOR PRESSURE (psia): Not applicable.
EVAPORATION RATE (nBuAc = 1): Not applicable.
FREEZING POINT: -189.2°C (-308.9°F)
BOILING POINT(@ 1 atmos.): -185.9°C (-302.6°F)
SPECIFIC VOLUME (ft^3/lb): 9.71
MOLECULAR WEIGHT: 39.95
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

9. PHYSICAL and CHEMICAL PROPERTIES (Continued)

The following information is for Helium, a possible main component of this gas mixture:

GAS DENSITY: 0.103 lb/cu ft (1.165 kg/m^3)
SPECIFIC GRAVITY (air = 1): 0.138
SOLUBILITY IN WATER: 0.0094
EXPANSION RATIO: Not applicable.
ODOR THRESHOLD: Not applicable.
VAPOR PRESSURE (psia): Not applicable.
EVAPORATION RATE (nBuAc = 1): Not applicable.
FREEZING POINT: Not applicable.
BOILING POINT(@ 1 atmos.): -268.9°C (-452.1°F)
SPECIFIC VOLUME (ft^3/lb): 97.09
MOLECULAR WEIGHT: 4.00
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for Nitrogen, a possible main component of this gas mixture:

GAS DENSITY: 0.072 lb/cu ft (1.153 kg/m^3)
SPECIFIC GRAVITY (air = 1): 0.967
SOLUBILITY IN WATER: 0.023
EXPANSION RATIO: Not applicable.
ODOR THRESHOLD: Not applicable.
VAPOR PRESSURE (psia): Not applicable.
EVAPORATION RATE (nBuAc = 1): Not applicable.
FREEZING POINT: -209.9°C (-345.8 °F)
BOILING POINT(@ 1 atmos.): -195.8°C (-320.4°F)
SPECIFIC VOLUME (ft^3/lb): 13.89
MOLECULAR WEIGHT: 28.01
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is pertinent to this product:

APPEARANCE, ODOR AND COLOR: This gas mixture is colorless and odorless.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no distinct warning properties of this gas mixture. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

10. STABILITY and REACTIVITY

STABILITY: Stable at standard temperatures and pressures.

DECOMPOSITION PRODUCTS: The Methane component of this gas mixture will decompose into carbon dioxide and carbon monoxide at extremely high temperatures. The inert gas components of this product does not decompose, per se, but may react with other compounds in the heat of a fire.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: The Methane component of this gas mixture is incompatible with strong oxidizers (i.e. chlorine, bromine pentafluoride, oxygen difluoride, and nitrogen trifluoride). The inert balance gas components, are relatively inert gases.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: Argon, Helium, Nitrogen and Methane are simple asphyxiants (SA), which act to displace oxygen in the environment.

SUSPECTED CANCER AGENT: The components of this gas mixture are not found on the following lists: FEDERAL OSHA Z LIST, IARC, NTP, CAL/OSHA, and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: This gas mixture is not irritating to contaminated tissue.

SENSITIZATION TO THE PRODUCT: The components of this product are not known to be skin or respiratory sensitizers.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of the components of this gas mixture on the human reproductive system.

Mutagenicity: The components of this gas mixture are not reported to cause mutagenic effects in humans.

Embryotoxicity: The components of this gas mixture are not reported to cause embryotoxic effects in humans.

Teratogenicity: The components of this gas mixture are not reported to cause teratogenic effects in humans.

Reproductive Toxicity: The components of this gas mixture are not reported to cause adverse reproductive effects in humans.

11. TOXICOLOGICAL INFORMATION (Continued)

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, there are no Biological Exposure Indices (BEIs) determined for the components of this gas mixture.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas mixture will be dissipated rapidly in well-ventilated areas.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to oxygen deficient environments.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No an adverse effect from this gas mixture on aquatic life is expected.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with any residual product to Matheson Tri-Gas. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS GAS MIXTURE IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME:	Compressed gases, n.o.s. (Methane, Argon) ***or*** (Methane, Helium) ***or*** (Methane, Nitrogen) ***or*** (Methane, Air)
HAZARD CLASS NUMBER and DESCRIPTION:	2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER:	UN 1956
PACKING GROUP:	Not applicable.
D.O.T HAZARD LABEL:	Non-Flammable Gas

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MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as a Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles present serious safety hazards and should be discouraged.

NOTE: Shipment of compressed gas cylinders which have not been filled with the owner's consent is a violation of Federal law [49 CFR, Part 173.301 (b)].

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas mixture is considered as dangerous goods, per regulations of Transport Canada.

PROPER SHIPPING NAME:	Compressed gases, n.o.s. (Methane, Argon) ***or*** (Methane, Helium) ***or*** (Methane, Nitrogen) ***or*** (Methane, Air)
HAZARD CLASS NUMBER and DESCRIPTION:	2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER:	UN 1956
PACKING GROUP:	Not Applicable
HAZARD LABEL:	Class 2.2 (Non-Flammable Gas)
SPECIAL PROVISIONS:	None
EXPLOSIVE LIMIT AND LIMITED QUANTITY INDEX:	0.12
ERAP INDEX:	None
PASSENGER CARRYING SHIP INDEX:	None
PASSENGER CARRYING ROAD VEHICLE OR PASSENGER CARRYING RAILWAY VEHICLE INDEX:	75

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126

NOTE: Shipment of compressed gas cylinders via Public Passenger Road Vehicle is a violation of Canadian law (Transport Canada Transportation of Dangerous Goods Act, 1992).

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: No component of this product is subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act.

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for the components of this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lbs (4,540 kg) therefore applies, per 40 CFR 370.20.

U.S. SARA HAZARD CATEGORIES (SECTION 311/312, 40 CFR 370-21): ACUTE: No; CHRONIC: No; FIRE: No; REACTIVE: No; SUDDEN RELEASE: Yes

U.S. TSCA INVENTORY STATUS: Components of this product are listed on the TSCA Inventory.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

OTHER U.S. FEDERAL REGULATIONS: Methane is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The threshold quantity for Methane is 10,000 lbs (4,540 kg). Methane is listed as a Regulated Substance in quantities of 10,000 lbs (4,540 kg) or greater, per 40 CFR, Part 68 of the Risk Management for Chemical Accidental Release.

U.S. STATE REGULATORY INFORMATION: Components of this product are covered under some specific State regulations, as denoted below (other State regulatory lists may exist; individual States should be contacted regarding full compliance).

California - Permissible Exposure Limits for Chemical Contaminants: Argon, Helium, Methane.

New Jersey - Right to Know Hazardous Substance List: Argon, Helium, Methane, Nitrogen.

Pennsylvania - Hazardous Substance List: Argon, Helium, Methane, Nitrogen.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this product is on the California Proposition 65 lists.

LABELING: Cylinders of this gas mixture should be labeled for precautionary information per the guidelines of the CGA. Refer to the CGA for further information.

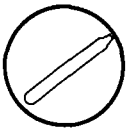
ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: The components of this product are listed on the DSL Inventory.

OTHER CANADIAN REGULATIONS: Not applicable.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: The components of this product are not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS CLASSIFICATION AND SYMBOLS: This gas mixture would be categorized as a Controlled Product, Hazard Class: **A** (compressed gas). The following symbol is required for WHMIS compliance for this gas mixture.



16. OTHER INFORMATION

CREATION DATE: March 13, 2000 **REVISION DATE:** November 19, 2003

REVISION HISTORY: Up-date of manufacturer address and phone.

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you use the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

"Safe Handling of Compressed Gases in Containers" (P-1, 1999)
"Safe Handling and Storage of Compressed Gases" (AV-1, 1999)
"Handbook of Compressed Gases" (1992)

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 3519, La Mesa, CA 91944-3519
800/441-3365

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number that uniquely identifies each constituent.

EXPOSURE LIMITS IN AIR:

CEILING LEVEL: The concentration that shall not be exceeded during any part of the working exposure.

LOQ: Limit of Quantitation.

MAK: Federal Republic of Germany Maximum Concentration Values in the workplace.

NE: Not Established. When no exposure guidelines are established, an entry of NE is made for reference.

NIC: Notice of Intended Change.

NIOSH CEILING: The exposure that shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, the ceiling shall be assumed as a 15-minute TWA exposure (unless otherwise specified) that shall not be exceeded at any time during a workday.

