PARSONS

Technical Memorandum

To: Gabe Moreno, CSSA

From: Parsons Staff

CC: Chris Beal, Julie Burdey, Scott Pearson, file (747145.03000)

Date: October 26, 2010

Re: Construction Summary for SWMU B-3 Extraction Well 02 (B3-EXW02) and Shallow Monitoring Wells (B3-MW26 through B3-MW34)

This Technical Memorandum summarizes construction information for nine shallow monitoring wells (B3-MW26 through B3-MW34) and one groundwater extraction well (B3-EXW02) for incorporation into the Solid Waste Management Unit (SWMU) B-3 Bioreactor system in Camp Stanley Storage Activity (CSSA), Boerne, Texas.

INTRODUCTION

Parsons received a proposal to construct a groundwater extraction well and eight shallow monitoring wells under U.S. Army Corps of Engineers - Fort Worth District, Contract W9126G-07-D-0028, delivery order 0050 (DO50), Task 3, as part of the CSSA SWMU B-3 Bioreactor Treatability Study. A ninth monitoring well was constructed under separate agreement by CSSA during a technology demonstration, and is also described herein. Services were performed in accordance with Texas Commission on Environmental Quality (TCEQ) Rules and Regulations, and the Texas Department of Licensing and Regulation (TDLR) standards.

PROJECT BACKGROUND AND OBJECTIVES

Between December 2009 and August 2010, Parsons constructed 9 groundwater monitoring wells and one groundwater extraction well around the immediate vicinity of SWMU B-3 at CSSA (Figure 1) under scoped DO50 project tasks. The wells were drilled by a licensed well service contractor, GeoProjects International (GPI) of Austin, Texas. Well construction and surface completions meet or exceed local and state regulatory requirements.

Nine shallow groundwater monitoring wells are located at various intervals around the outside perimeter of the SWMU B-3 site, and monitor groundwater present in the Upper Glen Rose (UGR) limestone. The purpose of the new wells is to provide data for a refined understanding of local groundwater occurrence and movement, additional characterization of subsurface contamination related

to past and present activities at SWMU B-3, and for other general monitoring of the ongoing bioreactor pilot study.

The groundwater extraction well is located adjacent to SWMU O-1 for purposes of monitoring select groundwater parameters and water levels, and to provide groundwater to the SWMU B-3 Bioreactor treatability study system. The well produces groundwater from the Lower Glen Rose formation (LGR) of the Middle Trinity Aquifer. Under normal conditions, this well can supplement and enhance current water demands of the treatment system presently provided by wells MW16-LGR, MW16-CC, and B3-EXW01.

Before commencement of well drilling, GPI and Parsons assisted Noblis, Inc. personnel in the collection of 4 shallow bedrock samples (Figure 1). The samples were collected on April 27, 2010 by air rotary coring through hollow stem augers. One sample was taken from the floor of SWMU B-3 Trench 2, two from under Trench 1, and one background sample core from an upgradient location approximately 110 feet northwest of CS-B3-WB08.

SHALLOW MONITORING WELL CONSTRUCTION

Nine new monitoring wells were installed in the bioreactor vicinity under DO50 (Figure 1). The first well (B3-MW27) was installed on December 1, 2010 by Boart-Longyear as part of a Roto-Sonic technology demonstration for CSSA. Drilling of the remaining wells (B3-MW26 and B3-MW28 through B3-MW34) was performed by GPI under direct supervision of Parsons geologists. The wells were drilled to the base of the UGR in the Upper Trinity aquifer. The drilling of these shallow UGR monitoring wells complements the existing SWMU B-3 monitoring well network.

Drilling locations were chosen based on information from previous investigations as included in well installation reports and the CSSA Hydrogeologic Conceptual Site Model (HCSM), as well as new data generated through recent SWMU B-3 Treatability Study activities. The CSSA Environmental Office approved the drilling locations after review of Parsons' recommendations. Topography and drill rig accessibility were factors also considered for location selection. GPI mobilized to the CSSA UGR drilling site on April 27, 2010.

Typical monitor well design (Figure 2) and construction followed CSSA specifications and met TCEQ requirements. GPI drilled the shallow wells to a nominal diameter of 8 inches. Non-chlorinated water used for fluid injection during drilling was obtained from CSSA water supply well CS-12. Final drilling footage was a function of each well's location, land surface elevation, and depth to UGR-LGR contact based on correlation of area geophysical logs and from direct observations of cuttings. Geophysical logs from previously drilled wells were used to estimate local UGR/LGR contact depths and total depths of each new well. Plastic sheeting was laid around each wellhead to contain extruded subsurface materials. Boreholes were cleaned by air-lifting and surging when feasible (not all wells contained sufficient water for proper surging).

Construction materials for each well included nominal 4-inch Schedule 40 PVC with flush-threaded joints. The factory-slotted PVC well screens are constructed with a slot size of 0.050-inches (50-slot). Wells deeper than 20 feet had centralizers attached to the screen and riser. Other wells have one centralizer near the base of the screen. The annular space was filled with a 4/10-mesh filter pack from the base of the borehole to 1 to 2 feet above the top of the screened interval, depending on location. Dehydrated bentonite pellets were added to create a sealed plug above the sand. These uncoated pellets were added by hand to prevent bridging in the upper portions of the well. The bentonite pellets were hydrated per manufacturer's recommendations before proceeding with grouting of the annular space above.

In the deeper wells (MW31-UGR and MW32-UGR), the annular space was pressure-grouted with a Volclay/bentonite grout mixture by the positive displacement exterior method from the bottom of the hole to 2 feet below ground surface (bgs). In the remaining shallower wells, grouting consisted only of extending the bentonite seal up to 2 feet bgs, as this proved much more economical and efficient as opposed to mixing and applying grout to annuli less than 7 feet deep, and is an acceptable method as administered by the TDLR. The remaining 2 feet were filled with cement during well pad construction to satisfy the TDLR atmospheric barrier requirement. A monitoring well construction summary is shown in Table 1.

After materials installation the MWs were then developed by bailing when sufficient water was present. After each borehole was drilled, the drilling rig was decontaminated and washed. No geophysical logging was undertaken for the new UGR wells. All fluid and solid IDW were managed according to *CSSA RCRA Facility Investigation and Interim Measures Waste Management Plan* (Volume 1-1, Encyclopedia) approved by USEPA and TCEQ.

The monitoring wells were completed with risers extending approximately 3 feet above ground surface in a 4-foot square concrete pad. A 2-inch diameter brass marker stamped with the well's official identification was set into each concrete pad as a permanent benchmark. A 4-inch square, steel, locking well protector was installed over the PVC riser at each wellhead. Each cover is secured by a CSSA-supplied, corrosion-resistant steel lock. Protective bollards were also emplaced in concrete at each well. Covers and bollards were painted with two coats of OSHA safety-yellow. Surface completions meet CSSA, TDLR, and general industry specifications.

Wells were developed by bailing and pumping where sufficient water was present (Table 1). New wells on the north side of SWMU B-3 (B3-MW26, B3-MW32, B3-MW33, B3-MW34) generated much more water than wells toward the south. In addition to the volume developed from B3-MW26, approximately 1500 gallons was generated during drilling and installation. In contrast, B-3-MW28 remained dry and could not be developed. Very limited quantities of turbid water were bailed B3-MW29, B3-MW30, and B3-MW31. These wells will be subjected to additional bailing and purging prior to sampling as conditions permit.

Table 1

DO-50 B3 UGR Monitoring Wells Construction Summary
Camp Stanley Storage Activity
April-May 2010

SWMU B-3 Wells Construction Summary									
Well ID	**Elevations**		**Total Drilled Depth**	**Top PVC above ground**	**Finished Depth TOC to Bottom**	**Screened Interval**	**Development**		
	Natural Ground	**Top of PVC riser**					Bailer	Pump	Total
	(feet MSL)	*(feet MSL)*	*(feet bgs)*	*(feet)*	*(feet)*	*(feet)*	*(gallons)*		
MW26-UGR	1,235.53	1,238.49	17.5	2.96	20.5	10 (17.5-7.5)	600	160	760
MW27-UGR	1,230.62	1,233.42	17.0	2.80	19.8	10 (17.0-7.0)	0	0	0
MW28-UGR	1,223.94	1,226.67	15.5	2.73	18.2	10 (15.5-5.5)	dry		0
MW29-UGR	1,230.38	1,233.25	17.5	2.87	20.4	10 (17.5-7.5)	0.5	0	0.5
MW30-UGR	1,242.83	1,246.01	20.8	3.18	24.0	10 (20.8-10.8)	2	0	2
MW31-UGR	1,254.52	1,257.20	36.0	2.68	38.7	20 (36.0-16.0)	2.6	0	2.6
MW32-UGR	1,264.00	1,266.98	56.0	2.98	59.0	30 (56.0-26.0)	540	230	770
MW33-UGR	1,247.17	1,249.55	26.0	2.38	28.4	20 (26.0-6.0)	365	105	470
MW34-UGR	1,241.51	1,244.51	22.0	3.00	25.0	10 (22.0-12.0)	825	105	930
B3-EXW02	1,246.42	1,249.55	358	3.13	361.1	casing 0-65 open 65-358	0	8,260	8,260

bgs = below ground surface
MSL = Mean Sea Level
TOC = top of PVC casing

Shallow UGR monitoring well sampling methods and results will be addressed in subsequent Bioreactor quarterly reports.

Well B3-MW27 was completed in December 2009 by Boart-Longyear using sonic drilling methods as part of a demonstration effort. The well contains 2-inch PVC screen and riser in a 6-inch diameter borehole, all other construction methods

and specifications equal those of the other 8 shallow wells. B3-MW27 will undergo extra bailing and purging prior to first sampling event. Surveys of all the new SWMU B-3 wells were completed by a State of Texas registered land surveyor in July 2010. State of Texas Well Reports and land surveying data are included in Attachment 1.

EXTRACTION WELL CONSTRUCTION

This second SWMU B-3 groundwater extraction well (B3-EXW02) was constructed approximately 625 feet south of SWMU B-3, on the east edge of SWMU O-1 (O-1 soil unit approved for closure in 2002). The drilling subcontractor (GPI) mobilized to the new extraction well site on May 18, 2010. A containment area consisting of 2 feet by 10 feet wood planks and heavy gauge plastic sheeting was first constructed to surround the wellhead and the drilling table to capture drilling fluids and solid cuttings. Non-chlorinated water used for fluid injection during drilling was obtained from CSSA water supply well CS-12.

B3-EXW02 was first drilled at 6¼-inch diameter to 358.3 feet bgs, penetrating approximately 27 feet of basal UGR Limestone and advancing to 13 feet below the LGR - Bexar Shale (BS) formational contact. Total depth of the pilot hole was achieved on May 28, 2010. A “TOTCO” single shot declination tool was used during drilling after every 50 feet of borehole advancement to check borehole plumbness. Borehole declination may not deviate more than 2 degrees from true vertical as per specifications. All TOTCO shots during this field effort were within specifications (Attachment 2). The borehole was cleaned by surging and air-lifting. At this time, the driller could not estimate well yield due to significant loss of returns, presumably through voids in the upper subsurface.

Drilling was paused overnight at 38 feet bgs and a groundwater sample was retrieved by bailer in order to get a general characterization of shallow inflow. Before reaming, a second bailer sample was collected from 30 feet below static level, at approximately 110 feet bgs to provide general characterization of the well water based on Bioreactor requirements. Significance of the initial B3-EXW02 water sample results will be addressed in subsequent Bioreactor quarterly reports. Laboratory analysis volatile organic compound (VOC) detections are summarized below in Table 2, and the complete results are included in Attachment 3. The samples were analyzed for full list VOCs and 10 metals (As, Ba, Cd, Cr, Cu, Hg, Mn, Ni, Pb, and Zn). No metals concentration exceeded Primary Drinking Water Standards. Arsenic and lead were not detected in the first sample, and J-flagged (concentration >MDL but <PQL) in the second, while cadmium and mercury were not detected in either sample.

Geophysical and camera logging surveys were conducted (Attachment 2) upon completion of the 6-inch pilot hole. No extraordinary geologic features (e.g., large fractures or faults) were observed. Loss of returns was presumed to be due to openings seen at 38 feet bgs. Groundwater was first seen entering the

Table 2
Results of B3-EXW02 Groundwater Sampling during Drilling (ppb)

Volatile Organic Compound	B3-EXW02 (38' bgs) May 19, 2010	B3-EXW02 (110' bgs) June 2, 2010
PCE	15	12
TCE	3.8	5.8
cis-1,2-DCE	12	10

borehole at 21.8 feet bgs. This infiltration appeared to be about 2 to 4 gallons per minute (gpm). Selection of casing depth was determined based on the geologic logs.

After logging, the borehole was reamed at 12¼ inches diameter to a depth of 65.1 feet bgs. Drilling fluids were discharged into adjacent rolloff containment. Then after settling to remove suspended solids, fluids were transported for management at SWMU B-3 Trench 1 after being pumped through a bag filter unit to further reduce turbidity.

In order to maximize yield and promote closed-loop circulation between the bioreactor and the aquifer, 8-inch diameter Certa-lok™ schedule 40 PVC surface casing was installed to 65 feet. Two shale traps were affixed to the terminus of the surface casing and covered by a 5-foot seal of bentonite to assist the grouting of the casing. The surface casing closed off potentially unstable wall sections and several perched water-bearing zones. Beginning with 120-gallon lifts, a Volclay grout mixture was slowly pumped into the annular space using a side-discharge tremie pipe. The grout was allowed to cure more than 48 hours before further borehole reaming occurred. The hole was then reamed to nominal 8-inch diameter to total depth. The well completion is diagrammed in Figure 3.

All investigation-derived media, including soil cuttings, drilling fluids, and purged groundwater was managed within the confines of SWMU B-3. All fluid and solid IDW was disposed according to *CSSA RCRA Facility Investigation and Interim Measures Waste Management Plan* (Volume 1-1, Encyclopedia) approved by USEPA and TCEQ.

On June 17, 2010, GPI set a new 4-inch diameter, 5-hp submersible pump (Grundfos model 40S50-15) on 2-inch galvanized steel column pipe at 333 feet bgs in the newly constructed well. The pump operates using a 5 hp, 200 volt, 3-phase Franklin Electric electrical motor. Manufacturer information and specifications are included in Attachment 4. The pump size was determined by analyzing water level data and aquifer characteristics derived from pumping tests conducted in previous years at SWMU B-3 wells. The potential dynamic head calculated for the system was also based on this information. The system has been designed to provide between 5 and 40 gpm to the bioreactor water supply

tank. Two check valves are included in the well piping, one above the pump, and one between the eighth and ninth pipe joint at approximately 162 feet bgs. The wellhead is equipped with a brass sample spigot, pressure gauge and vacuum breaker, a 2-inch by-pass connection, and flow control/isolation valves installed by GPI. No additional water quality samples were collected at this time, and the well was not chlorinated.

On June 17, 2010 a short pumping test was conducted after pump installation. The well maintained a generally steady rate and pumping water level of 31 gpm and 232.8 feet bgs, respectively, for 2.5 hours, after an initial drawdown of 121.2 feet. The pumping rate was then increased and maintained at 35 gpm for the final 43 minutes of the test, resulting in an additional 22.7 feet of drawdown. During the last 10 minutes of this step, the pumping water level trend began to flatten at an average depth of 256.1 feet bgs.

USA Environment, L.P. (USA) of New Braunfels, Texas continued the plumbing installation where GPI's scope ended, installing 1.5-inch galvanized piping from the wellhead, a flanged flowmeter, and a connection to 2-inch HDPE pipe. The HDPE piping was laid by USA from the wellhead system to a connection in existing supply pipe at B3-EXW01, located in the southeast quadrant of the bioreactor between Trenches 5 and 6. The B3-EXW02 HDPE piping runs mostly above-grade except where buried under two unpaved tracks. At the Bioreactor tank (Figure 1) the HDPE conveyance is converted to 2-inch rigid PVC and connects to a galvanized manifold. The manifold directs groundwater from the MW16-LGR/CC wells and the two extraction wells into the Bioreactor tank.

The extraction well surface completion consists of a 12'x10'x6" square concrete pad. The pad, control panel stanchion, and electrical connections were constructed in August 2010 by Joe Sanchez Contracting, Inc. (JSCI) of San Antonio, Texas, as a tiered subcontractor to USA. Subgrade conduit was constructed beneath the pad to accommodate well pump motor leads and control wiring (Figure 4). The State of Texas Well Report and land surveying data are included in Attachment 1.

Electrical Installation

The supply well electrical controls and metering is protected by a steel stanchion structure built by JSCI. The structure holds the electrical controls and SCADA equipment. It is bolted at each end to the concrete pad. The CSSA electrical distribution system was extended to the well location. JSCI extended the existing CSSA electrical system from an existing pole-mounted transformer on the east side of SWMU O-1 underground around the north side of the SWMU O-1 cap, providing 120/208V, 3-phase power to the extraction well. The existing utility pole structure was already equipped with an electrical distribution panel. The service entrance conductors are routed 2 feet underground from the utility pole to the well pad stanchion in 2-inch diameter Schedule 80 PVC conduit. Electrical system tasks were completed in conformance with NFPA 70. Figure 1 shows the location of the existing electrical utility pole and the buried extension to the new

extraction well and controls structure.

The stanchion panel was equipped with a 100-amp, 4-wire service panel. The service panel includes a main breaker for disabling all the wellhead circuits. The subcontractor wired the service panel to 208V, three phase power, and included a triple-pole breaker for operating a 60-amp/200-volt motor and single-pole breakers for the 20-amp/120-volt Remote Telemetry Unit (RTU) panel (installed by System Controls and Instrumentation, Inc. [SCI]), and a 15-amp/120-volt GFI utility outlet.

Equipment Installation

To assist in the operation of the well, a SymCom Model 777 KW/HP PumpSaver® (Attachment 4) was installed by GPI in the motor control panel during pump installation. The PumpSaver module protects the submersible pump from adverse electrical conditions such as under/over voltage and/or current, as well as protection against running the pump dry. In its current configuration, well B3-EXW02 can be pumped manually or automatically to the Bioreactor storage tank for distribution to the trenches.

The well was fully incorporated into the SWMU B-3 automation system by SCI in October 2010. The well is equipped with an Endress+Hauser (E+H) FMX167 WaterPilot transducer to report the water level in the well to the SCADA system. A spare (E+H) Prowirl 72F flowmeter is also in place (installed by USA) on the discharge piping to measure and digitally record the flowrate and total discharge from the well (Figure 4). Both instruments have 4-20 milliamp (mA) output to provide the SCADA system operation with accurate water level and discharge measurements. These instruments (Attachment 4) are connected to the RTU that transmits this information and receives operational pumping commands via wireless 900 MHz radio from the GAC Shack RTU, where the Bioreactor automation is centralized. The operators also manually monitor the amount of groundwater produced from the well as part of their routine Bioreactor Operation and Maintenance (O&M).

The actuation of the well is based upon the demand of the 5000-gallon storage tank at the north end of the Bioreactor. As the tank empties water into the Bioreactor trenches, it wirelessly calls upon all the extraction wells to convey water until the tank if filled. More information regarding the operation of the extraction wells can be found in the ***"B-3 Bioreactor Operations & Maintenance Manual"*** in ***Treatment Technologies and Treatability Studies (Volume 4)*** of the CSSA Environmental Encyclopedia.

