REPORT

Inspection and Maintenance Plan for Ravensdale 6 LLC Closed Limited Purpose Landfills Site

Closed Limited Purpose Landfills Permit PR0015708

Submitted to:

Holcim USA Inc

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Alpena, Michigan 49707

Submitted by:

WSP USA Inc.
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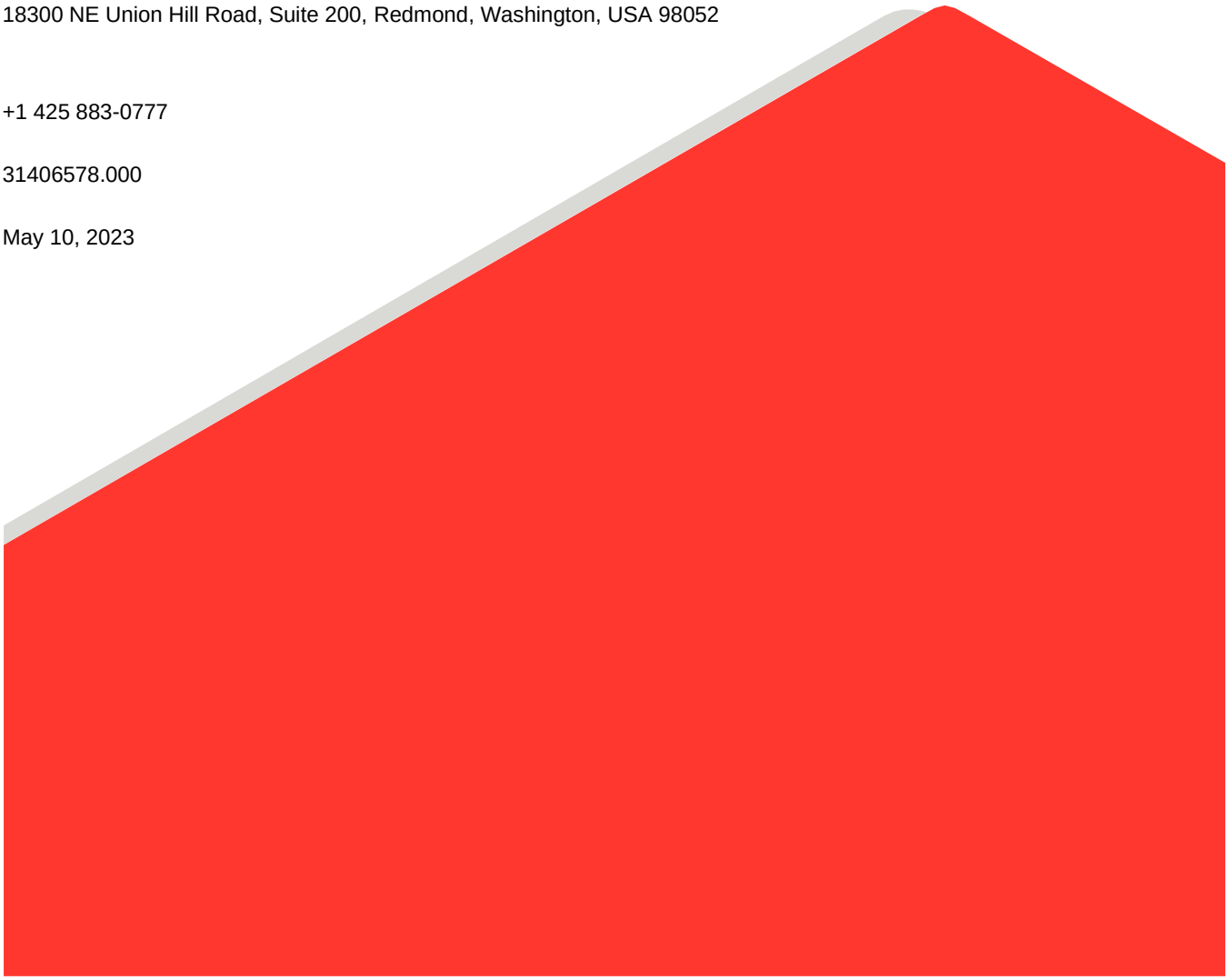
31406578.000

May 10, 2023



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1.0 BACKGROUND AND PURPOSE

1.1 Background

The Ravensdale 6 LLC Closed Limited Purpose Landfills site (Site) is located at 28131 Ravensdale-Black Diamond Road in Ravensdale, Washington. Figure 1 shows the Site location.

1.1.1 Disposal Areas

Cement kiln dust (CKD) was used, in part, for post-mining reclamation in two areas of the Site. The Lower Disposal Area (LDA) encompasses about 7 acres and is located in the northwestern portion of the Site. The second area is the Dale Strip Pit (DSP), an area of about 6 acres located in the southeastern portion of the site. These areas are shown in Figure 2. The Site is currently owned by Ravensdale 6 LLC and operated by the Reserve Silica Corporation.

During September and October 2007, the existing soil cover on the LDA was regraded to provide positive drainage at all locations, reduce overly-steep slope areas, and place a minimum 2-foot-thick clean soil cover over the entire area, including locations where CKD was exposed at the surface. In addition, a diversion ditch was constructed around the upper elevations of the LDA to intercept and divert surface water and shallow seepage. A culvert system was installed to carry flow from this diversion ditch under the main site access road to the discharge location. The toe ditch along the base of the LDA was cleaned out and reshaped, and the entrance to an existing culvert under the access road was also cleared. These features are shown in Figure 3. Details of the LDA cover construction, including as-built drawings, were presented in the Construction Summary Report (Golder 2008).

Cover upgrade activities began at the DSP in November 2010 and were completed in July 2011. Cover upgrade activities included stripping surficial vegetation and topsoil, regrading the existing surface to establish positive drainage, placing low permeability soil to provide a minimum 2-foot-thick layer at all locations, filling the existing ditch along the northeast side of the DSP, replacing topsoil, and revegetating the cover surface. In addition, shallow V-ditches were constructed on either side of the access road along the east perimeter of the DSP cover to intercept and divert surface water and shallow seepage. Drainage culverts were installed under the gravel access road on the east perimeter of the DSP to allow surface water to drain away from the DSP cover to the east side drainage ditch along the access road. An existing access road that was located across the top of the DSP cover was resurfaced with gravel. These features are shown in Figure 4. Details of the DSP cover construction, including as-built drawings, are presented in the Construction Summary Report (Golder 2013).

1.1.2 Seepage Collection and Treatment

Historically, high pH seepage surfaced along the slope west of the LDA. The outbreaks are primarily located along the northern half of the western boundary of the LDA. The leachate drained through low-lying, marshy areas and commingled with stormwater before flowing to the three infiltration ponds near the Ravensdale-Black Diamond Road (ARCADIS 2004). In 2013 a new seepage collection ditch was installed to intercept and collect the seepage, which then flowed inside a pipe to the infiltration ponds. In 2017, the collection ditch was extended to the north to capture additional seepage, and the high pH water treatment system was constructed. The high pH water is captured by the collection ditch and piped to the on-site treatment area for pH neutralization and dissolved metals removal. The treated water is piped from the treatment system to the infiltration ponds. The treatment system operations and maintenance (O&M) manual, found in Appendix B, provides information and guidelines for the operation and maintenance of the seepage treatment system.

1.2 Purpose

This plan describes the procedures that will be conducted to meet the Post-Closure Plan requirements as specified in Section III C of the 2023 Ravensdale 6 LLC Closed Limited Purpose Landfills PR0015708 (Public Health, Seattle & King County [Public Health] 2023).

2.0 INSPECTION ACTIVITIES

2.1 Covers

The primary concern related to the soil covers is loss of integrity that could expose CKD to the environment or increase the amount of infiltration into the CKD. Loss of integrity could result from erosion or slope instability. Inspection activities will therefore focus on identifying the signs of these types of problems.

The reclamation area will be visually inspected by personnel walking around the perimeter and across the cover in at least one longitudinal and two transverse sections. The inspector will look for the following types of features:

1) Gullies or bare spots due to sheet erosion, indicating excessive erosion.
2) Ponding or damp areas, including the presence of wetland vegetation, indicating significant local settlement.
3) Cracks, slumps, or scarps, indicating localized differential settlement or slope failure.
4) Areas of sparse vegetation that may need re-seeding for continued erosion control.

2.2 Surface Water Management System

The purpose of the surface water management system is direct runoff away from the covers. Inspection activities will therefore focus on identifying conditions that reduce the flow capacity of the system or disrupt its integrity.

The surface water management system will be visually inspected by personnel walking along all ditches, culvert entrances, and culvert discharge locations. The inspector will look for the following types of features:

1) Lack of vegetation, scour in grass-lined channels.
2) Loss of quarry spalls in rock-lined channels and discharge aprons.
3) Localized settlement and ponding.
4) Excessive sediment accumulation.
5) Blockage by debris.
6) Bank sloughing.
7) Excessive debris at culvert entrances.
8) Damage to or deterioration of trash racks and grates.
9) Significant deformation of the culvert cross-section.
10) Exposure of the culvert pipe at the ground surface.

2.3 Security Facilities

The inspector will verify that gates are locked and in working order and will identify any damaged or missing signs as applicable.

2.4 Documentation

Inspection documentation will include a completed inspection checklist, marked-up drawings, and digital photographs. The results of the inspection will be recorded on the forms presented in Appendix A. Areas of concern and photo locations will be sketched on copies of the drawings included with this plan. Digital photographs will be taken during each inspection at specific locations and areas of concern. Specific locations are shown in Figure 3 and Figure 4 and have been selected to include overall views of the cover slopes and drainage ditches. Other photos will be taken of any areas requiring maintenance and to document the condition of key, small-scale features such as culvert inlets, if necessary.

Copies of the inspection documents will be retained in the project files for a period of 5 years.

2.5 Frequency

Inspections will be performed twice each year, generally at the end of the winter and summer seasons.

3.0 MAINTENANCE

3.1 Periodic Maintenance

The primary regular maintenance required for the covers is mowing to prevent trees and large bushes from becoming established. This type of vegetation could send roots down through the cover or blow over in a windstorm, disrupting the cover surface. The covers will continue to be mowed at least once each year.

3.2 As-Needed Maintenance

Maintenance of the soil covers and surface water management facilities will be performed on an as-needed basis when the results of the inspections indicate that repairs are necessary. The nature of the maintenance will depend on the type of problem. The following activities are typical examples of minor maintenance that could be required. These should be used as general guidelines for maintenance activities and can be modified as necessary to accommodate the actual field conditions. If uncertain, contact the Project Manager who will consult with a qualified engineer as necessary.

3.2.1 Covers

1) *Erosion:* Replace eroded soil to grade. Revegetate, using jute matting or other material to keep seed in place until established. If erosion is a repeated problem, add crushed gravel to replacement soil, retaining sufficient fine soil to support vegetation (typically 50% to 75% fine soil).

2) *Inadequate vegetation:* Reseed, using jute matting or other material to keep seed in place until established. If vegetation fails to establish, consult qualified specialist to obtain recommendations for evaluating soil chemistry, seed mix, and other factors. Modify revegetation procedures accordingly.

3) *Ponding:* Regrade cover surface to provide positive drainage and reseed. If necessary to achieve grade, add fine-grained soil containing a minimum of 25% by dry weight of material passing the U.S. No. 200 sieve.

4) *Instability:* Offsets or deformation in the cover that reflect deep-seated failure should be evaluated by a qualified engineer and appropriate remedial measures implemented to stabilize the subgrade. After these measures have been completed, the cover surface should be repaired as described above.

3.2.2 Surface Water Management System

1) *General:* Obtain the advice of a qualified engineer prior to making significant changes in materials or geometry of the surface water facilities. All repair and replacement work should be performed in accordance with the original plans and specifications, unless approved otherwise.

2) *Excess sediment:* Remove excess sediment from ditches, inlet structures, culverts and pipes, and other facilities. When removing sediment, take care not to disturb the underlying rock lining or other parts of the facility. If these components are disturbed, restore them to their original condition. Dispose of sediment only in approved locations where it will not re-enter the surface water drainage system. Identify sediment source and mitigate, if feasible.

3) *Debris:* Clear debris from ditches, culvert trash racks, and other facilities. Dispose of garbage off site in a permitted disposal facility. Place vegetation debris on site in approved locations only.

4) *Loss of rock ditch lining:* Replace rock ditch lining and other protective layers that have been lost. Use rock of similar quality, size, and gradation to original material; place to nominal design thickness. If protective layer is lost again, use larger rock, grouted riprap, or other more resistant material.

5) *Loss of soil ditch lining:* Replace soil in scoured sections of swales to original grade. Revegetate, using jute matting or other material to keep seed in place until established. If scour is a repeated problem, add crushed gravel to replacement soil, retaining sufficient fine soil to support vegetation (typically 50% to 75% fine soil).

6) *Damage to inlet structures:* Replace or repair metal portions of inlet structures that are damaged or corroded. Where appropriate, prevent future corrosion by fabricating from stainless steel, galvanizing, coating with epoxy, or similar approach.

7) *Damage to culverts:* Replace damaged culverts and pipes that have lost flow capacity. If damage was caused by crushing, use heavier pipe. During replacement, ensure that pipe is placed on suitable granular bedding material and that backfilling is complete and continuous, particularly under pipe haunches.

3.2.3 Security

Repair or replace gates, locks, warning signs, and other security features as required.

3.3 Documentation

Maintenance reports will be prepared to provide comprehensive documentation of all maintenance activities, using the form presented in Appendix A. Each report will reference the inspection report that triggered the maintenance activity. The report will include a summary of the maintenance activity, the date of the activity, the contractor, sources, and descriptions of materials used, and other pertinent information. A complete chronology of maintenance activities will be maintained.

Copies of the maintenance reports will be retained in the project files for a period of 5 years.

4.0 SURFACE WATER AND GROUNDWATER MONITORING

A Model Toxics Control Act (MTCA) Remedial Investigation/Feasibility Study (RI/FS) is being conducted at the Site under Agreed Order (AO) No. DE 16052. The RI Work Plan (Golder 2021) describes the groundwater and surface water monitoring plan that is being conducted at the Site. Section III.C.2 of the 2023 Ravensdale 6 LLC Closed Limited Purpose Landfills PR0015708, indicates that RI Work Plan monitoring meets the substantial compliance with the monitoring and reporting requirement of the Permit.

5.0 POINTS OF CONTACT

The points of contact at the time of preparing this inspection and maintenance plan are:

The Designer for this project is:

WSP
18300 N.E. Union Hill Rd., Suite 200
Redmond, WA 98052
(425) 883-0777
Mr. Gary Zimmerman

The Project Manager for this project is:

Lafarge Holcim
1435 Ford Avenue
Alpena Michigan 49707
(989) 916-9637
Mr. Travis Weide

The Site contact for Reserve Silica is:

Fred White
Reserve Silica Corporation
28131 Ravensdale Way SE,
Ravensdale, WA 98051
fwhite@seanet.com

Note that personnel may change; Public Health and Ecology will be notified if any of the above personnel change.

6.0 REFERENCES

ARCADIS (U.S.) Inc. (ARCADIS). 2004. Lower Disposal Area and Dale Strip Pit Conceptual Design Plan, Reserve Silica Property, 28131 Black Diamond-Ravensdale Road, Ravensdale, Washington. April 28.

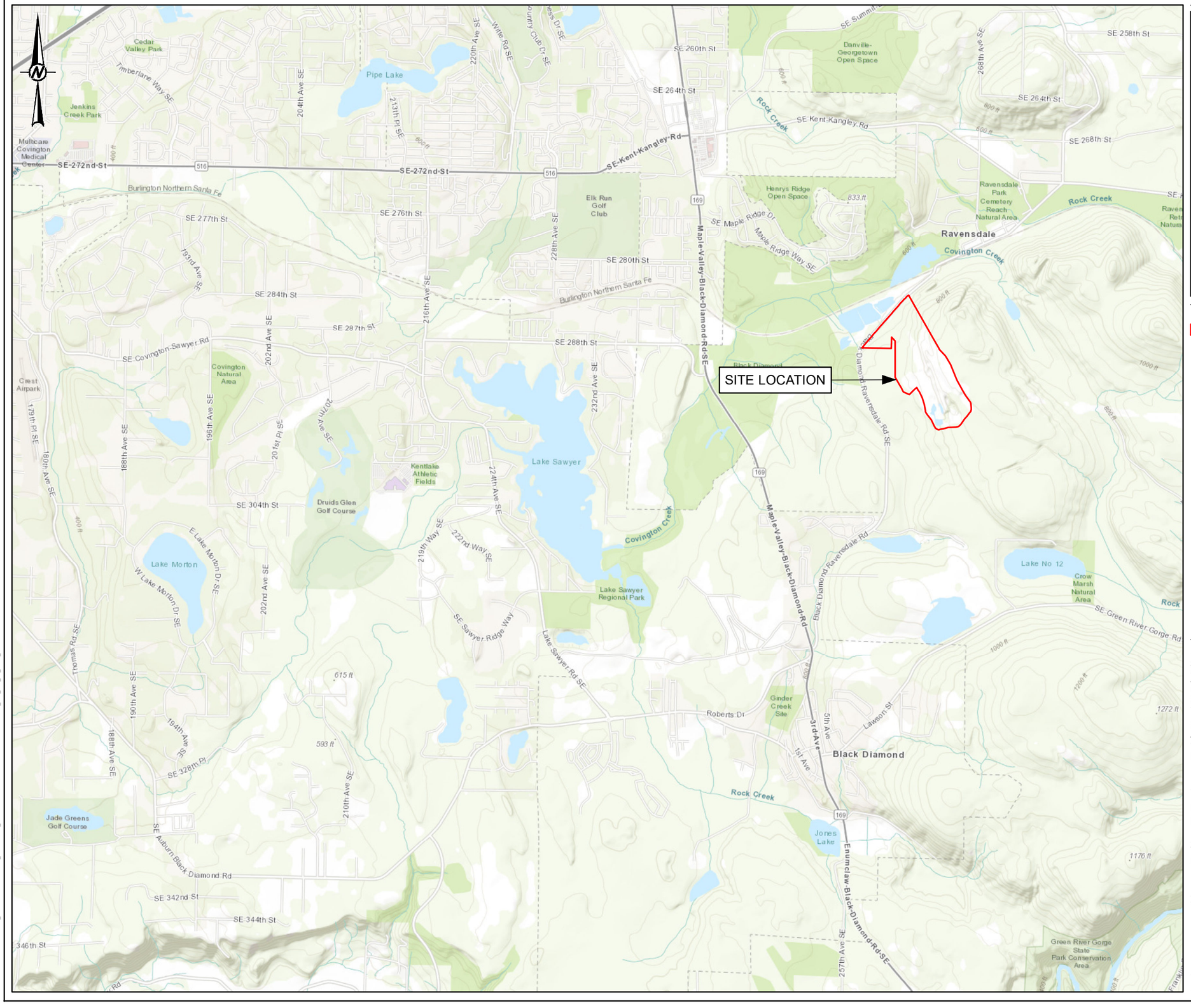
Golder Associates Inc., (Golder). 2008. Construction Summary Report, Lower Disposal Area Cover Upgrade, Reserve Silica Site, Ravensdale, Washington, July 25.

Golder. 2013. Construction Report, Dale Strip Pit Cover Upgrade Project, Ravensdale Site. August 30.

Golder.2021. Remedial Investigation/Feasibility Study Work Plan, Reserve Silica Reclamation Site, Ravensdale, Washington. July 22.

Public Health, Seattle & King County [Public Health] 2023. Ravensdale 6 LLC Closed Limited Purpose Landfills PR0015708. March 27, 2023.

Figures



LEGEND

Property Boundary

0 3,000 6,000

1 " = 3,000 FEET FEET

REFERENCE(S)

1. ASPECT CONSULTING (PROPERTY BOUNDARY)
2. ESRI (WASHINGTON STATE COUNTY BOUNDARY)
3. COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON NORTH FIPS 4601 FEET
4. MAP SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
HOLCIM

PROJECT
RI WORK PLAN 2020
RAVENSDALE, WA

TITLE
SITE LOCATION MAP

CONSULTANT

YYYY-MM-DD	2021-02-10
DESIGNED	TL
PREPARED	TL
REVIEWED	JX
APPROVED	GZ

PROJECT NO.	PHASE	REV.	FIGURE
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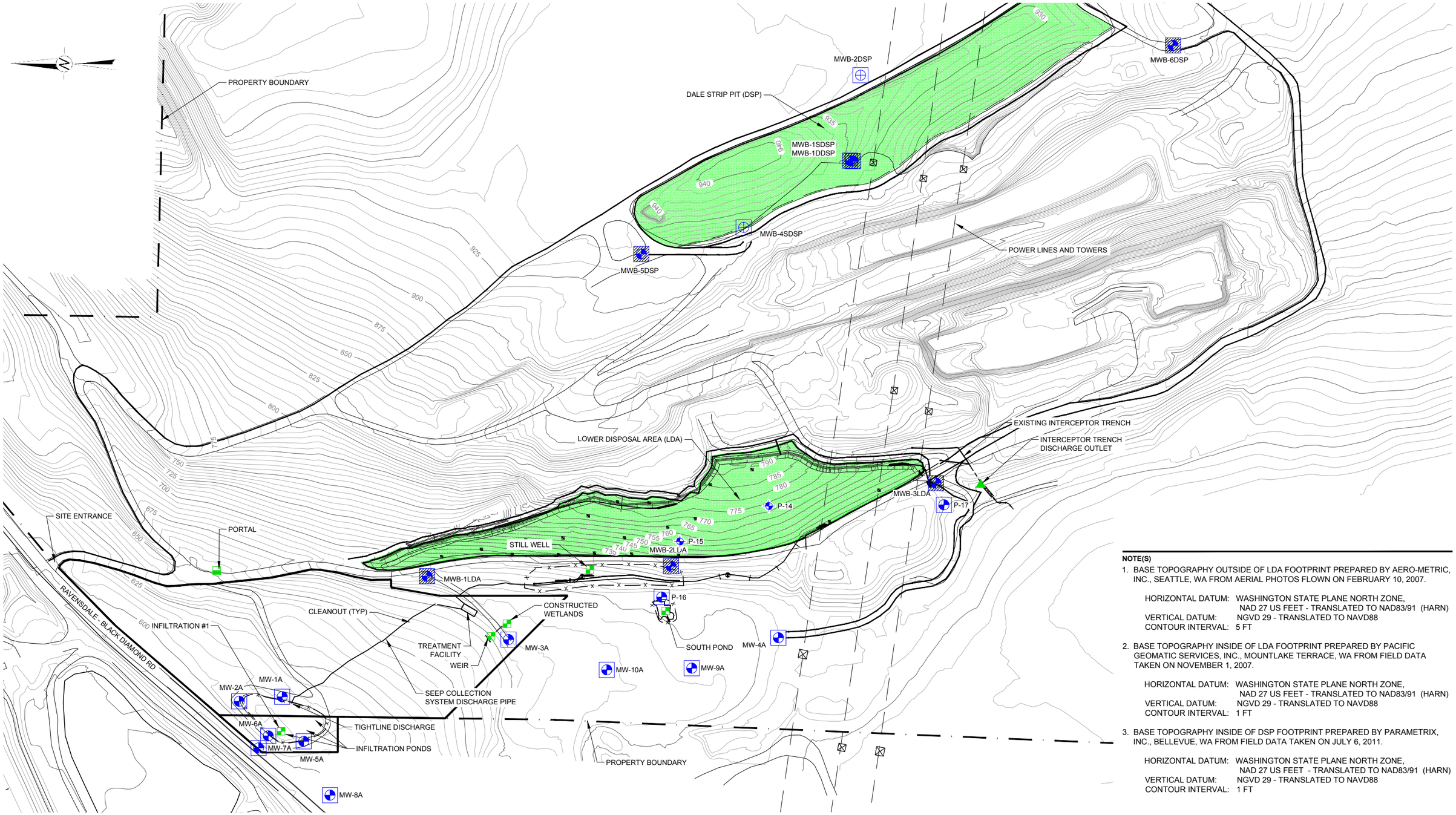

LEGEND

	COVER AREA		LDA SURFACE WATER SAMPLING LOCATION
MW-1A	ALLUVIAL MONITORING WELL		DSP BEDROCK SAMPLING LOCATION (PORTAL)
MWB-1DDSP	BEDROCK MONITORING WELL		INTERCEPTOR TRENCH SAMPLING LOCATION
MWB-2DSP	BEDROCK MONITORING WELL (NOTE 4)	— x — x —	FENCE LINE
	DISPOSAL AREA MONITORING WELL		

0 150 300
1" = 150' FEET

NOTE(S)

1. BASE TOPOGRAPHY OUTSIDE OF LDA FOOTPRINT PREPARED BY AERO-METRIC, INC., SEATTLE, WA FROM AERIAL PHOTOS FLOWN ON FEBRUARY 10, 2007.
   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET - TRANSLATED TO NAD83/91 (HARN)
   VERTICAL DATUM: NGVD 29 - TRANSLATED TO NAVD88
   CONTOUR INTERVAL: 5 FT
2. BASE TOPOGRAPHY INSIDE OF LDA FOOTPRINT PREPARED BY PACIFIC GEOMATIC SERVICES, INC., MOUNTLAKE TERRACE, WA FROM FIELD DATA TAKEN ON NOVEMBER 1, 2007.
   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET - TRANSLATED TO NAD83/91 (HARN)
   VERTICAL DATUM: NGVD 29 - TRANSLATED TO NAVD88
   CONTOUR INTERVAL: 1 FT
3. BASE TOPOGRAPHY INSIDE OF DSP FOOTPRINT PREPARED BY PARAMETRIX, INC., BELLEVUE, WA FROM FIELD DATA TAKEN ON JULY 6, 2011.
   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET - TRANSLATED TO NAD83/91 (HARN)
   VERTICAL DATUM: NGVD 29 - TRANSLATED TO NAVD88
   CONTOUR INTERVAL: 1 FT

CLIENT
HOLCIM

CONSULTANT
wsp

YYYY-MM-DD	2022-01-20
DESIGNED	JX
PREPARED	REDMOND
REVIEWED	JX
APPROVED	GZ

PROJECT
RI WORK PLAN 2020
RAVENSDALE, WA

TITLE
SITE PLAN

PROJECT NO.	PHASE	REV.	FIGURE
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NOTES

1 BASE TOPOGRAPHY OUTSIDE OF LDA FOOTPRINT PREPARED BY AERO-METRIC, INC., SEATTLE, WA FROM AERIAL PHOTOS FLOWN ON FEBRUARY 10, 2007.

HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET
VERTICAL DATUM: NDVD 29
CONTOUR INTERVAL: 5 FT

2. BASE TOPOGRAPHY INSIDE OF LDA FOOTPRINT PREPARED BY PACIFIC GEOMATIC SERVICES, INC., MOUNTLAKE TERRACE, WA FROM FIELD DATA TAKEN ON NOVEMBER 1, 2007.

HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET
VERTICAL DATUM: NDVD 29
CONTOUR INTERVAL: 1 FT

3. PHOTO POINTS ARE FOR GENERAL PHOTOS OF THE LDA COVER SURFACE. TAKE ADDITIONAL PHOTOS OF ALL SMALLER SCALE FEATURES INDICATED.

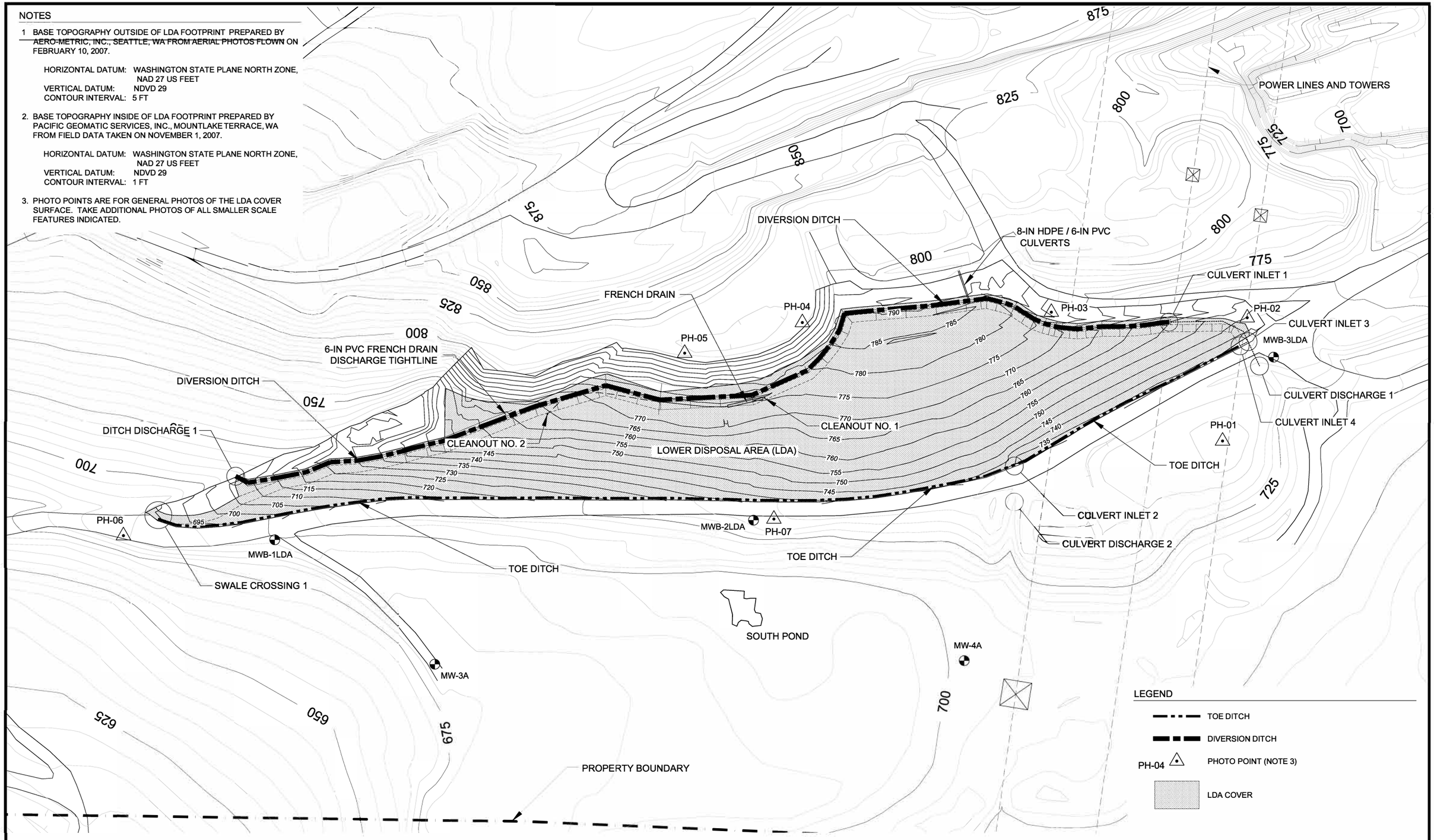

Figure 3
LDA INSPECTION LOCATIONS
HOLCIM / RAVENSDALE PROJECT / WA

Golder Associates

NOTES

1. BASE TOPOGRAPHY OUTSIDE OF DSP FOOTPRINT PREPARED BY AERO-METRIC, INC., SEATTLE, WA FROM AERIAL PHOTOS FLOWN ON FEBRUARY 10, 2007.

   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET
   VERTICAL DATUM: NDVD 29
   CONTOUR INTERVAL: 5 FT

2. BASE TOPOGRAPHY INSIDE OF DSP FOOTPRINT PREPARED BY PARAMETRIX, INC., BELLEVUE, WA FROM FIELD DATA TAKEN JULY 6, 2011.

   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET
   VERTICAL DATUM: NGVD 29
   CONTOUR INTERVAL: 1 FT

3. PHOTO POINTS ARE FOR GENERAL PHOTOS OF THE DSP COVER SURFACE. TAKE ADDITIONAL PHOTOS OF ALL SMALLER SCALE FEATURES INDICATED.

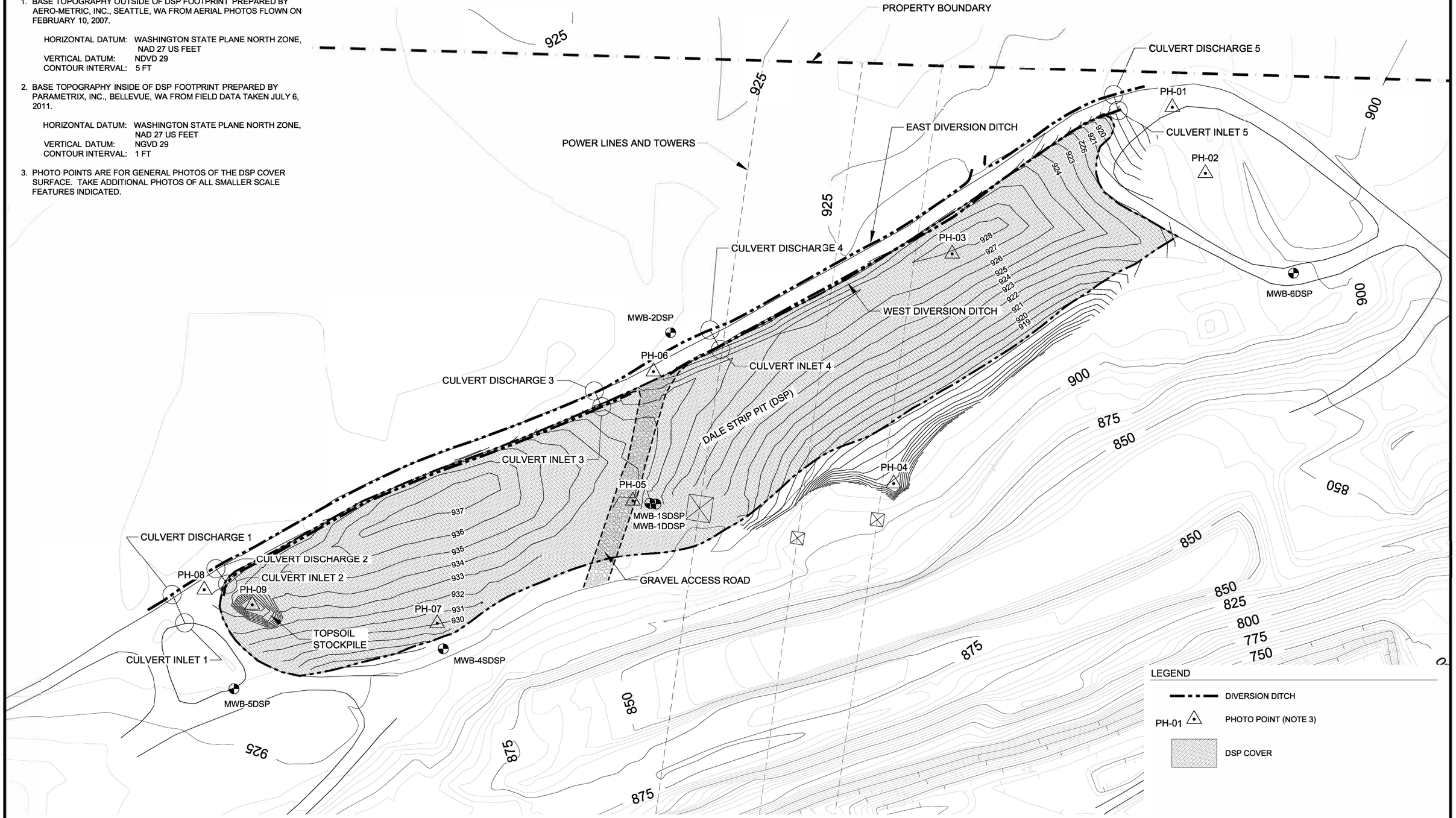

Figure 4
DSP INSPECTION LOCATIONS
HOLCIM / RAVENSDALE PROJECT / WA

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Golder Associates

APPENDIX A

Inspection and Maintenance Forms

Ravensdale Site - CKD Disposal Areas
INSPECTION CHECKLIST **Checklist No.:** _____

Date of Inspection: _____ **Weather Conditions:** _____

Inspected by (print name): _____

Signature of Inspector: _____

Inspection Feature	Photo. No.	Overall Condition **G/F/P**	Problem Severity **0/1/2**	Maintenance Required? **N/Y**	Notes and Comments
Lower Disposal Area (LDA) - Sheet IM-02					
Cover					
Erosion					
Settlement					
Slope Failure					
Sparse Vegetation					
Photo Point PH-01					
Photo Point PH-02					
Photo Point PH-03					
Photo Point PH-04					
Photo Point PH-05					
Photo Point PH-06					
Photo Point PH-07					
Surface Water Facilities					
Diversion Ditch					
V-Notch Ditch					
Tightline Discharge					
Ditch Discharge 1					
Toe Ditch					
Swale Crossing 1					
Culvert Inlet 1					
Culvert Discharge 1					
Culvert Inlet 2					
Culvert Discharge 2					
Culvert Inlet 3					
Culvert Inlet 4					
8-in HDPE / 6-in PVC Culverts					
Security					
Site Entrance Gates & Locks					
Warning Signs					
LDA Access Road Barriers					

Condition: G = Good F = Fair P = Poor

Severity: 0 = None or minor, feature appears stable 1 = Moderate, potential for future problems 2 = Major, function presently compromised

Indicate problem areas on attached map

Ravensdale Site - CKD Disposal Areas
INSPECTION CHECKLIST **Checklist No.:** _____

Date of Inspection: _____ **Weather Conditions:** _____

Inspected by (print name): _____

Signature of Inspector: _____

Inspection Feature	Photo. No.	Overall Condition **G/F/P**	Problem Severity **0/1/2**	Maintenance Required? **N/Y**	Notes and Comments
Dale Strip Pit (DSP) - Sheet IM-03					
Cover					
Erosion					
Settlement					
Slope Failure					
Sparse Vegetation					
Topsoil Stockpile					
Gravel Access Road					
Photo Point PH-01					
Photo Point PH-02					
Photo Point PH-03					
Photo Point PH-04					
Photo Point PH-05					
Photo Point PH-06					
Photo Point PH-07					
Photo Point PH-08					
Photo Point PH-09					
Surface Water Facilities					
East Diversion Ditch					
West Diversion Ditch					
Culvert Inlet 1					
Culvert Discharge 1					
Culvert Inlet 2					
Culvert Discharge 2					
Culvert Inlet 3					
Culvert Discharge 3					
Culvert Inlet 4					
Culvert Discharge 4					
Culvert Inlet 5					
Culvert Discharge 5					
Security					
Site Entrance Gates & Locks					
Warning Signs					
DSP Access Road Barriers					

Condition: G = Good F = Fair P = Poor

Severity: 0 = None or minor, feature appears stable 1 = Moderate, potential for future problems 2 = Major, function presently compromised

Indicate problem areas on attached map

Reserve Silica Site - CKD Disposal Areas
MAINTENANCE RECORD

Maintenance Record No.: _____

Date(s) of Maintenance: _____

Weather Conditions: _____

Feature: _____

Cross-Reference Inspection Checklist No.: _____

Maintenance Contractor:

Name _____

Address _____

_____

Phone _____

Maintenance Activities: (describe in detail, including any problems or unforeseen conditions; use additional sheets as necessary)

_____

_____

_____

_____

_____

_____

Materials and Products: (list and describe all materials and products used for the maintenance activity, including supplier name and location; use additional sheets as necessary)

_____

_____

_____

_____

_____

_____

Reserve Silica Site - CKD Disposal Areas
MAINTENANCE RECORD

Maintenance Record No.: _____

Maintenance Documentation: (list all photos and / or drawings of maintenance activity, during and after completion of maintenance; attach photos and / or drawings to this record)

_____

_____

_____

_____

_____

_____

Did Maintenance Require Changes from Recommended Procedures?

Yes ☐

No ☐

If yes, describe changes: (use additional sheets as necessary)

_____

_____

_____

Additional Maintenance Activities Required for this Feature?

Yes ☐

No ☐

If yes, describe changes: (use additional sheets as necessary)

_____

_____

_____

Maintenance Inspected by (print name): _____

Organization: _____

Signature of Maintenance Inspector: _____

Date: _____

APPENDIX B

Treatment System O&M Manual

REPORT

Treatment Facility Operations and Maintenance Manual

Reserve Silica Closed Landfill Site

Submitted to:

Holcim USA Inc.

1435 Ford Avenue
Alpena, Michigan 49707

Submitted by:

WSP USA Inc.

18300 NE Union Hill Road, Suite 200, Redmond, Washington, USA 98052

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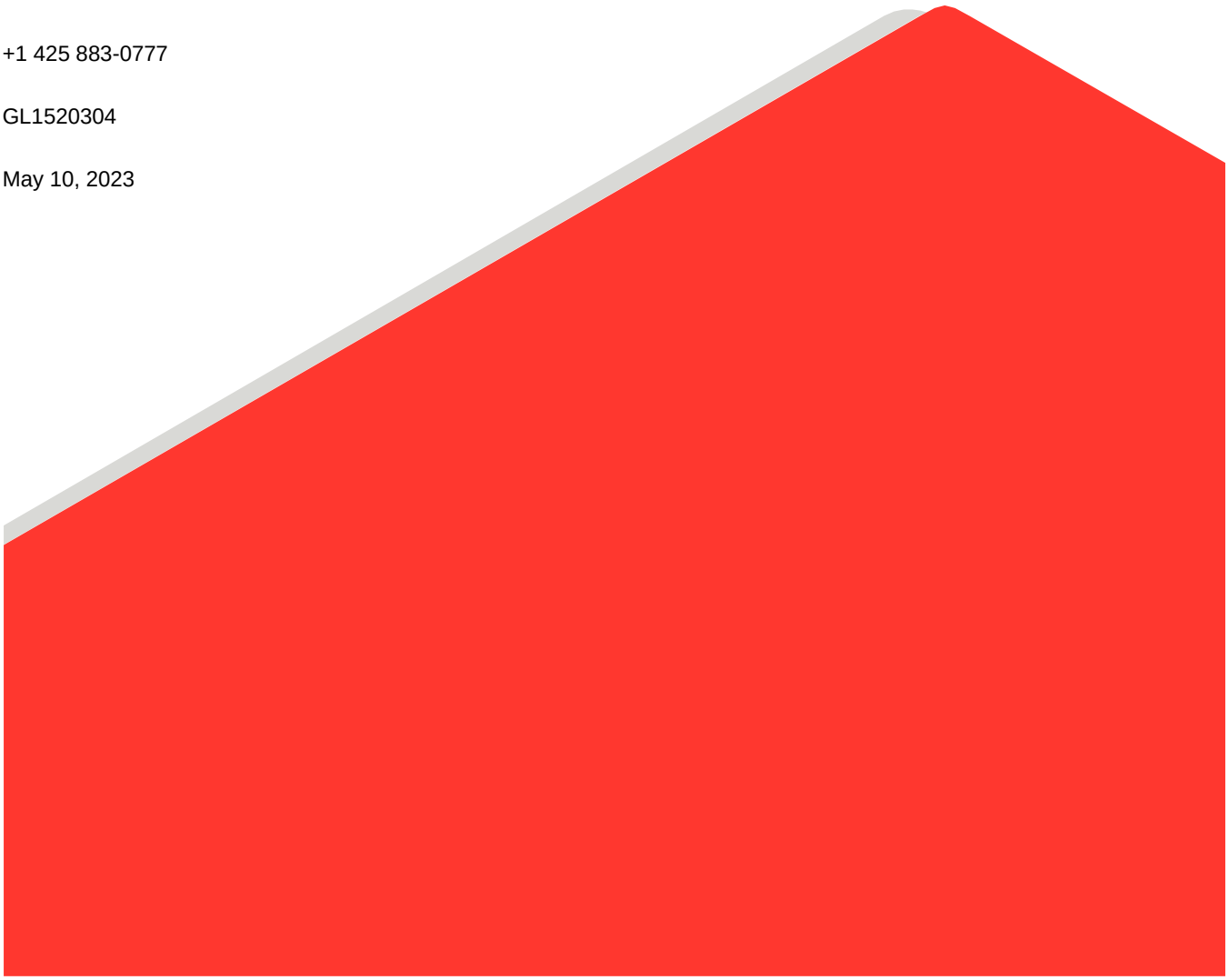
GL1520304

May 10, 2023



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O&M Health and Safety Plan

APPENDIX D
Equipment Specification Sheets

ACRONYMS AND ABBREVIATIONS

CAP	Cleanup Action Plan
CKD	Cement Kiln Dust
CMP	Compliance Monitoring Plan
CO_2	Carbon Dioxide
COC	Contaminant of Concern
DSP	Dale Strip Pit
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FS	Feasibility Study
Golder	Golder Associates Inc.
gpm	Gallon per minute
LDA	Lower Disposal Area
LOTO	lockout/tagout
SDS	safety data sheet
O&M	Operations and Maintenance
PLC	programmable logic controller
Psi	pounds per square inch
PVC	Polyvinyl Chloride
RI	Remedial Investigation
WAC	Washington Administrative Code

1.0 INTRODUCTION

This document is the Operations and Maintenance (O&M) Manual for the seepage collection and treatment system at the Reserve Silica Closed Landfill site (site) in Ravensdale, Washington. The purpose of the treatment system is to collect and neutralize high pH seepage water and reduce dissolved metal concentrations prior to discharge of the water to the on-site infiltration ponds. This plan provides information and guidelines for the operation and maintenance of the seepage treatment system.

1.1 Background

The following is a brief description of the historical mining and reclamation activities that occurred at the site.

1.1.1 LDA Background

The Lower Disposal Area (LDA) is a former open pit sand mine that was reclaimed by placing cement kiln dust (CKD) and other material into the mine excavation from June 1979 to October 1982. The LDA was filled with approximately 175,000 tons of CKD. Records indicate that a cap consisting of clay and up to 7 feet of overburden material from sand mining operations was placed over the CKD.

Historically, high pH seepage surfaced along the slope west of the LDA. The outbreaks are primarily located along the northern half of the western boundary of the LDA. The leachate drained through low-lying, marshy areas and commingled with stormwater before flowing to the three infiltration ponds near the Ravensdale-Black Diamond Road (ARCADIS 2004). In 2013 a new seepage collection ditch was installed to intercept and collect the seepage, which then flowed inside a pipe to the infiltration ponds. In 2017, the collection ditch was extended to the north to capture additional seepage, and the high pH water treatment system was constructed. The high pH water is captured by the collection ditch and piped to the on-site treatment area for pH neutralization and dissolved metals removal. The treated water is piped from the treatment system to the infiltration ponds.

1.1.2 DSP Background

The Dale Strip Pit (DSP) was created to mine the Dale No. 4 coal seam from the surface in 1946. Prior to 1946, the coal seam was worked from an underground mine. The underground mining chutes were driven upward to the surface to provide ventilation and allow the transportation of timbers into the mine. Construction of the mine allowed groundwater to drain by gravity to the mine portal (Portal). The Portal has since collapsed, and now a pipe in the collapsed Portal allows water to continuously drain from the mine under an Ecology Sand and Gravel General Permit (Ecology 2005) with monitoring as described below. The Portal is located north of the LDA on the east side of the main haul road.

The DSP was approximately 1,800 feet long (north to south), averaged 140 feet wide (east to west), and averaged 40 feet deep. It was filled in the 1970s and 1980s with approximately 250,000 cubic yards of material including CKD, borrow, and other materials pursuant to a permit from Public Health – Seattle and King County. It is estimated that about one-third of the DSP was filled with CKD (ARCADIS 2004). Routine sampling of the water discharging from the Portal and from groundwater monitoring wells installed around the DSP have not indicated impacts to the groundwater underlying the DSP.

1.2 Mitigation Activities

1.2.1 LDA Cover Upgrade

During September and October 2007, the existing soil cover on the LDA was regraded to provide positive drainage at all locations, reduce overly-steep slope areas, and place a minimum 2-foot-thick, clean soil cover over

the entire area, including locations where CKD was exposed at the surface. The construction activities are described in the Construction Summary Report (Golder 2008a).

1.2.2 LDA Seep Collection System Test Trenches

During September and October 2008, test trenches for collecting high pH seepage were constructed (Golder 2008b). The purpose of this test system was to evaluate the feasibility of using a more extensive trench system to collect high pH seepage that would otherwise discharge at the ground surface adjacent to the LDA. Details of the test trench construction are presented in the Construction Summary Report (Golder 2009a).

Between October 2008 and September 2009, Golder monitored seepage flow rates from each of two test trenches and the tightline discharge once per month, on average. A summary of activities and results of this monitoring program was presented in the flow monitoring report (Golder 2009b).

1.2.3 LDA Seep Collection Ditch and Seepage Treatment System

In February 2013, a surface water collection ditch and concrete catch basin were constructed on the bench below the main access road on the west side of the LDA. This system was installed to capture leachate seeps emerging from the bank along the east side of the bench (west of the main access road) and direct them into the existing tightline that carries flow from the test trenches to the infiltration pond. In April 2015, the 4-inch diameter pipeline from the catch basin to the infiltration ponds, approximately 1,000 feet in length, was replaced with a 12-inch diameter pipeline to alleviate plugging issues.

In December 2017, the seepage collection ditch was further extended approximately 100 feet to the north to collect additional seepage that was not previously captured. Seepage water was then redirected into the seepage treatment system, which completed construction and started initial operations on September 28, 2018. The treatment system uses CO_2 sparging to neutralize pH levels and metals adsorption using an iron-based adsorption media.

During the initial year of operation, the system operated intermittingly, with system shutdowns occurring as various upgrades and modifications were completed to increase the long-term operational efficiency of the treatment system. The system began continuous operating in June 2019, with only minor shutdowns occurring to complete routine maintenance.

1.2.4 LDA Interceptor Trench

In September 2013, a gravel-filled interceptor trench that included a perforated drainpipe and vertical downgradient liner was installed south of the LDA to intercept and direct away from the LDA clean groundwater moving in a northerly direction prior to encountering the cement kiln dust in the LDA.

1.2.5 DSP Cover Upgrade

Cover upgrade activities began at the DSP in November 2010 and were completed in July 2011. Cover upgrade activities included stripping surficial vegetation and topsoil, regrading the existing surface to establish positive drainage, placing low permeability soil to provide a minimum 2-foot-thick layer at all locations, filling the existing ditch along the northeast side of the DSP, replacing topsoil, and revegetating the cover surface.

2.0 PURPOSE AND SCOPE

This document presents the O&M Plan for the site seepage water treatment system and has been prepared to fulfill the Post Closure Operation and Maintenance Plan requirements of the Reserve Silica Corporation Closed Landfill Permit # PR0015708. Additionally, this document follows the O&M Plan requirements listed in WAC 173-340-400(4)(c).

The purpose of this report is to provide or document the following:

- Name and phone number of the responsible individuals
- Process description and operating principles
- Design criteria and operating parameters and limits
- General operating procedures
- Discussion of operation of individual treatment units
- Procedures and sample forms for collection and management of operating and maintenance records
- Discussion on equipment contingencies such as spare parts inventories and equipment warranties
- Inspection and maintenance schedules
- Contingency procedures
- Health and safety provisions
- Procedures for maintenance of the facility after completion of the cleanup action

2.1 Responsible Individuals

The treatment system is operated by WSP USA Inc. (WSP). The contacts for WSP personnel are:

Gary Zimmerman
WSP
Vice President and Project Manager
Phone: 425-883-0777 or 206-316-5621

Sean Johnson
WSP
Consultant Engineer
Phone: 425-883-0777 or 425-495-9365

The contact for the site representative is:

Fred White
Reserve Silica Corporation
28131 Ravensdale Way SE,
Ravensdale, WA 98051
fwhite@seanet.com

3.0 PROCESS DESCRIPTION AND OPERATING PRINCIPLES

The high pH seepage that is collected in the ditch west of the LDA, enters drop structures to the 12-inch diameter subsurface pipe that conveys the water to the seepage treatment system. The seepage treatment system uses CO_2 sparging to neutralize pH and metals adsorption using iron-based media. CO_2 sparging creates a weak carbonic acid that buffers the pH levels to below 8.5 standard units in short periods of time (within minutes, depending on the volume of water being treated). The adsorption media used is BayOxide, a fine granular iron media, which can reduce arsenic concentrations by more than 90% of the initial arsenic concentration; which can range in concentration from 10-100 parts per billion (ppb). Following neutralization of the water, arsenic has a high affinity to adsorb onto iron, and the Bayoxide fine iron granulars provide a significant surface area for adsorption to occur.

The collected seepage gravity flows into the pH treatment tank (pH Treatment Tank), where it is constantly circulated via a 1 HP pump (Circulation Pump). The pump runs the water through the CO_2 sparging unit (Fortrans Panel) to create carbonic acid, which reduces the pH to within established parameters. As the water in the pH Treatment Tank water rises, a float switch triggers a ½ HP pump (Transfer Pump) to move the treated water into a series of filter vessels (Filter Vessels) to remove particulates and adsorb metals. The treatment system lowers the high pH to levels that are below the upper numerical pH standard of 8.5 in WAC 173-200-040, and reduces the concentration of dissolved arsenic and other metals before discharging treated water to the infiltration ponds where further precipitation of dissolved metals occurs prior to infiltration of the water to the underlying aquifer. Groundwater monitoring wells surround the infiltration ponds and are monitored to evaluate if impacts to the groundwater are occurring. The locations of the seepage collection trench, the conveyance system, the treatment system, and the infiltration ponds are provided on as-built drawings in Appendix A.

The high pH seepage occurs continuously with total flow rates of 2 to 18 gpm, as such the treatment system is designed to operate continuously. Emergency flow paths have been designed so that, in the event of equipment failure of the treatment system, the seepage water is still collected and will gravity drain into the infiltration ponds. This reduces the likelihood that an uncontrolled spill may occur at the treatment system or elsewhere at the site where safety fencing is not located. These emergency flow paths are further described in Section 5.0.

4.0 EQUIPMENT INFORMATION

4.1 Equipment List

The major equipment components of the treatment system are as follows:

- Fortrans control panel (Fortrans Panel)
- 1 HP CO_2 sparging circulation pump (Circulation Pump)
- 4,200-gallon pH Treatment Tank (pH Treatment Tank)
- ½ HP transfer pump (Transfer Pump)
- Two 300-pound capacity filter media vessels (Filter Vessels)
- Programmable Logic Controller (PLC) located in the Fortrans Panel
- 2000-liter Airgas CO_2 storage tank

4.2 Manufacturer's Information

Manufacturer's manuals or other information is provided in Appendix D.

4.3 Spare Parts Suppliers

Suppliers for major equipment items are identified in the manufacturers' information (including supplier addresses and phone numbers) or are readily available through online retailers. A spare Circulation Pump, Transfer Pump, and items that routinely require replacement have been pre-purchased by WSP and are readily available at all times in the event a pump experiences failure.

5.0 DESIGN CRITERIA AND OPERATIONAL PARAMETERS AND LIMITS

The treatment system consists of a CO_2 sparging system, sand filter, and an iron adsorption media filtration system. Except for conveyance pipes and structures, all equipment and control panels are located above-ground. The treatment system design as-built drawings are provided in Appendix A. A fenced concrete pad was constructed to place and enclose the required equipment used in the treatment system. The fenced area contains power connections for all equipment used.

The Fortrans CO_2 sparge unit is built and assembled by Fortrans Inc. A copy of their operations manual is provided in Appendix D. High pH seepage water is collected via a series of collection ditches and underground conveyance pipes, which conveys the impacted water to the pH Treatment Tank, where inlet and outlet hoses are set to constantly circulate the water through the Fortrans Panel with the Circulation Pump. The circulated water is constantly checked for pH by a pH probe located within the Fortrans Panel. When the system detects the pH to be at a level higher than that set by the user, it begins sparging the water with CO_2 until the water is at a level lower than that set by the user. The Fortrans CO_2 sparging system uses pulsed CO_2 injection; that is, air is injected into the influent flow at a relatively high rate for a short duration of time using an electronically actuated solenoid valve.

After the water is treated for pH, it is transferred by the Transfer Pump through the Filter Vessels for removal of arsenic. A float system is installed that will trigger the Transfer Pump to pump treated water from the pH Treatment Tank to the Filter Vessel when the water level reaches 3 feet from the bottom of the pH Treatment Tank. The float system then switches the pump off when the water level reaches 2 feet from the bottom of the pH Treatment Tank. The first vessel contains sand media to remove suspended solids and the second vessel contains the adsorption media to remove potential arsenic. In the event the Transfer Pump is not operating, an overflow has been built into the tank so that it can discharge to the existing conveyance system to the infiltration ponds without undergoing arsenic treatment.

The CO_2 sparging system was designed using the following design basis:

Maximum influent flow (design)	40 gpm
pH limits for sparging (design)	Begin sparge at pH at or above 8.3, stop sparge at pH at or below 7.5.
CO_2 operating pressure	25 to 30 psi
Minimum circulation pump flow	40 gpm

Per manufacturer's information, the CO_2 sparging system should not be operated outside the following limits:

Maximum CO_2 operating pressure	30 psi
Minimum circulation pump flow	40 gpm
Maximum ambient temperature	32°F (0°C)

The CO_2 sparging unit is equipped with a built-in heater unit to prevent freezing of the piping if the ambient temperature drops below 32°F (0°C).

The iron adsorption media filtration system was designed using the following design basis:

Operating pressure (design)	Less than 15 pounds per square inch (psi) (35 feet head) Treatment Bayoxide iron adsorption media

The filtration system flow rate is based on the pump used and the head loss through the pipe and filter media. The filtration system influent flow rate is to be greater than the influent flow rate of high pH water into the pH Treatment Tank. The iron filter media transfer pump is designed to handle flows up to 50 gpm at a total dynamic head of 10 feet.

Per manufacturer's information, the Transfer Pump will have a flow of approximately 17 gpm at a total suction lift of 5 feet and discharge pressure of 30 psi. The majority of total dynamic head will be from any friction losses within the Filter Vessels. The pressure encountered within the vessel is monitored by pressure gauges.

Flow	5 feet suction lift, discharge pressure 30 psi for flow of 17 gpm
Max ambient temperature	32°F (0°C)

As the Transfer Pump only operates when there is enough accumulated treated water in the pH Treatment Tank, there is a potential for water to sit still in the Transfer Pump and hoses leading to the Filter Vessels. Heat tracing has been provided around the Transfer Pump and hoses leading to the Filter Vessel to prevent freezing from occurring during cold months. Heat tracing will be turned on, at minimum, from the months of October to April each year.

Two emergency flow paths have also been designed and implemented to provide relief in the event of a high-volume storm or equipment failure:

1) The catch basin immediately upstream of the pH Treatment Tank, which houses the influent pipe, has an invert elevation 6-inches lower than the original pipe that directs flow to the infiltration ponds. This means that any flows that result in more than 6-inches of flow in the 12-inch influent pipe will be automatically redirected to the infiltration ponds via the original pipe. A 12-inch pipe at 50% capacity at a slope of 0.03 ft/ft would sufficiently capture flows of up to 1,000 gpm. Therefore, uncharacteristically high flows above 1,000 gpm would be redirected to the infiltration pond without treatment.

2) The pH Treatment Tank is equipped with a 4-inch diameter overflow hose that allows the pH tank to discharge water treated for pH to the discharge vault if the Transfer Pump is not operating. This bypasses the Filter Vessels.

Alarms have been set up to trigger in the event the system operates at conditions outside of designed loading. These alarms are discussed in Section 6.0.

6.0 OPERATIONS

6.1 Computer Control

Local operation of the CO_2 sparging system is controlled using a programmable logic controller (PLC) in the Fortrans Panel. The PLC can be programmed directly with the operating parameters. The PLC computer system security is provided by operating system user/password security. A copy of the PLC programming manual is maintained at WSP's Redmond office as backup.

6.2 System Operations

6.2.1 Normal Operation

The Fortrans PLC allows the user to set a high pH limit and a low pH limit. Under normal operating conditions, the Fortrans CO_2 sparging system continuously circulates water in the pH Treatment Tank. A pH probe within the Fortrans system reads the pH of the circulated water, and sparges the water with CO_2 if the pH is detected higher than the high pH limit. The sparging stops when the pH of the circulated water is detected below the low pH limit. Currently, the high pH limit is set at 8.3 and the low pH limit is set at 7.5. When the water level of the pH Treatment Tank is at approximately 3 feet, a float switch turns on the Transfer Pump, which moves water from the pH Treatment Tank through the Filter Vessels. Discharge from the Filter Vessels then enters the discharge vault, which ultimately conveys to the infiltration ponds. Influent high pH water entering the tank is gravity fed via seepage collections trenches and a series of underground conveyance structures. The system is designed to be fully automated. The same process encountered during normal operation will also be followed when operating at conditions outside of designed loading. Operating parameters are provided in Section 5.0.

The treatment system is not equipped with any alarms that trigger partial or full system shutdown. However, the treatment system is equipped with the following alarms that will inform WSP of potential contingency situations via telemetry:

- High water level in pH Treatment Tank (set to the level of overflow pipe). This will alert WSP that the Transfer Pump may not be operating as intended.
- High pH level in the discharge vault (set to pH 9.0). This will alert WSP that the CO_2 treatment system may not be operating as intended.

The treatment system is also equipped with the following local alarms that will inform WSP of potential contingency situations during regular site inspections:

- High pH level at the Fortrans system (set to trigger below 6.5 and above 9.0). This will alert WSP that the Fortrans unit may not be operating as intended.

6.2.2 Operation at Conditions Outside of Designed Loading

The same process encountered during normal operation will also be followed when operating at conditions outside of designed loading. If significant flow quantities are encountered, the system may discharge untreated water to the infiltration ponds via two alternate flow paths, discussed previously in Section 5.0. Operating parameters are provided in Section 5.0.

6.2.3 System Startup

The procedure for treatment system startup is as follows:

1) Verify that the electrical switches are “off” at the main breaker panel and that the safety lockout/tagout procedures have been implemented (Section 6.2.4).
2) Verify that the electrical switches are “off” at the Fortrans Panel.
3) Verify that all hoses are properly connected and that hoses do not have significant scale or residue buildup.
4) Verify that pH Treatment Tank gate valves are properly opened or closed as appropriate.
5) Turn the main breaker panel electrical switches to “on”.
6) Turn the Fortrans Panel electrical switches to “on”.
7) Check that field operation coincides with operational parameters in Section 3.0. Ensure that there are no alarms.

6.2.4 System Shutdown

Any time the treatment system is shut down for equipment maintenance other than regular calibrations of the pH probes in the Fortrans Panel and the discharge vault, all equipment must be de-energized and the system locked out to prevent injury from unintended/unexpected startup.

After de-energizing, the equipment power source shall be locked in the off position and tagged by the maintenance worker at main breaker panel. The equipment power lockout will be removed and equipment re-energized only when the maintenance work is complete and all personnel are at a safe distance. The lockout/tagout (LOTO) procedure is especially vital to the situation in which the equipment being maintained cannot be clearly seen from the location of the power lockout.

Each employee working at the facility during treatment system shutdown must place an individual appropriate lockout device or tagout device to isolate the energy source from the work area (by opening circuits) to prevent unexpected energization, startup, or release of stored energy in order to prevent injury to employees [29 CFR 1910.147(a)(3)(i)].

Whenever performing any equipment maintenance other than regular calibrations of the pH probes in the Fortrans Panel and the discharge vault, use the following procedure:

1) Turn off the Fortrans Panel via the PLC.
2) Switch the electrical switch for the Fortrans Panel and Circulation Pump to “off” at the Fortrans Panel breaker.

3) Switch the electrical switch for the Fortrans Panel and Transfer Pump to “off” at the main breaker panel.

4) Place a lock and tag on the breaker to prevent unauthorized start-up. The tag must include the name of the person who placed it, date, and time.

5) Verify any residual energy has been released from the equipment before initiating maintenance activities.

6) Once maintenance is completed each employee who placed a lock must remove it. ONLY the person who put on the lock is authorized to remove it.

7) Re-start system only when all personnel are at a safe distance.

6.3 Contingency Procedures

The treatment system has minimal potential to create spills or releases. Alternate flow paths have been designed and implemented to provide relief in the event of a high-volume storm or equipment failure, as previously described. Leaks could potentially develop in the following scenarios:

- A leak in CO_2 piping would release carbon dioxide into the atmosphere.
- A leak in piping for the treatment system would release potentially high pH water onto the fenced concrete pad.
- A leak in the pH Treatment Tank itself would release potentially high pH water onto the fenced concrete pad.

The adverse effects of such releases would be minimal, given current site conditions and configuration.

If a release is identified, the following procedure will be followed:

- The system will be immediately shut down and the LOTO Procedure described above will be completed.
- The location and characteristics (estimated leakage rate, period of release, cause) of the release will be noted in the site log.
- The cause of the release will be rectified, and any necessary procedures revised to prevent the problem from recurring.

Minimal quantities of lubricants stored in their original containers may be transported to and from the site as maintenance requires. Copies of applicable SDSs will be maintained at the site. Any used oil generated will be transported to a local recycling facility.

Contingency and emergency health and safety procedures for site workers are addressed in the Health and Safety Plan for the Site (provided in Appendix C). No public access is allowed at the site.

7.0 MONITORING

7.1 CO_2 Sparging System Monitoring

Operational monitoring consists of monitoring the following:

- Status of Fortrans alarms

- Whether the pH Treatment Tank is overflowing
- Whether the Circulation Pump is operating
- Whether the pH Treatment Tank is receiving influent, and the pH of the influent
- Whether system pipes/hoses are free of scale buildup
- pH Treatment Tank pH reading from Fortrans PLC
- Fortrans Panel CO_2 Flow Meter Reading (if sparging is occurring during inspection)
- pH Treatment Tank pH checked with calibrated pH meter or pH strip
- Discharge Vault pH read from telemetry PLC
- Discharge Vault pH checked with calibrated pH meter or pH strip
- CO_2 Tank Inches Head read from CO_2 telemetry
- CO_2 Tank Pressure read from CO_2 tank gauge
- CO_2 Tank Regulated Pressure read from CO_2 regulator gauge
- CO_2 Tank inches H2O differential read from CO_2 regulator gauge

These data are manually recorded and subsequently stored in a database at the WSP office in Redmond, Washington for recordkeeping.

7.2 Iron Adsorption Media Filtration System Monitoring

The influent into the pH Treatment Tank, the influent into the Filter Vessels, and the treated effluent from the Filter Vessels will be sampled as needed and analyzed for arsenic using United States Environmental Protection Agency (USEPA) Method 200.8. Monitoring will be used to determine the effectiveness of arsenic removal by the iron adsorption media, as well as to determine when breakthrough has occurred and replacement of the adsorption media is required.

8.0 INSPECTION AND MAINTENANCE

8.1 Maintenance Overview

Maintenance consists of following the inspection and maintenance requirements for individual equipment items as specified in the manufacturer's instructions. These instructions will be used as the primary reference for maintenance requirements, procedures, and schedules for the treatment system equipment.

An inspection and maintenance checklist (Appendix B) will be used to document that the required items have been completed at the correct times. Inspections will be made on a generally biweekly (once every two weeks) schedule. Records of maintenance will be kept at the WSP office in Redmond, Washington.

Calibrations of the pH probe in the Fortrans Panel and the discharge vault will be completed according to manufacturer specifications. Calibrations will be completed, at minimum, on a monthly basis. pH levels of the pH Tank and the discharge vault will be checked using a calibrated pH meter during events where the system pH probes are calibrated. If a significant difference (±0.5 pH units) between the pH levels shown on the treatment

system instrument and the pH levels shown on the pH meter exist, the system pH probes may need to be recalibrated.

8.2 Circulation and Transfer Pumps

Routine and preventive maintenance of the Circulation and Transfer Pumps will be conducted according to the manufacturer recommendations and the best judgement of the operator. Scale buildup may require pump parts to be replaced and pumps rebuilt. A spare Circulation Pump and Transfer Pump will be kept readily available to quickly replace any pump that experiences failure.

8.3 Valves and Piping

The physical condition of valves (i.e., freedom of movement during system operation), piping, and fittings will be inspected monthly. Valves that do not move freely may need to be replaced. Piping or hoses will be inspected for scale buildup, and significant scale buildup will be removed, or the pipe/hose lengths replaced. Physical connections and/or any piping and fittings that show signs of significant wear or leakage will be repaired or replaced.

8.4 Filter Vessels Backwashing and Replenishing the Iron Adsorption Media

When monitoring indicates the Filter Vessels need to be backwashed, the Transfer Pump will be shut off at the breaker panel according to Section 6.2.4 and a spare Transfer Pump will be connected to the Filter Vessels. The spare Transfer Pump can be easily turned on/off by plugging it into an available electrical outlet. The multi-port valve will be placed in the “backwash” position to begin backwashing. Backwashing shall follow manufacturer recommendations. Backwash liquids will be filtered through a bag filter to remove suspended solids and discharged to the Discharge Vault. Backwashing events will be recorded in the site log.

When monitoring indicates the iron adsorption media needs to be replenished, the Transfer Pump will be shut off at the breaker panel according to Section 6.2.4. After the tank has been allowed to drain into the Discharge Vault the BayOxide Filter Vessel can be opened and Iron Adsorption media can be added to the vessel. Annually when a contracted vacuum truck comes and cleans out the influent lines and pH tank they should also be instructed to clean out the Iron Adsorption vessel and then fresh media should be added.

9.0 REFERENCES

ARCADIS (U.S.) Inc. (ARCADIS). 2004. Lower Disposal Area and Dale Strip Pit Conceptual Design Plan, Reserve Silica Property, 28131 Black Diamond-Ravensdale Road, Ravensdale, Washington. April 28.

ARCADIS. 2006. Sampling and Analysis and Quality Assurance Project Plan, Reserve Silica Site, Ravensdale, Washington. March 2.

ARCADIS. 2009. Quarterly Monitoring Report, Second Quarter 2009, Reserve Silica Site, Ravensdale, Washington. September 16.

Golder Associates Inc. (Golder). 2008a. Construction Summary Report, Lower Disposal Area Cover Upgrade, Reserve Silica Site, Reserve Silica Site, Ravensdale, Washington, July 25.

Golder. 2008b. Draft Workplan for Seep Collection Test Trenches, Lower Disposal Area, Reserve Silica Site, Ravensdale, Washington. August 4.

Golder. 2009a. Construction Summary Report, Seep Collection System Test Trenches, Reserve Silica Site, Ravensdale, Washington. March 6.

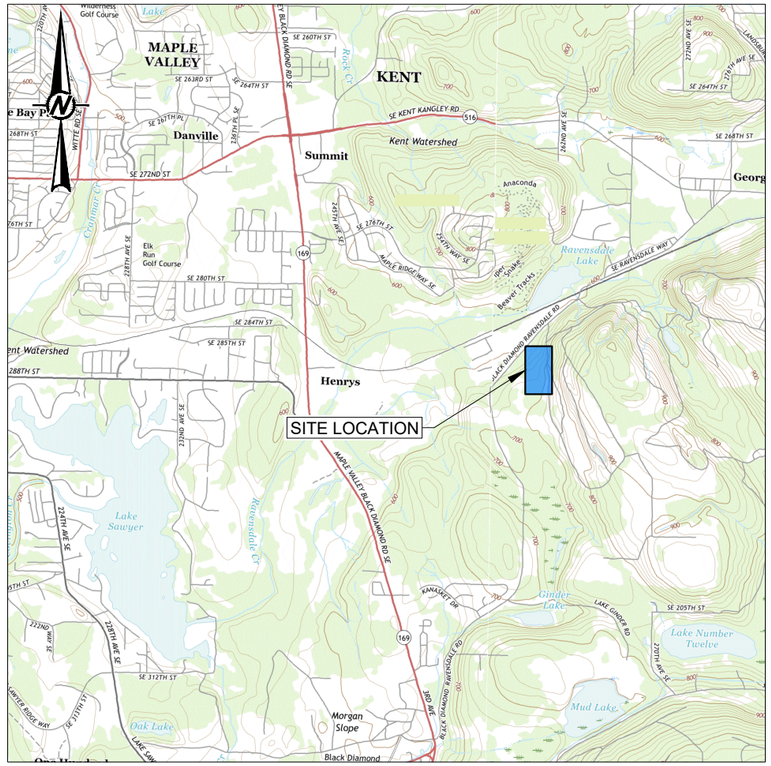
Golder. 2009b. Flow Monitoring Seep Collection System Test Trenches, Reserve Silica Site, Lower Disposal Area, Ravensdale, Washington. December.

Washington State Department of Ecology. 2005. Sand and Gravel General Permit. Limit for Discharge to Ground Water. January 5.

APPENDIX A

As Built Drawings

HOLCIM (US) INC.
SEEPAGE WATER TREATMENT SYSTEM DESIGN
LOWER DISPOSAL AREA
28130 BLACK DIAMOND RD SE
RAVENSDALE, WA 98051



VICINITY MAP

0 2000 4000
1" = 2000' FEET

SHEET LIST TABLE	
Sheet Number	Sheet Title
001	COVER SHEET
002	CONSTRUCTION NOTES AND SPECIFICATIONS
003	PROPERTY BOUNDARY MAP
004	SITE OVERVIEW
005	PROJECT AREA TOPOGRAPHIC SURVEY
006	GRADING, CLEARING, AND GRUBBING PLAN
007	SITE PLAN
008	TREATMENT SYSTEM FACILITIES GENERAL LAYOUT
009	DETAILS I
010	DETAILS II
011	DETAILS III

AS BUILT

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

SEAL

JING SONG XI — STATE OF WASHINGTON — 24185 — REGISTERED PROFESSIONAL ENGINEER

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HOLCIM (US) INC.