NIOSH RELs: NIOSH's Recommended Exposure Limits.

PEL-Permissible Exposure Limit: OSHA's Permissible Exposure Limits. This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA.

The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL that was vacated by Court Order.

SKIN: Used when a there is a danger of cutaneous absorption.

STEL-Short Term Exposure Limit: Short Term Exposure Limit, usually a 15-minute time-weighted average (TWA) exposure that should not be exceeded at any time during a workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or REL-TWA.

TLV-Threshold Limit Value: An airborne concentration of a substance that represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour.

TWA-Time Weighted Average: Time Weighted Average exposure concentration for a conventional 8-hr (TLV, PEL) or up to a 10-hr (REL) workday and a 40-hr workweek.

IDLH-Immediately Dangerous to Life and Health: This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS: This rating system was developed by the National Paint and Coating Association and has been adopted by industry to identify the degree of chemical hazards.

HEALTH HAZARD:

0 (Minimal Hazard: No significant health risk, irritation of skin or eyes not anticipated. *Skin Irritation*: Essentially non-irritating. PII or Draize = "0". *Eye Irritation*: Essentially non-irritating, or minimal effects which clear in < 24 hours [e.g. mechanical irritation]. Draize = "0". *Oral Toxicity LD_{50} Rat*: < 5000 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: < 2000 mg/kg. *Inhalation Toxicity 4-hrs LC_{50} Rat*: < 20 mg/L.);

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

HEALTH HAZARD (continued):

1 (Slight Hazard: Minor reversible Injury may occur; slightly or mildly irritating. *Skin Irritation*: Slightly or mildly irritating. *Eye Irritation*: Slightly or mildly irritating. *Oral Toxicity LD_{50} Rat*: > 500-5000 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: > 1000-2000 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: > 2-20 mg/L); **2** (Moderate Hazard: Temporary or transitory injury may occur. *Skin Irritation*: Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation*: Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD_{50} Rat*: > 50-500 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: > 200-1000 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: > 0.5-2 mg/L.); **3** (Serious Hazard: Major injury likely unless prompt action is taken and medical treatment is given; high level of toxicity; corrosive. *Skin Irritation*: Severely irritating and/or corrosive; may destroy dermal tissue, cause skin burns, dermal necrosis. PII or Draize > 5-8 with destruction of tissue. *Eye Irritation*: Corrosive, irreversible destruction of ocular tissue; corneal involvement or irritation persisting for more than 21 days. Draize > 80 with effects irreversible in 21 days. *Oral Toxicity LD_{50} Rat*: > 1-50 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: > 20-200 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: > 0.05-0.5 mg/L.); **4** (Severe Hazard: Life-threatening; major or permanent damage may result from single or repeated exposure. *Skin Irritation*: Not appropriate. Do not rate as a "4", based on skin irritation alone. *Eye Irritation*: Not appropriate. Do not rate as a "4", based on eye irritation alone. *Oral Toxicity LD_{50} Rat*: ≤ 1 mg/kg. *Dermal Toxicity LD_{50}Rat or Rabbit*: ≤ 20 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: ≤ 0.05 mg/L).

FLAMMABILITY HAZARD:

0 (Minimal Hazard-Materials that will not burn in air when exposure to a temperature of 815.5°C [1500°F] for a period of 5 minutes.); **1** (Slight Hazard-Materials that must be pre-heated before ignition can occur. Material require considerable pre-heating, under all ambient temperature conditions before ignition and combustion can occur, Including: Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 93.3°C [200°F] (e.g. OSHA Class IIIB, or; Most ordinary combustible materials [e.g. wood, paper, etc.]; **2** (Moderate Hazard-Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not, under normal conditions, form hazardous atmospheres in air, but under high ambient temperatures or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres in air, Including: Liquids having a flash-point at or above 37.8°C [100°F]; Solid materials in the form of course dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards (e.g. cotton, sisal, hemp; Solids and semisolids that readily give off flammable vapors.);

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (*continued*):

FLAMMABILITY HAZARD (continued):

3 (Serious Hazard- Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures, or, unaffected by ambient temperature, are readily ignited under almost all conditions, including: Liquids having a flash point below 22.8°C [73°F] and having a boiling point at or above 38° C [100°F] and below 37.8°C [100°F] [e.g. OSHA Class IB and IC]; Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air [e.g., dusts of combustible solids, mists or droplets of flammable liquids]; Materials that burn extremely rapidly, usually by reason of self-contained oxygen [e.g. dry nitrocellulose and many organic peroxides]); **4** (Severe Hazard-Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily, including: Flammable gases; Flammable cryogenic materials; Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C [73°F] and a boiling point below 37.8°C [100°F] [e.g. OSHA Class IA; Material that ignite spontaneously when exposed to air at a temperature of 54.4°C [130°F] or below [e.g. pyrophoric]).

PHYSICAL HAZARD:

0 (*Water Reactivity*: Materials that do not react with water. *Organic Peroxides*: Materials that are normally stable, even under fire conditions and will not react with water. *Explosives*: Substances that are Non-Explosive. Unstable *Compressed Gases*: No Rating. *Pyrophorics*: No Rating. *Oxidizers*: No "0" rating allowed. *Unstable Reactives*: Substances that will not polymerize, decompose, condense or self-react.); **1** (*Water Reactivity*: Materials that change or decompose upon exposure to moisture. *Organic Peroxides*: Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy. *Explosives*: Division 1.5 & 1.6 substances that are very insensitive explosives or that do not have a mass explosion hazard. *Compressed Gases*: Pressure below OSHA definition. *Pyrophorics*: No Rating. *Oxidizers*: Packaging Group III; Solids: any material that in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3:7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met. Liquids: any material that exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65%)/cellulose mixture and the criteria for Packing Group I and II are not met. *Unstable Reactives*: Substances that may decompose, condense or self-react, but only under conditions of high temperature and/or pressure and have little or no potential to cause significant heat generation or explosive hazard. Substances that readily undergo hazardous polymerization in the absence of inhibitors.); **2** (*Water Reactivity*: Materials that may react violently with water. *Organic Peroxides*: Materials that, in themselves, are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water. *Explosives*: Division 1.4 – Explosive substances where the explosive effect are largely confined to the package and no projection of fragments of appreciable size or range are expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package. *Compressed Gases*: Pressurized and meet OSHA definition but < 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating. *Oxidizers*: Packing Group II Solids: any material that, either in concentration tested, exhibits a mean burning time of less than or equal to the mean burning time of a 2:3 potassium bromate/cellulose mixture and the criteria for Packing Group I are not met. Liquids: any material that exhibits a mean pressure rise time less than or equal to the pressure rise of a 1:1 aqueous sodium chlorate solution (40%)/cellulose mixture and the criteria for Packing Group I are not met.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (*continued*):

PHYSICAL HAZARD (continued):

2 (continued): *Unstable Reactives*: Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure, but have a low potential for significant heat generation or explosion. Substances that readily form peroxides upon exposure to air or oxygen at room temperature); **3** (*Water Reactivity*: Materials that may form explosive reactions with water. *Organic Peroxides*: Materials that are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before initiation; or materials that react explosively with water. *Explosives*: Division 1.2 – Explosive substances that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but do not have a mass explosion hazard. *Compressed Gases*: Pressure ≥ 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating. *Oxidizers*: Packing Group I Solids: any material that, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3.:2 potassium bromate/cellulose mixture. Liquids: Any material that spontaneously ignites when mixed with cellulose in a 1:1 ratio, or which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50%)/cellulose mixture. *Unstable Reactives*: Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a moderate potential to cause significant heat generation or explosion.); **4** (*Water Reactivity*: Materials that react explosively with water without requiring heat or confinement. *Organic Peroxides*: Materials that are readily capable of detonation or explosive decomposition at normal temperature and pressures. *Explosives*: Division 1.1 & 1.2-explosive substances that have a mass explosion hazard or have a projection hazard. A mass explosion is one that affects almost the entire load instantaneously. *Compressed Gases*: No Rating. *Pyrophorics*: Add to the definition of Flammability "4". *Oxidizers*: No "4" rating. *Unstable Reactives*: Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a high potential to cause significant heat generation or explosion.).

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS:

HEALTH HAZARD: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury).