FIGURES

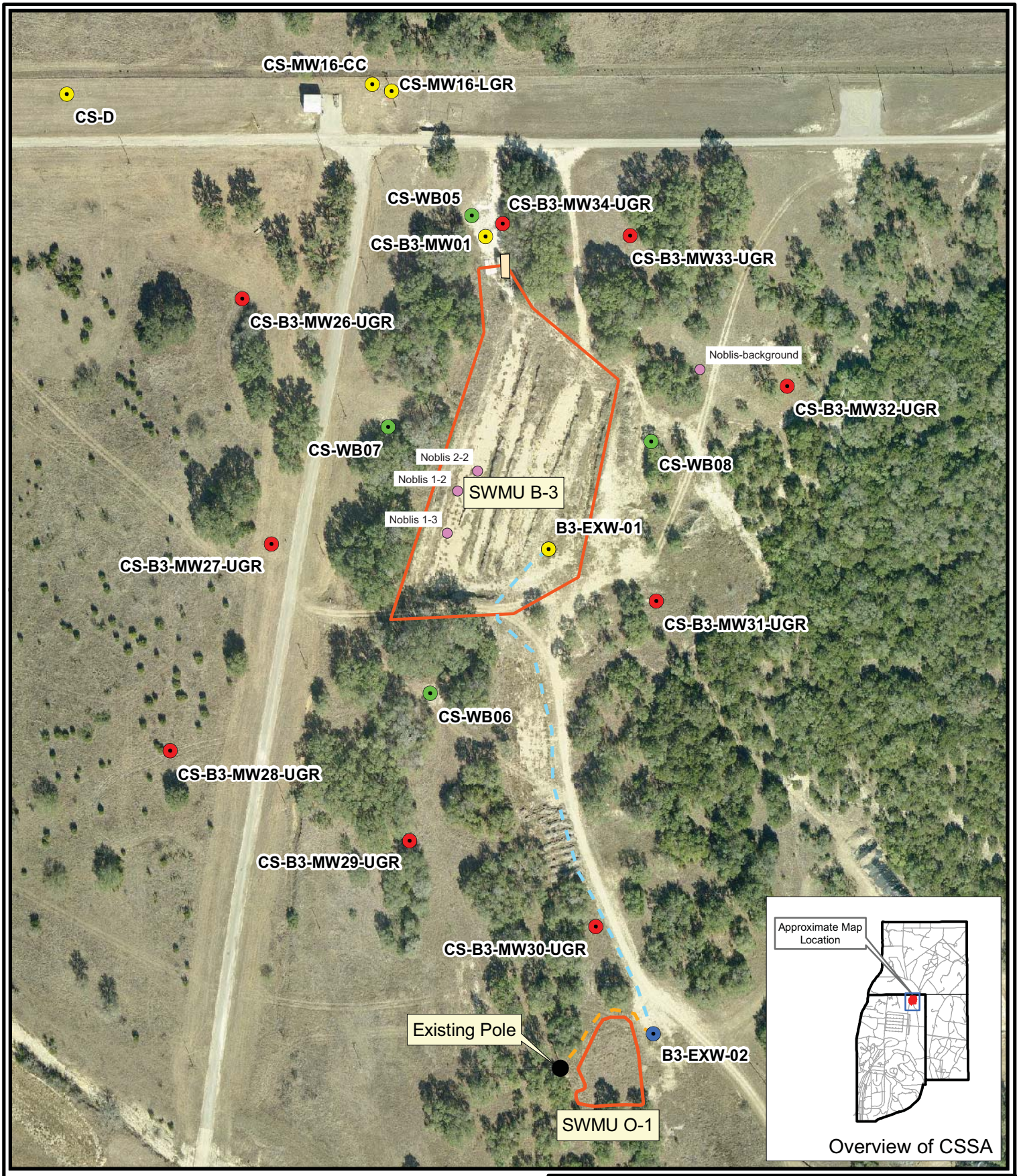

Figure 1

New Wells, Groundwater Delivery, and Electrical Service for SWMU B-3 Camp Stanley Storage Activity April - July 2010

PARSONS

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Figure 2

SWMU B-3 Typical Monitoring Well Completion
Camp Stanley Storage Activity

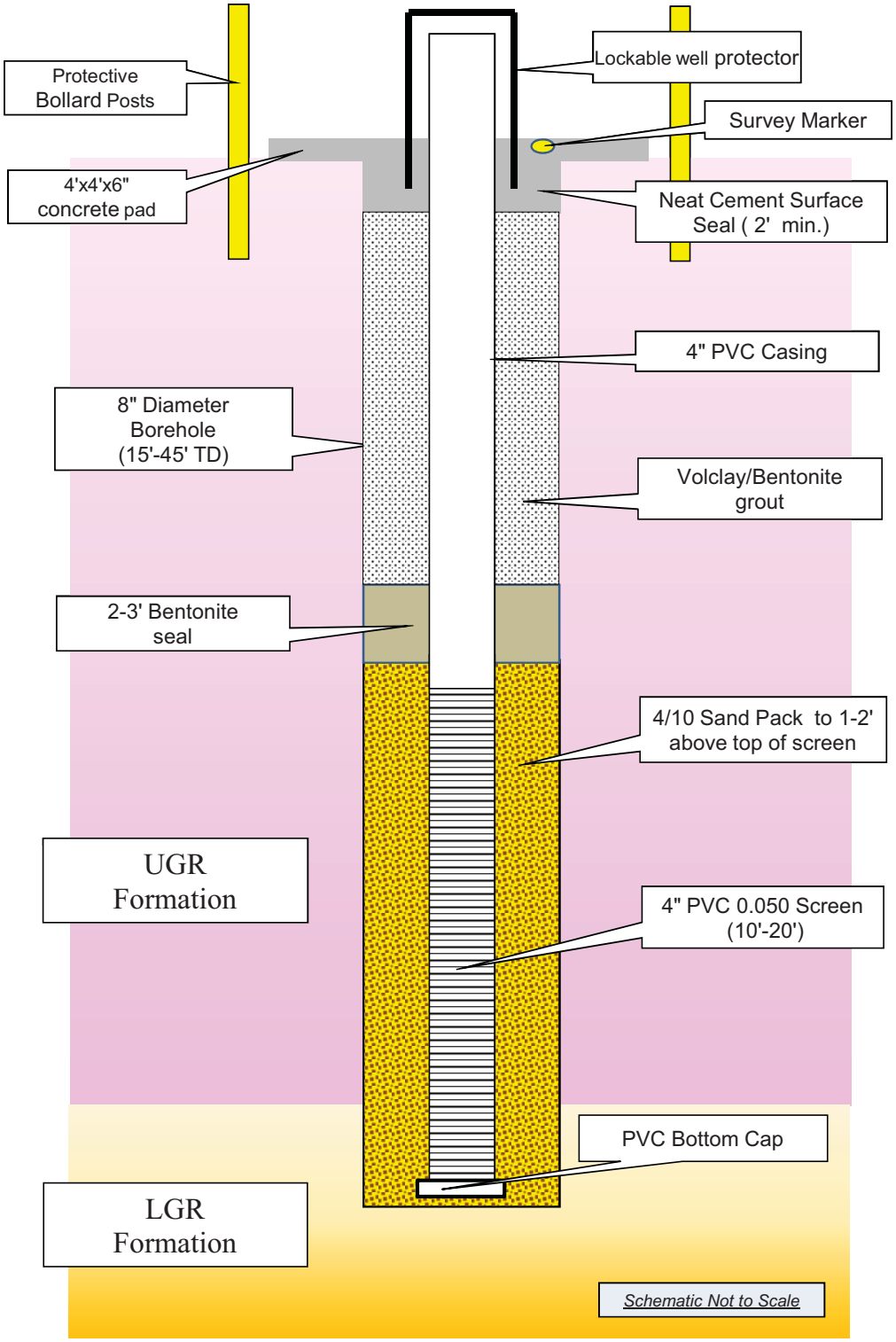
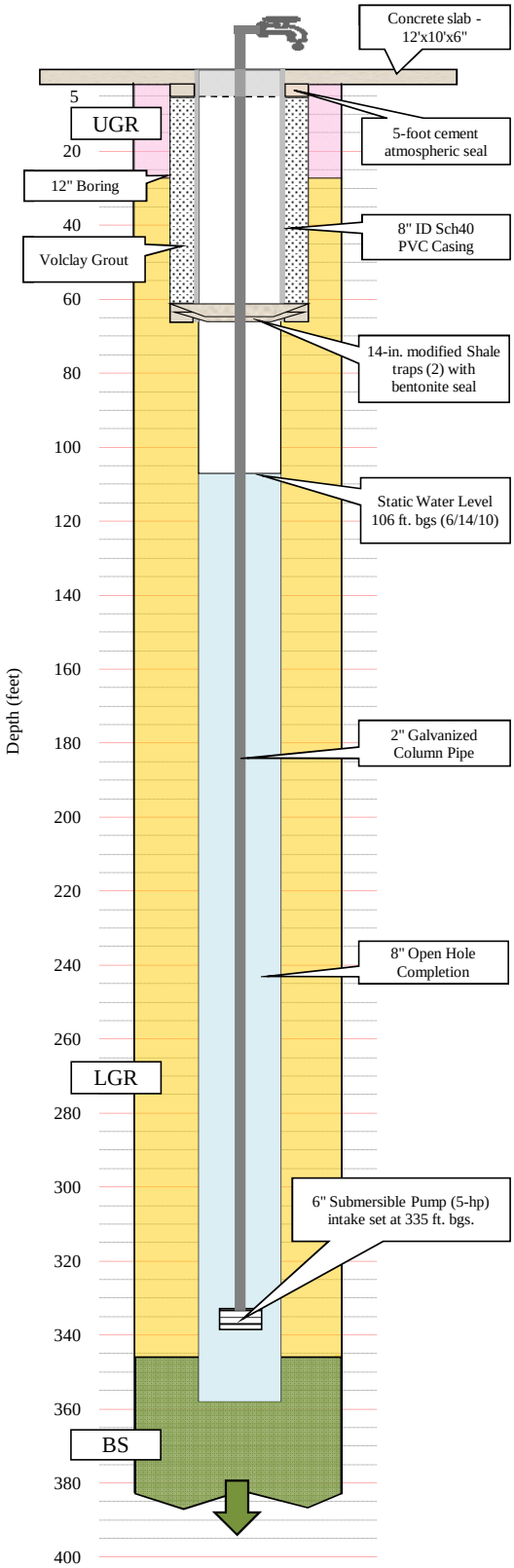
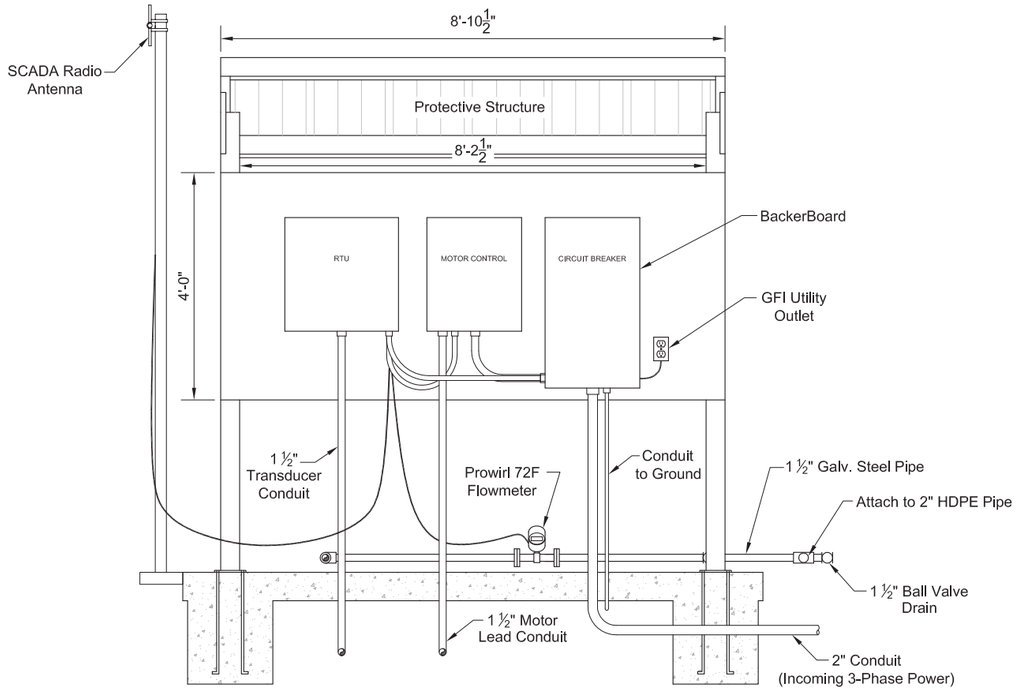


Figure 3

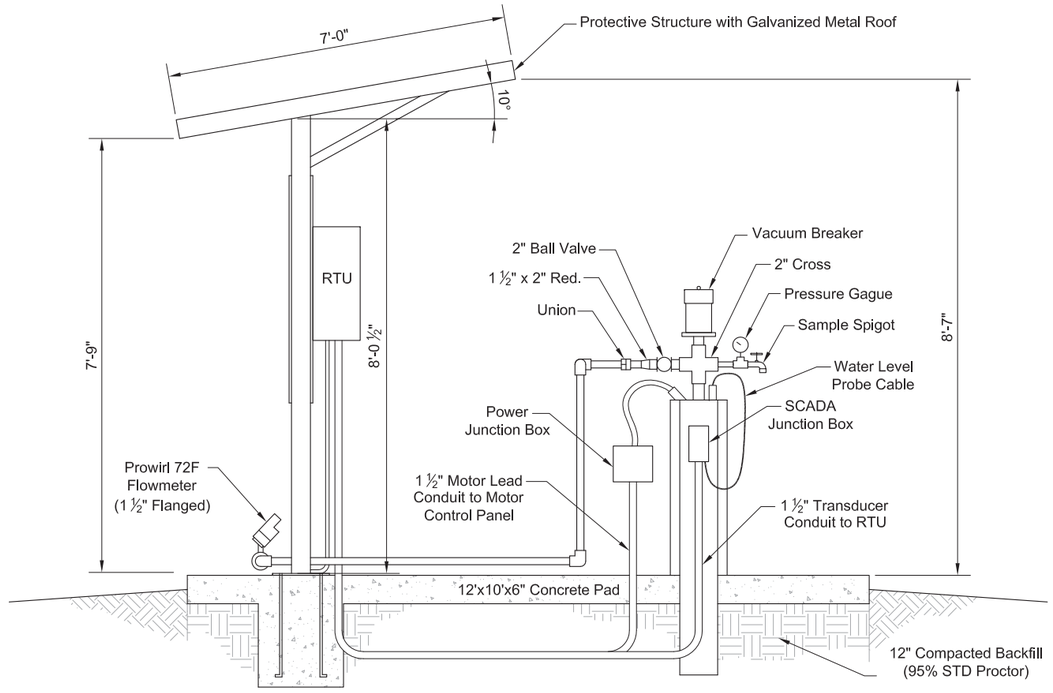
SWMU B-3 Groundwater Extraction Well B3-EXW02
General Construction Design
Camp Stanley Storage Activity - Boerne, TX





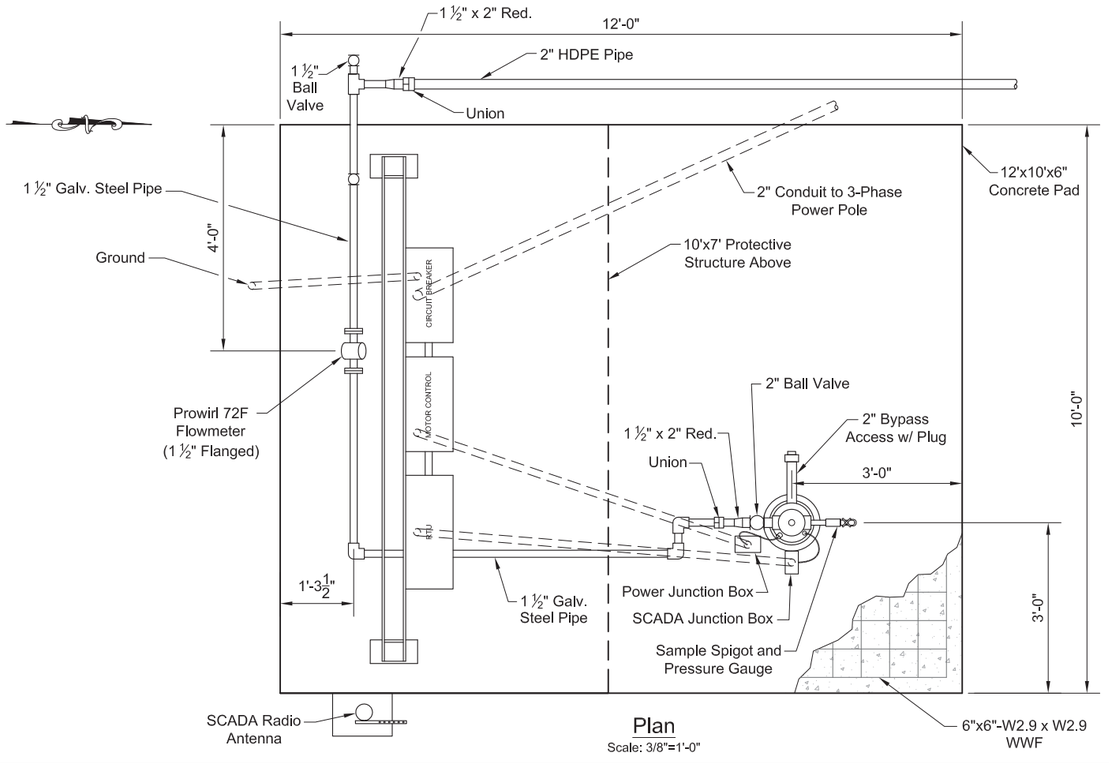
Panel Elevation

Scale: 3/8"=1'-0"



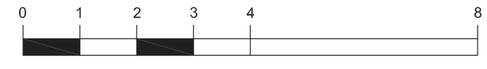
West Elevation

Scale: 3/8"=1'-0"



Plan

Scale: 3/8"=1'-0"



Feet

Scale: 3/8"=1'-0" at 11"x17"

Figure 4

B-3 Extraction Well EXW-02
AS-BUILT Surface Completion Design

Camp Stanley Storage Activity

747145 EXW02 WELLHEAD PLAN2 ASBUILT.DWG 10/21/10

ATTACHMENT 1

State of Texas Well Reports
Survey Data

STATE WELL REPORTS

CS-MW26-UGR

CS-MW27-UGR

CS-MW28-UGR

CS-MW29-UGR

CS-MW30-UGR

CS-MW31-UGR

CS-MW32-UGR

CS-MW33-UGR

CS-MW34-UGR

CS-B3-EXW02

STATE OF TEXAS WELL REPORT for Tracking #233151

Owner:	**U.S. Government**	Owner Well #:	**B3-MW26-UGR**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 Ralph Fair Road Boerne , TX 78015**	Latitude:	**29° 42' 37" N**
Well County:	**Bexar**	Longitude:	**098° 36' 55" W**
Elevation:	**1235 ft.**	GPS Brand Used:	**Professional**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **5/4/2010** Completed: **5/4/2010**
Diameter of Hole:	Diameter: **8 in From Surface To 17.4 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	**Straight Wall** Gravel Packed From: **7 ft to 17.4 ft** Gravel Pack Size: **6/9**
Annular Seal Data:	1st Interval: **From 0 ft to 2 ft with 1-Cement (#sacks and material)** 2nd Interval: **From 2 ft to 6 ft with 3-Bentonite (#sacks and material)** 3rd Interval: **No Data** Method Used: **Poured from Surface** Cemented By: **Jose Landeros and Evan Schaefer** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Slab Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Geoprojects International, Inc.** **8834 Circle Drive**

	Austin , TX 78736
Driller License Number:	**2551**
Licensed Well Driller Signature:	**Jose Landeros**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #**233151**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 17.4 Upper Glen Rose Formation Limestone

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4 New SCH 40 PVC Casing set from +2.5 to 7
4 New SCH 40 PVC Screen set from 7 to 17.4 with 0.050-inch mill slot

STATE OF TEXAS WELL REPORT for Tracking #210185

Owner:	**U.S. Government**	Owner Well #:	**MW-27**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-1**
Well Location:	**Camp Stanley Storage Activity Boerne , TX 78015**	Latitude:	**29° 42' 33" N**
Well County:	**Bexar**	Longitude:	**098° 36' 54" W**
Elevation:	**No Data**	GPS Brand Used:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **12/1/2009**
Completed: **12/1/2009**

Diameter of Hole: Diameter: **6 in From Surface To 47 ft**

Drilling Method: Other: **Sonic**

Borehole Completion: Gravel Packed From: **17 ft to 5 ft**
Gravel Pack Size: **10-20**

Annular Seal Data: 1st Interval: **From 47 ft to 17 ft with Bentonite (#sacks and material)**
2nd Interval: **From 17 ft to 5 ft with 10-20 Sand (#sacks and material)**
3rd Interval: **From 5 ft to 3 ft with Bentonite (#sacks and material)**
Method Used: **poured from surface**
Cemented By: **Self**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No Data**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Boart Longyear**
7773 West Seldon Lane

	Peoria , AZ 85345
Driller License Number:	**58094**
Licensed Well Driller Signature:	**Fred Hafner**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #**210185**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0'-4' Brown silty clay
4'-6' Reddish silty clay
6'-8' yellow/brown caliche
8'-9' gypsum
9'-16' yellow/white limestone
16'-47 blue/gray clayey shale

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New Plastic 17'-7 .010 Screen
2" New Plastic 7'-surface Riser

STATE OF TEXAS WELL REPORT for Tracking #233157

Owner:	**U.S. Government**	Owner Well #:	**B3-MW28-UGR**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 Ralph Fair Road Boerne , TX 78015**	Latitude:	**29° 42' 31" N**
Well County:	**Bexar**	Longitude:	**098° 36' 56" W**
Elevation:	**1223 ft.**	GPS Brand Used:	**Professional**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **5/4/2010** Completed: **5/4/2010**
Diameter of Hole:	Diameter: **8 in From Surface To 15.5 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	**Straight Wall** Gravel Packed From: **4 ft to 15.5 ft** Gravel Pack Size: **6/9**
Annular Seal Data:	1st Interval: **From 0 ft to 2 ft with 1-Cement (#sacks and material)** 2nd Interval: **From 2 ft to 4 ft with 2-Bentonite (#sacks and material)** 3rd Interval: **No Data** Method Used: **Poured from Surface** Cemented By: **Jose Landeros and Evan Schaefer** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Slab Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Geoprojects International, Inc.** **8834 Circle Drive**

	Austin , TX 78736
Driller License Number:	**2551**
Licensed Well Driller Signature:	**Jose Landeros**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 15.5 Upper Glen Rose Formation Limestone

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4 New SCH 40 PVC Casing set from +2.5 to 5
4 New SCH 40 PVC Screen set from 5 to 15.5 with 0.050-inch mill slot

STATE OF TEXAS WELL REPORT for Tracking #233159

Owner:	**U.S. Government**	Owner Well #:	**B3-MW29-UGR**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 Ralph Fair Road Boerne , TX 78015**	Latitude:	**29° 42' 31" N**
Well County:	**Bexar**	Longitude:	**098° 36' 56" W**
Elevation:	**1230 ft.**	GPS Brand Used:	**Professional**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **5/3/2010** Completed: **5/3/2010**
Diameter of Hole:	Diameter: **8 in From Surface To 17.5 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	**Straight Wall** Gravel Packed From: **6 ft to 17.5 ft** Gravel Pack Size: **6/9**
Annular Seal Data:	1st Interval: **From 0 ft to 2 ft with 1-Cement (#sacks and material)** 2nd Interval: **From 2 ft to 6 ft with 3-Bentonite (#sacks and material)** 3rd Interval: **No Data** Method Used: **Poured from Surface** Cemented By: **Jose Landeros and Evan Schaefer** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Slab Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Geoprojects International, Inc.** **8834 Circle Drive**