CONSULTANT
GOLDER

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PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
COVER SHEET

PROJECT NO.	PHASE	REV.		SHEET
1520304	400	0	1 of 11	001

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

1 in 0

GENERAL CONSTRUCTION

1. MATERIALS AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE PLANS.
2. DIMENSIONS AND DETAILS OF EXISTING FEATURES SHOWN ON THESE PLANS ARE APPROXIMATE IN NATURE, AND CAUTION SHOULD BE EXERCISED USING THEM TO ESTIMATE THE ASSOCIATED QUANTITIES OF WORK (E.G., CLEARING, GRUBBING, GRADING, ETC.).
3. SUBMITTALS:
   REQUIRED SUBMITTALS ARE LISTED IN OTHER SECTIONS OF THESE SPECIFICATIONS, AND ADDITIONAL SUBMITTALS SHALL BE PROVIDED IF DETERMINED NECESSARY TO DEMONSTRATE COMPLIANCE BY THE ENGINEER. CONTRACTOR SHALL SUBMIT ANY REQUESTS FOR ALTERNATE MATERIALS OR METHODS FROM THOSE SHOWN ON THE DRAWINGS TO THE ENGINEER FOR EVALUATION AND APPROVAL. ADEQUATE TIME SHALL BE ALLOWED IN CONTRACTOR'S SCHEDULE FOR THE ENGINEER TO EVALUATE THE ALTERNATE AND PROVIDE A RESPONSE TO THE CONTRACTOR. ADEQUATE TIME SHALL BE AT LEAST 1 WEEK, BUT MAY BE LONGER DEPENDING ON THE PROPOSED ALTERNATE.
4. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL PERMITS, APPROVALS, AND AUTHORIZATIONS FROM REGULATORY AUTHORITIES HAVING JURISDICTION OVER THIS PROJECT, UNLESS OTHERWISE PROVIDED OR INDICATED BY THE ENGINEER .
5. CONTRACTOR HAS SOLE RESPONSIBILITY FOR FIELD VERIFICATION OF ALL EXISTING FACILITIES AND CONDITIONS SHOWN ON DRAWINGS. PRIOR TO BEGINNING WORK IN THE AFFECTED AREA, THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES AND SHALL RESOLVE ALL SUCH DISCREPANCIES WITH THE SITE OPERATOR (RESERVE SILICA CORP.) OR THE APPROPRIATE UTILITY COMPANY.
6. THE LOCATION OF EXISTING UTILITIES SHOWN ON THE DRAWINGS IS APPROXIMATE ONLY. BEFORE COMMENCING GROUND-DISTURBING ACTIVITIES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL UTILITIES BY CONTACTING THE UTILITY NOTIFICATION CENTER AND USING UTILITY LOCATE SERVICES IN ACCORDANCE WITH STATE AND LOCAL REGULATIONS. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGE WHICH OCCURS DUE TO HIS FAILURE TO REQUEST THE LOCATION AND PRESERVATION OF UTILITIES. ANY DAMAGE TO EXISTING UTILITIES INCURRED AS A RESULT OF CONSTRUCTION OPERATIONS SHALL BE REPAIRED BY THE CONTRACTOR AT HIS OWN EXPENSE.
7. DETAILS PRESENTED IN THIS DRAWING PACKAGE DO NOT EXTEND TO OR INCLUDE DESIGNS OR SYSTEMS PERTAINING TO THE SAFETY OF THE CONTRACTOR OR ITS EMPLOYEES, AGENTS, OR REPRESENTATIVES IN THE PERFORMANCE OF THE WORK. THE CONSTRUCTION CONTRACTOR SHALL PREPARE OR OBTAIN THE APPROPRIATE SAFETY SYSTEMS REQUIRED BY LAW TO ENSURE SAFETY OF THE CONTRACTOR AND ITS EMPLOYEES.
8. ADEQUATE DRAINAGE SHALL BE MAINTAINED AT ALL TIMES DURING CONSTRUCTION, AND ANY DRAINAGE DITCH OR STRUCTURE DISTURBED DURING CONSTRUCTION SHALL BE RESTORED TO ITS CONDITION PRIOR TO CONSTRUCTION.
9. THE CONTRACTOR SHALL IMPLEMENT EROSION AND SEDIMENT CONTROL (ESC) MEASURES IN ACCORDANCE WITH THE *KING COUNTY 2016 SURFACE WATER DESIGN MANUAL, APPENDIX D CONSTRUCTION STORMWATER POLLUTION PREVENTION MEASURES*. ESC MEASURES SHALL BE SUFFICIENT TO PREVENT SEDIMENT FROM LEAVING THE DISTURBED AREA AND SHALL BE MAINTAINED THROUGHOUT CONSTRUCTION.
10. EXISTING ROADS AND/OR RIGHT-OF-WAYS DISTURBED DURING CONSTRUCTION SHALL BE RESTORED TO A CONDITION AS GOOD OR BETTER THAN THE CONDITION PRIOR TO STARTING THE WORK, UPON COMPLETION OF THE PROJECT.
11. ALL EQUIPMENT, UNUSED MATERIAL, TOOLS, AND DEBRIS FROM CONSTRUCTION SHALL BE REMOVED AT THE END OF THE PROJECT.

EARTHWORK

1. SUBSURFACE SOIL CONDITIONS ARE UNKNOWN. THE ENGINEER WILL OBSERVE THE SUBGRADE AFTER CLEARING AND GRUBBING TO VERIFY THAT SOIL CONDITIONS ARE SUITABLE FOR PLACEMENT OF OVERLYING MATERIALS AND TO IDENTIFY ANY AREAS OF UNSUITABLE MATERIAL THAT REQUIRE REMOVAL. THE CONTRACTOR SHALL NOTIFY THE ENGINEER WHEN THE SUBGRADE SURFACE IS READY FOR INSPECTION AND SHALL ALLOW TIME IN HIS SCHEDULE FOR THIS ACTIVITY. UNSUITABLE MATERIAL SHALL BE REPLACED WITH CLEAN INORGANIC SOIL CAPABLE OF PROVIDING AN ADEQUATE FOUNDATION FOR THE OVERLYING CONSTRUCTION, AS DIRECTED BY THE ENGINEER.
2. SUBGRADE TOLERANCES: THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SURVEY ACTIVITIES REQUIRED TO LAY OUT THE WORK AS SHOWN ON THE DRAWINGS. IDENTIFY REQUIRED LINES, LEVELS, CONTOURS, AND DATUM TO BRING SITE GRADES TO THE PROPOSED SUBGRADE ELEVATIONS INFERRED FROM THE DRAWINGS. SUBGRADE ELEVATIONS SHALL BE CONSTRUCTED TO WITHIN PLUS 0 TO MINUS 1 INCH OF THE REQUIRED GRADES.
3. REMOVE SOILS TO AN ELEVATION AT LEAST 6 INCHES BELOW BOTTOM OF PROPOSED CONCRETE SLAB. BACKFILL TO TOP-OF-SUBGRADE ELEVATION WITH CLEAN, INORGANIC SOIL CONFORMING TO THE REQUIREMENTS OF THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WSDOT) 2016 STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION, SECTION 9-03.9(3) BASE COURSE, OR APPROVED EQUAL. COMPACT SUBGRADE SURFACE WITH A MINIMUM OF 4 PASSES OF A CATERPILLAR CS44 SMOOTH DRUM VIBRATORY ROLLER OR SIMILAR APPROVED PIECE OF EQUIPMENT.
4. NO FILL MATERIAL SHALL BE PLACED IN AREAS OF STANDING WATER, SOFT SUBGRADE CONDITIONS, OR IN AREAS THAT HAVE NOT BEEN APPROVED BY THE ENGINEER.
5. NO FILL MATERIALS SHALL BE PLACED DURING UNFAVORABLE WEATHER CONDITIONS. WHEN WORK IS INTERRUPTED BY HEAVY RAINS, AS DETERMINED BY THE ENGINEER, FILL OPERATIONS SHALL NOT BE RESUMED UNTIL ALL WET SURFICIAL SOILS ARE RETURNED TO A SATISFACTORY MOISTURE CONTENT.

ELECTRICAL SERVICE

1. PROVIDE COUPLINGS, CONDUIT CEMENT, JUNCTION BOXES, PULL BOXES, AND ANY OTHER REQUIRED ACCESSORIES. COUPLINGS AND CEMENT SHALL BE COMPATIBLE WITH CONDUIT MATERIAL PER MANUFACTURER RECOMMENDATIONS.
2. ALL ELECTRICAL MATERIALS AND INSTALLATION SHALL CONFIRM TO NATIONAL ELECTRIC CODE AND OTHER APPLICABLE CODES.

STRUCTURAL CONCRETE

1. DESIGN STANDARDS AND REFERENCES:
   AMERICAN CONCRETE INSTITUTE (ACI):
   ACI 301 SPECIFICATIONS FOR STRUCTURAL CONCRETE, INCLUDING ALL REFERENCED SPECIFICATIONS AND GUIDANCE DOCUMENTS.
2. LEVEL OF DETAIL AND CONTRACTOR VERIFICATION:
   DRAWINGS INDICATE GENERAL AND TYPICAL DETAILS OF CONSTRUCTION. WHERE CONDITIONS ARE NOT SPECIFICALLY INDICATED BY, BUT ARE OF SIMILAR CHARACTER TO, DETAILS SHOWN ON THE DRAWINGS, SIMILAR DETAILS OF CONSTRUCTION SHALL BE USED, SUBJECT TO REVIEW AND APPROVAL BY THE ENGINEER.
3. SPECIFICATION FOR CAST-IN-PLACE CONCRETE STRUCTURES:
   WORK SHALL CONFORM TO ALL REQUIREMENTS OF ACI 301, EXCEPT AS MODIFIED BY THESE CONTRACT DOCUMENTS. UNLESS NOTED OTHERWISE, ALL COMPATIBLE PROVISIONS FROM ACI 301 AND THESE CONTRACT DOCUMENTS SHALL ALL APPLY. ACI 301 INCLUDES, BUT IS NOT LIMITED TO, REQUIREMENTS FOR FORMWORK, REINFORCEMENT, CONCRETE MIXTURES, HANDLING, PLACING, FINISHING, AND CURING.
4. REINFORCING STEEL:
   REINFORCING STEEL SHALL CONFORM TO ASTM A615 STANDARD SPECIFICATION FOR CARBON STEEL REINFORCING BARS.
   #4 REINFORCEMENT BARS SHALL BE USED AT 12 INCHES ON CENTER, EACH WAY, WITH A MINIMUM OF 3 INCHES OF COVER AT THE BOTTOM, AND 2 INCHES OF COVER AT THE TOP.
5. CONCRETE MIX:
   CONCRETE SHALL HAVE 28-DAY COMPRESSIVE STRENGTH OF AT LEAST 4,000 PSI AND SHALL CONFORM TO THE REQUIREMENTS OF ACI 301 AND WSDOT 2016 STANDARD SPECIFICATIONS SECTION 6-02 CLASS 4000, AS APPLICABLE. MAXIMUM SIZE OF AGGREGATE SHALL NOT EXCEED 1 INCH AND SHALL NOT CONTAIN MATERIALS DELETERIOUSLY REACTIVE WITH ALKALIES IN THE CEMENT. MINIMUM CEMENTITIOUS MATERIAL CONTENT SHALL BE 564 LB/CY. WATER-CEMENTITIOUS MATERIAL RATIO SHALL NOT EXCEED 0.42. WATER-SOLUBLE CHLORIDE ION CONTENT OF CONCRETE SHALL NOT EXCEED 0.08 PERCENT. OBTAIN WRITTEN AUTHORIZATION FROM THE ENGINEER PRIOR TO USING ADMIXTURES, EXCEPT FOR AIR-ENTRAINING AGENTS. IF ADMIXTURES ARE USED, CONTRACTOR SHALL USE THE SAME APPROVED ADMIXTURES THROUGHOUT THE WORK.
6. CURING AND FINISHING:
   MINIMUM CURING PERIOD SHALL BE 7 DAYS. SURFACE WILL BE BROOM FINISHED. A CRACK CONTROL JOINT SHALL BE INSTALLED ACCORDING TO THE DETAILS OF THESE CONSTRUCTION DRAWINGS.
7. BACKFILLING:
   DO NOT BACKFILL AGAINST CONCRETE UNTIL THE CURING PERIOD IS COMPLETED AND THE CONCRETE HAS REACHED ITS DESIGN COMPRESSIVE STRENGTH. PROVIDE DRAINAGE PATH FOR RUNOFF SO STANDING WATER DOES NOT ACCUMULATE WITHIN 5 FT OF STRUCTURE.
8. TOLERANCES:
   TOLERANCES FOR THE CONCRETE WORK SHALL BE PER ACI 117, SECTIONS 1 THROUGH 4.

AS BUILT

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

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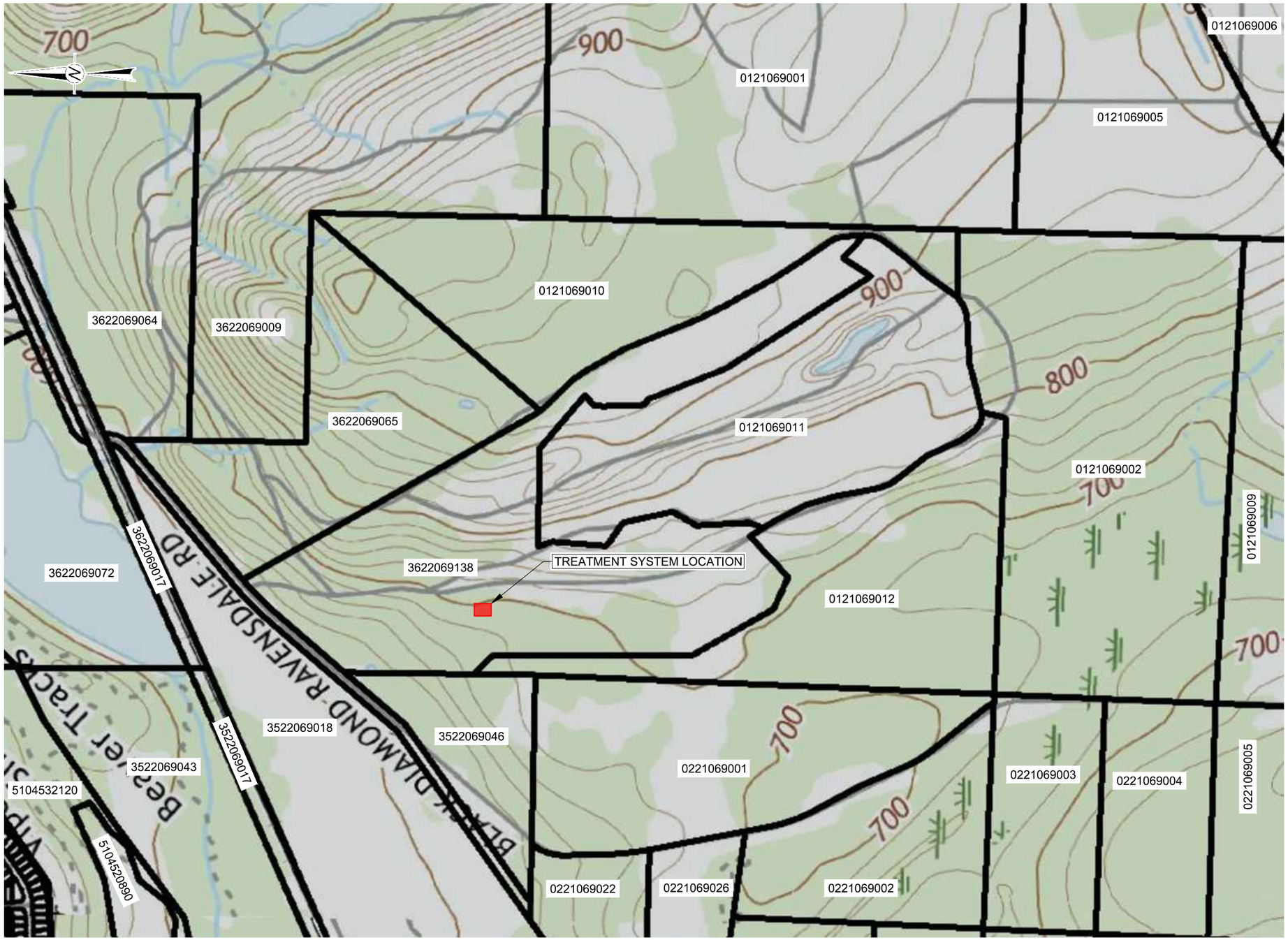
PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
CONSTRUCTION NOTES AND SPECIFICATIONS

PROJECT NO.	PHASE	REV.		SHEET
1520304	400	0	2 of 11	002



LEGEND

362206906509 PARCEL BOUNDARY AND TAX ID

REFERENCE(S)

1. PARCEL BOUNDARIES AND TAX IDENTIFICATION NUMBER PROVIDED BY THE KING COUNTY GIS DATABASE, DOWNLOADED AS A SHAPE FILE ON 2017-10-02.
2. DRAWING COORDINATE SYSTEM: NAD83 WASHINGTON STATE PLANE, NORTH ZONE, US FOOT.
3. 7.5-MINUTE QUADRANGLE TOPOGRAPHIC MAP PROVIDED BY THE UNITED STATES GEOLOGICAL SURVEY, DOWNLOADED AS GEOREFERENCED PDF ON 2017-06-16.

AS BUILT

0 300 600
1" = 300' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

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PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
PROPERTY BOUNDARY MAP

PROJECT NO.	PHASE	REV.		SHEET
1520304	400	0	3 of 11	003

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

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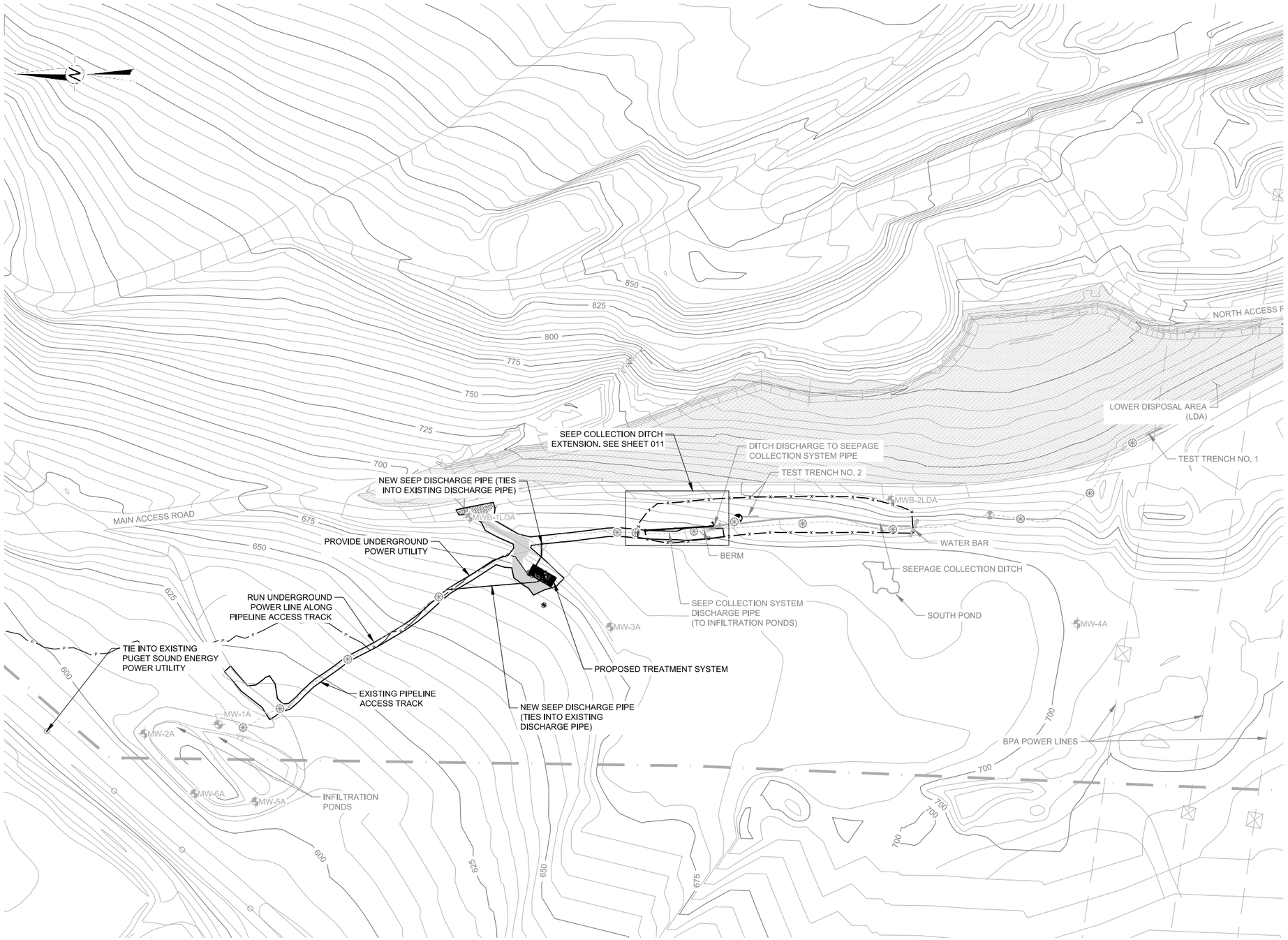

LEGEND

- PROJECT AREA
- PROPOSED UNDERGROUND POWER UTILITY LINE
- EXISTING MONITORING WELL
- EXISTING CLEANOUT

REFERENCE(S)

1. TOPOGRAPHY WITHIN PROJECT AREA, DRAWING "17080 TOPO" PROVIDED BY PLS, INC. DATED 2017-05-16, IN DWG FORMAT.
2. DRAWING COORDINATE SYSTEM: NAD83 WASHINGTON STATE PLANE, NORTH ZONE, US FOOT.
3. BASE TOPOGRAPHY OUTSIDE OF LDA FOOTPRINT PREPARED BY AERO-METRIC, INC., SEATTLE, WA FROM AERIAL PHOTOS FLOWN ON FEBRUARY 10, 2007.
   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET
   VERTICAL DATUM: NDVD 29
   CONTOUR INTERVAL: 5 FT
4. BASE TOPOGRAPHY INSIDE OF LDA FOOTPRINT PREPARED BY PACIFIC GEOMATIC SERVICES, INC., MOUNTLAKE TERRACE, WA FROM FIELD DATA TAKEN ON NOVEMBER 1, 2007.
   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET
   VERTICAL DATUM: NDVD 29
   CONTOUR INTERVAL: 1 FT

AS BUILT

0 100 200
1" = 100' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

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PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
SITE OVERVIEW

PROJECT NO.	PHASE	REV.		SHEET
1520304	400	0	4 of 11	004

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

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LEGEND

- PROJECT AREA
- EXISTING MAJOR AND MINOR SURFACE CONTOURS

REFERENCE(S)

1. TOPOGRAPHY WITHIN PROJECT AREA, DRAWING "17080 TOPO" PROVIDED BY PLS, INC. DATED 2017-05-16, IN DWG FORMAT.
2. DRAWING COORDINATE SYSTEM: NAD83 WASHINGTON STATE PLANE, NORTH ZONE, US FOOT.
3. TOPOGRAPHY OUTSIDE OF PROJECT AREA PREPARED BY AERO-METRIC, INC., SEATTLE, WA FROM AERIAL PHOTOS FLOWN ON FEBRUARY 10, 2007.
   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET
   VERTICAL DATUM: NDVD 29
   CONTOUR INTERVAL: 5 FT

AS BUILT

0 40 80
1" = 40'
FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

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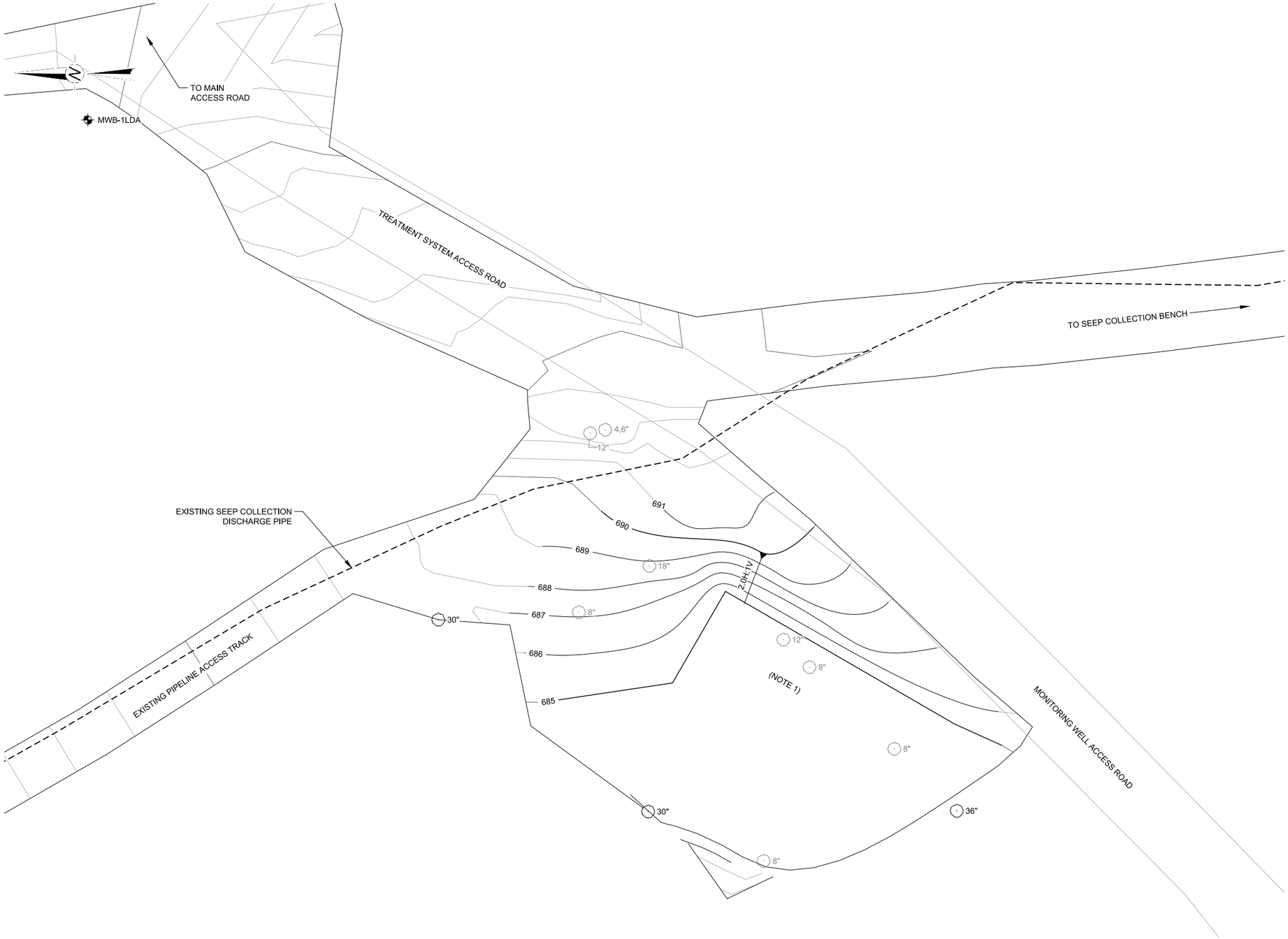
PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
PROJECT AREA TOPOGRAPHIC SURVEY

PROJECT NO.	PHASE	REV.	SHEET
1520304	400	0	5 of 11 005

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 1 in



LEGEND

- EXISTING MONITORING WELL
- EXISTING CLEANOUT
- EXISTING SEEP COLLECTION DISCHARGE PIPE
- EXISTING TREE PLANNED FOR REMOVAL (<24" DIAMETER)
- EXISTING TREE TO BE UNDISTURBED (>24" DIAMETER)
- EXISTING GRADE
- PROPOSED GRADE

CUT/FILL TABLE

METHOD	QUANTITY (YD^3)
CUT	31.380
FILL	77.290
NET	45.91 (FILL)

NOTE(S)

1. EXCAVATION FOR CONCRETE SLAB AND BELOW GRADE CONCRETE VAULT NOT SHOWN OR INCLUDED IN CUT/FILL TABLE.

REFERENCE(S)

1. TOPOGRAPHY WITHIN PROJECT AREA, DRAWING "17080 TOPO" PROVIDED BY PLS, INC. DATED 2017-05-16, IN DWG FORMAT.
2. DRAWING COORDINATE SYSTEM: NAD83 WASHINGTON STATE PLANE, NORTH ZONE, US FOOT.

AS BUILT

0 10 20
1" = 10' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

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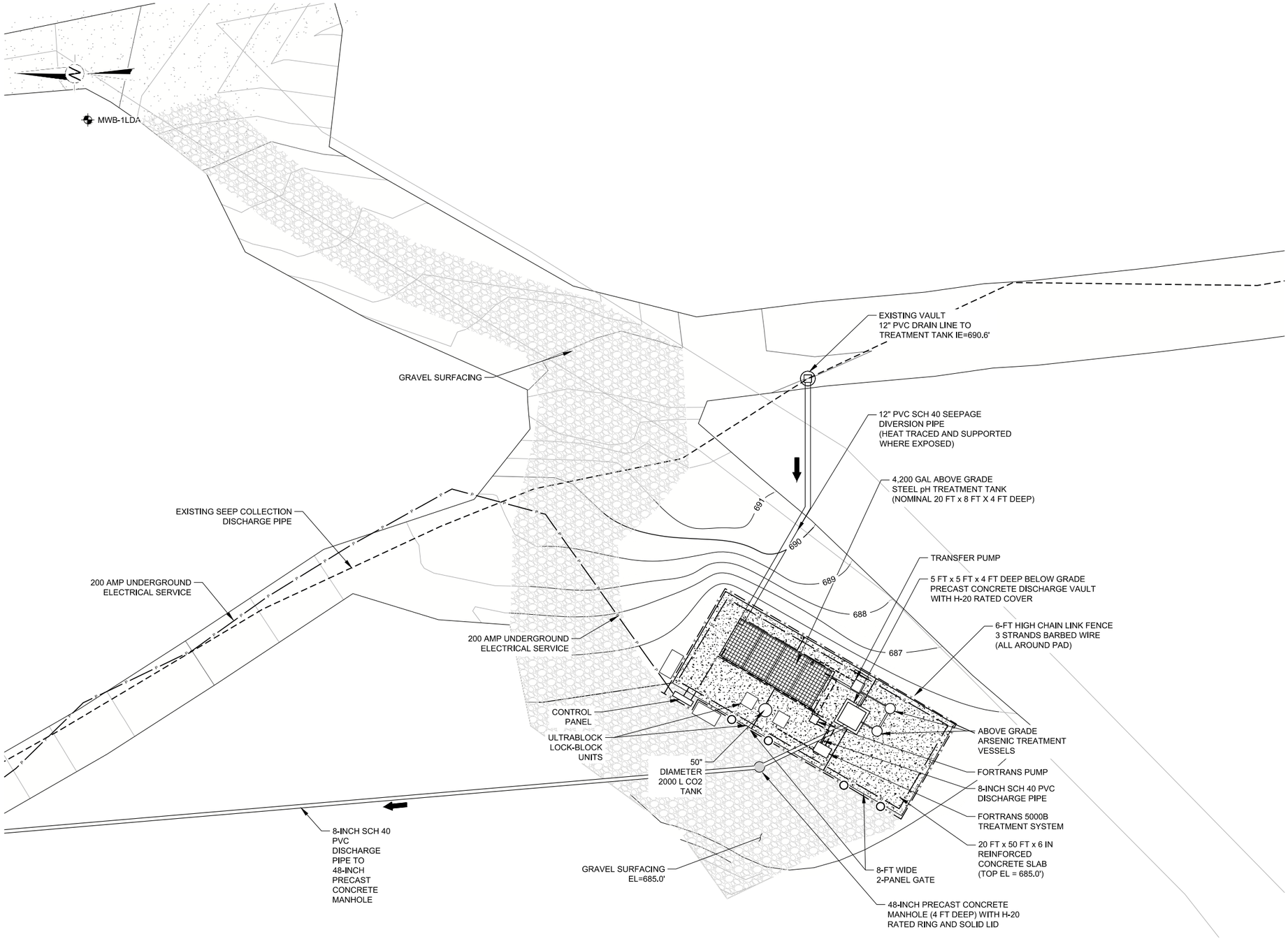
PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
GRADING, CLEARING, AND GRUBBING PLAN

PROJECT NO.	PHASE	REV.	6 of 11	SHEET
1520304	400	0		006



LEGEND

- EXISTING MONITORING WELL
- EXISTING CLEANOUT
- EXISTING SEEP COLLECTION DISCHARGE PIPE
- PROJECT AREA
- POWER UTILITY LINE
- FENCE LINE

NOTE(S)

1. pH TANK OVERFLOW PIPING AND TRANSFER PUMP INLET PIPING OFFSET FOR CLARITY.

REFERENCE(S)

1. TOPOGRAPHY WITHIN PROJECT AREA, DRAWING "17080 TOPO" PROVIDED BY PLS, INC. DATED 2017-05-16, IN DWG FORMAT.
2. DRAWING COORDINATE SYSTEM: NAD83 WASHINGTON STATE PLANE, NORTH ZONE, US FOOT.

AS BUILT

0 10 20
1" = 10' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

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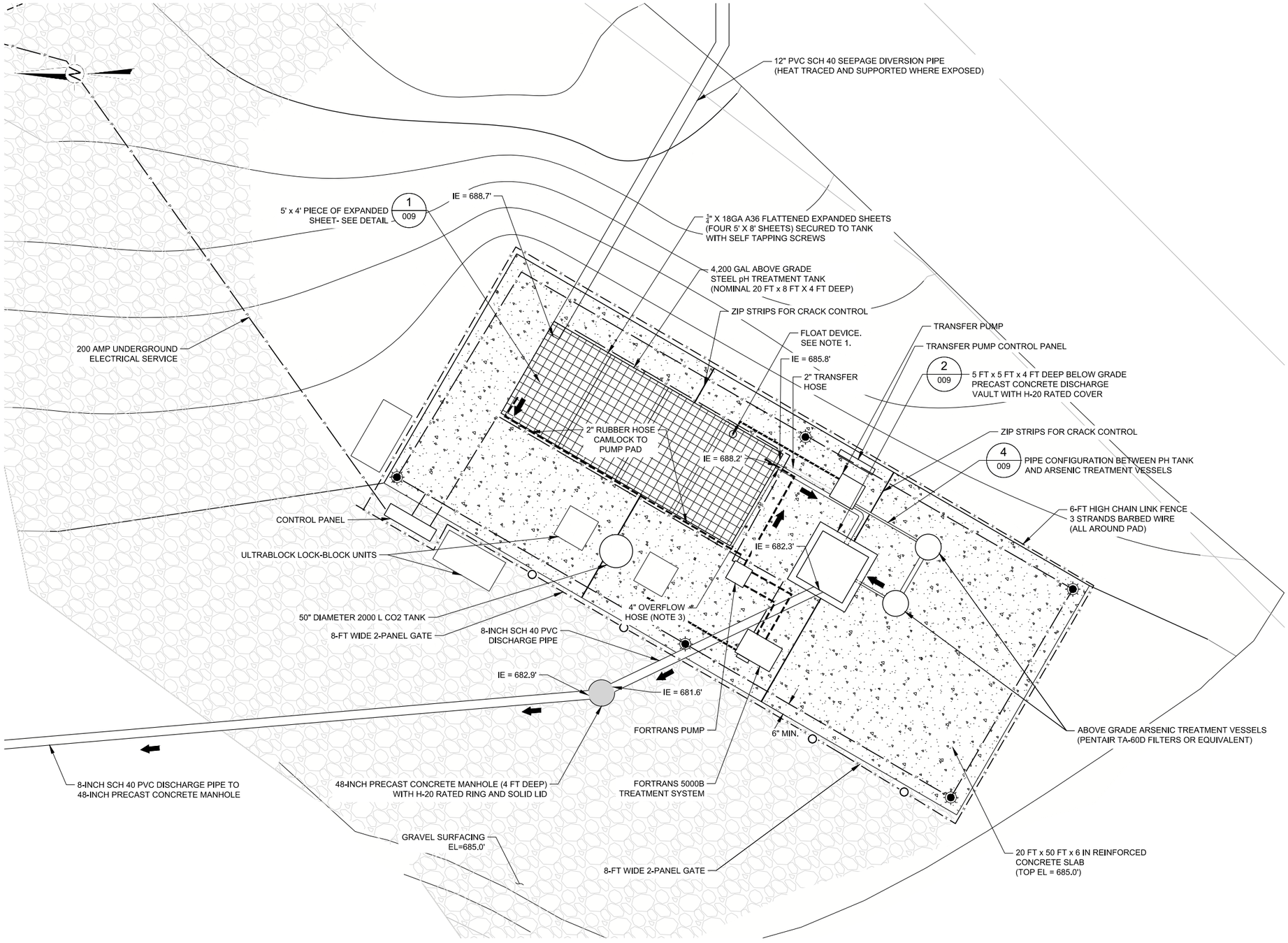
PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
SITE PLAN

PROJECT NO.	PHASE	REV.	SHEET
1520304	400	0	7 of 11 007

0 1in
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D



LEGEND

- POWER UTILITY LINE
- FENCE LINE
- LIGHT POLE LOCATION

NOTE(S)

1. FLOAT DEVICE PROGRAMMED TO START TRANSFER PUMP WHEN WATER LEVEL IN TANK REACHES 3 FEET AND TURNS THE PUMP OFF WHEN WATER LEVEL REACHES 2 FEET.
2. UNDERGROUND UTILITIES AND PIPING SHOWN FOR CLARITY
3. OVERFLOW HOSE AND TRANSFER PIPE OFFSET FOR CLARITY.

REFERENCE(S)

1. TOPOGRAPHY WITHIN PROJECT AREA, DRAWING "17080 TOPO" PROVIDED BY PLS, INC. DATED 2017-05-16, IN DWG FORMAT.
2. DRAWING COORDINATE SYSTEM: NAD83 WASHINGTON STATE PLANE, NORTH ZONE, US FOOT.

AS BUILT

0 4 8
1" = 4' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

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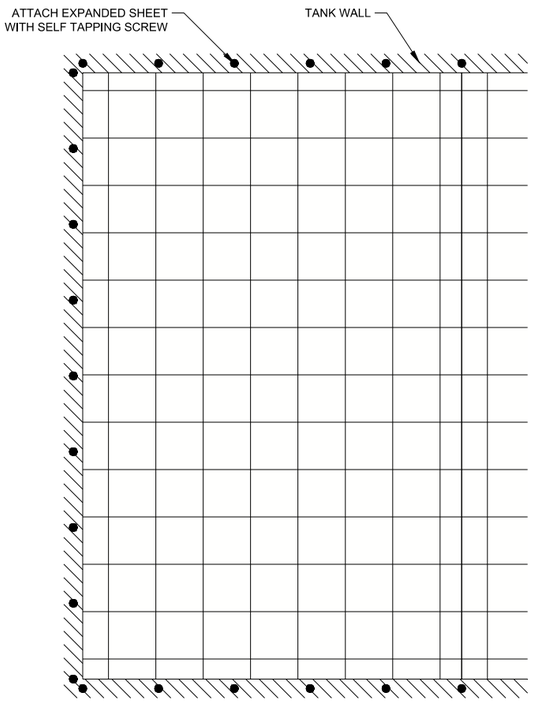
PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
TREATMENT SYSTEM FACILITIES GENERAL LAYOUT

PROJECT NO.	PHASE	REV.	8 of 11	SHEET
1520304	400	0		008

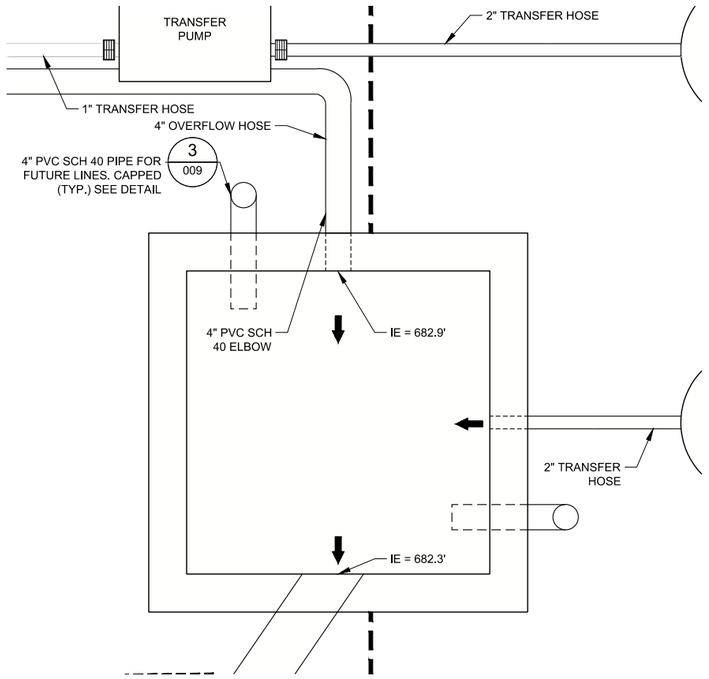
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 1 in



SCALE 1" = 1' 1 009 EXPANDED SHEET DETAIL

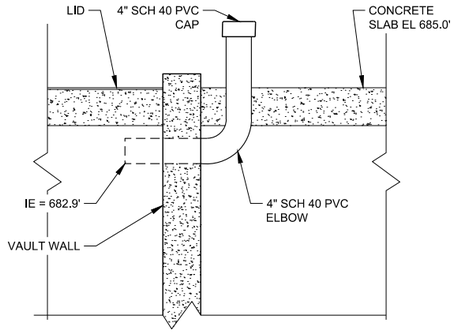
0 1 2
1" = 1' FEET



SCALE 1" = 1' 2 009 PRECAST CONCRETE VAULT - PLAN VIEW

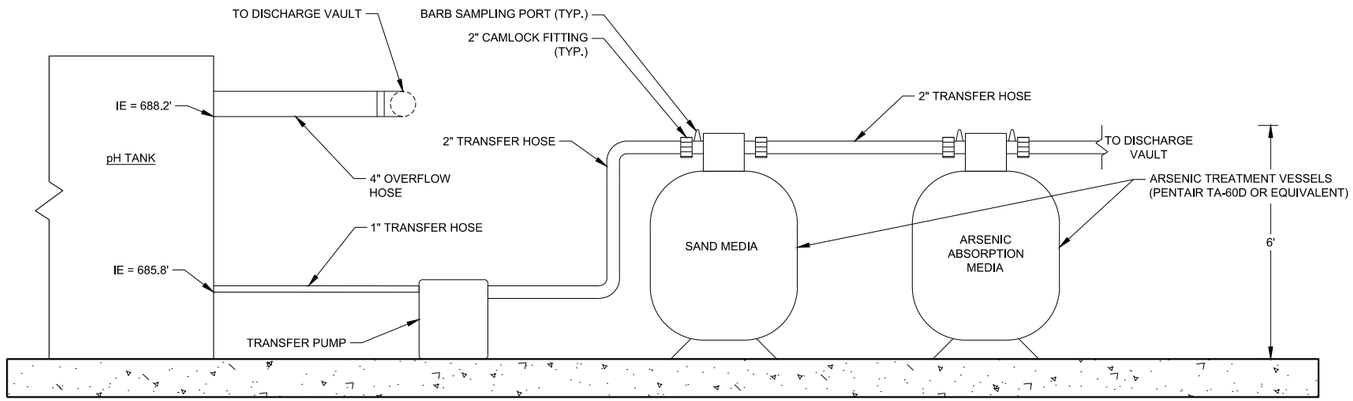
NOTE: OVERFLOW PIPE AND TREATMENT PIPE OFFSET FOR CLARITY.

0 1 2
1" = 1' FEET



SCALE 1" = 1' 3 009 FUTURE VAULT CONNECTIONS - SIDE VIEW

0 1 2
1" = 1' FEET



SCALE N.T.S. 4 009 PIPE CONFIGURATION BETWEEN PH TANK AND ARSENIC TREATMENT VESSELS

NOTE(S)

1. PIPES ABOVE SLAB SURFACE ARE HEAT TRACED AND INSULATED WHERE NECESSARY.

AS BUILT

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

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JING SONG XI — STATE OF WASHINGTON — 54185 — REGISTERED — PROFESSIONAL ENGINEER

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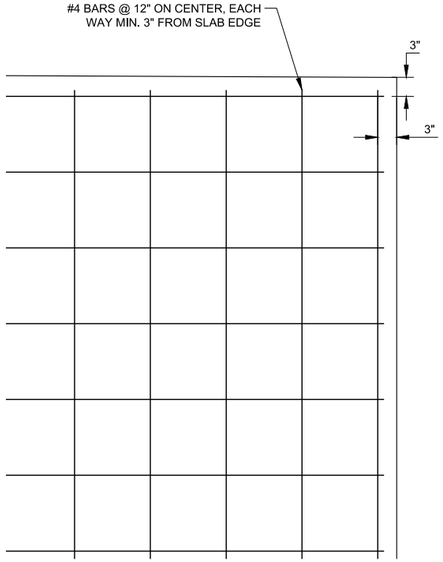
PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
DETAILS I

PROJECT NO.	PHASE	REV.		SHEET
1520304	400	0	9 of 11	009

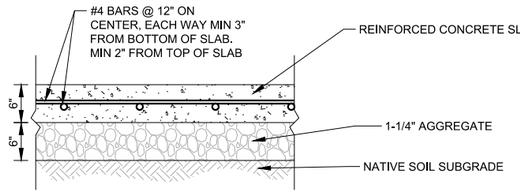
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 1 in



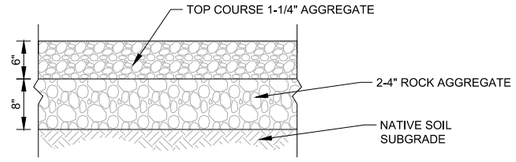
SCALE 1" = 1' (1 / 010) CONCRETE REINFORCEMENT (TYP. PLAN VIEW)

0 1 2
1" = 1' FEET



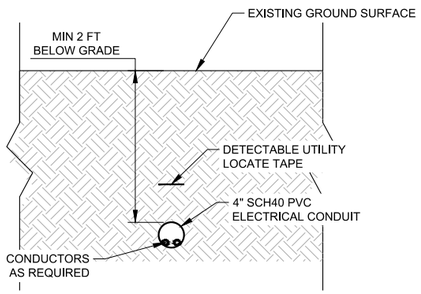
SCALE 1" = 1' (2 / 010) TREATMENT SYSTEM SLAB (TYP. SECTION VIEW)

0 1 2
1" = 1' FEET



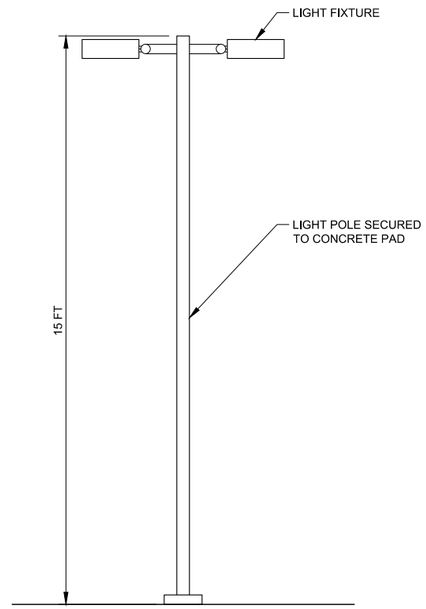
SCALE 1" = 1' (3 / 010) GRAVEL ACCESS ROAD AND PARKING AREA (TYP. SECTION VIEW)

0 1 2
1" = 1' FEET



SCALE 1" = 1' (4 / 010) UNDERGROUND ELECTRICAL SERVICE LINE (TYP. SECTION VIEW)

0 1 2
1" = 1' FEET



SCALE 1" = 2' (5 / 010) LIGHT POLES AND FIXTURES (TYP. ELEVATION VIEW)

0 2 4
1" = 2' FEET

AS BUILT

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

SEAL

JING SONG XU — STATE OF WASHINGTON — 54785 — REGISTERED PROFESSIONAL ENGINEER

CLIENT
HOLCIM (US) INC.

CONSULTANT
GOLDER

REDMOND OFFICE
18300 NE UNION HILL RD #200
REDMOND, WA
USA
[+1] (425) 883-0777
www.golder.com

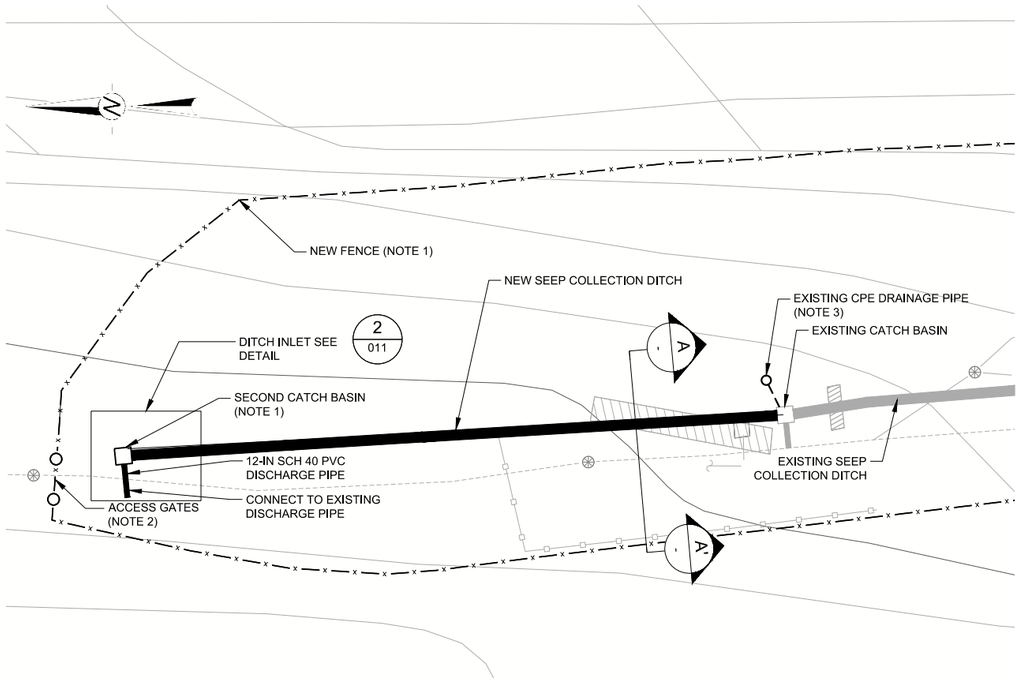
PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
DETAILS II

PROJECT NO.	PHASE	REV.	10 of 11	SHEET
1520304	400	0		010

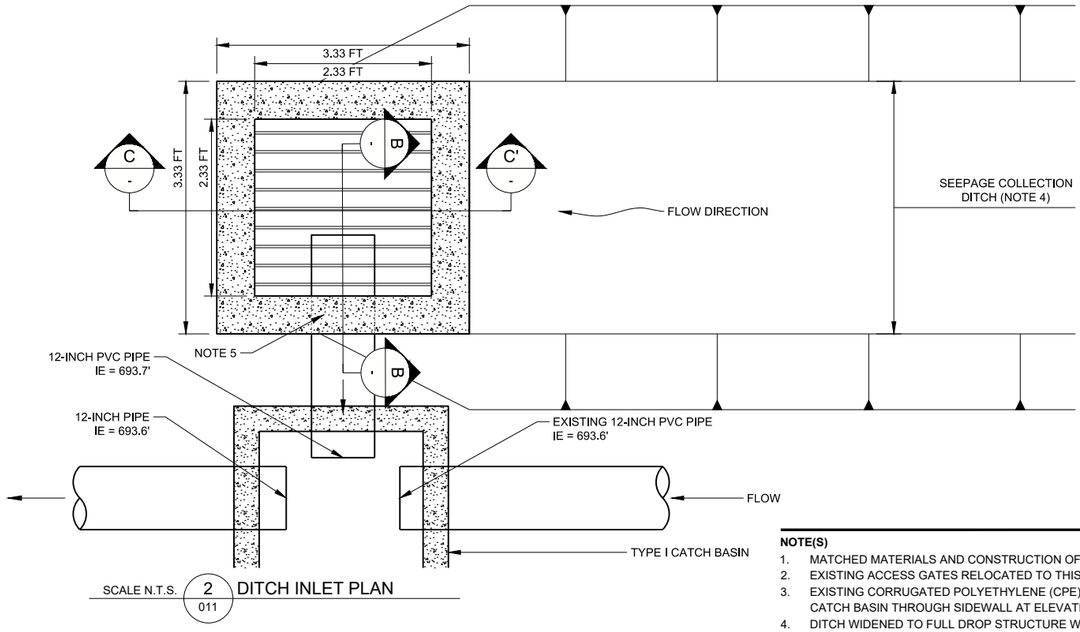
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 1 in



SCALE 1" = 15' 1/011 SEEPAGE DITCH EXTENSION OVERVIEW

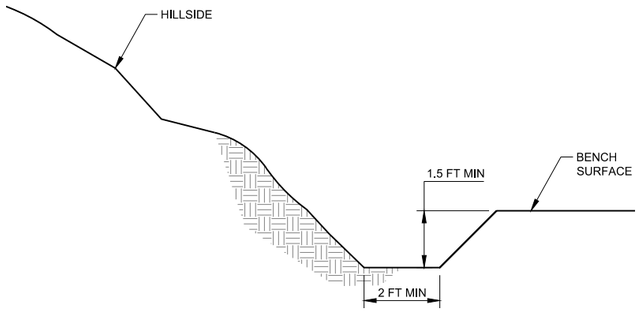
0 15 30
1" = 15' FEET



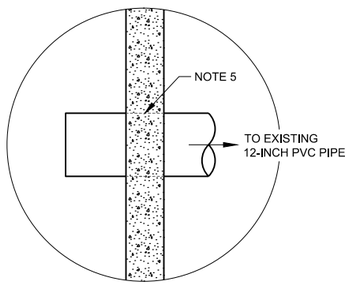
SCALE N.T.S. 2/011 DITCH INLET PLAN

NOTE(S)

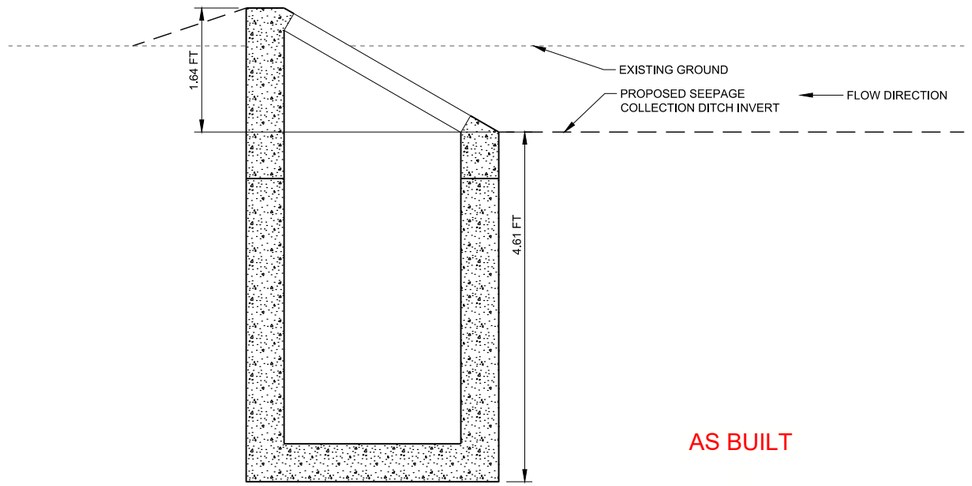
1. MATCHED MATERIALS AND CONSTRUCTION OF EXISTING FENCE.
2. EXISTING ACCESS GATES RELOCATED TO THIS LOCATION.
3. EXISTING CORRUGATED POLYETHYLENE (CPE) DRAIN PIPE ROUTED INTO EXISTING CATCH BASIN THROUGH SIDEWALL AT ELEVATION TO PROVIDE GRAVITY DRAINAGE.
4. DITCH WIDENED TO FULL DROP STRUCTURE WIDTH WITHIN 8-FEET OF DROP STRUCTURE.
5. OUTLET PIPE AND DITCH INLET STRUCTURE SEALED WITH HIGH-EARLY STRENGTH CEMENT MORTAR.



SCALE N.T.S. A/011 TYPICAL DITCH SECTION



SCALE N.T.S. B/011 DROP STRUCTURE INLET SECTION



SCALE 1" = 1' C/011 DITCH INLET SECTION

0 1 2
1" = 1' FEET

AS BUILT

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-03-16	AS-BUILT	JX	THR	JX	FSS
0	2017-10-03	ISSUED FOR CONSTRUCTION	JX	THR	JX	FSS

SEAL

CLIENT
HOLCIM (US) INC.

CONSULTANT
GOLDER

REDMOND OFFICE
18300 NE UNION HILL RD #200
REDMOND, WA
USA
[+1] (425) 883-0777
www.golder.com

PROJECT
SEEPAGE WATER TREATMENT SYSTEM
RAVENSDALE, WA

TITLE
DETAILS III

PROJECT NO.	PHASE	REV.	11 of 11	SHEET
1520304	400	0		011

APPENDIX B

Inspection and Maintenance Checklists

Inspection and Sampling Checklist **v. 4/30/2021**

Date	**Time**
Weather/Temp	**Inspector**
Frequency (Bi-weekly, Monthly, or Quarterly)	

System Checks	YES	NO	If NO, provide explanation
Fortrans Alarms not Triggered?			
pH Tank not Overflowing into Overflow Port?			
pH Tank Pump Circulating?			
pH Tank Influent Flowing?			
Discharge Vault pH OK?			

System Maintenance	Comments
Clean scale off Fortrans and Discharge Vault pH probes w/ 10% nitric acid (BW)	
Clear out filter basket of debris (BW) - not required if replacing pool filter basket	
Calibrate Fortrans pH probe (BW)	pH 7 mA: pH 4 mA:
Calibrate Discharge Vault pH probe (BW)	
Replace Pool Filter Basket (M)	
Backwash sand and arsenic filter vessels (M)	
Sweep Pad/Blow Leaves (M)	
Check Vaults for Buildup (M)	
Replace Pool Pump (Q)	
Replace Transfer Pump (Q)	
Clean out sand and Bayoxide filters, replace media (Q)	

Complete (BW) items bi-weekly, (M) + (BW) items monthly, and (Q) + (M) + (BW) items quarterly.

System Parameters	Location	Reading
Fortrans pH (should be 7.5-8.0)	Fortrans panel	
Fortrans CO2 Flow Meter Reading (should be ~150 during sparging)	Fortrans panel	
Tank pH (check with pH meter or pH strip)	-	
Discharge Vault pH	+GF+ panel	
Discharge Vault pH (check with pH meter or pH strip)	-	
Influent Flow Rate	pH Tank Influent	
EchoFlo Measurement	EchoFlo Panel	
Influent pH (check with pH meter or pH strip)	pH Tank Influent	
CO2 Tank Inches Head (should be >30)	CO2 Telemetry	
CO2 Tank Pressure (~300 psi)	CO2 Meter 1	
CO2 Tank Regulated Pressure (~25-30 psi)	CO2 Meter 2	
CO2 Tank inches H2O differential	CO2 Meter 3	

Signature _____

Arsenic Treatment Vessel Sampling

Sample ID	Sample Date/Time	pH Check (<2)	Sample Parameters
Tank-Influent			
Tank-Effluent			
Sand-Effluent			
As1-Effluent			
As2-Effluent			

-Add nitric acid using disposable pipettes to preserve samples and check using litmus strips that pH <2.
-Add under Notes Section in Lab COC:
"Report to MDL; Client-Specific EDD; As MDL 0.00076 mg/L; Analyze in accordance with MSA between ARI and Golder"

Other Notes/Comments/Calibration

Signature _____

Inspection and Sampling Checklist **v. 12/16/2019**

Date	**Time**
Weather/Temp	**Inspector**
Frequency (Bi-weekly, Monthly, or Quarterly)	

System Checks	**YES**	**NO**	**If NO, provide explanation**
Fortrans Alarms not Triggered?			
pH Tank not Overflowing into Overflow Port?			
pH Tank Pump Circulating?			
pH Tank Influent Flowing?			
Discharge Vault pH OK?			

System Maintenance	**Comments**
Clean scale off Fortrans and Discharge Vault pH probes w/ 10% nitric acid (BW)	
Clear out filter basket of debris (BW) - not required if replacing pool filter basket	
Calibrate Fortrans pH probe (BW)	pH 7 mA: pH 4 mA:
Calibrate Discharge Vault pH probe (BW)	
Replace Pool Filter Basket (M)	
Backwash sand and arsenic filter vessels (M)	
Sweep Pad/Blow Leaves (M)	
Loosen Scale in Hoses using Mallet (Q)	
Replace Pool Pump (Q)	
Replace Transfer Pump (Q)	
Clean out sand and Bayoxide filters, replace media (Q)	

Complete (BW) items bi-weekly, (M) + (BW) items monthly, and (Q) + (M) + (BW) items quarterly.

System Parameters	**Location**	**Reading**
Fortrans pH (should be 7.5-8.0)	Fortrans panel	
Fortrans CO2 Flow Meter Reading (should be ~150 during sparging)	Fortrans panel	
Tank pH (check with pH meter or pH strip)	-	
Discharge Vault pH	+GF+ panel	
Discharge Vault pH (check with pH meter or pH strip)	-	
Influent Flow Rate	pH Tank Influent	
Influent pH (check with pH meter or pH strip)	pH Tank Influent	
CO2 Tank Inches Head (should be >30)	CO2 Telemetry	
CO2 Tank Pressure (~300 psi)	CO2 Meter 1	
CO2 Tank Regulated Pressure (~25-30 psi)	CO2 Meter 2	
CO2 Tank inches H2O differential	CO2 Meter 3	

Signature _____

Arsenic Treatment Vessel Sampling

Sample ID	Sample Date/Time	pH Check (<2)	Sample Parameters
Tank-Influent			
Tank-Effluent			
Sand-Effluent			
As1-Effluent			
As2-Effluent			

-Add nitric acid using disposable pipettes to preserve samples and check using litmus strips that pH <2.
-Add under Notes Section in Lab COC:
"Report to MDL; Client-Specific EDD; As MDL 0.00076 mg/L; Analyze in accordance with MSA between ARI and Golder"

Other Notes/Comments/Calibration

Signature _____

APPENDIX C

O&M Health and Safety Plan

Health Safety And Environment Plan

A world of capabilities delivered locally

RAVENSDALE SITE

CO2 SYSTEM OPERATIONS AND MAINTENANCE

Site Address: Holcim Ravensdale
28130 BLACK DIAMOND-RAVENSDALE RD SE
RAVENSDALE, WA 98051

Submitted By: Golder Associates Inc.

Revision v1

Date: February 4, 2019 **Project No.1520304**

1.0 CONTACTS LIST SUMMARY

1.1 Emergency Contacts

Contact	Number
Ambulance	911
Fire	911
Police	911
Crisis Response Hotline (Outside Canada)	(403) 775-1041
Crisis Response Hotline (Within Canada)	(866) 249-0439
Golder National Health, Safety, Security, and Environment Advisor - Renee Weaver	(336) 707-3869
Human Resources-Local	Jamie Gunn (425) 883-0777
International SOS, Member ID: 11BYCA084630	+1-215-942-8226 (Philadelphia)
Local Electrical Authority - PSE	888-225-5773 Power Outages & Gas Leaks
Local Gas Authority - PSE	800-424-5555 Underground Utilities Locating
Local Telecom Authority	800-424-5555 Buried Cable- CenturyLink
Local Water Authority	253-631-0565 Covington Water District
Media Relations (Golder) - Tina Marano	1-647-402-3596
Roadside Assistance	
Spills Reporting	
WorkCare	(888) 449-7787

Hospital name	Address	Phone	Level of Care Available
Covington Multicare Medical Center	17700 S.E. 272nd St. Covington, WA 98042	253-372-7400	Emergency Room

1.2 Golder Contacts

	Name	Office Name	Office	Cell
Project Manager	Gary Zimmerman	Redmond	+1 (425) 883-0777 x52621	+1 425-753-4903
Project Director	Frank Shuri	Redmond	+1 (425) 883-0777 x52604	+1 206 799-8582
Field Lead	Jing Song Xi	Redmond	+1 (425) 883-0777	+1 (832) 416 3888
Field Staff	Ted Norton	Redmond	+1 (425) 883-0777	+1 (206) 755-4970
Field Staff	Vanessa Nancarrow	Redmond	+1 (425) 883-0777	+1 (206) 601-8946
Field Staff	Joseph Mitzel	Redmond	+1 (425) 883-0777	+1 (406) 240-4178
Field Staff	Joe Miller	Redmond	+1 (425) 883-0777	+1 (513) 602-1619
Field Staff	Reno Gregory	Redmond	+1 (425) 883-0777	+1 (805) 813-9346
Client	Holcim US			

1.3 Missed Check-in Contacts

	Name	Phone	Cell
Project Manager	Gary Zimmerman	+1 (425) 883-0777 x52621	+1 425-753-4903
Project Director	Frank Shuri	+1 (425) 883-0777 x52604	+1 206 799-8582

1.4 Client and Site Contacts

	Number
Site field cell phone	832-416-3888

Nearest Golder office	USA - Redmond
Phone	+1 (425) 883-0777
Fax	+1 (425) 882-5498
Email	

Role	Name	Number
Contact person on site	Jing Song Xi	Office: +1 (425) 883-0777 Cell: +1 (832) 416 3888
	Ted Norton	+1 (206) 755-4970
	Reno Gregory	+1 (805) 813-9346
	Joseph Mitzel	+1 (406) 240-4178
Client safety contact	Travis Bennett	(580) 421-2057
Company Golder reports to	Holcim US	
Company reporting to Golder	IO Environment & Infrastructure	See subcontractor details
Golder overall site supervisor and alternate:	Jing Song Xi	Office: +1 (425) 883-0777 Cell: +1 (832) 416 3888
Reserve Silica Contact	Fred White	Cell: 253-324-1474
Reserve Silica Contact	Dean	Cell: 253-632-2493

1.5 Subcontractor Contacts

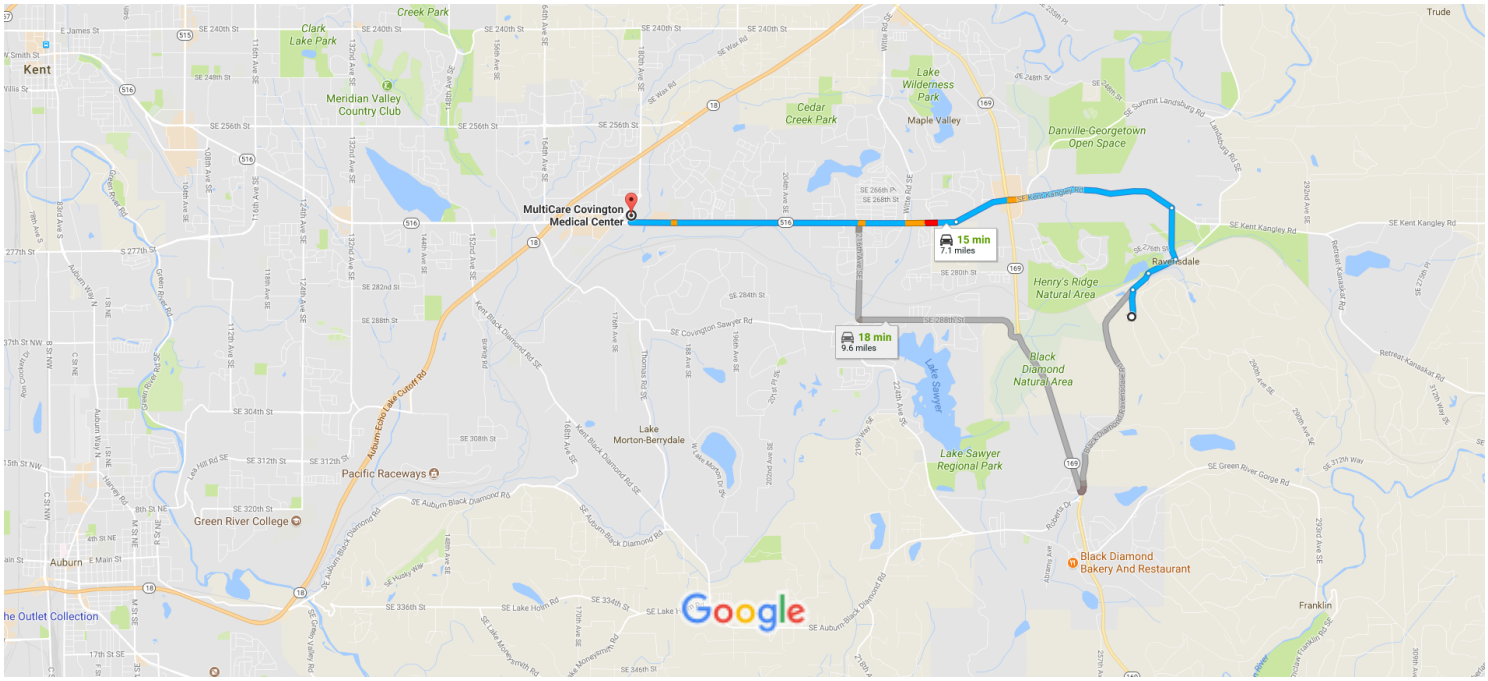
Name	Subcontractor key staff	Phone
IO Environmental & Infrastructure	Brad Coury	425-497-9896 425-686-0823
IO Environmental & Infrastructure	Scot Overdick	425-497-9896 425-417-5344
IO Environmental & Infrastructure	Michael Browne	425-582-1479

You have the right to refuse any work you feel is unsafe, or that you are not trained to do. Choose to work safely and in compliance with all HSE requirements.

Google Maps

47.344096, -121.993555 to MultiCare Covington Medical Center

Drive 7.1 miles, 15 min



Map data ©2017 Google United States 2000 ft

47.344096, -121.993555

1. Head north toward Black Diamond Ravensdale Rd — 0.3 mi
2. Turn right onto Black Diamond Ravensdale Rd — 0.2 mi
3. Continue onto SE Ravensdale Way — 0.3 mi
4. Turn left onto 268th Ave SE — 0.5 mi
5. Turn left onto SE Kent Kangley Rd — 2.4 mi
6. Continue onto SE 272nd St — 3.4 mi

MultiCare Covington Medical Center

17700 SE 272nd St, Covington, WA 98042

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

It is company policy to complete a HaSEP form including a task-based Health, Safety and Environment (HSE) risk assessment for every project that includes site work, working alone or international travel.

To get an updated table of contents, please right-click the table of contents below and choose 'Update Field'

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2.0 PROJECT PROPOSAL DETAILS

Project/Proposal Number	1520304	**Start Date**	Oct 19, 2018	**End Date**	Indefinite
Project Title	Holcim Ravensdale Site CO2 System Operations and Maintenance				
Client Name	Holcim US				

Brief description of project and scope of works (include any hazardous activities, if known)

Provide regular inspection and maintenance for high pH water treatment system. The site is an active inert waste landfill, but the work will take place on a relatively undisturbed portion of the site, away from the active face. The system treats high pH water with CO2 super saturation and run treated water through an iron filter media vessel before diverting it to the settlement ponds.

Except for routine maintenance completed weekly, A JSEA is completed prior to work commencing.

Bring 2-3 gallons of potable water with you when you conduct site visits. If high pH water comes into contact with personnel, the free liquid should be removed immediately with paper towel, clean towel or other absorbent material and the area should then be thoroughly rinsed with the potable water.

O&M work at the site can require various tasks that may not be specifically referenced in this HASP. Prior to any work being completed, formulate a plan that evaluates the potential risks for these new tasks and the precautions and mitigation measures to address those risks. Communicate the assessment to the PM before starting the new tasks.

The steel cover to the discharge vault is opened to allow work to occur within the vault (e.g. calibrating pH probe). No entry into the vault is to be conducted. This cover will be closed when active work is not occurring in association with the vault to avoid accidentally stepping/falling into the discharge vault.

3.0 GOLDER TEAM

Name	Office	Contact number (cell phone)	Office Phone	Role
Jing Song Xi	Redmond	+1 (832) 416 3888	+1 (425) 883-0777	Field Lead
Joseph Mitzel	Redmond	+1 (425) 883-0777	+1 (406) 240-4178	Field Staff
Ted Norton	Redmond	+1 (206) 755-4970	+1 (425) 883-0777	Field Staff
Reno Gregory	Redmond	+1 (805) 813-9346	+1 (425) 883-0777	Field Staff

Project Manager (PM)

- Appoint a competent site supervisor and alternate. For sites with multiple Golder projects/disciplines at work, coordinate with the overall site supervisor
- Oversee/develop hazard controls including work instructions and
- Assign only adequately trained and competent employees to the project

Site Supervisor

- The site supervisor is responsible for the safety of all Golder employees, subcontractors, visitors and public on the parts of the site under Golder control.
- Communicate all site hazards to affected parties, in real time, as hazards, conditions and employees change.
- Ensure that work is undertaken in accordance with the hazard controls included in this HaSEP.

Contractor

- All plant and equipment is maintained in a safe working condition

- All plant and equipment are to be registered/licensed and electrical equipment tagged and tested
- Potential hazards are to be controlled (e.g., cage over rotating parts)
- You will report any identified hazards to the Golder Associates field staff member

Field Staff

- Inspect your worksite and equipment before starting work
- Apply the controls outlined in this HaSEP
- Look out for the safety of yourself and others
- Report unsafe acts, conditions and incidents to the site supervisor

4.0 CLIENT/SITE LOCATION DETAILS

4.1 Client/Site Location Details

Project location map (paste URL here)	**https://goo.gl/maps/2EFnQGoSdN12**

4.1.1 *Site Description*

If the project is near another Golder Office, has the local Office been notified of the work? ☐Yes ☒No

Site Name	Holcim Ravensdale			
Address	28130 BLACK DIAMOND-RAVENSDALE RD SE 98051			
Coordinates	47.34409,-121.99355			
Description	Operating inert waste disposal facility.			
Access info	Provided by client under access agreement with landowner, Reserve Silica			
Previous land uses	Landfill with disposed Cement Kiln Dust			
Site Receptors that maybe impacted by the proposed work				
Additional Info	Contact Reserve Silica if there is an injury on site and 911 must be called. Also contact Reserve Silica if the main gate is locked and we require a key to access the site. Contact Dean (site operator) at 253-632-2493 and Fred White (site manager) at 253-324-1474. Dean and Fred are usually working at or around the site from 7am-3pm.			
HSE Induction / orientation provider	☒Golder	☐Client	☒Contractor	
Site Contact Numbers	**Field cell phone**	832-416-3888	**Satellite phone**	
	Other			
Nearest Golder office	USA - Redmond	**Address**	18300 NE Union Hill Road, Suite 200, Redmond, Washington, USA 98052	
Opening days and hours		**Email**	**Error! Hyperlink reference not valid.**	
Phone	+1 (425) 883-0777	**Fax**	+1 (425) 882-5498	
Google Maps				

5.0 SUBCONTRACTOR DETAILS

Has Golder been assigned the role of Principal Contractor? * ☒Yes ☐No

Name	Subcontractor key staff	Phone	Subcontractor activities	Risk Assessment Supplied	Method Statement Supplied	Approved Golder subcontractor?
IO Environmental & Infrastructure	Brad Coury	425-497-9896 425-686-0823	Field Supervisor	☐	☐	IO contracting with Holcim directly
IO Environmental & Infrastructure	Scot Overdick	425-497-9896 425-417-5344	Field Supervisor	☐	☐	IO contracting with Holcim directly
IO Environmental & Infrastructure	Michael Browne	425-582-1479	Field Supervisor	☐	☐	IO contracting with Holcim directly

5.1 Welfare / Hygiene Facilities

The following issues should be considered when planning welfare provision including: the work to be carried out; the associated health risks; duration and number of different locations; number of people working at different locations and distances from welfare facilities.
Describe the project's welfare facilities below:

Facility	Yes	No	Describe alternate arrangements:
Toilets available?	☒	☐	Portable toilet available downhill across the road at Reserve Silica Office
Rest areas available?	☐	☒	Field Vehicle
Washing facilities available?	☐	☒	
Drinking water available?	☐	☒	Supply own bottled water. Bring additional 2-3 gallons of potable water to wash off any high pH water that may come into contact with your skin.
Area for changing and storing clothes available?	☐	☒	Field Vehicle
Mode of transportation to site available?	☒	☐	
Smoking permitted on site?	☐	☒	

6.0 CHECK-IN SYSTEM

6.1 Check-in contacts

	Primary	Secondary
Name	Gary Zimmerman	Frank Shuri
Phone/Email	Office: +1 (425) 883-0777 x52621 Cell: +1 425-753-4903 Email: Gary_Zimmerman@golder.com	Office: +1 (425) 883-0777 x52604 Cell: +1 206 799-8582 Email: Frank_Shuri@golder.com
Check-in frequency*	once on site and once leaving site	once on site and once leaving site
By phone	☐	☐
By email	☐	☐
By SMS	☒	☒
On site	☐	☐

6.2 Missed Check-in Procedure

Within 2 hours of missed check-in time:

1. Attempt to contact employee
2. Contact accommodation or other project personnel to determine last contact with employee
3. Notify Project Manager.
4. Project manager to determine timing of further action, based on project details.