FLAMMABILITY HAZARD: **0** Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand. **1** Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur **2** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient quantities to produce hazardous atmospheres with air. **3** Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. **4** Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily.

DEFINITIONS OF TERMS (Continued)

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):

INSTABILITY HAZARD: **0** Materials that in themselves are normally stable, even under fire conditions. **1** Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures. **2** Materials that readily undergo violent chemical change at elevated temperatures and pressures. **3** Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation. **4** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures.

FLAMMABILITY LIMITS IN AIR: Much of the information related to fire and explosion is derived from the **N**ational **F**ire **P**rotection **A**ssociation (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology: Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD_{50}** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC_{50}** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m^3** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information:** **BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

ECOLOGICAL INFORMATION:

BCF = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter; **EC** is the Effect Concentration in water; **EC_{50}** is the Effect Concentration for 50% of the organisms exposed; **NOEC** is the No Observed Effect Concentration; MATC is the Maximum Acceptable Toxicant Concentration; **NOLC** is the No Observed Lethal Concentration; **TL_m** = median threshold limit; Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:

U.S. and CANADA:

ACGIH: American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. **O**ccupational **S**afety and **H**ealth **A**dministration (**OSHA**). **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act **(SARA)**; the Canadian Domestic/Non-Domestic Substances List **(DSL/NDSL)**; the U.S. Toxic Substance Control Act **(TSCA)**; Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act **(CERCLA or Superfund)**; and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label. **OSHA** - U.S. Occupational Safety and Health Administration.

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Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2000-07

Nitric Acid
MSDS 7
NIT1080

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Nitric Acid **CAS Number:** 7697-37-2
Chemical Formula: HNO_3
Structural Chemical Formula: HNO_3
Synonyms: ACIDE NITRIQUE; ACIDO NITRICO; AQUA FORTIS; AZOTIC ACID; AZOTOWY KWAS; ENGRAVER'S ACID; ENGRAVERS ACID; HYDROGEN NITRATE; KYSELINA DUSICNE; NITAL; NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH >70% NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH NOT >70% NITRICACID; NITROUS FUMES; NITRYL HYDROXIDE; RED FUMING NITRIC ACID (RFNA); SALPETERSAURE; SALPETERZUUROPLOSSINGEN; WHITE FUMING NITRIC ACID (WFNA)
General Use: Manufacture of organic and inorganic nitrates and nitro compounds for fertilizers, dye intermediates and many organic chemicals.
Used for etching and cleaning metals.
Operators should be trained in procedures for safe use of this material.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
nitric acid	7697-37-2	>95

OSHA PEL
TWA: 2 ppm; 5 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 2 ppm; 5 mg/m^3; STEL: 4 ppm; 10 mg/m^3.

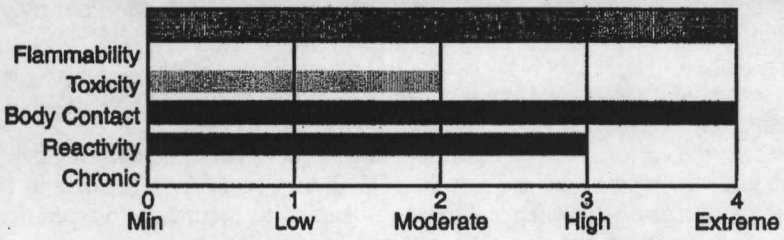
ACGIH TLV
TWA: 2 ppm; 5.2 mg/m^3; STEL: 4 ppm; 10 mg/m^3.

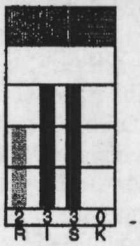
NIOSH REL
TWA: 2 ppm; 5 mg/m^3. STEL: 4 ppm; 10 mg/m^3.

IDLH Level
25 ppm.

DFG (Germany) MAK
TWA: 2 ppm; 5 mg/m^3.

Section 3 - Hazards Identification





Fire Diamond

ANSI Signal Word
Danger!

Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear to yellow fuming liquid; acrid, suffocating odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Also causes: heavy exposures: lung damage. Chronic: tooth erosion, bronchitis. Strong oxidizer capable of igniting combustibles.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion, skin contact, eye contact
Target Organs: eyes, skin, respiratory system, teeth

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Acute Effects

Inhalation: The vapor is extremely discomforting and corrosive to the upper respiratory tract and lungs and the material presents a hazard from a single acute exposure or from repeated exposures over long periods.
Inhalation hazard is increased at higher temperatures.
Reactions may occur following a single acute exposure or may only appear after repeated exposures.
Reactions may not occur on exposure but response may be delayed with symptoms only appearing many hours later.
The material may produce respiratory tract irritation which produces an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system. Unlike most organs the lung can respond to a chemical insult or agent by first trying to remove or neutralize the irritant and then repairing the damage. The repair process, which initially developed to protect mammalian lungs from foreign matter and antigens, may however, cause further damage the lungs when activated by hazardous chemicals. The result is often the impairment of gas exchange, the primary function of the lungs.
Inhalation of nitric acid mist or fumes at 2 to 25 ppm over an 8 hour period may cause pulmonary irritation and symptoms of lung damage.
Only several minutes of exposure to concentrated atmosphere i.e. 200 ppm may cause severe pulmonary damage and even fatality. Death may be delayed for several days.
Exposure to nitric acid fumes (with concurrent inhalation of nitrogen dioxide and nitric oxide) may elicit prompt irritation of the upper respiratory tract leading to coughing, gagging, chest pain, dyspnea, cyanosis if concentrations are sufficiently high and duration of exposure sufficiently long, pulmonary edema.

Eye: The liquid is extremely corrosive to the eyes and contact may cause rapid tissue destruction and is capable of causing severe damage with loss of sight.
The vapor is extremely discomforting to the eyes and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The material may produce moderate eye irritation leading to inflammation.
Repeated or prolonged exposure to irritants may produce conjunctivitis.
Eye contact with concentrated acid may give no pain, whilst diluted solution causes intense pain and both can cause permanent eye damage or blindness. Burns may result in shrinkage of the eyeball, symblepharon (adhesions between tarsal and bulbar conjunctivae), permanent corneal opacification, and visual impairment leading to blindness.

Skin: The liquid is extremely corrosive to the skin and contact may cause tissue destruction with severe burns.
Bare unprotected skin should not be exposed to this material.
The vapor is highly discomforting to the skin.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
Skin contact causes yellow discoloration of the skin, blisters and scars that may not heal. The skin may be stained bright-yellow or yellowish brown due to the formation of xanthoproteic acid. Dilute solutions may harden the epithelium without producing overt corrosion.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The material is extremely corrosive if swallowed and is capable of causing burns to mouth, throat, esophagus, with extreme discomfort, pain and may be fatal.
Even a small amount causes severe corrosion of the stomach, burning pain, vomiting and shock, possibly causing non-healing scarring of the gastrointestinal tract and stomach. Death may be delayed 12 hours to 14 days or to several months. Such late fatalities are attributed to a chemical lobular pneumonitis secondary to aspiration. Survivors show stricture of the gastric mucosa and subsequent pernicious anemia.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Prolonged or repeated overexposure to low concentrations of vapor may cause chronic bronchitis, corrosion of teeth, even chemical pneumonitis.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Immediately transport to hospital or doctor. DO NOT delay.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.

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Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor. DO NOT delay.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Immediately transport to hospital or doctor. DO NOT delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to strong acids:
1.Airway problems may arise from laryngeal edema and inhalation exposure.
Treat with 100% oxygen initially.
2.Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.
3. Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
4.Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.

INGESTION:
1.Immediate dilution (milk or water) within 30 minutes post-ingestion is recommended.
2.Do not attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
3.Be careful to avoid further vomiting since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
4.Charcoal has no place in acid management.
5.Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:
1.Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
2.Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:
1.Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. Do not use neutralizing agents or any other additives. Several liters of saline are required.
2.Cycloplegic drops (1% cyclopentolate for short-term use or 5% homatropine for longer term use), antibiotic drops, vasoconstrictive agents, or artificial tears may be indicated dependent on the severity of the injury.
3.Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.

Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Will not burn but increases intensity of fire.
Heating may cause expansion or decomposition leading to violent rupture of containers. Heat affected containers remain hazardous.
Contact with combustibles such as wood, paper, oil or finely divided metal may cause ignition, combustion or violent decomposition.
May emit irritating, poisonous or corrosive fumes.
Decomposes on heating and produces toxic fumes of nitrogen oxides (NO_x) and nitric acid.