	Austin , TX 78736
Driller License Number:	**2551**
Licensed Well Driller Signature:	**Jose Landeros**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 17.5 Upper Glen Rose Formation Limestone

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4 New SCH 40 PVC Casing set from +2.5 to 7
4 New SCH 40 PVC Screen set from 7 to 17.5 with 0.050-inch mill slot

STATE OF TEXAS WELL REPORT for Tracking #233160

Owner:	**U.S. Government**	Owner Well #:	**B3-MW30-UGR**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-4**
Well Location:	**25800 Ralph Fair Road Boerne , TX 78015**	Latitude:	**29° 42' 28" N**
Well County:	**Bexar**	Longitude:	**098° 36' 49" W**
Elevation:	**1243 ft.**	GPS Brand Used:	**Professional**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **4/30/2010**
Completed: **4/30/2010**

Diameter of Hole: Diameter: **8 in From Surface To 20.3 ft**

Drilling Method: **Air Rotary**

Borehole Completion: **Straight Wall** Gravel Packed From: **9.2 ft to 20.3 ft**
Gravel Pack Size: **6/9**

Annular Seal Data: 1st Interval: **From 0 ft to 2 ft with 1-Cement (#sacks and material)**
2nd Interval: **From 2 ft to 9.2 ft with 3-Bentonite (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Poured from Surface**
Cemented By: **Jose Landeros and Evan Schaefer**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Geoprojects International, Inc.**
8834 Circle Drive

	Austin , TX 78736
Driller License Number:	**2551**
Licensed Well Driller Signature:	**Jose Landeros**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 20.3 Upper Glen Rose Formation Limestone

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4 New SCH 40 PVC Casing set from +2.5 to 10.3
4 New SCH 40 PVC Screen set from 10.3 to 20.3 with 0.050-inch mill slot

STATE OF TEXAS WELL REPORT for Tracking #233162

Owner:	**U.S. Government**	Owner Well #:	**B3-MW31-UGR**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 Ralph Fair Road Boerne , TX 78015**	Latitude:	**29° 42' 33" N**
Well County:	**Bexar**	Longitude:	**098° 36' 49" W**
Elevation:	**1255 ft.**	GPS Brand Used:	**Professional**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **4/30/2010**
Completed: **4/30/2010**

Diameter of Hole: Diameter: **8 in From Surface To 36 ft**

Drilling Method: **Air Rotary**

Borehole Completion: **Straight Wall** Gravel Packed From: **14.5 ft to 36 ft**
Gravel Pack Size: **6/9**

Annular Seal Data: 1st Interval: **From 0 ft to 2 ft with 1-Cement (#sacks and material)**
2nd Interval: **From 2 ft to 14.5 ft with 3-Bentonite (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Poured from Surface**
Cemented By: **Jose Landeros and Evan Schaefer**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Geoprojects International, Inc.**
8834 Circle Drive

	Austin , TX 78736
Driller License Number:	**2551**
Licensed Well Driller Signature:	**Jose Landeros**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 36 Upper Glen Rose Formation Limestone

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4 New SCH 40 PVC Casing set from +2.5 to 16
4 New SCH 40 PVC Screen set from 16 to 36 with 0.050-inch mill slot

STATE OF TEXAS WELL REPORT for Tracking #233164

Owner:	**U.S. Government**	Owner Well #:	**B3-MW32-UGR**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 Ralph Fair Road Boerne , TX 78015**	Latitude:	**29° 42' 36" N**
Well County:	**Bexar**	Longitude:	**098° 36' 46" W**
Elevation:	**1264 ft.**	GPS Brand Used:	**Professional**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **4/28/2010**
Completed: **4/29/2010**

Diameter of Hole: Diameter: **8 in From Surface To 56 ft**

Drilling Method: **Air Rotary**

Borehole Completion: **Straight Wall** Gravel Packed From: **24.2 ft to 55.7 ft**
Gravel Pack Size: **6/9**

Annular Seal Data: 1st Interval: **From 0 ft to 2 ft with 1-Cement (#sacks and material)**
2nd Interval: **From 2 ft to 22.2 ft with 3-Bentonite (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Poured from Surface**
Cemented By: **Jose Landeros and Evan Schaefer**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Geoprojects International, Inc.**
8834 Circle Drive

	Austin , TX 78736
Driller License Number:	**2551**
Licensed Well Driller Signature:	**Jose Landeros**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Please include the report's Tracking number (Tracking #**233164**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 56 Upper Glen Rose Formation Limestone

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4 New SCH 40 PVC Casing set from +2.5 to 25.7
4 New SCH 40 PVC Screen set from 25.7 to 55.7 with 0.050-inch mill slot

STATE OF TEXAS WELL REPORT for Tracking #233165

Owner:	**U.S. Government**	Owner Well #:	**B3-MW33-UGR**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 Ralph Fair Road Boerne , TX 78015**	Latitude:	**29° 42' 38" N**
Well County:	**Bexar**	Longitude:	**098° 36' 48" W**
Elevation:	**1247 ft.**	GPS Brand Used:	**Professional**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **5/5/2010** Completed: **5/5/2010**
Diameter of Hole:	Diameter: **8 in From Surface To 26.5 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	**Straight Wall** Gravel Packed From: **5 ft to 26.5 ft** Gravel Pack Size: **6/9**
Annular Seal Data:	1st Interval: **From 0 ft to 2 ft with 1-Cement (#sacks and material)** 2nd Interval: **From 2 ft to 5 ft with 2-Bentonite (#sacks and material)** 3rd Interval: **No Data** Method Used: **Poured from Surface** Cemented By: **Jose Landeros and Evan Schaefer** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Slab Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Geoprojects International, Inc.** **8834 Circle Drive**

	Austin , TX 78736
Driller License Number:	**2551**
Licensed Well Driller Signature:	**Jose Landeros**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 26.5 Upper Glen Rose Formation Limestone

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4 New SCH 40 PVC Casing set from +2.5 to 16
4 New SCH 40 PVC Screen set from 16 to 26.4 with 0.050-inch mill slot

STATE OF TEXAS WELL REPORT for Tracking #233166

Owner:	**U.S. Government**	Owner Well #:	**B3-MW34-UGR**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 Ralph Fair Road Boerne , TX 78015**	Latitude:	**29° 42' 38" N**
Well County:	**Bexar**	Longitude:	**098° 36' 50" W**
Elevation:	**1242 ft.**	GPS Brand Used:	**Professional**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **5/4/2010**
Completed: **5/4/2010**

Diameter of Hole: Diameter: **8 in From Surface To 22.4 ft**

Drilling Method: **Air Rotary**

Borehole Completion: **Straight Wall** Gravel Packed From: **11 ft to 22.4 ft**
Gravel Pack Size: **6/9**

Annular Seal Data: 1st Interval: **From 0 ft to 2 ft with 1-Cement (#sacks and material)**
2nd Interval: **From 2 ft to 11 ft with 3-Bentonite (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Poured from Surface**
Cemented By: **Jose Landeros and Evan Schaefer**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Geoprojects International, Inc.**
8834 Circle Drive

	Austin , TX 78736
Driller License Number:	**2551**
Licensed Well Driller Signature:	**Jose Landeros**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 22.4 Upper Glen Rose Formation Limestone

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4 New SCH 40 PVC Casing set from +2.5 to 12
4 New SCH 40 PVC Screen set from 12 to 22.4 with 0.050-inch mill slot

STATE WELL REPORT

CS-B3-EXW02

STATE OF TEXAS WELL REPORT for Tracking #229441

Owner:	**U.S. Government**	Owner Well #:	**B3-EXW02**
Address:	**25800 Ralph Fair Road Boerne , TX 78015**	Grid #:	**68-20-4**
Well Location:	**25800 Ralph Fair Road Boerne , TX 78015**	Latitude:	**29° 42' 27" N**
Well County:	**Bexar**	Longitude:	**098° 36' 48" W**
Elevation:	**1246 ft.**	GPS Brand Used:	**Garmin**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **5/19/2010**
Completed: **6/9/2010**

Diameter of Hole: Diameter: **12.25 in From Surface To 65.1 ft**
Diameter: **7 7/8 in From 65.1 ft To 358.3 ft**

Drilling Method: **Air Rotary**

Borehole Completion: **Open Hole**

Annular Seal Data: 1st Interval: **From 0 ft to 2 ft with 1 Cement (#sacks and material)**
2nd Interval: **From 2 ft to 65.1 ft with 13-Bentonite (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Tremie Quick Grout Bentonite**
Cemented By: **Jose Landeros and Evan Schaefer**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **Submersible**
Depth to pump bowl: **336 ft**

Well Tests: **Estimated**
Yield: **40 GPM with (No Data) ft drawdown after (No Data) hours**

Water Quality: Type of Water: **Fresh**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information:	**Geoprojects International, Inc.** **8834 Circle Drive** **Austin , TX 78736**
Driller License Number:	**2551**
Licensed Well Driller Signature:	**Jose Landeros**
Registered Driller Apprentice Signature:	**Evan Schaefer**
Apprentice Registration Number:	**57623**
Comments:	**During Drilling, lost circulation at 38.5 feet due to void that ended at 42.5 feet**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #**229441**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 27 Upper Glen Rose Limestone Formation
27 to 345 Lower Glen Rose Limestone Formation
345 to 358.3 Bexar Shale Formation

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
8-inch New SDR-17 Certalok PVC Casing set from +2.5 to 65.1

SWMU B-3 DO-50 Survey Data
Camp Stanley Storage Activity
August 2010

Description	Point No.	Northing	Easting	Elevation *(feet)*
B3-EXW-02_NG	302	3286432.80	537399.90	1246.42
B3-EXW-02_CONC	303	3286432.86	537399.95	1246.31
B3-EXW-02_ELINE	300	3286431.68	537399.46	1249.66
B3-EXW-02_SCADA	301	3286431.67	537399.30	1249.61
B3-EXW-02_CASING	299	3286431.65	537399.53	1249.55
B3-EXW-02_CONC/DISC AREA	298	3286431.97	537399.29	1246.42
B3-MW26-UGR_NG	320	3286751.61	537221.79	1235.53
B3-MW26-UGR_CONC	321	3286751.52	537221.70	1235.61
B3-MW26-UGR_BRASS_DISC	322	3286751.22	537221.11	1235.64
B3-MW26-UGR_PVC	323	3286751.01	537221.13	1238.49
B3-MW27-UGR_NG	316	3286644.89	537234.53	1230.62
B3-MW27-UGR_CONC	317	3286644.83	537234.44	1230.77
B3-MW27-UGR_BRASS_DISC	318	3286644.32	537233.96	1230.81
B3-MW27-UGR_PVC	319	3286644.37	537233.76	1233.42
B3-MW28-UGR_NG	312	3286555.31	537190.42	1223.94
B3-MW28-UGR_CONC	313	3286555.24	537190.33	1224.07
B3-MW28-UGR_BRASS_DISC	314	3286554.67	537189.99	1224.14
B3-MW28-UGR_PVC	315	3286554.70	537189.76	1226.67
B3-MW29-UGR_NG	308	3286516.22	537294.03	1230.38
B3-MW29-UGR_CONC	309	3286516.14	537293.96	1230.58
B3-MW29-UGR_BRASS_DISC	310	3286515.49	537293.86	1230.59
B3-MW29-UGR_PVC	311	3286515.45	537293.65	1233.25
B3-MW30-UGR_NG	304	3286479.10	537374.83	1242.83
B3-MW30-UGR_CONC	305	3286479.05	537374.82	1242.97
B3-MW30-UGR_BRASS_DISC	306	3286478.41	537374.71	1243.03
B3-MW30-UGR_PVC	307	3286478.38	537374.48	1246.01
B3-MW31-UGR_NG	336	3286619.45	537401.73	1254.52
B3-MW31-UGR_CONC	337	3286619.47	537401.68	1254.64
B3-MW31-UGR_BRASS_DISC	338	3286619.89	537400.75	1254.65
B3-MW31-UGR_BRASS_PVC	339	3286619.71	537400.90	1257.20

Monitoring well northing and eastings based on NAD 83, UTM 14N from CSSA Site Benchmarks.
Elevation datum based on CSSA Site Benchmarks converted to feet MSL.
Survey by: *Survey & Appraisal Services, Marion, TX, 210-273-0946*

SWMU B-3 DO-50 Survey Data
Camp Stanley Storage Activity
August 2010

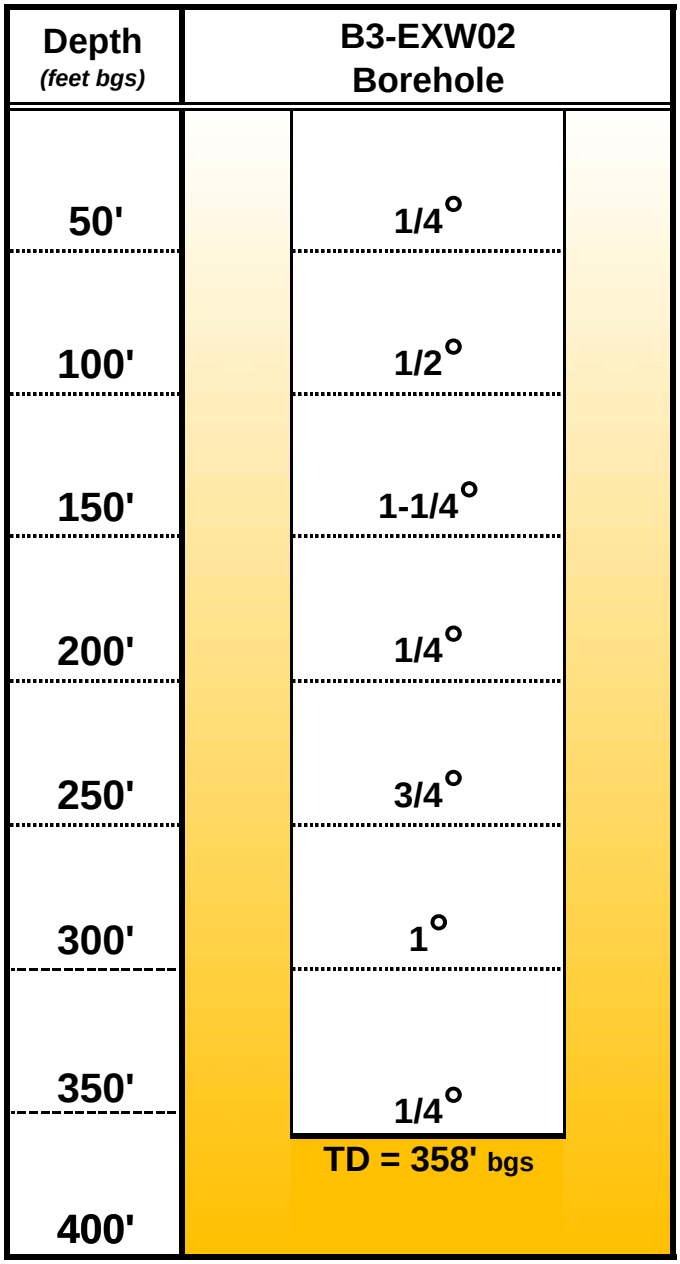
Description	Point No.	Northing	Easting	Elevation *(feet)*
B3-MW32-UGR_NG	332	3286713.79	537458.16	1264.00
B3-MW32-UGR_CONC	333	3286713.75	537458.14	1264.07
B3-MW32-UGR_BRASS_CONC	334	3286712.94	537457.55	1264.18
B3-MW32-UGR_PVC	335	3286713.06	537457.71	1266.98
B3-MW33-UGR_NG	328	3286779.16	537389.86	1247.17
B3-MW33-UGR_CONC	329	3286779.10	537389.83	1246.82
B3-MW33-UGR_BRASS_DISC	330	3286778.31	537389.21	1246.85
B3-MW33-UGR_PVC	331	3286778.41	537389.40	1249.55
B3-MW34-UGR_NG	324	3286784.28	537334.86	1241.51
B3-MW34-UGR_CONC	325	3286784.20	537334.78	1241.76
B3-MW34-UGR_BRASS_DISC	326	3286783.53	537333.99	1241.82
B3-MW34-UGR_PVC	327	3286783.61	537334.22	1244.51
B3-EXW-01_NG	340	3286644.68	537355.48	1241.81
B3-EXW-01_CONC	341	3286644.65	537355.43	1241.99
B3-EXW-01_ELINE	342	3286642.19	537354.16	1245.26
B3-EXW-01_SCADA	343	3286642.24	537354.15	1245.29
B3-EXW-01_CASING	297	3286642.16	537354.12	1244.96
B3-EXW-01_CONC/DISC AREA	296	3286642.15	537354.28	1241.81

Monitoring well northing and eastings based on NAD 83, UTM 14N from CSSA Site Benchmarks.
Elevation datum based on CSSA Site Benchmarks converted to feet MSL.
Survey by: *Survey & Appraisal Services, Marion, TX, 210-273-0946*

ATTACHMENT 2

B3-EXW02 TOTCO Summary
B3-EXW02 Geophysical Log
B3-EXW02 Borehole Video (DVD)
Short-Term Pumping Test Hydrograph

B3-EXW02
Borehole Deviation Surveys
Camp Stanley Storage Activity
May 2010



All measurements were colleted by *MD TOTCO* declination tool, double-punched on 7° target.

bgs = below ground surface

TD = Total Depth

GEO CAM

Borehole: B3-EXW02

Logs: GAMMA, SP, RESISTIVITY, CALIPER, SPR

Water Well Logging & Video Recording Services

Geo Cam, Inc. 126 Palo Duro, San Antonio, TX 210-495-9121

Project: CAMP STANLEY

Client: **GEOPROJECTS INC.**

Location: N 29* 42' 27", W 98* 36' 47.9"

Date: 06-01-10

County: BEXAR

State: TX

BOREHOLE DATA

Drilling Contractor: GEOPROJECTS

Elevation: 1,207' GPS

Depth Ref: G.L.

Driller T.D. (ft) : 358.3'

Logger T.D. (ft) : 357.9'

Date Drilled: 05-28-10

BIT RECORD				CASING RECORD		
RUN	BIT SIZE (in)	FROM (ft)	TO (ft)	SIZE/WGT/THK	FROM (ft)	TO (ft)
1	6"	0'	358.3'	OPEN		
2						
3						

Drill Method: AIR ROTARY

Weight:

Fluid Level (ft) :

Hole Medium:

Mud Type:

Time Since Circ: NA

Viscosity:

Rm: at: Deg C

GENERAL DATA

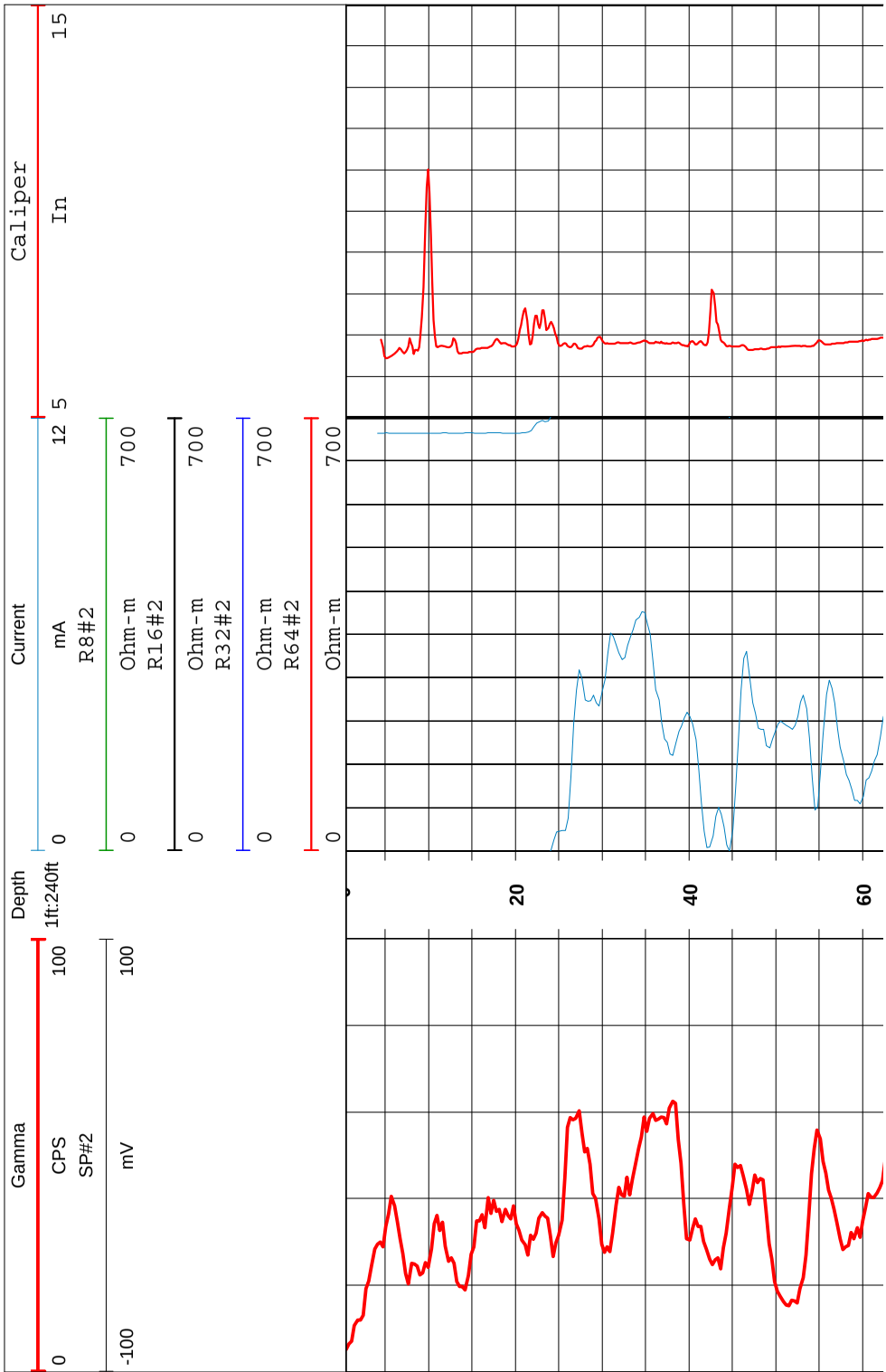
Logged by: Michael G. Miller

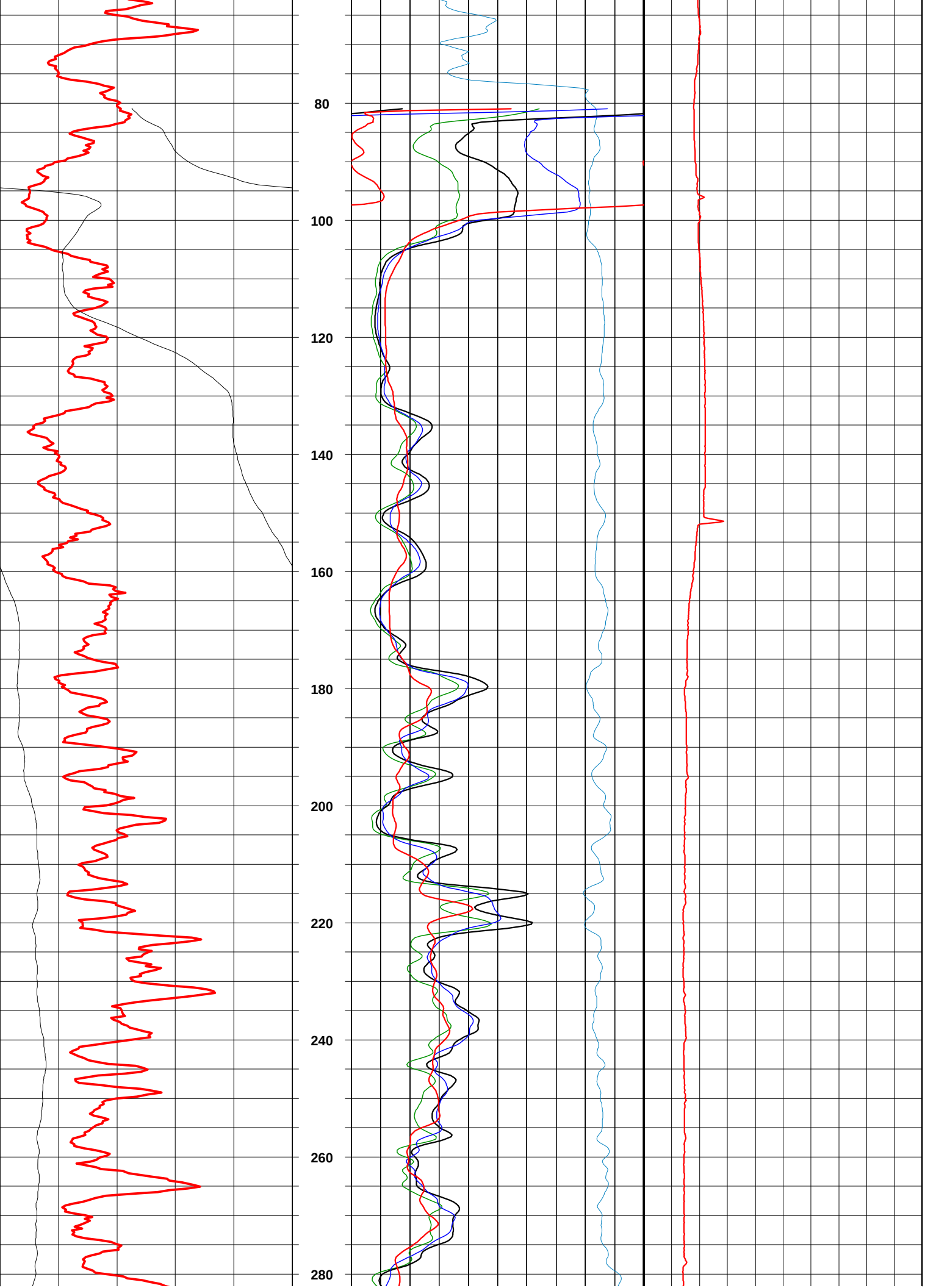
Unit/Truck: 03

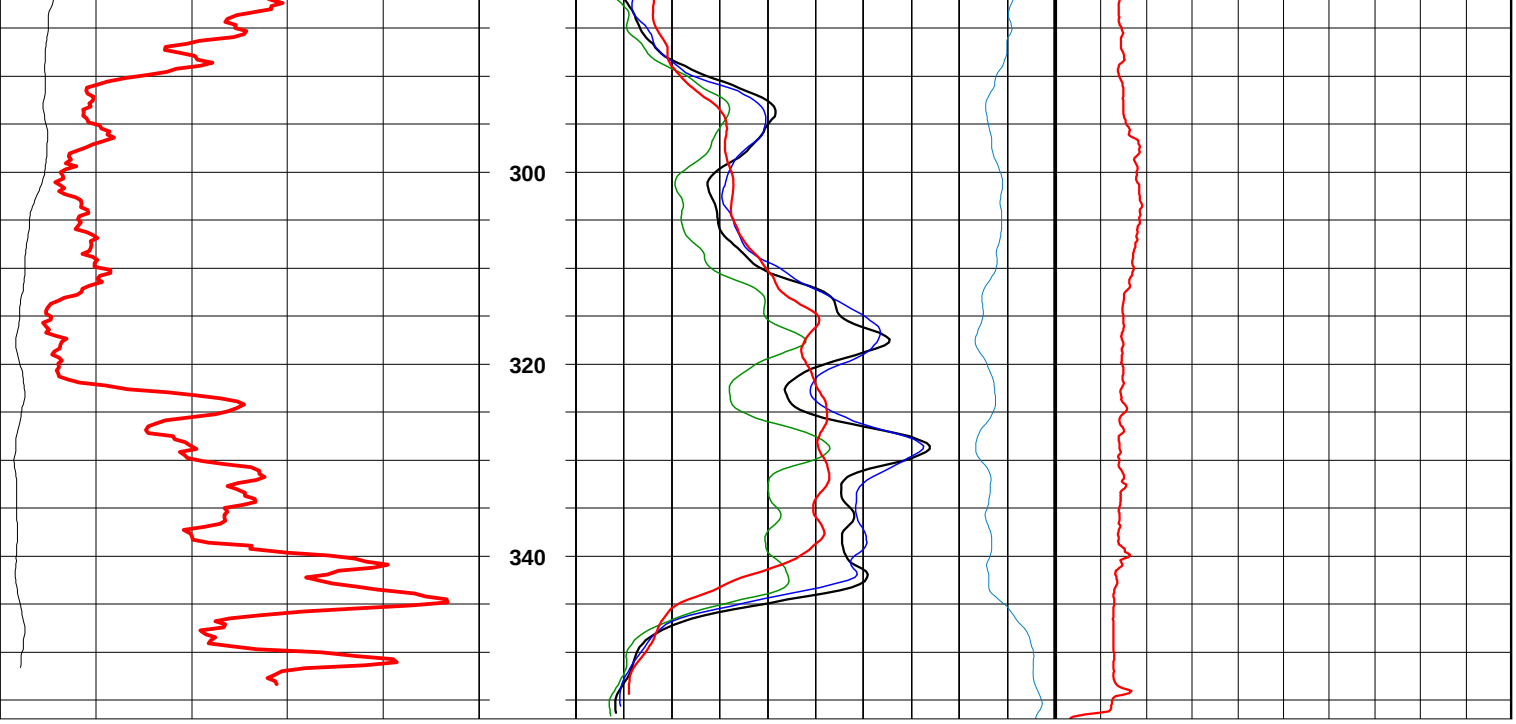
Witness: Eric T.

LOG TYPE	RUN NO	SPEED (ft/min)	FROM (ft)	TO (ft)	FT./ IN.
GAMMA	2	21'			20
SP, RESISTIVITY	2	21'			20
CALIPER	2	24'			20

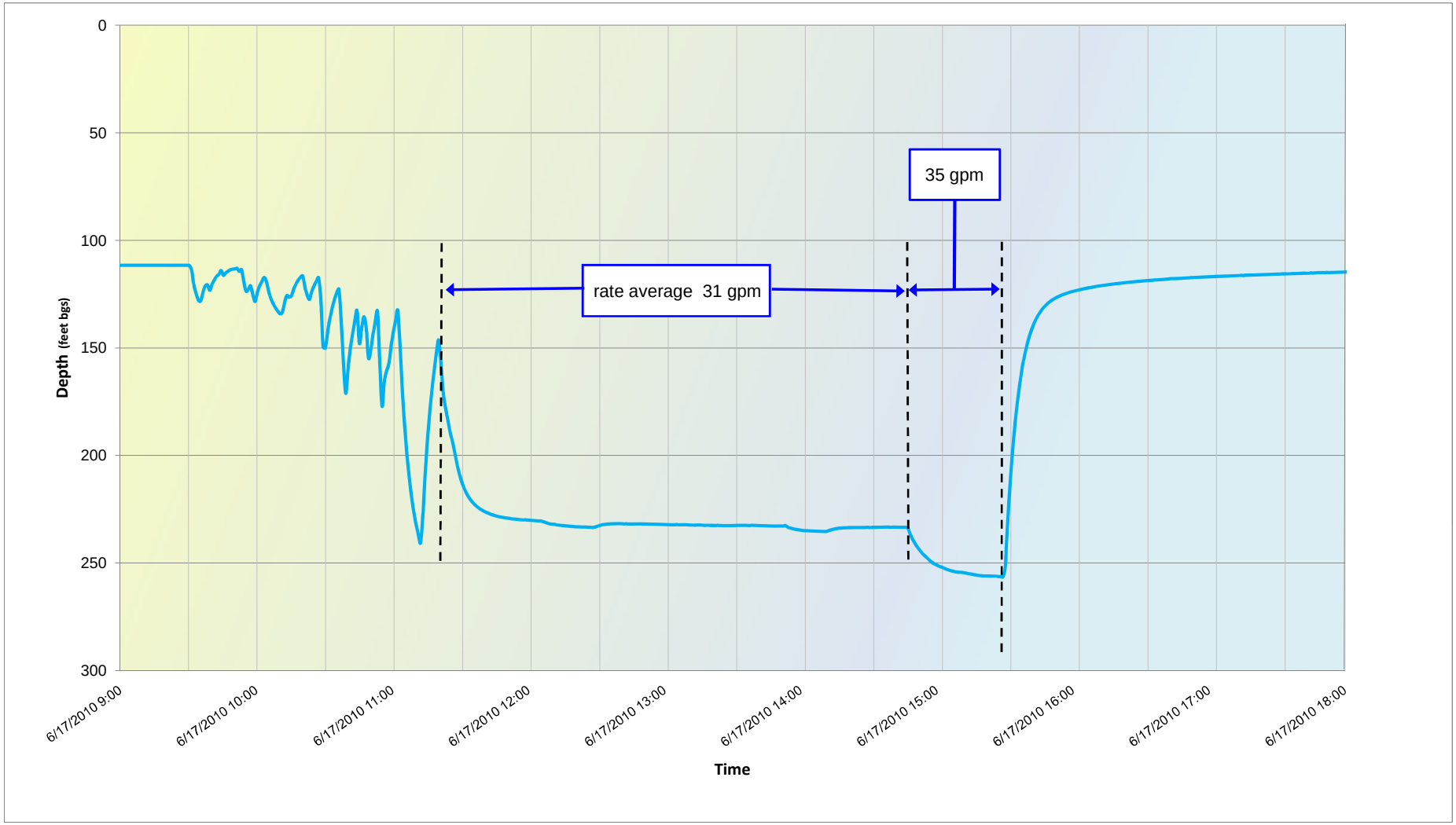
Comments:




80
100
120
140
160
180
200
220
240
260
280


300
320
340

SWMU B-3 Groundwater Extraction Well B3-EXW02
Short-Term Pumping Test
Camp Stanley Storage Activity
June 17, 2010



ATTACHMENT 3

B3-EXW02 Water Sample Laboratory Results

Metals Analysis

Parsons
8000 Centre Park Drive Ste 200
Austin, TX 78754

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Tammy Chang

Project: 747145.03000 CSSA B3 EXW02

ARF: 61700

Sample ID: B3-EXW02

APPL ID: AY15816

Sample Collection Date: 05/19/10

Method	Analyte	Result	PQL	MDL	Units	DF	Prep Date	Analysis Date
6010B/3010A	Arsenic (As)	Not detected	5.0	2.45	ug/L	1	05/21/10	05/21/10
6010B/3010A	Barium (Ba)	46.8	5.0	0.75	ug/L	1	05/21/10	05/21/10
6010B/3010A	Cadmium (Cd)	Not detected	5.0	0.51	ug/L	1	05/21/10	05/21/10
6010B/3010A	Chromium (Cr)	6.1	5.0	1.37	ug/L	1	05/21/10	05/21/10
6010B/3010A	Copper (Cu)	9.6	5.0	0.97	ug/L	1	05/21/10	05/21/10
6010B/3010A	Lead (Pb)	Not detected	5.0	1.58	ug/L	1	05/21/10	05/21/10
6010B/3010A	Manganese (Mn)	132	5.0	1.23	ug/L	1	05/21/10	05/21/10
7470A/7470A	Mercury (Hg)	Not detected	0.2	0.06	ug/L	1	05/21/10	05/21/10
6010B/3010A	Nickel (Ni)	6.2	5.0	0.39	ug/L	1	05/21/10	05/21/10
6010B/3010A	Zinc (Zn)	29.0 J	50.0	2.30	ug/L	1	05/21/10	05/21/10

J = Estimated value.

EPA 8260B - AFCEE 3.0 (Water)

Parsons
8000 Centre Park Drive Ste 200
Austin, TX 78754

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Tammy Chang
Project: 747145.03000 CSSA B3 EXW02
ARF: 61700
Sample ID: B3-EXW02
APPL ID: AY15816
Sample Collection Date: 05/19/10
QCG: #826AW-100524AS-143556

Method	Analyte	Result	PQL	MDL	Units	Extraction Date	Analysis Date
EPA 8260B	1,1,1,2-Tetrachloroethane	Not detected	0.5	0.13	ug/L	05/24/10	05/24/10
EPA 8260B	1,1,1-TCA	Not detected	0.8	0.14	ug/L	05/24/10	05/24/10
EPA 8260B	1,1,2,2-Tetrachloroethane	Not detected	0.4	0.10	ug/L	05/24/10	05/24/10
EPA 8260B	1,1,2-TCA	Not detected	1.0	0.20	ug/L	05/24/10	05/24/10
EPA 8260B	1,1-DCA	Not detected	0.4	0.19	ug/L	05/24/10	05/24/10
EPA 8260B	1,1-DCE	Not detected	1.2	0.30	ug/L	05/24/10	05/24/10
EPA 8260B	1,1-Dichloropropene	Not detected	1.0	0.20	ug/L	05/24/10	05/24/10
EPA 8260B	1,2,3-Trichlorobenzene	Not detected	0.3	0.29	ug/L	05/24/10	05/24/10
EPA 8260B	1,2,3-Trichloropropane	Not detected	3.2	0.39	ug/L	05/24/10	05/24/10
EPA 8260B	1,2,4-Trichlorobenzene	Not detected	0.4	0.21	ug/L	05/24/10	05/24/10
EPA 8260B	1,2,4-Trimethylbenzene	Not detected	1.3	0.19	ug/L	05/24/10	05/24/10
EPA 8260B	1,2-DCA	Not detected	0.6	0.14	ug/L	05/24/10	05/24/10
EPA 8260B	1,2-DCB	Not detected	0.3	0.17	ug/L	05/24/10	05/24/10
EPA 8260B	1,2-Dibromo-3-chloropropane	Not detected	2.6	0.76	ug/L	05/24/10	05/24/10
EPA 8260B	1,2-Dichloropropane	Not detected	0.4	0.17	ug/L	05/24/10	05/24/10
EPA 8260B	1,2-EDB	Not detected	0.6	0.20	ug/L	05/24/10	05/24/10
EPA 8260B	1,3,5-Trimethylbenzene	Not detected	0.5	0.12	ug/L	05/24/10	05/24/10
EPA 8260B	1,3-DCB	Not detected	1.2	0.11	ug/L	05/24/10	05/24/10
EPA 8260B	1,3-Dichloropropane	Not detected	0.4	0.17	ug/L	05/24/10	05/24/10
EPA 8260B	1,4-DCB	Not detected	0.3	0.19	ug/L	05/24/10	05/24/10
EPA 8260B	1-Chlorohexane	Not detected	0.5	0.17	ug/L	05/24/10	05/24/10
EPA 8260B	2,2-Dichloropropane	Not detected	3.5	0.22	ug/L	05/24/10	05/24/10
EPA 8260B	2-Chlorotoluene	Not detected	0.4	0.14	ug/L	05/24/10	05/24/10
EPA 8260B	4-Chlorotoluene	Not detected	0.6	0.13	ug/L	05/24/10	05/24/10
EPA 8260B	Benzene	Not detected	0.4	0.16	ug/L	05/24/10	05/24/10
EPA 8260B	Bromobenzene	Not detected	0.3	0.16	ug/L	05/24/10	05/24/10
EPA 8260B	Bromochloromethane	Not detected	0.4	0.15	ug/L	05/24/10	05/24/10
EPA 8260B	Bromodichloromethane	Not detected	0.8	0.14	ug/L	05/24/10	05/24/10
EPA 8260B	Bromoform	Not detected	1.2	0.14	ug/L	05/24/10	05/24/10
EPA 8260B	Bromomethane	Not detected	1.1	0.24	ug/L	05/24/10	05/24/10
EPA 8260B	Carbon tetrachloride	Not detected	2.1	0.10	ug/L	05/24/10	05/24/10
EPA 8260B	Chlorobenzene	Not detected	0.4	0.21	ug/L	05/24/10	05/24/10
EPA 8260B	Chloroethane	Not detected	1.0	0.21	ug/L	05/24/10	05/24/10
EPA 8260B	Chloroform	Not detected	0.3	0.07	ug/L	05/24/10	05/24/10
EPA 8260B	Chloromethane	Not detected	1.3	0.31	ug/L	05/24/10	05/24/10
EPA 8260B	Cis-1,2-DCE	12	1.2	0.16	ug/L	05/24/10	05/24/10
EPA 8260B	Cis-1,3-Dichloropropene	Not detected	1.0	0.15	ug/L	05/24/10	05/24/10

These results are preliminary and represent information available on 6/2/10 at 11:49am

Quant Method: S826AW.M
Run #: 0524S20
Instrument: Sweetpea
Sequence: S100521
Dilution Factor: 1
Initials: SV

Printed: 06/02/10 11:49:27 AM

APPL-F1-SC-MCRes/MCPQL-REG MDLs

EPA 8260B - AFCEE 3.0 (Water)

Parsons
8000 Centre Park Drive Ste 200
Austin, TX 78754

Attn: Tammy Chang

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Project: 747145.03000 CSSA B3 EXW02

ARF: 61700

Sample ID: B3-EXW02

APPL ID: AY15816

Sample Collection Date: 05/19/10

QCG: #826AW-100524AS-143556

Method	Analyte	Result	PQL	MDL	Units	Extraction Date	Analysis Date
EPA 8260B	Dibromochloromethane	Not detected	0.5	0.19	ug/L	05/24/10	05/24/10
EPA 8260B	Dibromomethane	Not detected	2.4	0.20	ug/L	05/24/10	05/24/10
EPA 8260B	Dichlorodifluoromethane	Not detected	1.0	0.19	ug/L	05/24/10	05/24/10
EPA 8260B	Ethylbenzene	Not detected	0.6	0.23	ug/L	05/24/10	05/24/10
EPA 8260B	Hexachlorobutadiene	Not detected	1.1	0.19	ug/L	05/24/10	05/24/10
EPA 8260B	Isopropylbenzene	Not detected	0.5	0.16	ug/L	05/24/10	05/24/10
EPA 8260B	m&p-Xylene	Not detected	0.5	0.40	ug/L	05/24/10	05/24/10
EPA 8260B	Methylene chloride	Not detected	1.0	0.35	ug/L	05/24/10	05/24/10
EPA 8260B	n-Butylbenzene	Not detected	1.1	0.15	ug/L	05/24/10	05/24/10
EPA 8260B	n-Propylbenzene	Not detected	0.4	0.21	ug/L	05/24/10	05/24/10
EPA 8260B	Naphthalene	Not detected	0.4	0.36	ug/L	05/24/10	05/24/10
EPA 8260B	o-Xylene	Not detected	1.1	0.19	ug/L	05/24/10	05/24/10
EPA 8260B	p-Isopropyltoluene	Not detected	1.2	0.12	ug/L	05/24/10	05/24/10
EPA 8260B	Sec-Butylbenzene	Not detected	1.3	0.12	ug/L	05/24/10	05/24/10
EPA 8260B	Styrene	Not detected	0.4	0.25	ug/L	05/24/10	05/24/10
EPA 8260B	TCE	3.8	1.0	0.16	ug/L	05/24/10	05/24/10
EPA 8260B	Tert-Butylbenzene	Not detected	1.4	0.13	ug/L	05/24/10	05/24/10
EPA 8260B	Tetrachloroethene	15	1.4	0.15	ug/L	05/24/10	05/24/10
EPA 8260B	Toluene	Not detected	1.1	0.17	ug/L	05/24/10	05/24/10
EPA 8260B	Trans-1,2-DCE	Not detected	0.6	0.19	ug/L	05/24/10	05/24/10
EPA 8260B	Trans-1,3-Dichloropropene	Not detected	1.0	0.18	ug/L	05/24/10	05/24/10
EPA 8260B	Trichlorofluoromethane	Not detected	0.8	0.24	ug/L	05/24/10	05/24/10
EPA 8260B	Vinyl chloride	Not detected	1.1	0.23	ug/L	05/24/10	05/24/10
EPA 8260B	Surrogate: 1,2-Dichloroethane-d4 (S)	77.1	69-139		%	05/24/10	05/24/10
EPA 8260B	Surrogate: 4-Bromofluorobenzene (S)	89.7	75-125		%	05/24/10	05/24/10
EPA 8260B	Surrogate: Dibromofluoromethane (S)	82.5	75-125		%	05/24/10	05/24/10
EPA 8260B	Surrogate: Toluene-D8 (S)	83.0	75-125		%	05/24/10	05/24/10

