Immediate Procedure Change (IPC) Cover			
Section 1 – Originator Request			
Document No.: SOP-5232		Revision No.: 1	IPC No.: 3
Title: Groundwater Sampling			
Description of need and requested action (Attach document mark-up and numbered additional sheets, if needed): IPC-3 Supersedes IPC-1 and IPC-2. Clarification to calibration of field parameter instruments to make sure instruments are calibrated in similar conditions to sample media. Option included to contact STR or Technical lead for direction. Checklist for sample parameter stabilization was developed for record keeping. Requirement to purge less than 5 gpm was removed from SOP.			
Originator Name (print): Margaret Casaus	Organization: BPS-DO	Z#: 102065	Date: 1/11/11

Section 2 –Reviews			
Discipline:	Name:	Signature:	Date:
Well Sampling Tech. Lead	Tim Goering	Tim Goering	1/11/11
USQ/USI Number: WDPNES-10-480-D, R0			☐ N/A

Section 3– Final Approvals			
FOD Concurrence: N/A	Print Name and Title:	Z#:	Date:
☒ Permanent ☐ Limited Use	Effective Date: 1/11/2011 Expiration Date: 9/23/2013		
Comments:			
Responsible Manager Signature:	Print Name and Title: Craig Douglass, ADEP –CAP Deputy Director	Z#: 216051	Date: 1/11/11

Identifier: **SOP-5232**	Revision: **1, IPC-3**	Los Alamos NATIONAL LABORATORY EST. 1943
Effective Date: 1/11/11	Next Review Date: 9/23/2013	

Environmental Programs Directorate

Standard Operating Procedure

For **GROUNDWATER SAMPLING**

APPROVAL SIGNATURES:

Subject Matter Expert:	Organization	Signature	Date
Tim Goering	ET-EI	Signature on File	9/22/10
Quality Assurance Specialist:	**Organization**	**Signature**	**Date**
Paul Lowe	QA-IQ	Signature on File	9/22/10
Responsible Manager:	**Organization**	**Signature**	**Date**
Craig Douglass	CAP	Signature on File	9/22/10

1. PURPOSE AND SCOPE

This standard operating procedure (SOP) describes the process for purging, collecting, documenting, and submitting groundwater samples, as well as setting up and breaking down the appropriate equipment, obtained from wells using an electric Gear-driven Submersible Pump (GSP) system, a bladder pump system, the Bennett pump system, the Baski pumping system, and portable versions of the bladder pump and the Bennett pump. This procedure applies to all personnel assigned to collect groundwater samples using the methods discussed. Groundwater sampling utilizing the Westbay MP System is covered under SOP 5225, Groundwater Sampling Using the Westbay MP System.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Water that remains in a monitoring well for a period of time may not be representative of formation water because of physical, chemical, or biological changes that may occur as the water remains in contact with the well casing, dedicated sampling equipment, and the air space in the upper casing. This stagnant water may not represent formation water at the time of sampling. To ensure that samples collected from a monitoring well are representative of formation water, stagnant water in the casing must either be removed (full purge) or isolated from the sampling zone within the well before sampling is conducted. It is preferred to use low-flow purge and sampling techniques when performing these activities. However, in many cases, wells completed in higher-yield formations are sampled using traditional sampling techniques.

Ideally, a well should be purged with minimal drawdown until field water-quality indicator parameters stabilize. Once the parameters stabilize, it is presumed that all stagnant water has been removed from the well, and that fresh formation water is available for sampling. The most sensitive indicator parameters are dissolved oxygen (DO) and turbidity. Other parameters, such as water temperature, specific conductance, pH, and oxidation-reduction potential (ORP) are also monitored, but are less sensitive indicators of formation water. Water-quality indicator parameters are monitored at 5- to 30-min intervals until stability has been achieved. The criteria for defining stability are discussed in section 4.3, Purging Operations. ORP is monitored during purging but is not used to define stability.

Personnel performing this work should be aware of hazards and recommended safety practices before setting up and operating pump and pressure systems.

This procedure has been developed to be consistent with the requirements of the March 1, 2005, Compliance Order on Consent and with the Interim Facility-Wide Groundwater Monitoring Plan (the Interim Plan).

2.2 Precautions

- If any issues arise in the field that would cause a variation on the sample collection as described in this SOP, the field team leader (FTL) shall contact the Groundwater Technical Leader, if possible, to resolve these issues before continuing with sampling.
- If unusual conditions occur at the sampling site or during the sampling that might affect the sampling results, the FTL shall discuss such conditions with the Groundwater Technical Leader.
- Decontaminate all equipment that will be placed inside the well in accordance with the provisions of EP-ERSS-SOP-5061, Field Decontamination of Drilling and Sampling Equipment.
- Before sampling, ensure that a process is in place for storing and disposing of purged water and that proper storage capacity is available for any purge water generated.
- To minimize the potential for cross contamination, use dedicated sampling equipment whenever possible. Equipment blanks should be taken before use of non-dedicated equipment in accordance with the quality assurance/quality control (QA/QC) requirements specified in the Interim Plan.