Fire Incompatibility: Oxidizing agents as a class are not necessarily combustible themselves, but can increase the risk and intensity of fire in many other substances.
Reacts vigorously with water and alkali.
Avoid reaction with organic materials/compounds, powdered metals, reducing agents and hydrogen sulfide (H_2S) as ignition may result.
Reacts with metals producing flammable/explosive hydrogen gas.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
Extinguishers should be used only by trained personnel.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.

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Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
If fire gets out of control withdraw personnel and warn against entry.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Dangerous levels of nitrogen oxides may form during spills of nitric acid.
Wear fully protective PVC clothing and breathing apparatus.
Clean up all spills immediately. No smoking, bare lights, ignition sources.
Avoid all contact with any organic matter including fuel, solvents, sawdust, paper or cloth and other incompatible materials, as ignition may result.
Avoid breathing dust or vapors and all contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with dry sand, earth, inert material or vermiculite. DO NOT use sawdust as fire may result.
Scoop up solid residues and seal in labeled drums for disposal.
Neutralize/decontaminate area.
Use soda ash or slaked lime to neutralize.
Large Spills: DO NOT touch the spill material. Restrict access to area.
Clear area of personnel and move upwind. Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, flames or ignition sources. Increase ventilation.
Contain spill with sand, earth or other clean, inert materials.
NEVER use organic absorbents such as sawdust, paper, cloth; as fire may result. Avoid any contamination by organic matter.
Use spark-free and explosion-proof equipment.
Collect any recoverable product into labeled containers for possible recycling. DO NOT mix fresh with recovered material.
Collect residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains. Decontaminate equipment and launder all protective clothing before storage and reuse.
If contamination of drains or waterways occurs advise emergency services.
DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Do not allow clothing wet with material to stay in contact with skin.
Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
Avoid smoking, bare lights or ignition sources.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Stainless steel drum. Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

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Personal Protective Clothing/Equipment

Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Bare unprotected skin should not be exposed to this material. Impervious, gauntlet length gloves i.e., butyl rubber gloves or Neoprene rubber gloves or wear chemical protective gloves, e.g. PVC.
Wear safety footwear or safety gumboots, e.g. Rubber.

Respiratory Protection:
Exposure Range >2 to <25 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 25 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face

Other: Operators should be trained in procedures for safe use of this material.
Acid-resistant overalls or Rubber apron or PVC apron.
Ensure there is ready access to an emergency shower.
Ensure that there is ready access to eye wash unit.
Ensure that there is ready access to breathing apparatus.

Glove Selection Index:

BUTYL	A
HYPALON	A
NEOPRENE	A
NEOPRENE/NATURAL	A
PE/EVAL/PE	A
SARANEX-23	A
NATURAL RUBBER	B
NATURAL+NEOPRENE	B
PVC	C
NITRILE+PVC	C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to slightly yellow liquid. Sharp strong odor.
CAUTION: exothermic dilution hazard.
HIGHLY CORROSIVE. Corrosive to most metals. Powerful oxidizing agent.
Darkens to brownish color on aging and exposure to light.

Physical State: Liquid
Vapor Pressure (kPa): 8.26
Vapor Density (Air=1): 1.5
Formula Weight: 63.02
Specific Gravity (H_2O=1, at 4 °C): 1.3-1.42
Water Solubility: Soluble in all proportions

pH: < 1
pH (1% Solution): 1
Boiling Point Range: 83 °C (181 °F) at 760 mm Hg
Freezing/Melting Point Range: -42 °C (-43.6 °F)
Volatile Component (% Vol): 100 (nominal)
Decomposition Temperature (°C): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Presence of heat source and direct sunlight. Storage in unsealed containers. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from reducing agents, finely divided combustible materials, combustible materials, sawdust, metals and powdered metals.
Avoid contamination of water, foodstuffs, feed or seed.
Segregate from alkalies, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (human) LD_{Lo}: 430 mg/kg
Inhalation (rat) LC_{50}: 2500 ppm/1 hr
Unreported (man) LD_{Lo}: 110 mg/kg

IRRITATION
Nil reported

See NIOSH, *RTECS* QU 5775000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

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Ecotoxicity: LC_{50} Starfish 100-300 mg/l/48 hr /Aerated water conditions; LC_{50} Shore crab 180 mg/l/48 hr /Static, aerated water conditions; LC_{50} Cockle 330-1000 mg/l/48 hr /Aerated water conditions

BCF: no food chain concentration potential

Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Special hazards may exist - specialist advice may be required.
Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Treat and neutralize at an approved treatment plant.
Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.
Puncture containers to prevent reuse and bury at an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NITRIC ACID
Hazard Class: 8
ID No.: 2031
Packing Group: I
Label: Corrosive[8],Oxid.Agent

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed 1000 lb
SARA EHS 40 CFR 355: Listed 1,000 lb
TSCA: Listed

Section 16 - Other Information

Research Date: .....1999-11 **Review Date:** 2000-07

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CAS # 7697-37-2 **Danger!** 1 3

Corrosive

Nitric Acid

aqua fortis; azotic acid; hydrogen nitrate

Clear to yellow fuming liquid; acrid, suffocating odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Also Causes: heavy exposures: lung damage. Chronic: tooth erosion, bronchitis. Strong oxidizer capable of igniting combustibles.

Target Organs

3 9 10

Eyes, Skin, Respiratory System, Mucous Membranes, Gastro intestinal

Personal Protective Equipment

8

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid

4

Inhalation: Remove to fresh air. Eyes/Skin: Flush with plenty of water for at least 15 min. Ingestion: Do not induce vomiting, give a cupful of water. Consult physician immediately.

Fire

5

Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks

6

Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Remove combustibles. Neutralize with sodium bicarbonate or lime. Take up with inert material such as sand or vermiculite. Cleanup crew should protect against exposure.

Consult MSDS 0007 for more information

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Issue Date: 2000-07

Portland Cement
MSDS 718
POR5000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Portland Cement **CAS Number:** 65997-15-1
Chemical Formula: Unspecified or Variable
Synonyms: CEMENT; HYDRAULIC CEMENT; PORTLAND CEMENT; PORTLAND CEMENT SILICATE
General Use: Hydraulic binder used for mixing concrete, concrete masonry, mortars and grouts; also soil stabilization.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
portland cement	65997-15-1	varies

OSHA PEL
TWA: 15 mg/m^3; total dust.

NIOSH REL
No data found.

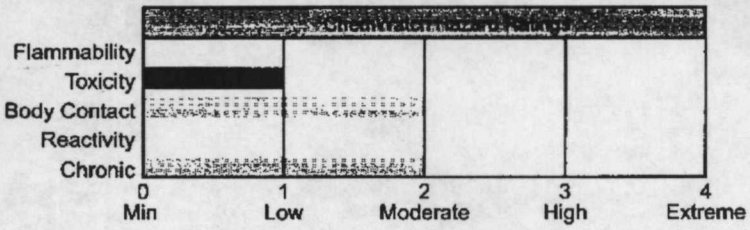
DFG (Germany) MAK
TWA: 5 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 10 mg/m^3; total. Other Values: respirable mg/m^3; 5.

IDLH Level
5000 mg/m^3.

ACGIH TLV
TWA: 10 mg/m^3.

Section 3 - Hazards Identification



Fire Diamond

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Gray powder; odorless. Irritating to eyes/skin/respiratory tract. Also causes (on contact with wet cement): corneal edema, dermatitis, cracked skin. Chronic: bronchitis, dermatitis.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion, skin contact
Target Organs: respiratory system, skin, eyes
Acute Effects

Inhalation: Generated dust may be highly discomforting if inhaled and may even cause in some cases, sensitization. Respiratory sensitization may result in allergic/asthma like responses; from coughing and minor breathing difficulties to bronchitis with wheezing, gasping.
Effects on lungs are significantly enhanced in the presence of respirable particles.

Eye: The solid/dust is highly discomforting, may be abrasive to the eyes and capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The dust is extremely discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.