These results are preliminary and represent information available on 6/2/10 at 11:49am

Quant Method: S826AW.M
Run #: 0524S20
Instrument: Sweetpea
Sequence: S100521
Dilution Factor: 1
Initials: SV

Printed: 06/02/10 11:49:28 AM

APPL-F1-SC-MCRes/MCPQL-REG MDLs

Metals Analysis

Parsons
8000 Centre Park Drive Ste 200
Austin, TX 78754

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Tammy Chang
Project: 747145.03000 CSSA B3 EXW02

ARF: 61766

Sample ID: B3-EXW02

APPL ID: AY16360

Sample Collection Date: 06/02/10

Method	Analyte	Result	PQL	MDL	Units	DF	Prep Date	Analysis Date
6010B/3010A	Arsenic (As)	4.5 J	5.0	2.45	ug/L	1	06/03/10	06/03/10
6010B/3010A	Barium (Ba)	44.5	5.0	0.75	ug/L	1	06/03/10	06/03/10
6010B/3010A	Cadmium (Cd)	Not detected	5.0	0.51	ug/L	1	06/03/10	06/03/10
6010B/3010A	Chromium (Cr)	1.5 J	5.0	1.37	ug/L	1	06/03/10	06/03/10
6010B/3010A	Copper (Cu)	3.2 J	5.0	0.97	ug/L	1	06/03/10	06/03/10
6010B/3010A	Lead (Pb)	1.7 J	5.0	1.58	ug/L	1	06/03/10	06/03/10
6010B/3010A	Manganese (Mn)	11.2	5.0	1.23	ug/L	1	06/03/10	06/03/10
7470A/7470A	Mercury (Hg)	0.060 J *	0.2	0.06	ug/L	1	06/03/10	06/03/10
6010B/3010A	Nickel (Ni)	Not detected	5.0	0.39	ug/L	1	06/03/10	06/03/10
6010B/3010A	Zinc (Zn)	13.3 J	50.0	2.30	ug/L	1	06/03/10	06/03/10

* Corrected by APPL to "Not Detected" .

J = Estimated value.

Printed: 06/07/10 8:55:15 AM

PL-F1-SC-MCRes/MCPQL-REG MDLs

EPA 8260B - AFCEE 3.0 (Water)

Parsons
8000 Centre Park Drive Ste 200
Austin, TX 78754

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Tammy Chang

Project: 747145.03000 CSSA B3 EXW02

ARF: 61766

Sample ID: B3-EXW02

APPL ID: AY16360

Sample Collection Date: 06/02/10

QCG: #826AW-100603AC-143837

Method	Analyte	Result	PQL	MDL	Units	Extraction Date	Analysis Date
EPA 8260B	1,1,1,2-Tetrachloroethane	Not detected	0.5	0.13	ug/L	06/03/10	06/03/10
EPA 8260B	1,1,1-TCA	Not detected	0.8	0.14	ug/L	06/03/10	06/03/10
EPA 8260B	1,1,2,2-Tetrachloroethane	Not detected	0.4	0.10	ug/L	06/03/10	06/03/10
EPA 8260B	1,1,2-TCA	Not detected	1.0	0.20	ug/L	06/03/10	06/03/10
EPA 8260B	1,1-DCA	Not detected	0.4	0.19	ug/L	06/03/10	06/03/10
EPA 8260B	1,1-DCE	Not detected	1.2	0.30	ug/L	06/03/10	06/03/10
EPA 8260B	1,1-Dichloropropene	Not detected	1.0	0.20	ug/L	06/03/10	06/03/10
EPA 8260B	1,2,3-Trichlorobenzene	Not detected	0.3	0.29	ug/L	06/03/10	06/03/10
EPA 8260B	1,2,3-Trichloropropane	Not detected	3.2	0.39	ug/L	06/03/10	06/03/10
EPA 8260B	1,2,4-Trichlorobenzene	Not detected	0.4	0.21	ug/L	06/03/10	06/03/10
EPA 8260B	1,2,4-Trimethylbenzene	Not detected	1.3	0.19	ug/L	06/03/10	06/03/10
EPA 8260B	1,2-DCA	Not detected	0.6	0.14	ug/L	06/03/10	06/03/10
EPA 8260B	1,2-DCB	Not detected	0.3	0.17	ug/L	06/03/10	06/03/10
EPA 8260B	1,2-Dibromo-3-chloropropane	Not detected	2.6	0.76	ug/L	06/03/10	06/03/10
EPA 8260B	1,2-Dichloropropane	Not detected	0.4	0.17	ug/L	06/03/10	06/03/10
EPA 8260B	1,2-EDB	Not detected	0.6	0.20	ug/L	06/03/10	06/03/10
EPA 8260B	1,3,5-Trimethylbenzene	Not detected	0.5	0.12	ug/L	06/03/10	06/03/10
EPA 8260B	1,3-DCB	Not detected	1.2	0.11	ug/L	06/03/10	06/03/10
EPA 8260B	1,3-Dichloropropane	Not detected	0.4	0.17	ug/L	06/03/10	06/03/10
EPA 8260B	1,4-DCB	Not detected	0.3	0.19	ug/L	06/03/10	06/03/10
EPA 8260B	1-Chlorohexane	Not detected	0.5	0.17	ug/L	06/03/10	06/03/10
EPA 8260B	2,2-Dichloropropane	Not detected	3.5	0.22	ug/L	06/03/10	06/03/10
EPA 8260B	2-Chlorotoluene	Not detected	0.4	0.14	ug/L	06/03/10	06/03/10
EPA 8260B	4-Chlorotoluene	Not detected	0.6	0.13	ug/L	06/03/10	06/03/10
EPA 8260B	Benzene	Not detected	0.4	0.16	ug/L	06/03/10	06/03/10
EPA 8260B	Bromobenzene	Not detected	0.3	0.16	ug/L	06/03/10	06/03/10
EPA 8260B	Bromochloromethane	Not detected	0.4	0.15	ug/L	06/03/10	06/03/10
EPA 8260B	Bromodichloromethane	Not detected	0.8	0.14	ug/L	06/03/10	06/03/10
EPA 8260B	Bromoform	Not detected	1.2	0.14	ug/L	06/03/10	06/03/10
EPA 8260B	Bromomethane	Not detected	1.1	0.24	ug/L	06/03/10	06/03/10
EPA 8260B	Carbon tetrachloride	Not detected	2.1	0.10	ug/L	06/03/10	06/03/10
EPA 8260B	Chlorobenzene	Not detected	0.4	0.21	ug/L	06/03/10	06/03/10
EPA 8260B	Chloroethane	Not detected	1.0	0.21	ug/L	06/03/10	06/03/10
EPA 8260B	Chloroform	Not detected	0.3	0.07	ug/L	06/03/10	06/03/10
EPA 8260B	Chloromethane	Not detected	1.3	0.31	ug/L	06/03/10	06/03/10
EPA 8260B	Cis-1,2-DCE	10	1.2	0.16	ug/L	06/03/10	06/03/10
EPA 8260B	Cis-1,3-Dichloropropene	Not detected	1.0	0.15	ug/L	06/03/10	06/03/10

Quant Method: C826AW.M
Run #: 0603C16
Instrument: Chico
Sequence: C100601
Dilution Factor: 1
Initials: GM

Printed: 06/07/10 8:57:08 AM

APPL-F1-SC-MCRes/MCPQL-REG MDLs

EPA 8260B - AFCEE 3.0 (Water)

Parsons
8000 Centre Park Drive Ste 200
Austin, TX 78754

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Tammy Chang
Project: 747145.03000 CSSA B3 EXW02
ARF: 61766
Sample ID: B3-EXW02
APPL ID: AY16360
Sample Collection Date: 06/02/10
QCG: #826AW-100603AC-143837

Method	Analyte	Result	PQL	MDL	Units	Extraction Date	Analysis Date
EPA 8260B	Dibromochloromethane	Not detected	0.5	0.19	ug/L	06/03/10	06/03/10
EPA 8260B	Dibromomethane	Not detected	2.4	0.20	ug/L	06/03/10	06/03/10
EPA 8260B	Dichlorodifluoromethane	Not detected	1.0	0.19	ug/L	06/03/10	06/03/10
EPA 8260B	Ethylbenzene	Not detected	0.6	0.23	ug/L	06/03/10	06/03/10
EPA 8260B	Hexachlorobutadiene	Not detected	1.1	0.19	ug/L	06/03/10	06/03/10
EPA 8260B	Isopropylbenzene	Not detected	0.5	0.16	ug/L	06/03/10	06/03/10
EPA 8260B	m&p-Xylene	Not detected	0.5	0.40	ug/L	06/03/10	06/03/10
EPA 8260B	Methylene chloride	Not detected	1.0	0.35	ug/L	06/03/10	06/03/10
EPA 8260B	n-Butylbenzene	Not detected	1.1	0.15	ug/L	06/03/10	06/03/10
EPA 8260B	n-Propylbenzene	Not detected	0.4	0.21	ug/L	06/03/10	06/03/10
EPA 8260B	Naphthalene	Not detected	0.4	0.36	ug/L	06/03/10	06/03/10
EPA 8260B	o-Xylene	Not detected	1.1	0.19	ug/L	06/03/10	06/03/10
EPA 8260B	p-Isopropyltoluene	Not detected	1.2	0.12	ug/L	06/03/10	06/03/10
EPA 8260B	Sec-Butylbenzene	Not detected	1.3	0.12	ug/L	06/03/10	06/03/10
EPA 8260B	Styrene	Not detected	0.4	0.25	ug/L	06/03/10	06/03/10
EPA 8260B	TCE	5.8	1.0	0.16	ug/L	06/03/10	06/03/10
EPA 8260B	Tert-Butylbenzene	Not detected	1.4	0.13	ug/L	06/03/10	06/03/10
EPA 8260B	Tetrachloroethene	12	1.4	0.15	ug/L	06/03/10	06/03/10
EPA 8260B	Toluene	Not detected	1.1	0.17	ug/L	06/03/10	06/03/10
EPA 8260B	Trans-1,2-DCE	Not detected	0.6	0.19	ug/L	06/03/10	06/03/10
EPA 8260B	Trans-1,3-Dichloropropene	Not detected	1.0	0.18	ug/L	06/03/10	06/03/10
EPA 8260B	Trichlorofluoromethane	Not detected	0.8	0.24	ug/L	06/03/10	06/03/10
EPA 8260B	Vinyl chloride	Not detected	1.1	0.23	ug/L	06/03/10	06/03/10
EPA 8260B	Surrogate: 1,2-Dichloroethane-d4 (S)	97.1	69-139		%	06/03/10	06/03/10
EPA 8260B	Surrogate: 4-Bromofluorobenzene (S)	110	75-125		%	06/03/10	06/03/10
EPA 8260B	Surrogate: Dibromofluoromethane (S)	96.6	75-125		%	06/03/10	06/03/10
EPA 8260B	Surrogate: Toluene-D8 (S)	93.2	75-125		%	06/03/10	06/03/10

Quant Method: C826AW.M
Run #: 0603C16
Instrument: Chico
Sequence: C100601
Dilution Factor: 1
Initials: GM

Printed: 06/07/10 8:57:08 AM
APPL-F1-SC-MCRes/MCPQL-REG MDLs

ATTACHMENT 4

EQUIPMENT INFORMATION

Grundfos Model 40S50-15 Submersible Pump

Franklin Electric Motor Model 234 307 8602

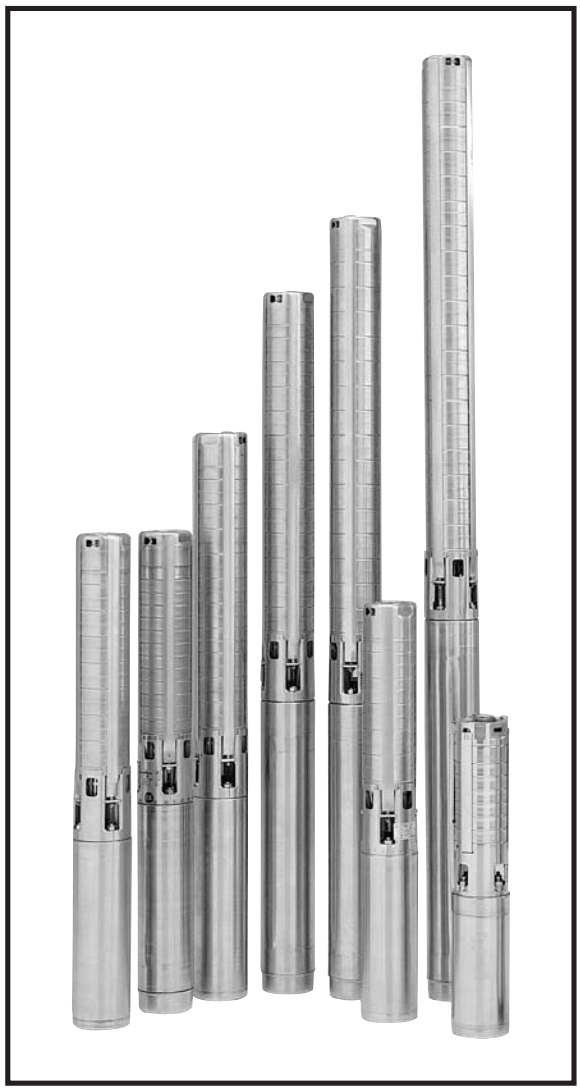
SymCom Model 777-KW/HP PumpSaver

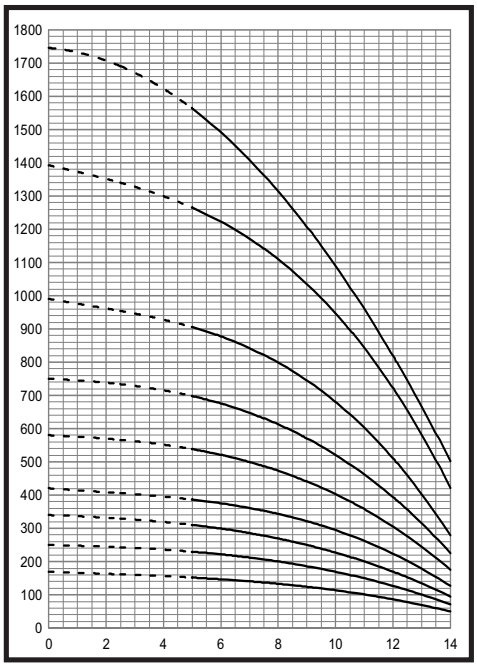
Endress-Hauser Prowirl 72F Flow Meter

Waterpilot FMX167 Level Probe

Easy Selection Chart
Performance Curves and Technical Data

4-Inch Submersible Pumps





Performance Curves

Materials of Construction

Grundfos Stainless Steel Submersible Pumps

4" Submersible

Easy Selection Charts.

40S EASY SELECTION CHART

40 GPM

SELECTION CHARTS

FLOW RANGE
(24 TO 55 GPM)

PUMP OUTLET
2 " NPT

(Ratings are in GALLONS PER MINUTE-GPM)

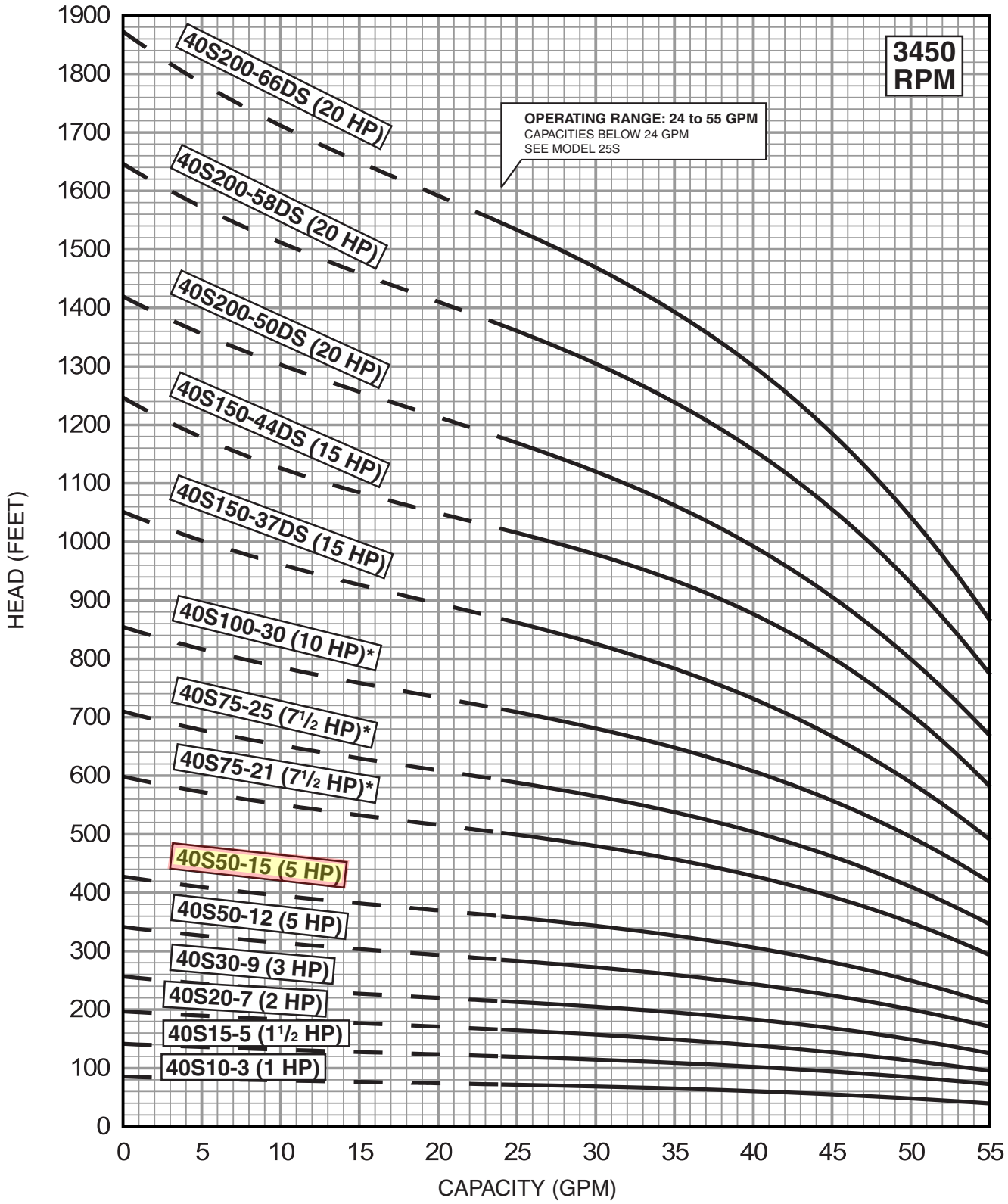
PUMP MODEL	HP	PSI		DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																									
				20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
40S10-3	1	20	46.2	33.0																								
		30	69.3																									
		40	92.4																									
		50	116																									
		60	139																									
SHUT-OFF PSI:			0	28	19	11	2																					
40S15-5	1 1/2	0	0				52.0	41.0	24.0																			
		20	46.2	57.0	50.0	37.0	18.0																					
		30	69.3	48.0	34.0	15.0																						
		40	92.4	31.0	11.0																							
		50	116	7.0																								
		60	139																									
SHUT-OFF PSI:			0	52	44	35	26	18	9																			
40S20-7	2	0	0					54.0	49.0	40.0	29.0	15.0																
		20	46.2			53.0	46.0	37.0	25.0	10.0																		
		30	69.3		52.0	45.0	35.0	23.0	8.0																			
		40	92.4	51.0	44.0	33.0	21.0	5.0																				
		50	116	42.0	32.0	18.0	2.0																					
		60	139	30.0	16.0																							
SHUT-OFF PSI:			0	77	68	59	51	42	33	25	16	7																
40S30-9	3	0	0							53.0	47.0	41.0	32.0	22.0														
		20	46.2					51.0	45.0	38.0	29.0	19.0																
		30	69.3				50.0	44.0	37.0	28.0	17.0																	
		40	92.4		54.0	50.0	43.0	35.0	26.0	15.0																		
		50	116	54.0	49.0	42.0	34.0	24.0	13.0																			
		60	139	48.0	41.0	33.0	23.0	11.0																				
SHUT-OFF PSI:			0	102	94	85	76	68	59	50	42	33	24	16	7													
40S50-12	5	0	0									53.0	49.0	44.0	39.0	32.0	25.0	16.0										
		20	46.2							52.0	48.0	43.0	37.0	30.0	22.0	13.0												
		30	69.3						51.0	47.0	42.0	36.0	29.0	21.0	12.0													
		40	92.4					51.0	46.0	41.0	35.0	28.0	20.0	11.0														
		50	116			54.0	50.0	45.0	40.0	34.0	26.0	18.0	9.0															
		60	139		53.0	49.0	45.0	39.0	33.0	25.0	17.0	8.0																
SHUT-OFF PSI:			0		130	122	113	104	96	87	78	70	61	52	44	35	26	18										
40S50-15	5	0	0											52.0	49.0	46.0	42.0	37.0	26.0									
		20	46.2									51.0	48.0	45.0	40.0	35.0	30.0	24.0										
		30	69.3								51.0	48.0	44.0	40.0	35.0	29.0	23.0	16.0										
		40	92.4							51.0	47.0	43.0	39.0	34.0	28.0	21.0	14.0											
		50	116						50.0	47.0	43.0	38.0	33.0	27.0	20.0	13.0												
		60	139					50.0	46.0	42.0	37.0	32.0	26.0	19.0	12.0													
SHUT-OFF PSI:			0					141	132	124	115	107	98	89	81	72	63	55	37	11								
40S75-21	7 1/2	0	0																49.0	41.0	29.0	15.0						
		20	46.2													53.0	51.0	48.0	43.0	32.0	19.0							
		30	69.3												52.0	50.0	48.0	45.0	39.0	27.0	13.0							
		40	92.4											52.0	50.0	48.0	45.0	42.0	35.0	22.0	6.0							
		50	116										52.0	50.0	47.0	44.0	41.0	38.0	30.0	16.0								
		60	139									51.0	49.0	47.0	44.0	41.0	38.0	34.0	25.0	10.0								
SHUT-OFF PSI:			0									181	172	163	155	146	137	129	111	85	59	33						
40S75-25	7 1/2	0	0																	51.0	45.0	37.0	23.0					
		20	46.2																52.0	47.0	39.0	29.0	14.0					
		30	69.3															54.0	50.0	44.0	35.0	25.0						
		40	92.4														54.0	52.0	48.0	41.0	32.0	21.0						
		50	116													53.0	52.0	50.0	45.0	38.0	28.0							
		60	139												53.0	51.0	49.0	47.0	43.0	34.0	24.0							
SHUT-OFF PSI:			0												203	194	186	177	160	134	108	82	47					
*40S100-30 40S100-30	10	0	0																		53.0	49.0	41.0	27.0				
		20	46.2																	54.0	50.0	44.0	35.0	20.0				
		30	69.3																	52.0	48.0	42.0	32.0	16.0				
		40	92.4																	51.0	46.0	39.0	28.0	12.0				
		50	116																	49.0	43.0	36.0	25.0	8.0				
		60	139																52.0	47.0	41.0	33.0	21.0					
SHUT-OFF PSI:																			222	196	170	144	110	66	23			