Within 4 hours of scheduled call-in time:

1. Contact client and request assistance to locate employee.
2. Notify Project Director, Office Manager, and local authorities (as appropriate)
3. Initiate Crisis Response Plan (as appropriate)

☐Does missed check-in procedure for this project deviate from the standard procedure?

7.0 CHEMICALS AND CONTAMINANTS

☒Hazardous substances likely to be used during this project and/or present at the site.

Spill kit available to manage potential spills? ☐Yes ☐No

7.1 Chemicals (Hazardous Substances)

Chemical Name	high pH seep water (pH>10)	**SDS Available** ☐
Exposure routes	**Exposure Controls**	**First Aid Measures**
Inhalation	No inhalation exposure	
Skin contact	wear gloves when working around seepage water to prevent contact with skin. If excessive potential contact is anticipated, wear Tyvek coveralls.	Wash off with water. Remove contaminated clothing and wash before reuse. Obtain medical attention if irritation persists.
Skin Absorption	wear gloves when working around seepage water to prevent contact with skin. If excessive potential contact is anticipated, wear Tyvek coveralls.	Wash off with water. Remove contaminated clothing and wash before reuse. Obtain medical attention if irritation persists.
Eye contact	wear splash goggles when working around seepage water to prevent contact with eyes	Flush eyes with large amounts of water for at least 15 mins. Obtain medical attention if irritation persists.
Ingestion	Do not smoke or eat if there is potential to be in contact with seep water pipes to prevent accidental ingestion.	Obtain immediate medical attention.
Injection or Puncture	No injection/puncture exposure.	
Additional Info		

Chemical Name	Cement Kiln Dust	**SDS Available** ☒
Exposure routes	**Exposure Controls**	**First Aid Measures**
Inhalation	Be aware that CKD may be buried in excavation areas and stay upwind of excavation area. Notify supervisor immediately if CKD is exposed.	Move person to fresh air. Seek medical attention for discomfort or if coughing or other symptoms do not subside.
Skin contact	wear gloves and tyvek coveralls when working in areas where exposure to CKD may be possible to prevent contact with skin	Wash with cool water and a pH neutral soap or mild skin detergent. Seek medical attention for rashes, burns, irritation, dermatitis, and prolonged unprotected exposures to wet CKD.

Chemical Name	Cement Kiln Dust	**SDS Available** ☒
Exposure routes	**Exposure Controls**	**First Aid Measures**
Skin Absorption	wear gloves and tyvek coveralls when working in areas where exposure to CKD may be possible to prevent contact with skin	Wash with cool water and a pH neutral soap or mild skin detergent. Seek medical attention for rashes, burns, irritation, dermatitis, and prolonged unprotected exposures to wet CKD.
Eye contact	wear splash goggles or faceshield when working in areas where CKD exposure may be possible.	Flush eyes with large amounts of water for at least 15 mins. Obtain medical attention if irritation persists.
Ingestion	Do not smoke or eat if there is potential to be in contact with seep water pipes to prevent accidental ingestion.	Obtain immediate medical attention.
Injection or Puncture	No injection/puncture exposure.	
Additional Info	Silicosis may be possible if exposure to CKD dust is persistent, or if exposed to large amounts of CKD dust at one time. Seek medical attention immediately if individual may be affected with silicosis. Refer to SDS for additional information to physician.	

8.0 RISK REGISTER

8.1 Risk Register

Header key:

- PA: Persons Affected
- IC: Initial Consequence
- IL: Initial Likelihood
- IR: Initial Risk
- RC: Residual Consequence
- RL: Residual Likelihood
- RR: Residual Risk
- AC: Additional controls

Risk Group	Initial Risk	Hazard	PA	IC	IL	IR	Controls	RC	RL	RR	AC
General	Waste Management	Waste Management	Golder Employee	4	2	8	Where appropriate, containers shall be provided for the collection and separation of waste, trash, oily and used rags, and other refuse. Containers used for garbage and other oily, flammable, or hazardous wastes, such as caustics, acids, harmful dusts, etc. shall be equipped with covers.	3	2	6	

Risk Group	Initial Risk	Hazard	PA	IC	IL	IR	Controls	RC	RL	RR	AC
General	Driving Vehicle (Personal)	Driving Vehicle (Personal)	Golder Employee	4	2	8	Follow Motor Vehicles and Driving on Company Business SWP24. Drivers will have a current driving license and appropriate insurance. Maintain vehicle in a roadworthy condition. Ensure any signs, stickers, or labels are affixed in such a manner that they do not obstruct the driver's vision or impede the driver's use of any controls. The driver should be fit to drive. Adhere to highway regulations and follow speed limits. Do not use any electronic devices while driving. Do not drive in adverse weather or when fatigued. Check weather and routes before departure. Conduct a pre-use inspection of the vehicle including fluid levels. Carry extra windshield washer fluid if expecting to enter a dirty road area. Equip vehicle used for on-site work with fire extinguisher and first aid kit.	2	2	4	
General	General Safety Precautions	Electrocution	Golder Employee	5	3	15	Follow Golder's Electrical Safety Program HSE204. Never work on energized equipment. Know and understand Golder's lock out/tag out (LOTO) procedures. Always de-energize and LOTO before conducting repairs or maintenance. Working on energized equipment can only be done in rare circumstances and only by trained and qualified workers, working per an approved procedure. Use qualified electricians when electrical work is required. PPE for electrical work includes: voltage rated gloves, arc flash clothing, face protection, and rubber mats.	3	1	3	

Risk Group	Initial Risk	Hazard	PA	IC	IL	IR	Controls	RC	RL	RR	AC
General	Pinch Points	Crush or Caught Between	Golder Employee	4	3	12	If required to work near equipment you must eliminate or guard if possible and clearly identify pinch points. Train all workers in the area about the pinch points and guards that are in use. Do not wear loose clothing, jewelry, or have loose hair around moving equipment with pinch points.	3	2	6	
General	Working on or Near Energized Equipment	Electrocution	Golder Employee	5	4	20	Working on live circuits means actually touching energized parts. Working near live circuits means working close enough to energized parts to pose a risk of electrocution, arc flash, or arc-blast even though the task is conducted on de-energized parts. ONLY a qualified electrician is allowed to work on energized circuits. If employees need to work near energized equipment, a written plan must be developed and task-specific training must be conducted to mitigate the hazards.	5	2	10	
General	Operating a Vehicle	Operating a Vehicle	Golder Employee	4	3	12	Comply with the Fitness for Duty and Fatigue SWP27. Employees will not operate a vehicle or mobile equipment if fatigued. Employees shall not drive if the work period has exceeded 14 hours. Travel to and from the work site may be considered part of the working hours. Arrange for accommodation close to the work location to limit travel time.	3	2	6	

Risk Group	Initial Risk	Hazard	PA	IC	IL	IR	Controls	RC	RL	RR	AC
General	Undertaking Work Without Adequate Rest	Undertaking Work Without Adequate Rest	Golder Employee	4	3	12	Identify hours of work and comply with the Fitness for Duty and Fatigue SWP27. There should be a minimum of one 30 minute break in each 8 hour work period or part thereof. If a period of 12 hours has been worked, an employee is required to ensure that a break away from work of at least 8 hours is taken prior to returning to work. Non-work activities must allow for sufficient rest.	3	2	6	
General	Working Abnormal Shifts	Working Without Adequate Rest	Golder Employee	4	3	12	Comply with the Fitness for Duty and Fatigue SWP27. Conduct a fatigue assessment prior to starting the project. Schedule work during daylight hours, if possible. If the project requires night work, modify the task to give people the opportunity for adequate rest between night shifts and time to acclimate. Avoid switching shifts during your rotation (i.e., stay on night shift or day shift) to allow your body to adjust to the working hours.	3	2	6	
General	Working Long Hours	Working Without Adequate Rest	Golder Employee	5	3	15	Identify hours of work to comply with the Fitness for Duty and Fatigue Management SWP27. All activities should be designed to fit into the standard work day/work shift of 12 hours (including travel time). If work exceeds the maximum, a fatigue risk assessment must be conducted and permission sought by PM or OM. Employees shall not drive if the work period has exceeded 14 hours - find alternative methods of transportation.	3	2	6	

Risk Group	Initial Risk	Hazard	PA	IC	IL	IR	Controls	RC	RL	RR	AC
General	Slips, Trips, and Falls	Slips, Trips, and Falls	Golder Employee	4	3	12	Follow Slips, Trips, and Falls SWP14. Use care and attention when walking. Before starting work, conduct a survey of the area looking for uneven ground, mud, water, loose material, or other conditions that could cause slips, trips, or falls. In cold weather environments, walkways shall be sanded, salted, or cleared of snow and ice as soon as practicable. Establish level pedestrian footpaths, avoiding slippery surfaces wherever possible. Relay identified hazards to others working at the site. Wear footwear appropriate to the tasks and identified hazards. Footwear should be in good condition and provide effective traction and ankle support. Close discharge vault cover if not actively working on discharge vault.	2	2	4	
General	Changing Weather Conditions	Changing Weather Conditions	Golder Employee	4	3	12	Assess forecasted weather conditions before beginning work. Postpone activities if weather conditions are not favorable. Remain vigilant at all times and continually re-assess weather conditions. Consider carrying a weather radio with spare batteries. Know how to contact the local weather resources. If weather conditions deteriorate, stop work and seek shelter as necessary. Understand who is responsible for suspending work due to extreme weather conditions.	3	2	6	

Risk Group	Initial Risk	Hazard	PA	IC	IL	IR	Controls	RC	RL	RR	AC
General	Lightning	Lightning	Golder employee	5	3	15	Check daily forecast. Carry a weather radio and extra battery as well as a personal lightning detector. Postpone outdoor activities if thunderstorms are imminent. Stay away from tall objects such as towers, fences, telephone poles and power lines. Avoid touching metal if you take shelter in your car. If you must take shelter outdoors, find a low spot away from trees, fences and poles. If you feel your skin tingle and hair stand on end, squat low to the ground, on the balls of your feet. Place hands over ears and your head between your knees. Make yourself the smallest target possible, with minimum contact with the ground. DO NOT lie down.	3	1	3	

Risk Group	Initial Risk	Hazard	PA	IC	IL	IR	Controls	RC	RL	RR	AC
General	Working in Cold Environments (SWP 05)	Frostbite, hypothermia	Golder employee	5	3	15	If ambient temperatures are 40 °F or below, site training should include prevention of cold injury, cold-injury symptoms, and cold-injury first-aid. If the equivalent wind chill temperature is less than minus 29 °F, outdoor work should be discontinued or effective engineering controls such as windscreens, temporary shelters, or portable heating units should be used. Work in sheltered areas, or provide barriers to give shelter from the wind. Provide a warm, sheltered place to take breaks. Never work alone in a cold environment. Check each other frequently for signs of frostbite and hypothermia (e.g. white of black spots on skin). Drink plenty of fluids, not caffeine or alcohol. Wear clothing appropriate for the weather conditions. Wear multiple layers. Foot, hand and facial protection is essential. Eye protection is required against ice particles, snow and sun. Survival kit to include hot packs, blankets and spare clothing. Workers must be trained in the use of survival equipment.	3	2	6	
General	Working in Cold Environments (SWP 05)	Maintaining necessary supplies	Golder Employee	4	3	12	Plan for, maintain and inspect supplies necessary for safe work in cold environments. These supplies may include food, water, blankets, extra clothes, hand warmers, jackets, tools, lighting and communication devices.	3	2	6	
General	Working in Cold Environments (SWP 05)	Slips, trips, and falls	Golder Employee	4	3	12	Walkways and foot paths shall be sanded, salted, or cleared of snow and ice as soon as practicable. On-going maintenance of all paths must be regular.	3	2	6	

Risk Group	Initial Risk	Hazard	PA	IC	IL	IR	Controls	RC	RL	RR	AC
General	Working in Cold Environments (SWP 05)	Unstable snow and ice build-up	Golder Employee	4	3	12	When working in locations where snow, rain and cold alter the safety of work areas, measures will be taken to advise all employees in the area of the hazard. This notification may come in the form of signs, discussions during safety meetings, or physical barriers placed around high risk areas.	3	2	6	
Tasks	Working Around Heavy Equipment (SWP 18)	Working around heavy equipment	Golder employee	4	3	12	Heavy equipment activity may change daily or hourly, with differing potential hazards that need to be identified and addressed. Never approach an operational piece of heavy equipment until the operator is aware of your presence, your desire to approach, and signals the OK – where possible use radio contact. Stand in a safe location. Never work or pass directly under a lifted or suspended load. Whenever a Golder employee works on a project site where heavy equipment is operated, the Working Around Heavy Equipment SWP 18 must be followed.	4	2	8	
Work Environment	Electrical (GAI electrical safety program HSE 204)	Electrical (extension cords, electrical panels)	Golder employee	5	3	15	Be aware of electrical cords lying on the ground. Report any damage or taped cords as these should be taken out of service and replaced. Keep extension cords away from traffic areas to prevent damage. Keep extension cords away from wet areas. Use ground fault circuit interrupter (GFCI) protection in wet or outdoor locations. Stay away from live electrical panels. Do not store material within 3 feet of electrical panels.	3	3	9	

Risk Group	Initial Risk	Hazard	PA	IC	IL	IR	Controls	RC	RL	RR	AC
Work Environment	Falls - Housekeeping (SWP 14 and 22)	Slips, trips, and falls	Golder employee	4	4	16	Conduct a survey of the work area to determine areas where slips, trips and falls could occur. Look for uneven ground, mud, water, loose material, snow, ice, or other housekeeping issues. Smooth out uneven ground, place material to counteract mud or water, clear snow and ice away, salt or sand icy areas.	3	3	9	
Work Environment	Working near unstable slopes	Falling, cave-ins Falls of ground	Golder employee	4	4	16	Watch for signs of unstable slopes (tension cracks). Watch your footing, stay off rocky, steep or unstable slopes.	3	3	9	

9.0 PERSONAL PROTECTIVE EQUIPMENT

Item	Required	Provided by Golder	Provided by Client	Specific Requirement
Cold Weather Gear	☒	☒	☐	When temperatures require
Wet Weather Gear	☒	☒	☐	If raining
Gloves				
Disposable	☒	☒	☐	If potential for contact with contaminants
Cut resistant	☒	☒	☐	When working with or near sharp objects
Head Protection				
Hard Hat	☒	☒	☐	
Hearing Protection				
Disposable foam ear plugs	☒	☒	☐	If chance of sustained sound above 85 db
High Visibility Clothing				
Orange or other approved High Visibility Vest	☒	☒	☐	
Safety Footwear				
Safety boots	☒	☒	☐	
Eye Protection				
Splash resistant safety goggles	☒	☒	☐	When potential exist for high pH water to splash onto field personnel

10.0 INCIDENT AND EMERGENCY MANAGEMENT

11.0 HSE PLAN CONTROL

It is the responsibility of the Project Manager to ensure that this HaSEP is prepared and the contents communicated at the pre-start / toolbox meeting to all project staff, Golder or subcontractor, with a copy held on site. The HaSEP has been reviewed or prepared by the Project Manager.
If the project site is remote from the home office, this HaSEP is to be reviewed and approved by the local Golder office whether in another country, province or city.

Role	Name (printed)	Date	Signature
Prepared by	Jing Song Xi		
Reviewed by	Ryan Kober		
Approved by	Gary Zimmerman		
Other			

9.0 PERSONAL PROTECTIVE EQUIPMENT

Item	Required	Provided by Golder	Provided by Client	Specific Requirement
Cold Weather Gear	☒	☒	☐	When temperatures require
Wet Weather Gear	☒	☒	☐	If raining
Gloves				
Disposable	☒	☒	☐	If potential for contact with contaminants
Cut resistant	☒	☒	☐	When working with or near sharp objects
Head Protection				
Hard Hat	☒	☒	☐	
Hearing Protection				
Disposable foam ear plugs	☒	☒	☐	If chance of sustained sound above 85 db
High Visibility Clothing				
Orange or other approved High Visibility Vest	☒	☒	☐	
Safety Footwear				
Safety boots	☒	☒	☐	
Eye Protection				
Splash resistant safety goggles	☒	☒	☐	When potential exist for high pH water to splash onto field personnel

10.0 INCIDENT AND EMERGENCY MANAGEMENT

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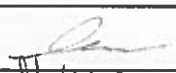
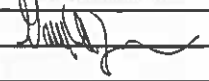
Role	Name (printed)	Date	Signature
Prepared by	Jing Song Xi	10/10/2017	
Reviewed by	Amber McAteer	10/10/2017	
Approved by	Gary Zimmerman	10/10/2017	
Other			

11.1 Golder Sign-off

Signing below indicates you have read and agree to comply with the information contained in this document.

Date	Name	Company	Signature
10/23/17	Jing Jing-yi	Golder	
11/7/17	Amber Wachter	Golder	
2/7/18	JASON BEH	ENCOMPASS	
2/7/18	Nik Landdeck	Encompass	
2/7/18	Steve McCaskey	ENCOMPASS	

11.1 Golder Sign-off

Signing below indicates you have read and agree to comply with the information contained in this document.

Date	Name	Company	Signature

APPENDIX A

Written Work Procedures

- HSE_200.014_SWP_Slips_Trips_and_Falls.pdf
- HSE_200.018_SWP_Working_Around_Heavy_Equipment.pdf
- HSE_200.022_SWP_Housekeeping.pdf
- HSE_200.027_SWP_Fitness_For_Duty.pdf
- HSE_200.036_SWP_FA_CPR_AED_BBP.pdf
- HSE_200.007_SWP_Inclement_Weather.pdf

Approved by	Jane Mills	Issue Date	August 2012
Revision by	Brian Tuccillo	Revision Date	August 2013

1.0 SCOPE

This Standard Work Procedure (SWP) applies to all Golder Associates Inc. (Golder) staff. The majority of falls occur on slippery, uneven, defective, cluttered or obstructed walking surfaces. A significant number of debilitating falls are the result of a person falling out of his or her own chair, typically while in the process of sitting down, or leaning back. Falls from elevations while reaching for an overhead object are also common, and frequently cause severe injuries.

2.0 SLIPS, TRIPS, AND FALLS

Slips are primarily caused by a slippery surface and compounded by wearing the wrong footwear.

Providing dry walking and working surfaces and slip-resistant footwear can minimize slips and their resultant falls and injuries. Shoes with rubber-cleated, soft soles and heels are recommended for most field work.

In work areas where the walking and working surface is likely to be slippery, non-skid strips, mats, or floor coatings should be used.

As little as a 3/8" rise in a walkway can cause a “stubbed” toe resulting in a trip and fall. The same thing can happen when going up a flight of stairs: Only a slight difference in the height of subsequent steps could cause a person to trip and fall. Be aware of uneven surfaces.

3.0 TYPES OF FALLS

Falls are of two basic types: elevated falls and same-level falls. Same-level falls are most frequent, but elevated falls are more severe.

- Same-Level Falls: high frequency--low severity.
- Elevated Falls: lower frequency--high severity.

Same-level falls are generally slips or trips. Injury results when the individual hits a walking or working surface or strikes some other object during the fall. Over 60 percent of elevated falls are from less than 10 feet.

4.0 CONTRIBUTING FACTORS

Proper housekeeping in work and walking areas can contribute to safety and the prevention of falls. It is important to maintain a safe working environment and walking surface. Work areas must remain free of obstacles that might cause slips and trips. One action which promotes good housekeeping in work

environments is the painting of yellow lines to identify working and walking areas. Working and walking areas should never be obstructed by objects of any kind.

Adequate lighting can improve visibility in an area and is an important factor in the prevention of slips and falls. Moving from light to dark areas, or vice versa, can cause temporary vision problems, that might be just enough to cause a person to slip on an oil spill, or trip over a misplaced object.

Carrying an oversized object can also obstruct one's vision and result in a slip or a trip. This is a particularly serious problem on stairs.

If a material spills on the floor, promptly clean it up and post the necessary precautionary signs until it is dry and free of slip hazards.

In addition to wearing the wrong footwear, there are specific behaviors which can lead to slips, trips, and falls. Walking too fast or running can cause major problems. Rapid changes in direction or walking backwards can create a similar problem.

Other problems that can lead to slips, trips and falls are: distractions; not watching where one is going; carrying materials which obstruct view; wearing sunglasses in low-light areas; and failure to use handrails. These and other behaviors, caused by lack of knowledge, impatience, or bad habits developed from past experiences, can lead to falls, injuries, or even death.

5.0 RELATED GOLDER DOCUMENTS

- GAI HSE 200.022 SWP Housekeeping.

Approved by	Jane Mills	Issue Date	August 31, 2012
Revision by	Brian Tuccillo	Revision Date	December 2013

1.0 SCOPE

This Standard Work Practice (SWP) applies to all Golder Associates Inc. (Golder) staff that will be operating and/or working around heavy or mobile equipment such as drill rigs, cranes, dozers, excavators, compactors, front end loaders, graders, tractors, flatbeds, trucks (dump and haul), aerial lifts, vacuum trucks, etc. Such sites include surface and underground mines, remediation areas, and construction sites. Heavy equipment activity may change daily or hourly, with differing potential hazards that need to be identified and addressed. The purpose of this SWP to provide employees with the basic information needed to safely work on or around mobile equipment.

2.0 DEFINITIONS

Competent Person A competent person is one who is capable of identifying existing and possible hazards in the workplace. A competent person must also have authority to take any corrective action necessary to safely complete the task.

Mobile Equipment Equipment propelled/powered by gasoline, propane, natural gas, diesel or electricity that is used to haul, transport, excavate, move, maneuver, drill, or hoist materials, equipment, products or personnel.

PPE Personal protective equipment.

ROPS Rollover protective structures.

Shall or must Means mandatory.

Should or may Means recommended.

Qualified Person A qualified person is one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience in a technical or engineering has successfully demonstrated his ability to solve or resolve problems relating to the operation, maintenance, and/or the safety controls of the equipment, the work, and/or the project.

3.0 MOBILE EQUIPMENT SAFETY

Only authorized and qualified personnel shall be allowed to operate mobile or electrical equipment. All mobile equipment operators must supply proof of training or show evidence of experience (work history) prior to initially operating equipment.

One of the most important points to remember about working around any piece of heavy equipment is that the operator has a limited field of vision. Always make eye contact with the operator of the equipment prior to moving into swing/operating radius.

3.1 Reviewing Safety Information

Prior to the start of work activities, employees shall review the site-specific Health, Safety, and Environment Plan (HASEP) and/or task-specific Job Safety Analysis (JSA). Employees must acknowledge having read and understood the information presented within the HASEP and/or JSA by signing the job safety briefing form located in the HASEP.

Prior to the work activities and/or in the event of any site or scope of work changes, employees and subcontractors shall conduct a safety meeting (i.e. toolbox meeting). Traffic control procedures regarding the equipment shall be included within that meeting where relevant.

3.2 Daily Inspections/Maintenance

The mobile equipment operator will complete a daily inspection of the equipment that they will be working on prior to its use. The inspections should be documented, and documentation should be maintained with the equipment being inspected and/or to meet any other additional site/client specific requirements.

- If any of the safety equipment (i.e. rollover protective structures, back up alarms functioning and audible above surrounding noise levels, shut off switches, lights, etc.) is not in proper working order and/or in the event of any defects or equipment failures (tires, braking, hydraulic, steering, or other critical systems), the equipment shall be removed from service and locked/tagged out until it can be fixed by a person qualified to make the repairs.
- Preventive maintenance procedures recommended by the manufacturer must be followed.
- Repairs shall not be made unless the equipment is turned off and properly blocked off from movement, such as choking off the wheels. In the event that an adjustment is necessary for the repair the equipment can be moved or turn on temporary.
- Use of any machinery or equipment found to be defective or potentially unsafe is prohibited until unsafe conditions have been corrected.
- In the event of change in shift or operator, the new operator is required to perform their own equipment inspection prior to operating the machine.
- Perform a walk around the equipment to identify any nearby hazards.

3.3 General Operation

- Machinery and mechanized equipment may be operated only by qualified, designated personnel.
- Do not solely rely on your mirrors when turning, swiveling, or backing up the equipment. Turn your head to look around the surrounding area. If necessary, get out of the vehicle to perform a check of the blind spots. Operators shall inform any people working around

the equipment of the potential blind spots and equipment swing radii so they can avoid those areas.

- Operators are to obey the signalers who are assisting with the loading or unloading of equipment from a transportation vehicle, performing traffic control duties, and/or otherwise assisting the operator in moving the equipment. Signalers are to maintain a clear line of site with the operator at all times. Signalers and operators shall have a radio for additional and/or emergency communications.
- Workers around the mobile equipment shall make periodic eye contact with the operator. Remember if you cannot see them then they cannot see you.
- Be alert at all times, the working area and equipment are constantly moving and changing. Listen and identify any back up alarms, periodically scan the area for moving equipment, and never stand next to operating equipment unless the operator has indicated for you to approach the equipment.
- Maintain high visibility when working around mobile equipment. Do not work around or operate equipment in dense fog or other inclement weather that reduces visibility around the immediate work area.
- Never lay on the ground.
- Wear high visibility PPE or clothing.
- Stay out of the blind spots of the equipment operator.

3.4 Roadways

- All pieces of haulage equipment and large mobile equipment will have the right-of-way on all roadways. All other equipment will give way and will keep a safe distance until the roadway is cleared.
- In areas of traffic congestion and narrow travel-ways, the smallest vehicle shall always yield to larger vehicles.
- When following heavy equipment, a safe travelling distance should be maintained at all times. The driver's side mirror should always be visible to you, and hence you to the operator.
- On the majority of operating surface mines, all traffic travels on the left-hand side of the road. However practices may vary between sites. Check with the site superintendent/foreman before travelling on site roadways.
- Overtaking hauling and dump trucks should be done only when the truck operator tells you to do so. Visual and/or radio contact must be made with the operator.
- Road or ground surfaces must be able to support the weight of the load. During slippery, icy, or muddy conditions the operator shall slow down to maintain control of the equipment. If ground conditions cannot be made safe through maintenance or reduced speeds, operations shall cease until such time as the conditions improve to allow safe operation of equipment.
- Mobile equipment operators shall obey all traffic signs and signals, and keep the equipment under control.
- Equipment operators shall maintain a minimum safe distance behind another piece of equipment. At a minimum you should follow behind 10 foot per 10 mph increasing distance with increased speed.
- Machinery or equipment must not be operated in a manner that will endanger persons or property. Do not exceed safe operating speeds and loads.

3.5 Approaching Mobile Equipment

- Never approach an operational piece of heavy equipment until the operator is aware of your presence, your desire to approach, and signals the OK – where possible use radio contact.
- Stand in a safe location well outside the maximum extended reach of the shovel, dragline, or excavator arm, and out of the way of other mobile equipment. With an excavator, the optimum location is within the quadrant of the operator's visual coverage.
- When contact is made either by radio or visual contact, advise the operator of your wish to approach the equipment. The operator may want to complete a task prior to shutting down. If so, remain at the same location until the operator signals the OK to advance. Usually this will involve lowering the bucket to the ground; however practices may vary between sites. It is advisable to check with the site superintendent/foreman before entering areas where heavy equipment is in operation.
- Advise the operator of your task and requirements. Complete your task, advise the operator that you have completed your work, and depart the work area.

3.6 Overhead Hazards

When elevating or lifting equipment near energized overhead lines, the following safety precautions shall be followed (see Overhead Hazards SWP):

- The operator of the lifting equipment shall post and maintain in plain view of the operator and driver on each crane, derrick, power shovel, drilling rig, hay loader, hay stacker, pile driver, or similar apparatus, a durable warning sign legible at 12 feet. The sign shall read "Unlawful To Operate This Equipment Within 10 Feet of High-Voltage Lines of 50,000 Volts or Less." **This is only required by California Occupational Safety and Health Administration (OSHA).**

4.0 CONTROL OR OPERATING MEASURES

- Mobile equipment operators shall give an audible warning prior to starting up the equipment.
- No personnel shall ride on or in the mobile equipment unless it is designed to seat passengers.
  - Employees are to keep all parts of their bodies within the protective confines of the equipment while the equipment is in motion.
  - Equipment shall not travel on the highway or other public roads unless it is specifically designed and licensed to do so.
- All personnel shall wear a seat belt while the equipment is in operation. Prior to the start of the equipment the seat belt(s) shall be fastened and properly adjusted. Unless the equipment is designed for the operator to be unrestrained/standing, no Golder personnel shall operate equipment that is not outfitted with functioning seatbelts.
- Modification to the equipment is not permitted unless the manufacturer approves of any modifications. The equipment shall be used in the manner it was designed and intended to be used.
- Operators shall not exceed the manufacturer's recommended equipment rating capacity found within the operations and maintenance (O&M) manual.
- All mobile equipment shall be equipped with a functioning back up alarm system.

- Rollover Protective Structures (ROPS) shall be in use on all mobile equipment unless specifically not required in 29 CFR 1926 Subpart O.
- Windshields or protective side glass/windows shall be free of cracks, damage, or any debris which could impair the vision of the operator. Windshields must be equipped with powered wipers, unless specifically designed otherwise. Vehicles that operate under conditions that cause fogging or frosting of windshields must be equipped with operable defogging or defrosting devices
- Loads for transportation shall be properly secured in a manner that will not allow the load to shift, slide, or fall. Loads should be properly centered to provide balance for the transportation vehicle.
    - Mobile loading and haulage equipment shall be inspected by a competent person prior to operation.
- Equipment shall only be fitted with counterweights approved by the equipment manufacturer and shall be installed and used in accordance with the information found within the O&M manual of the machine, Excess counter weighting is not permitted.
- Lift trucks, stackers, etc., must have the rated capacity posted on the vehicle so as to be clearly visible to the operator. When auxiliary removable counterweights are provided by the manufacturer, corresponding alternate rated capacities will also be clearly shown on the vehicle. The ratings are not to be exceeded.
- Unstable loads shall be restacked and secured until they are stable.
- Operators shall not use cell phones, eat, drink, read, or any other activity that would distract their attention from the proper operation of the equipment.
- During fueling activities the equipment shall be turned off, the filler nozzle in contact with the tank, an appropriately sized spill kit nearby, and no smoking within the immediate area of the equipment and fuel source.
- Preventative maintenance activities (fluid changes) shall be conducted in location that will minimize the impacts of any spills and appropriate spill response equipment shall be made available during these activities.
- In the event the equipment is parked on an incline, the wheels shall be properly chocked off to prevent unintended movement.
- Operator(s) and passengers shall use pre-designated access/egress points for the machine.

5.0 ADDITIONAL SPECIFIC REQUIREMENTS

5.1 Underground Mining Requirements

Employees that may be working in underground mining operations and working with the specific equipment outlined below shall follow these additional procedures:

- Before underground mobile equipment is trammed (box-shaped wagon or iron car run on tracks), the operator shall make sure all personnel in the area are clear and in a safe location away from harm. All employees shall notify the operator prior to approaching the equipment.
- When mobile trolley or battery equipment is not in use and unattended (out of sight), the trolley pole shall be removed from the wire or the battery breaker switches must be in the off position. The driveline directional controller must be in the neutral or centered position.

5.2 Suspended Loads

Employees that may be working under suspended loads shall follow these additional procedures:

- During the lifting or hoisting of equipment and materials, employees are to stay clear of the area during the lift and should never position themselves directly under a lifted or suspended load.
- Employees shall not work or pass under the buckets or booms of loaders in operation.
- Dippers, buckets, loading booms, or heavy suspended loads shall not be swung over the cabs of haulage vehicles until the drivers are out of the cabs and out of the area, unless the trucks are designed specifically to protect the drivers from falling material.

5.3 Aerial Lifts

Employees that may be using this type of equipment shall refer to the Aerial Lift SWP (GAI HSE 200.042) for use.

6.0 TRAINING

Any employee or subcontractor that will be operating mobile equipment shall be trained and certified to operate that specific piece of equipment by a qualified person. Training at a minimum should cover, but not limited to the operation procedures, equipment controls, safety work instructions, safety controls, and be conducted by a competent person. The training shall be evaluated through observation of practical operating skills, training and certification by an approved vendor, or documented work history. The training records shall be maintained in employee files, and at a minimum contain the name of the employee, date of training, the name of the trainer (i.e. competent person). Re-certification and/or re-evaluation of the training shall be conducted as required (new machines, change in process, near miss/accident, etc.).

7.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The following PPE may be required for work on or around mobile equipment. Additional PPE may be necessary depending on project site conditions and client requirements.

- Hard hat (except within enclosed cab).
- Steel toe boots.
- High visibility safety vest.
- Safety glasses (except within an enclosed cab).
- Work gloves, as needed.
- Hearing protection, as needed.

8.0 APPLICABLE REGULATORY REFERENCES

- 29 CFR 1910 Subpart F Powered Platforms, Manlifts, and Vehicle Mounted Platforms.

- 29 CFR 1910 Subpart N Materials Handling (section related to powered industrial trucks).
- 29 CFR 1926 Subpart O Motorized Vehicles.
- 29 CFR 1926 Subpart N Cranes.
- 29 CFR 1926 Subpart L Scaffolds (sections related to mobile scaffolds and aerial lifts).

9.0 RELATED GOLDER DOCUMENTS

- GAI HSE 200.001 SWP Drilling.
- GAI HSE 200.011 SWP Overhead Hazards.
- GAI HSE 200.037 SWP Traffic Safety.
- GAI HSE 205 Forklift Safety.
- GAI HSE 206 Crane and Rigging Safety.

Approved by	Jane Mills	Issue Date	August 31, 2012
Revision by	Richard Lovett	Revision Date	August 10, 2015

1.0 SCOPE

This Standard Work Procedure (SWP) applies to all Golder Associates Inc. (Golder) employees who are responsible for housekeeping activities in their workplace, in the office, or on a project site.

2.0 HOUSEKEEPING - GENERAL

The Occupational Safety and Health Administration (OSHA) requires that all places of employment, passageways, storerooms, and service rooms shall be kept clean and orderly and in a sanitary condition. The floor of every workroom shall be maintained in a clean and, so far as possible, a dry condition. Where wet processes are used, drainage shall be maintained and false floors, platforms, mats, or other dry standing places should be provided where practicable. To facilitate cleaning, every floor, working place, and passageway shall be kept free from protruding nails, splinters, holes, or loose boards.

3.0 HOUSEKEEPING IN THE OFFICE

Housekeeping in office areas is very important because these spaces are almost always occupied during work hours, and conditions in a work area can change depending on the activities being conducted.

- Tools, extension cords, fans, furniture, and loose materials should be located so as not to cause tripping or other hazards. Any tools, materials, and/or equipment subject to displacement or falling must be adequately secured.
- All walkways, stairways, access ways must be kept free of materials, supplies, and obstructions at all times. Be alert to tripping hazards. If you see one, correct it.
- If there is a spill of water, coffee, or other liquids; clean the spill up immediately.

A link to Golder's office inspection form is provided in the reference section of this document.

4.0 HOUSEKEEPING ON THE PROJECT SITE

Housekeeping on project sites is challenging because there are often employees from multiple companies, different tasks are being performed, and because conditions in a work area can change rapidly depending on the activities being conducted.

- Tools, extension cords, hoses, and loose debris/materials should be located so as not to cause tripping or other hazards. Any tools, materials, and/or equipment subject to displacement or falling must be adequately secured.
- Site conditions, vegetation, roadways, pathways must be maintained.
- Collect all waste generated by your work activities daily, and dispose in appropriate containers at the end of each day. Schedule appropriate pick-up and disposal as needed.

- Consolidate and minimize all waste materials, including Investigation Derived Waste (IDW) on a daily basis. Properly label IDW drums and containers and schedule appropriate disposal (as needed).
- Know and follow the site safety plan, practice good housekeeping, follow recommended work practices, and promptly report and/or correct hazards at the worksite.
- Keep the Golder worksite free of unnecessary clutter and debris that could cause an injury or accident. Limit the amount of materials and chemicals onsite to the quantities that you will need. Place trash and debris in the proper receptacles located throughout the job site. Promptly remove combustible materials such as wood and paper from the site.
- Keep storage, staging, and work areas, along with all access/egress points, stairs, and walkways on the construction site, free of obstructions and debris. Store tools and materials neatly and out of the way in storage bins or lockers and keep flammable or hazardous wastes in covered, segregated waste containers. Make sure materials stored on roofs or at heights are secured. Never throw waste, materials, or tools from a building or structure.

5.0 GENERAL WASTE MANAGEMENT

If Golder produces or is responsible for management of large amounts of project waste, trash, and/or scrap metal, a plan shall be made prior to the start of work that details any required disposal procedures and equipment. Additional responsibilities may include:

- The materials and waste shall be handled, stored, and transported to minimize the potential for a spill or impact on the environment.
- Outdoor waste receptacles shall be covered to prevent possible waste run-off.
- Project related wastes must be stored and maintained in an organized fashion and the proper waste shall be deposited within the proper receptacle.
- Employees shall follow the site established disposal methods. If waste generated is classified as hazardous, employees must be trained to make sure the proper handling, disposal, and transport of the hazardous waste.
- The client may have recycling programs on the site. Employees are encouraged to recycle waste to the extent practical.

6.0 SPILL PREVENTION

Proper housekeeping practices can help eliminate spills when storing and using chemicals. Good housekeeping best management practices include maintaining clean and organized storage areas, proper labeling, secondary containment, etc. In the event that the chemicals are hazardous by definition, employees shall refer to the Hazardous Waste and Emergency Response SWP (GAI 200.041) and Golder's Hazard Communication Program (GAI HSE 203).

- Chemical substances should be stored in the proper containers to minimize the potential for a spill. Chemicals should be kept in closed containers and stored in such a way that unintended releases can be contained.
- Prior to the initiation of work, the site Health, Safety and Environment Plan (HaSEP) shall identify the chemicals that are being used by Golder and those that may be present around

the work area. A copy of the Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) should accompany any chemical. Employees should be familiar with the information on each relevant MSDS or SDS.

- Employees working with chemicals shall have the appropriate spill kit(s). The spill kit(s) must be easily accessible when required in the event of an emergency. Employees must make sure adequate spill response is available by the estimates for the quantity of chemicals being used. The spill kits shall be periodically inspected to make sure the kit(s) have the appropriate materials to contain a spill.
- Employees responsible for cleanup of a spill must have the proper training on the equipment, materials, communication procedures, waste disposal and spill response procedures.
- The HaSEP shall outline the proper communication or emergency measures in the event of a spill. Communication procedures should be based on the type and quantity of materials involved.

7.0 APPLICABLE REGULATORY REFERENCES

- 29 CFR 1910.22 “General Requirements”

8.0 RELATED GOLDER DOCUMENTS

- GAI HSE 200.014 SWP Slips Trips and Falls
- GAI HSE 200.041 SWP Hazardous Waste and Emergency Response
- GAI HSE 203 Hazard Communication Program (HAZCOM)
- Golder Office Inspection Form

Approved by	Jane Mills	Issue Date	December 10, 2009
Revision by	Brian Tuccillo	Revision Date	April 4, 2014

1.0 INTRODUCTION

This Standard Work Procedure (SWP) applies to all Golder Associates Inc. (Golder) employees and contractors to evaluate if they are fit for duty. This SWP follows the minimum standards set forth in Golder's Global Procedure 6 (GP 6) Management of Health and Safety.

2.0 DEFINITIONS

Company-Related Business – Any act performed by a Golder employee within the scope of the employee's duties. Generally, operating one's personal vehicle from home to work and/or from work to home does not constitute company-related business. However, this travel time is included in the calculation of working hours for fatigue management purposes.

Downtime - Work Break – Non-work periods within a work day allowing time for eating, drinking and relaxation. Rest Period – Non-work periods outside of the 12 hour work day.

Emergency Situation – Where life and/or property are in danger of immediate harm.

Fit for Duty/Fitness for Duty – Physically, mentally and emotionally able to perform all assigned duties and in a manner which does not compromise or threaten the safety and health of themselves or others while preserving the integrity of property and the environment. An individual may be unfit for duty for a variety of reasons, including the adverse effects of fatigue, alcohol or drug use, or a range of physical, psychological or emotional limitations.

Fatigue – Physical, mental or emotional exhaustion resulting from a number of causes including, but not limited to, work, physical, mental or emotional exertion, lack of sleep, various stressors, or a combination of these factors.

Fatigue Leave – Time off to be taken immediately after completing 14 consecutive 12 hour days or at the end of the scheduled shift rotation if longer.

Golder's Contractor – A third-party retained by Golder to perform services at any location where Golder employees are engaged in company-related business. The term contractor includes all sub-consultants and subcontractors and their employees. A contractor representative is the person responsible for directing, controlling and/or supervising the contractors who perform or provide contractor services.

Standard Working Day/Shift – Working up to 12 hours including travel time, for fatigue management purposes.

Sufficient Rest – Rest period is the time away from work when an employee has the opportunity to eat, relax and sleep. Sufficient rest period is typically a period of between 8 and 10 hours between the time work is ceased and returning to work. In some instances travel can be considered as a rest period, providing the employee can ensure effective sleep during the time of travel.

Supervisor – For the purposes of this SWP, a Supervisor is the person who reviews an employee's weekly time record and has the authority to direct their work schedule, among other responsibilities.

Work Hours – Work Hours - A maximum of 12 hours worked per day. Shift Rotation - A maximum of 14 consecutive 12 hour days without two days off of fatigue leave.

3.0 GOLDER'S RESPONSIBILITIES UNDER THIS SWP

Golder is responsible for implementing and enforcing this SWP. The responsibilities for Golder employees in their different roles are detailed below:

3.1 Operations Manager

It is the responsibility of the **Operations Manager** to:

- Communicate the fitness for duty SWP to employees and refresh with annual training as appropriate to ensure that all employees are familiar with the SWP and with their duties and responsibilities under the SWP.
- Inform Golder employees of situations that might affect their fitness for duty through education sessions and during project planning.
- Provide training to supervisors who review timesheets in appropriate response measures for employees with excessive weekly hours.
- Determine who is fit for duty under this SWP, and respond as appropriate to employees who are unfit for duty.
- Conduct a risk assessment with affected employees for office work when required by this SWP.
- Review and, when appropriate, approve task-specific risk assessments for office assignments.
- Discipline violations of this SWP in accordance with Section 9 of this SWP.

3.2 Supervisor

It is the responsibility of the **Supervisor** to:

- Review employee weekly timecards and evaluate compliance with this SWP.
- If deviations from the SWP (relative to hours worked) are noted, contact the employee to discuss the deviations, and make immediate corrections, as necessary, involving the Project Director (when applicable).

3.3 Project Director

It is the responsibility of the **Project Director** to:

- Consider the requirements of this SWP when determining work shifts.
- Review and, if appropriate, approve task-specific risk assessments for field assignments.

3.4 Project Manager

It is the responsibility of the **Project Manager** to:

- Advise employees and contractors of situations that may impact their safety at their worksite through hazard analysis conducted during project planning (HASEP).
- Inform Golder employees of situations that may affect their fitness for duty through education sessions and during project planning.
- Provide a copy of this SWP to the contractor representatives.
- Conduct a risk assessment with affected employees for field work when required by this SWP.
- Respond as appropriate to employees who are unfit for duty.
- Provide a copy of this SWP to the contractor representatives.

3.5 Human Resources Representative

It is the responsibility of the **Human Resources Representative (HRR)** to:

- Respond to confidential fitness for duty inquiries from employees.
- Communicate, as necessary, with Project Managers or Supervisors on behalf of the employee.
- Understand federal, state and/or local laws as they may relate to work hours.

4.0 EMPLOYEE RESPONSIBILITY UNDER THIS SWP

- Arrive at work each day fit for duty.
- Comply at all times with Golder's Code of Conduct, employee handbook, all Golder policies, procedures, and safe work practices.
- Notify your HRR, your supervisor, or any designated company representative immediately if:
  - You have any doubts or concerns about your fitness for duty, or about your ability to safely perform your assigned responsibilities.
  - For any reason, you become unfit for duty during the course of the workday.
  - You observe another employee or Golder contractor who might appear to be unfit for duty.
  - You observe another employee or Golder contractor engaging in unsafe behavior.
  - You believe the work you are assigned to perform is unsafe, or if you feel you are not adequately trained to safely perform any of your assigned responsibilities.
  - You are using drugs, alcohol, and other substances that might impair your fitness for duty.

- Schedule sufficient rest (as defined in Section 8.3) before arriving at work.
- Ensure non-work activities allow for sufficient rest.
- Ensure illnesses that might affect your fitness for duty are managed.
- Refrain from using drugs, alcohol, and other substances that might impair your fitness for duty.

5.0 FACTORS THAT CAN AFFECT AN INDIVIDUAL'S FITNESS FOR DUTY

A number of factors can affect an individual's fitness for duty. Among the most common factors are fatigue, temporary physical or psychological conditions, alcohol consumption, and the use of prescription medication and illegal drugs and substances. Many symptoms are commonly associated with fatigue. Because these symptoms might not be recognized by the fatigued employee, it is important for all employees to watch for symptoms of fatigue in each other during long work shifts.

6.0 KEY HAZARDS

Employees who are unfit for duty have a significantly higher risk than others do of suffering a serious injury or death, causing serious injury or death to others, and committing mistakes in performing their job responsibilities. Individuals who are unfit for duty:

- Tend to overestimate their ability to perform tasks safely, underestimate potential hazards in the workplace, and often disregard the use of appropriate personal protective equipment.
- Tend to be less efficient, less productive, and more prone to making technical errors.

7.0 WORK HOURS

Golder acknowledges flexible working hours might be required to ensure business continuity and delivery of client service. Golder has established the following work hour limits that all employees must adhere to, and all employees must follow when establishing work schedules:

All activities at Golder should be designed to fit into the standard working day of 12 hours (including travel time). In addition, all activities at Golder should be designed and managed so that no employee works more than fourteen consecutive 12-hour days without experiencing two days of fatigue leave.

The standard working-day guidelines rely on each employee to monitor their own fitness for duty in preparation for work periods of up to 12 hours in duration.

If under extreme or unforeseen circumstances a project or office activity requires an extended working day (greater than 12 hours), a project-specific or activity-specific fatigue risk assessment (Section 8) must be conducted and permission must be obtained from either the Project Director or Operations Manager. If

permission to work in excess of 12 hours is granted, the following minimum control measures must be implemented:

- A "buddy" system so the employees are not working the extended work day alone. Work at home or in a hotel room after the extended work day represents a lower safety risk, because driving while fatigued is eliminated.
- The Project Director (for field work) or Supervisor (for office work) and the affected employees shall identify factors that might impact the employees' ability to work safely beyond the standard working day. During this consultation, the employees must notify the Project Manager and supervisor of any personal or other matters that might affect their fitness for duty or their ability to safely work the extended hours.

If international or remote site work requires employees to be onsite for greater than the two-week period, a project-specific or activity-specific risk assessment must be conducted, and permission for the extended (>14 days) rotation is required from either the Project Director (for field work) or the Operations Manager (for office work). If permission is granted, the following minimum control measures must be implemented:

- All effort must be made to ensure breaks are taken during the work period so that 14 consecutive 12-hour days in a row are not exceeded.
- The working plan must allow for flexibility in work hours such as half-day breaks for rest.
- During downtime in operation (such as equipment breakdowns), employees must be given the opportunity to rest.

A modified standard working day might be established based on environmental factors and the specific nature of the work to be performed. These factors include, for example, extreme weather conditions, remoteness, and degree of the physical exertion required.

Work schedules for projects involving employees from multiple operating companies must be defined in advance of employee deployment to the site. GAI employees will only be deployed to a project site where compliance with this SWP is assured. A GAI employee working for another Golder operating company would still need to follow GAI's Fitness For Duty SWP (this document), if the other Golder operating company's Fitness For Duty requirements are less stringent.

7.1 Compliance With Federal, State and Local Laws Governing Working Hours

Certain federal, state and/or local laws or client requirements can impose specific requirements with respect to the maximum number of hours an employee is permitted to work at any one time. Golder will comply with applicable laws governing working hours (MSHA and DOT, where applicable) or client requirements. Any questions regarding these laws or client requirements should be directed to your HRR or Project Manager as appropriate.

8.0 FATIGUE RISK ASSESSMENT

If operational requirements necessitate staff exceeding the work-hour guidelines, a risk assessment shall be conducted that can demonstrate all risks are adequately controlled. The risk assessment process is detailed in the toolkit associated with this SWP.

8.1 Fatigue Risk Assessments for Field Work

The risk assessment must be conducted by the employee and the Project Manager for work outside of the office. The risk assessment must be documented on the form provided in the toolkit associated with this SWP. Work cannot proceed until this risk assessment has been reviewed and authorized by the Project Director or Operations Manager. Work schedules/activities to minimize risks associated with fatigue will be incorporated into the project HASEP as identified through the risk assessment process.

8.2 Fatigue Risk Assessments for Office Work

The risk assessment must be conducted by the employee and the employee's supervisor for office work whether conducted at the office or at a remote location like a hotel. This assessment can take the form of a conversation that includes the elements defined in the toolkit associated with this SWP.

8.3 Breaks

Breaks are an important part of managing fatigue. Time spent away from work allows individuals to recover from mental and physical fatigue and improve safety, work performance, efficiency. Factors such as the physical demands of the task or weather conditions must be considered.

Consistent with applicable federal, state or local laws, breaks during a standard working day should be adequate and regular. Rest during your lunch break. At other times this could be as simple as taking a break while demobilizing from a project site. There should be a minimum of one 30-minute break in each 8-hour work period.

As a guide, the amount of sleep required in the previous 48-hours needs to be no less than the length of the next intended work period. For example, if you plan to work 12 hours in any given day, you need to have had at least 12 hours sleep over the previous 48-hours.

For extended working days/shifts:

- If an employee has worked at least 12 hours (excluding breaks), the employee must rest for at least 8 hours before returning to work.
- On rare occasions when an employee has worked more than 12 hours, the employee is required to rest for at least 10 hours before returning to work.

8.4 Travel/Transport

- When an employee has worked consecutively for 14 hours or more in a single day they shall not operate a vehicle. Arrangements must be made, not at the employee's expense, for alternative transportation or accommodations. In unforeseen situations, an employee may complete their journey without being in violation of the provisions of this procedure, provided the planned journey could reasonably have been completed within the provisions of this procedure in the absence of the unforeseen situation.

9.0 COMPLIANCE

All individuals are required to comply with this SWP. For employees, failure to comply with this SWP will result in disciplinary action up to, and including termination of employment. Contractors who fail to comply with this SWP can be removed from the worksite or prohibited from engaging in any further Company-Related Business. Supervisors, Project Managers or Project Directors who chronically fail to ensure their staff follow the SWP are subject to disciplinary action up to, and including termination of employment.

10.0 GOLDER RELATED DOCUMENTS

- GP-6 Management of Health and Safety
- Golder's Code of Conduct
- Golder's Employee Handbook

Approved by	Jane Mills	Issue Date	June 20, 2014
Revision by	Amanda Cote	Revision Date	January 12, 2015

1.0 SCOPE

This Standard Work Procedure (SWP) applies to all Golder Associates Inc. (Golder) employees working in areas where an injury that requires first-aid care may occur or where emergency medical services may be slow to respond or not available. This SWP is intended to represent minimum standards and does not supersede requirements of local agencies or jurisdictions.

2.0 FIRST-AID/CPR/AED

Golder recognizes the value of training our employees to respond to emergency situations, including those situations involving an injury. Golder employees are not required to provide first-aid as a routine part of their job duties. In the event of a life threatening emergency, Golder employees are trained to contact professionally trained Emergency Medical Technicians (EMTs) through the local 911 system or other site-specific emergency contact numbers listed in the site-specific Health, Safety, and Environment Plan (HASEP).

In accordance with OSHA General Industry and Construction standards, at least one Golder employee on every field project site shall be designated as a first-aid provider if EMT services are not readily available (less than 10 minute response). Field personnel are trained in First-Aid/CPR/AED to provide on-site first-aid in the absence of EMTs. This training is required for field personnel because many client work sites do not have an infirmary, clinic, or hospital in near proximity to the workplace that is used for the treatment of injured employees. Additionally, adequate first-aid supplies are provided to field employees, to respond to reasonably anticipated injuries.

3.0 FIRST-AID FACILITIES

3.1 Classification of First-Aid Kits

Under the American National Standards Institute (ANSI) standard, Z308.1-2009, first-aid kits are divided into four different categories or classifications:

- **Type I:** Intended for use in stationary, indoor applications where kit contents have minimal potential for damage. These kits are not intended to be portable and should have a means for mounting in a fixed position. Some applications for Type I first-aid kits are general indoor use, office use, or in a light manufacturing facility. First-aid cabinets would fall in this classification.
- **Type II:** Intended for use in portable indoor applications. Kit contents should have minimal potential for damage. These kits should be equipped with a carrying handle. Some applications for Type II first-aid kits are general indoor use, office, or manufacturing environments.

- **Type III:** Intended for portable use in mobile industries and/or outdoor applications. Kits should be moisture resistant, equipped with a carrying handle, have the means for being mounted in a fixed position, and should also be corrosion resistant. Transportation industry or construction jobs present typical applications for Type III first-aid kits.
- **Type IV:** Intended for portable use in the mobile and/or outdoor applications where the potential for damage to the kit contents due to environmental factors and rough handling is significant.

3.2 Basic Fill Contents for Type I, II, III, and IV First-Aid Kits

All first-aid kits meeting the first-aid standard of ANSI Z308.1-2009 should contain the first-aid items listed in Section 6.1, Table 1 of the standard and included in Appendix A of this SWP. The quantity and size specifications of these components are the minimum necessary to comply.

In addition to the minimum contents listed in the standard, a kit should have recommended items added based upon specific workplace hazards. Additional supplies may include oral analgesics, antibiotic treatments, compress bandages, Cardiopulmonary Resuscitation (CPR) barriers, burn dressings, cold packs, eye covers, eyewash, and a roller bandage.

3.3 Providing and Inspecting First-Aid Supplies

The contents of the first-aid kits shall be checked before being sent out to each job site by the HSC, Project Manager, or the Site Safety Officer (SSO)/Site Supervisor, and should contain at least Type III or Type IV contents. For long-term projects, weekly on-site inspections shall be conducted by the SSO to make sure the first-aid supplies are intact and/or that any expended/expired items are replaced. First-aid supplies should be stored in a weather-proof container (if being brought into the field) with individually sealed packages of each item.

First-aid stations are required when there are 50-200 persons working at a field worksite, in each permanent Golder office location, in each temporary project trailer that Golder may rent/lease, and in each Golder laboratory location. The stations must be located as close as practicable to the highest concentration of personnel. First-aid stations must be well marked and available to personnel during all working hours. One first-aid kit may be a permanent wall-mounted kit, but in all cases the station shall be equipped with at least one portable first-aid kit (kits within field vehicles may be used to meet this requirement).

- Maintenance of first-aid kits stationed within the office is the responsibility of the HSC or their designee.
- Maintenance of first-aid kits in the laboratory is the responsibility of the lab manager.
- Maintenance of first-aid kits in field vehicles, or otherwise established first-aid stations, where required, is the responsibility of the Project Manager or Site Supervisor or their designee for the project.

3.4 Emergency Eyewash and Shower Equipment

Where the eyes or body of any employee may be exposed to injurious corrosive materials, emergency eye wash provisions (eyewash station or portable kits) for quick drenching or flushing of the eyes and body must be provided. Depending on the potential hazard, facilities or bottled eyewash shall be capable of providing copious amount (15 minutes) of potable water at a suitable temperature, generally between 60 degrees F and 105 degrees F. Facilities must be provided for immediate emergency use in the laboratory and near the work area or office trailer for field-related activities. Facilities shall meet and be inspected following ANSI Z358.1-2009.

4.0 AUTOMATED EXTERNAL DEFIBRILLATORS

4.1 Definitions

Automated External Defibrillator (AED): An external defibrillator is capable of cardiac rhythm analysis and will charge and deliver a shock if needed to restore normal heart rhythm.

Cardiopulmonary Resuscitation (CPR): An emergency live-saving procedure employed when someone's breathing or heartbeat has stopped. Through CPR the heart and lungs are made to work by manually compressing the chest overlying the heart and forcing air into the lungs. CPR is used to maintain circulation when the heart stops functioning.

4.2 Using an AED

Golder's offices with more than one employee are expected to have an AED available for use, either in the office or in the building where Golder is a tenant. AEDs should be stored in locations that are easily accessed and clearly labeled. When an AED is acquired, the applicable local emergency communication center or dispatch center (such as 911) should be notified about the existence, the storage location, and type of AED(s). In some locations, written notification or registry with a state agency may be required.

Golder's AEDs will be maintained, tested, and inspected according to the manufacturer's operational guidelines. Inspections will be conducted at least every 30 days. Written inspection records will be maintained in every office with an AED.

Anyone who may use an AED must receive CPR/AED training from the American Red Cross, American Heart Association, or equivalent with a demonstrated proficiency. Where local regulations require, use of the AED will be limited to people who have received the appropriate training. Training records will be maintained for each office location.

When an AED is used to provide emergency assistance to someone experiencing cardiac arrest, the local emergency medical services must also be notified as soon as possible. A written report documenting the

incident will be prepared and submitted to Golder's supervising physician for review. If required by state regulations, a physician will review these AED procedures and recommend modifications as necessary to comply with applicable regulations.

5.0 EMERGENCY ACTION PLANS

The HASEP or office Emergency Action Plan shall identify the emergency action plan for transporting an injured person to a physician or hospital. In the event that the work area is not served by emergency services (i.e., "911"), a list of the telephone numbers and addresses of doctors, hospitals, and ambulance services shall be posted at each first-aid station or within the field vehicle(s). For field operations, the list shall also include the physical address of the worksite.

For work in remote locations or where medical care may be sub-standard, please reference GAI HSE 200.012 SWP Remote Work-Working Alone.

6.0 OSHA'S BLOODBORNE PATHOGENS REQUIREMENTS

The Occupational Safety and Health Administration (OSHA) promulgated regulations (29 CFR 1910.1030 Bloodborne Pathogens [BBP]) to protect employees who may be occupationally exposed to blood and other potentially infectious materials. The primary concerns include protection from exposure to the Human Immunodeficiency Virus (HIV) and Hepatitis B virus (HBV), which may be present in infected individuals' body fluids. For the purposes of the BBP Standard, occupational exposure means "reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of the employee's duties."

7.0 BBP EXPOSURE CONTROL PLAN

This SWP will serve as Golder's Exposure Control Plan. Where applicable, the Exposure Control Plan will be documented within the site-specific HASEP and within the corporate Health and Safety Orientation Manual and Injury and Illness Prevention Program. The Plan will also be maintained on the company intranet and will be available to any employee upon request. All employees will have access to a copy of the Exposure Control Plan in accordance with 29 CFR 1910.1020(e).

OSHA's BBP regulations require that employees "treat all human blood and other potentially infectious materials **as if they were infectious (i.e., universal precautions)**." In the event that an employee does administer CPR or render first-aid involving the presence of blood or other potentially infectious materials, occupational exposure as defined above is presumed. While there is some risk associated with any contact with another human being's body fluids, the risk associated with providing emergency first-aid is low and the measures set out below are intended to reduce the risk even further. The direct life-saving benefits of immediate emergency assistance (e.g., administering CPR to a heart attack victim or

controlling severe bleeding in traumatic injury cases), far outweigh the risks associated with properly administered assistance. First-aid providers shall take reasonable and universal precautions to limit contact with the victim's body fluids.

After providing first-aid care, do not eat anything, use tobacco products, or touch your eyes until you thoroughly wash your hands with, at a minimum, soap and water.

8.0 BBP WORK PRACTICE CONTROLS

The following work practice controls shall be used to eliminate or minimize employee exposure:

- Personal Protective Equipment (PPE) (including nitrile, neoprene, and/or latex gloves, CPR mask) will be provided at no cost to the employee. PPE will be made available within the appropriate sizes and shall be replaced as needed.
- Employees who choose to assist in a medical emergency shall wear the appropriate PPE for the treatments in which they are engaged. If an employee does not use the PPE provided, appropriate disciplinary action may be taken.
- The use of a "biohazard' bag for BBP-impacted waste is required when the waste meets the definition of "regulated waste." Regulated waste means liquid or semi-liquid blood or other potentially infectious materials, contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed, items that are caked with dried blood or other potentially infectious materials and are capable of releasing these materials during handling, contaminated sharps, and pathological and microbiological wastes containing blood or other potentially infectious materials.
- Do not eat, drink, use tobacco products, or touch your eyes and mouth until you have thoroughly washed your hands. Hand washing facilities and/or antiseptic solutions/towelettes will be made available at all work locations for use.
- All equipment or environmental surfaces shall be cleaned and decontaminated (using disinfectant solutions or cleaners) after contact with blood or other infectious materials, and all cleaning materials shall be properly disposed of. Due to a lack of laundering facilities, contaminated clothing will be disposed of and replaced as needed. Contaminated clothing must be promptly removed and placed in the "biohazard bags" for disposal. You should also wash your skin under where the clothing was contaminated.
- Equipment and engineering controls will be evaluated and updated based on current regulations and standard medical practices. Evaluations will be performed by Golder's National Leader Health, Safety, and Environment (NLHSE) and/or their designee. Equipment or materials shall be replaced based upon use or expiration date, and medical kits will be taken out of service until necessary replacement items can be procured.

9.0 PROCEDURES FOR BBP EXPOSURE INCIDENT

Golder is required to prepare an Exposure Determination Plan for employees with occupational exposure. In the event that an Exposure Determination Plan is needed, exposure determinations shall be made without regards to the use of PPE.

9.1 BBP Exposure Incident

In the event of a BBP exposure incident, immediately report the incident to your office Human Resources Representative (HRR). Also, Golder employees should immediately report any non-life threatening work-related injury or exposure incident to WorkCare at 888-449-7787. WorkCare will communicate with the Corporate Human Resources Manager for injury or exposure reporting.

If necessary, WorkCare will request testing of the "source individual's" blood for potential BBPs. The results of the source individual's blood test will be made available to Golder's occupational physician as soon as possible through the injured person's attending physician.

If a post-exposure medical evaluation is conducted, it will include a review of the exposure incident, a review of your medical history including HBV vaccination status, a review of the source individual's blood test results if available, a baseline sample of your blood, and possibly (if appropriate in the opinion of the attending physician) a Hepatitis B vaccination or booster.

Following the post-exposure evaluation, the attending physician will provide a written opinion regarding medical clearance to the HRR. This opinion shall be limited to a statement that the employee has been informed of the results of the evaluation and told of the need, if any, for any further evaluation or treatment. Golder is required to provide the affected employees with a copy of the physician's opinion within 15 days. The physician's written opinion shall be the only information provided to Golder's HRR regarding the exposure incident; all other medical findings and records will remain confidential.

10.0 TRAINING

Field employees are required to maintain current first-aid, CPR, and AED training. The first-aid, CPR, and AED training must occur every two years and be conducted by a certified program sanctioned by the American Red Cross, American Heart Association, National Safety Council, or equivalent.

Employees who attend first-aid, CPR, and AED training will automatically be enrolled in BBP training. BBP training is required annually for employees with occupational exposure as defined in the Standard, and must be given at the time of initial assignment to tasks where occupational exposure may take place. Employees who do not attend the annual refresher shall not be authorized to provide medical care of any kind until refresher training is complete.

Training will be re-evaluated based on changes in regulations, near misses, exposures, accidents, or any other time as deemed necessary by the NLHSE or HSC.

Participation in training courses will be documented. Evidence of training will be maintained at the employee's local office. It is the responsibility of the employee to maintain adequate training records and to make sure training is kept current.

11.0 HEPATITIS B VACCINATION

All medical evaluations and procedures including the Hepatitis B vaccine and vaccination series and post-exposure evaluation and follow-up, including prophylaxis, are made available at no cost to the employee; made available to the employee at a reasonable time and place; and performed by or under the supervision of a licensed physician or by or under the supervision of another licensed healthcare professional.

Golder employees do not render medical assistance as a primary job duty and therefore will not be routinely offered the pre-exposure Hepatitis B vaccination. Employees who primarily provide first aid or emergency response duties must be vaccinated. The Bloodborne Pathogen Standard excludes employees who perform unanticipated "Good Samaritan acts" from coverage by the Standard since such an action does not constitute "occupational exposure."

In the event that a Golder employee renders first aid or performs emergency response duties involving the presence of blood or other potentially infectious materials, the Hepatitis B vaccine will be made available to that employee, unless the employee has previously received the complete Hepatitis B vaccination series, antibody testing has revealed that the employee is immune, or the vaccine is contraindicated for medical reasons.

If an employee renders first aid or performs emergency response duties involving the presence of blood or other potentially infectious materials and declines to accept the Hepatitis B vaccination offered by Golder, the employee must sign a form, which states:

> *I understand that due to my occupational exposure to blood or other potentially infectious materials I may be at risk of acquiring hepatitis B virus (HBV) infection. I have been given the opportunity to be vaccinated with hepatitis B vaccine, at no charge to myself. However, I decline hepatitis B vaccination at this time. I understand that by declining this vaccine, I continue to be at risk of acquiring hepatitis B, a serious disease. If in the future I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with hepatitis B vaccine, I can receive the vaccination series at no charge to me.*

12.0 RECORDKEEPING

Training records shall be maintained for a minimum of 3 years from the date on which the training occurred. Medical records will be maintained during the period of employment plus 30 years.

According to 29 CFR 1910.1020(h), records are available to employees, to employee representatives, and to OSHA. Employees have the right to request, transfer, or release training and exposure medical records. This process requires written authorization from the employee in question. Records can be picked up in person or mailed via certified mail to make sure they are delivered properly. All record transmittals will be compliant with the Bloodborne Pathogens Standard.

13.0 APPLICABLE REGULATIONS AND STANDARDS

- 29 CFR 1926.50 Medical Services and First Aid
- 29 CFR 1910.151 Medical Services and First Aid
- 29 CFR 1910.1030 Bloodborne Pathogens
- ANSI Standard Z308.1-2009 Minimum Requirements for Workplace First Aid Kits and Supplies
- ANSI Z358.1-2009 Emergency Eyewashes and Shower Equipment
- 29 CFR 1910.1020 “Access to Employee Exposure and Medical Records”.

14.0 RELATED GOLDER DOCUMENTS

- GAI HSE 200.012 SWP Remote Work-Working Alone

APPENDIX A

FIRST-AID KIT CHECKLIST

List of Minimum Required First-Aid Kit Equipment per ANSI Z308.1-2009

ANSI/ISEA Z308.1-2009 Type I, II, III, or IV			
Required Minimum Fill		**Recommended Supplies**	
	1 First Aid Guide		Analgesic (Oral)
	1 Absorbent Compress 4 x 8 in. min.		Bandage Compress 2 x 36 in. min.
	16 Adhesive Bandages 1 x 3 in.		Breathing Barrier, single use
	1 Adhesive Tape 2.5 yd.		Burn Dressing 12 sq. in. min.
	10 Antiseptic Treatment Applications 0.5 gm. Each		Cold Pack 4 x 5 in. min.
	6 Burn Treatment Applications 0.9 gm. Each		Eye Covering 1/4 in. thick min.
	4 Sterile Pads 3 x 3 in. min.		Eye/Face Wash, sterile 4 fl. oz. min
	2 Pair Medical Exam Gloves		Roller Bandage 2 in. x 4 yd. min.
	1 Triangular Bandage 40 x 40 x 56 in. min.		Hand Sanitizer, 0.9 gm. min
	6 Antibiotic Treatment Applications 0.5 gm. Each		Tweezers
			Surgical Scissors
			Bloodborne Pathogens Exposure Prevention Kit
The described kit may be suitable for some businesses. However, the adequacy of the contents for hazards of each work environment should always be evaluated by competent personnel. For a variety of operations, employers may find that additional first-aid supplies and kits are needed.			

Note: This kit meets ANSI Z308.1–2009 only when the minimum is maintained with first-aid products marked “ANSI Z308.1–2009.”

Approved by	Jane Mills	Issue Date	August 31, 2012
Revision by	Jane Mills	Revision Date	February 2, 2015

1.0 SCOPE

This Standard Work Procedures (SWP) applies to all Golder Associates Inc. (Golder) employees who work in locations where potential inclement weather conditions may develop.

2.0 INTRODUCTION

Severe weather can occur at any hour of the day, and any day of the year. Hurricanes, hailstorms, tornadoes, snowstorms, ice storms, wind storms, floods, severe cold, heat waves and drought occur daily.

3.0 LIGHTNING

Lightning is a rapid discharge of electrical energy in the atmosphere. The resulting clap of thunder is the result of a shock wave created by the rapid heating and cooling of the air in the lightning channel. Lightning is extremely dangerous and according to the National Weather Service there are an estimated 25 million lightning flashes each year with an average of 58 fatalities per year and about 300 injuries per year. A lightning flash can travel horizontally many miles away from the thunderstorm and then strike the ground. These types of lightning flashes are called “Bolts from the Blue” because they seem to come out of a clear blue sky. Even when blue sky may exist overhead (or in part of the sky overhead) a thunderstorm could be located 5 to 10 miles away (and sometimes even farther). **If you can hear thunder, you are within striking distance. Seek safe shelter immediately.**

The 30/30 Lightning Rule is a good rule of thumb for anyone who finds themselves outside with a storm on the horizon. The best way to gauge the distance from a thunderstorm to your location is to measure the elapsed time from the flash of the lightning to the bang of the thunder. The 30/30 Rule says to stop outdoor activities when lightning is six miles away. Use the “flash to bang” (lightning to thunder) count in which five seconds equals one mile (10 sec. = 2 miles, 20 sec. = 4 miles, 30 sec. = 6 miles). Conditions are usually considered to be safe after no thunder and no lightning have been observed for thirty minutes. The best places to take cover (in order from what is considered to be the safest to least safe) are as follows:

1. Sturdy Building: A sturdy building is an enclosed building with metal plumbing or wiring to ground the structure. While inside a sturdy building, the following areas should be avoided: open doors and windows; close proximity to electrical equipment and appliances that are plugged into an electrical socket; near pools, tubs, showers, and other plumbing; and land line phones. Do not lie on concrete floors or lean against concrete walls.
2. Vehicle: An enclosed vehicle such as a car, truck, van, or bus with a metal roof and widows that are completely shut. Avoid touching anything metal or any conducting path to the outside such as a steering wheel, ignition, radio, gear shifter, etc. while inside the

car. While inside a safe vehicle, do not use electronic devices such as radio communications. Lightning striking the vehicle, especially the antenna(s), could cause serious injury if you are talking on the radio or holding the microphone at the time of the flash.

3. In the open or unsafe buildings and vehicles: If option 1 or 2 are not available, you may have to stay in the open. Avoid all water, metal objects, high ground, isolated trees, and telephone poles. If lightning is striking nearby, avoid all direct contact with other people; remove all metal objects from your person, and crouch down with feet together and hands on knees making sure that only your feet are touching the ground. Do not lay flat on the ground because it will increase your chance of being struck by a ground current. Unsafe buildings include things like a car ports, open garages, covered patios, picnic shelters, beach pavilions, golf shelters, tents of any kinds, baseball dugouts, sheds and greenhouses. Unsafe vehicles include convertibles, motorcycles, golf carts, 4 wheelers, riding mowers, open cab construction equipment, and boats without cabins.

4.0 TORNADOES

Tornadoes are nature's most violent storms. They are most frequently reported east of the Rocky Mountains during spring and summer months. Peak tornado season in the southern states is March through May; in the northern states, it is late spring through early summer. Tornadoes are most likely to occur between 3 p.m. and 9 p.m., but can occur at any time. However, tornados are often products of power storm systems associated with thunderstorms and hurricanes that can cause high winds, flying debris, heavy rain, and hail.

The Federal Emergency Management Agency (FEMA) reports that tornados generally develop rapidly and can strike with little or no warning and can last for a few minutes to several hours. The forward speeds of tornados range from approximately 0 miles per hour (mph) to 70 mph, with the average being approximately 30 mph. Tornadoes generally occur near the trailing edge of a thunderstorm; however, it is not uncommon to see clear, sunlit skies behind a tornado. Some tornadoes are clearly visible, while rain or nearby low-hanging clouds obscure others. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible. Before a tornado hits, the wind may die down and the air may become very still. A cloud of debris can mark the location of a tornado even if a funnel is not visible. Winds are generally in excess of 100 mph but can be as high as 300 mph.

Whenever weather conditions develop that indicate tornadoes are expected, the National Weather Service may issue a tornado watch to alert people in a designated area for a specific time period. The tornado watch is upgraded to a tornado warning when a funnel cloud is actually sighted. Tornadoes are often preceded by large hail, which follows shortly after the heavy rains and gusts from a thunderstorm have passed.

4.1.1 What to do before a Tornado:

Be alert to changing weather conditions. If you see approaching storms or any of the danger signs, be prepared to take shelter immediately. Look for the following danger signs:

- Dark, often greenish sky.
- Large hail.
- A large, dark, low-lying cloud (particularly if rotating).
- Loud roar, similar to a freight train.

4.1.2 Hazards and Possible Consequences:

Some of the hazards associated with tornadoes include:

- Lightning.
- High winds.
- Heavy rain.
- Hail.

The most serious hazard caused by severe weather is lightning and heavy winds. The most serious hazard caused by tornadoes is from the force of violent wind strength and the fact that these same winds project dangerous debris through the air. Secondary hazards include the following:

- Flash flooding.
- Electric power outages.
- Transportation-system and communication-system disruption.
- Fires.

4.1.3 Control Measures (actions to be taken during severe weather include):

- If severe weather strikes without warning, take cover immediately.
- Seek shelter in designated shelters, basement, storm cellar, hallways or under furniture or other solid structure; or the lowest building level. If there is no basement, go to the center of an interior room on the lowest level away from corners, windows, doors, and outside walls. Put as many walls as possible between you and the outside.
- Remain calm. Do not run, push, or panic.
- Do not open windows.
- Do not use telephones except to report a site emergency.
- Use a battery operated radio in case of a power failure.
- Do not leave the shelter unless directed to do so by your Supervisor (if applicable).

- Wait for the “All Clear” announcement, (30 minutes after last thunder/lightning event), if applicable.

5.0 HURRICANES

A hurricane is a type of tropical cyclone, the generic term for a low pressure system that generally forms in the tropics. The Atlantic hurricane season lasts from June to November, with the peak season from mid-August to late October. Hurricanes and tropical storms can also spawn tornadoes and micro bursts, create storm surges along the coast, and cause extensive damage from heavy rainfall. Winds can exceed 155 mph. The wind scale used by the National Weather Service is based on the Saffir-Simpson Hurricane Wind Scale of Category 1 though Category 5 with Category 1 being the weakest in sustained winds and Category 5 being the strongest in sustained winds. Category Three and higher hurricanes are considered major hurricanes, though Categories One and Two are still extremely dangerous and warrant your full attention.

5.1.1 Hazards and Possible Consequences:

- Hurricane Winds.
- Rainfall and Flooding.
- Flying Debris.
- Storm Surge.
- Tornadoes.