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Handling wet cement can cause dermatitis. Cement when wet is quite alkaline and this alkali action on the skin contributes strongly to cement contact dermatitis since it may cause drying and defatting of the skin which is followed by hardening, cracking, lesions developing, possible infections of lesions and penetration by soluble salts. Cement contact dermatitis (CCD) may occur when contact shows an allergic response, which may progress to sensitization. Sensitization is due to soluble chromates (chromate compounds) present in trace amounts in some cements, cement products. Soluble chromates readily penetrate intact skin.

Cement dermatitis can be characterized by fissures, eczematous rash, dystrophic nails, and dry skin; acute contact with highly alkaline mixtures may cause localized necrosis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The material is harmful if swallowed.

The dust is discomforting to the gastrointestinal tract.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Cement eczema may be due to chromium in feed stocks or contamination from materials of construction. Sensitization to chromium may be the leading cause of nickel and cobalt sensitivity and the high alkalinity of cement is an important factor in cement dermatoses.

Repeated, prolonged severe inhalation exposure may cause pulmonary edema and rarely, pulmonary fibrosis. Workers may also suffer from dust-induced bronchitis with chronic bronchitis reported in 17% of a group occupationally exposed to high dust levels.

Data suggests that occupational exposure to Portland cement dust may lead to a higher incidence of chronic respiratory symptoms and a reduction of ventilatory capacity.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages.

Ask patient to rinse mouth with water but to not drink water.

Seek immediate medical attention.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically as for strong alkaline material.

Section 5 - Fire-Fighting Measures

Flash Point: Noncombustible

Autoignition Temperature: Not applicable

LEL: Not applicable

UEL: Not applicable

Extinguishing Media: If small amounts are involved in a fire, there is no restriction on the type of extinguisher. Otherwise, use LARGE AMOUNTS of water to absorb heat generated.

Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Noncombustible.

Not considered to be a significant fire risk; however, containers may burn.

Decomposes on heating and produces toxic fumes of caustic compounds.

Fire Incompatibility: No known incompatibility with normal range of industrial materials.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.

Use fire fighting procedures suitable for surrounding area.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.

Wear protective clothing, gloves, safety glasses and dust respirator.

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Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up. Place in clean drum then flush area with water.
Large Spills: Clear area of personnel and move upwind.
Use dry clean-up procedures. Avoid generating dust.
If inhalation risk of exposure exists, wear NIOSH-approved dust respirator.
Collect recoverable product into labeled containers for recycling.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing dust. Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Atmosphere should be checked against exposure standards to ensure safe working conditions are maintained.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling.
Use good occupational work practices.
Observe manufacturer's storing and handling recommendations.
Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Metal pail or Paper bag with sealed plastic liner.
Multi-ply woven plastic or paper bag with sealed plastic liner.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
If exposure to workplace dust is not controlled, respiratory protection is required; wear NIOSH-approved dust respirator.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved dust respirator.
Correct fit is essential to obtain adequate protection.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream and Wear chemical protective gloves, eg. PVC.
Wear safety footwear or safety gumboots, eg. Rubber.
Respiratory Protection:
Exposure Range >5 to 50 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >50 to 500 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >500 to <5000 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 5000 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)
Other: Overalls. Eyewash unit. Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Finely divided grey to off-white colored powder with no odor. Hardens after reaction with water. A finely ground mixture of cement clinker and gypsum, surface area 300-500 m2/kg (Blaine Method).

Physical State: Divided solid
Vapor Pressure (kPa): Not applicable
Vapor Density (Air=1): Not applicable
Formula Weight: Not applicable.
Specific Gravity (H_2O=1, at 4 °C): 3.0-3.2
Water Solubility: Insoluble
Evaporation Rate: Not applicable
pH: alkaline
Boiling Point Range: No data found.
Freezing/Melting Point Range: > 1200 °C (2192 °F)
Decomposition Temperature (°C): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers and strong acids.

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Section 11 - Toxicological Information

No relevant toxicological data found at time of research.

See NIOSH, *RTECS* VV 8770000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NONE
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date:.....1999-11 **Review Date:** 2000-07

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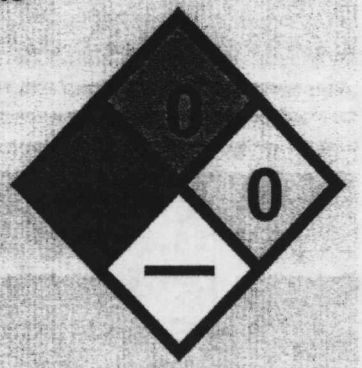
CAS # 65997-15-1 **Caution** 1 3

Portland Cement

hydraulic cement; portland cement silicate

Gray powder; odorless. Irritating to eyes/skin/respiratory tract. Also Causes (on contact with wet cement): corneal edema, skin burns, dermal necrosis, first/second/third degree burns, esophagus/stomach burns. Chronic: bronchitis, dermatitis.



Target Organs

3 9 10

Eyes

Skin

Respiratory System

Personal Protective Equipment

8

Goggles

Gloves

Apron

Check to see is respirator required?

Emergency Procedures

First Aid

4

Inhalation: Remove to fresh air and support breathing. Eyes/Skin: Flush with flooding amounts of water. Thoroughly wash skin with soap and water. Ingestion: Do not induce vomiting. Contact physician immediately.

Fire

5

Noncombustible. Use agent suitable for surrounding fire.

Spills & Leaks

6

Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. DO NOT SWEEP! Carefully scoop up or vacuum (with a HEPA filter). Cleanup crew should protect against exposure.

Consult MSDS 0718 for more information

Material Safety Data Sheet Collection

Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2000-07

Sulfuric Acid
MSDS 9
SUL7960

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Sulfuric Acid **CAS Number:** 7664-93-9
Chemical Formula: H_2O_4S
Structural Chemical Formula: H_2SO_4
Synonyms: ACIDE SULFURIQUE; ACIDO SOLFORICO; ACIDO SULFURICO; BATTERY ACID; BOV; DIHYDROGEN SULFATE; DIPPING ACID; ELECTROLYTE ACID; EPA PESTICIDE CHEMICAL CODE 078001; HYDROGEN SULFATE; MATTLING ACID; OIL OF VITRIOL; SCHWEFELSAEURELOESUNGEN; SULFURIC ACID; SULFURIC ACID (AQUEOUS); SULFURIC ACID,SPENT; SULPHURIC ACID; VITRIOL BROWN OIL; ZWAVELZUUROPLOSSINGEN
General Use: The manufacture of superphosphate fertilizer, inorganic and petro-chemicals, explosives and pigments.
Component of heavy duty metal cleaners, pickles.
In manufacture of rayon, cellulose film.
As battery electrolyte and also in electroplating processes.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
sulfuric acid	7664-93-9	>51
water	7732-18-5	remainder

OSHA PEL
TWA: 1 mg/m^3.

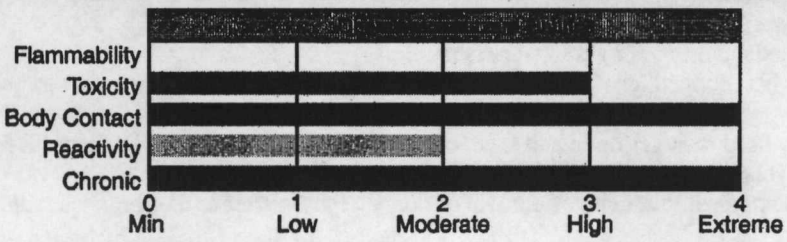
NIOSH REL
TWA: 1 mg/m^3.

DFG (Germany) MAK
TWA: 1 mg/m^3.

ACGIH TLV
TWA: 1 mg/m^3; STEL: 3 mg/m^3.

IDLH Level
15 mg/m^3.

Section 3 - Hazards Identification



Fire Diamond

ANSI Signal Word
Danger!

Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless to dark-brown, oily, odorless liquid. Corrosive, causes severe burns to eyes/skin/respiratory tract. May cause blindness. Chronic: tooth erosion, GI disturbances, and dermatitis. Reaction with water produces excessive heat.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact
Target Organs: respiratory system, eyes, skin, teeth
Acute Effects
Inhalation: The vapor is extremely discomforting to the upper respiratory tract and is capable of causing severe mucous membrane irritation, upper respiratory tract inflammation.
Exposure to high concentrations causes bronchitis and is characterized by the onset of hemorrhagic pulmonary edema.