*** 6" Motor**

See 40S performance curves for higher head models.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

FLOW RANGE: 24 - 55 GPM **OUTLET SIZE: 2 " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 1-10 HP/3450 RPM.
6" MOTOR STANDARD,15-20 HP/3450 RPM.
* Also available with 6" motor.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 5 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
40S10-3	A	1	4"	2" NPT	24.6	11.8	12.8	3.8	3.9	32
40S15-5	A	1 1/2	4"	2" NPT	29.7	13.6	16.1	3.8	3.9	37
40S20-7	A	2	4"	2" NPT	34.5	15.1	19.4	3.8	3.9	41
40S30-9	A	3	4"	2" NPT	43.3	20.6	22.7	3.8	3.9	65
40S50-12	A	5	4"	2" NPT	51.3	23.6	27.7	3.8	3.9	78
40S50-15	A	5	4"	2" NPT	56.2	23.6	32.6	3.8	3.9	84
40S75-21*	A	7 1/2	4"	2" NPT	74.6	29.6	45.0	3.8	3.9	120
40S75-25*	A	7 1/2	4"	2" NPT	81.2	29.6	51.6	3.8	3.9	124
40S100-30*	A	10	4"	2" NPT	103.7	43.9	59.8	3.8	3.9	181
40S150-37DS	A	15	6"	2" NPT	99.5	28.0	71.5	5.4	5.4	244
40S150-44DS	A	15	6"	2" NPT	111.0	28.0	83.0	5.4	5.4	340
40S200-50DS**	B	20	6"	2" MPT	136.0	30.6	105.4	5.4	5.5	319
40S200-58DS**	B	20	6"	2" MPT	149.2	30.6	118.6	5.4	5.5	334
40S200-66DS**	B	20	6"	2" MPT	162.4	30.6	131.8	5.4	5.5	394

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Also available with 6" motor.
** Built into sleeve 2" MPT discharge, 6" min. well dia.

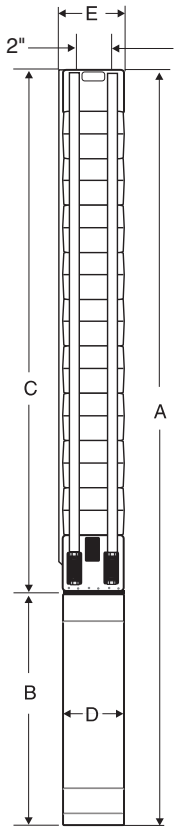


Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (3-44 Stgs.)	DEEP SET (50-66 Stgs.)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel
Pump Shaft	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel **	329/416 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Intermediate Bearings	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	LCP (Vectra®)	LCP (Vectra®)
Split Cone	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	304 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	304 Stainless Steel

NOTES: Specifications are subject to change without notice.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
***Stainless Steel option available.**

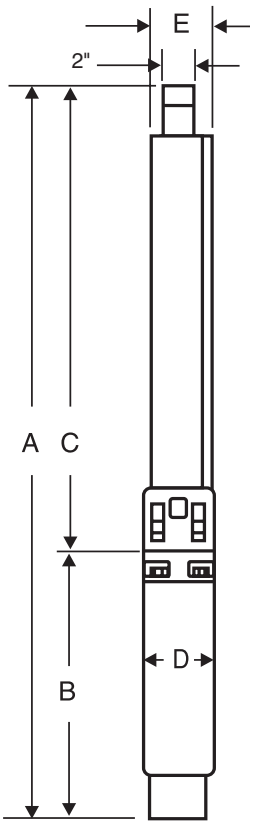


Fig. B

Model: 234 307 8602

4-inch Motors - High Thrust

Related Links

- More High Thrust 4-inch Motors
- High Thrust 4-inch Motors Leads

Motor Specifications:	
Horsepower:	5
Voltage:	200
Frequency:	60
Phase:	Three-Phase
RPM:	3450
Service Factor:	1.15
Rotation:	CCW Facing Shaft End
Poles:	2
Downward Thrust (lbs):	1500 LBS (6500 N)
Max. Ambient Temp.:	86°F / 30°C
Duty Rating:	Continuous at 0.25 ft/sec flow past motor
Construction Materials:	
Construction:	Water Well
Length (inches):	23.2
Shipping Weight (lbs / kg):	56 / 25.4
Carton Size:	6 x 6 x 28
Stator Shell:	301 SS
Stator Ends:	Low Carbon Steel
Shaft Extension:	17-4 SS
Fasteners:	300 Series SS
Seal:	Nitrile Rubber Lip
Seal Cover:	Acetol
Slinger:	Nitrile Rubber
Lead in Motor:	YES
Lead Wire (or Cable):	XLPE*
Lead Potting:	Epoxy
Diaphragm:	Nitrile Rubber
Diaphragm Cover:	Gray Iron
Diaphragm Cup:	316 SS
Diaphragm Spring:	316 SS
Filter:	Delrin & Polyester

400 E. Spring St., Bluffton, IN 46714 U.S.A. Tel: 260.824.2900 Fax: 260.824.2909

Features

- Digital programmability permits precise customization.
- Sixteen setpoints can be programmed for maximum protection.
- Last fault memory provides instant troubleshooting diagnostics.
- Voltage, current, last 4 faults, kW, hp and power factor are recordable when using communications package.
- An RS485 communication port comes standard for use with computerized systems using Modbus protocol.
- UL and CSA listed as an overload relay.

PumpSaver®
SUBMERSIBLE PUMP PROTECTOR

777-KW/HP
777-LR-KW/HP
777-575-KW/HP
777-HVR-KW/HP
777-HVR-LR-KW/HP

Power Monitor Motor Protection Relay
•
Engineered Protection

Applications

The Model 777-KW/HP can be used on ANY 3-phase motor. It has advantages over current monitors in low speed motor applications (less than 1800 rpm), lower power applications and in lightly loaded applications. Some examples include **LOW SPEED MIXERS, CAN PUMPS, MAG DRIVE PUMPS, FRACTIONAL HORSEPOWER PUMPS and MOTORS, SUBMERSIBLE PUMPS AND COAL BED METHANE WELLS.**

Description

The Model 777-KW/HP is a fully-programmable motor and pump protection relay with power-monitoring capability. Voltage, current and power measurements are displayed on the three-digit display, as well as fault information and setpoints. The display simplifies troubleshooting and allows the user to easily and precisely configure setpoints. The Model 777-KW/HP has the following adjustable protection features:

1) Low voltage
2) High voltage
3) Voltage unbalance
4) UL listed/CSA approved overload
5) Trip class (5, 10, 15, 20, 30)
6) Current unbalance
7) Ground fault
8) Low power
9) High power (via network only)
10) Rapid-cycle timer
11) Fault/overload restart delay
12) Underload restart delay
13) Underpower/overpower trip delay

Other user adjustable features include:

1) CT/loop multiplier so overcurrent and power setpoints can be made in actual amps, kW or hp
2) Number of restarts after faults - manual, automatic and semiautomatic options
3) Number of restarts after underload - manual, automatic and semiautomatic options
4) Network address

Adding the optional RS485MS-2W communications module activates the built-in Modbus RTU bus capabilities. The 777-KW/HP can communicate with the SymCom RM-1000 and RM-2000 remote display modules, PLCs, RTUs, SCADA systems, PCs and other similar control devices. Real-time operating parameters can be gathered and setpoints can be viewed or modified via the RS-485 bus using Modbus RTU protocol.

Protects 3-Phase Motors and Pumps from:

- Underload (Low KW or HP)
- High power
- Overload (UL listed)
- Jams
- Undervoltage
- Overvoltage
- Single-phasing
- Unbalance (voltage & current)
- Ground fault (Class II)
- Rapid cycling
- Phase reversal

Additional Features

- Fully programmable
- UL and CSA listed
- CE marked
- Automatic or manual reset
- Tamper guard
- RS-485 communications port
- Surface or DIN rail mountable
- Alphanumeric LED diagnostic display
- Last fault memory
- Up to 99 individually programmable addresses
- 5-year warranty
- Made in USA

New Features

- Network programmable
- Ability to clear last fault
- Remote setup, Diagnostics and control
- Remote data logging

SymCom Inc
Motor Protection & Controls Since 1974

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email: sales@electricmotorwholesale.com 11/05

PumpSaver®

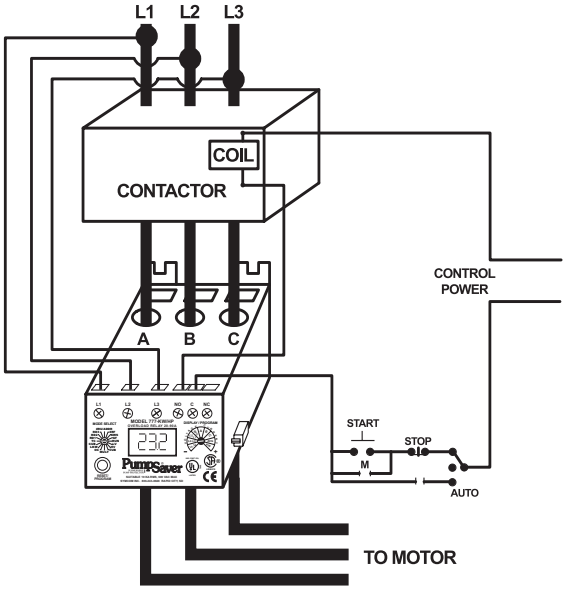
SUBMERSIBLE PUMP PROTECTOR

Specifications
•
Operating Points
•
Special Options

777-KW/HP
777-LR-KW/HP
777-575-KW/HP
777-HVR-KW/HP
777-HVR-LR-KW/HP

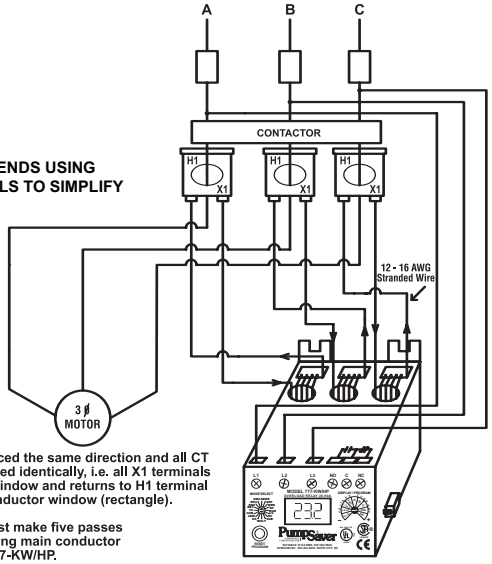
Power Monitor/Motor Protection Relay

TYPICAL WIRING DIAGRAM FOR
MODEL 777-KW/HP (20-90 AMPS)
& 777-LR-KW/HP (2-9 AMPS)



CURRENT TRANSFORMER WIRING DIAGRAM FOR
MODEL 777-KW/HP (80-800 AMPS)

SYMCOM RECOMMENDS USING CTs WITH TERMINALS TO SIMPLIFY INSTALLATION.



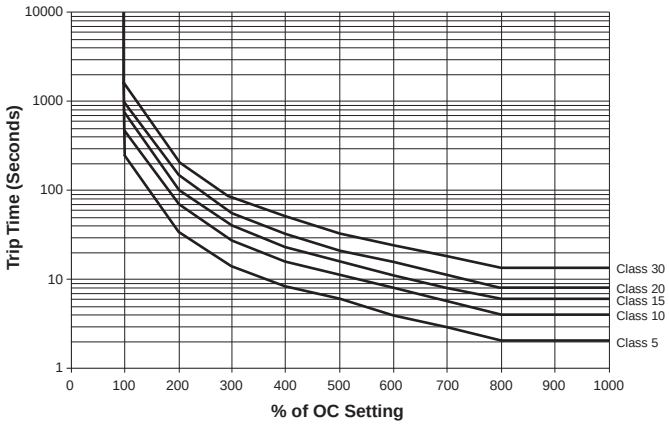
Note: All CTs must be faced the same direction and all CT secondaries must be wired identically, i.e. all X1 terminals enter the main (round) window and returns to H1 terminal after exiting the loop conductor window (rectangle).

Every CT secondary must make five passes through the corresponding main conductor window on the Model 777-KW/HP.

Wiring configuration based on motor amps.

Model	Full Load Amps	# of Loops	# of Conductors through A, B and C	MULT to Program (CT Ratio)
777-LR-KW/HP	1 - 2	1	2	2
	2 - 9	0	1	1
777-KW/HP	8 - 12	2	3	3
	12 - 25	1	2	2
	25 - 90	0	1	1
External CTs required. See wiring diagram for external CTs	80 - 110	4	5	100 (100:5)
	110 - 160	4	5	150 (150:5)
	160 - 220	4	5	200 (200:5)
	220 - 320	4	5	300 (300:5)
	320 - 420	4	5	400 (400:5)
	400 - 520	4	5	500 (500:5)
	480 - 600	4	5	600 (600:5)
	560 - 800	4	5	800 (800:5)

Overload Trip Classes



SymCom Inc
Motor Protection & Controls Since 1974

11/05

PumpSaver®
SUBMERSIBLE PUMP PROTECTOR

Specifications
•
Operating Points
•
Special Options

777-KW/HP
777-LR-KW/HP
777-575-KW/HP
777-HVR-KW/HP
777-HVR-LR-KW/HP

Power Monitor/Motor Protection Relay

Advantages:

- Integrated UL Listed/CSA approved electronic overload relay
- Greater underload sensitivity than power factor or current monitors
- Built-in undervoltage, overvoltage and unbalance protection
- Digitally programmable
- Remote programmability
- Digital display
- Optional remote display
- Data logging capabilities

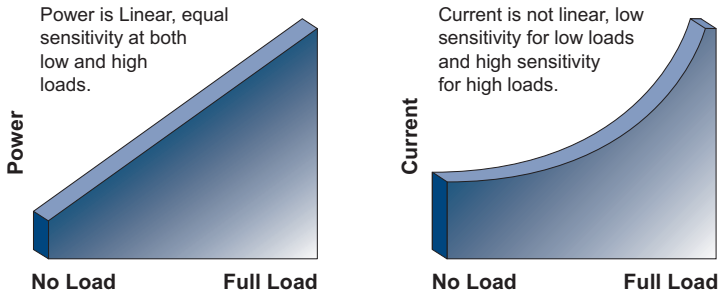
The Model 777-KW/HP has important advantages over current monitors in many protection applications. Any motor load that has a small or very non-linear change in current vs. load requires the use of a power monitor for underload, dry-run and dead-head protection. The change in power vs. load is more linear for most motor loads and is greater in magnitude than the change in current in all motor loads. This is because power measurements take into account both power factor (pf) and current.

Small motors, those under 3 hp and especially fractional horsepower, exhibit small changes in current vs. load but the change in power is large. When larger motors are derated, run below their rated horsepower, the change in current is small vs. load, but again, the change in power is large and linear. Other typical applications include slower speed mixer or agitator motors up to 50 hp and beyond. These motors and others that run slower than around 3400 rpm usually have small current changes vs. load.

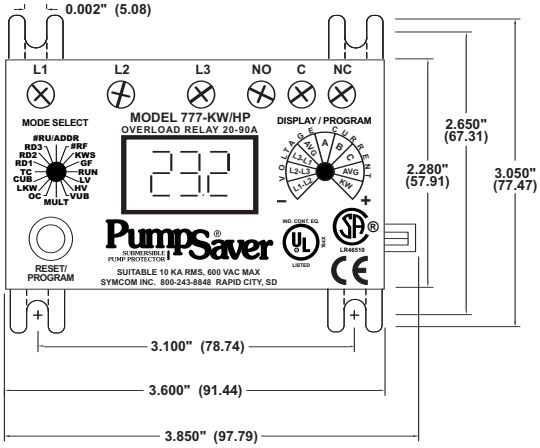
Magdrive and can pumps tend to be small horsepower, positive displacement-type pumps. These pumps need the high sensitivity of a power monitor to protect them from dry-run using the underpower feature and dead-head conditions using the underpower feature if the motor decouples from the pump and the overpower feature if the motor does not decouple.

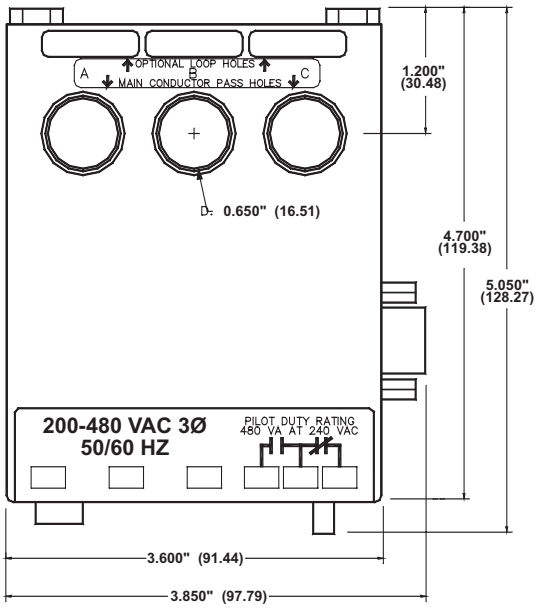
The built-in UL Listed/CSA approved overload, current unbalance, reverse-phase, single-phase and other protection features are significant benefits over similar products. The Modbus communications capability allows this device to be directly integrated with the SymCom RM-1000 and RM-2000 remote displays or other remote monitoring and control equipment.

777-KW/HP uses power measurements for sensitive underload protection, while using current measurements for UL listed overload protection.