6.0 WINTER STORMS

Heavy snowfall and extreme cold can immobilize an entire region. Even areas that normally experience mild winters can be hit with a major snowstorm or extreme cold. Winter storms can result in flooding, storm surge, closed highways, blocked roads, downed power lines, and hypothermia. Some indicators of a winter storm are freezing rain, sleet, frost/freeze, and blizzards.

- **Freezing Rain**: Rain that freezes when it hits the ground, creating a coating of ice on roads, walkways, trees, and power lines.
- **Sleet**: Rain that turns to ice pellets before reaching the ground. Sleet also causes moisture on roads to freeze and become slippery.
- **Blizzard**: Sustained winds or frequent gusts to 35 miles per hour or greater and considerable amounts of falling or blowing snow (reducing visibility to less than a quarter mile) are expected to prevail for a period of three hours or longer. Add the following supplies to your disaster supplies kit:
  - Rock salt to melt ice on walkways.
  - Sand to improve traction.
  - Snow shovels and other snow removal equipment.

6.1.1 Control Measures (actions to be taken during winter storms) include:

- Listen to your radio, television, or National Oceanic and Atmospheric Administration (NOAA) Weather Radio for weather reports and emergency information.
- Eat regularly and drink ample fluids, but avoid caffeine and alcohol.
- Conserve fuel.
- Maintain ventilation when using kerosene heaters to avoid build-up of toxic fumes. Refuel kerosene heaters outside and keep them at least three feet from flammable objects.

6.1.2 If you are outdoors:

- Avoid overexertion when shoveling snow. Overexertion can bring on a heart attack-a major cause of death in the winter. If you must shovel snow, stretch before going outside.
- Cover your mouth. Protect your lungs from extremely cold air by covering your mouth when outdoors. Try not to speak unless absolutely necessary.
- Keep dry. Change wet clothing frequently to prevent a loss of body heat. Wet clothing loses all of its insulating value and transmits heat rapidly.
- Watch for signs of frostbite. These include loss of feeling and white or pale appearance in extremities such as fingers, toes, ear lobes, and the tip of the nose. If symptoms are detected, get medical help immediately.
- Watch for signs of hypothermia. These include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and apparent exhaustion.

6.1.3 If you are driving:

- Drive only if it is absolutely necessary. If you must drive, consider the following:
- Travel in the day, don't travel alone, and keep others informed of your schedule. Stay on main roads; avoid back road shortcuts.

6.1.4 If a blizzard traps you in the car:

- Pull off the highway. Turn on hazard lights and hang a distress flag from the radio antenna or window.
- Remain in your vehicle where rescuers are most likely to find you. Do not set out on foot unless you can see a building close by where you know you can take shelter. Be careful; distances are distorted by blowing snow. A building may seem close, but be too far to walk to in deep snow.
- Run the engine and heater about 10 minutes each hour to keep warm. When the engine is running, open a downwind window slightly for ventilation and periodically clear snow from the exhaust pipe. This will protect you from possible carbon monoxide poisoning.
- Exercise to maintain body heat, but avoid overexertion. In extreme cold, use road maps, seat covers, and floor mats for insulation. Huddle with passengers and use your coat for a blanket.
- Take turns sleeping. One person should be awake at all times to look for rescue crews.

- Drink fluids to avoid dehydration.
- Be careful not to waste battery power. Balance electrical energy needs - the use of lights, heat, and radio - with supply.
- Turn on the inside light at night so work crews or rescuers can see you.
- Leave the car and proceed on foot - if necessary - once the blizzard passes.

7.0 COMMUNICATIONS

The Site Safety Officer will act as the Golder Incident Coordinator during all inclement weather events. They will monitor the NOAA broadcasts and the instructions of local authorities. They will notify all facility site staff of the weather status, shutdown orders, and evacuation orders. If a hurricane is likely in your area, you should:

- Listen to the radio or TV for information.
- Secure the building, close storm shutters, and secure outdoor objects or bring them indoors.
- Turn off utilities if instructed to do so. Otherwise, turn the refrigerator thermostat to its coldest setting and keep its doors closed.
- Turn off propane tanks. Avoid using the phone, except for serious emergencies.
- Obtain a supply of water for sanitary purposes such as cleaning and flushing toilets. Fill large containers with water.

If you're at the site 36 hours before the predicted arrival of a hurricane:

- Survey site grounds and pick up all loose items and debris.
- Move all barricading materials, such as sandbags and plywood to areas where they will be installed.
- Notify contractors to secure their areas.
- Remove all trailers and scaffolding from site.
- Review hurricane preparedness plan with all personnel.
- Dismiss all site personnel.
- Secure vehicles as needed.
- Bring in outdoor equipment and anchor items that cannot be brought in.
- Close and board up windows.

8.0 RELATED GOLDER DOCUMENTS

- GAI HSE 200.004 SWP Heat Stress
- GAI HSE 200.005 SWP Cold Environment Cold Stress

APPENDIX B

Golder Electrical Safety Program

Electrical Safety Program

ELECTRICAL SAFETY PROGRAM

Golder Associates Inc.

Revision Level 3

August 2013

A world of capabilities delivered locally

Golder Associates

OBJECTIVE

This program establishes minimum standards to prevent hazardous electrical exposures to Golder personnel and to meet regulatory requirements applicable to electrical systems. Working on equipment in a de-energized state is required unless de-energizing introduces an increased hazard or is infeasible.

This Electrical Safety Program applies to all Golder Associates Inc. employees who work on or near electrical equipment operating at or above voltage levels 50 volts direct current (dc) or alternating current (ac). This program applies to electrical work conducted on ground level equipment, on elevated poles, below grade enclosures and inside confined spaces.

This program is designed to provide Golder employees with the appropriate training, safe work procedures, protective equipment and other controls so that electrical work at Golder facilities and/or jobsites is performed safely and by qualified workers. This program is intended to help employees protect against electrical shock, burns and other potential electrical safety hazards. This program has been established in order to:

- Protect the safety of employees who may work on or near energized electrical equipment.
- Provide employees with necessary information to understand and comply with regulatory standards (i.e. OSHA or MSHA) related to electrical work including:
  - A written safety program with defined responsibilities.
  - Appropriate hazard and warning labeling on equipment.
  - Worker training on lockout/tagout procedures, requirements of NFPA 70e, and the hazards of electrical shock, arc flash, and arc blast.
  - Definition of appropriate PPE, tools, and testing equipment for safe work (properly insulated and rated for the potential voltage to be encountered).
- Establish uniform procedures for electrical work.

This Program is not intended to present the contents of all applicable regulations and standards. Federal, state and local requirements must be understood and followed,

This program does not address working on low voltage/low current systems (for example, 4–20 mili ampere (mA) signals). Low voltage/low current systems operate at less than 50 volts dc or ac are exempt from this program.

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1.0 DEFINITIONS AND ACRONYMS

AC Alternating current

ANSI American National Standards Institute

ASTM American Society of Testing and Materials.

Barricade A physical obstruction such as tapes, cones, or A-frame-type wood or metal structures intended to provide a warning about and to limit access to a hazardous area.

Barrier A physical obstruction that is intended to prevent contact with equipment or energized electrical conductors and circuit parts or to prevent unauthorized access to a work area.

CCR California Code of Regulations.

CFR Code of Federal Regulations.

Competent person Is defined by OSHA as an individual who is capable of identifying an existing hazard and/or a predictable hazard. This individual also has the authority to issue corrective actions. A competent person has received the proper training in the field of their competency and is in possession of a recognized degree, certificate, or professional standing, and/or has extensive knowledge, training, or experience

Conductive apparel Conductive articles of jewelry and clothing (such a watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) may not be worn if the possibility exists for contact with exposed energized parts. However, such articles may be worn if they are rendered nonconductive by covering, wrapping, or other insulating means

Conductive material and equipment Conductive materials and equipment that are in contact with any part of an employee's body shall be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, the employer shall institute work practices (such as the use of insulation, guarding, and material handling techniques) that will minimize the hazard.

Confined space An enclosed space that has limited egress and access and has an atmospheric hazard (e.g., explosive atmosphere or asphyxiating hazard) and/or other serious safety hazards (e.g., electrical hazard). When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized parts, the employer shall provide and the employee shall use protective shields, protective barriers, and/or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts.

Damp location Partially protected locations subject to moderate degrees of moisture, such as some basements.

DC Direct current

De-energized electrical work Electrical work that is performed on equipment that has been previously energized and is now free from any electrical connection or source. The equipment or circuits does not have an electrical charge.

Disconnecting (or Isolating) switch A device designed to close and/or open an electric circuit.

Dry location Locations not normally subject to dampness or wetness, as in the case of a building under construction.

Electrical Standby Person Worker who is knowledgeable of the energized system, can disconnect power and provide assistance in the event of an emergency or other incident.

Electrically Safe Work Condition An electrical conductor or circuit part that has been:

- Disconnected from energized parts
- Locked/tagged in accordance with established standards
- Tested to verify the absence of voltage
- Grounded, if determined necessary (See Grounding)

Energized electrical work Repair, maintenance, troubleshooting, or testing on electrical circuits, components, or systems while energized (i.e., live). Only Qualified High Voltage Electrical Workers are permitted to work on energized circuitry of 50 volts/25 amps to ground or greater.

Energy source Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

EPA Environmental Protection Agency.

Exposed electrical parts Energized parts that can be inadvertently touched or approached by a person. Exposed electrical parts may be not suitably guarded, isolated, or insulated. Examples include terminal contacts or lugs and bare wiring.

Flame Resistant (FR) A material that has been treated with a special chemical agents or finishes to make it resistant to burning. FR also refers to a material that will only burn when continuously exposed to a source but will stop burning when the source is removed.

Ground Fault Circuit Interrupt (GFCI) A device whose function is to interrupt the electric circuit to the load when a fault current to ground exceeds a predetermined value that is less than that required to operate the over-current protective device of the supply circuit.

Ground A conducting connection whether intentional or accidental between an electrical circuit or equipment and the earth or to some conducting body that serves in place of the earth.

Hazardous Location An area where an airborne flammable dust, vapor or gas may be present and would represent a hazard if a source of ignition were present.

HSC Health and Safety Coordinator.

HASEP Health, Safety and Environment Plan.

IEEE Institute of Electrical and Electronics Engineers.

Interlock An electrical, mechanical, or key-locked device intended to prevent an undesired sequence of operations.

Isolating Switch A switch intended for isolating an electric circuit from the source of power. It has no interrupting rating, and is intended to operate only after the circuit has been opened by some other means.

JSA Job Safety Analysis.

Lockout	The placement of a lockout device on an energy isolating device, in accordance with an established procedure ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed
Lockout device	A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds. That employee must be the only person who has the key or combination for their lockout device, and should be the only person to remove the lock after all work has been completed.
Lockout / Tagout	A standard that covers the servicing and maintenance of machines and equipment in which the unexpected re-energization of the equipment or release of stored energy could cause injury to employees. It establishes performance requirements for the control of such hazardous energy.
Lockout/Tagout Employee	A person who has completed the required hazardous energy control training and is authorized to lockout or tagout a specific machine or equipment to perform service or maintenance.
MSHA	Mine Safety and Health Administration.
"Must" or "shall"	Means mandatory.
NEC	National Electrical Code.
NFPA	National Fire Protection Association.
NIOSH	National Institute of Occupational Safety and Health.
NLHSE	National Leader of Health Safety and Environment.
OSHA	Occupational Safety and Health Administration.
PPE	Personal Protective Equipment.

Qualified Electrical Worker A qualified person trained and knowledgeable of construction and operation of equipment or a specific work method and is trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

RMS Root-mean-square. The RMS value is the effective value of a varying voltage or current. It is the equivalent steady DC (constant) value which gives the same effect. To calculate the RMS first square all the values, then find the average (mean) of these square values over a complete cycle, and find the square root of this average.

Service The conductors and equipment for delivering energy from the electricity supply system to the wiring system of the premises served.

Service Equipment The necessary equipment, usually consisting of a circuit breaker or switch and fuses, and their accessories, located near the entrance of supply conductors to the building and intended to constitute the main control and means of cutoff of the supply.

SSO Site Safety Officer.

Switching Devices Devices designed to close and/or open one or more electric circuits. Included in this category are circuit breakers, cutouts, disconnecting (or isolating) switches, disconnecting means, interrupter switches, and oil (filled) cutouts.

Tagout The placement of a tagout device on an energy-isolating device according to procedure to indicate that the equipment may not be operated until the tagout device is removed.

Tagout device A tag is used to identify the individual who has turned off an energy source (usually placed on a lockout device). The tag shall be able to withstand at least 50 pounds of force. Tagout devices should be used alone when it is not possible to install a lockout device. The tag shall have a label prohibiting unauthorized operation of the disconnecting means and unauthorized removal of the device.

UL Underwriter Laboratories.

Voltage (of a circuit) The greatest root-mean-square (effective) difference of potential between any two conductors of the circuit concerned.

Voltage, high Circuits with a nominal voltage more than 50 volts.

Voltage, low Circuits with a nominal voltage less than or equal to 50 volts.

Voltage, nominal An approximate value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240, 480/277, and 600).

Wet location Installations subject to saturation with water or other liquids.

2.0 RESPONSIBILITIES

2.1 National Leader Health Safety and Environment (NLHSE)

- Annually review and update this written program.
- In the event of an injury oversee the accident investigation and immediately make any changes to this program.
- Communicate any updates or learning with the office Health and Safety Coordinators (HSC) and employees.
- Provide the necessary training materials to the employees either through the office HSCs or a third party system.

2.2 Health and Safety Coordinators (HSCs)

- Review any of the necessary documents such as a site specific Health Safety and Environment Plan (HASEP), Job Safety Analysis (JSA), job checklist, and/or work permit, etc. to confirm compliance with this program and any government agency requirements.
- Maintain training records.
- Assist with identifying the training needs for Golder employees.

2.3 Supervisors or Site Safety Officers (SSO)

- When working on a client site, communicate the following to the client or site-owner/operator:
  - Hazards present on the site as a result of Golder's presence or activities, or the presence of our subcontractors
  - Hazards identified during the work that were not initially anticipated
  - Actions taken to control or eliminate hazards and to prevent them from reoccurring in the future.
- Promote electrical safety awareness to all employees during the work activities.
- Verify that employees comply with the procedures and policies of this electrical safety program. Review all hazard/risk classifications conducted by employees working with electrical systems.
- Verify that employees have received training appropriate to their assigned electrical tasks and assist in under their supervision.
- Maintain the training records, health safety and environment plan (HASEP), job safety analysis (JSA), job checklist, work permit and other on-site documentation in a manner that can be easily accessed by employees, subcontractors, and/or government agencies.
- Provide all involved employees with appropriate personal protective equipment (PPE) at no cost to the employee, and verify that it is properly used.

2.4 Project Manager

- All electrical work must be completed in accordance with the requirements outlined in this program, as needed and during equipment replacement or upgrading.
- Emphasize controlling electrical hazards through the application of engineering and design controls.

2.5 Employees

- Perform a hazard/risk classification of the electrical work prior to beginning the task assigned. This assessment shall be conducted using the minimum protection requirements outlined in NFPA 70e.
- Follow the work practices described in this document and outlined in the HASEP, JSA, job checklist, work permit, etc., including the use of appropriate PPE and tools.
- Participate in the training required by this program, site specific training, or other identified training requirements such as fall protection, confined space, lockout/tagout, respiratory protection, hazard communication, hot work permit, etc.
- Immediately report any hazards not previously identified, any concerns related to the scope of work, work environment, PPE or training deficiencies, unexpected problems to the Project Manager.

2.5.1 California-Specific Sites

- When employees are working in the California on any exposed conductors or exposed parts of equipment connected to high-voltage systems, a qualified electrical worker, and/or employee in training, shall be in close proximity at each work location to act as an observer for the purpose of preventing an accident.
  - An observer will not be required in connection with work on overhead trolley distribution circuits not exceeding 1,500 volts direct current where there is no conductor of opposite polarity less than 4 feet away or where such work is performed from suitable tower platforms or other similar structures.
  - An observer will render immediate assistance in the event of an accident.
- When performing work with live line tools, minimum clear distances shall be maintained. Conductor support tools, such as link sticks, strain carriers, and insulator cradles, shall be permitted to be used provided that the clear insulation is at least as long as the insulator string or the minimum distance specified for the operating voltage.

3.0 ELECTRICAL HAZARDS

Electrical hazards include electric shock and burns, arc flash burns, arc blast impacts, and falls. The following are descriptions of each potential hazard:

- **Electric shock and burns.** An electric shock occurs from electricity passing through the body. An electrical burn is a burn that results from electricity passing through the body causing rapid injury including severe burns or death.
- **Arc flash burns.** Electric arc flash can occur if a conductive object gets too close to a high-amp current source. The arc flash can heat the air temperatures as high as 35,000 degrees Fahrenheit. The arc flash can vaporize metal and can cause severe skin burns by direct heat exposure or by igniting clothing.
- **Arc blast impacts.** Arc blast impacts occur when the heating of air or the vaporization of metal creates a pressure wave that can cause impact damage to the body from the pressure wave or flying debris, hearing loss, or memory loss (from a concussion).
- **Falls.** Electric shocks and arc-blasts can cause a person to fall by a shockwave, flying debris, and loss of conscious. Any time an employee is working in heights above 4 feet, fall protection shall be worn.

4.0 PRECAUTIONS

Safe work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contact when work is performed near or on equipment or circuits that are or may be energized. The most important principle of electrical safety is to **assume all electric circuits are energized unless each involved worker verifies they are not through approved testing methods.** Employees shall test all circuits and conductors every time work is to be performed on them, even if the circuit or conductor had previously been worked on earlier that day and left alone for a period of time. Additional precautionary work practices shall include but not limited to the following:

- **De-energize:** Whenever an individual is working on electrical equipment, circuits, or wiring they should de-energize that equipment, circuits, or wiring whenever possible.
- **Identify the hazards:** A hazard analysis in the form of a site specific HASEP and task specific JSA will be prepared for all project site and task specific work activities. These analyses will identify sources of a potential electric shock, arc flash and arc blast, or other hazards associated with the work activities such as confined spaces, falling hazards, size of workspace areas, etc. The hazard analysis should also cover the work procedures involved, special precautions, emergency contact information and procedures, engineering and administrative controls, energy source controls, PPE requirements, training requirements, and the severity, frequency, probability and engineering controls of the limited approach boundary.
- **Plan every task:** A written approach and step-by-step procedures shall be prepared, discussed, and agreed upon between all involved employees before the beginning of any work. Discuss the site and task specific hazards and procedures in a daily toolbox safety meeting with all employees, supervisors, and subcontractors that will be working on the equipment or within the affected area each day. The toolbox safety meetings shall be conducted prior to the start of work activities and in the event of any environmental, site, or scope of work changes.
- **Minimize the hazards:** De-energize any equipment. Insulate or isolate exposed live parts using a non-conductive material or other means as not to transmit electrical current. In the event that engineering or administrative controls cannot remove the hazard, the proper insulated PPE and tools shall be used to prevent contact and conduction with electrical sources.
- **Obtain training:** All involved employees shall be a qualified electrical worker with appropriate training for the task to be completed. Every employee who faces a risk of electric shock, but who are not qualified, shall be trained and familiar with electrically related safety practices and the relationship between electrical hazards and associated injuries. Employees shall be trained in safety related work practices that pertain to their respective job assignments. See section 5 for training requirements.

5.0 TRAINING

5.1 Qualified Electrical Worker

A person must be an authorized lockout/tagout employee in order to apply a lock or tag to control hazardous energy. Qualified electrical workers shall be familiar with the proper use of the special precautionary techniques, personal protective clothing, arc flash insulating and shielding materials, and insulated tools and test equipment. A person can be considered qualified with respect to certain equipment and methods but is unqualified for others. Employees must receive training in avoiding the electrical hazards associated with working on or near exposed energized parts prior to performing energized electrical work. Training shall be provided prior to the start of all electrical work activities and refresher training will be provided every three years; as required by state and federal requirements; after changes in regulations; after near-misses or incidents; or when site conditions or procedures change. An employee who is undergoing on-the-job training and who in the course of such training has performed duties safely at their level of training and who is under the direct supervision of a qualified person shall be considered to be qualified. Only a qualified electrical worker is allowed to work on energized circuits, equipment, or systems.

Qualified electrical workers must be competent in the following areas:

- Understand the requirements of the NFPA 70e Standard including arc flash and arc blast hazards and precautions/controls, and the requirements of Table 130.2 to determine appropriate protective measures for the work.
- Knowledge of lockout/tagout including work practices required to safely de-energize electrical equipment.
- Understand electrical safety procedures.
- Able to distinguish exposed live parts from other parts of electric equipment.
- Have the skills and techniques necessary to determine the nominal voltage of exposed live parts.
- Selection and use of proper work practices, tools, insulating and shielding materials, and equipment for working on or near energized parts.
- Prior on-the-job training with a qualified electrical worker.
- Recognition of the signs and symptoms of electric shock, heart fibrillation, electric burns, and proper first aid protocols for these conditions, including the following training:
  - Cardio pulmonary resuscitation (CPR).
  - Automatic external defibrillator (AED).
  - Basic first-aid.
- Able to identify safe and unsafe electrical elements of each specific work area.
- Ability to understand the maximum voltage of the work area.
- Ability to understand the minimum approach distances for the maximum voltage within the area.

- Knowledge of the applicable clearance distances
- Trained in the recognition, proper use, limitation, maintenance, and inspection of PPE that will be used to provide protection for them and the work practices necessary for performing their specific work assignments within the area.

Only qualified electrical workers shall work on energized conductors or equipment connected to energized high-voltage systems. Qualified electrical workers **shall not** be assigned to work alone, except for, operating switches, or other operations that do not require the employee to contact energized high voltage conductors or energized parts of equipment, clearing trouble, and/or emergencies involving hazard to life or property.

5.2 Non-Qualified Electrical Worker

Non-qualified personnel are not expected to have full knowledge of the operation of electrical equipment or systems and all of the inherent electrical hazards. They may be required to provide assistance to the qualified electrician who is responsible to provide safety oversight. While non-qualified personnel do not work directly on energized equipment, they can still be potentially exposed to the risks of electrical hazards and must be protected based on the results of the hazard analysis. Non-qualified personnel shall not be permitted to enter spaces or enter the approach boundaries that are required to be accessible to qualified employees, unless the electric conductors and equipment involved are in an electrically safe work condition.

5.3 Retraining

An employee shall receive additional training (or retraining) under any of the following conditions:

- If the supervision or annual inspections indicate that the employee is not complying with the safety related work practices
- If new technology, new types of equipment, methods, and/or changes in the procedures necessitate the use of safety related work practices that are different from those that the employee would normally use
- If they must employ safety related work practices that are not normally used during their normal job duties
- Changes in government regulations or to this program
- If any near-misses or incidents occur
- At regular intervals not to exceed every three years.

5.4 Documentation of Training and Experience

Golder maintains documentation of employee training and qualified experience within the employee's health and safety training database and/or personnel files. This documentation demonstrates that individuals have met the training and experience requirements for the types of work being performed and that the employees have shown proficiency in those tasks. The training records will be properly maintained and include the employee's name, date of training, and signature of instructor and shall be retained for the employee's length of employment.

6.0 GROUNDING CONDUCTOR ASSURANCE

Golder's grounding conductor assurance program (assured grounding program) applies to all Golder project sites including construction sites, maintenance facilities, warehouses, and operating plants. This covers all cord sets, receptacles that are not a part of the building or structure, and equipment connected by cord and plug. Golder's site-specific assured equipment grounding conductor program shall be written by a competent person, and a copy shall be maintained in the project file. This program will outline the specific procedures for the required equipment inspections, tests, and test schedule. The written program description and the recorded tests will be made available at the jobsite or upon request.

Prior to use, each cord set, attachment cap, plug and receptacle of cord sets, and any equipment connected by cord and plug shall be visually inspected for damage before the work activities or use. Cord sets and receptacles that are fixed and not exposed to damage will not require a daily inspection. The inspection should include the following:

- Equipment grounding conductors will be tested for continuity using a continuity tester or multimeter and shall be electrically continuous.
- Each receptacle and attachment cap or plug shall be tested for correct attachment of the equipment grounding conductor.
- The equipment grounding conductor shall be connected to its proper terminal.

Inspections shall occur at the following frequencies:

- Before equipment is returned to service following any repairs.
- Before equipment is used after any incident that can be reasonably suspected to have caused damage (for example, when a cord set is run over).
- At intervals not to exceed 3 months, except that cord sets and receptacles that are fixed and not exposed to damage shall be tested at intervals not exceeding 6 months.

The results of the inspections shall be recorded for each receptacle, cord set, and cord- and plug-connected equipment (e.g., a log shall be created to document every component inspected). The records at a minimum shall indicate the last date it was tested or the interval for which it was tested, the person performing the inspection, and if the inspection passes or fails. Each piece of electrical equipment should be tagged with an identification number so that each is singularly identifiable during inspections or audits. Equipment that does not meet test requirements or has failed the testing will not be used, removed from the work area, and labeled "damaged, do not use".

Golder will establish an appropriate method for marking cord sets and cord- and plug-connected equipment. Table 6-1 below lists a color code method that is used by electricians and contractors. Colored plastic or vinyl electrical tape is placed on one or both ends of cords and cord- and plug-connected equipment to denote the month that the tests were performed.

Table 6-1 – OSHA Testing Color Codes

Assured Equipment Grounding Conductor Program Color Code			
Month #	Month Tested	Color of tape(s) to apply to cord	
1	January	White	
2	February	White +	Yellow
3	March	White +	Blue
4	April	Green	
5	May	Green +	Yellow
6	June	Green +	Blue
7	July	Red	
8	August	Red +	Yellow
9	September	Red +	Blue
10	October	Orange	
11	November	Orange +	Yellow
12	December	Orange +	Blue

As an easy reminder of the color of the tape to place on the newly tested cord, remember the color for the start of each calendar quarter by the season:

- White in January for Winter.
- Green in April for Spring.
- Red in July for Summer or the 4th of July.
- Orange in October for Fall.

Then add:

- Yellow for the second month in each quarter.
- Blue for the third month of each quarter.

At a minimum, Golder will inspect cord sets, receptacles that are not a part of the building or structure, and equipment connected by cord and plug every three months with the color code as follows

- White-January
- Green-April
- Red-July
- Orange-October

Alternative color schemes may be employed on project sites if the color scheme system is documented and known to all affected employees.

7.0 REQUIREMENTS FOR TEMPORARY WIRING

Temporary electrical power and lighting installations 600 volts or less, including cords, cables and extension cords may only be used during and for renovation, maintenance, repair, or experimental work. Extension cords shall not be used as a substitute for the permanent wiring of a structure; when run through, behind, or under floors, doors, windows, or walls; when affixed to building surfaces. The following additional requirements apply:

- Ground-fault circuit interrupters (GFCIs) must be provided on all temporary-wiring circuits, including extension cords. GFCIs must be rated to trip at (standard 5mA) shall trip within 1/40th of a second. Additional requirements for GFCIs include:
  - GFCIs shall be installed in any 120-volt, single-phase 15- and 20-ampere receptacle outlets on construction sites that are not part of the permanent wiring of the building or structure.
  - GFCIs are not required for receptacles on a two-wire, single-phase portable or vehicle-mounted generator rated not more than 5 kilovolts (kV) where the circuit conductors of the generator are insulated from the generator frame or other grounded surfaces.
  - A GFCI shall be placed somewhere in line (between the power tool and electrical outlet) unless it is plugged directly into a wall outlet and has a 3-pronged (grounded) plug. Extension cords or power tool cords shall not be used for raising, lowering, or carrying the equipment or tools.
- All equipment and tools connected by cord and plug must be grounded except for listed or labeled double insulated tools and appliances. Feeders must originate in an approved distribution center, such as a panel board that is rated for the voltages and currents the system is expected to carry.
- Branch circuits must originate in an approved power outlet or panel board.
- Neither bare conductors nor earth returns may be used for the wiring of any temporary circuit.
- Receptacles must be grounded except for those installed in a complete metallic raceway. Each branch circuit must contain a separate equipment-grounding conductor and all receptacles must be electrically connected to the grounding conductor.
- Cords and cables shall have the approved usage type, suitable for the location, and for its intended use. They may only be used for pendants, wiring of fixtures, connection of portable lamps or appliances, elevators, hoists, connection of stationary equipment where frequently interchanged, prevention of transmission of noise or vibration, data processing cables, or where needed to conduct maintenance or repair. Cords and cables may not be used as a substitute for the fixed wiring, run through holes in walls, ceilings or floors, doorways, windows or similar openings, attached to building surfaces, or be concealed behind building walls, ceilings or floors.
- Suitable disconnecting switches or plug connects must be installed to permit the disconnection of all ungrounded conductors of each temporary circuit.
- Lamps for general illumination must be protected from accidental contact or damage, either by elevating the fixture or by providing a suitable guard. Hand lamps supplied by cord must be equipped with a handle of molded composition or other approved material and must be equipped with a substantial bulb guard.

- Cords and cables shall be protected from sharp corners, crushing blows, stretching, pinch points, and anything else that may cause damage to the cord.

7.1 Portable Electrical Equipment and extension cords

Several common work tasks require the use of electrically powered tools with attached cords, with or without the use of extension cords. The use of corded tools and extension cords is regulated under multiple federal and state safety standards including but not limited to, 29 CFR 1910 Subpart S, 29 CFR 1910.147, and 29 CFR 1926 Subpart K. The following requirements apply to the use of cord-and-plug-connected equipment and flexible cord sets (extension cords):

- Extension cords may only be used to provide temporary power.
- Portable cord-and-plug connected equipment and extension cords must be visually inspected before use on any shift for external defects such as loose parts, deformed and missing pins, damage to the outer jacket or insulation, and for possible internal damage such as pinched or crushed outer jacket. Any defective cord or cord-and-plug-connected equipment must be removed from the work area and tagged as “damaged, do not use”. Damaged equipment may not be used until it is repaired and tested by a competent person.
- Extension cords must be of the three-wire type, have a GFCI between the power supply and the equipment, and the approval rating must be visible and legible (for example, types S, ST, and SO).
- Job-made (altered) extension cords or plug in boxes shall not be used by Golder employees or our subcontractors.
- In general, all equipment and tools connected by cord and plug must be grounded. Listed or labeled double insulated tools and appliances need not be grounded.
- Feeders must originate in an approved distribution center, such as a panel board, that is rated for the voltages and currents the system is expected to carry.
- Branch circuits must originate in an approved power outlet or panel board.
- Receptacles must be of the grounding type. Unless installed in a complete metallic raceway, each branch circuit must contain a separate equipment-grounding conductor, and all receptacles must be electrically connected to the grounding conductor.
- Personnel performing construction work in damp or wet locations must be provided, and must use, a GFCI. At no times shall an extension cord or piece of equipment run through or be used in a standing body of water. In the event that electric equipment and flexible cords are used in a highly conductive work location, such as water or other conductive liquids, employees shall get approval from the Project Manager and have a GFCI in line with the tool.
- Do not run cords through windows or doors unless they are protected from possible damage and may only be used in this fashion on a temporary basis. Cords may not be run above ceilings, inside or through walls, on the ceilings or wall surfaces, or be fastened with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation.
- Cords must be covered by a cord protector or tape while in walkways or traffic areas. This will help prevent tripping hazards and damage to the cord.
- Attachment plugs and receptacles may not be connected or altered in any way that would interrupt the grounding abilities, to be altered to allow the grounding pole to be inserted

into current connector slots, or by clipping the grounding prong from an electrical plug. Cords may only be plugged into grounded receptacles and the continuity of the ground shall be verified within a two-prong outlet before use. If possible any two-prong outlet should be replaced with a three-prong outlet. Adapters that interrupt the continuity of the equipment grounding connection may not be used.

- If a cord or piece of equipment is energized then employee's hands must be dry when using or when plugging and unplugging the cords or equipment.
- In the event that the connection could provide a conducting path to employee's hands (i.e. if a cord connector is wet from being immersed in water), the energized plug and receptacle connections must be handled only with insulating PPE.
- Locking-type connectors must be properly locked into the connector.

7.2 Electrical Supply for Lighting Sources

- Lamps for general illumination must be protected from breakage and metal shell sockets must be grounded.
- Temporary lights must not be suspended by their cords unless they have been designed for this purpose.
- Portable lighting used in wet or conductive locations, such as tanks or boilers shall be operated at no more than 12 volts or must be protected by GFCI devices.

8.0 PORTABLE GENERATORS

Portable and vehicle mounted generators that are used to provide power to cord-connected tools and equipment shall meet the following requirements

- The generator frame has a connection to ground (earth)
- Only the receptacles (sockets) mounted on the generator or vehicle are used to provide power to cord connected tools or equipment
- Non-current carrying metal parts of the equipment and the equipment grounding conductor of the receptacles are bonded to the generator frame
- For vehicle mounted generators, the frame of the generator is bonded to the frame of the vehicle
- Any neutral conductor is bonded to the generator frame
- For generators which produce greater than 5kW, GFCI units either need to be built into the receptacles or portable GFCI devices shall be used
- Generators shall not be refueled while hot unless provisions are made to prevent flash fires
- Appropriate PPE shall be used when connecting or disconnecting main power supplies where the electrical hazard is greater than 110 volts (ac).

9.0 WET OR DAMP LOCATIONS

Work in wet or damp work locations (i.e. areas surrounded or near water or other conductive liquids) should not be performed. Electrical work should be postponed until the liquid can be cleaned up. The following special precautions must be incorporated while performing work in damp locations:

- Only use electrical cords that have GFCIs.
- Place a dry barrier over any wet or damp work surface.
- Remove standing water before beginning work. Work is prohibited in areas where there is standing water.
- Do not use electrical extension cords in wet or damp locations.
- Keep electrical cords away from standing water.

10.0 WORKING ON DE-ENERGIZED EQUIPMENT

10.1 Electrically Safe Condition

The most important principle of electrical safety is to **assume all electric circuits are energized unless each involved worker verifies they are not.** Employees shall test all circuits and conductors every time work is to be performed on them, even if the circuit or conductor had previously been worked on earlier that day and left alone for a period of time. The testing equipment shall be properly rated for the voltage of the equipment being worked on. While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts shall be locked out or tagged or both. Conductors and parts of electrical equipment that have been de-energized but not been locked or tagged out shall be treated as live parts and shall require a written energized electrical work permit prior to the start of work.

Six steps for safe electrical work:

1. Identify all sources of power to the equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
2. Remove the load current and then open the disconnecting devices for each power source.
3. When possible employees shall visually verify that blades of disconnecting devices are fully open or that drawout-type circuit breakers are fully withdrawn.
4. Apply lockout/tagout devices in accordance with Golder's "GAI_HSE_200.034_SWP_Lockout_Tagout" and any site or government requirements.
5. Test each phase conductor or circuit part with an adequately rated voltage detector to verify that the equipment is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Check the voltage detector before and after each test to be sure it is working.
6. Properly ground all possible sources of induced voltage and stored electric energy (such as, capacitors) before touching. If conductors or circuit parts that are being de-energized could contact other exposed conductors or circuit parts, apply ground-connecting devices rated for the available fault current.

Note: The process of de-energizing is "live" work and can result in an arc flash. When de-energizing follow the procedures described in "Working On or Near Energized Equipment" of this program.

10.2 Lockout/Tagout Program

When applicable, a project-specific lockout/tagout program shall be prepared and the employees shall be trained and authorized by Golder in lockout/tagout policies, procedures, and PPE. The program should include locating and labeling energy sources, identifying employees at risk, how and by whom the equipment is de-energized, releasing of stored energy, verifying that the circuit is de-energized and can't be restarted, voltage testing, grounding requirements, shift changes, coordination with other jobs in progress, a procedure for keeping track of all involved personnel, applying and removing lockout/tagout

devices, return to service, and temporary re-energizing for testing/positioning. Lockout/tagout procedures should be developed for each machine or piece of equipment that will require servicing:

- Lockout/tagout application: Each person who could be exposed to electric energy shall be involved in the lockout/tagout process.
- After the de-energizing of equipment, circuits, panels, or lines, each employee at risk should apply their own individual lockout/tagout device to each energy source. Pushbuttons or selector switches cannot be used as the only way to de-energize equipment.
- Before the start of any work activity, each employee involved must verify through testing that all energy sources have been de-energized and have been properly locked out/tagged out.
- Electric lockout/tagout procedures should be coordinated with all other site procedures for controlling exposure to electric energy and other types of energy sources.
- Individual qualified-employee control procedure: For minor servicing, maintenance, inspection, etc. on plug-connected equipment, work may be conducted without attaching lockout/tagout devices if the plug is next to where the employee is working, always easy to see, and the equipment is never left alone while being serviced.
- Complex lockout/tagout procedures: Special procedures are needed when there is more than one energy source, crew, craft, location, employer, way to disconnect, lockout/tagout procedure, or work that lasts beyond one shift. There shall be only one qualified person at a time in charge of the lockout/tagout procedures with full responsibility and accountability. The written lockout/tagout plan shall address the specific details of the person in charge.
- Removal of lockout/tagout devices: Lockout and tagout devices should be removed only by the person that had installed them. **No employee shall remove another employee's lockout/tagout device**. If work is not completed when the shift changes, workers arriving on the next shift should apply their own lockout/tagout devices before the departing workers remove their lockout/tagout devices.
- The person responsible for initiating the lockout (authorized person) shall be responsible for:
  - Removing any temporary personal protective equipment from the work area
  - Reinstalling all permanent barriers or covers
- Return to service: Once work is completed employees shall conduct a visual inspection to confirm that all tools, mechanical restraints, electric jumpers, shorts, personnel and grounds have been removed from the area before the lockout/tagout devices are removed and the equipment is re-energized.
- Temporary release: If the job requiring lockout/tagout is interrupted for testing or positioning equipment, follow the same steps as in return to service (above).

11.0 WORKING ON OR NEAR ENERGIZED EQUIPMENT

Working on live circuits means actually touching energized parts. Working near live circuits means working close enough to energized parts to pose a risk of electrocution, arc flash, or arc-blast even though the work is on de-energized parts. Prior to beginning work, the work area must be examined for safe access to all electrical equipment associated with the work. Only a qualified electrical worker is allowed to work on energized circuits. Such persons shall be made familiar with the use of special precautionary techniques, PPE, insulating and shielding materials, and insulating tools. Common tasks that shall need to performed work on or near live circuits include:

- Taking voltage measurements.
- Opening and closing disconnects and breakers.
- Racking breakers on and off the bus.
- Removing panels and dead fronts.
- Opening electric equipment doors for inspection.

Project-specific written procedures and training shall be developed for these common tasks. When an unqualified person is working in an elevated position near overhead lines, the location shall be at a distance so that person and the longest conductive object that they may operate cannot come closer to any unguarded energized overhead line than the below distances:

- Voltages less than or equal to 50 kV = 10 feet
- Voltages greater than 50kV = 10 feet plus 4 inches per 10kV over 50kV

11.1 Approach Boundaries For Exposed Live Parts

The NFPA defines the following approach boundaries for shock hazards and arc flash.

- The Limited Approach Boundary is the distance from an exposed live part within which a shock hazard exists.
- The Restricted Approach Boundary is the closest distance to exposed live parts a qualified person can approach with without proper PPE and tools. Inside this boundary, accidental movement can put a part of the body or conductive tools and equipment in contact with live parts. To cross the restricted approach boundary the qualified person must perform the following:
  - Prepare and/or review the energized work permit that is approved by the Project Manager or supervisor.
  - Conduct a hazard assessment and complete the job training checklist.
  - Use PPE suitable for working near exposed lived parts and rated for the voltage and energy level involved.
  - Minimize the risk from unintended movement by keeping as much of the body as possible out of the restricted space. Body parts in the restricted space should be protected by the appropriately rated PPE for the voltage and energy level involved.

- The Prohibited Approach Boundary is the minimum approach distance to exposed live parts to prevent flashover or arcing. Approaching any closer is comparable to making direct contact with an energized part. To cross the prohibited approach boundary the qualified person must:
  - Have specified training to work on exposed live parts.
  - Have a permit with proper written work procedures and justifying the need to work that close.
  - Perform a JSA (in addition to the HASEP and job checklist).
  - Have the JSA and permit approved by the Project Manager or supervisor.
  - Use PPE appropriate for working near exposed live parts and rated for the voltage and energy level involved.
- The Flash Protection Boundary is the approach limit distance from which an exposed live part could arc-flash to a person giving them second degree burns or greater injuries. The follow are the requirements to work within the flash protection boundary:
  - Use PPE appropriate for working near exposed live parts and rated for the voltage and energy level involved.
  - For systems of 600 volts and less the flash protection boundary is 9 feet. Based on an available bolted fault current of 50 kilo amps (kA),a clearing time of 6 cycles (0.1 seconds) for the circuit breaker to act, or any combination of fault currents and clearing times not exceeding 300 kA cycles (5000 ampere seconds).

When working on de-energized parts and inside the flash protection boundary for nearby live exposed parts and if the parts cannot be de-energized, insulated, or protected against by contact then follow minimum distances required by federal, state or local regulations and standards.

Table 11-1 – NFPA table 130.2(C)

Approach boundaries to live parts for shock prevention

(All dimensions are distance from live part to employee)

	Limited approach boundary			
Nominal system voltage range, phase to phase	**Exposed movable conductor**	**Exposed fixed-circuit part**	**Restricted approach boundary (allowing for accidental movement)**	**Prohibited approach boundary**
0 to 50 volts	Not specified	Not specified	Not specified	Not specified
51 to 300 volts	10 ft. 0 in.	3 ft. 6 in.	Avoid contact	Avoid contact
301 to 750 volts	10 ft. 0 in.	3 ft. 6 in.	1 ft. 0 in.	0 ft. 1 in.
751 to 15 kV	10 ft. 0 in.	5 ft. 0 in.	2 ft. 2 in.	0 ft. 7 in.
15.1 kV to 36 kV	10 ft. 0 in.	6 ft. 0 in	2 ft. 7 in.	0 ft. 10 in.
36.1 kV to 46 kV	10 ft. 0 in.	8 ft. 0 in	2 ft. 9 in.	1 ft. 5 in.
46.1 kV to 72.5 kV	10 ft. 0 in.	8 ft. 0 in.	3 ft. 2 in.	2 ft. 1 in.
72.6 kV to 121 kV	10 ft. 8 in.	8 ft. 0 in.	3 ft. 3 in.	2 ft. 8 in.
138 kV to 145 kV	11 ft. 0 in	10 ft. 0 in.	3 ft. 7 in	3 ft. 1 in.

	Limited approach boundary			
Nominal system voltage range, phase to phase	**Exposed movable conductor**	**Exposed fixed-circuit part**	**Restricted approach boundary (allowing for accidental movement)**	**Prohibited approach boundary**
161 kV to 169 kV	11 ft. 8 in.	11 ft. 8 in.	4 ft. 0 in.	3 ft. 6 in.
230 kV to 242 kV	13 ft. 0 in.	13 ft. 0 in.	5 ft. 3 in.	4 ft. 9 in.
345 kV to 262 kV	15 ft. 4 in	15 ft. 4 in.	8ft. 6 in.	8 ft. 0 in.

Source: NFPA 70E Standard for Electrical Safety Requirements for Employee Workplaces

11.2 Work Inside Limited Approach Boundary

Only qualified persons shall perform tasks such as testing, troubleshooting, and voltage measuring within the limited approach boundary of energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists. Two workers shall be present for work inside the limited approach boundary where a shock hazard exists. One of the two workers shall be a qualified electrical person and the second may be either a qualified or competent electrical person; the second person shall act as an Electrical Standby Person. This person's responsibility is to know where to immediately shut off the source of voltage and to provide assistance, if needed, in case of an incident.

Exception: The presence of two workers shall not be required if one of the following conditions is satisfied:

- All voltage sources to the equipment of 50 volts or more have been de-energized (including possible back-feeds) prior to starting work, or
- The equipment has a built-in grounding device where the device is fully visible to be able to confirm that grounding has been accomplished.
- Prior to working on a previously energized conductor or circuit part, the qualified electrical worker shall test for voltage using insulating rubber gloves rated for the equipment's nominal voltage.

11.3 Safe Work Zone Barriers

A safe working zone, as defined by the limited approach boundary, shall be visibly barricaded using tape or ropes with red “Dangerous - Do Not Enter” warning labels. More substantial barricades are required where mechanical work or extensive pedestrian or vehicle traffic is expected in the work area. These barriers are intended to prevent accidental contact with exposed energized electrical conductors or circuit parts.

Suitable temporary barriers or barricades shall be installed when access to opened enclosures containing exposed energized equipment is not under the control of a qualified person who is authorized by Golder to be in the work zone.

11.4 Work Inside Restricted Approach Boundary

Only qualified electrical personnel are allowed to work at or inside the restricted approach boundary. Any work inside the restricted approach boundary is considered high risk and shall be conducted under an approved Energized Electrical Work Permit (Appendix B). This includes work not directly performed on the energized electrical equipment, such as pulling new wires into an energized electrical junction box or mounting new equipment inside an enclosure with energized electrical conductors or circuit parts. Qualified electrical persons working at or within the restricted approach boundary shall wear protective equipment appropriate for working on exposed energized electrical conductors or circuit parts and rated for the voltage and energy exposure level involved (see “Personal Protective Equipment” section 12 of this document).

Barricades and insulation devices shall be used to minimize the potential for unprotected body parts to cross the restricted approach boundary. This restriction shall be enforced to help prevent inadvertent electrical shock. Safe distances vary with the voltage levels of the equipment or systems.

11.5 Energized Electrical Work Permit For 120 Volts and Higher

Work shall not be performed on exposed energized parts of equipment or systems until the following conditions are met:

- Responsible supervision has determined that the work is to be performed while the equipment or systems are energized.
- Involved employees have received instructions on the work techniques and hazards involved in working on energized equipment.
- Suitable personal protective equipment and safe guards are provided and used.

If live parts are not placed in an electrically safe condition, the work to be performed shall be considered energized electrical work and shall be performed in accordance with a written permit only.

A copy of the Golder “Energized Electrical Work Permit” can be found in Appendix B of this document. The intent of this permit is to document that appropriate safety precautions are taken prior to the start of any energized electrical work.

Work related to testing, troubleshooting, and voltage measuring may be completed without a permit provided that appropriate safe work practices and PPE are used. The permit must be originated by a qualified electrical worker, and reviewed by the appropriate Project Manager or supervisor.

11.6 Other Precautions

When working on de-energized the parts, but still inside the flash protection boundary for nearby live exposed parts, the following steps shall be taken:

- If the parts cannot be de-energized, barriers such as insulated blankets must be used to protect against accidental contact, and by the appropriately rated PPE for the voltage and energy level involved.
- Employees shall not reach blindly into areas that might contain exposed live parts.
- Employees shall not enter spaces containing live parts unless illumination is provided that allows the work to be performed safely. In the event of poor illumination or an obstruction that precludes observation of the work, employees shall not perform any task within the limited approach boundary of the energized electrical conductors or with any circuits operating at 50 volts or more.
- Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn in the presence of an electrical contact hazard with exposed live parts.
- Conductive materials, tools, and equipment that are in contact with any part of an employee's body shall be handled in a manner that prevents accidental contact with energized parts. Such materials and equipment include, but are not limited to, long conductive objects such as ducts, pipes, tubes, conductive hose and rope, metal-lined rules and scale, metal scaffold parts, structural members, and chains.
- Conductive measuring tapes, ropes or similar devices shall not be used when working on or near exposed energized conductors or parts of equipment conductive fish tapes shall not be used in raceways entering enclosures containing exposed energized parts unless such parts are isolated by suitable barriers.
- When an employee works in a confined space or enclosed spaces (such as a manhole or vault) that contains exposed live parts then the employee shall use protective shields, barriers or insulating materials as necessary to avoid contact with the energized parts. Doors, hinged panels, and the like shall be secured to prevent them from swinging into employees.
- When working at heights or when using a ladder, the ladder must be made of non-conductive materials and side rails to prevent electrical shock.

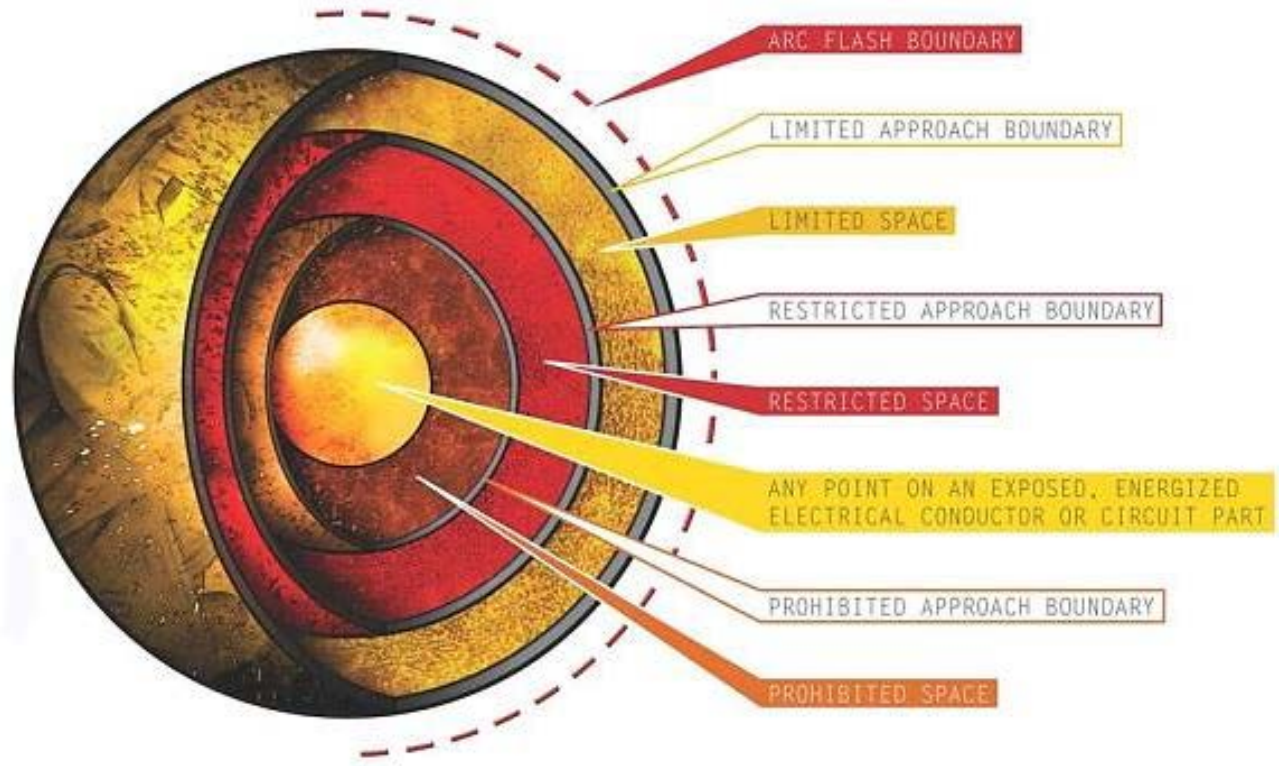
11.7 Testing Equipment

All testing equipment and their accessories shall be rated for the circuits and equipment to which they will be connected. Testing equipment and their accessories shall meet the requirements within the American National Standards Institute (ANSI) and the International Society of Automation (ISA) document number 61010-1 "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use". When testing for the absence of voltage on conductors or circuit parts operating at 50 volts or more, the test instruments used shall be verified before and after an absence of voltage test is performed.

11.8 Determine the Arc Flash Protection Boundary

The arc flash protection boundary determined during the arc flash hazard analysis is utilized to initiate the need for personal protective equipment.

Refer to Section 130 of NFPA 70E for formulas and other information needed to establish the arc flash protection boundary. This section in NFPA 70E also contains information and recommendations that address personal protective equipment required for personnel to cross inside the arc flash protection boundary.



12.0 PERSONAL PROTECTIVE EQUIPMENT

12.1 General Requirements

- All PPE, tools, and equipment shall be inspected prior to use and immediately following any incident that can reasonably be suspected of having caused damage. Any damaged or defective PPE, tools, and equipment stall be tagged out, removed from the area, and replaced. Insulating gloves shall be given an air test along with the daily inspection.
- Insulating equipment designed for the voltage levels to be encountered shall be provided and employees shall be instructed to use the equipment.
- Insulating equipment made of materials other than rubber shall provide electrical and mechanical protection at least equal to that of rubber equipment.
- Employees working in areas where there are potential electrical hazards must be provided with and use PPE that is appropriate for the specific work to be performed. The electrical tools and PPE must be specifically approved, rated, and tested for the voltage and energy levels involved to which an employee may be exposed.
- Employees shall not wear conductive apparel (conductive jewelry or clothing) while working on electrical equipment unless the conductive apparel is rendered non-conductive by covering, wrapping, removing, or other insulating means.
- Electrical PPE (Arc Flash Gear) will be provided on a project-specific basis, depending on the results of the hazard analysis. Such equipment may include rated arc flash apparel, eye protection, head protection, hand protection, insulated footwear, and face shields where necessary.
- Employees shall wear nonconductive head protection whenever there is a danger of head injury from electric shock or burns due to contact with live parts or from flying objects resulting from an electrical explosion.
- If fall protection is required, it must meet standards for electrical safety and have non-conductive hardware.
- See Table 12-1 for additional information on the types of protective clothing for the prevention of burns due heat exposure from arc flashes.

Table 12-1 – NFPA table 130.7(C)(11)

Protective Clothing Characteristics

Hazard Risk Category	Clothing Description (number of layers in parenthesis)	Minimum Arc Thermal Performance Value (ATPV) or EBT Rating of PPE cal/cm2
0	Non-melting, flammable materials (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight at least 4.5 oz/yd^2 (1)	N/A
1	Flame Resistant (FR) shirt and FR pant or FR coverall (1)	4
2	Cotton Underwear -- conventional short sleeve and brief/shorts, plus FR shirt and FR pants (1 or 2)	8
3	Cotton Underwear plus FR shirt and FR pants plus FR coverall, or cotton underwear plus two FR coveralls (2 or 3)	25
4	Cotton underwear plus FR shirt and FR pant plus	40

	double-layer switching coat and pants (multilayer flash suit) (3-4)	

Source: NFPA 70E, 2009 Edition, Table 130.7(C)(11).
Note: E_{BT} is defined in American Society of Testing and Materials F 1959-99 as the average of the five highest incident energy exposure values below the Stoll curve where the specimens do not exhibit breakopen. E_{BT} is reported when ATPV cannot be measured due to FR fabric break open.

- Employees shall wear rated rubber insulating gloves where there is a danger of hand or arm contact with live parts or possible exposure to arc flash burn.
- Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated soles shall not be used as the primary electrical PPE.
- Only face shields with arc rating shall be used for electrical work. Safety glasses or goggles must always be worn under face shields. Additional illumination may be needed when using tinted face shields as protection during electrical work.
- Electrical PPE must be selected to meet the criteria established by the American Society of Testing and Materials (ASTM) and by the ANSI.
- Employees must use electrically insulated tools and handling equipment that are rated for the voltages to be encountered when working near exposed energized conductors or circuits. Tools and handling equipment shall be replaced if the insulating capability is decreased due to damage. Protective gloves must be used when employees are working with exposed electrical parts above fifty (50) volts.
- Fuse handling equipment (insulated for circuit voltage) must be used to remove or install fuses when the fuse terminals are energized. Ropes and hand lines used near exposed energized parts must be made of non-conductive material.
- Protective shields, barriers, barricades, and/or insulating materials must be used to protect each employee or the public from shock, burns, or other electrical injuries near open enclosures that has exposed energized parts, or where dangerous electric heating or arcing may occur.

12.2 Flame-Resistant Apparel & Underlayers

Golder's Flame-Resistant Clothing Program – GAI HSE 208 must be followed when workplace conditions, or types of operations when the potential for flash fire and electric arc flashes exists. Specific flame-resistant clothing and other PPE requirements are detailed in Section 3 of the FRC Program.

12.3 Rubber Insulating Equipment

Rubber insulating equipment includes PPE such as gloves, sleeves, blankets, and matting.

- Insulating equipment must be inspected for damage before each day's use and immediately following any incident that could have caused damage to the equipment or PPE.
- An air test must be performed on rubber insulating gloves before each use (inflating glove to determine if any pinhole leaks are present). If leaks are present, gloves must be replaced before use).
- Insulating equipment found to have damage or defects that might affect its insulating properties must be removed from the service immediately and not returned until testing indicates that it is acceptable for continued use.
- If the insulating capability of PPE is subject to damage during use then the insulating material shall be protected by an outer covering of leather or other appropriate materials.

- Rubber insulating equipment must be tested according to the schedule supplied by the manufacturer or when there is suspected damage.
- Rubber insulating equipment must be stored in an area protected from light, temperature extremes, excessive humidity, ozone, and other substances and conditions that my cause damage to the material.
- No repairs to rubber insulating equipment shall be attempted without the approval of the Project Manager or supervisor.

12.3.1 Test Intervals for Rubber Insulation PPE

Gloves, sleeves, and blankets shall not be placed into service unless they have been electrically tested within the previous 12 months. Insulating equipment and PPE must be marked with the latest test date.

- Blankets – before first issue and every 12 months thereafter (ASTM standard F 479-06).
- Gloves – before first issue and every 6 months thereafter (ASTM standard F 476-06).
- Sleevers – before first issue and every 12 months (ASTM standard F 476-06).
- Covers and Line hose if insulating value is suspect, defective, or damaged (ASTM standard F 478-99).

12.4 Insulated Tools and Materials

All tools and equipment used for work in areas where there are potential electrical hazards must be appropriate for the work.

- Damaged or defective insulated tools or equipment shall be tagged out and removed from the area.
- Insulated tools and equipment shall be used within the Limited Approach Boundary of exposed energized parts.
- Insulated tools shall be rated for the voltages and energy levels on which they are used.
- Insulated tools shall be designed and constructed for the environment to which they are exposed and to the manner in which they are used.
- Fuse or fuse holder handling equipment that is insulated for the circuit voltage rating shall be used to removed or install a fuse if the fuse terminals are energized.
- Ropes and hand-lines used near exposed energized parts shall be made of nonconductive materials.
- Portable ladders used for electrical work be made of nonconductive materials and have side rails made of nonconductive materials such as fiberglass, wood, etc.
    - Portable ladders that are conductive and on site shall be marked with signs reading “Caution – Do Not Use Near Energized Electrical Equipment” (or equivalent writing).

12.5 Access Limiting Methods

- Barricades shall be used in conjunction with safety signs to prevent or limit access to the work areas containing energized parts. Conductive barricades shall not be used where they might cause an additional electrical hazard. Barricades shall be placed no closer than the Limited Approach Boundary.
- If signs and barricades do not provide sufficient protection, an attendant will be assigned to warn and protect people. The primary duty of the attendant shall be to keep any unqualified person out of the work area where an electrical hazard exists. The attendant shall remain in the area as long as there is a potential exposure to electrical hazards.

13.0 OVERHEAD HAZARDS

No Golder employee or subcontractor will be allowed to perform any function in proximity to energized high-voltage lines unless and until danger from accidental contact with said high-voltage lines has been effectively guarded against.

If work must be performed near overhead lines, the lines shall be de-energized and grounded, or other protective measures shall be provided before work is started.

- Unqualified employees shall maintain a clearance distance of at least 10’ (see table XX for additional required distances based on nominal voltage) from energized overhead power lines
- If electrical lines are to be de-energized and grounded, arrangements shall be made with the person or organization that operates or controls the electric circuits involved to de-energize and ground them.
- The employer responsible for the operations of equipment shall post and maintain in plain view of the operator and driver a durable warning sign legible at 12 feet reading: "Unlawful To Operate This Equipment Within 10 Feet Of High-Voltage Lines of 50,000 Volts Or Less.".
- Protective measures such as guarding, isolating, or insulating help to prevent employees from contacting such electrical lines directly with any part of their body or indirectly through conductive materials, tools or equipment.

Table 13.1 Minimum Clearance Distances

Voltage (nominal, kV, alternating current)	**Minimum clearance distance (feet)**
up to 50 over 50 to 200 over 200 to 350 over 350 to 500 over 500 to 750 over 750 to 1,000 over 1,000	10 15 20 25 35 45 (as established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).

13.1 Elevated Equipment

If any vehicle or equipment is elevated or lifting near energized overhead lines, the equipment operators shall maintain the minimum safe distances outlined within the Limited Approach Boundary distance Table 11-1 – NFPA table 130.2(C) Approach boundaries to live parts for shock prevention. Under the following conditions, the clearances shall be permitted to be reduced:

- If the vehicle or equipment is in transit with its appendages (i.e. crane boom, drilling mast, personnel bucket, etc.) in a lowered state, the Limited Approach Boundary distance to the overhead lines can be reduced by 6 feet (ft).
- If insulated barriers rated for the voltages involved are installed, and are not part of an attachment to the vehicle, then the clearance shall be permitted to be reduced to the design working dimensions of the insulating barrier.
- If the equipment is an aerial lift insulated for the voltage involved and if the work is performed by a qualified person, the clearance (between the un-insulated portion of the aerial lift and the power line) can be reduced to the Restricted Approach Boundary given in Table 3 - NFPA table 130.2(C), column 4, Table 11-1.

13.1.1 Approach Distances for California

In California the approach distance by elevated or lifting equipment near energized overhead lines is found in the Cal/OSHA T8 CCR 2946 (subchapter 5, group 2, article 37 (formerly article 86)) and in Table 13-2 of this document.

Table 13-2

Boom-type lifting or hoisting equipment clearances required from energized overhead high-voltage lines

Nominal Voltage Range (Phase to Phase)	Minimum Required Clearance (Feet)
600 – 50,000	10
50,000 – 75,000	11
75,000 – 125,000	13
125,000 – 175,000	15
175,000 – 250,000	17
250,000 – 370,000	21
370,000 – 550,000	27
550,000 – 1,000,000	42

When elevating or lifting equipment near energized overhead lines, the following safety precautions shall be followed:

- The operator of the lifting equipment shall post and maintain in plain view of the operator and driver on each crane, derrick, power shovel, drilling rig, hay loader, hay stacker, pile driver, or similar apparatus, a durable warning sign legible at 12 ft. The sign shall read “Unlawful To Operate This Equipment Within 10 Feet of High-Voltage Lines of 50,000 Volts or Less”.
- The erection, operation or dismantling of any boom-type lifting or hoisting equipment, or any part thereof, closer than the minimum clearances from energized overhead high-voltage lines set forth shall be prohibited.

13.1.2 Equipment Contact

Employees standing on the ground shall not make contact with the vehicle, equipment, or any of its attachments, unless either of the following conditions applies:

- The employee is using protective equipment rated for the voltage.
- The equipment is located so that no un-insulated part of the structure (that portion of the structure that provide a conductive path to employees on the ground) can come closer to the line than permitted in NFPA 130.5 (E)(1).

13.1.3 Equipment Grounding

If a vehicle or piece of equipment has the potential to come in contact with an overhead line or other energy source and if the vehicle or piece of equipment is grounded, employees shall not stand or work near the grounding point. Precautions such as the use of barricades or insulation shall be taken to protect employees from grounding point hazards such as step and touch potential that can develop within a few feet or more from the grounding point outward.

14.0 WORKING SPACE AROUND ELECTRIC EQUIPMENT

14.1 Spaces Around Electric Equipment

- Sufficient access and working space shall be provided and maintained around all energized equipment to permit ready and safe operating and maintenance of such equipment. Enclosures that house electric apparatus and are controlled by lockout/tagout and shall only be accessible to qualified persons.
- The working space for equipment operating at 600 volts or less shall comply with relevant NFPA standards
- The depth of the working space in the direction of live parts shall comply with the NFPA standards. Distances shall be measured from the exposed energized parts or from the enclosure or opening of the energized parts.

Table 17-1 – NFPA table 400.15(A)(1)

Working Spaces

Nominal Voltage to Ground	Minimum Clear Distance		
	Condition 1	Condition 2	Condition 3
0-150	900mm (3 feet)	900 mm (3 feet)	900mm (3 feet)
151-600	900mm (3 feet)	1m (3-1/2 feet)	1.2 m (4 feet)

  - **Condition 1:** Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating materials. Insulated wire or insulated busbars operating not over 300 volts to ground shall not be considered live parts.
  - **Condition 2:** Exposed live parts on one side and grounded parts on the other side. Concrete, brick, or tile walls shall be considered as grounded surfaces.
  - **Condition 3:** Exposed live parts on both sides of the work space (not guarded as provided in condition 1) with the operator in-between.
- **Dead-Front Assemblies**. Working space shall not be required in the back or sides of the assemblies such as dead-front switchboards or motor control centers where all the connections and all the renewable or adjustable parts (i.e. fuses or switches), are accessible from locations other than from the back or the sides. If rear access is required to work on non-electrical parts on the back of the enclosed equipment then a minimum horizontal working space of 762 millimeters (30 inches) shall be provided.
- **Low Voltage**. Smaller working spaces can be permitted where all un-insulated parts operate not greater than 30 volts, 42 volts peak, or 60 volts direct current direct current.
- **Existing Buildings.** In existing buildings were electric equipment is being replaced, Condition 2 working clearance shall be permitted between dead-front switch boards, panel boards, or motor control centers located across the aisle from each other. Condition 2 clearances are allowed only if written maintenance and supervision procedures have been adopted to prohibit equipment on both sides of the aisle from being open at the same time. Only qualified electrical workers shall service the installation.
  - **Width of Working Space.** The width of the working space in front of the electrical equipment shall be the width of the equipment or 750 millimeters (30 inches),

whichever is greater. In all cases the work space shall permit at least a 90 degree opening of equipment doors or hinged panels.

- **Height of Working Space.** The workspace shall be clear and extend from the grade, floor, or platform to the height required by NFPA 70E 400.15(E). Within the height requirements of this section, other equipment that is associated with the electrical installation and is located above or below the electrical equipment shall be permitted to extend not more than 150 millimeters (6 inches) beyond the front of the electrical equipment.
- **Clear Spaces.** Working space required by the NFPA 70E standard shall not be used for storage. When normally enclosed live parts operating at 50 volts or more are exposed for inspection or service then the working space, passageway, or general opened space shall be suitably guarded.

14.2 Access and Entrance to Working Space

- **Minimum Required**. At least one entrance of sufficient area shall be provided to give access to the working space around the electric equipment.
- **Large Equipment**. For equipment rated 1200 amperes or more and over 1.8 meters (6feet) wide that contains overcurrent devices, switching devices, or control devices, there shall be one entrance to the required working space not less than 610 millimeters (24inches) wide and 2.0 meters (6-1/2 feet) high at each end of the working space. Where the entrance has a personnel door(s) then the doors(s) shall open in the direction of the egress and be equipped with panic bars, pressure plates, or other devices that are normally latched but open under simple pressures. A single entrance to the required working space shall be permitted if either of the conditions in NFPA 70E 400.14(c)(2)(a) or 400.14(c)(2)(b) is met.
- **Unobstructed Exit**. Areas of ingress or egress shall have unobstructed access at all times.
- **Extra Working Space**. Where the depth of the working space is twice that required by NFPA 400.15(A)(1), a singled entrance shall be permitted. It shall be located so that the distance from the equipment to the nearest edge of the entrance is not less than the minimum clear distance specified in Table 6 in this document for equipment operating at that voltage and in that condition.

14.3 Illumination

Illumination shall be provided for all working areas about service equipment, switchboards, panel boards, or motor control centers installed indoors. Additional lighting outlets shall not be required where the work space is illuminated by an adjacent light source. In electrical equipment rooms, the illumination shall not be controlled by automatic means only.

14.4 Headroom

The minimum headroom of working spaces about service equipment, switchboards, panel boards, or motor control centers shall be 6.5 ft. If the electrical equipment exceeds 6.5 ft in height, then the minimum headroom shall not be less than the height of the equipment.

14.5 Dedicated Equipment Space

All switchboards, panel boards, distribution boards, and motor control centers shall be located in dedicated spaces and protected from damage. Exception: Control equipment that by its nature or because of other requirements must be adjacent to or within sight of the operating machinery shall be permitted in those locations.

15.0 MINING FACILITIES

In the event that employees will be performing electrical activities at a surface or underground mine facility (especially coal mines) they shall either be qualified to perform the work (testing and experience along with certification required) or be under the supervision of a qualified person. They shall use only approved equipment in accordance to MSHA 30 CFR 75.511 “low, medium, or high voltage distributing circuits and equipment; repair” and 30 CFR 77.501 “electric distribution circuits and equipment; repair”. Additional safety precautions shall be taken:

- Disconnection devices or working on energized equipment shall be locked out and tagged out per OSHA 29 CFR 1910.147 “the control of hazardous energy (lockout/tagout).
- Disconnecting devices shall be locked out and suitably tagged by the persons who perform such work, except that in cases where locking out is not possible, such devices shall be opened and suitably tagged by such persons.
- Locking and tagging devices shall be removed by only those who placed the devices on the energy source(s). No other employee shall remove another person’s lock or tag.
- In the event that there is a shift change or the employee leaves the area, every attempt to contact the person who left their lockout/tagout devises on the energized source shall be made prior to removing the devises. The Project Manager or their authorized designee shall be the only person(s) to be allowed to remove other employees lockout/tagout devises only after the area has be inspected and it is confirmed that there are no personnel or tools within the affected area.
- Locks or tags shall be removed only by the persons who installed them or, if such persons are unavailable, by persons authorized by the operator.

16.0 SUBCONTRACTOR RESPONSIBILITIES

- The Project Manager of Golder-operated sites must notify any subcontractors of any electrical/arc flash hazards in the workspace to which they may be exposed.
- Golder subcontractors are responsible for training their employees in electrical safety. Copies of training records shall be submitted to Golder before the start of any work activities.
- The subcontractor shall communicate any hazards, processes, or chemicals brought onto a Golder-operated site to the site manager and other Golder personnel. A copy of the MSDS or SDS shall be maintained on site.
- For new work, a JSA must be completed by the subcontractor and/or the Golder employees prior to the start of any work activities. A toolbox meeting will take place to communicate the hazards and task requirements with all affected parties.
- Golder employees must understand the work of the subcontractors in order to prepare for any risks they may bring to a workplace.
- Unless approved by the Project Manager, Golder lockout and tagout equipment will not be issued to subcontractors.
- Golder subcontractors shall submit an arc flash/electrical hazard assessment prior to the start of any work activities for Golder during any new equipment installation or repairs.
- Safety programs used by Golder subcontractors shall meet or exceed all applicable guidelines of this electrical safety program and any government requirements.
- Subcontractors are required to comply with all applicable safety and health regulations found in OSHA, ANSI, Underwriters Laboratories (UL), NEC, NFPA, and Environmental Protection Agency (EPA).
- Subcontractors are required to submit copies of their safety program to the Project Manager.
- The subcontractor shall advise Golder of any of the following issues that may arise on the project site:
- Any corrective measures the subcontractor took to correct any hazards reported by both by Golder or any unexpected hazards reported by the subcontractor. Include what engineering controls or preventive measures were taken to prevent these hazards from recurring in the future.