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Mists are highly irritating to eyes, mucous membranes and respiratory tract and high mist concentrations may lead to pulmonary edema.

Eye: HIGHLY CORROSIVE The liquid is extremely corrosive to the eyes and any contact may cause rapid tissue destruction and is capable of causing severe damage with loss of sight.
The mist is highly corrosive and contact may cause rapid tissue destruction.
The vapor is extremely discomforting to the eyes.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: HIGHLY CORROSIVE. The liquid is extremely corrosive to the skin and any contact may cause rapid tissue destruction with severe burns.
The mist is highly discomforting to the skin and may cause deep ulceration to body tissue.
Topical application of a 10% solution to skin on the scapula or waist produces only negligible evidence of irritation.

Ingestion: HIGHLY CORROSIVE and Considered toxic by all exposure routes.
The liquid is extremely corrosive and may rapidly cause severe burns to the gastrointestinal tract and may be fatal if swallowed in quantity.
Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Not listed; IARC - Group 1, Carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A2, Suspected human carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Repeated minor exposure to mists can cause erosion of teeth and inflammation of the upper respiratory tract leading to chronic bronchitis.
Repeated skin contact with dilute solutions may cause dermatitis.
Lungs of sulfuric acid plant workers appear to be less affected than the lungs of workers exposed to "dust".
There is evidence that the corrosion of tooth enamel occurs at 1 mg/m^3 but that acclimatized workers could tolerate three to four times that level. Forming room workers in a battery factory exposed to 3 to 16 mg/m^3 sulfuric acid mist concentrations exhibited the most serious signs of erosion whilst charging room workers exposed to 0.08 to 2.5 mg/m^3 were affected to a lesser degree.
Workers chronically exposed to sulfuric acid mists may show various skin lesions, tracheobronchitis, stomatitis, conjunctivitis and gastritis.
Increased risk of laryngeal cancer is associted with chronic exposures.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.
DO NOT attempt to neutralize burns with alkaline solutions.

Ingestion: Rinse mouth out with plenty of water.
Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to strong acids:
1.Airway problems may arise from laryngeal edema and inhalation exposure.
Treat with 100% oxygen initially.
2.Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.
3. Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
4.Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.
INGESTION:
1.Immediate dilution (milk or water) within 30 minutes post-ingestion is recommended.
2.Do not attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
3.Be careful to avoid further vomiting since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
4.Charcoal has no place in acid management.
5.Some authors suggest the use of lavage within 1 hour of ingestion.

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SKIN:

1.Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.

2.Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:

1.Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. Do not use neutralizing agents or any other additives. Several liters of saline are required.

2.Cycloplegic drops (1% cyclopentolate for short-term use or 5% homatropine for longer term use), antibiotic drops, vasoconstrictive agents, or artificial tears may be indicated dependent on the severity of the injury.

3.Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable

Autoignition Temperature: Not applicable

LEL: Not applicable

UEL: Not applicable

Extinguishing Media: Use extinguishing media suitable for surrounding area. Water spray or fog, from a safe distance only.

Fire Diamond

General Fire Hazards/Hazardous Combustion Products: HIGHLY CORROSIVE.

Noncombustible liquid. Reacts vigorously with water.

Heating may cause expansion or decomposition leading to violent rupture of containers.

Contact with readily oxidizable organic material may cause ignition /fire.

Reacts with metals producing flammable/explosive hydrogen gas.

Decomposes on heating and produces acrid and toxic fumes of sulfur oxides (SO_x).

Fire Incompatibility: Reacts with mild steel, galvanized steel/zinc producing hydrogen gas which may form an explosive mixture with air.

Contact with readily oxidizable organic material may cause ignition /fire.

Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

Use water delivered as a fine spray to control fire and cool adjacent area.

Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately.

Avoid breathing vapors and contact with skin and eyes.

Control personal contact by using protective equipment.

Contain and absorb spill with sand, earth, inert material or vermiculite.

Wipe up. Place in a suitable labeled container for waste disposal.

Use soda ash or slaked lime to neutralize.

Large Spills: DO NOT touch the spill material. Clear area of personnel and move upwind.

Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

Stop leak if safe to do so.

Contain spill with sand, earth or vermiculite.

Collect recoverable product into labeled containers for recycling.

Neutralize/decontaminate residue.

Collect solid residues and seal in labeled drums for disposal.

Wash area and prevent runoff into drains.

After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

If contamination of drains or waterways occurs, advise emergency services.

DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

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Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
Avoid smoking, bare lights or ignition sources.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Glass carboy. Glass container is suitable for laboratory quantities.
Plastic carboy. Polylined drum.
Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
DO NOT use mild steel or galvanized containers.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.
Personal Protective Clothing/Equipment
Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, eg. PVC.
Wear safety footwear or safety gumboots, eg. Rubber.
Respiratory Protection:
Exposure Range >1 to 10 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to <15 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range 15 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: white with dust/mist prefilter (use P100 or consult supervisor for appropriate dust/mist prefilter)
Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.
Glove Selection Index:

NATURAL RUBBER	A
NATURAL+NEOPRENE	A
NEOPRENE	A
NEOPRENE/NATURAL	A
NITRILE	A
PE	A
PVC	A
SARANEX-23	A

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, oily, dense, HIGHLY CORROSIVE liquid. Faint acid odor.
Material is a powerful oxidizing and dehydrating agent causing rapid human tissue destruction on contact.
Concentrated acid is very exothermic (generates heat) when mixed with water.
DANGER: Adding water to acid will cause violent steam explosion, scattering corrosive acid. Always add acid slowly to water.
Mixes with alcohol in all proportions. Available in technical, pure and analytical grades

Physical State: Liquid
Vapor Pressure (kPa): 0.133 at 146 °C
Vapor Density (Air=1): 3.40
Formula Weight: 98.07
Specific Gravity (H_2O=1, at 4 °C): 1.6-1.84 at 15 °C
Water Solubility: Soluble in water
Evaporation Rate: Non Vol. at 38 °C
pH: < 1
pH (1% Solution): 1
Boiling Point Range: About 290 °C (554 °F)

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Freezing/Melting Point Range: 10.36 °C (50.648 °F) **Decomposition Temperature (°C):** 340

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from alkalies, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates.
Reacts vigorously with water and alkali.
Contact with readily oxidizable organic material may cause ignition /fire.
Avoid contamination of water, foodstuffs, feed or seed.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (rat) LD_{50}: 2140 mg/kg
Inhalation (rat) LC_{50}: 510 mg/m^3/2h
Inhalation (human) TC_{Lo}: 3 mg/m^3/24w

IRRITATION
Eye (rabbit): 1.38 mg SEVERE
Eye (rabbit): 5 mg/30sec SEVERE

See NIOSH, *RTECS* WS 5600000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: TLm Lepomis macrochirus (bluegill) 24.5 ppm/24 hr fresh water /Conditions of bioassay not specified; LC_{50} Flounder 100 to 330 mg/l/48 hr aerated water /Conditions of bioassay not specified; LC_{50} Shrimp 80 to 90 mg/l/48 hr aerated water /Conditions of bioassay not specified; LC_{50} Prawn 42.5 ppm/48 hr salt water /Conditions of bioassay not specified
BCF: no food chain concentration potential
Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Treat and neutralize at an effluent treatment plant.
Use soda ash or slaked lime to neutralize.
Recycle containers, otherwise dispose of in an authorized landfill.
Bury residue in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: SULFURIC ACID, with more than 51% acid
Hazard Class: 8
ID No.: 1830
Packing Group: II
Label: Corrosive[8]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed 1000 lb
SARA EHS 40 CFR 355: Listed 1,000 lb
TSCA: Listed

Section 16 - Other Information

Research Date:.....1999-11 **Review Date:** 2000-07

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CAS # 7664-93-9 **Danger!** 1 3

Corrosive

Sulfuric Acid

battery acid; hydrogen sulfate; sulphuric acid

Colorless to dark-brown, oil, odorless liquid. Corrosive, causes severe burns to eyes/skin/respiratory tract. May cause blindness. Chronic: tooth erosion, GI disturbances, and dermatitis. Reaction with water produces excessive heat.

Target Organs

3 9 10

Eyes, Skin, Respiratory System, Mucous Membranes, Gastro intestinal

Personal Protective Equipment

8

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid

4

Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Do not induce vomiting. Consult physician immediately.