3. EQUIPMENT AND TOOLS

Refer to Attachment 1, Equipment and Supplies Checklist for Groundwater Sampling.

4. STEP BY STEP PROCESS DESCRIPTION

4.1 Sampling Preparation

Field Team Leader	1.	Print out the applicable analytical request/chain-of-custody form(s) from the Sample Management Office (SMO) database before leaving for field.
	2.	Review the sampling plan for the current sampling activity to ensure that samples are collected as specified and discuss any purging, sample collection, or site issues with the Groundwater Technical Lead.
	3.	Obtain and review pertinent information, such as the well construction diagrams or the well completion report. This information will be entered on the Groundwater Sampling Log (Attachment 2).
	4.	Contact the waste coordinator for instructions on containerization or other waste handling measures. Samplers will use the appropriate waste disposal path for all other generated wastes.
	5.	Ensure that work activities are on an approved plan of the day (POD) for the appropriate facility in which work will be performed before starting any field or laboratory activities.
	6.	Notify the appropriate facility personnel before working in restricted areas to ensure your names are included in the plan of the week/plan of the day for that location.
	7.	Assemble the required equipment and supplies for the particular pump system according to the Equipment and Supplies Checklist for Groundwater Sampling (Attachment 1).
	8.	Calibrate field parameter instruments. As recommend in the USGS National Field Manual for the Collection of Water-Quality Data, calibration should be conducted in temperature conditions similar to the water being monitored. The temperature of groundwater at the Pajarito Plateau ranges from 17 to 22 ºC. This is nearly the same as room temperature (approximately 18-21ºC). Calibration of instruments to be used to sample groundwater can be completed indoors at the TA-59 lab. When sampling shallow alluvial wells, springs, or baseflow, seasonal temperature considerations should be taken into account for determining whether calibrating at the sample site or indoors is appropriate. All instrument calibration is to be completed in accordance with manufacturer's instructions. IPC-3 *NOTE If sampling at multiple locations within the same day, perform calibration check at each subsequent sampling site.

4.2 System Setup for Sampling

Field Team Member	1.	Mobilize the support equipment required for purging and sampling the well.
	2.	If a large generator is required, follow the guidance contained in ENV-WQH-SOP-014, Large Generator Use for Pumping.

Field Team Member (continued)	3	Follow the appropriate attachment for setup of the pumping system to be used: • Attachment 3—Electric Gear-driven Submersible Pump System • Attachment 4—Bladder Pump System • Attachment 5—Bennett Pump system • Attachment 6—Baski Pumping systems • Attachment 7—Portable Bladder Pump system • Attachment 8—Portable Bennett Pump system
	4	Set-up the flow-through cell System and field parameter instruments to be used during the purging operation.

4.3 Purging Operations

Field Team Member	1.	Determine the depth of the water table utilizing one of the methods below and record on the Groundwater Sampling Log (Attachment 2). • If the well has a water-level transducer installed, record the water-level elevation on the Groundwater Sampling Log (Attachment 2). • If a water-level transducer is not present, determine the water level using one of the methods described in SOP-5223, Manual Groundwater Level Measurements and record the depth to water on the Groundwater Sampling Log (Attachment 2). [NOTE: Alluvial wells may have water-level transducers, but alluvial water levels should be manually measured. Alluvial transducers are often located above the pump and are often set to depth, as opposed to water-level elevation.]
	2.	Determine the volume of water in the casing as follows: • Determine the linear feet of water column by the difference between the total depth of well and the water level determined in Step 1 above. • Calculate the casing volume using the well diameter multiplier (found in the Logbook Front Matter). • If the well has a dedicated pump, calculate the volume of water in the drop pipe by subtracting the water-level elevation from the surface elevation and using the drop pipe diameter multiplier (found in the Logbook Front Matter). [Note: This step is unnecessary for Alluvial wells, due to the negligible contribution from the drop pipe.] • If the well is a dual-screen well, casing volume calculations are complicated by the presence of packers in the water column. Refer to well completion information to determine the appropriate water column value.

Field Team Member (continued)

2.

- Determine the minimum required purge volume based on whether the well is completed in an alluvial aquifer, or in an intermediate/regional aquifer.
  - Alluvial wells are to be purged a minimum of 1 casing volume (CV) and until water quality parameters stabilize as defined in Section 8 below.
  - Intermediate and regional wells are to be purged a minimum of 3 CVs plus the volume of the drop pipe and until water quality parameters stabilize as defined in Section 8 below.
- Deviations to the prescribed purge volumes above, is acceptable if required, as documented in an approved work plan.
- Record the calculated 1 CV and 3 CV purge volumes on the Groundwater Sampling Log in Attachment 2.