17.0 REFERENCES

17.1 Applicable Regulations and Standards

- NFPA 70 and 70-E, “Standard for Electrical Safety in the Workplace”.
- IEEE Standard 1584-2002, “Guide for Performing Arc Flash Hazard Calculations”.
- OSHA 29 CFR 1910.331 through 1910.335, “Electrical Safety-Related Work Practices”.
- OSHA 29 CFR 1910.147, “The Control of Hazardous Energy (Lockout/Tagout).”
- OSHA 29 CFR 1926 Subpart K “Construction Electrical Safety”
- OSHA 29 CFR 1926.404, “Wiring design and protection”
- MSHA 30 CFR 56/57 Subpart K Electricity for Surface and Underground M/NM Mines
- MSHA 30 CFR 75/77 Subpart B “Qualified Persons”
- MSHA 30 CFR 75/77 Subparts F, G, H, I, J, KMSHA 30 CFR 75.511 “low, medium, or high voltage distributing circuits and equipment; repair”
- MSHA 30 CFR 77.501 “electric distribution circuits and equipment; repair”
- Cal/OSHA T8 California Code of Regulations (CCR) 2940 (subchapter 5, group 2, article 36 (formerly article 85)) “General Provisions”,
- Cal/OSHA T8 CCR 2320 (.1, .2, .3, .4. and .7),

17.2 Golder Programs

- GAI_HSE_200.011_SWP_Overhead_Hazards
- GAI_HSE_200.033_SWP_Fall_Protection
- GAI_HSE_200.034_SWP_Lockout_Tagout
- GAI_HSE_208_FRC_Program

APPENDIX A

Electrical Safety Training Check List

ELECTRICAL SAFETY TRAINING CHECKLIST			
TRAINING ITEM	**YES ☑**	**N/A ☑**	**COMMENTS**
SCOPE AND TRAINING			
1. All employees who work on, near or with facility wiring, wiring for connections to supply, other wiring, and installation of optical fiber cable along with electrical conductors have been trained as either qualified or unqualified workers.	❑	❑	
2. Unqualified person have been trained in and are familiar with any electrically related safety practices not covered by this standard but necessary for their safety.	❑	❑	
3. Qualified persons trained in and familiar with:			
a) Skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.	❑	❑	
b) Voltage determination.	❑	❑	
c) Clearance distances that must be maintained.	❑	❑	
d) Training conducted has been specific to the hazards to which the employee may or will be exposed and their particular job duties.	❑	❑	
SELECTION AND USE OF WORK PRACTICES			
1. Work practices used to prevent electric shock and other injuries address de-energized parts that may be energized.	❑	❑	
2. Work practices used to prevent electric shock and other injuries address exposure to energized parts.	❑	❑	
3. Procedure provided for work on or near exposed de-energized parts includes:			
a) Written procedures specific to the equipment or worksite.	❑	❑	
b) De-energizing equipment.	❑	❑	
c) Application of locks and tags.	❑	❑	
4. Working on or near exposed energized parts:			
a) All employees near enough to be exposed to a hazard have been trained, and are aware of the practices that must be followed to protect them from the hazard.	❑	❑	
b) Only qualified employees work on energized parts.	❑	❑	
c) Overhead lines de-energized and grounded prior to working near them **or** other protective measures used.	❑	❑	
d) Unqualified persons working near overhead lines are aware that they may not come approach, or use conductive objects closer than, 10 feet for lines up to 50 kV, or 10 feet plus 4 inches for every 10 kV over 50 kV.	❑	❑	
e) Qualified persons are to have a working knowledge of the allowable approach distances of this program.	❑	❑	
f) Vehicle and mechanical equipment operators understand that they must maintain:			
i) A clear distance of 10 feet plus 4 inches for every 10 kV over 50 kV while working near energized overhead lines.	❑	❑	
ii) A clear distance of 4 feet plus 4 inches for every 10 kV over 50 kV while in transit.	❑	❑	

TRAINING ITEM			YES ☑	N/A ☑	COMMENTS
	iii)	Insulating barriers are used and installed as required.	❑	❑	
	iv)	Insulated aerial lift operated by a qualified person must comply with the separation distances.	❑	❑	
	v)	Employees standing on the ground understand they may not contact the vehicle unless using protective equipment rated for the voltage or the equipment located so no un-insulated part can provide a conductive path to persons on the ground.	❑	❑	
g)		Illumination is provided at all worksites to assure safe work.	❑	❑	
h)		Protective shields and barriers provided and used for work in confined spaces to prevent contact with exposed energized parts.	❑	❑	
i)		All conductive materials such as pipes, rods, etc. are handled so as to prevent contact with exposed energized parts.	❑	❑	
j)		Conductive articles of clothing and jewelry such as watches, rings, etc. are not worn if they might contact exposed energized parts unless rendered nonconductive.	❑	❑	
k)		Portable ladders with nonconductive siderails are used when working near or on exposed energized conductors.	❑	❑	
l)		Housekeeping conducted only when exposed energized parts may not be contacted. Barriers provided and nonconductive cleaning materials used.	❑	❑	
m)		Only qualified persons are allowed to bypass electrical interlocks on temporary basis while they work on equipment.	❑	❑	
USE OF EQUIPMENT					
1.		Portable electric equipment such as cord-and-plug connected equipment, including flexible cords:			
a)		Handled in a manner to avoid damage.	❑	❑	
b)		Not used to raise or lower equipment.	❑	❑	
c)		Not fastened with staples or hung so as to damage insulation.	❑	❑	
d)		Visually inspected before each use on each shift.	❑	❑	
e)		Defective items removed from service and not used until rendered safe.	❑	❑	
f)		Plugs and receptacles mate properly.	❑	❑	
g)		Flexible grounding-type cords have a grounding conductor.	❑	❑	
h)		Grounding plug not defeated.	❑	❑	
i)		Adapters that interrupt grounding continuity not used.	❑	❑	
j)		Approved equipment used for work in conductive work locations (e.g. wet locations, etc.).	❑	❑	
k)		Locking-type connectors are properly secured after connection.	❑	❑	

TRAINING ITEM	YES ☑	N/A ☑	COMMENTS
ELECTRIC POWER AND LIGHTING CIRCUITS			
1. Only load rated switches or circuit breakers used as disconnecting means.	❑	❑	
2. Circuits not manually reenergized until it is determined that it is safe to do so.	❑	❑	
3. Overcurrent protection of circuits not modified.	❑	❑	
TEST INSTRUMENTS AND EQUIPMENT			
1. Used by qualified persons only.	❑	❑	
2. Visually inspected before use.	❑	❑	
3. If circuit tested is over 600 volts, nominal, test instrument tested for proper operation before and immediately after the test.	❑	❑	
4. Test instrument rated for the circuit to be tested and appropriate for the environment.	❑	❑	
5. Electrical equipment capable of igniting flammable or ignitable materials not used if present in the worksite.	❑	❑	
SAFEGUARDS FOR PERSONNEL PROTECTION			
1. Protective equipment used when there is exposure to potential electrical hazards.	❑	❑	
2. Protective equipment maintained in safe and reliable condition and tested and inspected as required.	❑	❑	
3. Protective equipment protected from damage during use.	❑	❑	
4. Approved electrically rated hardhats used as needed to protect head from electric shock or burns.	❑	❑	
5. Safety glasses or goggles used as needed to protect eyes or face when there is a danger of arcs, flashes or flying objects.	❑	❑	
6. Approved gloves worn that are appropriate for the hazard present	❑	❑	
7. Insulated tools or handling equipment used when conductors may be contacted.	❑	❑	
8. Insulated fuse handling equipment used to remove or install fuses when terminals are energized.	❑	❑	
9. Ropes and handlines used near energized parts are nonconductive and are protected from moisture.	❑	❑	
10. Protective shields, barriers or insulating materials are used to protect employees working near exposed energized parts.	❑	❑	
ALERTING TECHNIQUES			
1. Safety signs and tags used when necessary to warn employees about electrical hazards.	❑	❑	
2. Barricades used with safety signs when necessary to prevent or limit employee access to work areas with un-insulated energized conductors or parts.	❑	❑	
3. Attendants stationed as needed to warn when signs or barricades are not sufficient to prevent unauthorized access.	❑	❑	

Name of Trainer:		Date:
EMPLOYEE NAME	Employee Name	Employee Name

Appendix B

Energized Electrical Work Permit

ENERGIZED ELECTRICAL WORK PERMIT
(For Applications of 120 volts or greater)

1. Golder Project Number:	Work Date:
2. Project Location:	
3. Description of Work:	
4. Check the following considerations as applicable:	
☐ Work is within the restricted approach boundary and there is a work plan	
☐ Work is within the prohibited approach boundary, it is very hazardous and there is a work plan	
☐ Request to shut down equipment was made	
☐ Conducted a shock hazard analysis	
☐ Shock protection boundaries have been determined	
☐ Flash hazard analysis has been conducted (Table 130.7) and appropriate PPE identified for the work activity	
☐ Flash protection boundary has been determined	
☐ Personal protective equipment including tools needed for the job have been determined and are available	
☐ Unqualified persons are restricted from the work area	
☐ Safe work practices that need to be employed have been considered	
☐ Job can be done safely	

By approving this Energized Electrical Work Permit, I certify that I am a Qualified Electrical Worker as defined in 29 CFR 1910.332; and that I have knowledge and understanding of site conditions to prepare this permit and conduct the work safely.

Name of Qualified Electrical Worker	Signature	Date
Name of Project Manager or Supervisor	Signature	Date

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

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Golder Associates

APPENDIX C

Safety Data Sheets

Material Safety Data Sheet

Section 1: PRODUCT AND COMPANY INFORMATION

Product Name(s): Cement Kiln Dust

Product Identifiers: New Lime™, Cement Kiln Dust (CKD), Kiln Dust, Cement Lime, Raw Mix, Kiln Feed, Baghouse Dust.

Manufacturer:
Lafarge North America Inc.
12018 Sunrise Valley Drive, Suite 500
Reston, VA 20191

Information Telephone Number:
703-480-3600 (9am to 5pm EST)

Emergency Telephone Number:
1-800-451-8346 (3E Hotline)

Product Use: Kiln dust used in the manufacture of bricks, mortar, cement, concrete, plasters, paving materials, and other construction applications.

Note: This MSDS covers many types of kiln dust. Individual composition of hazardous constituents will vary between types of kiln dust.

Section 2: COMPOSITION/INFORMATION ON INGREDIENTS

Component	Percent (By Weight)	CAS Number	OSHA PEL -TWA (mg/m^3)	ACGIH TLV-TWA (mg/m^3)	LD_{50} (mouse, intraperitoneal)	LC_{50}
Portland Cement Kiln Dust	100	68475-76-3	NA	NA	NA	NA
Calcium Carbonate*	10-80	1317-65-3	15 (T); 5 (R)	3 (R); 10 (T)	NA	NA
Calcium Oxide	5-50	1305-78-8	5 (T)	2 (T)	3059 mg/kg	NA
Crystalline Silica	0-10	14808-60-7	[(10) / (%SiO_2+2)] (R); [(30) / (%SiO_2+2)] (T)	0.025 (R)	NA	NA
Magnesium Oxide	0-2	1309-48-4	15 (T)	10 (T)	NA	NA

Note: Exposure limits for components noted with an * contain no asbestos and <1% crystalline silica

Cement is made from materials mined from the earth and is processed using energy provided by fuels. Trace amounts of chemicals may be detected during chemical analysis of cement and cement kiln dust. For example, cement kiln dust may contain trace amounts of potassium and sodium sulfate compounds, chromium compounds, nickel compounds, and other trace compounds.

Section 3: HAZARD IDENTIFICATION

Section 3: HAZARD IDENTIFICATION (continued)

Emergency Overview: Kiln dust is a solid, grey or tan, odorless powder. It is not combustible or explosive. A single, short-term exposure to the dry powder presents little or no hazard. Exposure of sufficient duration to wet kiln dust, or to dry kiln dust on moist areas of the body, can cause serious, potentially irreversible tissue (skin, eye, respiratory tract) damage due to chemical (caustic) burns, including third degree burns.

Potential Health Effects:

Eye Contact: Airborne dust may cause immediate or delayed irritation or inflammation. Eye contact with large amounts of dry powder or with wet kiln dust can cause moderate eye irritation, chemical burns and blindness. Eye exposures require immediate first aid and medical attention to prevent significant damage to the eye.

Skin Contact: Kiln dust may cause dry skin, discomfort, irritation, severe burns, and dermatitis.

Burns: Exposure of sufficient duration to wet kiln dust, or to dry kiln dust on moist areas of the body, can cause serious, potentially irreversible damage to skin, eye, respiratory and digestive tracts due to chemical (caustic) burns, including third degree burns. A skin exposure may be hazardous even if there is no pain or discomfort.

Kiln dust may be shipped or stored hot and can cause thermal burns to unprotected skin.

Dermatitis: Kiln dust is capable of causing dermatitis by irritation and allergy. Skin affected by dermatitis may include symptoms such as, redness, itching, rash, scaling, and cracking.

Irritant dermatitis is caused by the physical properties of kiln dust including alkalinity and abrasion.

Allergic contact dermatitis is caused by sensitization to hexavalent chromium (chromate) present in kiln dust. The reaction can range from a mild rash to severe skin ulcers. Persons already sensitized may react to the first contact with kiln dust. Others may develop allergic dermatitis after years of repeated contact with kiln dust.

Inhalation (acute): Breathing dust may cause nose, throat or lung irritation, including choking, depending on the degree of exposure. Inhalation of high levels of dust can cause chemical burns to the nose, throat and lungs.

Inhalation (chronic): Risk of injury depends on duration and level of exposure.

Silicosis: This product contains crystalline silica. Prolonged or repeated inhalation of respirable crystalline silica from this product can cause silicosis, a seriously disabling and fatal lung disease. See Note to Physicians in Section 4 for further information.

Carcinogenicity: Kiln dust is not listed as a carcinogen by IARC or NTP; however, kiln dust contains trace amounts of crystalline silica and hexavalent chromium which are classified by IARC and NTP as known human carcinogens.

Autoimmune Disease: Some studies show that exposure to respirable crystalline silica (without silicosis) or that the disease silicosis may be associated with the increased incidence of several autoimmune disorders such as scleroderma (thickening of the skin), systemic lupus erythematosus, rheumatoid arthritis and diseases affecting the kidneys.

Section 3: HAZARD IDENTIFICATION (continued)

Tuberculosis:	Silicosis increases the risk of tuberculosis.
Renal Disease:	Some studies show an increased incidence of chronic kidney disease and end-stage renal disease in workers exposed to respirable crystalline silica.
Ingestion:	Do not ingest kiln dust. Although ingestion of small quantities of kiln dust is not known to be harmful, large quantities can cause chemical burns in the mouth, throat, stomach, and digestive tract.
Medical Conditions Aggravated by Exposure:	Individuals with lung disease (e.g. bronchitis, emphysema, COPD, pulmonary disease) or sensitivity to hexavalent chromium can be aggravated by exposure.

Section 4: FIRST AID MEASURES

Eye Contact:	Rinse eyes thoroughly with water for at least 15 minutes, including under lids, to remove all particles. Seek medical attention for abrasions and burns.
Skin Contact:	Wash with cool water and a pH neutral soap or a mild skin detergent. Seek medical attention for rash, burns, irritation, dermatitis, and prolonged unprotected exposures to wet cement or kiln dust, cement mixtures or liquids from wet cement.
Inhalation:	Move person to fresh air. Seek medical attention for discomfort or if coughing or other symptoms do not subside.
Ingestion:	Do not induce vomiting. If conscious, have person drink plenty of water. Seek medical attention or contact poison control center immediately.
Note to Physician:	The three types of silicosis include: • Simple chronic silicosis – which results from long-term exposure (more than 20 years) to low amounts of respirable crystalline silica. Nodules of chronic inflammation and scarring provoked by the respirable crystalline silica form in the lungs and chest lymph nodes. This disease may feature breathlessness and may resemble chronic obstructive pulmonary disease (COPD). • Accelerated silicosis – occurs after exposure to larger amounts of respirable crystalline silica over a shorter period of time (5-15 years). Inflammation, scarring, and symptoms progress faster in accelerated silicosis than in simple silicosis. • Acute silicosis – results from short-term exposure to very large amounts of respirable crystalline silica. The lungs become very inflamed and may fill with fluid, causing severe shortness of breath and low blood oxygen levels. Progressive massive fibrosis may occur in simple or accelerated silicosis, but is more common in the accelerated form. Progressive massive fibrosis results from severe scarring and leads to the destruction of normal lung structures.

Section 5: FIREFIGHTING MEASURES

Flashpoint & Method:	Non-combustible	**Firefighting Equipment:**	Kiln dust poses no fire-related hazard. A SCBA is recommended to limit exposures to combustion products when fighting any fire.
General Hazard:	Avoid breathing dust. Wet kiln dust and cement is caustic.		
Extinguishing Media:	Use extinguishing media appropriate for surrounding fire.	**Combustion Products:**	None.

Section 6: ACCIDENTAL RELEASE MEASURES

General: Place spilled material into a container. Avoid actions that cause the kiln dust to become airborne. Avoid inhalation of kiln dust and contact with skin. Wear appropriate protective equipment as described in Section 8. Scrape wet kiln dust or cement and place in container. Allow material to dry or solidify before disposal. Do not wash kiln dust down sewage and drainage systems or into bodies of water (e.g. streams).

Waste Disposal Method: Dispose of kiln dust according to Federal, State, Provincial and Local regulations.

Section 7: HANDLING AND STORAGE

General: Keep bulk and bagged kiln dust dry until used. Stack bagged material in a secure manner to prevent falling. Bagged kiln dust and cement is heavy and poses risks such as sprains and strains to the back, arms, shoulders and legs during lifting and mixing. Handle with care and use appropriate control measures.

Engulfment hazard. To prevent burial or suffocation, do not enter a confined space, such as a silo, bin, bulk truck, or other storage container or vessel that stores or contains kiln dust. Kiln dust and cement can buildup or adhere to the walls of a confined space. The kiln dust and cement can release, collapse or fall unexpectedly.

Properly ground all pneumatic conveyance systems. The potential exists for static build-up and static discharge when moving cement powders through a plastic, non-conductive, or non-grounded pneumatic conveyance system. The static discharge may result in damage to equipment and injury to workers.

Usage: Cutting, crushing or grinding hardened cement, concrete or other crystalline silica-bearing materials will release respirable crystalline silica. Use all appropriate measures of dust control or suppression, and Personal Protective Equipment (PPE) described in Section 8 below.

Housekeeping: Avoid actions that cause the kiln dust to become airborne during clean-up such as dry sweeping or using compressed air. Use HEPA vacuum or thoroughly wet with water to clean-up dust. Use PPE described in Section 8 below.

Storage Temperature: Unlimited. **Storage Pressure:** Unlimited.

Clothing: Promptly remove and launder clothing that is dusty or wet with kiln dust. Thoroughly wash skin after exposure to dust or wet kiln dust.

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering Controls: Use local exhaust or general dilution ventilation or other suppression methods to maintain dust levels below exposure limits.

Personal Protective Equipment (PPE):

Respiratory Protection: Under ordinary conditions no respiratory protection is required. Wear a NIOSH approved respirator that is properly fitted and is in good condition when exposed to dust above exposure limits.

Eye Protection: Wear ANSI approved glasses or safety goggles when handling dust or wet kiln dust to prevent contact with eyes. Wearing contact lenses when using kiln dust, under dusty conditions, is not recommended.

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION (continued)

Skin Protection: Wear gloves, boot covers and protective clothing impervious to water to prevent skin contact. Do not rely on barrier creams, in place of impervious gloves. Remove clothing and protective equipment that becomes saturated with wet kiln dust or cement and immediately wash exposed areas.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid (powder).	**Evaporation Rate:**	NA.
Appearance:	Gray, tan, or white powder.	**pH (in water):**	10 – 13
Odor:	None.	**Boiling Point:**	>1000° C
Vapor Pressure:	NA.	**Freezing Point:**	None, solid.
Vapor Density:	NA.	**Viscosity:**	None, solid.
Specific Gravity:	2.6-2.8	**Solubility in Water:**	2-20%

Section 10: STABILITY AND REACTIVITY

Stability: Stable. Keep dry until use. Avoid contact with incompatible materials. Kiln dust reacts with water, resulting in a slight release of heat, depending on the amount of lime (Calcium oxide) present.

Incompatibility: Kiln dust and wet cement is alkaline and is incompatible with acids, ammonium salts and aluminum metal. Kiln dust and cement dissolves in hydrofluoric acid, producing corrosive silicon tetrafluoride gas. Kiln dust and cement reacts with water to form silicates and calcium hydroxide. Silicates react with powerful oxidizers such as fluorine, boron trifluoride, chlorine trifluoride, manganese trifluoride, and oxygen difluoride.

Hazardous Polymerization: None. **Hazardous Decomposition:** None.

Section 11 and 12: TOXICOLOGICAL AND ECOLOGICAL INFORMATION

For questions regarding toxicological and ecological information refer to contact information in Section 1.

Section 13: DISPOSAL CONSIDERATIONS

Dispose of waste and containers in compliance with applicable Federal, State, Provincial and Local regulations.

Section 14: TRANSPORT INFORMATION

This product is not classified as a Hazardous Material under U.S. DOT or Canadian TDG regulations.

Section 15: REGULATORY INFORMATION

OSHA/MSHA Hazard Communication: This product is considered by OSHA/MSHA to be a hazardous chemical and should be included in the employer's hazard communication program.

CERCLA/SUPERFUND: This product is not listed as a CERCLA hazardous substance.

EPCRA SARA Title III: This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 and is considered a hazardous chemical and a delayed health hazard.

EPRCA SARA Section 313: This product contains none of the substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Section 15: REGULATORY INFORMATION (continued)

RCRA: If discarded in its purchased form, this product would not be a hazardous waste either by listing or characteristic. However, under RCRA, it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste.

TSCA: Kiln dust and crystalline silica are exempt from reporting under the inventory update rule.

California Proposition 65: Crystalline silica (airborne particulates of respirable size) and Chromium (hexavalent compounds) are substances known by the State of California to cause cancer.

WHMIS/DSL:  Products containing crystalline silica and calcium carbonate are classified as D2A, E and are subject to WHMIS requirements.

Section 16: OTHER INFORMATION

Abbreviations:

>	Greater than	NA	Not Applicable
ACGIH	American Conference of Governmental Industrial Hygienists	NFPA	National Fire Protection Association
CAS No	Chemical Abstract Service number	NIOSH	National Institute for Occupational Safety and Health
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	NTP	National Toxicology Program
		OSHA	Occupational Safety and Health Administration
CFR	Code for Federal Regulations	PEL	Permissible Exposure Limit
CL	Ceiling Limit	pH	Negative log of hydrogen ion
DOT	U.S. Department of Transportation	PPE	Personal Protective Equipment
EST	Eastern Standard Time	R	Respirable Particulate
HEPA	High-Efficiency Particulate Air	RCRA	Resource Conservation and Recovery Act
HMIS	Hazardous Materials Identification System	SARA	Superfund Amendments and Reauthorization Act
IARC	International Agency for Research on Cancer	T	Total Particulate
		TDG	Transportation of Dangerous Goods
LC_{50}	Lethal Concentration	TLV	Threshold Limit Value
LD_{50}	Lethal Dose	TWA	Time Weighted Average (8 hour)
mg/m^3	Milligrams per cubic meter	WHMIS	Workplace Hazardous Materials Information System
MSHA	Mine Safety and Health Administration		

This MSDS (Sections 1-16) was revised on March 1, 2011.

An electronic version of this MSDS is available at: www.lafarge-na.com under the Sustainability section.

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APPENDIX D

Equipment Specification Sheets

MicroBulk Systems

Equipment for Cryogenic Service

MICROBULK SOLUTIONS | SYSTEM DESIGN | MANUFACTURING | TRAINING | INSTALLATION | SERVICE

MicroBulk Systems Product Catalog

www.MicroBulk.com

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Innovative Design, Technology & Reliability

Across Chart, we pride ourselves on designing innovative products with advanced technology and high reliability to enhance customer value. Our understanding of our customer's business needs and end-use applications has helped us achieve a wide product portfolio of solutions. We provide the right product for the application – driving a competitive advantage for our customer and our company.

Innovative Design

Our integrated MicroBulk advantage is based on a system that incorporates patented and proven innovative technologies. Every component is designed, built and tested to create the safest and most reliable MicroBulk delivery system available today.

Installation Ready

Only Chart allows you to custom build your Perma-Cyl® MicroBulk Storage System to match your customer's application and your business operation. With over 10 sizes and three pressures, there's a Perma-Cyl model to meet your requirements.

Telemetry Capable

The Cyl-Tel® Liquid Level Gauge is designed exclusively for the Perma-Cyl system. Packed with user-friendly features, the Cyl-Tel gauge is ready to work with many remote monitoring systems.

Marketing Services

Our sales process doesn't stop with the equipment supply. We offer electronic sales tools, customized literature, marketing assistance and sales training to make our authorized partners positioned for growth in the MicroBulk market.

When you choose Chart, you get single-source accountability from the integrated MicroBulk system through business support.

MicroBulk Applications

Metal Fabrication

Welding – GMAW/MIG, GTAW/TIG and Laser Beam Welding

Metal fabrication uses many different welding processes for the wide range of materials, thickness and product applications. Many of these unique and specialized welding processes use inert shielding gas or the combination of gases to obtain the maximum weld quality and optimized productivity. For single gas or mixed gas requirements, MicroBulk provides you with all the benefits of bulk, such as an uninterrupted gas supply – in an economical compact package.

Cutting – Laser, Oxy Fuel and Plasma

All thermal cutting techniques utilize gases to assist in the cutting process. High-pressure nitrogen and oxygen are used as an assist gas to rapidly remove the molten metal from the cut zone or burn it away during the laser cutting process. To maintain maximum laser uptime and achieve the best cut quality, it is critical that the gas supply be uninterrupted and the required pressures and flows for the material and thickness being cut are maintained. Oxy Fuel and Plasma cutting processes have similar requirements. Only Chart offers an engineered "High-Pressure, High-flow Package" to customize your Perma-Cyl® MicroBulk Storage System for these demanding applications.

Analytical / Laboratory

ICP/ICP-MS – Inductively Coupled Plasma/Mass Spectrometry
GC – Gas Chromatograph

A continuous flow of high purity argon gas is required for ICP/ICP-MS systems to repeatedly process material samples trouble-free. With Chart's all stainless steel Pura Perma-Cyl option and MicroBulk's short delivery chain, you can be assured of getting the proper purity of argon necessary for peak equipment performance. Similarly, GC's get the same benefits with a Perma-Cyl system in nitrogen service. And with MicroBulk and telemetry, you get a continuous supply of uninterrupted gas so you never have to change cylinders or restart a sample test from a gas outage.

Biological Storage and Research

A sufficient supply of high-quality liquid nitrogen is needed to keep valuable biological samples stored indefinitely. Any interruption in supply can result in the loss of many years of research. With the optional vacuum-insulated liquid withdrawal valve and bayonet on the Perma-Cyl system, you get a continuous supply of quality liquid to your freezer — reducing liquid losses and giving you more control. Adding telemetry to the liquid supply, allows you and your gas supplier to monitor the Perma-Cyl liquid level via the internet for added security. For requirements that prohibit a permanent installation, the Perma-Cyl 230 caster base model is an excellent choice.

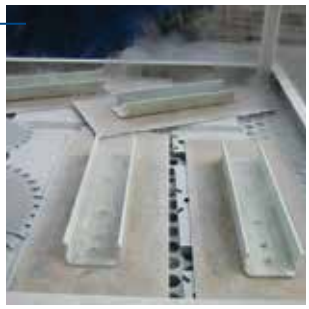
MBE – Molecular Beam Epitaxy

Chart Inc. provides vacuum insulated closed loop LN_2 piping systems utilizing liquid/vapor phase separators and triaxial feed/coaxial return piping to provide low pressure, ultra-pure LN_2. In a closed loop system, the LN_2 is recirculated back to the phase separator via return pipes connected to the phase separator from the tool. These pipes are designed to flow LN_2 back to the head space inside the phase separator reusing the LN_2 in a continual loop, providing completely wetted surfaces within the cryoshrouds, while maintaining constant LN_2 temperatures at low pressure with minimal gas. The gas is then vented to the atmosphere, leaving pure LN_2 at the desired temperature to be delivered to the cryoshroud.

Metal Processing

Heat Treating, Cryotempering, Thermal Spray Coating

Heat treating and cryotempering processes are dependent on the quality of the nitrogen gas and liquid supply to maintain production at peak performance. With the MicroBulk system directly piped to the equipment or conveniently transported with the caster base Perma-Cyl® model, these applications are assured of a consistent supply of nitrogen with minimal operator intervention. In the thermal spray coating process, oxygen or argon is used at high pressure and high flows. With the Perma-Cyl VHP ZX coil option, your gas supply will exceed these requirements and provide long-term trouble-free service.



Medical

Oxygen Therapy, Hyperbaric Chamber, Cryotherapy

Medical applications have some of the most stringent gas requirements and the MicroBulk system meets these requirements with NF grade availability. Liquid oxygen for respiratory therapy is easily and safely dispensed from a Perma-Cyl system into the Liberator® and Stroller style systems to lower distribution costs. Similarly, the Perma-Cyl system is an excellent solution as the main oxygen gas supply for hyperbaric chambers. NF grade nitrogen can also be supplied for gas applications to operate pneumatic surgical tools and supply liquid for medical uses such as cryotherapy.

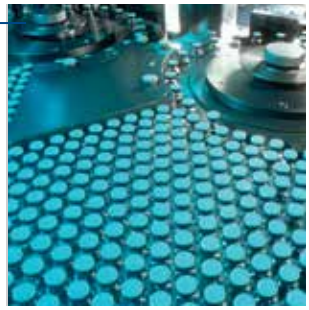
General Processing

Food and Beverage Packaging

In beverage packaging, liquid nitrogen is used to create a positive pressure in non-carbonated drinks to improve the containers rigidity for lower-cost handling. Additionally, this process eliminates oxygen to improve the products shelf life. For food packaging, nitrogen gas yields the same benefits and when combined with carbon dioxide and carbon monoxide for processing meat, a longer shelf life of the desired red color is maintained. The Perma-Cyl system gives you optimum control of your liquid and gas supply for maximum production uptime.

Purging and Blanketing

Inert purging and blanketing with nitrogen or argon gas is a common processing step in many manufacturing applications. These range from pharmaceutical to chemical to the wine industry, and they require a secure supply of gas for optimum processing results. With a dedicated Perma-Cyl tank and the optional telemetry system, you are assured of a continuous, oxygen-free gas supply because cylinder change outs are eliminated.



Electronic Manufacturing and Testing

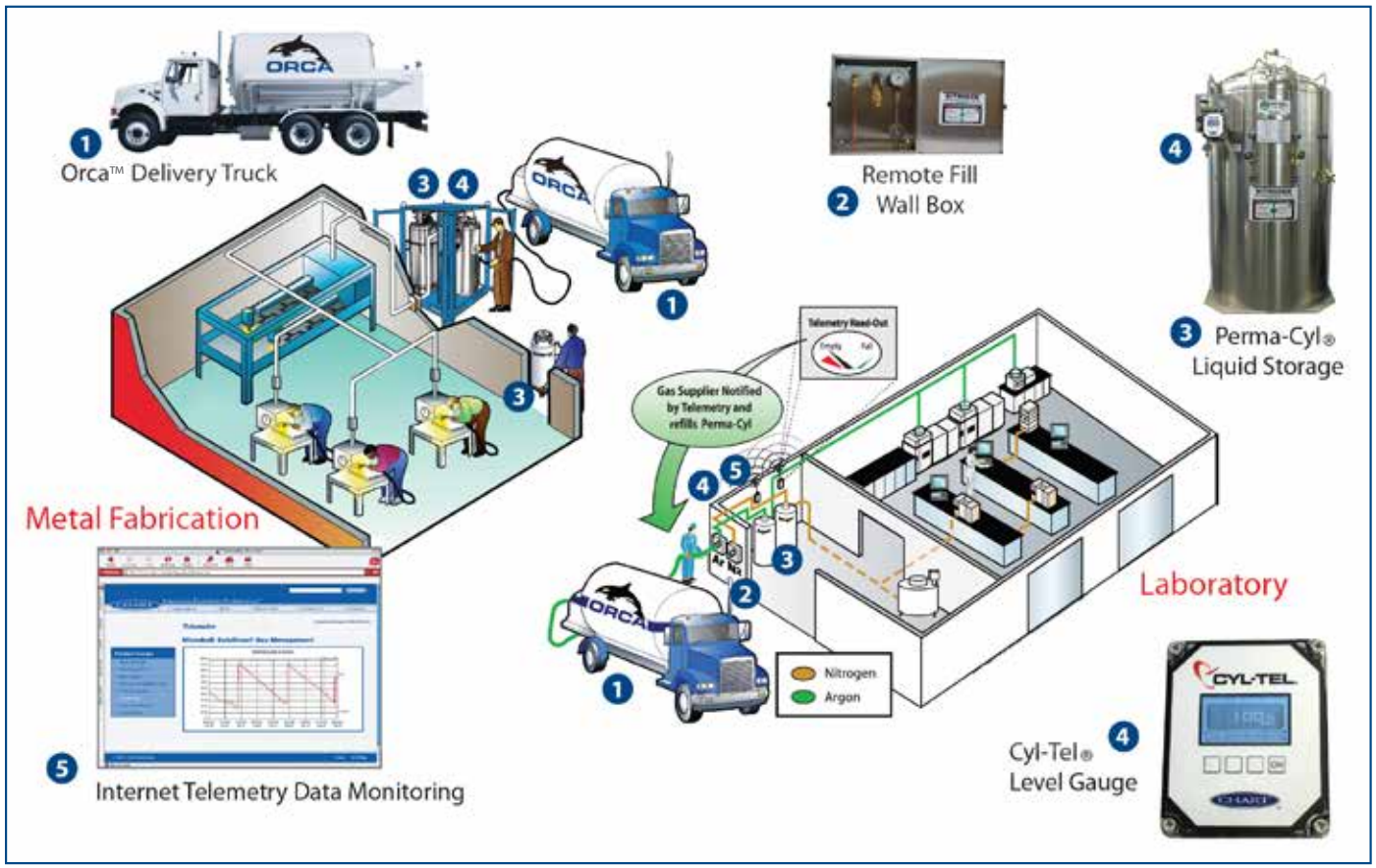
Electronic grade manufacturing requires an Ultra High Purity gas stream void of contamination. The Pura Perma-Cyl system is built with all stainless steel construction from the internal vaporizer to the exterior plumbing to maintain gas purity. And with the MicroBulk delivery system, the reduced handling results in higher purity over conventional cylinder supplies. In a related business, printed circuit board testing performed in liquid nitrogen-powered environmental test chambers require quality liquid at the point of use. For intermittent uses or small chambers, the Perma-Cyl series offers a variety of options to customize the installation for optimum benefits.

Engineered for Efficiency—Built to Last

At Chart we have always taken pride in developing the best thermal insulation system possible in our MicroBulk storage tanks. Years of experience have driven us to engineer our multi-layer Composite Super Insulation™ system to achieve the ultimate thermal protection in our MicroBulk storage equipment. Providing the best insulation system to protect your valuable gases from harsh ambient conditions results in lower pressure rise and lower losses, yielding better gas utilization. Our Super Insulation and Chart Vacuum Technology® is at the core of why Chart storage tanks are recognized around the world as the premier cryogenic MicroBulk storage tank.

A Turnkey Approach

Chart engineers work closely with our customers to ensure that the total system is designed properly, making the MicroBulk system as effective as possible. Chart's turnkey approach ensures consistent, quality liquid to keep your system operating at peak efficiency. Built for long-term integrity and industry leading efficiency, these systems give our customers the highest performance at the lowest operating cost, while providing a single point of contact.



1. Liquefied gases are delivered to the customer's facility with the Orca™ MicroBulk Delivery System. Key controls and components on the Orca unit allow the driver to safely and quickly deliver the proper amount of liquid accurately into the Perma-Cyl® MicroBulk Storage System or small bulk tanks.
2. When the Perma-Cyl storage vessel is installed indoors, an external wall box can be added for remote filling. This allows the gas delivery to safely take place without the driver entering the building in most installations.
3. Liquefied gases are stored at ultra-cold temperatures in the vacuum-insulated Perma-Cyl tank. Customized controls for the application on the Perma-Cyl tank maintain the vessel at the proper delivery pressure and deliver gas or liquid on demand.
4. The Cyl-Tel® Liquid Level Gauge accurately monitors the cryogenic liquid level and is telemetry-ready for remote monitoring or connection to customer monitoring systems.
5. Telemetry systems allow the gas supplier to remotely monitor the Perma-Cyl liquid level to maximize delivery efficiency without the risk of product outages.

The Perma-Cyl® Storage System Built for Your Application

The Perma-Cyl® MicroBulk Storage System allows small users to enjoy the benefits of on-site gas delivery. Gone are the hassles, waste, and expense of full-for-empty gas cylinders. Using Perma-Cyl storage tanks, there are no cylinders to change, no residual gas losses*, no back, hand or foot injuries from handling cylinders, and no lost or damaged cylinders.

The Perma-Cyl system is reliable, efficient, and more economical than comparable transportable cylinders. Designed for a higher level of thermal efficiency, they can hold their gas contents longer with lower pressure rise than other similar sized vessels. Their extraordinary thermal quality limits product losses during extended periods of little gas use.

The innovative Perma-Cyl system incorporates a top fill float designed to allow single-hose filling without losses. It automatically shuts off the Orca™ MicroBulk Delivery System for a safe and reliable fill.

Chart Exclusive - Internal top float assembly assures a safe, efficient and reliable fill.

Pat. No. - 5,954,101

Perma-Cyl® Benefits

- The first fill-at-site solution for packaged or cylinder gas users
- Fast filling capable
- Single hose no-loss/low-loss filling
- Automatic fill shutoff when used with Orca system
- Extended holding times
- Telemetry ready with Cyl-Tel® Liquid Level Gauge

The Perma-Cyl® Advantage

- Sizes, pressures and configurations to meet most applications
- Capacities from 230 liters to 5500 liters (60.8 gal to 1350 gal)
- Pressures from 235 psig to 500 psig (16.2 barg to 34.5 barg)
- Patented automatic fill shut-off feature with optional fill box allows for remote filling from outside the building or compound when a Perma-Cyl system is installed indoors
- The Orca system automatically safely stops the fill process when the Perma-Cyl system is full
- Patented Cyl-Tel gauge supports remote alarms or telemetry communications
- High-pressure high flow models for laser assist applications
- Combination pressure control regulators with micrometer adjustment knob or screw
- Outdoor or indoor installation and operation
- Horizontal configuration available on the 3000 HP/VHP model
- Top and bottom fill with auto shut off available on some models
- Integrated pallet base standard on some models
- Vacuum jacketed bayonet for liquid withdrawal available on some models

**In normal low-pressure applications.*

Build Your Own Perma-Cyl®

Custom build your Perma-Cyl MicroBulk Storage System to match your customer's application and your business operation.

Features & Benefits of customizing your Perma-Cyl tank

Perma-Cyl tank operating and relief valve pressures match the application
- Select the ideal operating pressure for your customer's product delivery
- Select the ideal relief valve pressure for your customer's optimum hold time and your asset flexibility requirements

Optional features available to isolate key controls
- Reduce on-site maintenance time and costs

Perma-Cyl tank is "installation ready" for direct shipment to customer site
- Reduce pre-installation time, costs and unnecessary shipping
- Eliminate tank inventory (1)

How to Build Your Perma-Cyl

1. Select bottle Volume.
2. Select bottle MAWP.
3. Select Operating Pressure / Relief Valve Setting.
4. Select Application Package.
5. Select Service Kit.
6. Select Gauge Option

The Chart Industries Tank Sizing App can assist you in this process – it's that simple!

Custom Order Code

Bottle | Operating Pressure | Application | Service | Gauge

Steps 1 & 2 Select Bottle

Volume (ltrs)	MAWP (psig)
450	MP,HP,VHP
700	HP
1000	HP,VHP
1500 (2)	HP,VHP
2000 (2)	HP,VHP
3000 (2)	HP,VHP
5500 (2)	VHP
Note:	MP = 250 psig
	HP = 350 psig
	VHP = 500 psig

Step 3 Select Oper. Pressure/Relief Valve (psig)

25 / 125
125 / 250
300 / 350
450 / 500
Note: Operating pressure cannot exceed the relief valve pressure

Step 5 Select Service Kits

A	Nitrogen - CGA
B	Argon - CGA
C	Oxygen - CGA
D	Carbon Dioxide - CGA
E	Nitrogen - SDC
F	Argon - SDC
G	Oxygen - SDC
H	Carbon Dioxide - SDC
Note: SDC - Single-Direction Clutch	
Consult factory for other options	

Step 6 Select Gauge Options

CT	Cyl-Tel (7)
ADP	Analog DP
BF	Blank Face (8)
NG	No Gauge

Step 4 Select Option Package for the Application

Option Package	Tank Configuration	4-way Gauge Isolation Valve (2)	Regulator Isolation Valves	Liquid Withdrawal Ball Valve	25 to 50 PSI Secondary Relief w/Isolation	CO_2 Package (3)	External PB Vaporizer	HP^2 System
01	Chart Standard							
02 (4)	Cyl-Tel Gauge Service Valve	X						
03	Service Valves	X	X					
04	Low Pressure Liquid	X	X	X	X			
05	CO_2 Service	X	X	X		X		
07 (5)	Fast Pressure Builder Recovery	X	X				X	
09 (6)	High Flow PB and Vaporizer	X	X					X

Notes:
(1) Target ship date: Five working days or less ARO providing the bottle is in stock.
(2) Models 1500, 2000, 3000 and 5500 come standard with integral fork-lift/lab metal base.
(3) CO_2 Package includes: Standard restaurant fill fitting, CO_2 standard top fill tube, patented optionalSure-Fill™ CO_2 Tank Filling System (for complete fill of any size tank), and regulator isolation valves.
(4) Standard on 1500, 2000, 3000 and 5500 models.
(5) Option Package is only available on 1000, 1500, 2000 and 3000 HP models.
(6) Option Package is standard on 2000, 3000 and 5500 VHP models.
(7) Cyl-Tel® Liquid Level Gauge comes standard on all 450L and larger Perma-Cyl tanks.
(8) Designed for DataOnline special face, direct from DataOnline.

SPECIFICATIONS

MODEL	230L MP, LCCM Sq/Rnd Base w/Casters	230L HP, LCCM Sq/Rnd Base w/Casters	265L MP, LCCM Sq/Rnd Base w/Casters	265L HP, LCCM Sq/Rnd Base w/Casters	450L HP Plate Base	450L MP Plate Base	450L VHP Plate Base	700L HP Plate Base	1000L HP/VHP Plate Base	1500L HP/VHP Pallet Base	2000L HP/VHP Pallet Base	3000L HP/VHP Pallet Base	3000L HP/VHP Horizontal Forklift Base	5500L MP/VHP Pallet Base
CAPACITY (Liters)														
Gross	240	240	276	276	450	450	450	688	1,056	1,550	2,042	2,911	2,911	5510/5434
Net	230	230	265	265	420	420	420	645	950	1,455	1,945	2,707	2,707	5262/5110
CAPACITY (Gallons)														
Gross	63.4	63.4	72.9	72.9	118.9	118.9	118.9	181.8	279.0	409.5	539.5	770	770	1456/1435
Net	60.8	60.8	70.0	70.0	111.0	111.0	111.0	170.4	251.0	384.4	513.9	715	715	1390/1350
MAWP														
psig	230	350	230	350	350	250	500	350	350/500	350/500	350/500	350/500	350/500	250/500
barg	15.9	24.1	15.9	24.1	24.1	17.2	34.5	24.1	24.1/34.5	24.1/34.5	24.1/34.5	24.1/34.5	24.1/34.5	17.2/34.5
PRE-SET OPERATING PRESSURE														
psig	125	300	125	300	300	125	450	300	300/450	300/450	300/450	300/450	300/450	125/450
barg	8.6	20.7	8.6	20.7	20.7	8.6	31.0	20.7	20.7/31.0	20.7/31.0	20.7/31.0	20.7/31.0	20.7/31.0	8.6/31.0
DESIGN SPECIFICATIONS														
DOT/ASME	DOT	DOT	DOT	DOT	DOT/ASME	ASME	DOT/ASME	ASME	ASME	ASME	ASME	ASME	ASME	ASME
STORAGE CAPACITY (1)														
Nitrogen														
SCF	5,024	4,734	5,769	5,769	8875/10332	10,332	7922/10332	15,860	24,350	35,790	47,847	66,592	66,592	128700/125000
Nm^3	142	134	152	152	271/272	272	271/272	449	689	1,013	1,257	1,750	1,750	3644/3540
Oxygen														
SCF	6,244	5,930	7,186	7,186	11124/12760	12,760	11124/12760	19,600	30,070	44,220	59,089	82,239	82,239	159400/154900
Nm^3	177	168	189	189	315/336	336	315/336	554	850	1,250	1,553	2,161	2,161	4514/4386
Argon														
SCF	6,073	5,763	6,982	6,982	10812/12478	12,478	10812/12478	19,160	29,400	43,220	57,786	80,425	80,425	156200/151700
Nm^3	172	163	183	183	306/328	328	306/328	542	832	1,223	1,519	2,115	2,115	4423/4296
CO_2														
SCF	N/A	4,615	N/A	5,306	8312/8200	N/A	8312/8200	12,608	19,960	29,340	38,048	52,954	N/A	N/A
Nm^3	N/A	130.7	N/A	150.3	235/232	N/A	235/232	357	564	830	1,000	1,390	N/A	N/A
Lbs	N/A	528	N/A	607	951/938	N/A	951/938	1,442	2,283	3,356	4,352	6,058	N/A	N/A
THERMAL PERFORMANCE (2) (NER%/Day)														
N_2	1.8%	1.8%	2%	2%	1.9%/1.6%	1.6%	1.9%/1.6%	1%	1%	1%	1%	1%	1%	.7%
O_2-Ar	1.12%	1.12%	1.4%	1.4%	1.2%/1%	1%	1.2%/1%	.62%	.62%	.62%	.62%	.62%	.62%	.43%
CO_2	N/A	.6%	N/A	.7%	.6%/.5%	N/A	.6%/.5%	.3%	.3%	.3%	.3%	.3%	N/A	N/A
GAS DELIVERY RATE (LIN/LAR/LOX)														
SCFH	400	400	400	400	575	575	575	660	960	1,350	1350/2000[3]	1350/2000[3]	2,000	3500/5000[4]
Nm^3h	10.5	10.5	10.5	10.5	15.1	15.1	15.1	18.6	25.2	35.4	35.4/52.4	35.4/52.4	52.4	99/141
GAS DELIVERY RATE (CO_2)														
SCFH	N/A	133	N/A	133	192	N/A	192	220	320	450	450/667[3]	450/667[3]	N/A	N/A
Nm^3h	N/A	3.8	N/A	3.8	5.4	N/A	5.4	6.2	9.0	12.7	12.7/17.5	12.7/17.5	N/A	N/A
Lbs/H	N/A	22	N/A	22	22	N/A	22	25	36	51	51/76	51/76	N/A	N/A
DIMENSIONS														
Diameter														
in	26	26	26	26	30	30	30	42	42	48	48	58	58	80
mm	660	660	660	660	762	762	762	1,067	1,067	1,219	1,219	1,473	1,473	2,032
Height														
in	61.8/62	61.8/62	64.6/64.8	64.6/64.8	69	69	69	62.5	82	92/91	118.5/119.6	122/122.25	71	119
mm	1570/1575	1570/1575	1641/1646	1641/1646	1,753	1,753	1,753	1,588	2,083	2337/2311	3,010/3,037	3099/3105	1,803	3,023
Tare Weight														
lbs	300	340	340	340	688*	605*	812*	1,250*	1500/1750*	2200/2500**	2600/3860**	3300/4500**	3800/4250**	6800/9100**
kg	136	154	154	154	312	274	368	567	680/794	998/1134	1179/1751	1497/2045	1724/1928	3084/4128

All specifications are subject to change without prior notice.

1) Values are based on net capacity at 0 psig (0 barg) for ASME vessels. CO_2 vessels are based on net capacity at 300 psig (20.7 barg). DOT vessels are per code.

2) Values are based on gross capacity.

3) Optional 3,500 SCFH (92 Nm^3h) flow kit available.

4) Optional 3,500 SCFH hang on vaporizer or 5,000 SCFH stand alone vaporizer.

Patents: 5,954,101 • 6,542,848 - Other Patents Pending

DOT- Department of Transportation, 4L Code

ASME- American Society of Mechanical Engineers, Section VIII, Division 1

Contact Factory for Canadian Approvals.

** Weights do not include lab base option. (265 lbs) ** Weights include lab bases.*

All dimensions are measured from the floor to the top of the highest plumbing component.

Perma-Cyl® 3000 Horizontal MicroBulk Storage System

Chart has developed a horizontal version of the popular Perma-Cyl® 3000 HP and VHP MicroBulk Storage System. This new product offering has the same performance as our 3000 HP and VHP, but in a package that is easily delivered on a flatbed truck and short enough to fit behind a 6' fence. It also utilizes our new FlexFill™ Piping Option technology.

The horizontal Perma-Cyl is built on a base that can be properly anchored in all seismic zones and allows for easy forklift access on all sides. This tank also has lifting lugs for crane operation.

The FlexFill piping option is a top and bottom fill circuit that replaces the top float assembly so the driver can control the tank pressure while filling the Perma-Cyl. This new design maintains the auto shut-off feature with the Orca™ MicroBulk Delivery System for a safe and reliable fill. The FlexFill option uses technology adopted from our LNG fueling system which allows for a ventless fill. This patented automatic delivery system simulates the same process drivers have used for years to safely fill Perma-Cyl storage tanks with a single hose. The new FlexFill feature works with all Orca models, both new and existing.

**The FlexFill tank is presently not approved for service with CO_2.*

Product Advantages

- Nominal capacity of 3,000 liters (715 gal)
- Pressures up to 350 psig (24.1 barg) or 500 psig (34.5 barg)
- Gas supply rate up to 2,000 scfh (52.4 Nm3H)
- All 304 stainless steel tank construction
- Patented automatic fill shut-off with optional fill box for remote filling from outside the building
- Orca unit automatically safely stops the fill process when Perma-Cyl system is full
- Patented Cyl-Tel® Liquid Level Gauge supports remote alarms or telemetry communications
- Separate pressure builder and economizer regulators
- Outdoor or indoor installation and operation

Perma-Cyl® 450 ZX VHP Portable High-Performance MicroBulk Storage

The Perma-Cyl® 450 ZX VHP is designed and built with a rugged internal support system for mobility full of liquid within its protective metal pallet. Unlike the Mega-Cyl™ Liquid Cylinder Series, the Perma-Cyl 450 ZX VHP features the internal float and spray system for single-hose auto shut off with the Orca™ MicroBulk Delivery System. With the on-board external aluminum heat exchanger, the Perma-Cyl 450 ZX VHP is rated at a flow rate of 2000 SCFH while sustaining 420 to 450 psig.

The Perma-Cyl 450 ZX VHP vessel is bolted to a dedicated metal pallet for full protection and transportability with an overhead crane or forklift. The portable design makes the Perma-Cyl 450 ZX VHP the ideal quick-response solution for demanding industrial gas applications, like laser-assist gas.

Product Advantages

- Internal Perma-Cyl top fill float assembly for single-hose auto shut off with the Orca unit
- Rugged internal support system allows full mobility full of product
- High flow external aluminum vaporizer and pressure builder system provides up to 2000 SCFH at 420 to 450 psig
- Metal pallet incorporates forklift slots and crane lifting lugs while protecting plumbing and tank during transportation and application use
- Pallet has durable exterior coating for maximum corrosion resistance

Perma-Cyl® CO_2 HP Fast Fill MicroBulk Storage for CO_2 Service

The Perma-Cyl® 2000 and 3000 CO_2 HP MicroBulk Storage Systems are specifically designed for CO_2 service. One notable performance improvement is the fast fill feature – at least three times the fill rate over our standard Perma-Cyl Series from a typical beverage delivery truck. The upsizing and redesign of the top fill eductor circuit reduces the overall fill time, and also reduces the amount of vent gas during delivery for a more efficient fill. Other new design features include larger internal pressure builder and vaporizer coils, allowing for faster pressure recovery and increased gas flow rates. Dedicated pressure builder and economizer regulators also contribute to this improved performance.

The Perma-Cyl CO_2 HP tank comes with many of the standard features found on the Perma-Cyl Series for easy installation and fast start up. The Perma-Cyl Series is well known for holding its liquefied gas contents for long periods of time without venting, thus limiting product loss during periods of little or no gas use.

Perma-Cyl 2000 CO_2 HP

Product Advantages

- The better alternative to full-for-empty cylinders
- Fast, efficient fills
- High-performance vaporizer
- Cyl-Tel® Liquid Level Gauge
- Ergonomic instruments and controls
- Long life, low maintenance

Perma-Cyl® 5500 MP/VHP High Capacity – High Pressure MicroBulk Storage System

The innovative Perma-Cyl® 5500 MicroBulk Storage System is designed for configuration to any LIN, LAR or LOX gas or liquid application and comes in MP and VHP operating pressures. Both of these versions are engineered to supply up to 5000 SCFH to satisfy the most demanding gas applications. With our industry-exclusive *configure to order* plumbing, you can build your own Perma-Cyl 5500 system to meet your business plan and your customer's requirements.

The Perma-Cyl 5500 system comes with many of the standard Perma-Cyl features including the FlexFill™ Piping Option and the dual safety tree. Additionally, this model comes with a standard dual-fin external PB vaporizer and an optional side-mounted vaporizer rated at 3500 SCFH.

Perma-Cyl 5500 VHP Model

Product Advantages

- Fast, accurate fills
- Cyl-Tel® Liquid Level Gauge
- Easy to use instruments and controls
- Long life, low maintenance
- Application ready
- Easy economical installation

Product Options

- Analog liquid level gauge (Replaces Cyl-Tel® Liquid Level Gauge)
- Cyl-Tel gauge with blank face for DataOnline® system
- VJ withdrawal valve (½" male bayonet – left or right orientation, MP model only)*
- Phase line tees with isolation valves for remote telemetry
- New larger high-flow flare fill fitting
- Bulk 1½" CGA fill fitting
- 3500 SCFH mounted vaporizer**
- 5000 SFCH free standing Thermax® vaporizer**

Perma-Cyl 5500 MP Model with VJ withdrawal valve – left orientation

**Built to order option only – allow for longer delivery time.*

***Process vaporizers do not come standard. Customer must specify either the 3500 SCFH hang on style, the 5000 SCFH stand alone, or the vaporizer can be supplied by the customer.*

Mixed Gas Skid MicroBulk Gas Blending System

Chart's improved Mixed Gas Skid is a pre-fabricated blending system that provides a reliable source of high-precision mixed gas in a safe and secure package. The system includes options that make it flexible and capable of handling a wide range of gas blends required in welding and other applications. The Mixed Gas System's pre-engineered simplicity provides higher interconnecting piping integrity, faster start up time, and reduced installation costs. This system also features all the advantages of Chart's MicroBulk Solutions.™

Product Advantages

- Provides a turnkey solution: two vessels, pressure control manifolds, a mixer, and an emergency HP cylinder mixed gas reserve (HP bottles not included)
- Pre-fabricated reduces installation time and costs
- Provides versatility and on-site filling using Chart's Orca™ MicroBulk Delivery System
- Two standard size skid packages to select from
- Transported by pallet jack, forklift or overhead crane
- Thermco® world class mixer provides high quality and proven reliability
- Gas mixer supports two gas sources and a mixed gas output of 0-50% CO_2 in argon
- Provides a regulated source of pure argon gas
- Excellent solution for emergency back-up or temporary requitrements
- Gas connection ½" FPT

Skid Package	Primary Gas Source	Second Gas Source
Small Skid	Perma-Cyl 450 HP DOT	Perma-Cyl 230 HP RB
Large Skid	Perma-Cyl 1000 HP	Perma-Cyl 450 HP DOT

Perma-Cyl® with FlexFill™ Top & Bottom Fill Option

The new FlexFill™ Piping Option has a top and bottom fill circuit that replaces the top float assembly so the driver can control the tank pressure while filling the Perma-Cyl® MicroBulk Storage System. The FlexFill option uses technology adopted from our LNG fueling system which allows it to safely go liquid full. Once the Orca™ MicroBulk Delivery System meter senses a flow rate reduction, the pump is automatically shut down. This patented automatic dispensing system simulates the same process drivers have used for years to safely fill Perma-Cyl storage tanks with a single hose.

The FlexFill feature is critical for applications like laser assist gas and medical gas supply where a significant drop in downstream pressure during the Perma-Cyl tank refill could result in equipment alarms. The new FlexFill feature works with all Orca models, both new and existing units.

**The FlexFill tank is presently not approved for service with CO_2.*

Pat. No. - 6,128,908 & others pending

Product Advantages

- Allows top & bottom filling for accurate pressure control in Perma-Cyl system during refill
- Provides the same safe, single hose, no-loss, auto shut-off fill with the Orca delivery system as the the top fill float design
- Backward compatible – works with new and existing Orca delivery units without modifications
- Available on 1000 HP/VHP, 1500 HP/VHP, 2000 HP/VHP, 3000 HP/VHP, and 5500 MP/VHP Perma-Cyl models

Cyl-Tel® Liquid Level Gauge

Cyl-Tel® Gen 5 is a digital electronic liquid level gauge designed specifically for the Perma-Cyl® MicroBulk Storage System. The Cyl-Tel gauge has been updated to Gen 5 to include the latest in electronic and differential pressure measurement technologies. The new design includes: accurate liquid level reading using differential pressure, a graphical display, and a simplified logic with nine selectable units of measure that eliminates the need for lookup charts. The Cyl-Tel gauge is telemetry-ready with built in outputs, which eliminate the need for additional boards and is completely compatible to most current telemetry system requirements.

Pat. No. - 6,542,848

Product Advantages

- Standard on 450 L and larger Perma-Cyl tanks (optional on smaller models)
- Improves customer readability by eliminating calibration charts
- Programmable to tank model or by tank geometry
- Telemetry-ready outputs compatible with many systems, including cellular
- Truly Telemetry-ready with standard pulse and voltage outputs (and optional 4-20mA with interface board); as well as 3 alarm (digital) outputs
- Power: Battery (2 x 1.5V Long Life Lithium) powered or optional 12Vdc adapter (for continuous power on)
- Built-in additional analog input port (0-5V) for optional pressure sensor connection

OnSite Telemetry℠ System

The OnSite Telemetry℠ System is the only integrated telemetry solution for distribution. It provides distributors the access to levels, tank pressure and line pressure at customer locations via the Internet. Centralized reports, information management tools and integrated fleet routing/scheduling software allows distributors to operate more efficiently.

Product Advantages

- Accurate, up-to-date measurements of liquid levels
- Self-administered system for maximum service and flexibility
- Account customization for best cost/benefit
- Up to four data ports per call
- Tank and line pressure readings for troubleshooting capabilities
- Email, pager or cell phone alarm capability
- Analog telephone line based
- Easy integration with other gas markets

Options and Accessories engineered to enhance Perma-Cyl® system installations in any application.

Exterior stainless steel wall box for remote filling of the Perma-Cyl storage vessel.

Optional external pressure build vaporizer coil for high-pressure, high flow gas applications. (Optional on 1000 VHP, 1500 VHP, 2000 HP & 3000 HP models)

Lab/pallet base is designed to catch or drain water — galvanized coated for corrosion resistance. (Optional on 450 & 1000 models /standard on 1500, 2000, 3000 & 5500)

Stainless steel plumbing for high purity applications. (Optional on 230 HP, 450 HP, 1000 HP & 2000 HP models)

Relief valve and burst disc vent-out safety piping accessory for indoor installations.

Fill Isolation Valve Kit option with ball valve and in-line relief valve on fill circuit.

Horizontal Shipping Kit can be used to safely lay the 2000 and 3000 liter Perma-Cyl® tanks on their side for ease of shipment or access through doorways. (Shown with forklift.)

Dual Safeties & Rupture Discs— Diverter valve allows to safely change relief valves or rupture discs without depressurizing the tank. (Optional on all models / standard on Perma-Cyl horizontal, 5500, 2000 CO_2 HP & FlexFill)

Phase Line tee connections allow for a convenient connection point of high and low phase lines for an owner supplied telemetry system or remote level gauge.

Bulk CO_2 Fill Fittings are available for 1500 HP, 2000 HP and 3000 HP Perma-Cyl tanks to accept CO_2 deliveries from large transport trucks.

Wika Liquid Level Gauge option replaces the standard Cyl-Tel® Liquid Level Gauge.

Vacuum jacketed valve and bayonet for efficient liquid withdrawal. ½" female bayonet. (Optional on 1000 HP, 1500 HP, 2000 HP & 3000 HP – specify tank side – built-to-order.)

Perma-Cyl® VIP Ready C-Flex Vacuum Insulated Transfer Hoses

Cryo-Flexible vacuum insulated liquid nitrogen transfer hoses are used in a wide variety of applications, such as Cryosaunas and CryoBio freezers to reduce liquid loss. The coaxial bellows construction allows for optimal flexibility, while the use of lightweight stainless steel reduces cool-down loss to an absolute minimum. C-Flex hoses are protected by a stainless steel spiral wrap or a braided outer cover.

Product Advantages

- Minimize Safety Issues – eliminate many of the hazards associated with non-insulated hoses
- Minimal Cool Down & Steady State Losses – compared to standard non-insulated hoses
- MVE Bayonet with Shrink-Fit™ technology – plugs into Perma-Cyl® tank for a robust easy cryogenic seal
- Easy Installation & Modifications – bendable, lightweight, and its plug-n-play approach facilitates easy installation and allows for on-site layout changes
- Integrated Pump Out & DV-6R Vacuum Gauge – confirms peak operation and long serviceable life
- Hose protection between isolation valves – integrated 150 psig safety relief valve
- Approved for liquid argon service – consult factory for liquid oxygen service

Applications (Recommended size: 3/8")

- Biological Storage Freezers
- Controlled-Rate Freezers
- Cryosaunas
- Cryo Ice Cream
- Test Chambers

Vertical VIP Run w/ RV - MVE2 End1

Horizontal VIP Run w/ RV - MVE2 End1

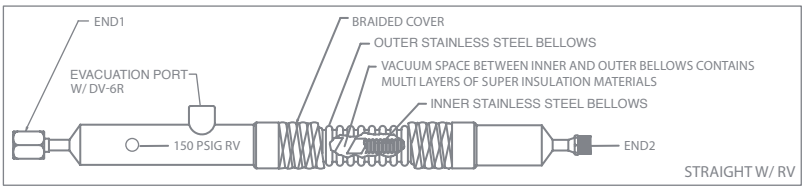
C-Flex Technical Information

Model	06S/B	08S/B
Inner Diameter (ID)	3/8" (9.5 mm)	1/2" (12.7 mm)
Outer Diameter (OD)	1.65" (41.91 mm)	1.80" (45.72 mm)
Minimum Flexible Bend Radius	8" (203 mm)	10" (254 mm)
Minimum Static Bend Radius	6" (152 mm)	7" (177 mm)
Maximum Operating Pressure	150 psi (10.3 bar)	150 psi (10.3 bar)

S: Spiral wrap outer covering **B:** Braided outer covering

Smart Numbering System

Inner Flex Diameter	Overall Length	Outer Wrap	End1 Termination	End2 Termination	Orientation w/ RV
06 = 3/8" 08 = 1/2"	XX = ft (60 max)	S = Spiral B = Braided	8SE = 1/2" SAE 45° Female Flare 4PT = 1/4" MPT 6PT = 3/8" MPT 8PT = 1/2" MPT 10PT = 5/8" MPT 8T = 1/2" Smooth Tube MVE1 = 1/2" MVE Female Bayonet MVE2 = 1/2" MVE Male Bayonet D = 625 Male Bayonet (Doser) DS = 625 Short Male Bayonet (Doser)		HRV = Horizontal w/ RV VRV = Vertical w/ RV SRV = Straight w/ RV None = None



C-Flex Flow data 22 psi LN_2 Source; 4 psi Pressure Drop (max)

Length (in / ft)	48" / 4'	72" / 6'	96" / 8'	120" / 10'	144" / 12'	192" / 16'	240" / 20'
3/8" Inner Diameter (ID)	6.0 gpm	4.8 gpm	4.1 gpm	3.6 gpm	3 gpm	2.8 gpm	2.6 gpm
1/2" Inner Diameter (ID)	11.4 gpm	9.0 gpm	7.6 gpm	6.8 gpm	6 gpm	5.2 gpm	4.4 gpm

The Orca™ Delivery System

Standard and Custom Delivery Units

All Orca™ MicroBulk Delivery System models feature an exclusive "Smart" flow metering system that contains no moving parts for an accurate, trouble-free service life. The Orca system controls automatically sense the Perma-Cyl® MicroBulk Storage System float shut-off for a safe and reliable fill.

XT-2500

ST-4100

HL-3300

XT Models

Designed for smaller markets or as a starter system, the XT Series delivers product efficiently from an innovative Pulse Technology process. This pumpless design uses a high-pressure pulse tank that integrates with the low-pressure main tank for a low-loss and low cost delivery solution. The XT Series' pulse pressure design benefits larger deliveries from the main tank.

Chart Exclusive - Submerged pump for inert service. Eliminates cool down losses and reduces delivery time.

Pat. Nos.: 5,616,838 · 5,682,750

ST & HL Models

The ST & HL models incorporate an external pump for oxygen service or an innovative submerged pump for inert service. The submerged pump eliminates cool down time and completes a Perma-Cyl system fill in 3 to 15 minutes without product loss under normal conditions.

	Pressure Transfer						Pump Transfer		
MODEL	XT-2000			XT-2500			HL-1650		
Gas Services	LIN, LAR & LOX			LIN, LAR & LOX			LIN, LAR & LOX		
Pressure Builder Type	HP² & ZX technologies			HP² & ZX technologies			Pump force-feed/Auto Subcool		
Design Codes	ASME and CGA-341			ASME and CGA-341			ASME, MC-338, CGA-341		
SPECIFICATIONS	**Overall Unit**	**Main Tank**	**Pulse Tank**	**Overall Unit**	**Main Tank**	**Pulse Tank**	**Overall Unit**		
Gross Capacity (gal/ltrs)	2026 / 7671	1947 / 7372	79 / 299	2489 / 9422	2410 / 9123	79 / 299	1726 / 6534		
Capacity* ** - CGA-341 (gal/ltrs)	1929 / 7302	1850 / 7003	79 / 299	2369 / 8966	2290 / 8667	79 / 299	1640 / 6207		
Capacity** - MC338 (gal/ltrs)							1534 / 5807		
MAWP (psig/bar)		217 / 15.0	350 / 24.1		217 / 15.0	350 / 24.1	50 / 3.4		
Overall Length (in/cm)	234 / 594			270 / 686			192 / 488		
Overall Height (in/cm)	78 / 198			78 / 198			87 / 221		
Overall Width (in/cm)	96 / 244			96 / 244			102 / 259		
Tank Diameter (in/cm)	72 / 183			72 / 183			80 / 203		
Tare Weight (lbs/kg)	10,900 / 4944			11,600 / 5262			7700 / 3493		
PERFORMANCE									
Dispense Method/Technology	Pulse Transfer / Pressure			Pulse Transfer / Pressure			External	Submerged Pump	
Pump	None			None			Ext 60	Sub 60	Sub 100 KA
Min. Dispensing Rate (gpm/lpm)		10 / 38	10 / 38		10 / 38	10 / 38	10 / 38	10 / 38	10 / 38
Max. Dispensing Rate (gpm/lpm)		75 / 284	30 / 114		75 / 284	30 / 114	60 / 227	60 / 227	100 / 379
Max. Dispensing Pressure (psig/barg)		217 / 15.0	350 / 24.1		217 / 15.0	350 / 24.1	260 / 17.9	275 / 19.0	425 / 29.3
Max. Receiving Tank Pressure (psig/barg)		167 / 11.5	250 / 17.2		167 / 11.5	250 / 17.2	210 / 14.5	225 / 15.5	375 / 25.9

* With road relief valve at 25.3 psig

** Maximum fill levels depend on vehicle weight, local road weight limits, etc.

The Orca™ Advantage

- Fast on-site filling of the Perma-Cyl® storage system with auto shut-off
- Exclusive low maintenance submerged pump for instant starts and continuous delivery (ST/HL Series - Inert Service)
- Pumpless pulse transfer plus pulse pressure technology reduces equipment costs and associated maintenance costs (XT Series)
- Single Hose Delivery system minimizes contamination, cool down losses and pressure drop
- Push-button Flowcom® 3000 Flow Meter System with manual override to simplify operator training (ST/HL Series)
- Electronic pump speed control allows driver to safely optimize delivery rate (ST/HL Series)
- National Institute of Standards & Technology (NIST) and California Weights & Measures approved metering system
- Stainless steel and bronze plumbing for long service life
- Robust inner vessel support system for rugged road conditions

HL Series updated controls and plumbing

Chart Exclusive - "Smart" flow metering system monitors flow electronically with no moving parts in meter section. (Standard on all models.)

HL Series Updated Features

- Auto Subcool – standard on all pump models, simplifies operator training and reduces product loss
- Updated electronics for operations to -40ºF / -40ºC
- Single hose dispense circuit for low flow Perma-Cyl tank and high flow bulk tank deliveries
- Larger cabinet with removable access panels for ease of maintenance and servicing
- Calibrated meter column system that can be easily removed for recalibration or service

Pump Transfer				
HL-2000	**HL-2800**	**HL-3300**	**HL-4400**	**ST-4100*** **
LIN, LAR & LOX	LIN, LAR & LOX	LIN, LAR & LOX	LIN Only	LIN, LAR & LOX
Pump force-feed/Auto Subcool	Pump force-feed/Auto Subcool	Pump force-feed/Auto Subcool	Pump force-feed/Auto Subcool	Pump force-feed/Auto Subcool
ASME, MC-338, CGA-341	ASME, MC-338, CGA-341	ASME, MC-338, CGA-341	ASME, MC-338, CGA-341	ASME, MC-338, CGA-341
Overall Unit	**Overall Unit**	**Overall Unit**	**Overall Unit**	**Overall Unit**
2144 / 8116	2880 / 10,902	3399 / 12,867	4654 / 17,617	4460 / 16,883
2037 / 7710	2736 / 10,357	3229 / 12,223	4421 / 16,736	4230 / 16,012
1907 / 7219	2560 / 9691	3023 / 11,443	4068 / 15,398	4030 / 15,225
50 / 3.4	50 / 3.4	50 / 3.4	50 / 3.4	38 / 2.6
200 / 508	244 / 620	273 / 693	344 / 874	350 / 889
87 / 221	87 / 221	87 / 221	87 / 221	135 / 343
102 / 259	102 / 259	102 / 259	102 / 259	102 / 259
80 / 203	80 / 203	80 / 203	80 / 203	80 / 203
8500 / 3856	9400 / 4264	10,500 / 4763	12,200 / 5534	17,100 / 7756
External	Submerged Pump		Submerged Pump	External / Submerged Pump
Ext 60	Sub 60	Sub 100 KA	Sub 100 KA	Ext 60 / Sub 60 / Sub 100 KA
10 / 38	10 / 38	10 / 38	10 / 38	10 / 38 / 10 / 38 / 10 / 38
60 / 227	60 / 227	100 / 379	100 / 379	60 / 227 / 60 / 227 / 100 / 379
260 / 17.9	275 / 19.0	425 / 29.3	425 / 29.3	235 / 16.2 / 250 / 17.2 / 400 / 27.6
210 / 14.5	225 / 15.5	375 / 25.9	375 / 25.9	185 / 12.8 / 200 / 13.8 / 350 / 24.1

MAWP = Maximum Allowable Working Pressure, NIST = National Institute of Standards and Technology, FET = Federal Excise Tax, DP = Differential Pressure
Specifications subject to change without notice. ***ST model also available in 6800 gallons upon request.

Chart Online Marketing Services

As Chart Inc. continues to provide distributors and customers with the best products and services in the industry, we would like to introduce you to an innovative marketing support tool designed to assist you in growing your business faster! Chart Online Marketing Services is like having your very own 24/7 marketing department providing you the marketing materials needed to drive customers to you. But this is much more than just a site to download product photos, you now have the ability to truly customize brochures, spec sheets and posters with your local contact information and company logo.

3 Easy Steps To Getting Onto Our Website To Order Marketing Materials!

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2. Enter your User ID and Password. Click Login, or click on email us to create an account.
3. Click on Catalog and choose whether you'd like to download or order printed materials.

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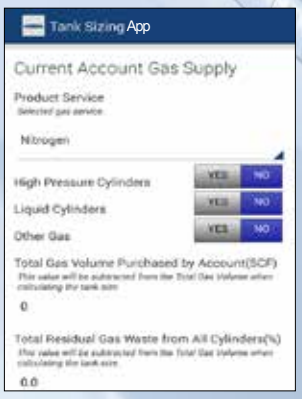

Chart Tank Sizing App

Correctly sizing your cryogenic equipment supply is easy when you know how – or know who to ask. For decades, Chart has helped gas distributors select the optimal cryogenic storage products for their customers. But now, Chart has developed a new **Tank Sizing App** that can advance your mode-change sales process faster and more accurately. No matter the challenge, Chart will provide the tools you need to succeed.

Download the app today for free at your app store and start learning from our experience.

SCF of GAS / Liter of LIQUID

Pressure psig	Argon	Nitrogen	Oxygen	CO_2	Pressure psig	Argon	Nitrogen	Oxygen	CO_2
0	29.69	24.60	30.36		225	23.58	18.35	24.24	20.34
25	28.24	23.17	28.89		250	23.17	17.89	23.83	20.07
50	27.32	22.26	27.97		275	22.77	17.43	23.43	19.82
75	26.60	21.53	27.25	22.40	300	22.37	16.96	23.03	19.58
100	25.98	20.89	26.63	21.96	325	21.98	16.47	22.64	19.34
125	25.43	20.33	26.09	21.57	350	21.43	15.96	22.25	19.11
150	24.93	19.80	25.59	21.23	375	21.19	15.42	21.86	18.88
175	24.46	19.30	25.12	20.91	400	20.79	14.80	21.47	18.66
200	24.01	18.82	24.67	20.61	425	20.39	14.07	21.08	18.44

ARGON	Weight		Gas		Liquid	
	Pounds (Lb)	Kilograms (Kg)	Cubic Feet (SCF)	Cubic Meters (Nm^3)	Gallons (Gal)	Liters (L)
1 Pound	1.0	0.4536	9.671	0.2543	0.08600	0.3255
1 Kilogram	2.205	1.0	21.32	0.5605	0.18957	0.7176
1 SCF Gas	0.1034	0.04690	1.0	0.02628	0.008893	0.03366
1 Nm^3 Gas	3.933	1.7840	38.04	1.0	0.3382	1.2802
1 Gal Liquid	11.630	5.276	112.5	2.957	1.0	3.785
1 L Liquid	3.072	1.3936	29.71	0.7812	0.2642	1.0

NITROGEN	Pounds (Lb)	Kilograms (Kg)	Cubic Feet (SCF)	Cubic Meters (Nm^3)	Gallons (Gal)	Liters (L)
1 Pound	1.0	0.4536	13.803	0.3627	0.1481	0.5606
1 Kilogram	2.205	1.0	30.42	0.7996	0.3262	1.2349
1 SCF Gas	0.07245	0.03286	1.0	0.02628	0.01074	0.04065
1 Nm^3 Gas	2.757	1.2506	38.04	1.0	0.4080	1.5443
1 Gal Liquid	6.745	3.060	93.11	2.447	1.0	3.785

OXYGEN	Pounds (Lb)	Kilograms (Kg)	Cubic Feet (SCF)	Cubic Meters (Nm^3)	Gallons (Gal)	Liters (L)
1 Pound	1.0	0.4536	12.076	0.3174	0.1050	0.3977
1 Kilogram	2.205	1.0	26.62	0.6998	0.2316	0.8767
1 SCF Gas	0.08281	0.03756	1.0	0.02628	0.008691	0.0329
1 Nm^3 Gas	3.151	1.4291	38.04	1.0	0.3310	1.2528
1 Gal Liquid	9.527	4.322	115.1	3.025	1.0	3.785
1 L Liquid	2.517	1.1417	30.38	0.7983	0.2642	1.0

SCF (Standard Cubic Foot) gas measured at 1 atmosphere and 70°F. Liquid measured at 1 atmosphere and boiling temperature.

CARBON DIOXIDE	Weight			Gas		Liquid		Solid
	Pounds (Lb)	Tons (T)	Kilograms (Kg)	Cubic Feet (SCF)	Cubic Meters (Nm^3)	Gallons (Gal)	Liters (L)	Cubic Feet (Cu Ft)
1 Pound	1.0	0.0005	0.4536	8.741	0.2294	0.11806	0.4469	0.010246
1 Ton	2000.0	1.0	907.2	17,483.0	458.8	236.1	893.9	20.49
1 Kilogram	2.205	0.0011023	1.0	19.253	0.5058	0.2603	0.9860	0.2260
1 SCF Gas	0.1144	—	0.05189	1.0	0.02628	0.013506	0.05113	0.0011723
1 Nm^3 Gas	4.359	0.002180	1.9772	38.04	1.0	0.5146	1.9480	0.04468
1 Gal Liquid	8.470	0.004235	3.842	74.04	1.9431	1.0	3.785	0.08678
1 L Liquid	2.238	0.0011185	1.0151	19.562	0.5134	0.2642	1.0	0.02293
1 Cu Ft Solid	97.56	0.04880	44.25	852.8	22.38	11.518	43.60	1.0

SCF (Standard Cubic Foot) gas measured at 1 atmosphere and 70°F.
Liquid measured at 21.42 atmospheres and 1.7°F.

Nm^3 (normal cubic meter) gas measured at 1 atmosphere and 0°C.
All values rounded to nearest 4/5 significant numbers.

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 P/N 11926802

FORTRANS
PH CONTROL SYSTEMS: CONCRETE REMOVERS

SOLD TO: Holcim
PO # 4501093507
SHIP TO: 14734 NE 95th Street Redmond WA
SHIP DATE: 11/17/17

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2 wire Differential pH Probe

Speck Pump

Blue-White Flow Meter Manual

Panel Heater

FORTRANS
PH CONTROL SYSTEMS: CONCRETE REMOVERS

PRODUCT SHEET

INSTALLATION INSTRUCTIONS

MODEL 5000B - MODEL 5000SK pH CONTROL SYSTEMS

WARNING: DO NOT LOCATE CO2 CYLINDERS, TANKS OR REGULATORS INSIDE ENCLOSURES.

TURN OFF THE CO2 SUPPLY VALVE BEFORE WORKING IN THE SYSTEM.

OWNER SUPPLIED ITEMS

1. 8' X 8' concrete pad for enclosure
2. Dewar's type 400 lb. Tanks or Micro Bulk tanks - 50 lb. high pressure C02 cylinders are also acceptable
3. A Victor Model SR-310-320 high flow- low pressure C02 regulator should be used with the system.
4. Do not use CO_2 welding regulators. They do not have enough flow to support the system.
5. 115V-20 Amp electrical connection to disconnect on rear of system or load center in control panel for Model 5000SK
6. 10' of 2" diameter schedule 80 PVC pipe - 2" Schedule 80 Female adapter and 2" Schedule 80 elbow fitting (2 required)
7. **Clean out pit or basin being treated before commencing operation. Do not place pump or discharge into slurry layer in basin.**

INSTALLATION INSTUCTIONS:

1. Place panel on concrete pad and level with shims. Fasten steel L brackets to concrete pad and Trex 4X4 base for stability. Connect 115V- 20 AMP electrical service to disconnect on the back. Not applicable to Model 5000SK. The SK system requires 115V 20 AMP electric service to the load center on the control panel. Mount control panel on wall. Install the supplied ⅜" hose to hose fitting on solenoid valve and then to the hose fitting on the Dif-Jet gas injector.