Fire

5

Noncombustible. Use extinguishing agents suitable for surrounding area. However, avoid water: contact with sulfuric acid can generate sufficient heat to ignite combustibles.

Spills & Leaks

6

Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Neutralize with soduim bicarbonate. Take up with inert material such as sand or vermiculite. Cleanup crew should protect against exposure.

Consult MSDS 0009 for more information

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

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Unleaded Gasoline
MSDS 467
AUT5000

Section 1 - Chemical Product and Company Identification §4.1

Material Name: Unleaded Gasoline **CAS Number:** 8006-61-9
Chemical Formula: Mixture of hydrocarbons
Synonyms: AUTOMOTIVE GASOLINE, LEAD-FREE; GASOLINE; MOTOR FUEL; MOTOR SPIRITS; NATURAL GASOLINE; PETROL; UNLEADED PETROL
General Use: Lead free motor fuel for internal combustion engines, 2-stroke and 4-stroke.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
gasoline	8006-61-9	>90
benzene	71-43-2	5 max.

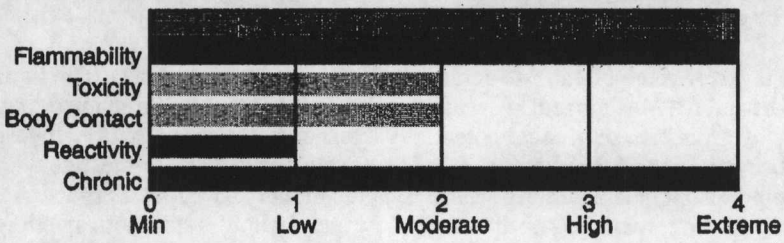
OSHA PEL
No data found.

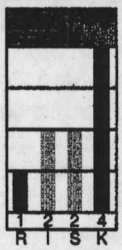
NIOSH REL
No data found.

OSHA PEL Vacated 1989 Limits
TWA: 300 ppm; 900 mg/m^3;
STEL: 500 ppm; 1500 mg/m^3.

ACGIH TLV
TWA: 300 ppm; 890 mg/m^3;
STEL: 500 ppm; 1480 mg/m^3.

Section 3 - Hazards Identification





Fire Diamond

ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear liquid; distinctive odor. Irritating to eyes/skin/respiratory tract. Also causes: dizziness, drunkenness, unconsciousness. Absorbed through skin. Chronic: dermatitis. Possible cancer hazard. Flammable. Can form explosive mixtures in air.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion, skin contact
Target Organs: skin, eye, respiratory system, central nervous system (CNS)

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Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract and may be harmful if exposure is prolonged. Inhalation hazard is increased at higher temperatures. Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death. WARNING: Intentional misuse by concentrating/inhaling contents may be lethal. High inhaled concentrations of mixed hydrocarbons may produce narcosis characterized by nausea, vomiting and lightheadedness. Inhalation of aerosols may produce severe pulmonary edema, pneumonitis and pulmonary hemorrhage. Inhalation of petroleum hydrocarbons consisting substantially of low molecular weight species may produce irritation of mucous membranes, incoordination, giddiness, nausea, vertigo, confusion, headache, appetite loss, drowziness, tremors and anesthetic stupor. Massive exposures may produce central nervous system depression with sudden collapse and deep coma; fatalities have been recorded. Irritation of the brain and/or apneic anoxia may produce convulsions. Although recovery following overexposure is generally complete, cerebral micro- hemorrhage of focal post-inflammatory scarring may produce eleptiform seizures some months after the exposure. Pulmonary episodes may include chemical pneumonitis with edema and hemorrhage. The lighter hydrocarbons may produce kidney and neurotoxic effects. Liquid paraffins may produce anesthesia and depressant actions leading to weakness, dizziness, slow and shallow respiration, unconsciousness, convulsions and death. C_{5-7} paraffins may also produce polyneuropathy. Aromatic hydrocarbons accumulate in lipid-rich tissues (typically the brain, spinal cord and peripheral nerves) and may produce functional impairment manifested by nonspecific symptoms such as nausea, weakness, fatigue, vertigo; severe exposures may produce inebriation or unconsciousness. Many of the petroleum hydrocarbons are cardiac sensitizers and may cause ventricular fibrillations.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration. The vapor is discomforting to the eyes. Petroleum hydrocarbons may produce pain after direct contact with the eyes. Slight, but transient, disturbances of the corneal epithelium may also result. The aromatic fraction may produce irritation and lachrymation. The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The material is moderately discomforting to the skin if exposure is prolonged. The material contains a component that may be absorbed through the skin and may cause drying of the skin, which may lead to dermatitis from repeated exposures over long periods. Toxic effects may result from skin absorption. Open cuts, abraded or irritated skin should not be exposed to this material. The material may accentuate any pre-existing dermatitis condition.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments. The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis. Ingestion of petroleum hydrocarbons may produce irritation of the pharynx, esophagus, stomach and small intestine with edema and mucosal ulceration. Resulting symptoms include a burning sensation in the mouth and throat. Large amounts may produce narcosis with nausea and vomiting, weakness or dizziness, slow and shallow respiration, swelling of the abdomen, unconsciousness and convulsions. Myocardial injury may produce arrhythmias, ventricular fibrillation and electrocardiographic changes. Central nervous system depression may also occur. Light aromatic hydrocarbons produce a warm, sharp, tingling sensation on contact with taste buds and may anesthetize the tongue. Aspiration into the lungs may produce coughing, gagging, and a chemical pneumonitis with pulmonary edema and hemorrhage.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes. Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following. Chronic poisoning may occur from vapor inhalation or skin absorption. The most significant toxic effect is insidious and irreversible injury to the blood-forming tissue by benzene. Leukemia may develop. Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes. Gasoline "sniffing" has caused severe nerve damage. Repeated or prolonged exposure to mixed hydrocarbons may produce narcosis with dizziness, weakness, irritability, concentration and/or memory loss, tremor in the fingers and tongue, vertigo, olfactory disorders, constriction of visual field, paresthesias of the extremities, weight loss and anemia and degenerative changes in the liver and kidney. Chronic exposure by petroleum workers to the lighter hydrocarbons has been associated with visual disturbances, damage to the central nervous system, peripheral neuropathies (including numbness and paresthesias), psychological and neurophysiological deficits, bone marrow toxicities (including hypoplasia, possibly due to benzene) and hepatic and renal involvement. Chronic dermal exposure to petroleum hydrocarbons may result in defatting which produces localized dermatoses. Surface cracking and erosion may also increase susceptibility to infection by microorganisms.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air. Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital, or doctor.

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Eye Contact: Immediately hold the eyes open and wash continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids. Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water). Wash affected areas thoroughly with water (and soap if available). Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short term repeated exposures to petroleum distillates or related hydrocarbons:

1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2. Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3. Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
4. A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5. Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.

   Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6. Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures

Flash Point: -43 °C

Autoignition Temperature: 280 °C

LEL: 1.4% v/v

UEL: 7.6% v/v

Fire Diamond

Extinguishing Media: Foam. Dry chemical powder. Bromochlorodifluoromethane (BCF) (where regulations permit). Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable. Severe fire hazard when exposed to heat, flame and/or oxidizers. Vapor forms an explosive mixture with air. Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition. Heating may cause expansion/decomposition with violent rupture of containers. On combustion, may emit toxic fumes of carbon monoxide (CO).

Fire Incompatibility: Avoid contamination with oxidizing agents, i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc., as ignition may result.

Fire-Fighting Instructions: Alert fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or water ways. If safe, switch off electrical equipment until vapour fire hazard removed.

Use water delivered as a fine spray to control fire and cool adjacent area. Avoid spraying water onto liquid pools. Do not approach containers suspected to be hot. Cool fire exposed containers with water spray from a protected location. If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately. Avoid breathing vapors and contact with skin and eyes. Control personal contact by using protective equipment. Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind. Alert fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or water ways. No smoking, naked lights or ignition sources. Increase ventilation. Stop leak if safe to do so.

Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite. Use only spark-free shovels and explosion proof equipment. Collect recoverable product into labeled containers for recycling. Absorb remaining product with sand, earth or vermiculite. Collect solid residues and seal in labelled drums for disposal. Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

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Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation. Wear protective clothing when risk of exposure occurs. Use in a well-ventilated area. Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked. Avoid smoking, bare lights, heat or ignition sources. When handling, DO NOT eat, drink or smoke. Vapor may ignite on pumping or pouring due to static electricity. DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling. Avoid contact with incompatible materials. Keep containers securely sealed. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately. Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can, metal drum. Packing as recommended by manufacturer. Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area. If inhalation risk of overexposure exists, wear a NIOSH approved organic-vapor respirator. Correct respirator fit is essential to obtain adequate protection. In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus. Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves or PVC gloves. Safety footwear. Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >300 to 1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1000 to 15,000 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >15,000 to 300,000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >300,000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Ensure that there is ready access to eye wash unit. Ensure there is ready access to an emergency shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Purple, highly flammable, volatile liquid with characteristic sharp odor. Floats on water. Consists of a complex mixture of hydrocarbons with small amounts of residual benzene from the refining operations.

Physical State: Liquid
Vapor Pressure (kPa): 53.33 at 20 °C
Vapor Density (Air=1): > 2
Formula Weight: Not applicable.
Specific Gravity (H_2O=1, at 4 °C): 0.72-0.735 at 15 °C
Water Solubility: Insoluble
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 38.89 °C (102 °F)
Freezing/Melting Point Range: Not available
Volatile Component (% Vol): 100
Decomposition Temperature (°C): Not available.

Section 10 - Stability and Reactivity

Stability/Polymerization: Presence of incompatible materials. Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

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Section 11 - Toxicological Information

Unless otherwise specified, data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (rat) LD50: 18800 mg/kg

IRRITATION
Skin (rabbit): 500 mg/24h mild

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.
Biochemical Oxygen Demand (BOD): 8%, 5 days

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible. Follow all applicable federal, state, and local laws. Incinerate residue at an approved site. Recycle containers where possible, or dispose of in an authorized landfil.
BEWARE: Empty solvent, paint, lacquer and flammable liquid drums present a severe explosion hazard if cut by flame torch or welded. Even when thoroughly cleaned or reconditioned, the drum seams may retain sufficient solvent to generate an explosive atmosphere in the drum.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: MOTOR SPIRIT OR GASOLINE OR PETROL
Hazard Class: 3.1
ID No.: 1203
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information: PETROL

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date:.....1999-11 **Review Date:** 2000-07

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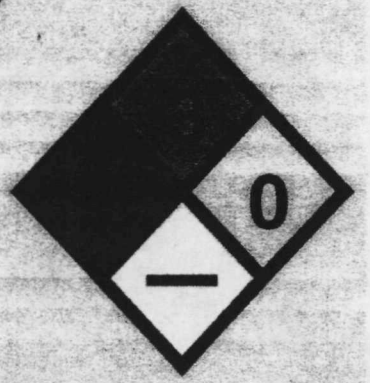
CAS # 8006-61-9 **Danger!** 1 3

Flammable

Gasoline

gasolene; motor spirits; natural gasoline; petrol

Clear liquid; distinctive odor. Irritating to eyes/skin/respiratory tract. Also Causes: dizziness, drunkenness, unconsciousness. Absorbed through skin. Chronic: dermatitis. Possible cancer hazard. Flammable. Can form explosive mixtures in air.



Target Organs

3 9 10

Eyes, Skin, Respiratory System, Nervous System, Liver, Kidneys

Personal Protective Equipment

8

Goggles, Gloves, Apron

Check to see is respirator required?

Emergency Procedures

First Aid

4

Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Thoroughly wash skin with soap and water. Ingestion: Do not induce vomiting! Consult physician.

Fire

5

Flammable. Can form explosive mixtures in the air. Use dry chemical, carbon dioxide, or foam. Water may be ineffective for extinguishment, but should be used to knock-down vapors and cool containers.

Spills & Leaks

6

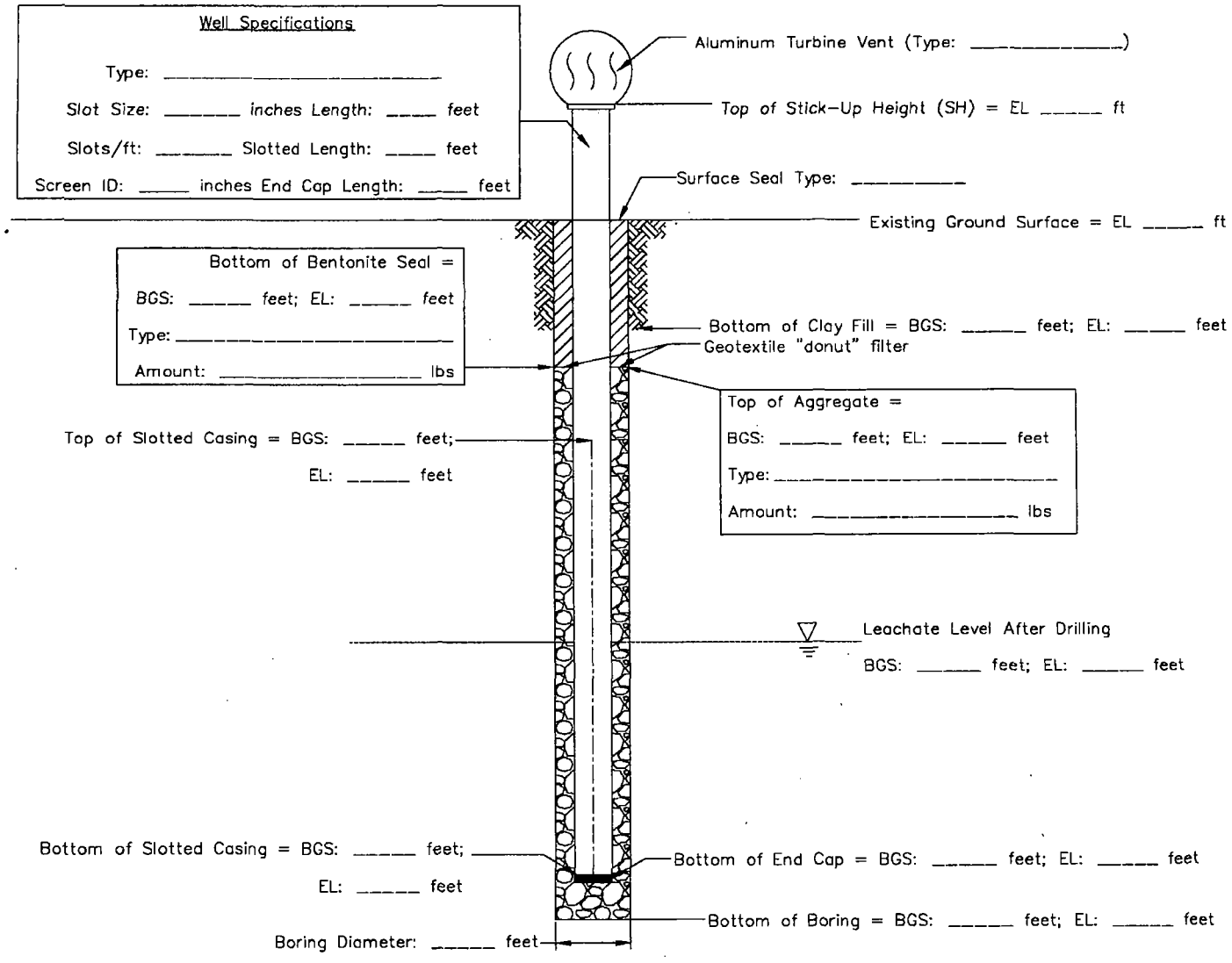
Notify safety personnel, isolate and ventilate area. Shut off ignition sources. Take up with inert material such as sand or vermiculite. Do not release to sewers or waterways. Cleanup crew should protect against exposure.

Consult MSDS 0467 for more information

APPENDIX D

WELL AND VENT CONSTRUCTION FORM

Geosyntec consultants

DUAL PHASE WELL AND PASSIVE GAS VENT CONSTRUCTION FORM

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Driller Info Drilling Company	Geosyntec Representative Inspector	Boring ID	
		Location	
	Checked By:		
Driller Name (Last Name, First Name)	Office	Northing	Easting
Boring Completion Date	Well/Vent Installation Date	Elevation	Boring Depth