Dimensions for All 777-KW/HP Units





SymCom Inc
Motor Protection & Controls Since 1974

Specifications

Electrical			
Input Voltage Ranges and Low and High Voltage Setpoints			
	Low Setpoint (LV)	Nominal Voltage Range	High Setpoint (HV)
777-KW/HP 777-LR-KW/HP	170-HV Setting	200-480 VAC	LV Setting - 528
777-HVR 777-HVR-LR	340-HV Setting	380-480 VAC	LV Setting - 528
777-575 777-575-LR	450-HV Setting	480-600 VAC	LV Setting - 660
Nominal Motor Full Load Current and Overcurrent Setpoint			
	Nom. Current Range	Overcurrent Setpoint (OC)	Ground Fault Setpoint (GF)
777, 777-HVR, 777-575	2-25A Looped	(20 to 100A)/MULT	OFF, (3 to 20A)/MULT
	25-90A Direct	20 to 100A	OFF, 3-20A
	80-800A Ext CTs	80-120% of CT Prim	OFF, 10-30% of CT Prim
777-LR, 777-HVR-LR, 777-575-LR	1-2.5A Looped	1-5A	0.15-1A
	2-9A Direct	2-10A	0.3-2A
Frequency	50/60 Hz		
Short Circuit	100 kA		
Power Consumption	10 Watts (max.)		
Output Contact Rating SPDT (Form C)			
All 777-XXX-XX KW/HP types except -HVR	Pilot duty rating: 480VA @ 240VAC		
	General purpose: 10A @ 240VAC		
	Max Voltage: 277VAC		
777-HVR-KW/HP	Pilot duty rating: 480VA @ 600VAC		
777-HVR-LR-KW/HP			
Expected Life			
Mechanical	1 x 10^6 operations		
Electrical	1 x 10^5 operations at rated load		
Accuracy at 25° C (77° F)			
Voltage	±1%		
Current	±3%(<100 Amps Direct)		
GF Current	±15%		
Timing	5% ± 1 second		
Repeatability			
Voltage	± 0.5% of nominal voltage		
Current	± 1% (<100 amps direct)		
Safety Marks			
UL	UL508, UL1053		
CSA	LR46510		
CE	IEC 60947-1, IEC 60947-5-1		
Standards Passed			
Electrostatic Discharge (ESD)	IEC 1000-4-2, Level 3, 6kV contact, 8kV air		
Radio Frequency Immunity (RFI), Conducted	IEC 1000-4-6, Level 3 10V/m		
Radio Frequency Immunity (RFI), Radiated	IEC 1000-4-3, Level 3 10V/m		
Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5 kV input power		
Surge			
IEC	1000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground		
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to 6kV line-line		
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)		
Vibration	IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis		
Shock	IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse		
Mechanical			
Dimensions	3.0"H x 5.1 " D x 3.6"W		
Terminal Torque	7 in.-lb.		
Enclosure Material	Polycarbonate		
Weight	1.2 lbs.		
Maximum Conductor Size Through 777-KW/HP	0.65" with insulation		
Environmental			
Temperature Range	Ambient Operating: -20° to 70° C (-4° to 158°F) Ambient Storage: -40° to 80° C (-40° to 176°F)		
Pollution Degree	3		
Class of Protection	IP20, NEMA 1		
Relative Humidity	10-95%, non-condensing per IEC 68-2-3		
Programmable Operating Points	**Range**		
LV, HV, OC, GF	See electrical specifications above		
UB- Voltage Unbalance Threshold	2 - 15% or 999%		
MULT- # of Loops or CT Ratio (XXX:5)	1-10 Loops or 100-800 Ratio		
LP- Low Power Setting	See Power Ranges Below or 0=off		
CUB- Current Unbalance Threshold	2 - 25% or 999%		
TC- Overcurrent Trip Class **	5, J5, 10, J10, 15, J15, 20, J20, 30, J30		
RD1- Rapid Cycle Timer	0, 2 - 500 Seconds		
RD2- Restart Delay After All Faults Except Underload (motor cool down timer)	2 - 500 Minutes		
RD3- Restart Delay After Underload (dry-well recovery timer)	2 - 500 Minutes		
#RU- Number of Restarts After Underload	0, 1, 2, 3, 4, A(Automatic)		
ADDR- RS485 Address	A01- A99		
#RF-Number of Restarts After All Faults Except Underload***	0, 1, oc1, 2, oc2, 3, oc3, 4, oc4, A, ocA		
Low Power (LP) / Power Range Setting (PWS)	1 = 0.01 - 0.99 KW	5 = 0.01 - 0.99 HP	
	2 = 1.00 - 9.95 KW	6 = 1.00 - 9.95 HP	
(PWS = LP Range)	3 = 10.0 - 99.5 KW	8 = 10.0 - 99.5 HP	
	4 = 100 - 650 KW	9 = 100 - 650 HP	

NOTES: SymCom's 777-KW/HP & 777-LR-KW/HP can be preprogrammed prior to installation by applying 120 VAC between the L1 and L2 terminals.

* 575 volt Model (MS 777-575-KW/HP)

** If J prefix is displayed in trip class setting, jam protection is enabled.

*** If "oc" is disabled in the #RF setting, the overcurrent will be included as a normal fault and the relay will automatically restart after RD2 expires, otherwise, manual reset is required after an overcurrent fault.

INSTALLATION INSTRUCTIONS FOR
MODELS 777-KW/HP, 777-LR-KW/HP,777-575-KW/HP,
777-HVR-LR-KW/HP, 777-HVR-KW/HP
POWER MONITOR/MOTOR PROTECTION RELAY
BE SURE POWER IS DISCONNECTED PRIOR TO INSTALLATION!
FOLLOW NATIONAL, STATE AND LOCAL CODES!
READ THESE INSTRUCTIONS ENTIRELY BEFORE INSTALLATION.

The Model 777-KW/HP is a solid-state power monitor/motor protection relay. It is fully-programmable for customized protection. It is designed to protect three phase systems operating on voltages from 190 to 480 VAC (500-600VAC for 777-575-KW/HP). The output relay is a Form C contact, which can control a contactor or other device within the output relay contact rating. The unit can be programmed prior to installation by applying 120VAC to terminals 'L1' and 'L2' (except 777-575-KW/HP and 777-HVR-KW/HP). The unit can NOT be tested for proper operation using this voltage. For testing purposes, three phase power needs to be used with a minimum voltage of 190VAC (450VAC for 777-575-KW/HP and 777-HVR-KW/HP).

DANGER!

HAZARDOUS VOLTAGES MAY BE PRESENT DURING INSTALLATION.
Electrical shock can cause death or serious injury.
Installation should be done by qualified personnel following all national, state and local electrical codes.

CONNECTIONS

1. Disconnect power and verify power is off.

2. Using the four corner tabs or the DIN rail mount, mount the 777 directly above or below the contactor. To use the DIN rail mount, hook the top clip first then apply downward pressure until the lower clip 'clicks' onto the rail.

3. A) For amperage ranging from 25-90 amps (2-9 Amps -LR types), insert the motor conductors through the holes marked 'A', 'B', and 'C'. Make certain that the conductor through each hole corresponds to the right motor conductor, i.e. the 'A' phase conductor should go through the 'A' round hole. See Figure 1 for a typical wiring diagram.
   B) For amperage less than 25 amps, loop the motor conductors according to Table 1. Figure 3 shows an example of the looping required for current ranging from 8.1 to 12 amps (MULT=3).
   C) For amperage greater than 90 amps, external CT's (current transformers) are required. SymCom recommends CT's with terminals be used for ease of installation. All CT secondaries must make five passes through the round holes on the PumpSaver. See Figure 2 for a typical wiring diagram using external CT's.
   NOTE: Pay close attention to this diagram to eliminate any power factor errors that will create errors in the horsepower measurements.

4. Connect the three phase power from the line side of the contactor to 'L1', 'L2', and 'L3' terminals using 12-18AWG copper wire (See Figure 1). Figure 1 is drawn for a power system wired in "ABC" phase sequence. For power systems with "ACB" phase sequence, switch L1 and L3 connections on 777-KW/HP input.

5. Connect the control circuit wires to the appropriate terminals. The relay is a fail safe design so the 'NO' contact should be in series with the coil on the contactor for motor control (see Figure 1). For alarm circuits, the 'NC' contact is in series with the alarm circuitry.

Model	Full Load Amps	# of Loops	# of Conductors through A, B and C	MULT to Program (CT Ratio)
777-XXX-LR-KW/HP	1 - 2	1	2	2
	2 - 9	0	1	1
777-KW/HP 777-HVR-KW/HP 777-575-KW/HP	2 - 2.5	9	10	10
	2.5 - 3	8	9	9
	3 - 3.5	7	8	8
	3.5 - 4	6	7	7
	4 - 5	5	6	6
	5 - 6	4	5	5
	6 - 8	3	4	4
	8 - 12	2	3	3
	12 - 25	1	2	2
	25 - 90	0	1	1
External CTs required. See wiring diagram for external CTs.	80 - 110	4	5	100 (100:5)
	110 - 160	4	5	150 (150:5)
	160 - 220	4	5	200 (200:5)
	220 - 320	4	5	300 (300:5)
	320 - 420	4	5	400 (400:5)
	400 - 520	4	5	500 (500:5)
	480 - 600	4	5	600 (600:5)
	560 - 800	4	5	800 (800:5)

Table 1: Wiring Configuration Based on Motor Full Load Amps

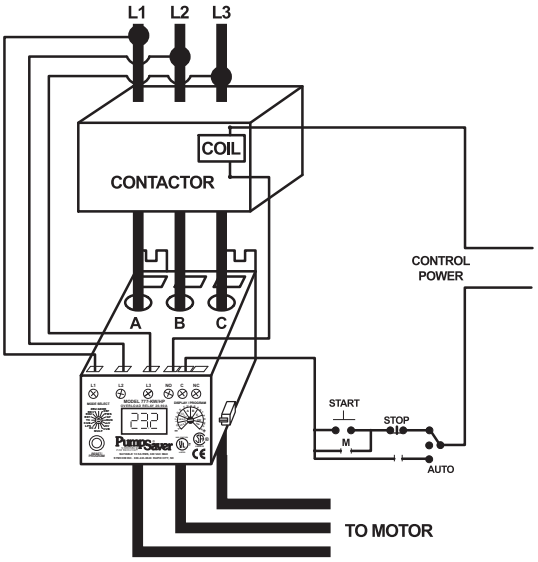


Figure 1: Typical Wiring Diagram for FLA of 26-90 ("ABC" phase sequence*)
***For input power configuration of "ACB" phase sequence, invert the L1 and L3 terminals on the 777-KW/HP.**

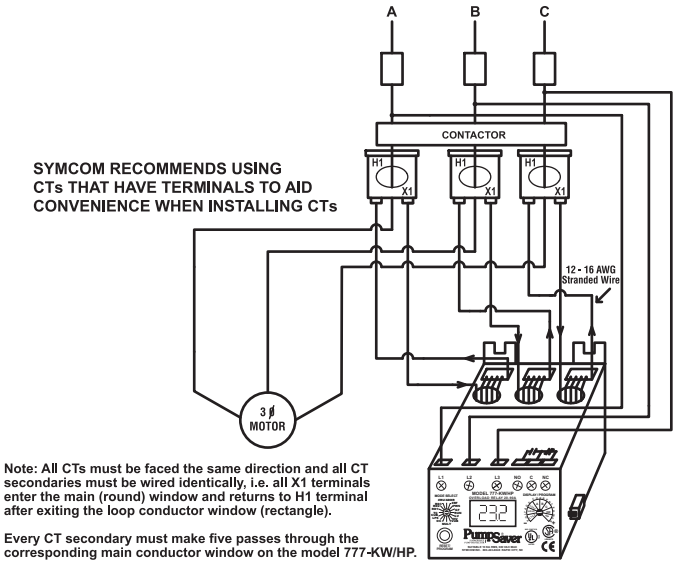


Figure 2: Typical Wiring Diagram Using External CTs.

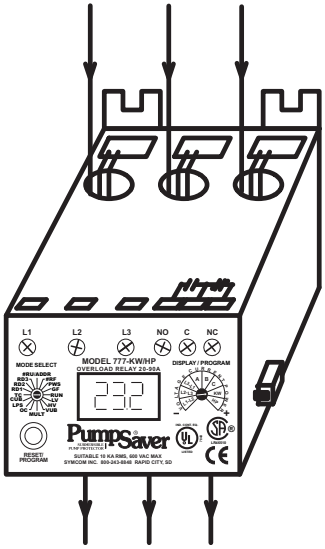


Figure 3: Looping Example Showing Three Conductors (MULT=3 from Table 1) (No other necessary connections are shown.)

! WARNING !

UNEXPECTED OUTPUT ACTUATION CAN OCCUR.
Use hard-wired safety inerlocks where personnel and/or equipment hazards exist.
Failure to follow this instruction can result in death, injury or equipment damage.

PROGRAMMABLE PARAMETERS

The programmable parameters are the parameters which the user MUST program to provide the correct protection for the application. All parameters are actual values except for the "VUB" and the "CUB" settings. These are programmed as percentages. The range these parameters can be programmed to is found on the electrical specifications on page 11. See page 7 for programming examples.

LV/HV - The recommended settings for LV (low-voltage) and HV (high-voltage) according to the NEMA MG1 standard are ±10% of the motors nameplate voltage. For other settings the motor manufacturer should be contacted. Example: The motor nameplate voltage is 230 volts. If we take 90% and 110% of 230 we get 0.9 x 230= 207 volts for the LV setting and 230 x 1.1= 253 volts for the HV setting. These parameters are based on the average voltage going to the motor.

VUB - VUB (voltage unbalance) is factory set at 6%. The NEMA MG1 standard says a motor should not be operated above a 1% voltage unbalance without **DERATING** the motor. Most utility supplied power sources have a difficult time sustaining a 1% VUB. The motor manufacturer should be consulted for an exact VUB setting. A setting of 999 for VUB will disable the VUB protection and SP (single phase protection).

The VUB is calculated as follows:

%VUB = [(Maximum deviation from the average)/Average] x 100%

Example: Measured line-line voltages = 203, 210, and 212, so the average = (203+210+212)/3 = 208.3, the maximum deviation from the average is the biggest difference between the average voltage (208.3) and any one voltage reading, 212-208.3 = 3.7, 210-208.3 = 1.7 and 208.3-203 = 5.3, therefore the maximum deviation from the average is 5.3. The VUB is then = 5.3/208.3 x 100= 2.5%

MULT - MULT (multiplier) setting is found from table 1. The MULT setting is determined by the current the unit will be monitoring. This allows the unit to display the correct current. Changing this setting will also change the "OC", and "GF" set points.

OC - OC (overcurrent) is usually set at the service factor amperage (typically 100-115% of motor FLA) of the motor, which is determined by the motor manufacturer. If any one leg of current exceeds the oc setting, the unit will follow its overload trip curve. (see Figure 4).

LP- LP (low power setting) is used to shut down the motor or pump on an underload condition. Setting LP to 0 disables the underload trip feature. LP is set in either kilowatts (KW) or horsepower (HP) depending on the PWS setting. NOTE: PWS must be set before setting LP.

HP- HP (high power setting) is used to shut down the motor or pump on an overpower condition. The High Power trip uses the underload trip delay and dry well recovery timer (RD3) to delay trips and restarts. The HP and underload trip delay settings can only be adjusted from the SymCom Solutions software or another software utility that can send Modbus write commands. The 777-KW/HP is shipped from the factory with this feature disabled.

CUB - CUB (current unbalance) is factory set to 7%. SymCom recommends the motor manufacturer be contacted for an exact setting. The CUB is calculated the same way the VUB is determined above. The CUB protection can be disabled by programming a 999 in this setting. This will disable current unbalance protection and current single phasing protection.

TC - TC (trip class) is the parameter used to determine when the unit will trip when an overload condition is detected. For standard motors, the TC is typically set at 20. The motor manufacturer should be contacted for exact TC settings. Table 2 and Figure 4 show the range of TC settings and trip times.

RD1 - RD1 (restart delay one) is the rapid cycle timer in seconds. This timer is initiated when power is first applied to the unit. If everything is okay (voltages are within the programmed limits and no SP or RP condition exists), after power is applied to the device and the RD1 time expires, the output relay will energize (the NO will close and the NC will open). Typically, this is set to 20-30 seconds. This will provide adequate protection for successive power outages or short cycling caused by other motor controls. This timer is also initiated when another control shuts the motor off (current goes to zero). If the user does not want the units' relay to de-energize when another control shuts the motor off, then RD1 should be set to zero. This will also assure that when an alarm circuit is used, an alarm will sound only when there is a true problem or when power is lost.

RD2 - RD2 (restart delay two) is the restart timer, in minutes, used when the unit has shut off due to a current unbalance, current single phasing, or an overload condition (if "oc" is the prefix to the number in #RF, see #RF description). This timer is known as a motor cool down timer. A setting of 5-10 minutes will give most motors adequate time to cool down after an overload condition. The motor manufacturer should be contacted for an exact value.

RD3- Restart Delay 3 (Dry Well Recovery Timer) RD3 can be set from 2-500 minutes or to 'A' to enable the Automatic Dry Well Recovery Calculator. The RD3 timer causes a restart delay after an under load (LP) trip.

The Automatic Dry Well Recovery Calculator allows the 777 to automatically select a restart delay based on the run time of the last run cycle. Table 2 shows the next restart delay vs. run time. In general a longer run time produces a shorter restart delay. This feature allows the 777 to optimize running and rest times automatically.

Run time	Next Restart Delay (min)	Starts/Hr
> 1hr	6	10
30 min - 59.99 min	15	4
15 min - 29.99 min	30	2
< 15 min	60	1

Table 2: State Table

#RU - The #RU/ADDR is a dual function setting. #RU can only be set to 0, 1, 2, 3, 4, or A. ADDR settings have the following format: Axx. The "xx" is any number combination from 01-99. This is how to identify which parameter is being programmed. The #RU settings cover from the 7 o'clock position to the 11 o'clock position. ADDR settings start after the 11 o'clock position. #RU (# of restarts after an underload) is the number of restarts after a low power trip condition before the unit locks and requires a manual restart. This counter will be cleared one minute after start-up if the unit does not trip again on LPR. A setting of zero means no automatic restarts after an under load. A setting of "A" means the unit will always automatically restart after an underload.

ADDR - ADDR (address) is the RS485 address of the particular device. This is only used when communicating with an RM-2000 (set ADDR=A01), RM-1000, a PLC, or PC. The ADDR can be programmed from A01-A99.

#RF - #RF (# of restarts after a fault) is the number of restarts allowed after a current unbalance, current single phasing, or an overload condition. A setting, which includes an "oc" prefix, will include over current in the number of successive restarts. If "oc" is not a prefix to the programmed setting, the unit will require a manual restart after an overcurrent. A setting of zero means the unit will not try to restart after a CUB, OC, or SP. A setting of "ocA" means the unit will always try to restart after a CUB, OC, or SP.

PWS - PWS (power scale) is the range setting for the LP setting.
1=0.01 - 0.99 KW; 2=1.00 - 9.95 KW; 3=10.0 - 99.5 KW; 4=100 - 650 KW
5=0.01 - 1.30 HP; 6=1.34 - 13.3 HP; 7=13.4 - 133.0 HP; 8=134 - 871 HP
Settings 1-4 will allow the LP setting to display in KW.
Settings 5-8 will allow the LP setting to display in HP.

GF - GF (ground fault) is the maximum allowable current, which can flow to ground before the unit de-energizes its relay. This is a residual, class II ground fault system and should not be used for personnel safety. A typical setting for this is 10%-20% of the motor full load current. The real GF current level is programmed into the unit. The GF test procedure on the last page of the installation instructions must be conducted before the device is brought online.

PROGRAMMING

1. Rotate the mode select switch to the parameter to be programmed. SymCom recommends that "LV" be programmed first and then move clockwise through the positions to complete the process.
2. Press and hold the "RESET/PROGRAM" button.
3. Rotate the "DISPLAY/PROGRAM" knob until the proper setting for the parameter that is being programmed is displayed in the LED display.
4. Release the "RESET/PROGRAM" button. This stores the new parameter in the nonvolatile memory. If the number changes back to what is was before programming, then the tamper guard is "on" and will need to be unlocked before programming can be completed.(See page 11 for tamper guard procedures.)
5. Continue steps 1-4 until all parameters are programmed.
6. The programming is now complete. Please see "Operations" section (p.6) for operating the unit.

Operation

The relay operation of the 777-KW/HP is a fail safe design. This means when everything is within the limits programmed into the unit, the relay will energize; the normally open (NO) contact will close and the normally closed (NC) contact will open. Once the unit has been wired and programmed, the unit is ready to operate. Turn the mode select to the "RUN" position. The display will show "RUN" alternating with some number (the numbers displayed will be the number corresponding to where the "DISPLAY/PROGRAM" knob is pointed). It will do this for the amount of time programmed into "RD1". After this time has expired, the relay will energize (normally open will close and normally closed contact will open). If something else is in the display, see the troubleshooting section for more information. If the mode select is taken out of the "RUN" position, the unit's relay will de-energize.

Trip Class	Application Description
5	Small fractional horsepower motors where acceleration times are almost instantaneous or where extremely quick trip times are required.
10	(Fast Trip) Hermetic refrigerant motors, compressors, submersible pumps and general purpose motors that reach rated speed in less than 4 seconds.
15	Specialized applications.
20	(Standard Trip) Most NEMA-rated general purpose motors will be protected by this setting.
30	(Slow Trip) Motors with long acceleration times (>10 seconds) or high inertia loads.
J Prefix	Programming any of the trip classes with the J Prefix will enable jam protection. This additional protection is enabled 1 minute after the motor starts and provides a 2 second trip time for motors exceeding 400% of the "OC" setting, regardless of trip class.