2. Connect hose to regulator and then connect to ¼" NPT fitting on bottom rear of C02 flow meter. Remove flow meter bracket for easy connection.

   A 75 lb. pressure relief valve is installed on the $C0_2$ line. **Do not install a check valve in the line from the C02 regulator to the solenoid valve.**

3. A check valve has been installed on the Dif-Jet™ injector to prevent any back flow. **Use CO2 gas to operate the system. Do not use liquid CO2.**

4. The operating pressure should be set at 18 – 25 PSI. Do not exceed 30 PSI.
   Check for CO2 leaks using a soap and water solution. Check for leaks at tank and all inside fittings after every C02 delivery. Small C02 leaks are very costly. Ensure that the nylon flat washer is installed on the regulator. If regulator "ices" up quickly, there is a CO_2 leak.

5. Screw (use Teflon tape on threads) pH probe into the 1½" bushing installed in the Y shaped probe holder on the discharge line. Hand tighten probe.
6. Connect the wires from the pH probe to the "green" pin terminal on the rear of the flip down panel. A wiring diagram is included inside the box the probe was shipped in.
7. pH probe has been calibrated at the factory. It should be re-calibrated every week. See laminated instruction sheet for step-by-step calibration instructions. Cut breaker to pump or unplug pump when calibrating.

Note: Ensure that pH probe does not freeze. A 200 Watt panel heater is installed in 5000B models.

8. Catalog # 2866-L pH 4.01 buffer and catalog # 2881-L pH 7 buffer fluids are included. Purchase a gallon bottle of distilled water for rinsing probe and small plastic cups for calibrations.

HOSE CONNECTIONS:

9. Suction or inlet and discharge/outlet quick connect fittings are pre-installed in rear of the unit. **DO NOT INSTALL A 90° ELBOW ON THE DISCHARGE PIPING AT THIS LOCATION. Use supplied hose for discharge, do not hard pipe.**

10. Construct discharge piping per our drawing and install in pit or basin.
    The discharge should not be placed in any slurry present in the pit or basin. Fabricate discharge line per installation drawing detail to ensure discharge flows parallel to surface of water not down into bottom of basin.

11. Connect the suction hose to the hose barb on the submersible pump a heat gun is required. Fasten the other end to the quick connect fitting marked "suction in rear of unit. Connect return/discharge hose to the quick connect fitting in rear of unit. Fasten the 6' length of hose to the discharge fitting on rear of system and then connect the 19' length to it. The short length is for easy cleaning if hose scales up.

12. Install supplied pump boom. Place the submersible pump in the basin above any slurry. Plug pump power cord into to the back of the float switch plug into the GFCI outlet on rear of unit. On Model 5000SK units the receptacle is furnished loose, the bell box, GFCI receptacle and 4 ½" deep weather proof cover are to be installed by customer.

13. Install alarm light bulb and red cover. On Model 5000SK systems install the alarm light on exterior of owner supplied enclosure and wire to relay C in controller.

14. **The controller is preset** at factory to activate the normally closed solenoid valve to feed $C0_2$ if pH is over 8.25 It will feed CO2 gas until the pH reaches 7.5 The pump continually circulates the water. When the pH reaches 8.25, the controller restarts the $C0_2$ feed automatically. Preset pH range is 7.5 to 8.25

15. The solenoid valve will cycle on for 60 seconds and off for 30 seconds while feeding CO_2 to ensure the regulator does not ice up. Cycle times are easily changed for field conditions.

16. The alarm light will turn on if the pH exceeds 9.0 or if the pH is lower than 6.5.

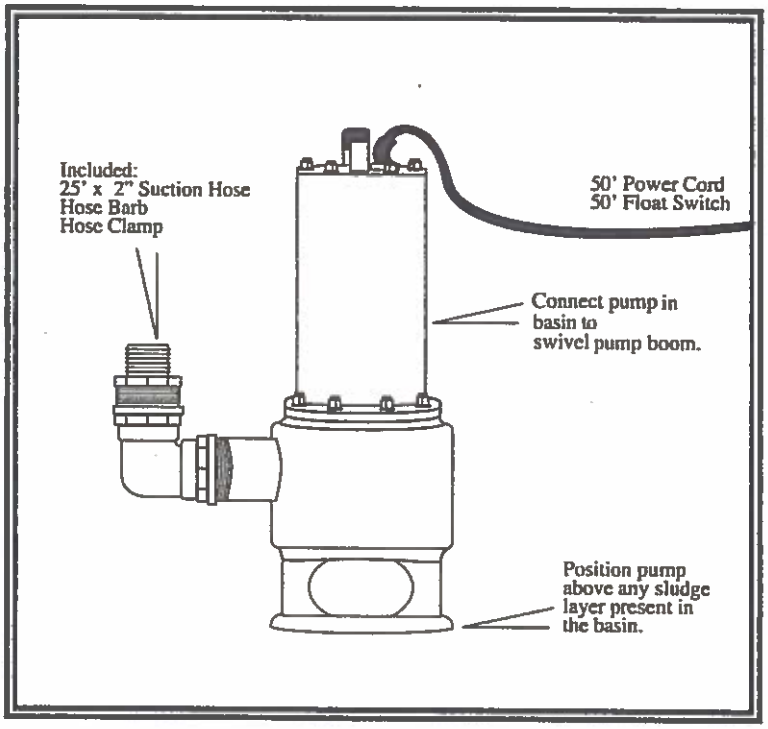
17. If System is slow to lower pH, ensure that the regulator is a high flow design similar to a Victor model SR-310-320 and not a C02 welding regulator.

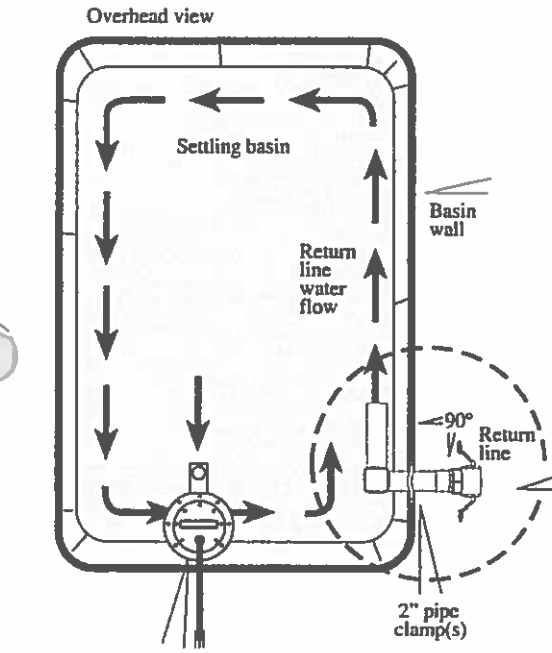
18. Once pump has been turned on check the water flow meter. **CHECK FOR LEAKS AT THE UNIONS. THE JOINTS COULD COME LOOSE DURING SHIPPING SO THE CONNECTIONS SHOULD BE HAND TIGHTENED.** Depending on head pressure the system should be operating at 45 to 70 GPM. Check the flow meter on a regular basis to ensure flow is maintained. If flow begins Dropping, check discharge hose for scaling and check pump to ensure it is not clogged or scaled up.

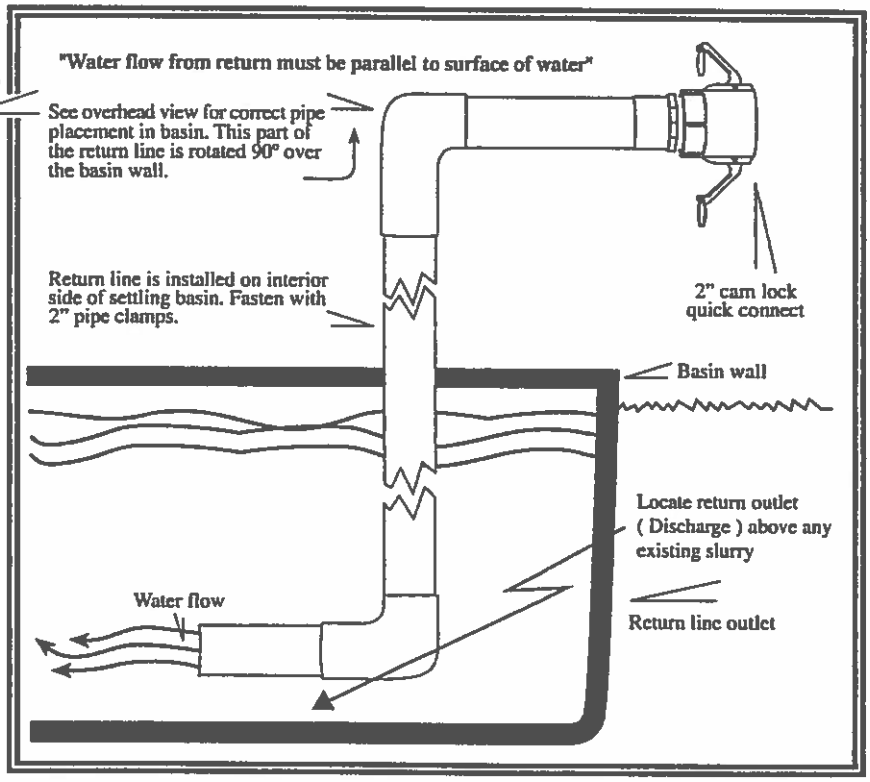
FORTRANS
PH CONTROL SYSTEMS: CONCRETE REMOVERS

PRODUCT SHEET

115v- 1 HP Submersible Pump







Return line detail

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FORTRANS
PH CONTROL SYSTEMS: CONCRETE REMOVERS

PRODUCT SHEET

Operation and Maintenance Information

Model 5000S, 5000B and Model 5000SK pH Control Systems

WARNING: DO NOT PUT C02 CYLINDERS, TANKS OR REGULATORS INSIDE SYSTEM

TURN OFF THE C02 SUPPLY VALVE BEFORE WORKING IN OR ON ANY SYSTEM

TURN OFF DISCONNECT IN REAR OF SYSTEM BEFORE ELECTRICAL REPAIRS

-FEED $C0_2$ GAS ONLY-

Set C02 regulator @ 20 to 25 PSI. System is most efficient under 28 PSI.
The pH controller has been preset to activate the $C0_2$ feed system at a pH of 8.25 and to deactivate the feed system when the pH reaches 7.5.

The solenoid valve is preset to open for 60 seconds and then close for 30 seconds and continually repeat that cycle in order to prevent the $C0_2$ regulator from freezing. A regulator heater may be required to prevent flash freezing in the return piping and hose when the system is operated at temperatures of 32°F or below.

All presets can be changed as needed. See Shark 120 PLC section in operations manual for information on changing "outputs".

The red warning light will come on if the pH exceeds 9.0 or is lower than 6.5 to alert the operator that there is a problem with the system. Always check $C0_2$ supply first to ensure that the tank is not empty.

All presets in the controller can be changed as needed. See operation manual for information on changing "outputs". DO NOT USE "SET UP" to make changes to programming use "outputs" for most changes. Entering the "Set up" menu can make all settings reset to manufacturer defaults.

Calibrate pH probe every week. Calibration instructions and buffers are included with system.

- PRIORITY MAINTENANCE ITEM-

Check discharge piping for scaling after first day of operation and at least every 2 weeks thereafter. Remove quick connect fitting and inspect inside pipe and hose for scale buildup. If more than ¼" of scale is present replace or clean hose. To clean hose, remove and let the scale dry for at least 2 days. Use a rubber hammer on hose to dislodge scale.
If discharge hose is not kept clean, scale may begin backing up into the interior pipe and the Dif-Jet $C0_2$ injector. If pipe treatment loop becomes scaled, it must be cleaned by placing the pump and the end of the discharge line into an open top 55 gallon drum and circulating an acid solution for 2 to 3 hours. We recommend our CR-650 concrete remover for this task.
Failure to keep lines clean will cause the submersible pump to overheat and eventually fail.
Check GPM reading on flow meter weekly. Clean discharge piping and pump when flow begins to drop.

Clean $C0_2$ injector every 6 months. To clean injector: loosen union fittings and remove injector then soak the injector overnight in acid. We recommend our CR-650 concrete remover for this task.

-CHECK OPERATING FLOW DAILY-

Check water flow meter daily. The flow meter should be operating at min, 40 GPM. If the reading is low check discharge hose for scaling. If piping and pump are free of scale and system is not at >40, remove and clean paddle wheel assembly by unscrewing the cap and gently removing the paddle wheel assembly.

-KEEP PUMP CLEAN-

Check submersible pump after first 2 to 3 days or operation. Clean pump if needed. When pumping high solids (unsettled process water check pump every week. In normal operation clean pump every 30 days.

-CHECK FOR C02 LEAKS-

Use a spray bottle with soap and water solution to check for C02 leaks at least once a week and after each $C0_2$ delivery. If the C02 regulator ices up or freezes quickly in operation, this usually indicates a leak. Find and repair immediately.

-DO NOT LET PH PROBE FREEZE OR DRY OUT-

To winterize the system, disconnect the suction and discharge hoses from the piping. Remove the submersible pump and drain. Drain and clean clear round sample cell Store pH probe with the tip submerged in water in warm location.

FORTRANS
PH CONTROL SYSTEMS: CONCRETE REMOVERS

PRODUCT SHEET

Model 5000 Series pH System Controller Presets

RELAY A: CONTROLS ON-OFF FUNCTION OF SOLENOID VALVE AND DURATION OF C02 FEED.

RELAY A: IS ON THE RIGHT SIDE OF THE CONTROLLER AND IS CONNECTED TO THE SOLENOID VALVE

RELAY A: ON AT A PH OF 8.25
OFF AT PH OF 7.25

SOLENOID VALVE WILL REMAIN OPEN FOR 60 SECONDS AND THEN TURN OFF FOR 30 SECONDS TO PREVENT C02 REGULATOR ICING OR FREEEZING-UP DURING OPERATION

RELAY B: NOT USED

RELAY C: ALARM LIGHT

ALARM LIGHT WILL ACTIVATE IF PH IS OVER 9.00 OR UNDER PH OF 6.5.

To Change Settings: Open front panel on controller - Main Menu will display

Use "down" key to scroll down to "OUTPUTS"

Press Arrow key -Relay A will display- Press arrow key- Relay A direction will display

"Rise" should display, if correct press down key- Relay A "ON" will display- To change

setting, press Arrow key- use UP and DOWN keys to change the setting at which you

want to start C02 feed - press Arrow key and then Down key - Relay "OFF" will display

Press Arrow key- Use UP and DOWN key to set the pH to stop C02 feed.

Press Arrow key- Relay Cycle ON will display- Press Arrow key and use UP key to set

To 60S (seconds) recommended- Press Arrow key- Relay A Cycle OFF will display Press

Arrow key and set Cycle off to 30S - Press Arrow key and then DOWN key

Press DOWN until "Save Settings displays- Press Arrow key, use UP and DOWN to

Place cursor on "Y" and Press DOWN key.

Press UP & DOWN Keys simultaneously to return to Run (main menu)

FORTRANS
PH CONTROL SYSTEMS: CONCRETE REMOVERS

PRODUCT SHEET

Fortrans 5000 Series pH Control Systems

pH Probe Calibration & Testing Procedure

Items required for calibration:

–Distilled water
–Buffer 7.0 (Buffer 1)
–small plastic cups
–Buffer 4.01 (Buffer 2)

1. Turn off pump breaker or unplug pump
2. Loosen case nut on pH probe holder and carefully slide out probe
3. Rinse probe in distilled water
4. Press "Cal" on front panel of Fortrans Model C Controller
5. Press "Enter"
6. "Buf 1" will flash – Place probe in buffer 1 (pH 7.0)
7. Press "Enter"
8. When pH reading stabilizes use the "UP" or "DOWN" buttons to match pH of Buffer 1(7.0)
9. Press "Enter". "Buf 2"flashes – Rinse Probe and place probe in Buffer 2(4.01)
10. Press "Enter"
11. When pH reading stabilizes use "UP" or "DOWN" button to match reading of buffer 2 (4.01)
12. Press "Enter". Display will flash "Eff" (efficiency). After 5 to 10 seconds the Eff will display the probe efficiency

To exit from any point on the menu, press UP and DOWN buttons together

IF EFFICIENCY IS BELOW 90%

Open front panel of controller: Loosen screws with a ¼ turn, front panel will flip down
Main menu will display: For menu "PRESS DOWN"
Scroll with "DOWN" button until "DIAGNOSTICS" is displayed. The curser must be flashing on Diagnostics.
Press "Arrow" button and then use "DOWN" button to scroll to "SENSOR INPUT"
Press "Arrow" button
Screen will display a millivolt result
Rinse and place probe in Buffer 1 (pH 7.0)
The displayed millivolt reading should be "0" ± 50mv
Rinse probe and place in Buffer 2 (pH 4.01)
The displayed mv reading should be approximately 175 mv MORE than the pH 7.0 reading.

If the millivolt readings are not within specification: replace pH probe.

Amp load for Model 5000B pH control system

1. Mody 1 HP submersible pump 115V (.075 kw) 10 AMPS, Thermal overload protection, rated for continuous duty. furnished with chemical resistant float switch with 40' power cord (0.545454545 pump plugs into float switch plugged into 115V GFCI receptacle with weatherproof cover on rear of pH system panel.

2. Shark 120 Controller with NEMA 4X enclosure, 115V, .5 AMP with no load on relays. Features 3-

110V relays and 4 each 4-20 outputs Relay A powers the solenoid valve (.083 AMPS). Relay B Not used, Relay C connects to alarm light which draws .545454 AMPS with 60 Watt bulb

3. 3800 Joule surge suppressor 115V on single 20A breaker. AMPS 0.008695

4. Stainless steel solenoid valve 115V, .083 AMPS

5. Panel Heater with thermostat, 115V, 200 Watts, .0986 Amps

6. Blue White model AOP 420 AT GPM 1 flow meter (water) Powered by 115V transformer that provides 15VDC not sure of AMPS for this device

Total Amp load: 11.235749

TECHNICAL BROCHURE
BJS+

JS+ J5S, J5SH, J7S, J10S, J15S

SHALLOW WELL JET PUMPS - ½, ¾, 1 AND 1½ HP

GOULDS
WATER TECHNOLOGY
a xylem brand

FEATURES

Compact: Design has an integral shallow well adapter built into the casing, which eliminates the need for a separate shallow well adapter.

Serviceable:

- Back pullout design allows disassembly of pump for service without disturbing piping.
- Two compartment motor for easy access to motor wiring and replaceable components.
- Nozzle clean out plug in pump case.
- Corrosion resistant, engineered plastic tubing and fittings are easily removed for cleaning. Premium O-ring design fittings need only be hand tight to seal.

Impeller: F.D.A. compliant, glass filled Noryl®. Corrosion and abrasion resistant.

Diffuser (Guidevane): Bolt down diffuser provides positive alignment with impeller. Diffuser also has stainless wear ring for extended performance in abrasive conditions. F.D.A. compliant, injection molded, food grade, glass filled Lexan® for durability and abrasion resistance.

Tubing and Fittings: F.D.A. compliant engineered plastic is corrosion and U.V. resistant.

Powered for Continuous Operation: Pump ratings are within the motor manufacturer's recommended working limits. Can be operated continuously without damage.

Corrosion Resistant: Electro-coated paint process is applied inside and out, then baked on.

Protected Mechanical Seal: Special diaphragm design retains water in the casing at all times to ensure the mechanical seal can never run dry.

Excellent Air Handling Ability: After initial priming the pump has the ability to re-prime itself even when air gets into the system. Pumping resumes once the water level rises above the foot valve.

APPLICATIONS

Specifically designed for the following uses:

- Homes
- Cottages
- Booster service

SPECIFICATIONS

Pump:

- **Pipe connections:** 1¼" NPT suction and 1" NPT discharge
- **Pressure switch:** AS4 preset (30-50 PSI).

Motor:

- NEMA standard
- 60 Hz
- ½ – 1½ HP, 115/230 V capacitor start
- Single phase
- 3500 RPM
- Built-in overload with automatic reset
- Stainless steel shaft
- Rotation: clockwise when viewed from motor end
- UL778 listed

Maximum temperature: 140°F.

SYSTEM COMPONENTS

- **Basic Pump Unit:** Includes pump with integral shallow well jet (nozzle and venturi), motor, pressure switch and tubing.

AGENCY LISTINGS

Canadian Standards Association

Underwriters Laboratories①

MODEL INFORMATION

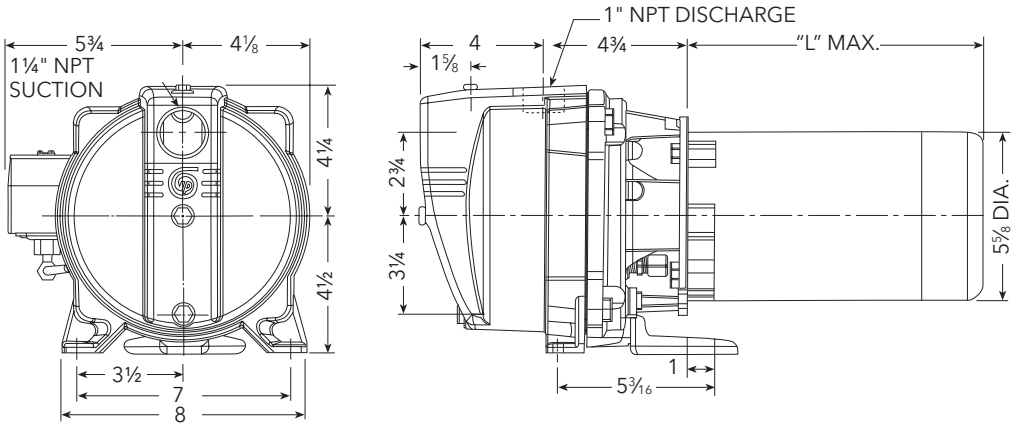
CSA Listed Order No.	U.L. Listed (Indoor use)① Order No.	HP
J5S	J5SUL	½
J5SH	J5SHUL	½
J7S	J7SUL	¾
J10S	J10SUL	1
J15S	J15SUL	1½

SHALLOW WELL PERFORMANCE RATINGS

HP/Model	½ HP – J5S					½ HP – J5SH						¾ HP – J7S					1 HP – J10S					1½ HP – J15S				
Nozzle	AN017					AN019						AN018					AN018					AN022				
Venturi	AD3332					AD3328						AD3336					AD3339					AD3342				
	Discharge Pressure – PSI					Discharge Pressure – PSI						Discharge Pressure – PSI					Discharge Pressure – PSI					Discharge Pressure – PSI				
Total Suction Lift (feet)	20	30	40	50	Max. Shut off (PSI)	20	30	40	50	60	Max. Shut off (PSI)	30	40	50	60	Max. Shut off (PSI)	30	40	50	60	Max. Shut off (PSI)	30	40	50	60	Max. Shut off (PSI)
	Gallons per minute					Gallons per minute						Gallons per minute					Gallons per minute					Gallons per minute				
5	17.5	16.5	10.2	5.0	63	11.5	11.3	11.0	7.7	4.8	83	21.3	18.3	12.5	6.6	70	24.8	24.4	16.6	9.9	74	26.6	26.3	25.0	15.6	80
10	15.7	14.4	9.2	4.3	61	10.3	10.0	9.6	7.0	4.2	81	18.8	17.3	11.3	5.0	68	22.9	22.2	15.8	8.6	72	24.7	24.3	22.6	13.9	77
15	13.7	12.5	8.0	3.6	59	8.8	8.6	8.3	6.3	3.7	79	16.4	15.5	9.6	3.7	66	19.8	19.5	13.8	6.9	70	21.6	21.5	20.4	12.9	75
20	11.5	10.4	7.1	2.3	57	7.0	7.0	6.8	5.8	3.2	76	13.6	13.2	8.3	2.0	63	16.6	16.6	12.2	5.6	67	18.1	18.0	17.6	12.0	73
25	8.7	8.6	6.2	1.3	54	5.3	5.2	5.2	5.0	2.8	73	10.0	9.9	6.4	1.0	59	12.5	12.4	10.4	3.6	65	14.0	14.0	14.0	10.1	71

DIMENSIONS AND WEIGHTS

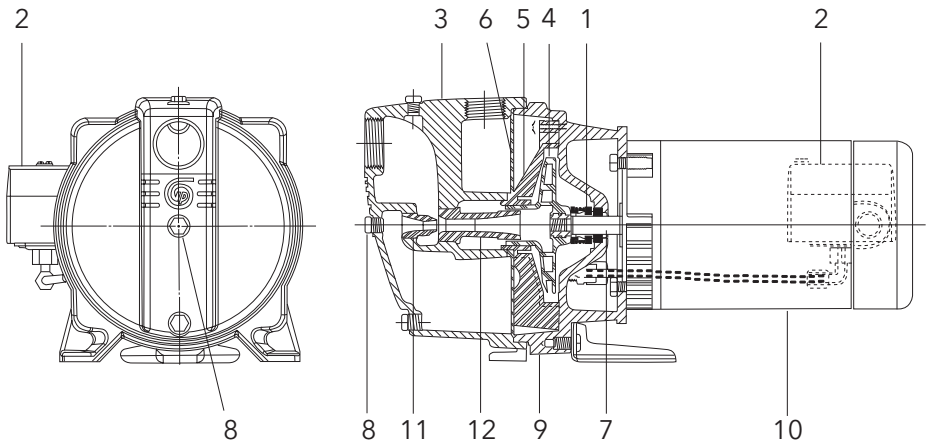
Model	J5S	J5SH	J7S	J10S	J15S
Wt. (lbs.)	43	43	47	50	60
Length	17¼	17¼	18¼	18¾	19¼
Width	9⅞				
Height	8¾				
HP	½	½	¾	1	1½
"L" Max.	8½	8½	9½	10	10½



(All dimensions are in inches and weights in lbs. Do not use for construction purposes.)

COMPONENTS

Item No.	Description
1	Mechanical seal
2	Pressure switch
3	Casing
4	Impeller
5	Diffuser (Guidevane)
6	Diaphragm
7	Stainless steel shaft
8	Nozzle clean-out plug
9	Motor adapter
10	Motor
11	Nozzle
12	Venturi (diffuser)



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IM102

ITT

Residential Water

Goulds Pumps

Jet Pumps

Installation, Operation and Troubleshooting Manual

GOULDS PUMPS

Goulds Pumps is a brand of ITT Corporation.

www.goulds.com

Engineered for life

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SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a **SAFETY ALERT SYMBOL.** When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that **WILL** cause serious personal injury, death or major property damage.

⚠ WARNING Warns of hazards that **CAN** cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that **CAN** cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

Important notice: Read safety instructions before proceeding with any wiring

⚠ WARNING All electrical work must be performed by a qualified technician. Always follow the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes. Code questions should be directed to your local electrical inspector. Failure to follow electrical codes and OSHA safety standards may result in personal injury or equipment damage. Failure to follow manufacturer's installation instructions may result in electrical shock, fire hazard, personal injury or death, damaged equipment, provide unsatisfactory performance, and may void manufacturer's warranty.

⚠ WARNING Standard units are not designed for use in hazardous liquids, or where flammable gases exist. Well must be vented per local codes. *See specific pump catalog bulletins or pump nameplate for all agency Listings.*

⚠ WARNING Disconnect and lockout electrical power before installing or servicing any electrical equipment. Many pumps are equipped with automatic thermal overload protection which may allow an overheated pump to restart unexpectedly.

⚠ WARNING Never over pressurize the tank, piping or system to a pressure higher than the tank's maximum pressure rating. This will damage the tank, voids the warranty and may create a serious hazard.

⚠ WARNING Protect tanks from excessive moisture and spray as it will cause the tank to rust and may create a hazard. See tank warning labels and IOM for more information.

SELECTING THE CORRECT JET PUMP SYSTEM

It is important to determine which jet pump system you need. A jet pump is a centrifugal pump with a jet (ejector) assembly. Goulds Pumps sells three types of jet pumps:

Shallow Well Jet Pumps with built-in jet assemblies for maximum lift of 25'. *See Fig. 1*

Convertible Jet Pumps can be used for Shallow wells (to 25'), with a bolt on shallow well adapter; or deep well (over 25') applications with a jet assembly in the well. *See Fig. 1, 2 and 3.*

Deep Well Jets should only be used on deep well (over 25') applications with the appropriate jet assembly. *See Fig. 2 and 3*

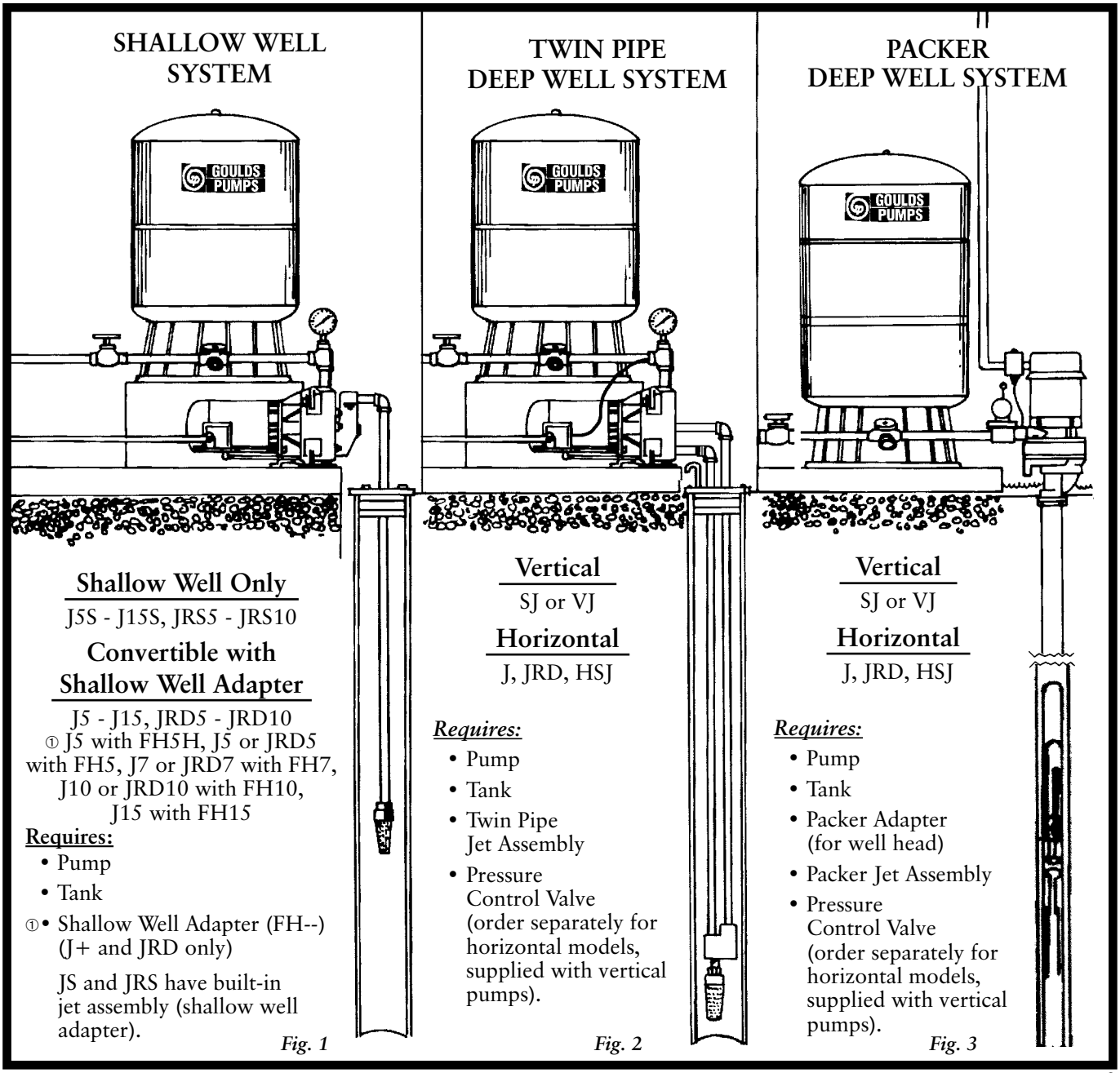
Use a shallow well pump or a convertible pump with a Shallow Well Adapter for wells with a maximum suction lift of 25'. This 25' includes actual vertical lift plus friction loss in the suction piping. Shallow well systems are identified by one (1) pipe going to the well, lake or river. They are good for city water booster systems and pumping from cisterns or tanks. *See Typical Installations, Figs. 1, 5 and 6.*

Deep well jet pumps are used for lifts greater than 25' and must have two pipes going to the well. There are two types of deep well jet assemblies, twin-pipe and packer systems. Deep well pumps come in both vertical and horizontal designs and in single and multi-stage models. *See Typical Installation Drawing, Fig. 2 and 3.*

Consult with your Professional Dealer or Distributor to select the best pump system for your application.

- Liquid temperature must not exceed 140° F (60°C).
- Protect unit from freezing

Typical Goulds Pumps Jet Pump Installations



PREPARING FOR INSTALLATION

Inspect the pump and the motor assembly for shipping damage.

Insure that you have all of the parts required for a proper installation. See component lists for different system types. There are shallow well, convertible shallow well, convertible deep well – twin pipe, convertible deep well-packer, vertical deep well-twin pipe, vertical deep well-packer, and booster systems. *See Typical Installation Drawings and Chart 1.*

Check power supply voltage and select motor voltage. Goulds ½ hp Jet pumps are factory pre-wired for 115 volts while ¾ hp and larger are pre-wired for 230 volts. Motors from ½ hp to 1½ hp can operate on either 115 or 230 volts. The 2 hp motors operate only on 230 volts. *See Fig. 7.*

Select a site where the pump and tank will not freeze. The pump must be within 4' of the tank to prevent switch chatter. There should be no filters or valves, other than a wide open gate valve, between the pump and tank. Fluid temperature must not exceed 140° F (60°C).

GENERAL INFORMATION - PIPING

Always follow state and local plumbing codes. Goulds Pumps does not sell or specify pipe types or materials, consult with your pipe supplier to determine the best pipe for your installation. Pipes can be threaded, glued, soldered, or clamped to available fittings and adapters. If using poly pipe with barbed connectors we suggest you double clamp all fittings to prevent air leaks. It is very important to eliminate high spots and dips in suction piping as they will trap air and make the system very hard to prime. Never route the piping up above and then down to the pump suction. Suction piping should be either straight from the well to the pump or should slope upward to the pump. Pumps do not "hold" prime, piping systems and check valves do. Go to the specific section for your system type.

SHALLOW WELL INSTALLATION - *start here*

Suction Piping

The suction pipe should be at least as large as the pump suction, typically 1¼". Use of smaller pipe increases friction loss and increases effective suction lift. This will reduce flow and pressure. On offsets over 50' we recommend using pipe larger than the pump suction. This will reduce friction loss and improve performance.

Install a foot valve on the end of your drop pipe if the well is 2" or larger. Lower the drop pipe with foot valve into the well. It is best to keep it at least 5' off the bottom of a clean well. If you set it lower you increase the chance of pulling debris into the screen or into the pump.

On sand points or driven wells you can install an in-line check valve near the well head or at the pump and use the well casing as the suction pipe. The closer the check valve is to the well the easier the system will prime. To prevent over pumping a low yield well you can throttle a jet pump using a ball valve in the suction line. You should install a compound pressure/vacuum gauge between the well and the valve. Do not throttle to more than 22" Hg (25' lift).

In areas where freezing occurs make the transition from vertical to horizontal below the frost line using a pitless adapter, consult with your plumbing supplier for pitless adapter information. In some areas they use a well seal and a 90° elbow.

We recommend not using filters on the suction side of a jet pump. Dirty filters increase the effective suction lift on the pump and can starve the pump of water. This will damage the impeller and diffuser which will affect performance.

Install Shallow Well Adapter On Convertible Pump
Unpack the Goulds Pumps "Shallow Well Adapter". Insure that the nozzle is installed in the adapter. Screw the venturi (long black tube) into the adapter. Install the gasket and bolt the adapter to the front of the pump using the four bolts provided. Tighten the bolts evenly to insure proper sealing and alignment of the venturi to the impeller. Do not over tighten the bolts. *See Chart 2.*

Shallow Well Pump – jet is built-in, proceed to next step.

Attach Suction Piping To Pump
Install a barbed adapter into the 1¼" pump suction if using poly pipe and double clamp the fitting.
OR
Thread a pipe nipple and union into the suction port to make a threaded pipe connection. Make sure the union is clean and well seated. Any air leak will ruin performance and the pump will not make pressure!

Discharge Piping
Install a tee or cross tee in the pump discharge. (They are not supplied with the pump!) Install a pipe plug or a pressure gauge into a reducer bushing in the top port of the tee. This will be used as the priming port.

Cross Tee - the discharge line to the home attaches to one port and the tank attaches to the other. This is called an Off-Line Tank installation.

Tee - you can use one line to supply the house with the tank tee installed off the line. This is called an On-Line Tank Installation and is most common.

Note: Goulds Pumps HydroPro Water System tanks are shipped with a tank installation guide. Please refer to it for more detailed tank instructions.

Do not place valves or filters between the pump and tank, other than a fully open gate valve or "full port" ball valve. The most common ball valves are not full port! Most valves and filters will create excessive friction loss and cause "switch chatter". Switch chatter is a rapid On-Off cycling of not only the pressure switch but also the motor. It will burn the points in the switch, the motor points, and cause motor damage if not corrected. If for

any reason you must have fittings or filters between the pump and tank and they cause switch chatter you should move the pressure switch to the tank cross tee. Go To "Install HydroPro Water Systems Tank" to Complete Shallow Well Installation.

DEEP WELL TWIN PIPE – *start here*

Twin Pipe Suction Piping
A twin pipe jet assembly is used in wells 4" and larger. Our 4" jet assemblies require a minimum 1¼" suction and 1" drive water pipe; 5" jets require a minimum 1½" suction and 1¼" drive water pipe. Use of smaller piping will reduce performance in gpm and pressure. Offsets over 50' require larger pipes to reduce friction loss and to obtain published performance.

Install Twin Pipe Jet Assembly

Check to make sure the nozzle is installed in the jet assembly. Install the venturi tube in line with the nozzle. On 4" jets attach the 1¼" suction and 1" pressure pipe to the jet assembly female threads. On 5" jets the pipes should be 1½" and 1¼". Install a foot valve on the male thread bottom port on the jet assembly or on the end of a 34' tail pipe. The tail pipe prevents over pumping a low yield well so the pump will not break suction. *See Tail Pipe in Technical Section*.

Lower the jet assembly into the well. It should be set at least 5' below the static water level. Keep the jet a few feet off the well bottom to lessen the possibility of sucking debris into the jet. The connections at the well head can be either a pitless adapter or a well seal. Priming will be easier if you fill the pipes with water before attaching the pump.

Connect the suction and pressure pipes to the threaded connections on the face of the pump. This can be done using unions and threaded pipe nipples, or barbed connectors with poly pipe. Always double clamp barbed connectors. Make sure that the piping slopes upward to the pump and that no point is above the pump suction. On long offsets it is easier to prime the system if you fill the pipes with water before connecting the pipes to the pump. *Go to Deep Well Discharge Piping*.

DEEP WELL PACKER SYSTEM – *start here*

Packer Suction Piping

Packers use the area between the well casing and the suction pipe as the drive water (pressure) pipe. The 2" or 3" well casing must be smooth and clean to insure a good seal with the packer leathers or the system will leak and not hold prime. The 2" packer requires 1¼" threaded suction pipe and the 3" requires 1½". On 2" packers only: Use the Goulds Pumps turned couplings part #64655 to connect the sections of 1¼" threaded pipe. This special diameter turned coupling increases the clearance between the 2" well I.D. and the O.D. of the coupling to allow the drive (pressure) water to easily pass the couplings. Failure to use them will have a negative impact on pump performance, both pressure and gpm will decrease. The pump may easily lose prime while pumping due to the restriction!

Using smaller than recommended pipe may reduce gpm output. The longer the pipe the worse the affect.

Install Packer Assembly
To ease installation soak the 2" or 3" packer assembly in warm water to make the leathers soft and pliable. DO NOT lubricate them with grease, oil, or petroleum jelly! The leathers must absorb water to seal the packer assembly against the well casing.

Check to make sure the nozzle is installed in the jet assembly. Install the venturi tube in line with the nozzle. Install a strainer (not supplied with packer assembly) on the bottom port of the packer assembly or on the end of a 34' tail pipe. The tail pipe prevents over pumping a low yield well so the pump will not break suction. Attach the packer assembly to the suction pipes using the Goulds Pumps' turned couplings to connect the sections. Insert the packer assembly into the well casing and push it down. Attach the other pipe sections as you lower the jet into the well. *See Tail Pipe in Technical Section*.

Attach Suction Pipe To Packer Adapter
Packer systems always require a Packer Adapter at the well head. The adapter makes the transition from vertical to horizontal for horizontal pumps, and it connects vertical pump casings to the well casing and suction pipe. See the list of Packer Adapters/Pump Models to see which one your pump system requires. *See Chart 1 for a list of Packer Adapters/Pump Models*.

After the jet assembly is inserted into the well, attach the Packer Adapter to the top of the suction pipe. Screw the top section of 1¼" male threaded suction pipe or a threaded adapter into the 1¼" NPT female threaded hole in the 2" packer adapter or a 1½" suction pipe into the 3" packer adapter.

Make sure that the O.D. of the well casing is free of dirt and burrs. With the gland bolts loosened the tapered seal ring on the packer adapter should slide over the well casing. After insuring that it is in place tighten the two gland nuts to compress the seal ring and seal it to the well casing O.D.

Install the pump by attaching it to the Packer Adapter using the bolts and gaskets provided. Vertical models use studs and nuts for ease of assembly.

DEEP WELL DISCHARGE PIPING

All deep well jet pumps require back pressure to operate the jet assembly. To insure we have the required back pressure or drive water pressure we must use a pressure control valve or some type of flow restrictor in the discharge line. The valve must be located between the pump and the first discharge port. It is best to locate it as close to the pump as possible. Failure to install and adjust a pressure control valve will result in loss of prime during peak usage such as filling a washing machine, bathtub or using outside hose bibs.

All ½ hp pumps can use a simple gas cock or full port ball valve, such as our AV15.

All other horizontal deep well jet pumps, ¾ hp and larger, should use an AV22KIT, or an AV22 and a JDW tubing kit. The AV22 has a tapping to which you connect the new, longer pressure switch tubing. This allows the pressure switch to read the pressure on the outboard side of the valve rather than in the pump casing. Remove the straight or elbow compression fitting from the pump casing. Use the pipe plug in the JDW or AV22KIT to plug the hole in the pump casing. Remove the fitting from the pressure switch. Cut the old tubing in half and slide the compression fittings off the old tubing. Note that the fitting will only slide in one direction. You can now reuse the elbow compression fitting with the new tubing at the pressure switch. Screw the new straight connector into the AV22 and attach the tubing from the switch to the AV22.

Vertical deep well pumps come with a built-in AV21 and only need to be adjusted.

After the pump is primed and flowing water at a steady pressure you should open a few faucets and adjust the pressure control valve to the pressure listed in the chart. To increase pressure close the valve, AV15 or AV22, or turn the AV21 screw clockwise. *See Chart 1.*

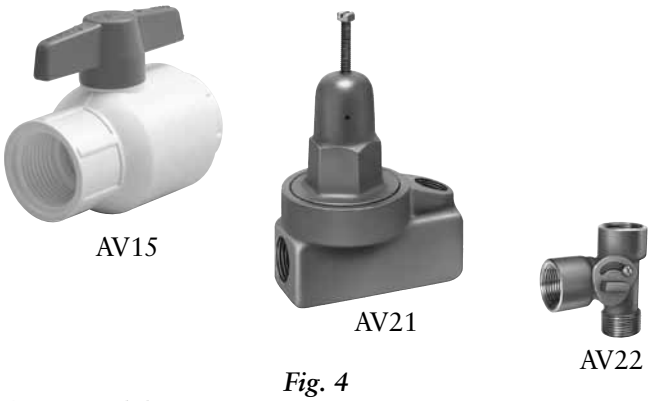


Fig. 4

ALL SYSTEMS

Install HydroPro Water Systems Tank

While the tank is empty check the pre-charge air pressure with a tire pressure gauge. The tank pre-charge should be set 2 psi lower than the pump cut-in (turn on) pressure. On Goulds Pumps HydroPro Water Systems tanks the valve cap is the primary seal so be sure to re-install the cap after checking air pressure. Avoid frequent air checking as you lose 1 – 2 psi every time you check. Goulds Pumps jet pumps are all supplied with 30 – 50 psi standard pressure switch settings.

Locate the tank on a firm, level surface.

A pressure relief valve is recommended for all systems, and mandatory for systems producing over 100 psi. It should be rated less than 100 psi but greater than the system pressure near the tank.

Make the piping connection between the pump discharge and the tank. Complete the piping by connecting to the house plumbing.

Note: Goulds Pumps only sells the HydroPro Water System tanks. They are all shipped with a tank installation guide in the carton, please refer to it for more detailed tank instructions. If you are using a tank from another manufacturer please contact that company for specific instructions on their tank.

Galvanized tanks are installed the same as pre-charged tanks except they require an Air Volume Control (AVC) to replenish air lost through absorption. The AVC requires connection to a vacuum port on the pump. The suction side of the AVC must have a minimum 3" vacuum for 15 seconds when the pump starts. Follow the instructions provided with the air volume control.

Priming a Shallow Well System

Priming means filling the pump and suction pipe with water. Most shallow well jet pumps handle air well and will evacuate air from the suction line but it may take several minutes to prime depending on depth to water, and pipe size and length.

VENT THE PUMP FOR EASIER PRIMING!

It is easier to prime a pump if you allow all the air to escape from the pump and the pipes, the water cannot go in unless the air can escape!

Remove the pipe plug or pressure gauge bushing in the discharge tee to fill the pump with water. On shallow well pumps you should remove the ⅛" pipe plug located between the suction and discharge ports to allow air to escape as you fill the casing with water. The port will be located on either the top of the casing or the top of the shallow well adapter. Fill the pump and as much of the suction pipe as possible with water through the discharge port.

Replace the ⅛" pipe plug and discharge gauge/bushing. Open the faucet closest to the pump/tank a small amount to allow air to escape the system. Do not open it too much or the pump will expel too much water and you will have to reprime the pump casing. On jobs with long suction pipes you may have to add water to the pump casing several times to complete the priming process. *Go to Power Motor.*

Priming a Deep Well System

Priming a deep well system means filling the pump and the suction/pressure pipes with water. Deep well single stage and multi-stage pumps require a complete prime before starting. Filling the pipes with water before installing the pump will make priming faster and easier.

VENT THE PUMP FOR EASIER PRIMING!

To insure a complete prime we recommend removing the angled ⅛" vent plug located just above the suction pipe on horizontal pumps. This will allow the air to easily escape as water enters. Our horizontal convertible deep well jets should be primed through a tee or the AV22 at the pump discharge. The tee is not supplied by Goulds Pumps.

Our vertical deep well jet pumps have built-in pressure control valves. Priming is done through the pressure gauge port on the pressure control valve. Most verticals have a vent plug located on the side of the motor adapter that vents the seal cavity which is the high point inside the pump. Removing this vent plug will make priming much easier.

Power the Motor

The electrical supply must be a separate branch circuit with a properly sized breaker or fuses. All wiring must conform to National (NEC), CSA, state, provincial, and local codes. Power supply voltage, phase and controls must match motor.

NEVER RUN A PUMP DRY, DAMAGE WILL RESULT, AND THE WARRANTY WILL BE VOIDED!

ALWAYS DISCONNECT AND LOCK-OUT ALL ELECTRICAL POWER WHEN INSTALLING OR WORKING ON PUMPS, MOTORS, OR SWITCHES. INSURE THE POWER SUPPLY BREAKER IS OFF OR THE DISCONNECT (WHERE USED) IS OFF.

Remove the pressure switch cover. Attach the power supply wires, either 115 or 230 depending on the motor voltage, to the Line terminals of the pressure switch.

Attach the green or bare ground wire to either green ground screw in the switch. It makes no difference which Line terminal you attach the hot- L1 (usually Black) and neutral- N (usually white) 115 volt wires to on the switch. The same goes for a 230 volt hook-up, either wire can go on either Line terminal. Re-install the switch cover. **NOTE:** Motor voltage is NOT changed in the pressure switch. *See Fig. 7 in Technical Data*.

Check to insure that the motor is wired to match the incoming voltage. All motors have a sticker near the pressure switch that identifies the pre-wired voltage. All ½ hp jet pumps are factory wired for 115 V, and ¾ hp and larger are wired for 230V. The motor voltage must be changed inside the motor cover, not in the pressure switch. Make sure the breaker or disconnect is OFF before entering the motor cover. All motors have a wiring diagram on the cover label and it is also found in this manual. *See Motor Wiring Diagram, Fig. 7, in Technical Data*.

BOOSTER SYSTEMS

Use the basic instructions for either a Shallow Well or Convertible with Shallow Well Adapter. If a city water booster system please plumb per Fig. *5*

J, JS, JRS OR HSJ SERIES

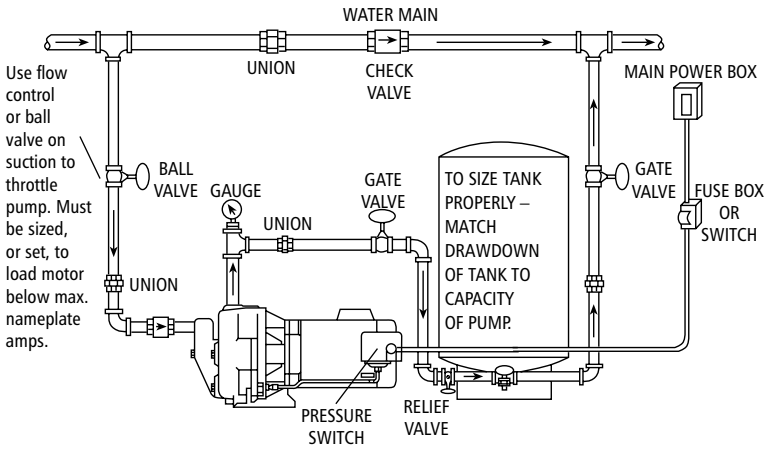


Fig. 5

If pumping from a cistern or water tank plumb per Fig. 6.

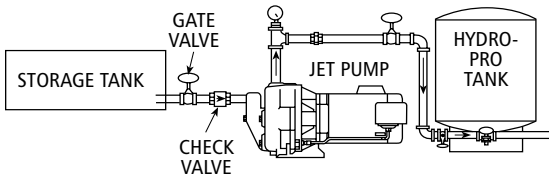


Fig. 6

SEASONAL SERVICE

It is necessary to drain the entire system where the pump, tank, and piping will be subjected to freezing. Vertical pumps have a drain plug located on the side of the pump casing near the bottom of the pump. Horizontal pumps may have two drain plugs, one on the casing (part where pipes attach) and another on the motor adapter. They are also located near the bottom of the pump. Multi-stage pumps also have 1 or 2 drain plugs and they may require you to tip the pump or blow compressed air in one hole to get all the water out of the stages.

CHART 1

RECOMMENDED DEEP WELL JET ASSEMBLIES AND CONTROL VALVE SETTINGS

PUMP MODEL	TWIN PIPE SYSTEMS *(see fig. 2)*				PACKER SYSTEMS *(see fig. 3)*					RECOMMENDED CONTROL VALVE *(see fig. 4)*
	JET ASSEMBLY	MIN. WELL DIAMETER	CONTROL VALVE SETTING (PSI)	DEPTH TO JET	JET ASSEMBLY	WELL DIAMETER	CONTROL VALVE SETTING (PSI)	DEPTH TO JET	PACKER ADAPTER	
J5	FT4-13	4"	30	30-40	FP2-13	2"	30	30-40	AWJ2	AV15 or AV22KIT
	FT4-31	4"	30	30-60	FP2-31	2"	30	30-60		
	FT4-08	4"	30	60-90	FP2-08	2"	30	60-80		
	FT5-14	4½"	30	50-90	FP3-36	3"	30	30-70	AWCJ3	
	—	—	—	—	FP3-24	3"	30	50-80		
J7	FT4-14	4"	28	30-60	FP2-40	2"	30	30-60	AWJ2	AV22KIT or AV22 and JDW
	FT4-34	4"	29	70-90	FP2-47	2"	32	60-90		
	FT4-18	4"	30	90-110	—	—	—	—	—	
	FT5-47	4½"	28	30-70	FP3-53	3"	27	30-70	AWCJ3	
	FT5-48	4½"	40	70-110	FP3-54	3"	30	70-110		
J10	FT4-44	4"	31	30-60	FP2-48	2"	35	30-60	AWJ2	AV22KIT / AV22 and JDW
	FT4-43	4"	33	60-80	FP2-43	2"	36	60-100		
	FT4-18	4"	35	80-110	—	—	—	—	—	
	FT5-49	4½"	30	30-80	FP3-55	3"	28	30-80	AWCJ3	
	FT5-11	4½"	32	80-120	FP3-14	3"	32	80-120		
J15	FT5-12	4½"	35	30-70	FP3-16	3"	34	30-60	AWCJ3	AV22KIT / AV22 and JDW
	FT5-11	4½"	40	70-140	FP3-18	3"	34	60-90		
	—	—	—	—	FP3-21	3"	34	90-150		
	—	—	—	—	FP3-24	3"	39	100-170		
SJ07 & HSJ07	FT4-48	4"	37	30-70	FP2-51	2"	40	30-70	AWD2	SJ - AV21 is built-in HSJ - use AV22KIT
	FT4-47	4"	40	70-90	FP2-50			70-90		
	FT4-06	4"		90-130	FP2-06			90-130		
					FP3-40	3"	36	30-80	AWD3	
					FP3-42		40	80-130		
SJ10 & HSJ10	FT4-47	4"	40	30-70	FP2-50	2"	40	30-60	AWD2	
	FT4-24	4"	43	70-110	FP2-07		45	60-110		
	FT4-08	4"		110-150	FP2-08			110-150		
					FP3-40	3"	40	30-90	AWD3	
					FP3-49		43	90-150		
SJ15 & HSJ15	FT4-45	4"	62	30-90	FP2-49	2"	62	30-90	AWD2	
	FT4-30	4"	65	90-130	FP2-30		65	90-130		
	FT4-29	4"	67	130-190	FP2-29		67	130-180		
					FP3-47	3"	62	30-100	AWD3	
					FP3-46		64	100-150		
					FP3-34		66	150-210		
SJ20 & HSJ20	FT4-45	4"	76	30-100	FP2-49	2"	76	30-100	AWD2	
	FT4-30	4"	78	100-150	FP2-30		78	100-150		
	FT4-29	4"	80	150-200	FP2-29		80	150-200		
					FP3-47	3"	75	30-110	AWD3	
					FP3-46		78	110-170		
					FP3-34		80	170-230		

NOTE: Offset adapters are available. See "Fittings" section of your Goulds Pumps Jet and Sub Catalog or consult your local distributor for information.

CHART 1 *(continued)*

RECOMMENDED DEEP WELL JET ASSEMBLIES AND CONTROL VALVE SETTINGS

PUMP MODEL	TWIN PIPE SYSTEMS *(see fig. 2)*				PACKER SYSTEMS *(see fig. 3)*					RECOMMENDED CONTROL VALVE *(see fig. 4)*
	JET ASSEMBLY	MIN. WELL DIAMETER	CONTROL VALVE SETTING (PSI)	DEPTH TO JET	JET ASSEMBLY	WELL DIAMETER	CONTROL VALVE SETTING (PSI)	DEPTH TO JET	PACKER ADAPTER	
JRD5	FT3-09	3"	30	30-50	FP2-13	2"	30	30-50	AWJ2	AV15 or AV22KIT
	FT4-13	4"	30	30-50						
	FT4-31	4"	30	30-70	FP2-31	2"	30	30-60		
	FT4-08	4"	30	60-90	FP2-08	2"	30	60-80		
	FT5-14	4½"	30	70-90						
JRD7	FT4-14	4"	27	30-60	FP2-40	2"	30	30-60	AWJ2	AV22KIT / AV22 and JDW
	FT4-34	4"	29	60-90	FP2-47	2"	32	60-90		
	FT4-18	4"	30	90-110						
	FT5-47	4½"	27	30-70	NA					
	FT5-48	4½"	30	70-110						
JRD10	FT4-44	4"	31	30-60	FP2-48	2"	35	30-60	AWJ2	AV22KIT / AV22 and JDW
	FT4-43	4"	33	60-80	FP2-43	2"	36	60-100		
	FT4-18	4"	35	80-110						
	FT5-49	4½"	28	30-80	NA					
	FT5-11	4½"	32	80-120						
VJ05	FT4-46	4"	23	30-60	FP2-38	2"	23	30-60	AWD2	AV21 is built-in
	FT4-08	4"		60-90	FP2-08			60-90		
				30-60	FP3-42	3"		30-60	AWD3	
				60-100	FP3-09			60-100		
VJ07	FT4-47	4"	34	30-60	FP2-50	2"	34	30-60	AWD2	
	FT4-46	4"		60-90	FP2-47			60-100		
	FT4-06	4"	40	90-110	FP2-09			100-120		
					FP3-40	3"		30-60	AWD3	
					FP3-43			60-130		
VJ10	FT4-14	4"	34	30-90	FP2-48	2"	36	30-60	AWD2	
	FT4-09	4"	36	90-120	FP2-43			60-100		
					FP2-08			100-120		
					FP3-40	3"	34	30-90	AWD3	
					FP3-49		36	90-140		

NOTE: Offset adapters are available. See "Fittings" section of your Goulds Pumps Jet and Sub Catalog or consult your local distributor for information.

CHART 2

SHALLOW WELL JET ASSEMBLIES FOR CONVERTIBLE PUMPS

PUMP MODEL	SHALLOW WELL ASSEMBLY ORDER NO.	INCLUDES	
		NOZZLE	VENTURI
J5	FH5 (std.)	AN017	AD3731
J5	FH5H (high pres.)	AN019	AD3528
JRD5	FH5JRD	AN018	AD3731
J7, JRD7	FH7	AN018	AD3536
J10, JRD10	FH10	AN018	AD3538
J15	FH15	AN022	AD3542
HSJ07N	FHSJ07	AN012	AD3432
HSJ10N	FHSJ10	AN012	AD3437
HSJ15N	FHSJ15	AN012	AD3439
HSJ20N	FHSJ20	AN012	AD3448

WARNING: DISCONNECT POWER SOURCE BEFORE CHECKING. DO NOT MAKE ANY CHANGES WITH POWER ON.

VOLTAGE CHANGES ARE MADE INSIDE THE MOTOR COVER, NOT IN THE PRESSURE SWITCH.

VOLTAGE CHANGE PROCEDURE AND TERMINAL BOARD DESIGN

A.O. Smith jet pump motors have a voltage plug to facilitate simple voltage changes from 115V to 230V. All ½ HP motors are factory wired for 115V operation. If wired for 115V, operation at 230V will destroy the windings in a matter of seconds and will not be covered by warranty. Larger HP motors are factory wired at 230V.

Terminal Board Design:

- L1 has two (2) male terminals, one switch wire is attached to one terminal.
- L2 has two (2) male terminals, one switch wire is attached to one terminal and when set up for 115V operation the voltage plug is connected to the other.
- "A" has 1 male terminal, the voltage plug is always connected to "A".

Voltage Change: ***failure to follow these instructions may damage the windings***

- 115V - Place the Black voltage plug on the open L2 male terminal and the "A" terminal.
- 230V - Place the Black voltage plug only on the "A" male terminal. The 2nd L2 male terminal will be open.

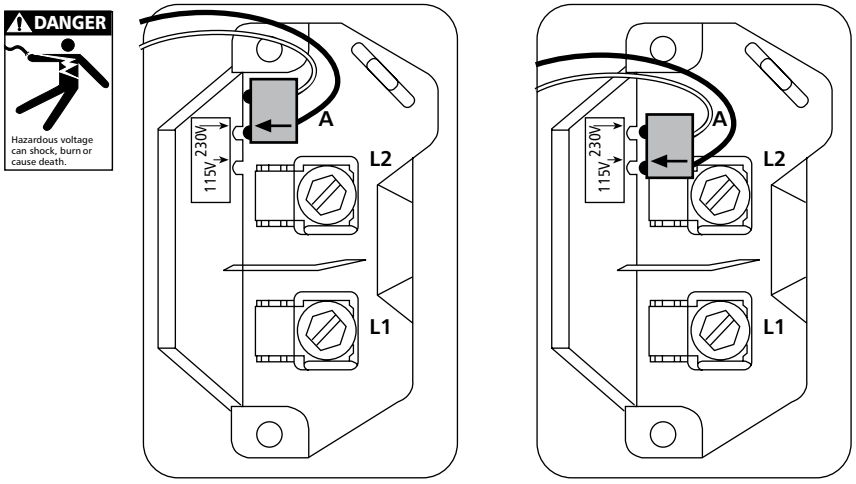


Fig. 7

A.O. SMITH MOTOR TERMINAL BOARD AND VOLTAGE CHANGE PLUG

■ **Pumps are Pre-Wired by HP:**

- ½ hp wired for 115 volts
- ¾ hp - 1½ hp and larger wired for 230 volts
- 2 hp is 230 volt only

A.O. SMITH MOTOR DATA

GP Number	Where Used	A.O. Smith Number	HP	Volts	Phase	Service Factor	Max. Load Amps	Watts	Circuit Breaker
J04853L	J5(S), GB	C48A93A06	½	115/230	1	1.6	10.8/5.4	968	25/15
J05853L	J7(S), GB, GT07, (H)SJ07, HSC07	C48A94A06	¾	115/230	1	1.5	14.8/7.4	1336	30/15
J06853L	J10(S), GB, GT10, (H)SJ10, HSC10	C48A95A06	1	115/230	1	1.4	16.2/8.1	1592	30/20
J07858L	J15(S), GB, GT15, HSJ15, HSC15	C48M2DC11A1	1½	115/230	1	1.3	21.4/10.7	1950	40/20
① J08854L	HSJ20, GB, GT20, HSC20	K48A34A06	2	230	1	1.2	12.9	2100	25
J09853	XSH30, GT30	C56P2U11A3HH	3	230	1	1.15	17.2	3280	30
SFJ04860	JRS5, JRD5, JB05	C48C04A06	½	115/230	1	1.6	12.6/6.3	990	25/15
SFJ05860	JRS7, JRD7, JB07	C48C05A06	¾	115/230	1	1.5	14.8/7.4	1200	30/15
SFJ06860	JRS10, JRD10, JB10	C48C06A06	1	115/230	1	1.4	16.2/8.1	1400	30/20

① Effective July, 1998, 230 V only.

USE OF TAILPIPE ON DEEP WELL JET PUMPS

If the capacity of a deep well jet pump exceeds the well production, well drawdown will allow your pump to break suction and lose prime. This can be overcome by using a 34' tailpipe between the jet assembly and the foot valve. Since the capacity of a pump falls off as the lift is increased your well inflow and pump output will equalize somewhere between the jet and foot valve. The drawing shows the percentage of rated capacity you will get at certain points. As in a normal situation the jet should be set 5' below the static water level.

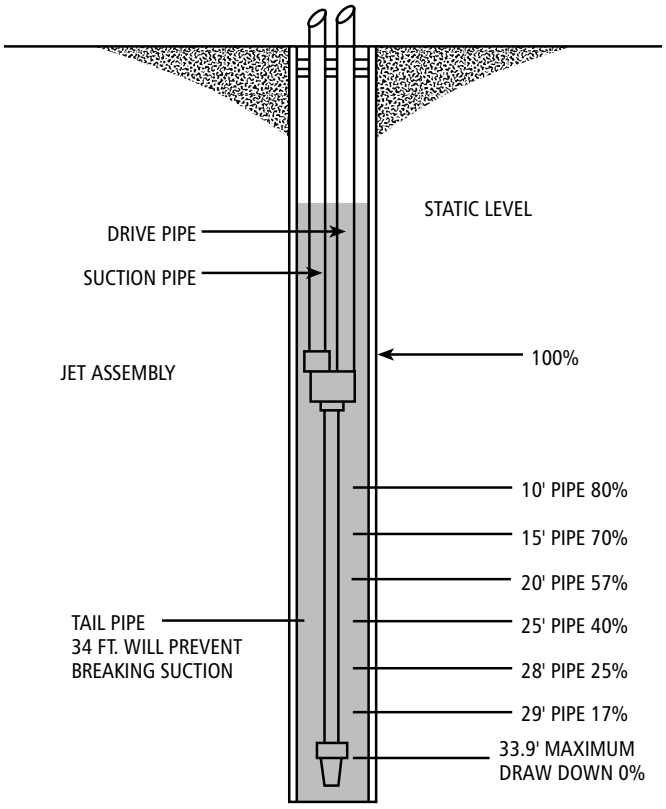


Fig. 8

CHECKING SUCTION LIFT ON A SHALLOW WELL

A vacuum gauge indicates Total Suction Lift (vertical lift + friction loss) in inches of mercury (Hg.). One inch (1") on the gauge = 1.13 feet of total suction lift (based on a pump at sea level). Practical suction lift at sea level is 25' or 22" Hg. Deduct 1 ft. for each 1000 ft. above sea level.

Install the compound vacuum/pressure gauge in the ⅛" hole in the shallow well adapter or the ⅛" hole between the suction and discharge pipes on a dedicated shallow well pump. This is the same hole that is used to connect an air volume control.

Interpreting the gauge readings:

High Vacuum (22" or more)
- Suction pipe buried in mud
- Foot valve or check valve stuck closed
- Suction lift exceeds lift capability of pump

Low Vacuum or 0 vacuum
- Suction pipe not submerged
- Suction leak (check joints and especially unions)

Gauge needle fluctuates rapidly
- Gaseous well
- Air leak in suction line
- Well producing less than pump capacity (throttle a ball valve in suction line do not exceed 22" Hg.) to reduce pump capacity

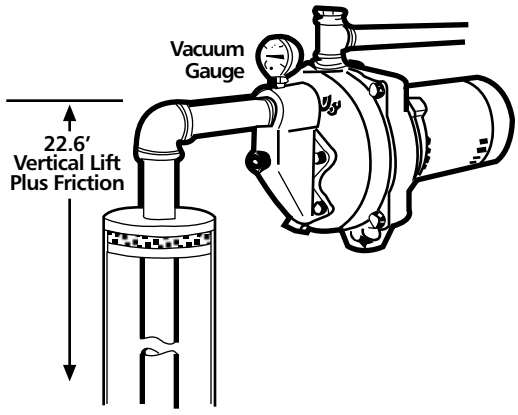


Fig. 9

A reading of 20" on a vacuum gauge placed on the suction side of the pump would tell you that you have a vacuum or suction lift of 22.6 ft.

20" x 1.13' = 22.6 ft.

ITT

TROUBLESHOOTING

DANGER Hazardous voltage

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING ANY MAINTENANCE CAN CAUSE SHOCK, BURNS OR DEATH.

SYMPTOM

MOTOR NOT RUNNING
See Probable Cause – 1 through 5

LITTLE OR NO LIQUID DELIVERED BY PUMP
See Probable Cause – 6 through 11

PUMP DELIVERS WATER – WILL NOT SHUT OFF
See Probable Cause – 9 through 13

PUMP CYCLES EXCESSIVELY
See Probable Cause – 14 through 17

PROBABLE CAUSE

1. Motor thermal protector tripped
2. Open circuit breaker or blown fuse
3. Impeller binding
4. Wiring incorrect/check motor voltage setting
5. Defective motor
6. Pump not primed, inadequate suction pipe submergence, air leak in suction pipe
7. Discharge or suction plugged, closed valve(s)
8. Low voltage causing reduced motor speed
9. Impeller worn or plugged, no jet assembly installed, or jet plugged
10. System head too high
11. Suction lift or suction losses excessive
12. Pressure switch plugged, incorrectly adjusted
13. Leaks in discharge piping or at house
14. Defective suction check or foot valve
15. Water logged pressure tank
16. Pump farther than 5 feet from tank
17. High friction loss valves between pump and tank. (Use only fully open gate valves)

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;
(b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment;
(d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.

(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.

(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

IM102 Rev 3 June, 2009

Engineered for life

ITT

Residential Water Systems

Goulds Pumps

JET PUMP REPAIR PARTS

GOULDS PUMPS

Goulds Pumps is a brand of ITT Corporation.

www.goulds.com

Engineered for life

Index

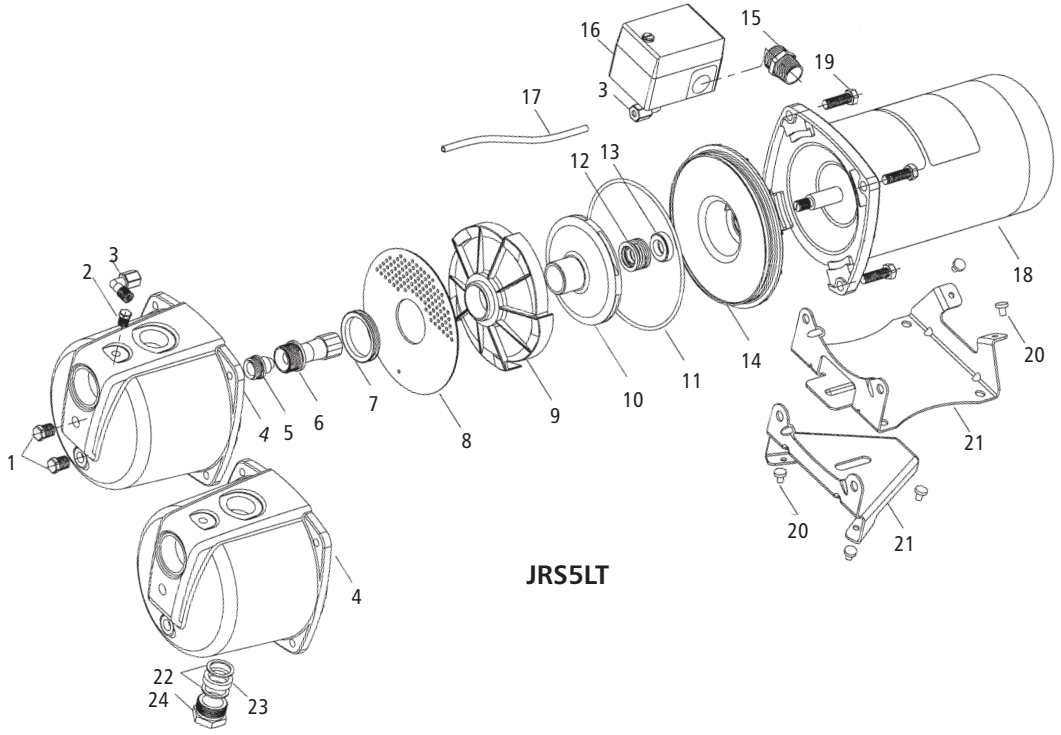
JETS

JRS 3
JRD 4
JRSG ..... moved to obsolete book
J+ and JS+ 5
JB ..... moved to obsolete book
HSJ 6
VJ 7
SJ 8
GT Irri-Gator™ 9
BF03S 10

The 10K2 has been replaced in production and as a repair part by the 10K10. The 10K10, John Crane Type 6, is a superior seal with a carbon rotary face, a ceramic stationary seat and BUNA N elastomers.