3. Begin pumping following the steps in the appropriate attachment for the pump being operated:

- Attachment 3—electric Gear-driven Submersible Pump system
- Attachment 4—Bladder Pump System
- Attachment 5—Bennett Pump system
- Attachment 6—Baski Pumping systems
- Attachment 7—Portable Bladder Pump system
- Attachment 8—Portable Bennett Pump system

4. The pumping rate should be adjusted, if possible, during purging so that excessive drawdown does not occur. Field crews may have limited ability to restrict flow, depending on the pumping system.

- Drawdown within alluvial wells should be limited to above the screened interval, if possible. Alluvial pumping systems must be shut off if water level approaches the bottom of the screened interval. Alluvial pumping rates should not exceed 1 liter per minute.
- Drawdown within intermediate and regional wells should be limited to above the screened interval. The pumping system should be shut off if water level is rapidly dropping while approaching the top of the screened interval.

5. Determine the discharge rate using one of the following methods and record in Attachment 2:

- If an in-line flow meter is installed, record the flow rate.
- Calculate the discharge rate by filling a bucket or bottle of known volume and record the fill time. Flow rate should be monitored at regular intervals during purge, preferably once per casing volume and while the drop pipe is being cleared.

Field Team Member (continued)	6.	Measure the parameters indicated below every 5 minutes for the first half hour, every 10 or 15 minutes for the next hour, and every 30 minutes thereafter, or at the FTL's discretion based on sampling conditions. Record the data in the Groundwater Sampling Log (Attachment 2). • pH • Temperature • Specific conductance • Dissolved Oxygen • Turbidity • Oxidation-Reduction Potential (ORP) • Water level • Observations of water clarity, color tinting, and odors.
	7.	Review the parameters being monitored periodically (about every casing volume) and recalculate the discharge rate as described in Step 5 above.

Field Team Member (continued)

8. Sampling depends on the purge requirements in the Interim Plan. In general, the well is ready to sample when the following conditions are met:

- Water-level drawdown has stabilized within the well's allowable limits per Section 4.3-4 of this SOP.
- A minimum of one casing volume has been removed for alluvial wells and a minimum of three casing volumes (plus drop pipe) have been removed for intermediate or regional wells. Note: in some cases, deviations from these purge volume requirements may be requested by the groundwater monitoring project leader to meet other regulatory or technical data quality objectives. Exceptions to this requirement are the wells DT-5a, DT-9 and DT-10 all of which only require one casing volume to be purged before sampling. IPC 3
- The field indicator parameters have stabilized within their allowable ranges for at least three consecutive measurements a minimum of 5 minutes apart, if there is sufficient purge time. In accordance with the Essential Handbook of Ground-Water Sampling (Nielsen and Nielsen, 2007) stabilization is defined as the point at which measured values are within the criteria listed below for all parameters for three consecutive readings. IPC 3

Field Parameter	Stabilization Criteria
Turbidity	<5 nephelometric turbidity units (NTUs), if possible; If turbidity remains >5 NTUs, ± 10% of the reading
Dissolved Oxygen	± 0.3 mg/L,
pH	± 0.1 pH units
Specific Conductance	± 3%
Temperature	± 0.2 ^{o}C

- If the field parameters do not stabilize after approximately 4-6 CV has been purged, the sampling team should contact the groundwater technical lead, the STR, or the project manager for further direction. IPC 3
- ORP should be monitored during purging but is not a criterion used to define stability.
- Alluvial wells often have excessive drawdown issues, and therefore are subject to different sampling requirements:
  - If an alluvial well has turbidity > 5 at 1 CV, it must be purged until turbidity < 5 or the purge has reached 3 CV's. At 3 CV's, it may be sampled if the turbidity is stable (± 10% of the reading).
  - If a well purges dry before it has met CV and stability requirements, the well should be sampled as soon as sufficient groundwater has entered the well to enable collection of the necessary groundwater samples. Re-purging should be performed if a well is inactive for more than 24 hours after full recharge. In many cases, an abbreviated analytical suite must be collected due to insufficient water. The abbreviated suite prioritization is provided by the Groundwater Technical Lead.
  - In situations where the well purges dry during sampling but recovers quickly, the sampling event may be interrupted to permit recharge.

	9.	Record the final indicator parameters and water level in the Groundwater Sampling Log (Attachment 2).
	10.	Record purge volume (volume purged at time of sampling minus the drop pipe volume) in the Groundwater Sampling Log (Attachment 2).