Table 3: Trip Class Descriptions

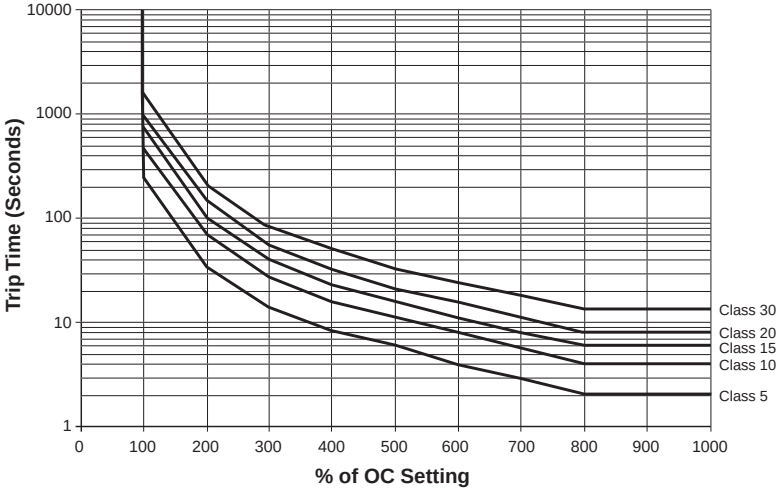


Figure 4: Overload Trip Curves

Programming Examples

Example
Pump To Be Protected: 3Ø, 460 Volt, 5 hp magnetic drive pump with a full load amperage rating of 7.1A and maximum service factor amps of 8.2. Use the following calculations and reasoning to determine the appropriate settings for this application. Use 777-LR-KW/HP from Table 1.

LV- 460 x 0.90 = 414

HV- 460 x 1.10 = 506

VUB- Standard NEMA motor = 5

MULT- From Table No. 1, Mult = 1 (777-LR-KW/HP)

OC- Service Factor Amperage = 8.2

LP- Normal pumping operation reads 2.86 KW
Pump with a momentarily restricted flow (dead head) reads 1.8 KW
Therefore setting is 2.0 KW (see PWS for proper range)

CUB- Standard NEMA motor = 5

TC- General purpose motor = 20

RD1- To protect the pump from accidental rapid cycling, RD = 20 seconds.

RD2- Because the motor may be hot from running in an unbalance or single phase condition, a motor cool down time of 10 minutes, RD2 = 10, should be appropriate.

RD3/#RU- Because an underload (low power) would signal a serious problem in this application (dead head), #RU should be set = 0 for a manual reset. Therefore, RD3 does not have any function.

#RF- Because an overload (overcurrent) fault signals a serious problem in this application (e.g., worn bearings), "oc" should not be included in the #RF setting so that a manual reset after an overload fault is required. A #RF=1 will give the system 1 chance to recover from an unbalance or single phasing problem before manual reset is required.

PWS- LP setting is 2.0 KW: therefore range = 2 (1.0 - 9.95).

GF- A ground fault setting of 15% of full load amps will be a significant indicator that the motor should be evaluated for repair or replacement. Therefore, GF = 7.1A x 0.15 = 1.0.

System Display

The output display can show one of the following parameters when the “MODE SELECT” switch is pointed at the “RUN” position: kilowatt or horsepower, each line current, or each individual line-line voltage. The display is also used for programming the operating parameters of the device. The display also identifies what caused the unit to de-energize its relay or what is keeping the unit from energizing its relay. The last fault, not the current fault, can be displayed by pressing and holding the “RUN/RESET” button while the “MODE SELECT” switch is in the “RUN” position. When the unit trips off or is holding the motor off, the current fault condition will be shown in the display without pressing the button. Table 3 below lists the fault codes the unit could display.

Displayed Message	Meaning
oc	Tripped on Overcurrent
SP	Tripped on current single phasing or unit won’t start because the voltage is sing phased.
ub	Tripped on current unbalance or unit won’t start because the voltage is unbalanced.
LPR	Tripped on Low Power
CF	Tripped on Contactor Failure
GrF	Tripped on Ground Fault
H I	A high voltage condition exists.
Lo	A low voltage condition exists.
rP	Incoming phases have been reversed. Your motor may run backward if started.
oFF	A stop command was issued from a remote source.

Table 4: Fault Codes and Their Meaning

Communications Port / Remote Reset

The unit comes with a 9-pin sub-D connector for remote communications and/or for using a remotely located reset button.

If communications are desired, a communication module (part number RS485MS-2W) needs to be plugged into this 9-pin connector (this is mandatory when communicating with the unit). This module provides isolation, signal conditioning for compatibility with Modbus RTU and RS485 networks, and provides terminals for terminating the shielded communications cable. Up to 99 units can be installed on one RS485 network. Further information can be obtained at http://www.symcominc.com or by calling in your request.

A remote reset button can be hooked up to the communications module (pn RS485MS-2W) or can be hooked directly to the 9-pin connector using a male sub-D connector. It should be wired as shown in Figure 5.

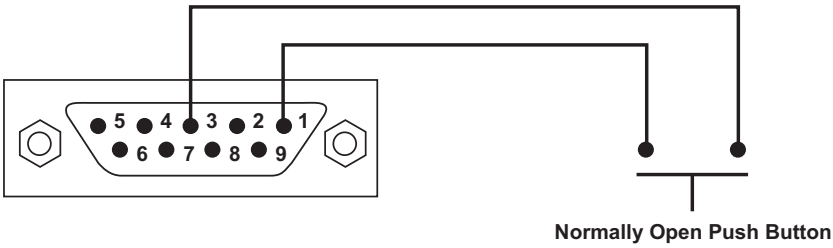


Figure 5: Remote Reset Button Wiring Diagram

Troubleshooting

The PumpSaver will display a fault code alternating with a number or with “run” when it is in a trip condition. If the unit is showing a fault code (see Table 5) alternating with the word “run”, then this indicates it has tripped on a current (amperage) condition. If the fault code is alternating with some number (voltage reading or zero) then the unit will not allow the motor to start because there is a problem with the incoming voltage. If the display is showing just a fault code, then the unit is in a mode that requires a manual reset. This could be because the number of restarts (#RF, #RU) has expired or is not allowed. If the display is showing ‘off’ then a stop command was issued through the communications network.

PROBLEM	SOLUTION
The unit will not start. Display alternates “rP” with the “DISPLAY / PROGRAM” switch parameter value.	The voltage inputs are reverse phased. If this is the initial start up, swap the leads connected to “L1” and “L3” on the 777-KW/HP to correct the problem. If the overload relay has been previously running, the power system has been reverse phased. Check the phase sequence of the incoming power lines. Note: “L1” must be tapped from conductor Phase A, “L2” from B, and “L3” from C for correct kilowatt measurements.
The unit will not start. Display alternates “SP”, “ub”, “HI”, or “Lo” with the “DISPLAY / PROGRAM” switch parameter value.	The incoming voltage is not within the limits programmed in the “VUB”, “HV”, and “LV” settings. Adjust the “DISPLAY / PROGRAM” switch to read the incoming line voltage values. Correct the incoming power problem and check programmed limits to verify they are correct.
Display alternates “SP”, “ub”, or “oc” with “RUN”	The overload relay has tripped on the fault shown on the LED display and is timing down “RD2” before restarting.
Display alternates “LPR” with “RUN”	The overload relay has tripped on low power (LPS) and is timing down “RD3” before restarting. If LPS is not a normal condition for this installation, check for loss of liquid, closed valves, broken belts, etc.
Display is showing a solid “SP”, “ub”, or “oc”	The unit has tripped on the fault shown and a manual reset is required because of the programmed setting in “#RF”. Check the system for problems that would produce the single phase, overload or current unbalance fault like a jam.
Display is showing a solid “LPR”	The unit has tripped on low power and a manual reset is required because of the setting in “#RU.” Check the system for problems that would produce a loss of load like a broken belt or a pump is out of liquid.
Display is showing a solid “CF”	The unit has tripped on a single phasing of the current, but was not single phased by the incoming voltage. Check for damaged contacts or loose wiring.
Display is showing a solid “GrF”	A ground fault current greater than the programmed “GF” value has been detected. A manual reset is required. Check the motor for insulation breakdown.
Unit displays currents when the motor starts but reads “0” KW or HP and trips on “LPR”after 4 seconds.	The unit is not wired properly to calculate correct power factor. See Figures 1, 2 & 3 (pages 2 & 3) for proper wiring and review step 4 in connection instructions (page 1).
Display alternates “HPR” with “RUN”	The overload has tripped on high power and is timing down RD3.
Display is showing solid “HPR”	The overload has tripped on high power and requires a manual reset.
Unable to change parameters	**See Tamper Guard Page 11**

Table 5: Troubleshooting

MODEL 777-KW/HP SPECIFICATIONS

Electrical			
Input Voltage Ranges and Low and High Voltage Setpoints			
	Low Setpoint (LV)	Nominal Voltage Range	High Setpoint (HV)
777-KW/HP 777-LR-KW/HP	170-HV Setting	200-480 VAC	LV Setting - 528
777-HVR 777-HVR-LR	340-HV Setting	380-480 VAC	LV Setting - 528
777-575 777-575-LR	450-HV Setting	480-600 VAC	LV Setting - 660
Nominal Motor Full Load Current and Overcurrent Setpoint			
	Nom. Current Range	Overcurrent Setpoint (OC)	Ground Fault Setpoint (GF)
777, 777-HVR, 777-575	2-25A Looped 25-90A Direct 80-800 A Ext CTs	(20 to 100A)/MULT 20 to 100A 80-120% of CT Prim	OFF, (3 to 20A)/MULT OFF, 3-20A OFF, 10-30% of CT Prim
777-LR, 777-HVR-LR, 777-575-LR	1-25A Looped 2-9A Direct	1-5A 2-10A	0.15-1A 0.3-2A
Frequency	50-60 Hz		
Short Circuit	100 kA		
Power Consumption	10W (Maximum)		
Output Contact Rating SPDT (Form C)			
All 777-XXX-XX KW/HP types except -HVR	Pilot duty rating: 480 VA @ 240 VAC General purpose: 10A @ 240 VAC Max Voltage: 277 VAC		
777-HVR-KW/HP 777-HVR-LR-KW/HP	Pilot duty rating: 480 VA @ 600 VAC		
Expected Life			
Mechanical	1 x 10^6 operations		
Electrical	1 x 10^5 operations at rated load		
Accuracy at 25° C (77° F)			
Voltage	±1%		
Current	±3%(<100 Amps Direct)		
GF Current	±15%		
Timing	5% ± 1 second		
Repeatability			
Voltage	± 0.5% of nominal voltage		
Current	± 1% (<100 amps direct)		
Ground Fault Trip Delay			
101%-200% of Setpoint	8 sec. +/- 1 sec		
201%-300% of Setpoint	4 sec. +/- 1 sec		
301%-400% of Setpoint	3 sec. +/- 1 sec		
401% or Greater	2 sec. +/- 1 sec		
Current Unbalance Trip Delay	(30 seconds) / (% over setpoint) see examples below		
% Over Setpoint Trip Time	% Over Setpoint Trip Time		
1% 30 sec	5% 6 sec		
2% 15 sec	6% 5 sec		
3% 10 sec	10% 3 sec		
Safety Marks			
UL	UL508, UL1053		
CSA	LR46510		
CE	IEC 60947-1, IEC 60947-5-1		
Standards Passed			
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kv contact, 8kv air		
Radio Frequency Immunity (RFI), Conducted	IEC 61000-4-6, Level 3 10V/m		
Radio Frequency Immunity (RFI), Radiated	IEC 61000-4-3, Level 3 10V/m		
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5 kv input power		
Surge			
IEC	61000-4-5, Level 3, 2kv line-to-line; Level 4, 4kv line-to-ground		
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to 6kv line-line		
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)		
Vibration	IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis		
Shock	IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse		
Mechanical			
Dimensions	3.0"H x 5.1 " D x 3.6"W		
Terminal Torque	7 inch•lb		
Enclosure Material	Polycarbonate		
Weight	1.2 lbs		
Maximum Conductor Size Through 777-KW/HP	0.65" with insulation		
Environmental			
Temperature Range	Ambient Operating: -20° - 70° C (-4° - 158°F) Ambient Storage: -40° - 80° C (-40° - 176°F)		
Pollution Degree	3		
Class of Protection	IP20, NEMA 1		
Relative Humidity	10-95%, non-condensing per IEC 68-2-3		

MODEL 777-KW/HP SPECIFICATIONS CONTINUED

Programmable Operating Points	Range
LV, HV, OC, GF	See electrical specifications above
UB- Voltage Unbalance Threshold	2 - 15% or 999%
MULT- # of Loops or CT Ratio (XXX:5)	1-10 Loops or 100-800 Ratio
LP- Low Power Setting	See Power Ranges Below or 0=off
CUB- Current Unbalance Threshold	2 - 25% or 999%
TC- Overcurrent Trip Class **	5, J5, 10, J10, 15, J15, 20, J20, 30, J30
RD1- Rapid Cycle Timer	0, 2 - 500 Seconds
RD2- Restart Delay After All Faults Except Underload (motor cool down timer)	2 - 500 Minutes
RD3- Restart Delay After Underload (dry well recovery timer)	2 - 500 Minutes
#RU- Number of Restarts After Underload	0, 1, 2, 3, 4, A(Automatic)
ADDR- RS485 Address	A01- A99
#RF-Number of Restarts After All Faults Except Underload***	0, 1, oc1, 2, oc2, 3, oc3, 4, oc4, A, ocA
Low Power (LP) / Power Range Setting (PWS) (PWS = LP Range)	1 = 0.01 - 0.99 KW 5 = 0.01 - 0.99 HP 2 = 1.00 - 9.95 KW 6 = 1.00 - 9.95 HP 3 = 10.0 - 99.5 KW 8 = 10.0 - 99.5 HP 4 = 100 - 650 KW 9 = 100 - 650 HP

NOTES: SymCom's Power Monitor/Motor Protection Relay can be preprogrammed prior to installation by applying 120 VAC between the L1 and L2 terminals (except 575 Volt model). Power applied must be 110 VAC or greater.

* 575 Volt Model.

** If J Prefix is displayed in trip class setting, jam protection is enabled.

*** If "oc" is displayed in the #RF setting, then overcurrent will be included as a normal fault and the relay will automatically restart after RD2 expires, otherwise, manual reset is required after an overcurrent fault.

**** Given current range within nominal specified range and power factor must be > 60%

Clearing Last Fault

The last fault stored can be cleared on the PumpSaver.
This procedure is outline as follows:

1. Rotate the Mode Select Switch to 'GF'.
2. Press and hold the Reset/Program Button. Adjust the Display/Program adjustment until cLr appears on the display. Release the Reset/Program Button.

To verify the last fault was cleared, place the Mode Select switch in the Run position. Then press and hold the Reset/Program Button, cLr should be on the display.

Tamper Guard

The PumpSaver can be protected from unauthorized program changes by locking in the setpoints.
This procedure is outlines as follows:

1. Rotate the Mode Select switch to 'GF'.
2. Rotate Display/Program adjustment fully clockwise.
3. Press and hold the Reset Button. Adjust the Display/Program adjustment until 'Loc' appears in the display.
4. Release the Reset Button.
5. Turn Mode Select switch to 'run'.

The program is now locked, but all settings can be viewed. The unit can be unlocked by following the procedure above except step three. This step should say: Press and hold the Reset Button. Adjust the Display/Program adjustment until 'unL' appears in the display.

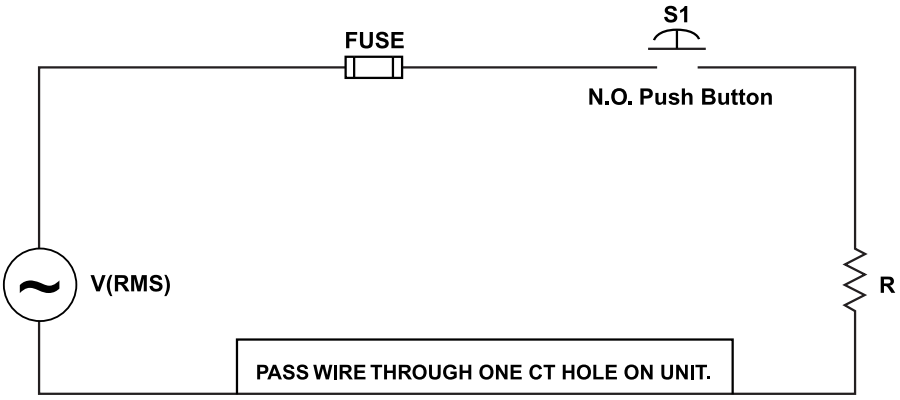
Network Tamper Guard

The PumpSaver can be protected from unauthorized program changes by locking each set point via the network. These set points can only be unlocked if the password is known. This feature is only available with SymCom Solutions software. For more information please call the factory.

The GF test must be performed before installing the PumpSaver as required by UL1053 and NEC, ANSI/NFPA 70.

Ground Fault Testing Procedure

1. Disconnect power
2. Hook up the three line voltages to L1, L2, and L3 as required by the installation instructions.
3. Program the desired parameters into the unit. For test purposes, set MULT to one and GF to the minimum allowed setting.
4. Construct the circuit below, using an AC power supply. This circuit simulates a ground fault condition by generating a current in one of the phases. Alternate test circuits may be used. The only requirement is the current through the current transformer must be between 115% and 150% of the GF setting and pass through only one CT window.



5. The values of V and R will be determined by the current required to generate a GF trip condition: I = Vrms/R, where I = 115% of GF setting.
6. Place the unit in the run position, apply three phase power and allow the N.O. contact to close.
7. Energize the test circuit by pushing and holding the test push-button until the unit trips (within 8.5 seconds). The display should show GrF and the N.O. contacts should be open. Release the N.O. push button.
8. The results of the test are to be recorded on the test form provided. The form should be kept by those in charge of the buildings electrical installation in order to be available to the authority having jurisdiction.
9. Confirm programmed parameters and proceed with installation instructions.

Ground Fault Test Results*

Date	Performed by	Results	Location

*A copy of this form should be retained by buildings electrical foreman.

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Proline Prowirl 72F, 72W, 73F, 73W

Vortex flow measuring system
Reliable flow measurement of gas, steam and liquids

Application
For the universal measurement of the volume flow of gases, steam and liquids.
The mass flow of steam, water (as per IAPWS-IF97 ASME), natural gas (as per AGA NX-19/AGA8-DC92 detailed method/AGA8 Gross Method 1/SGERG-88), compressed air, other gases and liquids can also be measured with the aid of integrated temperature measurement and by reading in external pressure values (optional).

Maximum range of applications thanks to:
- Fluid temperature range from –200 to +400 °C (–328 to +752 °F)
- Pressure ratings up to PN 250/Class 1500
- Sensor with integrated (optional) diameter reduction by one line size (R Style) or two line sizes (S Style)
- Dualsens version (optional) for redundant measurements with two sensors and electronics

Approvals for:
- ATEX, FM, CSA, TIIS, NEPSI, IEC
- HART, PROFIBUS PA, FOUNDATION Fieldbus
- Pressure Equipment Directive, SIL 2

Your benefits
The robust **Prowirl sensor**, tried and tested in over 100 000 applications, offers:
- High resistance to vibrations, temperature shocks, contaminated fluids and water hammer
- No maintenance, no moving parts, no zero-point drift ("lifetime" calibration)
- Software initial settings save time and costs

Additional possibilities:
- Complete saturated steam or liquid-mass measuring point in one single device
- Calculation of the mass flow from the measured variables volume flow and temperature in the integrated flow computer
- External pressure value read-in for superheated steam and gas applications (optional)
- External temperature value read-in for delta heat measurement (optional)

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People for Process Automation

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FM+SGML 6.0 ProMoDo

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Waterpilot FMX167

Hydrostatic level measurement
Reliable and robust level probe with ceramic measuring cell
Compact device for level measurement in fresh water, wastewater and saltwater

Application

The Waterpilot FMX167 is a pressure sensor for hydrostatic level measurement.
Three versions of FMX167 are available at Endress+Hauser:

- FMX167 with a stainless steel housing, outer diameter of 22 mm (0.87 in): Standard version suitable for drinking water applications and for use in bore holes and wells with small diameters
- FMX167 with a stainless steel housing, outer diameter of 42 mm (1.66 in): Heavy duty version, easy clean flush-mounted process diaphragm. Ideally suited to wastewater and sewage treatment plants
- FMX167 with a coated housing, outer diameter of 29 mm (1.15 in): Corrosion resistant version generally for use in saltwater, particularly for ship ballast water tanks.

Your benefits

- High mechanical resistance to overload and aggressive media
- High-precision, robust ceramic measuring cell with long-term stability
- Climate proofed sensor thanks to completely potted electronics and 2-filter pressure compensation system
- 4 to 20 mA output signal with integrated overvoltage protection
- Simultaneous measurement of level and temperature with optionally integrated Pt100 temperature sensor
- Usage in drinking water: KTW, NSF
- Approvals: ATEX, FM and CSA
- Marine certificate: GL, ABS
- Extensive range of accessories provides complete measuring point solutions

TI351P/00/EN/08.10
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Additional documentation

Field of activities	■ Pressure measurement: FA004P/00/EN ■ Recording technology: FA014R/09/EN ■ System components: FA016K/09/EN
Technical Information	■ Technical Information Waterpilot FMX21 with 4 to 20 mA with HART output signal: TI431P/00/EN ■ Technical Information Deltapilot M: TI437P/00/EN ■ Temperature Head Transmitter iTEMP PCP TMT181: TI070R/09/EN
Operating Instructions	■ Waterpilot FMX167: BA231P/00/EN ■ Cable shortening kit: SD552P/00/A6
Safety instructions	■ ATEX II 2 G Ex ia IIC T6: XA131P/00/A3 ■ ATEX II 3 G Ex nA II T6: XA132P/00/A3
Installation/Control Drawings	■ FM IS Class I, Div. 1, Groups A – D: ZD063P/00/EN ■ CSA IS Class I, Div. 1, Groups A – D: ZD064P/00/EN
Drinking water approval	■ SD126P/00/A3

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