MODEL JRS

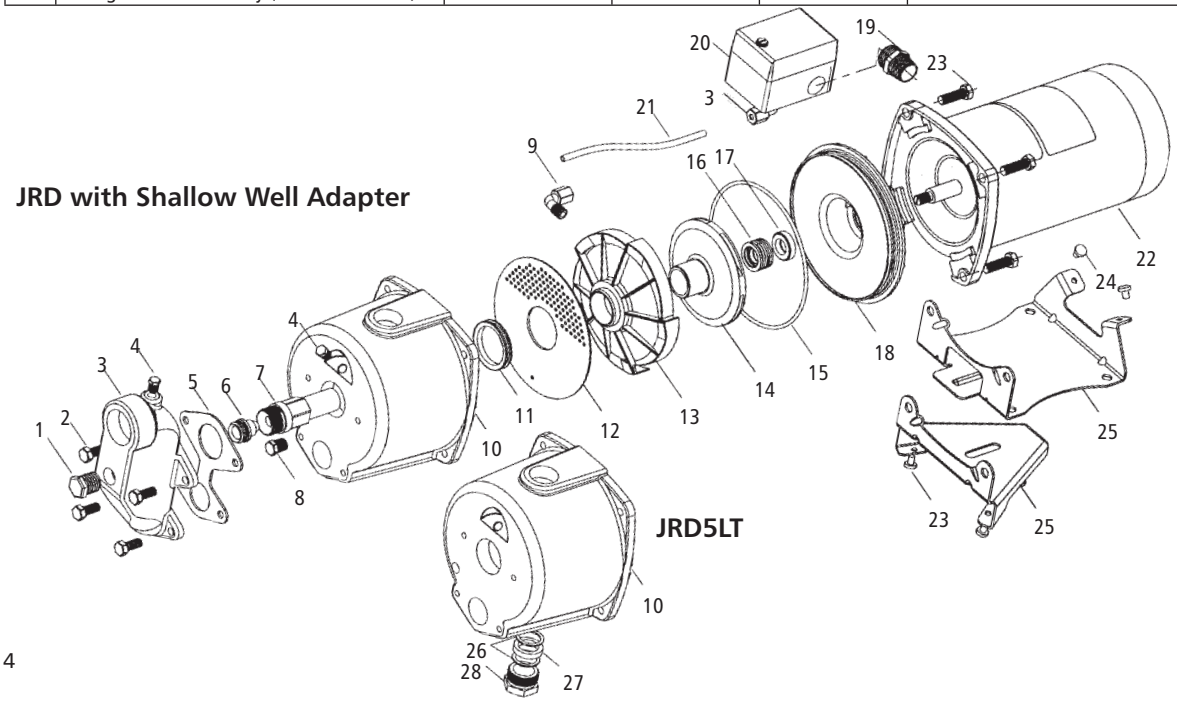
Item No.	Part Description	Material	Repair Part No.				
			JRS5	JRS5H	JRS5LT	JRS7	JRS10
1	Drain plug ¼" NPT	Steel	6K2				
2	Vent plug ⅛" NPT	Steel	6K1				
3	Elbow connector – tubing	Polypropylene	6K94				
4	Casing	Cast iron	1K342		1K382	1K342	
5	Nozzle	Delrin®	AN018	AN020	AN018		
6	Venturi tube	Lexan®	AD3330	AD3325	AD3330	AD3336	AD3339
7	Separator plate seal ring	BUNA-N	5K323				
8	Separator plate	Polypropylene	5K253				
9	Diffuser (guidevane)	Lexan®	3K64			3K65	
10	Impeller	Noryl®	2K900			2K901	2K902
11	O-ring	BUNA	5K230				
12	Mechanical seal – Rotary	Teepelite	10K10				
13	Mechanical seal – Stationary	Ceramic					
14	Seal housing	Amodel®	1K325				
15	Connector with locknut	Steel	6K24				
16	Pressure switch	NA	AS4FX				
17	Tubing – pressure switch	Polypropylene	6K92			6K101	6K108
18	Motor	Stainless steel shaft	SFJ04860			SFJ05860	SFJ06860
19	Hex cap screw	Steel	13K80				
20	Grommet – base	BUNA	4K405				
21	Base – JRS5, JRS7, JRS10 (off tank)	Steel	4K399		4K449	4K399	
	Tank base – JRS5LT (on tank model)						
22	Discharge gland washers (pkg 2)	N-8090	–		5K10	–	
23	Discharge gland packing	BUNA	–		5K8	–	
24	Dis. gland nut assembly (includes 22 & 23)	Brass	–		4K12	–	



JRS5LT

MODEL JRD

Item No.	Part Description	Material	Repair Part No.			
			JRD5	JRD5LT	JRD7	JRD10
1	Pipe plug ½" NPT	Steel	6K68			
2	Hex cap screw	Steel	13K1			
3	Shallow well adapter	Cast iron	4K62			
4	Pipe plug ⅛" NPT	Steel	6K1			
5	Gasket	BUNA – FDA/NSF	5K108			
6	Nozzle	Delrin®	AN018			
7	Venturi tube	Lexan®	AD3731		AD3536	AD3538
8	Drain plug ¼" NPT	Steel	6K2			
9	Elbow connector – tubing	Polypropylene	6K94			
10	Casing	Cast iron	1K416	1K417	1K416	
11	Separator plate seal ring	BUNA	5K323			
12	Separator plate	Polypropylene	5K253			
13	Diffuser (guide vane)	Lexan®	3K64		3K65	
14	Impeller	Noryl®	2K900		2K901	2K902
15	O-ring	BUNA	5K230			
16	Mechanical seal – rotary	Teeplelite	10K10			
17	Mechanical seal – stationary	Ceramic				
18	Seal housing	Amodel®	1K325			
19	Connector w/locknut	Steel	6K24			
20	Pressure switch	NA	AS4FX			
21	Tubing – pressure switch	Polypropylene	6K92		6K101	6K108
22	Motor	Stainless steel shaft	SFJ04860		SFJ05860	SFJ06860
23	Hex cap screw	Steel	13K80			
24	Grommet – base	BUNA	4K405			
25	Base – JRD5, JRD7, JRD10 (off tank)	Steel	4K399	4K449	4K399	
	Tank base – JRD5LT (on tank)					
26	Discharge gland washers (pkg 2)	N-8090	–	5K10	–	
27	Discharge gland packing	BUNA	–	5K8	–	
28	Dis. gland nut assembly (includes 26 & 27)	Brass	–	4K12	–	

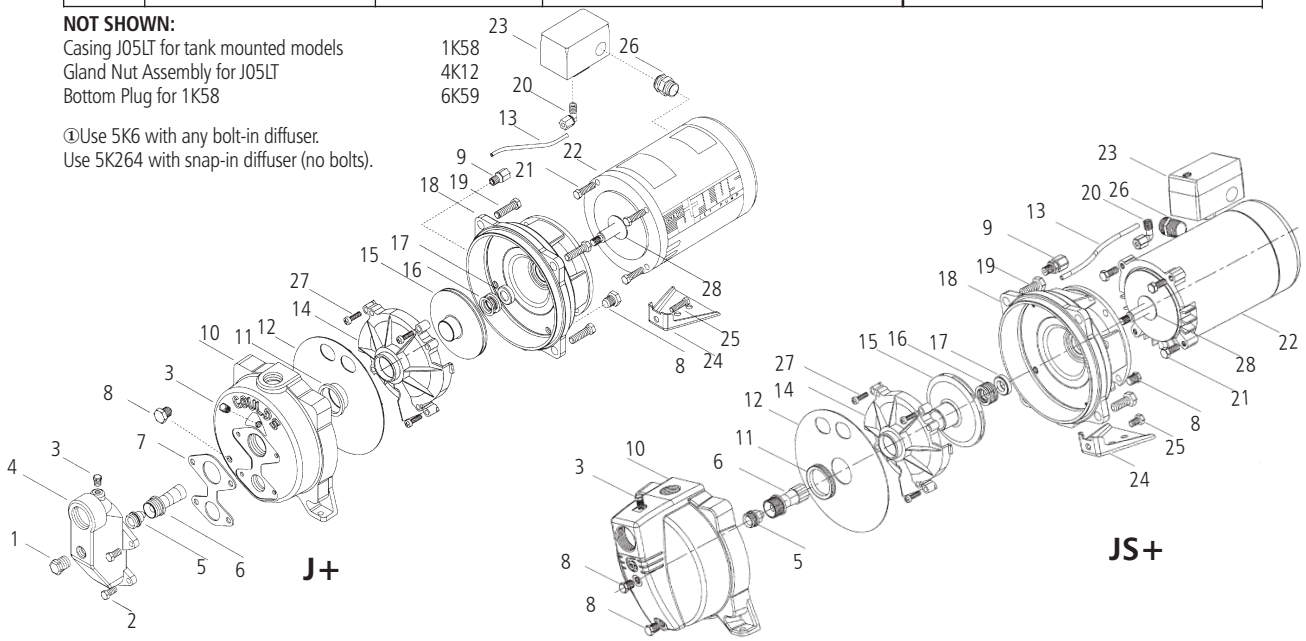


MODEL J+ and JS+

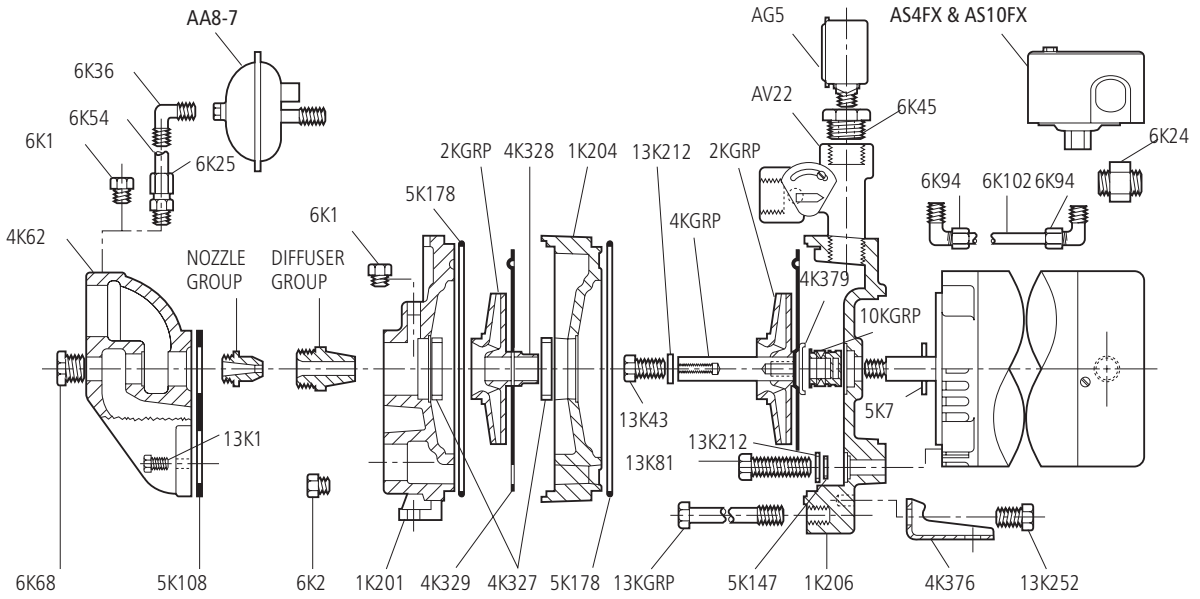
Item No.	Part Description	Material	J+ Series Repair Part No.					JS+ Series Repair Part No.				
			J5	J5H	J7	J10	J15	J5S	J5SH	J7S	J10S	J15S
1	Pipe plug – ½" NPT	Steel, plated	6K68					–				
2	Hex cap screw	Steel	13K1					–				
3	Pipe plug – ⅛" NPT	Steel, plated	6K1					6K1				
4	Shallow well adapter	Cast iron	4K62					–				
5	Nozzle	Delrin®	AN017	AN019	AN018		AN022	AN017	AN019	AN018		AN022
6	Venturi tube	Lexan® on model JS+ / Durez® on model J+	AD3731	AD3528	AD3536	AD3538	AD3542	AD3332	AD3328	AD3336	AD3339	AD3342
7	Gasket	BUNA - FDA/NSF	5K108					–				
8	Drain plug – ¼" NPT	Steel, plated	6K2					6K2				
9	Straight connector	Polypropylene	6K100					6K100				
10	Casing	Cast iron	1K311 (59395)					1K333 (59240)				
11	Seal ring	BUNA - FDA/NSF	5K6 or 5K231 ①					5K6 or 5K231 ①				
12	Diaphragm	BUNA - FDA/NSF	5K162					5K162				
13	Tubing	Polypropylene	6K92		6K93	6K101	6K102	6K92		6K93	6K101	6K102
14	Diffuser (guidevane)	Lexan® 10% G.F.	3K75		3K67		3K68	3K75		3K67		3K68
15	Impeller	Noryl® 20% G.F.	2K4		2K60	2K61	2K706	2K4		2K60	2K61	2K706
16	Mechanical seal, rotary	Teeplelite	10K10					10K10				
17	Mechanical seal, stationary	Ceramic										
18	Motor adapter	Cast iron	1K310 (59394)					1K310 (59394)				
19	Casing bolts	Steel	13K102					13K102				
20	Elbow connector	Polypropylene	6K94					6K94				
21	Motor adapter bolts	Steel	13K69					13K69				
22	Motor	Stainless steel shaft	J04853L		J05853L	J06853L	J07858L	J04853L		J05853L	J06853L	J07858L
23	Pressure switch	NA	AS3FX		AS4FX			AS3FX	AS4FX			
24	Pump foot	Steel	4K408					4K408				
25	Pump foot bolt	Steel	13K252					13K252				
26	Switch con. with locknut	Steel	6K24					6K24				
27	Fillister head machine screw	Stainless steel	13K4					13K4				
28	Deflector	BUNA	5K7					5K7				

NOT SHOWN:
Casing J05LT for tank mounted models 1K58
Gland Nut Assembly for J05LT 4K12
Bottom Plug for 1K58 6K59

①Use 5K6 with any bolt-in diffuser.
Use 5K264 with snap-in diffuser (no bolts).



MODEL HSJ



Part No.	Part Name	Pattern No.
① 1K201	Casing (4 bolt S.W.A.)	59160
1K204	Intermediate stage	59157
1K206	Motor adapter	59156
2K289	Impeller – ¾ and 1½ HP HSJ models	
2K290	Impeller – 1 and 2 HP HSJ models	
4K62	Adapter – shallow well (4 bolt)	
4K308	Foot - old style (cast)	
4K327	Wear ring	
4K328	Sleeve	55548
4K329	Coverplate – 1 per stage	
② 4K331	Shaft extension – 2 stage, ¾ and 1 HP	
② 4K332	Shaft extension – 3 stage, 1½ and 2 HP	
4K376	Foot - new style (stamped)	
4K379	Retainer – shaft sleeve assembly	
5K7	Deflector	
5K147	O-ring – motor adapter bolts	
5K108	Gasket – S.W. adapter (4 bolt)	
5K178	O-ring – casing and intermediate stage	
6K1	Pipe plug ⅛" NPT	
6K2	Pipe plug ¼" NPT	
6K24	Switch connector with nut	
6K25	Comp. fitting ⅛" NPT x ¼" tubing	
6K36	Comp. fitting elbow ⅛" NPT x ¼" tubing	
6K45	Reducing bushing ¼" x 1" NPT	
6K68	Pipe plug ½" NPT	
6K94	Elbow fitting (tubing)	
6K102	Tubing	
10K10	Shaft seal assembly	
13K43	Impeller bolt	
13K71	Bolt – foot to adapter (old foot)	
13K81	Bolt – adapter to motor	
13K1	Bolt – S.W. adapter (4 bolt)	
13K212	Washer – impeller and adapter	
13K213	Bolt – casing to adapter, 2 stage models	
13K214	Bolt – casing to adapter, 3 stage models	
13K252	Bolt – foot to adapter	

Part No.	Part Name	Pattern No.
AG2	Pressure gauge – 200 PSI maximum	
AG5	Pressure gauge – 100 PSI maximum	
AS4FX	Pressure switch – ¾, 1, 1½ HP rated	
AS10FX	Pressure switch – 2 HP rated	
AV22	Pressure control valve	
AA8-7	Air volume control valve – used with galvanized tanks	

MOTOR CODES

HP	Model	Order No.
¾	HSJ07N, 2 stage	J05853
1	HSJ10N, 2 stage	J06853
1½	HSJ15N, 3 stage	J07858
2	HSJ20N, 3 stage	J08854

SHALLOW WELL FITTINGS PACKAGES

HP	Model	Nozzle Group	Diffuser Group
¾	HSJ07N	AN012	AD3432
1	HSJ10N	AN012	AD3437
1½	HSJ15N	AN012	AD3439
2	HSJ20N	AN012	AD3448

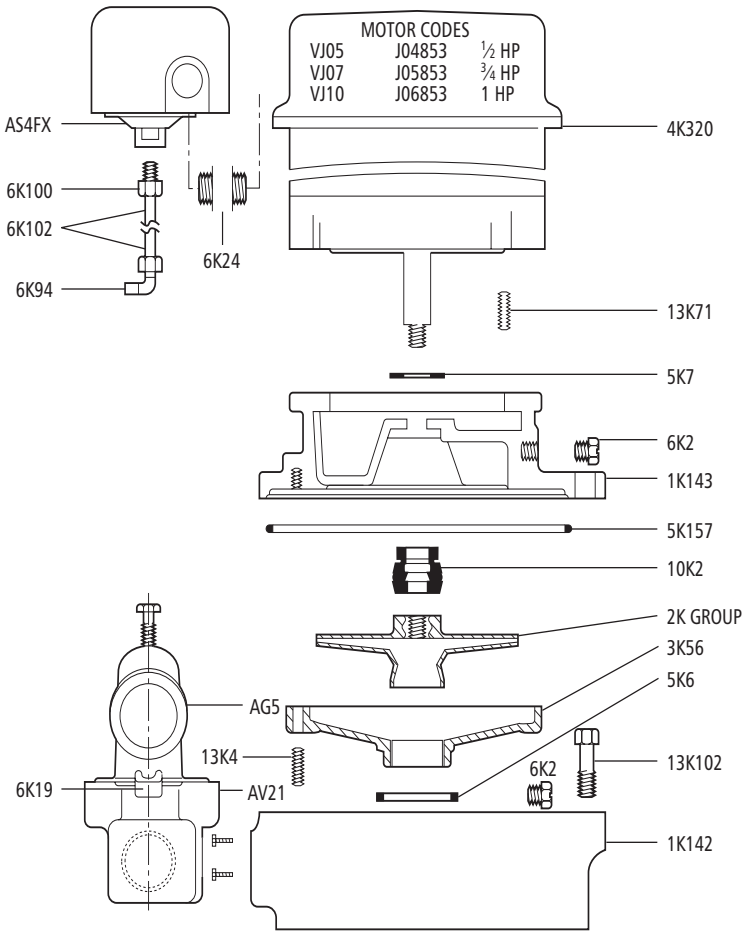
2 BOLT SHALLOW WELL ADAPTER – OBSOLETE (NOT AVAILABLE)

4K312	Adapter – shallow well (2 bolt)
5K173	Gasket – shallow well adapter (2 bolt)
13K1	Bolt – shallow well adapter (2 bolt)

① Casing for 2 bolt shallow well adapter not available. Order 1K261 kit which includes pump casing, 4 bolt adapter, gasket and bolts.

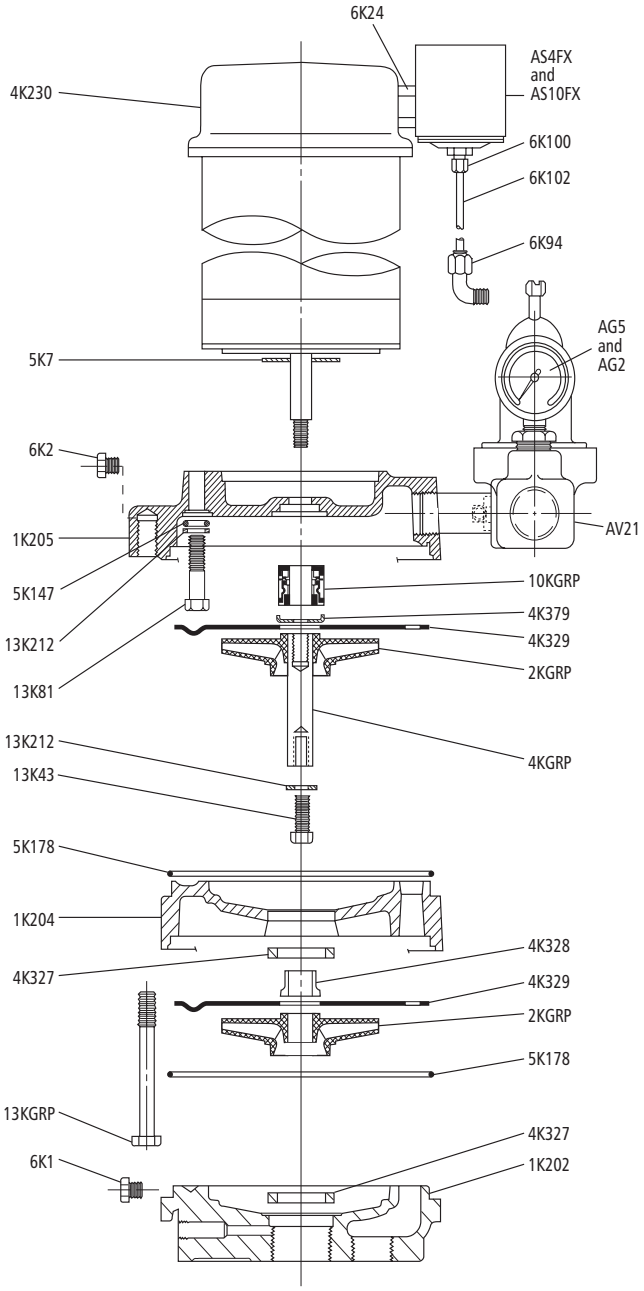
② Includes 4K379, 13K43 and 13K212.

MODEL VJ



Part No.	Part Name	Pattern No.
1K142 1K143	Casing Motor adapter	59202 59014
2K61 2K204	Impeller ¾ and 1 HP Impeller ½ HP 2K GROUP	
3K56	Guidevane – ½, ¾, 1 HP	
4K230	Drip cover – 48FR (A.O. Smith motor)	
5K6 5K7 5K157	Seal ring – guidevane Deflector O-ring	
6K2 6K19 6K24 6K94 6K100 6K102	Plug ¼ NPT Reducing bushing ¾" x ¼" (for AG5) Switch connector with nut Elbow fitting (tubing) Straight fitting (tubing) Tubing	
10K10	Shaft seal assembly	
13K4 13K71 13K102	Screw – guidevane Bolt – motor adapter to motor Bolt – casing to motor adapter	
AG5 AS4FX AV21	Pressure gauge Pressure switch Pressure control valve	 54382

MODEL SJ



Part No.	Part Name	Pattern No.
1K202	Casing – twin pipe system and packer	59159
1K203	Casing – packer system (OBSOLETE)	Use 1K202
1K204	Intermediate stage	59157
1K205	Motor adapter	59156
2K289	Impeller – ¾ and 1½ HP models	
2K290	Impeller – 1 and 2 HP models	
4K230	Drip cover	
4K327	Wear ring	
4K328	Sleeve	
4K329	Coverplate	
4K379	Retainer – shaft seal assembly	
①4K331	Shaft extension – 2 stage, ¾ and 1 HP models	
①4K332	Shaft extension – 3 stage, 1½ and 2 HP models	
②4K375	Retaining ring (OBSOLETE)	
5K7	Deflector	
5K147	O-ring – motor adapter bolts	
5K178	O-ring – casing and intermediate stage	
6K1	Pipe plug ⅛" NPT	
6K2	Pipe plug ¼" NPT	
6K19	Reducing bushing ¼" x ¾" NPT	
6K24	Switch connector with nut	
6K94	Elbow fitting (tubing)	
6K100	Straight fitting (tubing)	
6K102	Tubing	
10K10	Shaft seal assembly	
13K43	Impeller bolt	
13K81	Bolt – adapter to motor	
13K212	Washer – impeller and adapter	
13K213	Bolt – casing to adapter ¾ and 1 HP models	
13K214	Bolt – casing to adapter 1½ and 2 HP models	
②13K250	Impeller washer (OBSOLETE)	
AG2	Pressure gauge – 200 PSI max.	
AG5	Pressure gauge – 100 PSI max.	
AG4FX	Pressure switch – ¾, 1 HP, 1½ HP rated	
AS10FX	Pressure switch – 2 HP rated	
AV21	Pressure control valve	
AA8-7	Air volume control valve (not shown)	

① Includes 4K379, 13K43 and 13K212.

② Models built December 1988 through February 1991 used a retaining ring. Replace with 4K331 or 4K332 shaft extension assembly.

MOTOR CODES

HP	Model	Order No.
¾	SJ07, SJ07PK	JO5853
1	SJ10, SJ10PK	JO6853
1½	SJ15, SJ15PK	JO7858
2	SJ20, SJ20PK	JO8854

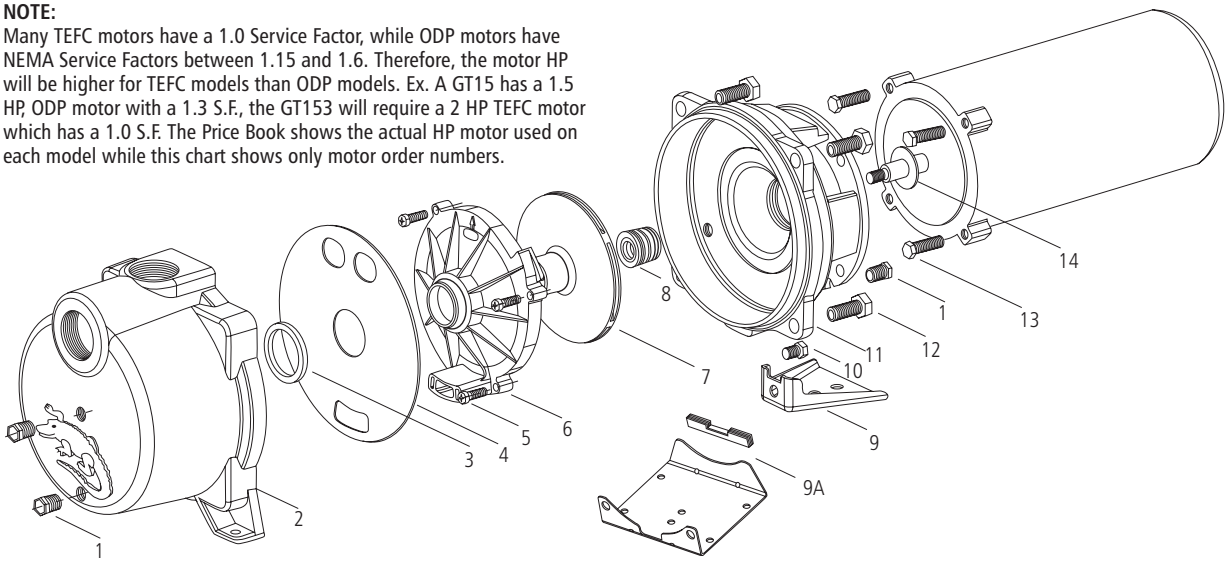
MODEL GT IRRI-GATOR

Item No.	Description	Material	Part No.				
			GT07/ GT073	GT10/ GT103	GT15/ GT153	GT20/ GT203	GT30/ GT303
1	¼" NPT Pipe Plug	Plated Steel	6K2				
2	Casing	Cast Iron	1K324				
3	Guidevane Seal Ring	BUNA	5K6 / 5K231 ①				
4	Diaphragm	Neoprene	5K256				
5	Fillister Head Machine Screw	Stainless Steel	13K4	13K4	13K2	13K2	13K2
6	Guidevane	Lexan® 10% G.F.	3K72	3K71	3K70	3K70	3K69
7	Impeller	Noryl® 20% G.F.	2K715	2K716	2K714	2K713	2K712
8	Mechanical Seal	Carbon/Ceramic/BUNA	10K10				
9	Pump Foot (old style)	Steel	4K408				
9A	Pump Base Assembly with Rubber Channel **Replaces foot 4K408**		15K60				
10	Pump Foot Bolt **use with 4K408 only**	Steel	13K252				
11	Motor Adapter	Cast Iron	1K310				
12	Casing Bolt	Steel	13K102 (4 required)				
13	Motor Adapter Bolt	Steel	13K69				
14	Deflector	BUNA	5K7				

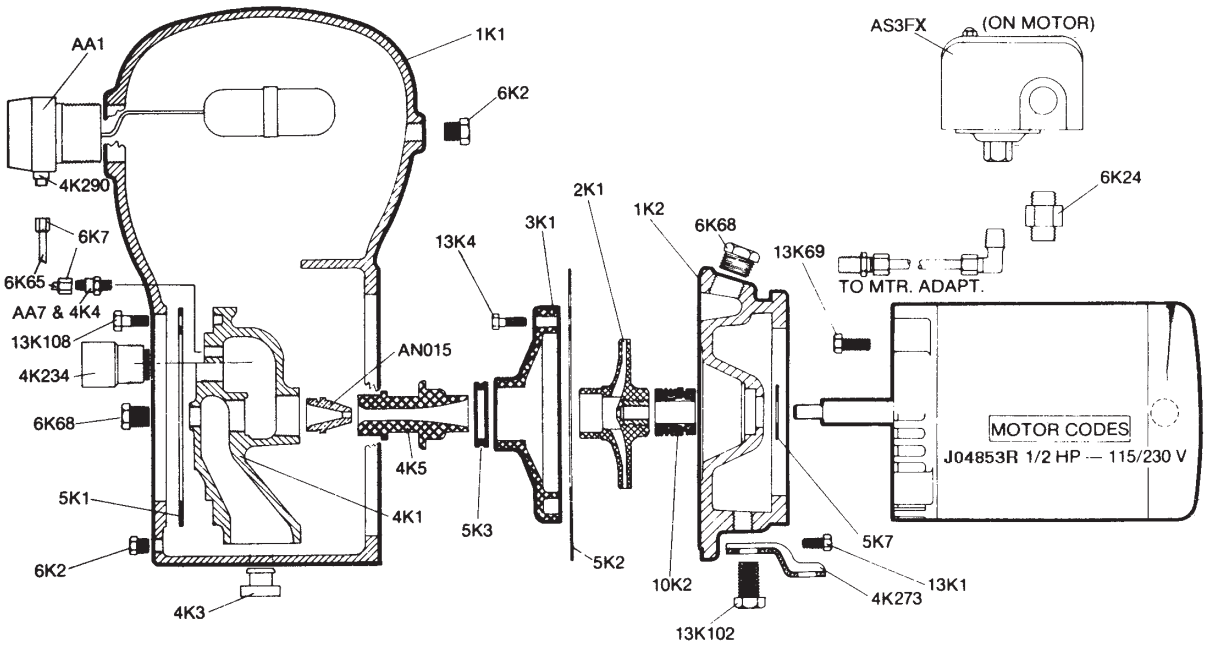
① 5K231 is used with snap in guidevanes.

HP	Motor Codes			
	1Ø – ODP	3Ø – ODP	1Ø – TEFC	3Ø – TEFC
.75	J05853R	C05873	C06821	C06876
1.0	J06853R	C06873	C07821	C07876
1.5	J07858R	C07878	C08821	C08876
2.0	J08854R	C08874	C09821	C09876
3.0	J09853	C09874	C09821	C09876

NOTE:
Many TEFC motors have a 1.0 Service Factor, while ODP motors have NEMA Service Factors between 1.15 and 1.6. Therefore, the motor HP will be higher for TEFC models than ODP models. Ex. A GT15 has a 1.5 HP, ODP motor with a 1.3 S.F., the GT153 will require a 2 HP TEFC motor which has a 1.0 S.F. The Price Book shows the actual HP motor used on each model while this chart shows only motor order numbers.



MODEL BF03S



Part No.	Part Name	Pattern No.
1K1	Casing with plug and 2 grommets	52125
1K2	Motor adapter with plug and foot	52932
2K1	Impeller	
3K1	Guidevane	
4K1	Backplate	52126
4K2	Strainer (with retaining wire)	
4K3	Rubber grommet	
4K4	Air valve core (fits inside AA7)	
4K5	Diffuser	
4K63	Foot	
4K234	Check valve	
4K290 ②	Valve assembly (fits inside AA1)	
5K1	Gasket – backplate	
5K2	Gasket – casing	
5K3	Seal ring – guidevane	
5K7	Deflector	
5K175	O-ring connect A.V.C. tubing to AA7	

Part No.	Part Name	Pattern No.
6K1	Plug ⅛ NPT (old style)	
6K2	Plug ¼ NPT	
6K7	Compression nut – A.V.C. tube (use with 5K175)	
6K24	Switch connector with nut	
6K65	Tubing – A.V.C. (3/16" O.D. x 9¾" long)	
6K68	Plug ½ NPT	

Part No.	Part Name	Pattern No.
10K2	Shaft seal assembly	
13K1	Bolt – adapter to casing	
13K2	Bolt – guidevane	
13K71	Bolt – motor to adapter	
13102	Bolt – foot to adapter	
13K108	Bolt – backplate to casing	
AA1	Air volume control (includes 4K290)	
AA7	Air valve (includes 4K4)	
AN015	Nozzle	
AS3	Pressure switch	

NOTE: 4K2 strainer not required on units with nozzle cleanout plug.

① 6K1 casing drain plug changed to 6K2 on 1981 and later models.

② Valve assembly 4K290 used to repair USG (black) only. 4K7 valve assembly no longer available.

NOTES

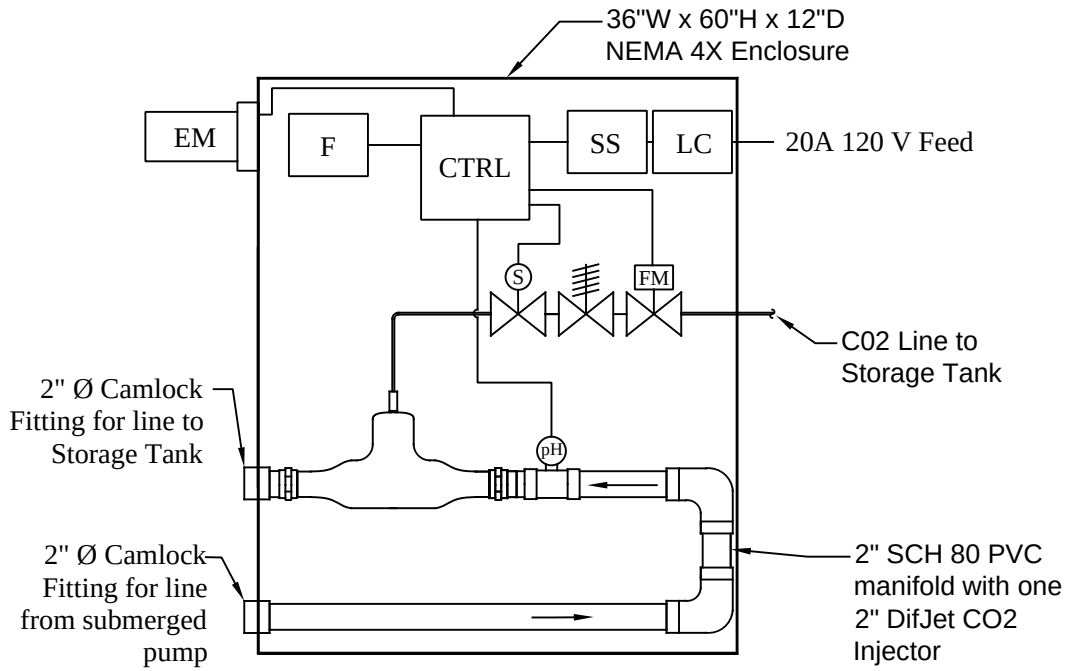
ITT

Residential Water Systems

GOULDS PUMPS

RJETPARTS June, 2007

Engineered for life



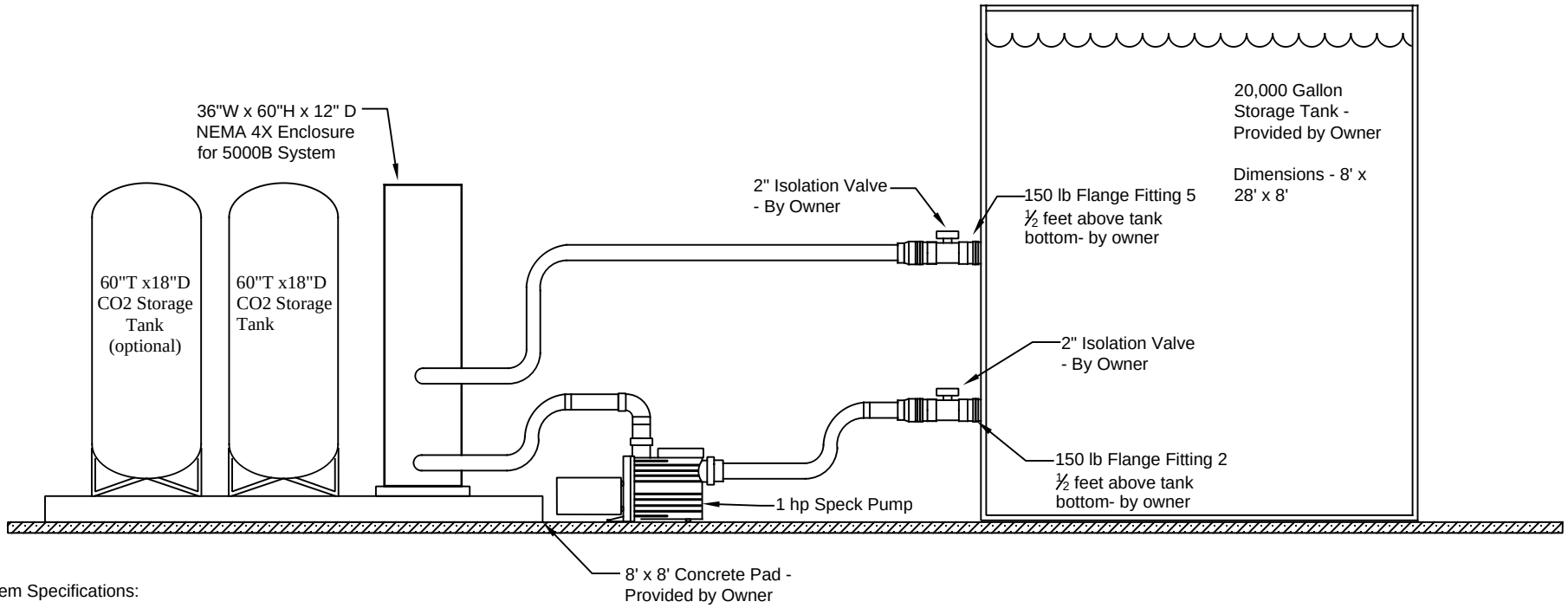
5000B Injector Assembly
Preassembled by Fortrans

FM	CO2 Flow Meter
	Victor model SR-310-321
S	115V Heavy Duty Solenoid Valve
F	Water Flow Meter Display Screen
pH	pH probe
SS	3800 Joule Surge Suppressor
CTRL	Precision PLC Model C Controller
LC	Load Center with 15A and 20A breakers
EM	Red Warning Light

NOT SHOWN:
-Water Storage Tank
-1 hp Pump (see sheet 2 of 2)
-CO2 Storage Tank
-Concrete Pad
-Manifold Mount Hardware

FORTRANS
7400 Siemens Rd. Suite B
Wendell, NC 27591
919-365-8004

Title: 5000B C02 Injector
Project: MW Watermark
Scale: NTS
Date: 2/10/2017
SHEET: 1 of 2



System Specifications:

The Model 5000 Series pH control system will be factory programmed to treat up to 75,000 GPD to a target pH of 7.5 in the water detention basin.

The system will be installed on a 8'x8' pad that will act as the footprint for the injector assembly, pump, and CO2 storage tan`ks.

The system will operate as a closed loop piping system between the injector manifold and the detention basin. The CO2 injector will be activated when the detention basin water pH reaches 8.25 and operate until the pH reaches the target level of 7.5. The pump will run continuously during plant operational hours. pH setpoints can be adjusted based on the owner's specific requirements for water acidity.

The CO2 injection manifold consists of one 2" Dif-Jet Injector. The system will be delivered with a Victor Model SR-310-321 high flow - low pressure regulators and required nylon hosing. CO2 storage is not inlcuded with the Fortrans 5000B system.

115V 20A electrical connection to be provided by owner.

All manifold piping to be schedule 80 PVC. Flexible 2" hose will be used to connect the 5000B assembly to the detention basin.

The red warning light will automatically flash when the system detects a fault.

pH probe to be equipped with replacable salt bridge for recalibration of sensor output. One spare sensor is included.

FORTRANS
7400 Siemens Rd. Suite B
Wendell, NC 27591
919-365-8004

Date: 2/10/2017

Title: 5000B C02 Injector

Project: MW Watermark

Scale: NTS

SHEET: 2 of 2

Pentair Pool Products®

Because reliability matters most®

Tagelus® Sand Filter

Models:
TA 40 / TA 40D
TA 50 / TA 50D
TA 60D
TA 100D

Model: TA 60 with ClearPro Technology®

Installation and User's Guide

IMPORTANT SAFETY INSTRUCTIONS
READ AND FOLLOW ALL INSTRUCTIONS
SAVE THESE INSTRUCTIONS

Customer Service

If you have questions about ordering Pentair replacement parts, and pool products, please use the following contact information:

Customer Service / Technical Support (8 A.M. to 5 P.M. — Eastern and Pacific Times)

Phone: (800) 831-7133

Fax: (800) 284-4151

Sanford, North Carolina (8 A.M. to 5 P.M. — Eastern Time)

Phone: (919) 566-8000

Fax: (919) 566-8920

Moorpark, California (8 A.M. to 5 P.M. — Pacific Time)

Phone: (805) 553-5000 (Ext. 5591)

Fax: (805) 553-5515

Web site

visit *www.pentairpool.com* or *www.sta-ritepool.com* to find information about Pentair products

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1620 Hawkins Ave., Sanford, NC 27330 • (800) 831-7133 • (919) 566-8000
10951 West Los Angeles Ave., Moorpark, CA 93021 • (800) 831-7133 • (805) 553-5000

P/N 155028 Rev. D 1/28/09

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HiFlow™ 6 Way Valve

Après – Filtres à Sable Tagelus™

Después – Filtros de Arena Tagelus™

IMPORTANT SAFETY PRECAUTIONS

Important Notice:

This guide provides installation and operation instructions for the Tagelus® Sand Filters. Consult Pentair Water with any questions regarding this equipment.

Attention Installer: This guide contains important information about the installation, operation and safe usage of this product. This information should be given to the owner and/or operator of this equipment after installation or left on or near the filter.

Attention User: This manual contains important information that will help you in operating and maintaining this filter. Please retain it for future reference.

⚠ **WARNING** — Before installing this product, read and follow all warning notices and instructions which are included. Failure to follow safety warnings and instructions can result in severe injury, death, or property damage. Call (800) 831-7133 for additional free copies of these instructions.

Consumer Information and Safety

The Tagelus® Sand Filters are designed and manufactured to provide many years of safe and reliable service when installed, operated and maintained according to the information in this manual and the installation codes referred to in later sections. Throughout the manual, safety warnings and cautions are identified by the "⚠" symbol. Be sure to read and comply with all of the warnings and cautions.

⚠ **WARNING — THIS FILTER OPERATES UNDER HIGH PRESSURE**

When any part of the circulating system, (e.g., closure, pump, filter, valve(s), etc.), is serviced, air can enter the system and become pressurized. Pressurized air can cause the top closure to separate which can result in severe injury, death, or property damage. To avoid this potential hazard, follow these instructions:

1. If you are not familiar with your pool filtering system and/or heater:
   a. **Do NOT** attempt to adjust or service without consulting your dealer, or a qualified pool technician.
   b. Read the entire Installation & User's Guide before attempting to use, service or adjust the pool filtering system or heater.
2. Before repositioning valve(s) and before beginning the assembly, disassembly, or any other service of the circulating system: (A) Turn the pump **OFF** and **shut OFF** any automatic controls to ensure the system is NOT inadvertently started during the servicing; (B) open the manual air bleeder valve; (C) wait until all pressure is relieved.
3. Whenever installing the filter closure **FOLLOW THE FILTER CLOSURE WARNINGS EXACTLY**.
4. Once service on the circulating system is complete **FOLLOW INITIAL START-UP INSTRUCTIONS EXACTLY.**
5. Maintain circulation system properly. Replace worn or damaged parts immediately, (e.g., closure, pressure gauge, valve(s), o-rings, etc).
6. Be sure that the filter is properly mounted and positioned according to instructions provided.

IMPORTANT SAFETY PRECAUTIONS (continued)

⚠**WARNING** — This filter must be installed by a licensed or certified electrician or a qualified pool serviceman in accordance with the National Electrical Code and all applicable local codes and ordinances. Improper installation could result in death or serious injury to pool users, installers, or others and may also cause damage to property.

Always disconnect power to the pool circulating system at the circuit breaker before servicing the filter. Ensure that the disconnected circuit is locked out or properly tagged so that it cannot be switched on while you are working on the filter. Failure to do so could result in serious injury or death to serviceman, pool users or others due to electric shock.

⚠ **WARNING** — Do not operate the filter until you have read and understand clearly all the operating instructions and warning messages for all equipment that is a part of the pool circulating system. The following instructions are intended as a guide for initially operating the filter in a general pool installation. Failure to follow all operating instructions and warning messages can result in property damage or severe personal injury or death.

⚠ **WARNING** — To reduce the risk of injury, do not permit children to use this product unless they are closely supervised at all times.

⚠ **WARNING** — Due to the potential risk that can be involved it is recommended that the pressure test be kept to the minimum time required by the local code. Do not allow people to work around the system when the circulation system is under pressure test. Post appropriate warning signs and establish a barrier around the pressurized equipment. If the equipment is located in an equipment room, lock the door and post a warning sign.

Never attempt to adjust any closures or lids or attempt to remove or tighten bolts when the system is pressurized. These actions can cause the closure to blow off and could cause severe personal injury or death if they were to strike a person.

⚠ **WARNING** — Never exceed the maximum operating pressure of the system components. Exceeding these limits could result in a component failing under pressure. This instantaneous release of energy can cause the closure to blow off and could cause severe personal injury or death if they were to strike a person.

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Section 1
Installation

Note: **Before installing this product, read and follow all warning notices and instructions in this manual.**

Installing the Tagelus® Sand Filter

Only a qualified service person should install the Tagelus® Sand Filter. This filter is designed and intended for use to filter water.

Tagelus® Introduction

The following general information describes how to install the Tagelus® Sand Filter. This filter operates under pressure and if assembled improperly or operated with air in the water circulation system, it can separate and result in an accident causing property damage or serious bodily injury. A warning label has been affixed to the top of the filter and should not be removed. Keep safety labels in good condition and replace if missing or illegible.

How your Tagelus® Filter works

Your high rate sand filter is designed to operate for years with a minimum of maintenance and when installed, operated and maintained in accordance with these instructions, it will provide years of trouble free operation.

Dirt is collected in the filter as the water flows through the control valve at the top of the filter and is directed downward onto the top surface of the filter sand bed. The dirt is collected in the sand bed and the clean water flows through the lower piping at the bottom of the filter up through the center pipe into the control valve at the top of the filter. Clean water then returns through the piping system into the pool.

The pressure will rise and the flow to the pool will be lowered as the dirt is collected in the filter. Eventually, the filter will become so plugged with dirt that it will be necessary to perform the backwash procedure. It is important to know when to backwash the filter. Backwashing is discussed further under the subsequent sections of this guide.

Please note that a filter removes suspended matter and does not sanitize the pool. The pool water must be sanitized and the water must be chemically balanced for sparkling clear water. Your filtration system should be designed to meet your local health codes. As a minimum, you must be sure that your system will turn over the total volume of water in your pool at least twice in a twenty-four hour period.

Refer to **Table 1** for Filter Operation Data.

Table 1.

FILTER MODEL NUMBER	FILTER AREA (Sq. Ft.)	FLOW RATE *(GPM)	TURNOVER CAPACITY (Gallons)			
			4 TURNS PER DAY	3 TURNS PER DAY	2.4 TURNS PER DAY	2 TURNS PER DAY
TA 40 / TA 40D	1.8	40	14,400	19,200	24,000	28,800
TA 50 / TA 50D	2.3	50	18,000	24,000	30,000	36,000
TA 60ClearPro® / TA 60D	3.1	60	21,600	28,800	36,000	43,200
TA 100D	4.9	100	36,000	48,000	60,000	72,000

⚠ **WARNING** — Failure to operate your filter system or inadequate filtration can cause poor water clarity obstructing visibility in your pool and can allow diving into or on top of obscured objects which can cause serious personal injury or drowning.

Clear water is the result of proper filtration as well as proper water chemistry. Pool chemistry is a specialized area and you should consult your local pool service specialist for specific details. In general, proper pool sanitation requires a free chlorine level of 1 to 2 PPM and a pH range of 7.2 to 7.6.

Tagelus® Installation

⚠ **WARNING** — Filters should never be tested or subjected to air or gas under pressure. All gases are compressible and under pressure create a danger. Severe bodily injury or property damage could occur if the filter is subjected to air or gas pressure.

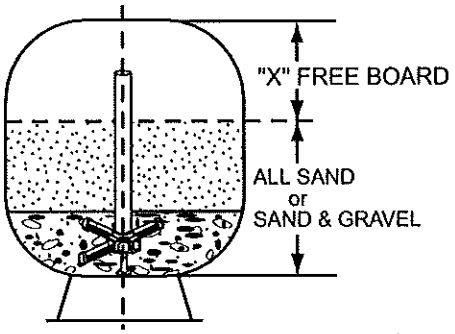
1. Check carton for any evidence of damage due to rough handling in shipment. If carton or any filter components are damaged, notify the freight carrier immediately.
2. Carefully remove the accessory package and the filter tank from the carton.
3. Mount the filter on a permanent slab, preferably concrete poured in a form or on a platform constructed of concrete block or brick. DO NOT use sand to level the filter or for the pump mounting, as it will wash away.
4. Provide space and lighting for routine maintenance access. Do not mount electrical controls over the filter. One needs to be able to stand clear of the filter when starting the pump. Minimum space requirements may be found on the large nameplate on the filter.
5. Sand specifications – be certain the proper sand is used as described in Table 2. Before pouring the sand into the filter, look inside and check the lower under-drain for broken or loose laterals (or fingers), which may have been accidentally damaged by rough handling during shipment. Replace any broken parts if necessary.
6. Install the sand guide in the top of the filter and fill the tank about half full with water. Pour the sand into the top of the filter at a slow rate so that the weight of the sand does not damage the laterals. See **Table 2** for proper amounts of sand. After filling to the proper level, remove and discard the sand guide. Wash away all sand around the opening at the top of the tank.
7. Be sure that all sealing surfaces are clean and apply a light coating of a silicone based lubricant to the valve o-ring.
8. Position valve so that the port locations are in the desired final positions. Follow the enclosed valve installation procedure instructions.
9. Assemble piping and pipe fittings to pump and valve. All piping must conform to local and state plumbing and sanitary needs.
10. Use sealant compounds on all male connections of pipe and fittings. Use only pipe compounds suited for plastic pipe. Support pipe to prevent strains on filter, pump or valve.

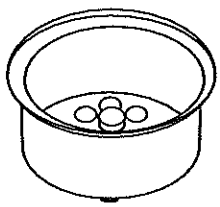
NOTE: The free board distance is the most important variable and should be maintained. Sand density will vary and therefore sand amount is given as a reference.

Table 2. Filter Sand Detail and Data

FILTER MODEL	FILTER MEDIA (POUNDS)			FREE BOARD "X"
	ALL SAND*	PEA GRAVEL ‡	SAND	
TA 40 / TA 40D	175	50	125	7¾"
TA 50 / TA 50D	225	50	175	9¼"
TA 60 ClearPro® / TA 60D	325	50	275	10¼"
TA 100D	600	150	450	11¼"

‡ Pea Gravel size to be 1/8" to 1/4" diameter.
* SAND SIZE: .018 - .022 in. particle size (.44-.55 mm particle size) = No. 20 Standard Silica Sand having a uniformity coefficient of 1.75 or less.





Sand Guide

11. Long piping runs and elbows restrict flow. For best efficiency, use the fewest possible number of fittings, large diameter pipe (at least 1½" for TA 60, and at least 2" for TA 100D) and locate equipment as close to pool as possible.

⚠ **CAUTION** —Operating at excessive vacuum levels can cause the tank to crack and could cause property damage.

12. When installing backwash lines it is recommended that a vacuum breaker, (P/N 272044), be installed on installations where the backwash line is 1½" and the length exceeds 40 ft., or if the backwash line discharges 10 ft. or more lower than the surface level of the pool. Alternately, a vacuum break pit could be provided on systems using 2" or larger backwash lines.
13. A check valve is recommended between the filter and heater to prevent hot water "back up" which will damage the filter and valve.
14. The maximum operating pressure of this unit is 50 pounds per square inch. Never operate this filter above this pressure or attach a pump to this filter that has more than 50 psi shut-off pressure.
15. Never install a chlorinator upstream from the filter. Always locate downstream with a check valve in between the chlorinator and filter.
16. A positive shut-off valve is not recommended at the outlet of the filtering system. If the system is ever run with such a valve closed, the internal air relief system becomes inoperative and an explosive situation could exist. Additionally, running the system with no flow will seriously damage the equipment.

⚠ **WARNING** — Chemical fumes and/or spills can cause severe attack of filter structural components. Structually weakened filter components can cause filter valve or attachments to blow off and could cause severe bodily injury and/or property damage.

17. Never store pool chemicals within 10 ft. of your pool filter. Pool chemicals should always be stores in a cool, dry, will ventilated area.

Initial Start-up

1. On a new pool, clean the pool before filling the pool with water. Excessive dirt and large particles can cause damage to the pump and filter.
2. Ensure that the backwash line is open so that water is free to come from the pool and flow out the backwash line. Set control valve to backwash position.
3. Check pump strainer pot to be sure it is full of water. Replace pump lid.

⚠ **WARNING** — Air entering the filter and the valve clamp not closed properly can cause the valve to blow off and could cause severe bodily injury and/or property damage.

4. Check valve clamp on Tagelus for tightness.
5. Open the manual air bleeder on the 6-Way Valve, (except TA 100D). Stand clear of the filter and start the pump allowing it to prime.
6. Close the air bleeder on the 6-Way Valve, (except TA 100D), when all the air is removed from the filter and a steady stream of water emerges.

NOTE: Pool filter sand is typically pre-washed and should not require extensive backwashing. However, the shipping process may cause excessive abrasion which could require an extended backwash cycle at initial start-up; continue to backwash until the backwash water is as clear as the pool water.

⚠ **CAUTION** — To prevent equipment damage and possible injury, always turn the pump off before changing the valve position.

7. Stop the pump. Set the valve to the filter position.
8. Ensure all suction and pool return lines are open so that water is free to come from the pool and return to the pool.
9. Open the manual air bleeder on the 6-Way Valve, (except TA 100D). Stand clear of the filter and start the pump.
10. Close the air bleeder on the 6-Way Valve, (except TA 100D), when a steady stream of water emerges.
11. The filter has now started its filtering cycle. You should ensure that water is returning to the pool and take note of the operating pressure when the filter is clean.

Section 2
Maintenance

This section describes how to maintain your Tagelus® Sand Filter.

Filter Care

The filter is a very important part of the pool equipment and installation. Proper care and maintenance will add many years of service and enjoyment to the pool. Follow these suggestions for long trouble-free operation:

1. To clean the exterior of the filter of dust and dirt, wash with a mild detergent and water then hose off. Do not use solvents.
2. If internal maintenance is required, sand may be removed by removing the entire drain spigot from the bottom of the filter and flushing with a garden hose. Pentair Water Pool and Spa's Sand Vacuum P/N 542090 may also be used.
3. If, after a number of years, the filter tank appears foggy in color or rough in texture, the tank surface can be painted. We recommend the use of a Quick Dry Spray Enamel. **Do NOT paint the VALVE.**

⚠ **WARNING** — Always visually inspect filter components during normal servicing to ensure structural safety. Replace any item which is corroded, deformed or otherwise visually defective. Defective filter components can allow the filter top or attachments to blow off and could cause severe bodily injury or property damage.

4. The valve clamp used on your Tagelus® Sand Filter was manufactured with high quality corrosion resistant materials. The manufacturing process could allow sharp edges to be present on htthe parts. When working around the clamp, use caution to prevent potential injury to fingers or hands from contact with sharp edges.
5. Your filter is a pressure vessel and should never be serviced while under pressure. Always relieve tank pressure and open air bleeder on the Tagelus® Valve before attempting to service your filter.
6. When restarting your filter, always open the manual air bleeder on the Tagelus® Valve and stand clear of the filter.

Cleaning Frequency

1. The filter on a new pool should be backwashed, and cleaned after approximately 48 hours of operation to clean out plaster dust and/or construction debris.
2. There are three different ways to identify when the filter needs backwashing.
   a. The most accurate indicator on pool systems with a flow meter is to backwash when the flow decreases 30% from the original (clean filter) flow. For example, if the original flow was 60 GPM, the filter should be backwashed when the flow is reduced by about 20 GPM (or 30%) to 40 GPM.
   b. A more subjective and less accurate indicator is to observe the amount of water flowing from the flow directionals located in the wall of the pool. The filter should be backwashed once it is detected that the flow has been reduced.
   c. The most commonly used but less accurate indicator is to backwash when the filter gauge reading increases 10 PSI over the initial (clean filter) reading.
3. It is important not to backwash the filter solely on a timed basis such as every three days. It is also important to note that backwashing too frequently actually causes poor filtration. Factors like weather conditions, heavy rains, dust or pollen, and water temperatures all affect the frequency of backwash. As you use your pool, you will become aware of these influences.
4. If, at any time, the starting pressure after backwashing the filter indicates 4 to 6 PSI higher than normal starting pressure, it is time to perform a chemical cleaning procedure.

Filter Backwash Procedure

⚠ **WARNING** —To prevent equipment damage and possible injury, always turn off pump before changing valve positions.

1. Stop the pump.
2. Ensure that the suction and backwash lines are open so that water is free to come from the pool and flow out the backwash line. Set control valve to backwash position.
3. **Stand clear of the filter** and start the pump.
4. Backwash filter for approximately 3 to 5 minutes or until backwash water is clean.
5. Stop the pump and set valve to rinse position.
6. **Stand clear of the filter** and start the pump.
7. Rinse filter for approximately 30 seconds.
8. Stop the pump and set valve to filter position.
9. Ensure that pool return line is open so that water may flow freely from the pool back to the pool.
10. Open manual air bleeder on 6-Way Valve, (except TA 100D). Stand clear of filter and start the pump.
11. Close manual air bleeder on the 6-Way Valve, (except TA 100D), when all the air is removed and a steady stream of water emerges from the bleeder.
12. The filter has now started its filtering cycle. You should ensure that water is returning to the pool and take note of the filter pressure.
13. The filter pressure, in the above Step 12, should not exceed the pressure originally observed on the filter when it was initially started. If after backwashing, the pressure is 4 to 6 PSI above the start condition, it will be necessary to chemically clean the sand bed.

Chemical Cleaning Procedure

1. It is recommended that one of the following cleaners be used:
   a. FILTER-CLEANSE – Great Lakes Biochemical
   b. FITLER-FREE – Hydrotech Chemical Corp.
   c. KLEEN-IT – Bio Lab, Inc.
   These cleaners will remove oils, scale and rust from the sand bed in one cleaning operation.
2. Mix a solution following the manufacturers instructions on the label.
3. Backwash the filter with the Multiport Valve as outlined above.
4. If the filter is below pool level, shut off the pump and close appropriate valving to prevent draining the pool.
5. Shut off pump, open filter drain and let filter drain. Place valve in backwash position.
6. After filter has drained, close filter drain and remove the pump strainer pot lid.
7. Ensure that the backwash lines are open.
8. Turn the pump on and slowly, pour the cleaning solution into the pump strainer with the pump running. If the filter is below pool, open shut-off valve slightly to allow pump to run.
9. Continue adding solution until the sand bed is saturated with cleaning solution.
10. Shut off the pump and leave filter in backwash position. Allow filter to stand overnight (12 hours).
11. Replace the pump lid and follow backwash procedures as outlined above.
12. Do not allow the cleaning solution to get into the pool.

Winterizing your Filter

1. In areas that have freezing winter temperatures, protect the pool equipment by backwashing the filter.
2. After backwashing, shut the pump off, open the manual air bleeder on the 6-Way Valve, (except TA 100D), and move the handle of the Multiport Valve to the Winterize Position.
3. Remove the wing-type plug on the bottom of the filter. The filter will drain very slowly, and therefore, it is recommended that the drain plug be left out during shutdown season.

**NOTE:* The Multiport Valve should be left in the "Winterize Position" during shutdown season so that the valve diverter has no pressure on the rubber seal.

4. Drain all appropriate system piping.
5. We recommend covering the equipment with a tarpaulin or plastic sheet to inhibit deterioration from weather. Do **NOT** wrap the pump motor with plastic.

Section 3
Troubleshooting

Use the following troubleshooting information to resolve possible problems with your Tagelus® Sand Filter.

⚠ WARNING — THIS FILTER OPERATES UNDER HIGH PRESSURE

When any part of the circulating system, (e.g., closure, pump, filter, valve(s), etc.), is serviced, air can enter the system and become pressurized. Pressurized air can cause the top closure to separate which can result in severe injury, death, or property damage. To avoid this potential hazard, follow these instructions:

1. If you are not familiar with your pool filtering system and/or heater:
   a. **Do NOT** attempt to adjust or service without consulting your dealer, or a qualified pool technician.
   b. Read the entire Installation & User's Guide before attempting to use, service or adjust the pool filtering system or heater.
2. Before repositioning valve(s) and before beginning the assembly, disassembly, or any other service of the circulating system: (A) Turn the pump **OFF** and **shut OFF** any automatic controls to ensure the system is NOT inadvertently started during the servicing; (B) open the manual air bleeder valve; (C) wait until all pressure is relieved.
3. Whenever installing the filter closure **FOLLOW THE FILTER CLOSURE WARNINGS EXACTLY.**
4. Once service on the circulating system is complete **FOLLOW INITIAL START-UP INSTRUCTIONS EXACTLY.**
5. Maintain circulation system properly. Replace worn or damaged parts immediately, (e.g., closure, pressure gauge, valve(s), o-rings, etc).
6. Be sure that the filter is properly mounted and positioned according to instructions provided.

Note: Turn off power to unit prior to attempting service or repair.

Problems and Corrective Actions

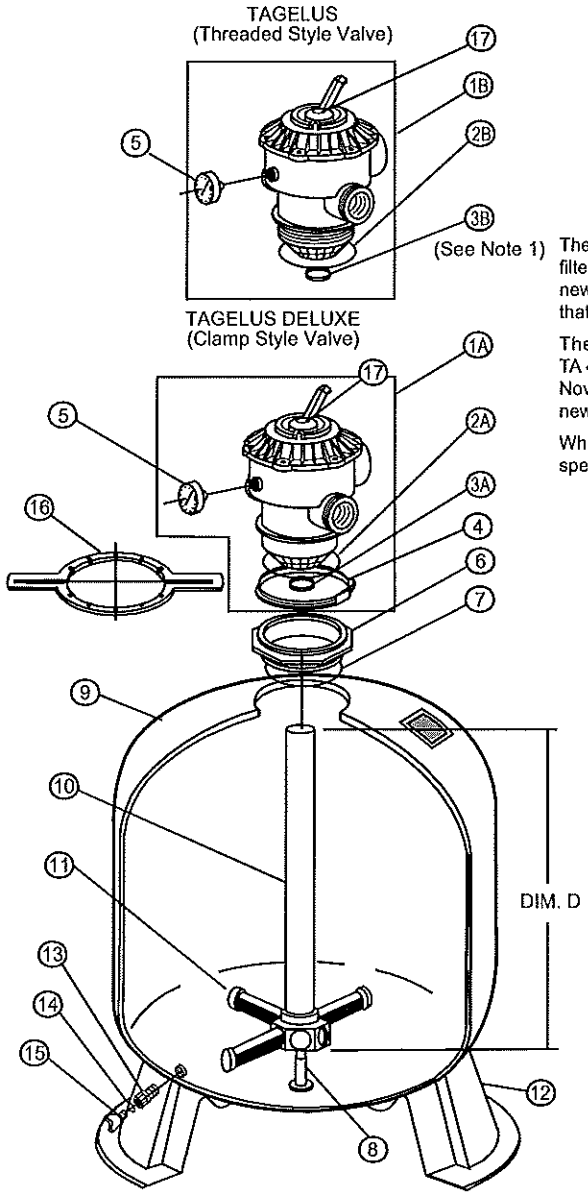
PROBLEM	CAUSE	REMEDY
Pool water not sufficiently clean	1. Pool chemistry not adequate to inhibit algae growth.	Maintain pool chemistry or consult pool service technician.
	2. Too frequent a backwash cycle.	Allow pressure to build to 10 psi above clean filter condition before backwashing.
	3. Improper amount or wrong sand size.	Check sand bed depth and sand size or consult a pool service technician.
	4. Inadequate turnover rate.	Run system for longer time or consult dealer or pool service technician.
High filter pressure	1. Insufficient backwashing.	Backwash until effluent runs clear.
	2. Sand bed plugged with mineral deposits.	Chemically clean filter.
	3. Partially closed valve or restriction in return.	Open valve or remove obstruction in return line.
Short cycles	1. Improper backwash.	Backwash until effluent runs clear.
	2. Pool chemistry not adequate to inhibit algae growth.	Maintain pool chemistry or consult pool service technician.
	3. Plugged sand bed.	Manually remove top 1" surface of sand bed, replace with new sand and chemically clean entire sand bed as described in the Chemical Cleaning Procedure.
	4. Flow rate too high.	Restrict flow to capacity of filter.
Return flow to pool diminished, low filter pressure	1. Obstruction in pump hair and lint strainer.	Clean basket in pump strainer.
	2. Obstruction in pump.	Disassemble and clean pump.
	3. Obstruction in suction line to pump.	Clean skimmer basket. Remove obstruction in lines. Open valves in suction line.
Sand returning to pool	1. Broken under drain lateral.	Replace broken or damaged laterals.
	2. Backwash rate too high.	Reduce backwash flow rate.
	3. Air strainer on Tagelus Valve is damaged or missing.	Replace damage components.

Section 4

Replacement Parts

TA 40 / TA 40D
TA 50 / TA 50D
TA 60 ClearPro® / TA 60D
TA 100D

TAGELUS® SAND FILTER

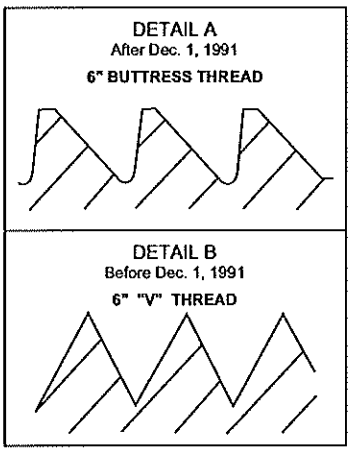


IMPORTANT NOTICE

The valve adaptor used on TA 40D, 50D, and 60D filters manufactured after November 1, 1994 has a new face seal design with a square sealing ring that is white in color, P/N 154494.

The black o-ring, P/N 154493, used on our TA 40D, 50D, and 60D filters manufactured before November 1, 1994 will NOT interchange with the new 154494 sealing ring.

When ordering a replacement seal, be sure to specifiy which seal your filter has in the adaptor.

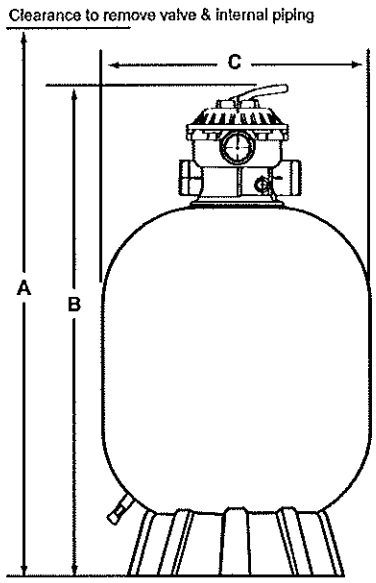


Filters manufactured after Dec 1, 1991 utilize a 6 in. buttress thread in the filter tank top opening and on the closure, see Detail A.

Filters manufactured before Dec 1, 1991 utilize a 6 in. "V" type thread, see Detail B.

6 in. closures in Detail A. and B. are NOT interchangeable.

MODEL	A DIM.	B DIM.	C DIM.
TA 40	46 in.	37 in.	18¾ in.
TA 50	50½ in.	38½ in.	21¼ in.
TA 60 ClearPro®	57 in.	42½ in.	24½ in.
TA 40D	47 in.	37 in.	19½ in.
TA 50D	51½ in.	39½ in.	21½ in.
TA 60D	57 in.	42½ in.	24½ in.
TA 100D	65½ in.	47¼ in.	30½ in.



TAGELUS® SAND FILTER
Replacement Parts

NOTE 1: Item 3A O-ring - Standpipe is used on model TA100D Filters only. Item 3B O-ring - Standpipe is used on Tagelus Filter models TA30, 40, 50, 60 manufactured before April, 1993. Item 3B is not used on Tagelus Clamp Filter models TA30D, 35D, 40D, 50D, 60D or on any Tagelus models manufactured after April, 1993.

NOTE 2: Tagelus Clamp Filter models Tank & ft. assy. have valve adptr. (Item 6) factory installed.

NOTE 3: Replacement of Tank ft. requires the use of mounting tape. See part number listed.

NOTE 4: Lubricate O-ring liberally w/ silicone lubricant and tighten to following spec: TA30D, 35D, 40D, 50D, 60D. Handtight plus ¼ turn min. TA100D Handtight plus ¾ turn min.

NOTE 5: Tagelus Filter models TA30, 35, 40, 50, 60 manufactured after Nov. 1, 1991 were manufactured w/ a btr. thread top opening and utilize a btr. style valve which is black in color. A change was made to the port arrangement in April, 1993 which will require that minor changes be made to the valve plumbing connections when replacing valves on filters manufactured between Nov. '91 and Mar. '93. **DO NOT ATTEMPT TO INTERCHANGE THREAD TYPES.**

NOTE 6: Tagelus Filter models TA30, 40, 50, 60 manufactured before Nov. 1, 1991 were manufactured w/ a "V" thread style valve that is white or brown in color. These valves may be replaced only w/ "V" thread style valve P/N 261124, see Detail B. **DO NOT ATTEMPT TO INTERCHANGE THREAD TYPES.**

NOTE 7: Tagelus Clamp Filter models TA30D, 35D, 40D, 50D, 60D manufactured after Nov. 1, 1991 were manufactured w/ a btr. thread top opening and utilize a btr. thread valve adptr. P/N 154555, see Detail A. **DO NOT ATTEMPT TO INTERCHANGE THREAD TYPES.**

NOTE 8: Tagelus Clamp Filter models TA30D, 40D, 50D, 60D manufactured before Nov. 1, 1991 were manufactured w/ a "V" thread top opening and utilize a "V" thread valve adptr. P/N 155225, see Detail B). **DO NOT ATTEMPT TO INTERCHANGE THREAD TYPES.**

NOTE 9: Tagelus Filter models TA 100D made before December 1, 1993, have a different threaded operation on the filter tank and require a different 8½" adaptor, P/N 154521.

TA 40 / TA 40D	❶
TA 50 / TA 50D	❷
TA 60 / TA 60D	❸
TA 100D	❹
TA 60 (ClearPro®)	❺
TA 50 (w/1/4 turn)	❻

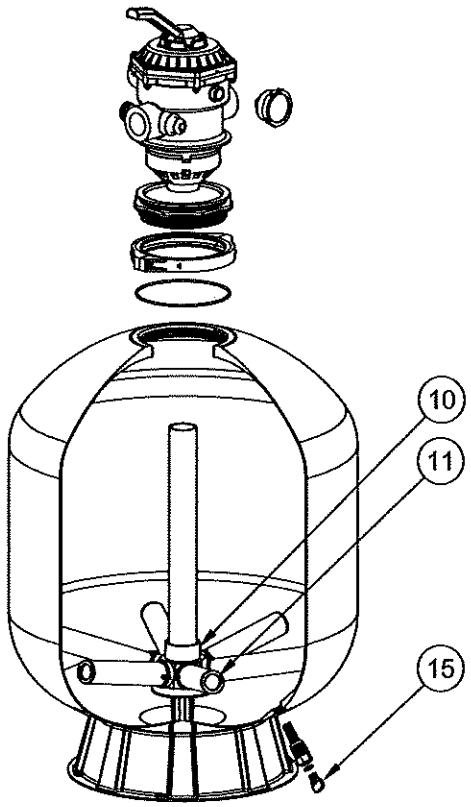
To determine manufacture date, the first 4 digits of the serial number indicate the month and year product was manufactured.

Item No.	Part No.	TAGELUS FILTERS WITH THD. & CLAMP VALVES
		Description
1A	262506	VALVE 1½ in. 6-WAY CLAMP STYLE ❶❷❸
1A	261185	VALVE 2 in. 6-WAY CLAMP STYLE ❹
1B	261130	VALVE 1½ in. 6-WAY BUTTRESS THREAD TA (NOTE 5)
1B	261124	VALVE 1½ in. 6-WAY "V" THREAD-TA (NOTE 6)
2A	272541	O-RING VALVE BODY 3/16 in. X 4¾ in. I.D. ❶❷❸
2A	275333	O-RING VALVE BODY 3/16 in. X 6½ in. I.D. ❹
2B	154493	O-RING VALVE BODY .157 in. X 5.75 in. I.D. - TA 40/50/60
3A	355330	O-RING STANDPIPE 1/8 in. X 2-3/8 in. I.D. (NOTE 1) ❹
3B	155064	O-RING STANDPIPE 1/8 in. X 1-7/8 in. I.D. (NOTE 1) ❶❷❸
4	152165	CLAMP 6½ in. DIA. S/S, PLASTIC ❶❷❸
4	152130	CLAMP 8.35 in. DIA. ❹
5	190059	GAUGE BACK MOUNT PRESSURE
6	154555	ADAPTER 6 in. BUTTRESS THD. (NOTES 4 & 7) ❶❷❸
6	155225	ADAPTER 6 in. "V" THREAD (NOTES 4 & 8) ❶❷❸
6	154521	ADAPTER 8½ in. btr. THREAD (NOTE 4 & 9) ❹
7	154494	O-RING VALVE ADAPTER .157 in. X 5.75 in. I.D. ❶❷❸
7	355619	O-RING VALVE ADAPTER 1/8 in. X 8 ¼ in. I.D. ❹
8	155002	STABILIZER, CENTER PIPE
9	155276	TANK & FT. ASSY. w/ VALVE ADAPTER (NOTES 2, 7 & 8) ❶
9	155279	TANK & FT. ASSY. w/ VALVE ADAPTER (NOTES 2, 7 & 8) ❷
9	155269	TANK & FT. ASSY. w/ VALVE ADAPTER (NOTES 2, 7 & 8) ❸
9	155324	TANK & FT. ASSY. w/ VALVE ADAPTER (NOTES 2, 7 & 8) ❹
9	155342	TANK & FT. ASSY. BUTTRESS THREAD STYLE (NOTES 5 & 6) ❶
9	155343	TANK & FT. ASSY. BUTTRESS THREAD STYLE (NOTES 5 & 6) ❷
9	155358	TANK & FT. ASSY. BUTTRESS THREAD STYLE (NOTES 5 & 6) ❸
10	155061	PIPING ASSY. (DIM. D = 17¾ in.) ❶
10	155062	PIPING ASSY. (DIM. D = 19-7/8 in.) ❷
10	155334	PIPING ASSY. (DIM. D = 19-7/8 in.) ❻
10	155063	PIPING ASSY. (DIM. D = 22-5/8 in.) ❸
10	155299	PIPING ASSY. (ClearPro®) (DIM. D = 22-5/8 in.) ❺
10	155340	PIPING ASSY. - LESS HUB (DIM. D = 27¼ in.) ❹
10	155323	PIPING ASSY. - w/HUB (DIM. D = 27¼ in.) ❹

TAGELUS® SAND FILTER
Replacement Parts

TA 40 / TA 40D
TA 50 / TA 50D
TA 60 ClearPro® / TA 60D
TA 100D

Item No.	Part No.	TAGELUS FILTERS WITH THD. & CLAMP VALVES
		Description
11	152290	LATERAL 6-11/16 in. LONG, 8 req. ❶❷❸
11	152202	LATERAL 9-1/8 in. LONG ❹
11	150088	LATERAL ASSY.,- ClearPro®, 6 req. ❺
11	150085	LATERAL ASSY. - 1/4 TURN, 6 req. ❻
12	154926	FOOT TANK ❶❷❸
12	154596	FOOT TANK (SEE NOTE 3) ❹
13	154698	SPIGOT ¾ in. NPT SAND DRAIN
13	154685	SPIGOT ½ in. NPT SAND DRAIN
13	152220	SPIGOT 2 in. NPT SAND DRAIN ❹
14	192115	O-RING DRAIN PLUG 1/16 in. X ½ in. I.D.
15	357161	PLUG ¼ in. NPT DRAIN
16	154512	WRENCH 6½ in. ACROSS FLATS ❶❷❸
16	151608	WRENCH 9 in. ACROSS FLATS ❹
	154402	TAPE FT. MOUNTING (NOT SHOWN) ALL EXCEPT ❹
	154407	TAPE FT. MOUNTING (NOT SHOWN) ❹
	155051	SAND GUIDE (NOT SHOWN)
	155281	HUB ASSY. ❶❷❸❹
	152222	HUB ASSY. - 1/4 TURN ❺❻



Detail for TAGELUS® – TA 60 Filters with ClearPro Technology®

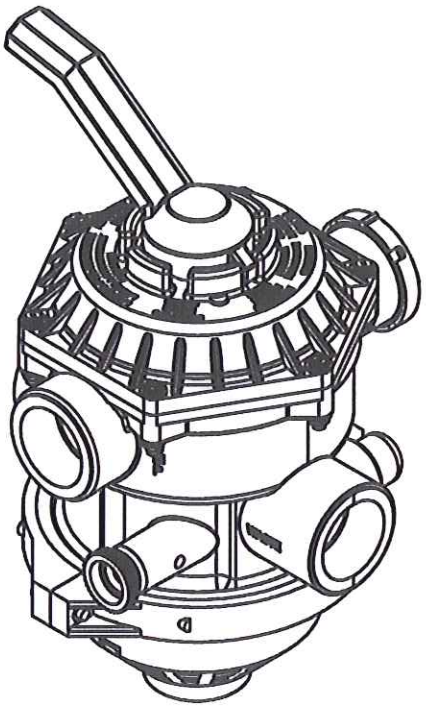
TA 40 / TA 40D	❶
TA 50 / TA 50D	❷
TA 60 / TA 60D	❸
TA 100D	❹
TA 60 (ClearPro®)	❺
TA 50 (w/1/4 Turn)	❻

To determine manufacture date, the first 4 digits of the serial number indicate the month and year product was manufactured.

Pentair Pool Products®

Because reliability matters most®

HiFlow™ 6 WAY VALVE - 1-1/2"



Installation, Operation & Service Manual

IMPORTANT SAFETY INSTRUCTIONS

READ AND FOLLOW ALL INSTRUCTIONS

SAVE THESE INSTRUCTIONS

⚠ **WARNING** — THIS MANUAL CONTAINS CRITICAL SAFETY INFORMATION WHICH MUST BE FURNISHED TO THE END USER. FAILURE TO READ AND FOLLOW INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY AND/OR MAJOR PROPERTY DAMAGE.

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This valve operates under pressure. When closed properly and operated without air in the water system. This valve will operate in a safe manner.

CAREFULLY READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN THIS MANUAL OR ON FILTER.

How Your Valve Works

Your six position valve is designed to provide all the necessary positions required to operate, maintain, troubleshoot and service your filter. It is provided with six operating positions and one Winterize position. The valve is constructed of high quality corrosion resistant materials and when installed, operated, and maintained in accordance to these instructions, your valve will provide years of trouble free operation.

⚠ **WARNING** — Air entering the filter and a valve clamp not closed properly can cause the valve to blow off and could cause severe bodily injury and/or property damage. (Some valve models do not have a clamp but thread into the filter tank.)

1. This valve is equipped with an external air bleeder device (Item 12). Always open this air bleeder and stand clear of filter and valve before starting system pump and leave open until a steady stream of water is expelled.

⚠ **CAUTION** — To prevent equipment damage and possible injury, always turn pump off before changing valve position.

2. This valve has a closed position. The pump should never be on when the valve is in the closed position. If the pump is operated with the valve closed, the air relief system becomes inoperative and an explosive situation could exist. Additionally, running the system with no flow will seriously damage the equipment.

VALVE POSITIONS:

FILTER - From pump, through valve downward THRU FILTER up through center pipe to valve RETURN port for normal filter action and vacuuming pool thru filter.

BACKWASH - From pump through valve, down through center pipe and to valve WASTE port for cleaning filter by reversing flow.

RINSE - From pump, through valve downward up through filter up through center pipe to valve WASTE port for start-up cleaning and resetting filter bed after backwashing.

WASTE - From pump through valve BYPASSES FILTER and goes to WASTE port for vacuuming directly to waste, lowering pool level, or draining pool.

CLOSED - NO FLOW - DO NOT USE THIS SETTING WITH PUMP OPERATING.

RECIRCULATE - From pump, through valve, bypasses filter and goes to return port for circulating water without going thru filter.

Installation

1. Check carton for any evidence of damage due to rough handling in shipment or any valve components are damaged, notify freight carrier immediately.

NOTICE: When working in and around the clamp use caution to prevent potential injury to fingers or hands from sudden contact with sharp edges.

2. After inspection, carefully remove valve components from carton.

Be sure sand has been placed into filter, sand guide has been removed and top of filter cleaned of any sand or debris.

NOTE: The filter valve will attach to the filter in one of two ways depending upon the filter and valve type.

Clamp style valves utilize a clamp which holds together the flanges of the valve and filter. Follow exactly, steps 3 thru 8 below to attach the valve to the filter. (Disregard steps 9 thru 12.)

3. Check to be sure (Item 14) o-ring is in place in groove on valve body. (*Note:* Item numbers in this portion of the instruction booklet refer to the replacement parts list tilled HiFlow™ Six Way Valve.)
4. Open clamp (Item 15) wide enough to place over the flange on the tank and rest on the tank before the valve is installed.
5. Place valve over opening in top of tank so that filter centerpipe slips into bore of valve body.
6. Valve parts are labeled with the location of where they should be connected, *(i.e.* pump port must go to pump discharge, waste port must go to the waste line and return port must go to the pool return).
7. Orient the valve to allow the ports to be plumbed to the proper location.
8. Press down on valve so that (Item 14) o-ring is down inside of opening of tank top.

⚠ **WARNING** — Improper tank valve assembly could cause the valve to blow off and cause severe injury and/or property damage.

Lift the clamp (Item 15) over the tank flange and carefully guide the clamp so that it catches both the valve flange and the tank flange. Tighten "T' bolt nut securely.

Threaded style valves utilize a large 6" buttress thread that screws directly to the filter tank. Follow exactly, steps 9 thru 12 below to attach the valve to the filter. (Disregard steps 3 thru 8.)

9. Check to be sure o-ring, (Item 14), is in place above large thread on valve body and that o-ring is lubricated. If o-ring requires lubrication, use only silicone type lubrication.

⚠ **WARNING** — Use of lubricants or pipe sealants other than recommended in this instruction booklet, can damage the valve and cause the valve to blow off and could cause severe bodily injury or property damage.

10. Check to be sure filter piping assembly is exactly centered about 1½" below the large threaded opening in the tank.
11. Carefully install the valve inside the filter opening so that the filter piping assembly slips into socket of the valve. Slowly turn valve clockwise until the thread engages with the thread on the tank. Continue to turn valve until the o-ring on valve contacts the tank. Grasp valve by the two opposing ports and tighten as secure as possible by hand.

⚠ **WARNING** — Do not install pipes into the threaded ports, for the purpose of gaining mechanical advantage, as this can over tighten and damage the valve and can cause the valve to blow off resulting in severe bodily injury and/ or property damage.

NOTE: The valve should not become hard to turn when installing in the filter opening until the valve o-ring contacts the filter surface. Failure to position the filter piping assembly in the center of the large filter opening can cause the valve to not thread properly into the filter tank.

12. Orient the filter with valve to allow the ports to be plumbed to the proper location.
13. The Maximum operating pressure of this valve is 50 psi. The filter unit also has a maximum operating pressure listed on the filter nameplate. DO NOT OPERATE this unit above the maximum operating pressure of the valve or the filter. Never connect the filter and valve unit to a pump which can generate a pressure that exceeds the operating pressure of the filter or valve.
14. Assemble piping and pipe fittings to pump and valve. All piping must conform to local and state plumbing and sanitary codes.
15. Use sealant on all tapered male connections of pipe and fittings. Use only sealant compounds suited for plastic pipe. Support pipe to prevent strains on filter, pump or valve.

NOTICE: All valve internal threads are tapered except the air bleeder connection. Do not overtighten tapered thread connections.

16. Install pressure gage in 1/4" NPT port directly across from the pump port.

17. Never store pool chemicals within 10 feet of your pool filter valve. Pool chemicals should always be stored in a cool, dry, well ventilated area.

⚠ **WARNING** — Chemical fumes and/or spills can cause severe attack of filter valve structural components. Structurally weakened components can cause filter valve or attachments to blow off and could cause severe bodily injury and or property damage.

Replacement of Valve Top and Diverter Assembly

1. Shut off pump and open air bleeder to relieve all internal pressure.
2. Set valve handle to winterize position.
3. Remove 6 cover screws (Item 9).
4. Lift off valve top and diverter assembly.

NOTICE: Valve diverter assembly has the sealing gasket attached to the diverter. When handling the diverter, use caution to prevent the sealing surface from being damaged during handling.

5. Clean valve body sealing surface with soft clean lint free cloth. Inspect surface for damage such as scratches or nicks. If surface is damaged the valve body must be replaced.
6. Carefully lubricate the new valve top replacement o-ring (Item 8) with a silicone based lubricant and place appropriately on valve top.

⚠ **WARNING** — Improper tank valve assembly could cause the valve to blow off and cause severe injury and/or property damage.

7. Place the new valve top handle in the winterize position. Install new valve top and diverter assembly making sure small recess on lid and small bump on valve body are aligned. Start all 6 screws with fingers to ensure that the screw is started in the formed thread of the valve body. Screws should be tightened progressively by tightening diametrically opposite screws and following a crisscross pattern. Tighten all 6 valve top attachment screws firmly. DO NOT OVER TIGHTEN.

NOTICE: Valve top is attached with self-tapping screws. The screws must be aligned properly to prevent cross threading of the screws in the valve body.

Valve Care

The valve is a very important part of your pool equipment and installation. Proper care and maintenance will add many years of service and enjoyment to the pool. Follow these suggestions for long trouble free operation.

1. To clean the exterior of the valve of dust and dirt, wash with a mild detergent and water and then hose off. Do not use solvents.

⚠ **WARNING** — Always visually inspect valve components during normal servicing to ensure structural safety. Replace any item which is corroded, bent or otherwise visually defective. Defective valve components can allow the valve or attachments to blow off and could cause severe bodily injury or property damage.

2. The valve clamp used on your valve has been manufactured with high quality corrosion resistant materials. The manufacturing process could allow sharp edges to be present on the parts. When working in and around the clamp use caution to prevent potential injury to fingers or hands from contact with sharp edges.
3. Your valve is a pressure vessel and should never be serviced while under pressure. Always relieve tank pressure and open air bleeder before attempting to service your valve.
4. Open the manual air bleeder and stand clear of the filter/valve before restarting your pump.

Winterizing Procedure

1. Shut off pump and open the valve air bleeder.
2. Drain and winterize the pump and filter per the manufacturer's instructions.
3. Depress valve handle and rotate so valve pointer is on circular rib on valve top at area on valve marked WINTERIZE.

NOTICE: The valve should be left in this position during the shutdown season so the valve diverter has no pressure on the rubber seal.

Troubleshooting Guide

Problem	Cause	Remedy
Leak to waste port	1. Dirt or sand under seal. 2. Damaged seal. 3. Damaged valve body in seal area.	Remove valve top and clean seal area. Replace valve top assembly. Replace valve body.
Leakage at port connections to valve	1. Cracked ports. 2. Did not use sealant on threads.	Replace valve body, use proper assembly and do not over tighten port connection. Use sealant.
Sand returning to pool	1. Filter problem. 2. Sand blowing thru air vent slots or between filter center pipe in valve.	Refer to filter manual. Sand size too small or flow rate thru filter too high.
Leakage at valve attachment to filter	Leakage past o-ring.	Remove valve and inspect o-ring & sealing surface. Replace as necessary.
Leakage at handle	Leakage past o-ring.	Replace valve top assembly.
Leakage at top of valve to valve body	Leakage past o-ring.	Remove valve and inspect o-ring & sealing surface, replace as necessary.
Leakage at sightglass with vacuum breaker	Dirt on sealing gasket.	Remove sightglass and rinse with cool water to remove dirt. Replace sightglass if damaged.

HiFlow™ 6-WAY VALVE

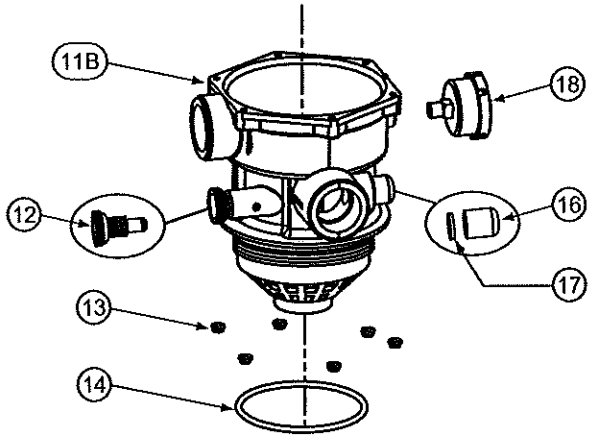
Replacement Parts

ITEM	P/N	DESCRIPTION
1	272520	HANDLE
2	272405	SCREW - HANDLE
3	272505	WASHER - 1.875" PLASTIC
4	270085	VALVE TOP - W/LABEL
5	272511	O-RING - .75" X 1" X 1/8"
6	272535	SPRING
7	272512	DIVERTER - VALVE W/GASKET
8	354053	O-RING - 3/16" DIA X 5-5/8" ID
9	354541	SCREW - SLOT HEX 10-24 X 1.5
10	272555	WASHER - 9/16" S/S
11A	272530	VALVE BODY - W/DIFFUSER CLAMP STYLE
11B	272538	VALVE BODY - W/DIFFUSER THREADED
12	273512	AIR BLEEDER - W/O-RING
13	272554	NUT - #10-24 SERR. FLANGED S/S
14	272541	O-RING - 4.60" ID x 3/16" DIA.
15	152165	CLAMP ASSY.
16	272550	SIGHTGLASS - W/VACUUM PROTECTOR
17	271106	GASKET - SIGHTGLASS
18	190059	PRESSURE GAGE
19	272531	HiFlow 1½" TOP VALVE ASSY.

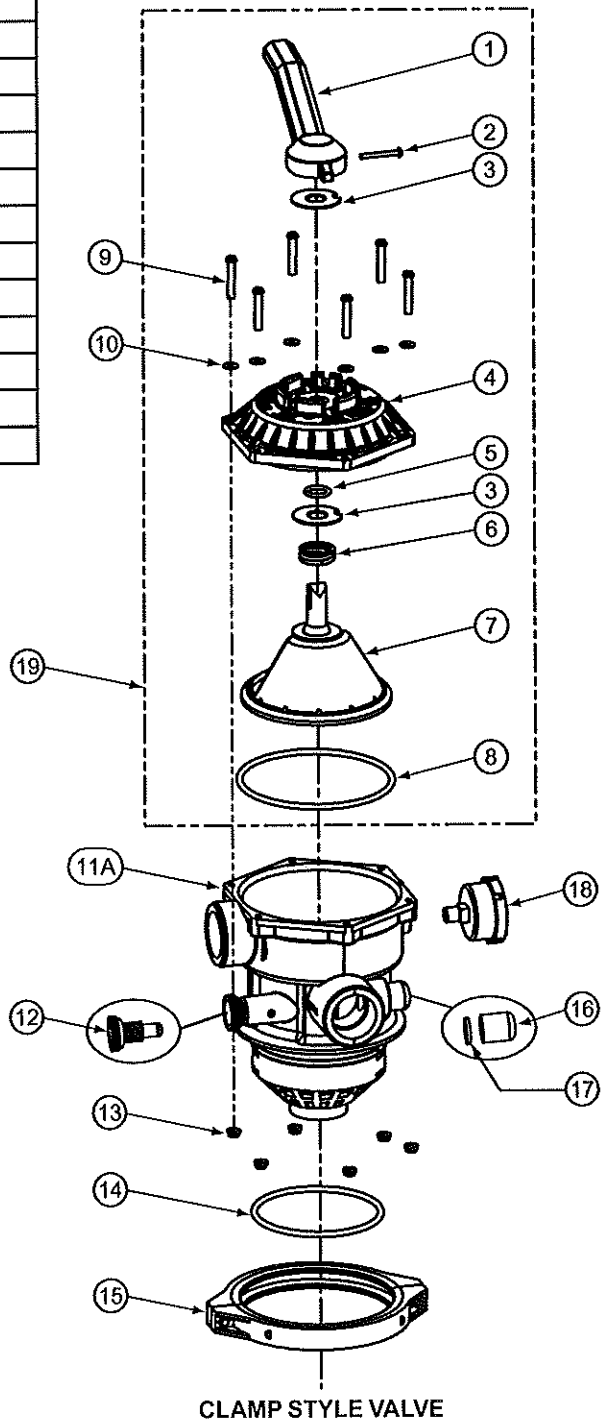
NOTE:

1. VALVE TOP ASSEMBLY P/N 272531 CONSISTS OF ITEMS 1 THRU 8 AND VALVE INSTRUCTIONS P/N 272517.
2. VALVES MANUFACTURED BEFORE MARCH 1, 1993, DO NOT CONTAIN ITEM 16 SIGHTGLASS OR ITEM 17 SIGHTGLASS GASKET .
3. CLAMP STYLE VALVES MANUFACTURED BEFORE MARCH 1, 1993, CONTAIN A DIFFERENT AIR BLEEDER WITH O-RING P/N 272515. THIS PART IS NOT INTERCHANGEABLE WITH P/N 273512.

   THREADED VALVES MANUFACTURED BEFORE MARCH 1, 1993, DO NOT CONTAIN AN AIR BLEEDER WITH O-RING.
4. ITEM 8 USED ON VALVES MANUFACTURED AFTER MAY 1, 1992, REPLACES P/N 272401-WASHER AND P/N 272400-SPRING.



6" BUTTRESS STYLE VALVE



CLAMP STYLE VALVE

OWNER'S MANUAL

Swimming Pool and Spa Pump

SPECK pumps

READ THIS MANUAL CAREFULLY

BEFORE USING THE SPECK PUMP

Notice: *The California Energy Commission requires all pumps purchased for sale or use in a residential pool for filtration in California be listed on their CEC website.*

Important Notice: This manual contains important information about the installation, operation and safe use of this product. This information should be given to the owner and/or operator of this equipment.

WARNING: *This product must be installed and serviced by a qualified pool professional, and must conform to all national, state, and local codes.*

WARNING: *Before installing this product, read and follow all warning notices and instructions which are included. Failure to follow safety warnings and instructions can result in severe injury, death, or property damage. Call (800) 223-8538 or visit www.usa.speck-pumps.com for additional copies of these instructions.*

IMPORTANT SAFETY INSTRUCTIONS

When installing and using this electrical equipment, basic safety precautions should always be followed, including the following:

1. READ AND FOLLOW ALL INSTRUCTIONS.

2. WARNING - To reduce the risk of injury, do not permit children to use this product unless they are closely supervised at all times.

3. WARNING - Risk of Electrical Shock. Connect only to a branch circuit protected by a ground-fault circuit interrupter (GFCI). Contact a qualified electrician if you cannot verify that a circuit is protected by a GFCI.

4. WARNING - To reduce the risk of electric shock, replace any damaged cord immediately.

5. *DO NOT* install within an outer enclosure or beneath the skirt of a hot tub or spa.

6. CAUTION - This pump is for use with permanently-installed pools and may also be used with hot tubs and spas if so marked. Do not use with storable pools. A permanently-installed pool is constructed in or on the ground or in a building such that it cannot be readily disassembled for storage. A storable pool is constructed so that it is capable of being readily disassembled for storage and reassembled to its original integrity.

7. The unit must be connected only to a supply circuit that is protected by a ground-fault circuit-interrupter (GFCI). Such a GFCI should be provided by the installer and should be tested on a routine basis. To test the GFCI, push the test button. The GFCI should interrupt power. Push the reset button. Power should be restored. If the GFCI fails to operate in this manner, the GFCI is defective. If the GFCI interrupts power to the pump without the test button being pushed, a ground current is flowing, indicating the possibility of an electric shock. Do not use this pump. Disconnect the pump and have the problem corrected by a qualified service representative before using.

8. TO REDUCE RISK OF ELECTRICAL SHOCK, A copper bonding connector (8 AWG) is provided for bonding the motor to all metal parts of the swimming pool, spa, or hot tub structure and to all electrical equipment, metal conduit, and metal piping within 5 feet of the inside walls of a swimming pool, spa, or hot tub, when the motor is installed within 5 feet of the inside walls of the swimming pool, spa, or hot tub.

NOTE: To installer and/or operator of the Speck Swimming Pool Pump; the manufacturer's warranty will be voided if the pump is improperly installed and/or operated.

9. SAVE THESE INSTRUCTIONS!

SECTION 1 EQUIPMENT OPERATION AND MAINTENANCE

1/1 LOCATION

1. Locate the pump as close to the pool as practical. Consult local codes for minimum distance between pool and pump.

2. The piping should be as direct and free from turns or bends as possible, as elbows and other fittings greatly increase friction losses.

3. Place pump on a solid foundation which provides a rigid and vibration-free support so that it is readily accessible for service and maintenance.

4. Though the pump is designed for outdoor use, it is advised to protect the pump from continuous direct heat. Install the pump in a well ventilated location protected from excessive moisture (flooding, sprinklers, rain downspouts, etc.).

5. Protect the pump against flooding and excess moisture, prevent foreign objects from clogging air circulation around motor. All motors generate heat that must be removed by providing proper ventilation.

6. ***DO NOT*** store or use gasoline or other flammable vapors or liquids in the vicinity of this pump. ***DO NOT*** store pool chemicals near the pump.

7. ***DO NOT*** remove any safety alert labels such as ***DANGER***, ***WARNING***, or ***CAUTION***. Keep safety labels in good condition and replace missing or damaged labels.

8. Provide access for future services by leaving a clear area around the pump. Allow plenty of space above the pump to remove lid and basket for cleaning.

1/2 INSTALLATION

1. When connecting pipework to pump with threaded ports, it is recommended that thread seal tape be used. If the suction pipe is not sealed correctly, the pump will not prime properly and pump small volumes of water or none at all.

2. When installing the pump, care should be taken to see that the suction line is below water level to a point immediately beneath and in front of the pump to ensure quick priming via a flooded suction line. The height between the pump and water level should not be more than five (5) feet.

3. Suction and discharge line should be independently supported at a point near the pump to avoid strains being placed on the pump.

4. It is advisable to install a gate valve in both the suction and discharge line in the event that the pump must be removed for servicing. *(Flooded suction application only)*

5. Before starting the pump for the first time, remove the see-through lid. (Turn lid ring counterclockwise to remove.) Fill strainer tank with water until it is level with the suction inlet. Replace lid with locking ring. *Hand-tighten* the lid to make an air-tight seal. ***DO NOT use any tools to tighten the lid.***

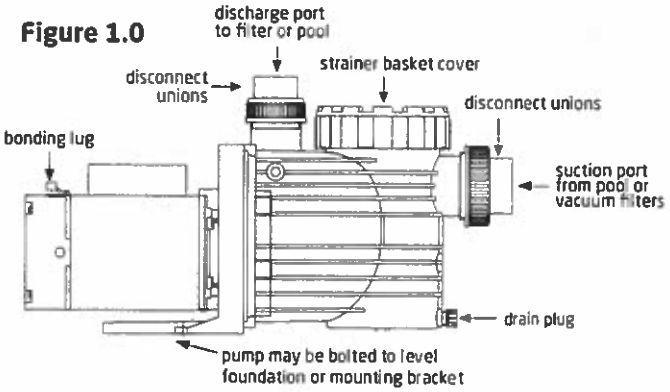
6. When installing and using the motor, basic safety precautions should be done by a licensed electrician in accordance with local codes. Be certain that the motor frame is grounded. Motor name plate has voltage, phase, ampere draw and other motor information as well as wiring connection instructions.

BONDING: As required by National Electrical Code Article 680-22, the pump motor must be electrically bonded to the pool structure (reinforced bars, etc.) by a solid copper conductor not smaller than #8 AWG (8.4 mm^2) wire via the external copper bonding lug on the pump motor.

GROUNDING: Permanently ground the pump motor using a conductor of appropriate size. Connect to the #10 green headed ground screw provided inside the motor terminal box.

NOTE: ***DO NOT*** connect to electric power supply until the unit is permanently grounded

Figure 1.0



1/3 MAINTENANCE

The pump requires little or no service other than reasonable care and periodic cleaning of the strainer basket. ***DO NOT*** strike basket to clean. When cleaning the basket inspect the lid o-ring for damage and replace if necessary.

NOTE: It is normal for a few drops of water to escape from the mechanical seal from time to time. This is especially true during the break-in period.

The mechanical seal may become worn and/or loose during the course of time, depending on the running time and water quality. If water continually leaks out, a new mechanical seal should be fitted. After long periods of NON operational (seasonal storage, etc.), the pump must be checked for ease of rotation while it is switched off.

SECTION 1 EQUIPMENT OPERATION AND MAINTENANCE

1/3 MAINTENANCE - continued

WARNING: *Before servicing the pump, switch off the circuit breakers at the power source. Severe personal injury or death may occur if the pump starts while your hand is inside the pump.*

Place a screwdriver, allen wrench or appropriate tool in the end of the motor shaft and turn it clockwise. *OR* Remove the fan cover and turn the fan in a clockwise direction manually. This may require removal of the cover at the rear of the motor or small circular cap at the rear center of the motor.

To Replace the Mechanical Seal
To replace the mechanical seal, remove the eight (8) bolts holding the casing to the flange. Slide the motor unit from inside the casing. Remve the terminal cover from the rear of the motor and secure the center motor shaft with a 7/17" wrench or screwdriver. Remove impeller nut by turning it counter-clockwise when facing it. Pull the impeller from the motor shaft noting the position of the seal. Remove the seal from the impeller shaft. To re-assemble, reverse the process. Use only water as a lubricant to install both sides of the seal. Make sure both sides of the seal (ceramic and spring portion) are clean. Gently wipe polished faces with soft and dry cotton cloth. Surfaces can easily be damaged by dirt and scratching. *(Use a drop of loc-tite to secure the impeller nut.)*

1/4 WINTERIZING - continued

CAUTION: *The pump must be protected when freezing temperatures are expected. Allowing the pump to freeze will cause severe damage and void the warranty.*

There are two options when winterizing the pump:

Option 1:
Drain all the water from the pump, system equipment, and piping. Remove drain plug(s). ***DO NOT*** replace plug(s). Store plug(s) in the strainer basket for winter. Keep the motor covered and dry.

Option 2:
Drain all the water from the pump, system equipment, and piping. Remove the pump and motor from the plumbing and store indoors in a warm and dry location.

NOTE: When the winter season is over the pump will need to be check and primed prior to start.

CAUTION: DO NOT *run the pump dry. If the pump is run dry, the mechanical seal will be damaged and the pump will start to leak at the seal. If this occurs, the mechanical seal will need to be replaced.* ***ALWAYS*** *maintain the proper water level in your pool. Continued operation in this manner could cause a loss of pressure, resulting in damage to the pump casing, impeller, and mechanical seal.*

SECTION 2 TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSES	SOLUTION
1. Pump will not prime.	a. Suction air leak.	Make sure the see-through lid and o-ring are clean and properly positioned. Tighten see-through lid (hand tight). Tighten all pipes and fittings on suction side of the pump. Be sure water in the pool is high enough to flow through skimmer.
	b. No water in pump.	Make sure strainer tank is full of water.
	c. Closed valves or blocked lines.	Open all valves in system. Clean skimmer and strainer tank. Open pump and check for clogging of impeller.
	d. Low voltage to motor.	Check voltage at motor. If low, pump will not come up to speed.
2. Motor does not turn.	a. No power to motor.	Check that all power switches are on. Be sure fuse or circuit breaker is properly set. Time set properly? Check motor wiring at terminals.
	b. Pump jammed.	With power off, turn shaft. It should spin freely. If not, disassemble and repair.

SECTION 2 TROUBLESHOOTING GUIDE - continued

PROBLEM	POSSIBLE CAUSES	SOLUTION
3. Low flow.	a. Dirty filter.	Back wash filter when filter pressure is high, or clean cartridges.
	b. No skimmer basket.	Clean skimmer and pump strainer basket.
	c. Closed valves or blocked lines.	See problem 1.
	d. Suction air leak.	See problem 1.
4. Noisy operation of motor.	a. Bad bearings.	Noise when shaft is turned up by hand. Motor is hot in bearing area when running. Replace bearing.
5. Motor runs hot.	These motors will run hot to the touch, however, this is normal. They are designed that way. Thermal overload protector will function to turn them off if there is an overload or high temperature problem. Excessive heat can be cause by:	
	a. Low voltage.	Increase size of electrical wire. Be sure motor is operating on correct voltage.
	b. Installed in direct sun.	Shield motor from sun's rays.
	c. Poor ventilation.	Do not tighten cover or enclosure motor.
6. Noisy operation of pump.	a. Air leak in suction line. Bubbles in water returning to pool at inlet.	Repair leak. Check suction pipe, see-through lid in place? O-ring clean?
	b. Restricted suction line due to blockage or under size pipe. Indicated by high vacuum reading at pump suction.	Remove blockage or increase suction pipe size. Make sure strainer tank is clean. Are all suction valves fully open?
	c. Foreign matter (gravel, metal, etc.) in pump impeller.	Disassemble pump and remove foreign matter from impeller.
	d. Cavitation.	Improve suction conditions. (Reduce suction life, reduce number of fittings, increase pipe size.) Increase discharge pressure and reduce flow by throttling discharge valve.
7. Motor overload protection "kicks out".	a. Motor is not connected properly.	Check wiring diagram on motor.
	b. Low voltage due to under size wire or low incoming voltage.	Check with volt meter. Increase size of supply wire. Reports low supply voltage to power company. Voltage at motor must be within 10% of motor nameplate voltage.
	c. Wrong size heaters in protective device.	Heaters should be one size larger than full load amps shown on motor nameplate.
	d. Overload due to binding in pump or wrong size impeller.	Indicated by high amperage readings on motor, binding shaft. Disassemble unit and correct.

SECTION 3 SERVICING INFORMATION

When calling the manufacturer regarding a question or problem with your pump, please have the serial number available. The serial number is located on the pump either on the flange or motor labels.

Replacement parts may be available from your installer. Call, fax, or write: Speck Pumps at 8125 Bayberry Road, Jacksonville, Florida 32256 Phone: (904) 739-2626 Fax: (904) 737-5261, e-mail: info.usa@speck-pumps.com

SECTION 4 LIMITED WARRANTY

Speck Pumps-Pool Products, Inc. grants solely to the original consumer purchaser ("Buyer") of the pump and motor the following personal, non-transferable and limited warranty on the following terms and conditions (the "Limited Warranty"): the pump and motor is warranted to be free of material defects in materials or workmanship under normal use for a period of two (2) year beginning on the date of the Buyer's purchase of the pump and motor. Not withstanding any provisions herein to the contrary, the warranties and obligations hereunder shall not in any event extend for more than three (3) years beyond the date of shipment of the pump and motor from the factory (the "Limited Warranty Period"). The Limited Warranty is subject to each of the following additional terms and conditions:

1. **IN THE EVENT OF ANY BREACH OF THE LIMITED WARRANTY, SPECK PUMPS - POOL PRODUCTS, INC.'S ENTIRE OBLIGATION AND LIABILITY TO BUYER, AND BUYER'S SOLE AND EXCLUSIVE REMEDY SHALL BE AS FOLLOWS:** Speck Pumps - Pool Products, Inc. will, at its option, either repair or replace the pump and motor or refund to Buyer the purchase price actually paid by Buyer for the pump and motor subject to the Limited Warranty. Speck Pumps - Pool Products, Inc. shall have no obligations under the Limited Warranty unless Buyer delivers timely written notice to Speck Pumps - Pool Products, Inc. of the Limited Warranty claim within the Limited Warranty Period and returns the pump and motor to Speck Pumps - Pool Products, Inc. if requested. To the fullest extent permitted by law, Speck Pumps - Pool Products, Inc. expressly disclaims any liability for, and the Limited Warranty does not include or cover, any labor, costs or other expenses in connection with the removal, transportation, shipment, insurance, replacement, repair, or installation of repaired or replaced parts or for any other costs or expenses or damages to property or things including, but not limited to, those arising in connection with the use of, or inability to use, the pump and motor.

2. To the fullest extent permitted by law, the Limited Warranty will be void and of no force or effect and Speck Pumps - Pool Products, Inc. will have no liability, responsibilities or obligations to Buyer or with respect to the pump and motor in the event of the occurrence of any one or more of the following:

(a) Any damage to the pump and motor caused by Buyer, any third party, ground movement, other natural forces, acts of God or any other sources or causes not arising from a breach of the Limited Warranty, excluding ordinary wear and tear;

(b) Any replacement, modification, alteration or repair of any parts or components of the pump and motor by anyone other than Speck Pumps - Pool Products, Inc.;

(c) Any abuse, misuse, accident, tampering with, improper installation or modification of the pump and motor or any other actions, inactions or failures to act that violate the terms and conditions of this Limited Warranty;

(d) Buyer's failure or inability to present an invoice, bill, receipt or other documentation clearly evidencing that the pump and motor was installed and maintained in strict compliance with this Limited Warranty and that the claim was timely submitted within the Limited Warranty Period; and/or

(e) Buyer's failure to comply with the conditions and contingencies set forth in paragraph 3 below.

3. The Limited Warranty is expressly conditioned and contingent upon Buyer's strict compliance with each of the following:

(a) Installation of the pump and motor by an experienced and qualified pool industry professional and a licensed electrician who is licensed within the jurisdiction in which the pump and motor is installed and will be used; and

(b) Buyer's operation and maintenance of the pump and motor in strict accordance with Speck Pumps - Pool Products, Inc.'s printed operator/maintenance manuals delivered with the pump and motor.

4. **DISCLAIMER: THE LIMITED WARRANTY IS THE ONLY WARRANTY MADE AND IS IN LIEU OF ALL OTHER WARRANTIES, AND ANY AND ALL IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY, THE IMPLIED WARRANTY AGAINST INFRINGEMENT, AND THE IMPLIED WARRANTY OR CONDITION OF FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY LIMITED IN THEIR SCOPE AND DURATION TO THE TWO YEAR TERM OF THE LIMITED WARRANTY SET FORTH HEREIN. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO THE BUYER.**

SECTION 4 LIMITED WARRANTY - continued

5. TO THE FULLEST EXTENT PERMITTED BY LAW, IN NO EVENT SHALL SPECK PUMPS - POOL PRODUCTS, INC. OR ITS OFFICERS, DIRECTORS, EMPLOYEES, SHAREHOLDERS, AGENTS, OR REPRESENTATIVES BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, EXEMPLARY OR CONSEQUENTIAL DAMAGES OR LOSS, INCLUDING TIME, MONEY, GOODWILL, AND LOST PROFITS IN ANY WAY WHICH MAY ARISE HEREUNDER OR FROM THE USE OF OR INABILITY TO USE THE PUMP AND MOTOR OR THE PERFORMANCE OR NONPERFORMANCE OF ANY OBLIGATION UNDER THIS LIMITED WARRANTY. THIS PARAGRAPH, THE WARRANTY DISCLAIMERS IN PARAGRAPH 4 ABOVE, AND THE SOLE AND EXCLUSIVE REMEDY SET FORTH IN PARAGRAPH 1 ABOVE SHALL APPLY EVEN IF SPECK PUMPS - POOL PRODUCTS, INC. HAS BEEN NOTIFIED OF THE POSSIBILITY OR LIKELIHOOD OF SUCH DAMAGES OCCURRING, WHETHER SUCH LIABILITY IS BASED ON CONTRACT, TORT, NEGLIGENCE, STRICT LIABILITY, PRODUCTS LIABILITY OR OTHERWISE, AND EVEN IF ANY REMEDY STATED HEREIN FAILS OF ITS ESSENTIAL PURPOSE. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF SPECIAL, INDIRECT, INCIDENTAL, EXEMPLARY OR CONSEQUENTIAL DAMAGES OR LOSS, SO THE ABOVE EXCLUSIONS AND LIMITATIONS MAY NOT APPLY.

6. This Limited Warranty gives the Buyer specific legal rights, and the Buyer may also have other rights, which vary from state to state.

7. A return merchandise authorization ("RMA") must be obtained from Speck Pumps - Pool Products, Inc. before returning any product. Products returned without an RMA will be refused and returned, unopened, to the Buyer. All returned products are to be sent freight prepaid and insured for Buyer's protection to the manufacturer at 8125 Bayberry Road, Jacksonville, Florida 32256. Under no condition will products be accepted after the expiration of the Limited Warranty Period. Speck Pumps - Pool Products, Inc. shall not bear any costs or risks incurred by Buyer in shipping a defective pump and motor to Speck Pumps - Pool Products, Inc. or in shipping a repaired or replaced pump and motor to Buyer.

Technical Support:

Address: Speck Pumps
8125 Bayberry Road
Jacksonville, FL. 32256
USA

Hours: (Monday - Friday) 8:00 am to 5:00 pm EST
Toll Free: 800-223-8538
Phone: 904-739-2626
Fax: 904-737-5261

Website: www.usa.speck-pumps.com

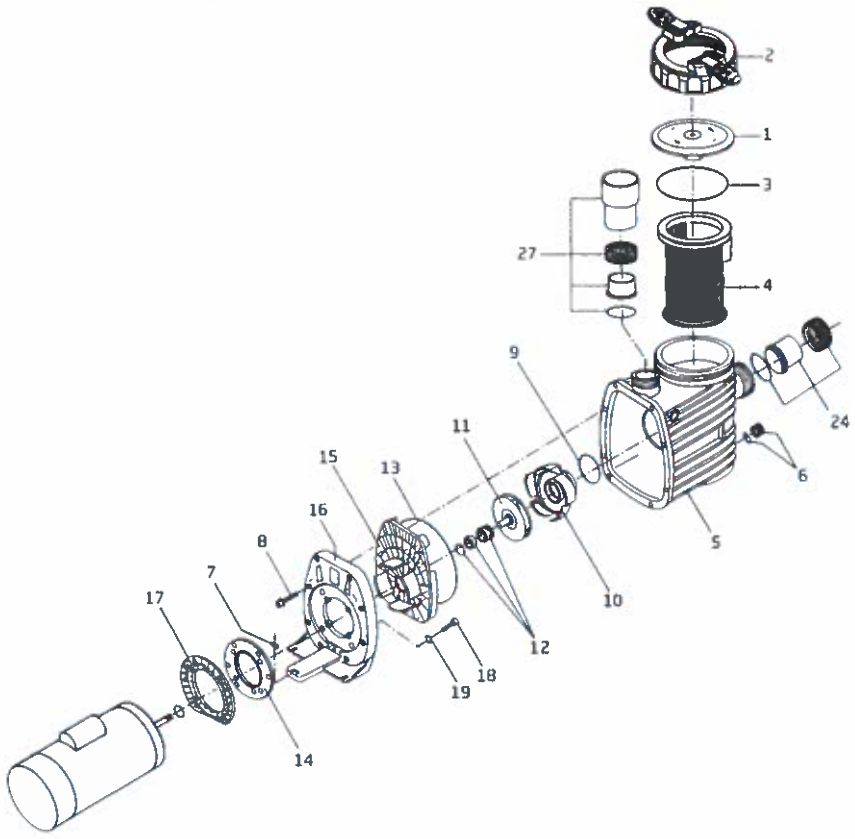
Date of Installation:	
Installed by:	
Serial Number:	
For Service Call:	

MODEL S90

SPECK X

Swimming Pool Pump

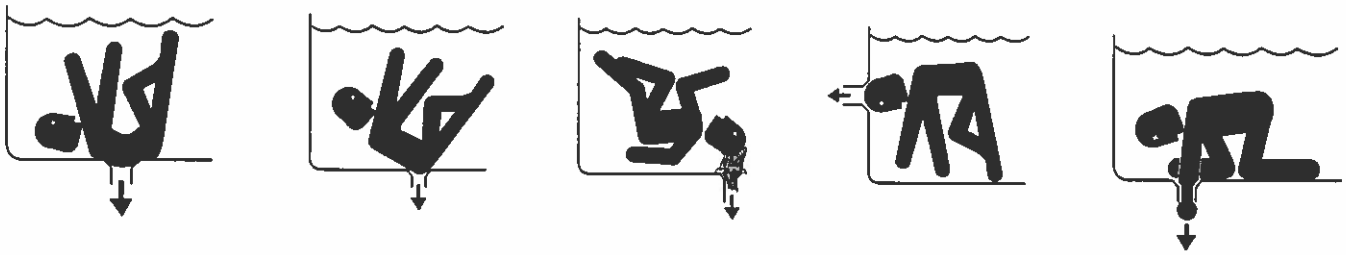
Order #	Drawing Number	Qty Required	Description
2901116010	1	1	LID - CLEAR
2921116012B	NOT SHOWN	1	LID - CLEAR WITH LED LIGHT
2921116022	2	1	LOCK RING WITH HANDLES - LID
2921141210	3	1	O-RING - LID 137 x 5mm
2901114300	4	1	BASKET - ONE PIECE
2921110130	5	1	CASING
2901158200	6	1	DRAIN CAP 3/8" WITH GASKET - CASING
2920889410	7	1	LEGO SPACER
2991000091	8	8	SCREW - CASING HEX/SLOT M7 x 48mm SS
2920141210	9	1	O-RING - DIFFUSER 90 x 5mm
2921117412	10	1	DIFFUSER
2920223090	11	1	IMPELLER (-II) 1.0 HP S.F. 1.0 101/9.0mm
2920223091	11.1	1	IMPELLER (-III) 1.5 HP S.F. 1.0 106/9.0mm
2920223092	11.2	1	IMPELLER (-IV) 2.0 HP S.F. 1.0 114/9.0mm
2920343310	12	1	MECHANICAL SEAL (20mm) COMPLETE
2921141222	13	1	O-RING - CASING 190 x 6mm
2920216110	14	1	INTERMEDIATE FLANGE
2921116110	15	1	SEAL HOUSING
2921111300	16	1	FLANGE
2920110200	17	1	MOTOR FLANGE - 56 FRAME
2991400029	18	4	BOLT - MOTOR (3/8-16 x 2.25")
2991400035	19	4	WASHER - MOTOR BOLT (3/8") SS
2921770005	24	1	SET - SUCTION UNION COMPLETE
2500300902	27	1	SET - DISCHARGE UNION COMPLETE
2500300914	24 & 27	1	COMPLETE UNION PACKAGE - SUCTION/DISCHARGE



8125 Bayberry Road, Jacksonville Florida 32256 USA | PHONE (904)739-2626 | FAX: (904)737-5261
Website: www.us-spec-pumps.com

READ THIS MANUAL CAREFULLY
BEFORE USING THE PUMP

⚠ DANGER: DO NOT BLOCK SUCTION ⚠



- Pump suction is hazardous and can trap and drown or disembowel swimmers.
- Blocking suction with body may cause severe or fatal injury.
- ***DO NOT*** use or operate swimming pools, spas, or hot tubs if a suction outlet cover is missing, broken, or loose.
- All suction outlet covers must be maintained. They must be replaced if cracked, broken, or missing.
- All suction outlets must have correctly installed screw-fastened cover in place.
- The pump suction system must provide protection against the hazard of suction entrapment or hair entrapment/entanglement.
- Provide at least two hydraulically balanced (3' apart) main drains, with covers as suction outlets for each circulating pump suction line.

⚠ WARNING: RISK OF ELECTRICAL SHOCK ⚠

Pool pump must be installed by a licensed or certified electrician or a qualified pool serviceman in accordance with the National Electrical Code and all applicable local codes and ordinances. Improper installation will create an electric hazard which could result in death or serious injury to pool users, installers, or others due to electrical shock, and may also cause damage to property.

Always disconnect power to the pool pump at the circuit breaker before servicing the pump. *Failure to do so could result in death or serious injury to serviceman, pool users, or others due to electric shock.*

⚠ SAVE THESE INSTRUCTIONS! ⚠

System:3®

Sand Filters for Inground Pools

by Sta-Rite®

Squeaky clean and crystal clear

That'll give you a clear idea of what it's like to have a System:3® sand filter at work in your swimming pool. This filter is designed to remove more dirt and impurities, which will make your water feel fresher and look more inviting. We've made maintenance easier, too. Cleaning is as simple as applying a little wrist action to the control valve and walking away. And you won't have to do it very often! Through innovative engineering, the filter's dirt-handling capacity is maximized, which pays off in less maintenance. But best of all, the System:3 will make your pool water sparkle in the sun and shimmer in the moonlight.

- Sta-Rite's reputation for top-of-the-line pool equipment makes the System:3 sand filter a #1 pick with pool professionals.
- Tank shape, internal component design and hydraulic flow have been engineered to evenly distribute water through the entire sand bed, which traps more dirt and extends the time between cleanings.
- Unlike cartridge-style filters, the System:3's sand filter media is permanent and doesn't require frequent replacement.
- The Posi-Lok™ clamps, controls, pressure gauge and operating instructions are conveniently positioned for easy access.

Enjoy the luxury of pool ownership even more with a System:3 sand filter.

System:3® Sand Filters

An up-close look
Top-mounted pressure gauge is conveniently positioned for easy reading.

Tough stuff
Dura-Glas™, Sta-Rite's exclusive high-density composite resin, will never corrode and weathers the elements.

Safe, easy access
Posi-Lok™ clamps provide safe, easy access to the filter module. 50/50 split-tank design provides extra room for cleaning and service. Fast in, fast out!

Smooth operator
2" plumbing ports improve hydraulic flow for greater efficiency.

Stylish good looks
Sleek, contemporary styling blends beautifully with any poolscape.

Less maintenance, more relaxation

Sand is the most widely used filtration method for swimming pools. Convenience, low maintenance and water quality are the reasons for sand's popularity. The System:3® sand filter is a time-tested favorite with pool owners for its simple maintenance, easy-to-operate control valve selector and outstanding water clarity. The biggest reason for installing the System:3 – the additional leisure time you'll spend enjoying your pool.

Low, low maintenance
16-spoke filter hub evenly distributes water through entire sand layer, which greatly increases the amount of dirt the System:3 can hold. Increased dirt loading extends the time between cleanings.

One-step cleaning
For quick and easy cleaning, simply move the valve selector to the backwash position – that's it! In seconds, your System:3 is at work, keeping your water crystal clear.

Filter Performance

Model	For Pools up to (Gal.) 8 Hr. Turnover	Filter Area (Sq. Ft.)	Optimal[1] Performance at this GPM	Sand Required[2] (lbs.)
S7S50	23,000	2.4	36	200
S8S70	33,000	3.4	51	300

[1] Operating at this GPM will provide the longest filter cycles combined with the best and greatest dirt-loading capacity.

[2] Use only #20 white quartz silica sand, size range .40-.55 mm; 12" to 15" sand bed depth required.

Operating Limits – Maximum continual operating pressure is 50 PSI. For pool/spa (bather) applications, the maximum operating water temperature within the filter is 104°F (40°C).

One-year limited warranty. See warranty for details.

Available from:

STA-RITE®
Simply Smarter.

www.staritepool.com
Phone: 800-831-7133 Fax: 800-284-4151

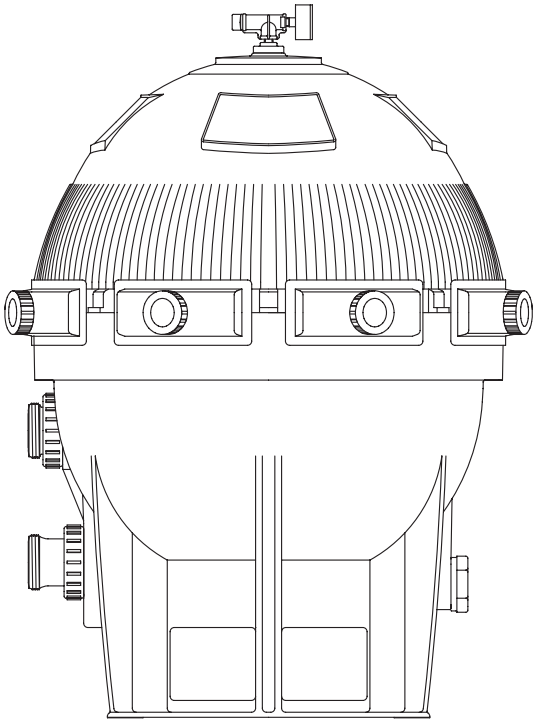
pumps / filters / heaters / heat pumps / automation / lighting / cleaners / sanitizers / maintenance products

2/08 Part # P1-715

STA-RITE®

SYSTEM 3®
HIGH RATE SAND FILTERS

O W N E R ' S M A N U A L



INSTALLATION, OPERATION & PARTS

MODELS

S7S50 S8S70

This manual should be given to the owner of this pump.

MEMBER
NATIONAL SPA & POOL INSTITUTE

Pentair Water Pool and Spa, Inc.

1620 Hawkins Ave., Sanford, NC 27330 • (919) 566-8000
10951 West Los Angeles Ave., Moorpark, CA 93021 • (805) 553-5000

Printed in U.S.A.

5-1-12 **S282** (Rev. C)

HIGH RATE SAND FILTERS

To avoid unneeded service calls, prevent possible injuries, and get the most out of your filter, READ THIS MANUAL CAREFULLY!

The Sta-Rite System 3 High Rate Sand Filter:

• Is designed to filter water for swimming pools.

• Is an excellent performer; durable, reliable.

Table of Contents

Safety Instructions....2-3
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Initial Filling....6
Filter Disassembly/Assembly....6-7
Startup/Operation....7
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Maintenance....8-9
Replace Internal Assembly....9
Winterizing....9
Repair Parts List....10-11
Troubleshooting Guide....12

READ AND FOLLOW SAFETY INSTRUCTIONS!

⚠ DANGER

⚠ WARNING

⚠ CAUTION

This is the safety-alert symbol. When you see this symbol on your valve or in this manual, look for one of the following signal words and be alert to the potential for personal injury.

DANGER warns about hazards that will cause serious personal injury, death or major property damage if ignored.

WARNING warns about hazards that can cause serious personal injury, death or major property damage if ignored.

CAUTION warns about hazards that will or can cause minor personal injury or property damage if ignored.

The label NOTICE indicates special instructions which are important but not related to hazards.

Carefully read and follow all safety instructions in this manual and on filter.

Keep safety labels in good condition.
Replace missing or damaged safety labels.

⚠ WARNING
Hazardous pressure

Incorrectly installed or tested equipment may fail, causing severe injury or property damage. Read and follow instructions in owner's manual when installing and operating equipment. Have a trained pool professional perform all pressure tests.

1. Do not connect system to a high pressure or city water system.
2. Use equipment only in a pool or spa installation.
3. Trapped air in system can cause explosion. BE SURE all air is out of system before operating or testing equipment.

Before pressure testing, make the following safety checks:

- Check all clamps, bolts, lids, and system accessories before testing.
- Release all air in system before testing.
- Tighten Sta-Rite pump trap lids to 30 ft. lbs. (4.1 kg-cm) torque for testing.
- Water pressure for test must be less than 25 PSI (172 kPa).
- Water temperature for test must be less than 100˚ F. (38˚ C).
- Limit test to 24 hours. After test, visually check system to be sure it is ready for operation. Remove pump trap lid and retighten hand tight only.

NOTICE: These parameters apply to Sta-Rite equipment only. For non Sta-Rite equipment, consult manufacturer.

⚠ DANGER

If filter clamp is adjusted under pressure, tank will blow off of base, causing severe injury or major property damage.

BEFORE WORKING ON FILTER:

1. Stop pump.
2. Open air release valve.
3. Release all pressure from system.

⚠ WARNING

Filter pumps require hazardous voltage which can shock, burn, or cause death

BEFORE WORKING ON PUMP OR MOTOR

Disconnect power to motor.

⚠ WARNING

Hazardous pressure. Can cause severe injury or major property damage from tank blow up.

Release all pressure and read instructions before working on filter.

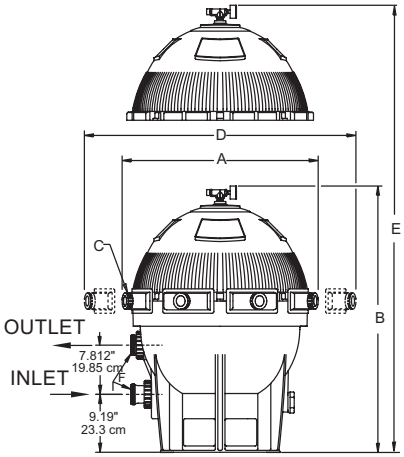


Figure 1 - Dimensions

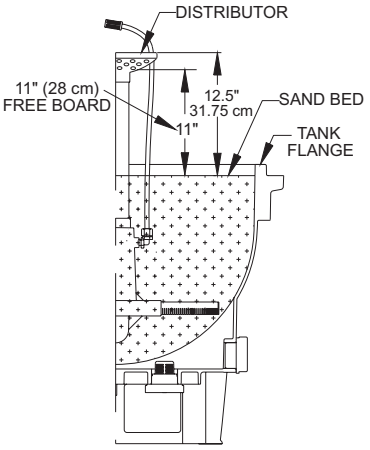
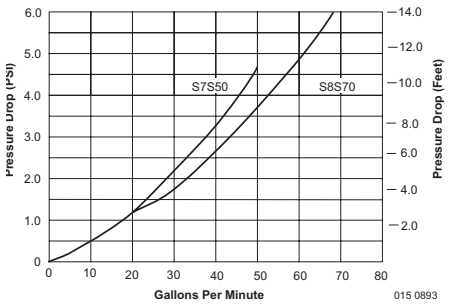


Figure 2 - Freeboard measurement



GENERAL INFORMATION

- Clean a new pool as well as possible before filling pool and operating filter. Excess dirt and large particles of foreign matter in the system can cause serious damage to the filter and pump.

⚠ Do not operate filter at water temperatures above 120°F (65.5°C).

⚠ NEVER operate this filter system at more than 50 pounds per square inch (50 PSI/345kPa) pressure!

TABLE I - OUTLINE DIMENSIONS IN INCHES (mm)

Sand Model	A	B	C No. of Clamps	D	E	F
S7S50	28-1/2(724)	42(1067)	7	36(914)	53-1/2(1360)	2” NPT
S8S70	32-1/2(825)	42-1/4(1073)	8	40(1020)	54-1/4(1380)	2” NPT

TABLE II - FILTER SPECIFICATIONS AND OPERATING INFORMATION

FILTER MODEL:	S7S50	S8S70
Filter Area	2.4 Ft.^{2}(.223M^2)	3.4 Ft.^{2}(.316M^2)
Flow Rate Range	33-48 GPM(125-182 L/m)	47-68 GPM(178-257 L/m)
Public Pool Flow Rate	48 GPM(182 L/m)	68 GPM(257 L/m)
Max. Operating Pressure	50 PSI(345 kPa)	50 PSI(345 kPa)
Freeboard (See Fig. 1B)*	11” (28 cm)	11” (28 cm)
Turnover in Hours:		
6 Hours	17,200 Gal.(65 102 liters)	24,400 Gal.(92 354 liters)
8 Hours	23,000 Gal.(87 055 liters)	32,600 Gal.(123 391 liters)
10 Hours	28,800 Gal.(109 008 liters)	40,800 Gal.(154 428 liters)
Qty. of Media Required:		
Cu. Ft.	2(56 540cm^3)	3(84 960cm^3)
Weight (Pounds)	200(90,7 kg)	300(136 kg)

* Freeboard is the open space between the top of the sand bed and the tank backwash outlet.

NOTICE: 1 cubic foot (28 320 cm^3) of sand weighs approximately 100 lbs. (45,4kg). DO NOT use a finer grade of sand than recommended.

RECOMMENDED SAND GRADES:

Use only: #20 Silica Sand, Size Range .40-.55mm., Uniformity Coefficient less than 1.75.

NOTICE: Use of other sands will reduce filter performance, may damage pump,and will void warranty.

Recommended:

1. Sand Grade: Wedron .45-.55mm., Effective Size .46mm, Uniformity Coefficient 1.22.
2. Sand Grade.45-.55 mm., Effective Size .48mm, Uniformity Coefficient 1.18.

INSTALLATION

Installation of filter should only be done by qualified, licensed personnel. For assembly and filling instructions, see pages 6 and 7.

Filter mount must:

- Provide weather and freezing protection.
- Provide space and lighting for easy access for routine maintenance. (See Figure I and Table 1, Page 4, for space requirements.)
- Be on a reasonably level surface and provide adequate drainage.
- Be as close to pool as possible to reduce line loss from pipe friction.

Piping:

- Piping must conform to local/state plumbing and sanitary codes.
- Use pipe joint sealing compound or thread seal tape on all male connections of metal pipe and fittings (except unions). Use thread seal tape on all male connections of plastic pipe and fittings. DO NOT use pipe dope on plastic pipe; it will cause stress cracking of the pipe. Do not use sealant or tape on unions – assemble them dry and hand tight.
- Do not damage union sealing surfaces and O-Rings.
- Support pipe independently to prevent strains on filter or valve.
- Use 2” pipe to reduce pressure losses as much as possible.

  NOTICE: Filter may be located away from pool, but for adequate flow larger pipe may be needed. For more information about hydraulic design, call Sta-Rite Customer Service.
- Fittings restrict flow; for best efficiency use fewest possible fittings.
- Keep piping tight and free of leaks: pump suction line leaks may cause trapped air in filter tank or loss of prime at pump; pump discharge line leaks may show up as dampness or jets of water.
- NOTICE: Overtightening can crack filter ports.

TABLE III - Sta-Rite valves for use with filters

Port Size	Part Number
	Multi-port
2"	18202-0200
1-1/2"	18202-0150
	Brass Slide
2"	WC212-136D
	Plastic Slide
2"	WC212-134P

NOTICE: Use of valves other than those listed above could cause reversed water flow through filters and damage to internal filter components.

Valves:

- A check valve installed ahead of filter inlet will prevent contaminants from draining back into pool.
- A check valve installed between filter and heater will prevent hot water from backing up into filter and deforming internal components.
- Install Sta-Rite Two Position Slide Valve or Multiport Selector Valve with filter. See Table lll.
- Filter ports and valve ports are furnished with union connections.

  DO NOT use pipe sealants on union collar (nut).
- Use care before assembly not to damage union sealing surfaces or O-Ring.

Wastewater:

- Be sure all provisions for waste water disposal meet applicable local, state or national codes. 100 gallons (379 liters) or more of pool water will be discharged during filter backwashing. Do not discharge where water will cause flooding or damage.

Assembly:

See Pages 6 and 7 for assembly filling instructions.

FILTER DISASSEMBLY/ASSEMBLY

⚠ To avoid equipment damage and personal injury, never change handle position on control valve while pump is running.

⚠ CAUTION

⚠ WARNING

Hazardous pressure. Can cause severe injury or major property damage from tank blow up.

Release all pressure and read instructions before working on filter.

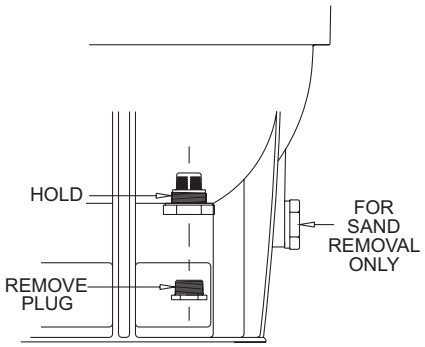


Figure 3 - Hold drain fitting and remove drain plug to drain filter.

BEFORE DISASSEMBLING FILTER:

⚠ 1. STOP PUMP.

2. OPEN air release valve and drain fitting.
3. WAIT until all pressure is released and water drained from filter tank and system before loosening clamp knobs.

Disassembly:

1. Backwash filter according to instructions under “Filter Backwash Procedure”, Page 8 (when first filling a new filter, omit this step).
2. Stop pump.
3. Open air release valve (Key No.1, Page 10) on top of filter tank to release all air pressure from inside of tank and system.
4. Remove filter drain plug (Key No. 17B, Page 10) and drain all water from tank (see Figure 3). Hold drain fitting securely in filter body to avoid losing sand.
5. To equalize flange stresses, loosen clamp knobs alternately (that is, on opposite sides of tank) around tank. Remove clamps.
6. Being careful not to damage Cord Ring (Key No.12, Page 10), lift upper tank shell (Key No. 7, Page 10) off lower tank shell (Key No. 14, Page 10).

Filling Filter with Sand:

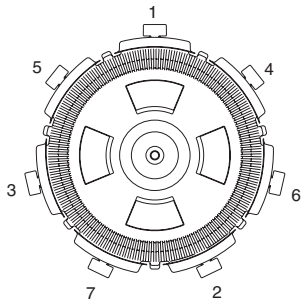
1. See Page 4 for correct sand grade and quantity.
2. Before pouring sand into filter, look inside and check internal assembly (Key No. 8, Page 10) for broken or loose laterals (Key No. 8A, Page 10) caused by shipping damage. Replace if necessary.
3. To eliminate stress on laterals (Key No. 8A) fill tank half-full of water before loading sand.
4. When full, top of sand bed should be about 12-1/2” (31.75 cm) below top of distributor (about 1-1/2” (3.8 cm) below tank flange (see Figure 2).
5. Wash all sand and dirt away from cord ring sealing area.
6. Assemble filter according to instructions, pages 6 and 7.

Assembly:

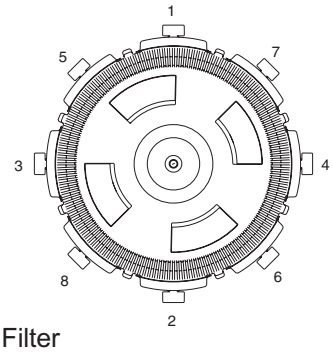
1. Remove cord ring slowly to avoid stretching or tearing it.
2. Inspect cord ring (Key No. 12, Page 10) for cuts, nicks, etc. If cord ring is damaged, deformed, or has lost its resiliency, replace with a new one.
3. Clean cord ring area of tank shell (both halves) and cord ring.
4. Carefully install cord ring and upper tank shell (Key No. 7, Page 10).

   NOTICE: Do not lubricate cord ring. Lubricants attract dirt and grit and may (especially when petroleum based) damage cord ring and void warranty.

   NOTICE: Be sure upper tank shell contacts cord ring surface evenly and seal area is clean and free from dirt.



21" Filter



25" Filter

Figure 4 - Clamp tightening sequence.

5. Install clamps. Do not tighten clamps yet.
6. See Figure 4 for clamp tightening sequence. Tighten all clamp knobs securely hand tight.

   NOTICE: To equalize stresses on tank, be sure to tighten clamps in sequence shown. DO NOT work your way around the filter tightening adjacent clamps.
7. Install air relief valve and gauge assembly on tank.

Startup (Multi-port Valve):

1. With pump OFF, set valve to 'BACKWASH' position.
2. Open air release valve (Key No. 1, Page 10).
3. Start pump, circulating water backwards through filter to waste.
4. Close air release valve when a steady stream of water is expelled.
5. Run pump five minutes or until waste water is clear (this purges excess fine particles from system).
6. Stop pump; set valve handle to 'RINSE' position.
7. Start pump; run pump for 15 to 30 seconds.
8. Stop pump; set valve to 'FILTER' position. Follow instructions under Regular Operation' (below) to place filter in service.

Startup (Slide Valve):

1. With pump OFF, raise handle to fully extended position.
2. Open air release valve (Key No. 1, Page 10).
3. Start pump, circulating water backwards through filter to waste.
4. Close air release valve when a steady stream of water is expelled.
5. Run pump five minutes or until waste water is clear (this purges excess fine particles from system).
6. Stop pump; lower handle completely to 'FILTER' position and pin in place. Follow instructions under 'Regular Operation' (below) to place filter in service.

REGULAR OPERATION

⚠WARNING Do not operate this filter at more than 50 PSI (345kPa) under any circumstances!

Run Filter:

1. With pump OFF, set valve to 'FILTER' position.
2. Fill trap on pump with water.
3. Open air release valve on top of filter assembly (Key No. 1, Page 10); start pump.
4. When steady stream of water comes from air release valve, close the valve.
5. With filter operating, record pressure gauge reading in owner's manual. When reading is 10 PSI (70kPa) above initial reading, backwash filter.

⚠ CAUTION

Backwash Filter (Multi-Port Valve):

⚠ To prevent equipment damage and possible injury, turn pump OFF before changing valve position.

1. With pump OFF, set valve to 'BACKWASH' position.
2. Open air release valve (Key No. 1, Page 10).
3. Start pump, circulating water backwards through filter to waste.
4. Close air release valve when a steady stream of water is expelled.
5. Backwash until water runs clear.
6. Stop pump; set valve to 'RINSE' position.
7. Start pump; run pump for one minute.
8. Stop pump; set valve to 'FILTER' position.
9. Filter is now ready for service.
10. Open air release valve and release ALL pressure from system.
11. Follow 'Run filter' procedure to restart system.

Backwash Filter (Slide Valve):

⚠ To prevent equipment damage and possible injury, turn pump OFF before changing valve position.

1. With pump OFF, raise valve handle to fully extended position.
2. Open air release valve (Key No. 1, Page 10).
3. Start pump, circulating water backwards through filter to waste.
4. Close air release valve when a steady stream of water is expelled.
5. Backwash until water runs clear.
6. Stop pump; lower handle completely to 'FILTER' position and pin in place.
7. Filter is now ready for service.
8. Open air release valve and release ALL pressure from tank and system.
9. Follow 'Run filter' procedure (above) to restart system.

MAINTENANCE

General:

- Wash outside of filter with a mild detergent and water. Rinse off with hose.

  NOTICE: DO NOT use solvents to clean filter; solvents may damage plastic components in system.

- Inspect sand bed at least once a year to remove foreign material which has not been backwashed out of system.

  ⚠WARNING Follow instructions on Pages 6 and 7 when disassembling and assembling filter.

  NOTICE: When the sand bed gets hard and crusty on top, remove all the old sand and replace it with new sand.

  NOTICE: Open air bleed valve and bleed all air from filter each time pump is stopped and restarted.

Weekly Pool Equipment Inspection:

1. Check pressure during operation. When pressure is 10 PSI (70kPa) higher than initial operating pressure, backwash filter (see instructions, page 7).

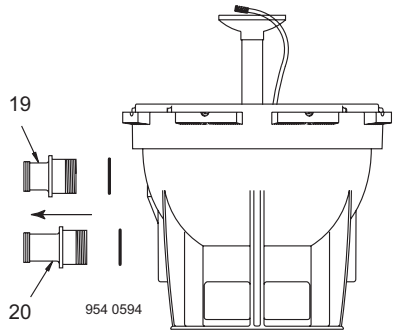


Figure 5

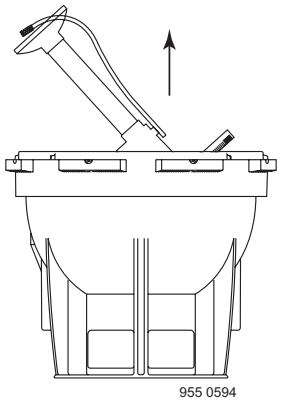


Figure 6

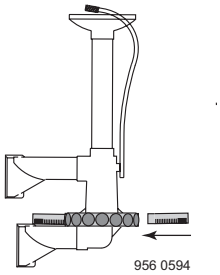


Figure 7

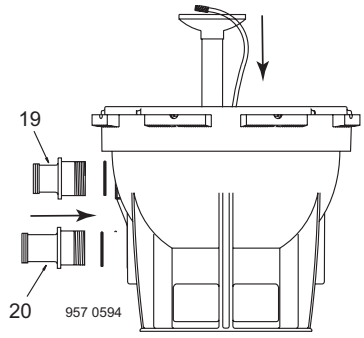


Figure 8

2. Skimmer basket - remove debris.
3. Stop pump, release all pressure from system. Remove trap cover and basket, remove debris.
4. Bleed air from filter each time system is started.
5. Check pump for leaks. If found, see pump owner's manual.
6. Check pump strainer lid for tightness. Do not overtighten!

Replace Internal Assembly:

1. Disassemble filter according to instructions in "Filter Disassembly" Page 6.

   ⚠WARNING Hazardous Pressure! To avoid severe injury and major property damage, follow instructions on Pages 6 and 7 when disassembling and assembling filter.

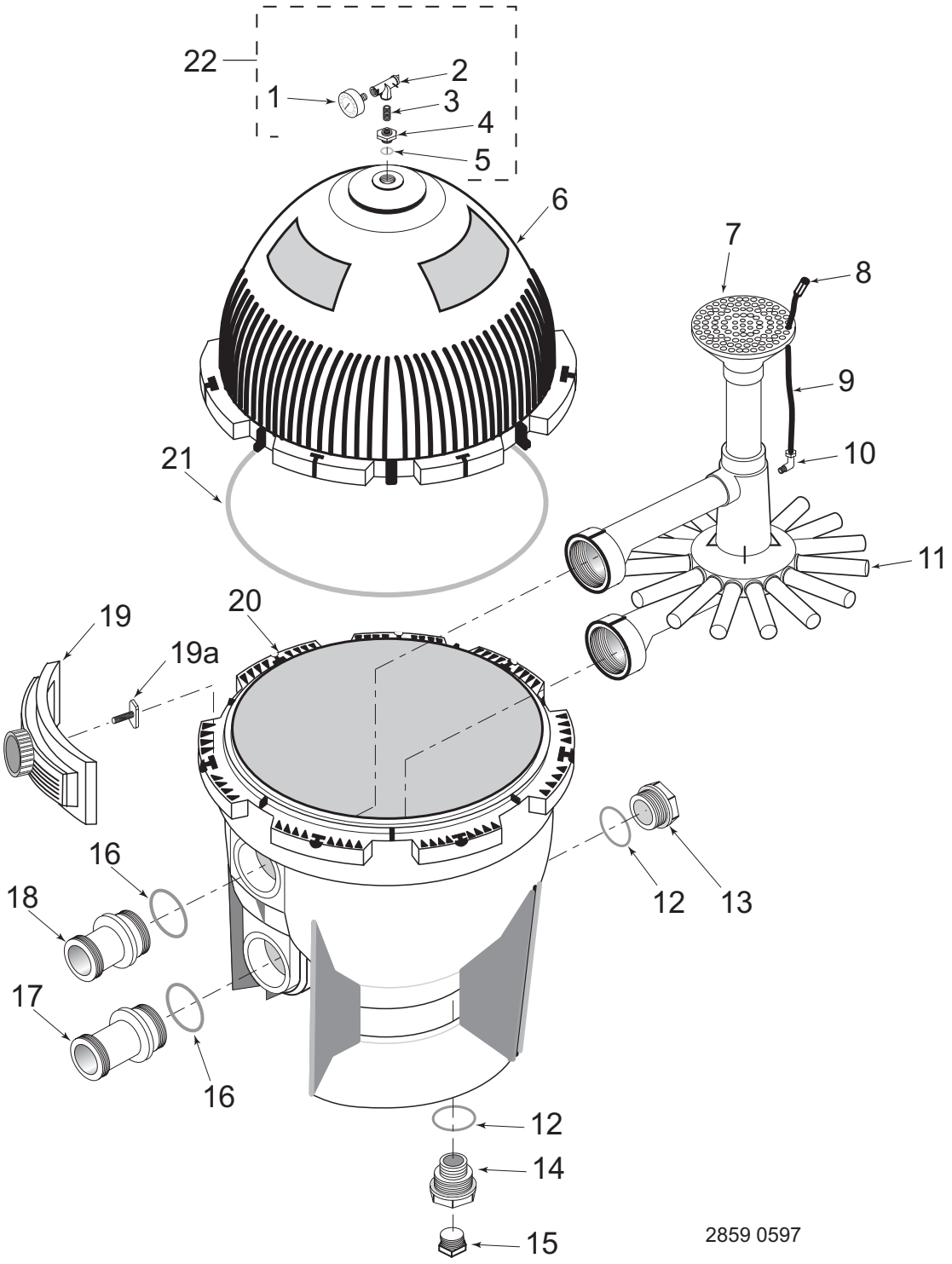
2. Remove sand from filter.
3. Remove union adapters and tank fittings, (Key Nos. 19 and 20, Figure 5). Turn Key Nos. 19 and 20 counterclockwise to remove.
4. Lift old internal assembly out of tank. (Figure 6)
5. Twist lock new laterals into hub on new internal assembly. (Figure 7)
6. Remove old O-Rings on tank fittings (Key Nos. 19 and 20) and install new O-Rings provided. Be sure sealing area is clean.
7. Drop new internal assembly into tank and secure with tank fittings (Key Nos. 19 and 20, Figure 8).
8. To refill, reassemble, and restart filter, follow instructions in owner's manual.

   ⚠WARNING To avoid severe injury or major property damage, exactly follow "Assembly" instructions, Pages 6 and 7.

9. Follow "Startup" instructions in owner's manual.

WINTERIZING

1. Open air release valve; open all system valves. Position multiport valve between port positions to allow air passage to all ports.
2. Remove drain plugs from trap, pump, valve and filter.
3. Drain system piping.
4. Cover with plastic or tarpaulin to protect from weather.
5. Protect from freezing.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REPAIR PARTS LIST

Key No.	Description	Qty.	Model S7S50	Model S8S70
1	2" Gauge	1	33600-0023T	33600-0023T
2	Valve Assembly	1	WC212-120P	WC212-120P
3	Nipple	1	U37-16P	U37-16P
4	Adapter Bushing	1	24900-0504	24900-0504
5	O-Ring	1	35505-1423	35505-1423
6	Tank - Upper Half Kit*	1	24851-9000	24851-9001
7	Collector - Manifold Assembly	1	24900-0100S	24901-0100S
8	Air Bleed Filter	1	WC8-126	WC8-126
9	Vent Tube	1	WC37-386P	WC37-386P
10	Elbow - Male Parflex	1	WC78-84P	WC78-84P
11	Lateral	16	24900-0002	24900-0003
12	O-Ring	2	35505-1424	35505-1424
13	Plug (Sand Removal)	1	24900-0503	24900-0503
14	Drain Fitting	1	24900-0505	24900-0505
15	1-1/2" NPT Plug	1	27001-0022S	27001-0022S
16	O-Ring	2	35505-1425	35505-1425
17	Tank Fitting	1	24900-0500	24900-0500
18	Tank Fitting	1	24900-0501	24900-0501
19	Clamp Assembly	**	24850-0200	24850-0200
19A	Clamp Bolt	**	24850-0010	24850-0010
20	Tank - Lower Half	1	24850-0102S	24851-0103S
21	Cord Ring	1	24850-0008	24850-0009
22	Valve and Gauge Assembly			
		(Includes Key Nos. 1-5)		24850-0105
24850-0105				
†•	Lateral Extension Adapter	as req'd	24700-0029	24700-0029
•	Decal - Model Label	1	32155-4045	32155-4047
•	Decal - Warning	1	32165-4004	32165-4005
•	Decal - Operating Instruction	1	32155-4046	32155-4048

† Available for lateral repairs.
• Not illustrated
* Includes all decals and labels.
** Model S7S50 uses seven clamps and bolts; Model S8S70 uses eight.

TROUBLESHOOTING GUIDE

⚠ WARNING

Hazardous pressure. Can cause severe injury or major property damage from tank blow up.

Release all pressure and read instructions before working on filter.

1. Short Cycle between backwashes:

NOTICE: Time between backwashes will vary with each installation and between different areas of the country. Ask installer about normal backwash interval in your area. The following causes and remedies are for cycle times shorter than normal for your area.

A. Flow rate too high or filter too small; consult dealer for system sizing recommendations.

B. Water is chemically out of balance; consult pool serviceman.

2. Low Flow/High Pressure:

A. Pipe blocked downstream from filter; remove obstruction.

B. Piping too small; use larger pipe (consult dealer for sizing).

C. Filter area too small or pump too large; consult dealer for recommendation.

3. Low Flow/Low Pressure:

A. Pump too small; consult dealer for recommendations.

B. Plugged pump, plugged line, or plugged hair and lint trap; clean thoroughly.

4. Pool Water Not Clear:

A. Water is chemically out of balance; consult pool professional.

B. Inadequate turnover rate; consult dealer about equipment sizing.

C. Sand in pool means broken lateral.

⚠ WARNING To avoid severe injury or major property damage, follow instructions under 'Disassembly' and 'Assembly' (pages 6 and 7)!

1. Follow filter disassembly procedure, Page 6.
2. Replace lateral according to instructions supplied with new lateral (See Page 9).
3. Reassemble filter according to instructions, Pages 6 and 7.

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