4.4 Sampling

Field Team Member	1.	Remove in-line flow-through monitoring instruments from sampling apparatus.
	2.	Observe the following general precautions for beginning sampling operations: • The rate at which a well is sampled should not exceed the rate at which it was purged. • Decontaminated sampling equipment should not come into contact with the ground. • Groundwater samples should be collected as soon as possible after the well is purged. Water that has remained in the well casing for more than 2 hours has had the opportunity to exchange gases with the atmosphere and to interact with the casing material.
	3.	Collect water samples in the order of priority as dictated by the Groundwater Technical Lead. If specific guidance is not available, the preferred collection order for some of the more common groundwater analytes is as follows: • Volatile organics (VOAs or VOCs) and total organic halogens (TOX) • Dissolved gases and total organic carbon (TOC) • Semivolatile organics (SVOCs) • Metals and cyanide • Major water quality cations and anions • Radionuclides.
	4.	Record the final water-level immediately after sampling on the Groundwater Sampling Log (Attachment 2). Record the total volume of waste water generated, as well as the contact waste volume.
	5.	Preserve the samples with the appropriate preservatives as identified on the field chain of custody form. Refer to EP-ERSS-SOP-5058, Sample Control and Field Documentation for specific guidance. Filtration should be performed in the field or as soon after sample collection as possible.
	6.	Seal the lid of every sample container with a custody seal (i.e., custody tape) to ensure samples are not tampered with.
	7.	Complete the field chain-of-custody form for each sample set collected.
	8.	Handle, package, and transport samples in accordance with EP-ERSS-SOP-5057, Handling, Packaging, and Transporting Field Samples.

Field Team Member (continued)	9.	Transport all sealed sample containers directly to the SMO. If this is not possible, store samples and their chain of custody forms overnight in the locked refrigerator at TA-64.
4.5		**System Disassembly/Breakdown**
Field Team Member	1.	Remove and rinse any equipment that has been in contact with the groundwater stream such as the water-level measuring tape, in-line flow-through cell and all monitoring parameter probes using deionized (DI) water, and wipe dry with a paper towel. Refer to EP-ERSS-SOP-5061 and the applicable attachment for specific guidance.
	2.	Secure contact waste in a labeled drum.
	3.	Secure the waste water container(s).
	4.	Secure all field equipment.
	5.	Secure and lock well.
4.6		**Records Management**
Field Team Member	1.	Maintain and submit records and/or documents generated to the Records Processing Facility according to EP-DIR-SOP-4004, Records Transmittal and Retrieval Process.

5. DEFINITIONS

None.

6. PROCESS FLOW CHART

Not applicable.

7. ATTACHMENTS

Attachment 1 Equipment and Supplies Checklist for Groundwater Sampling

Attachment 2 Groundwater Sampling Log

Attachment 3 Electric Gear-driven Submersible Pump System

Attachment 4 Bladder Pump System

Attachment 5 Bennett Pump System

Attachment 6 Baski Pumping Systems

Attachment 7 Portable Bladder Pump System

Attachment 8 Portable Bennett Pump System

Attachment 9 SOP 5232 Compliance Checklist

IPC 3

8. REVISION HISTORY

Revision No. *(Enter current revision number, beginning with Rev.0)*	Effective Date *(DCC inserts effective date for revision)*	Description of Changes *(List specific changes made since the previous revision)*	Type of Change *(Technical [T] or Editorial [E])*
0	02/24/2009	Replaces procedures RRES-WQH-SOP-048 and RRES-WQH-SOP-049. Incorporates NMED purging requirements specified in the NMED "Notice of Approval with Modifications for 2008 Interim Facility-Wide Groundwater Monitoring Plan", NMED November 12, 2008. Incorporates revised indicator parameter stability criteria, and restrictions on excessive drawdown and pumping rates.	All
1	9/23/2010	SOP updated to current field practices. Alluvial sampling requirements clarified. Technical procedures for all pump systems clarified. Technical language corrected and standardized. Attachment 6 (Baski Pumping System) revised to provide additional direction on the operation of Baski packer system valves, gauges, and fittings, as applicable, and to require limited system inspections.	T, E
IPC-1, Rev.1		SOP updated to include a table of all wells containing pumps that run at rates greater than 5 gpm. In the Step by Step process Description, Section 4.3 entitled Purging Operations; Step #4 added the following direction: "Submersible pumps installed at the following locations may require purging rates of greater than 5 gpm to prevent pump damage."	T
IPC-2	11/4/10	SOP updated to add to the table of all wells containing pumps that run at rates greater than 5 gpm; In the Step by Step process Description, Section 4.1 entitled Sampling Preparation; Step #8 changed to read: Upon arrival at first sampling location of the day and prior to commencing work, calibrate all field instruments to be used for water-quality readings in accordance with manufacturer's instructions. *NOTE If sampling at multiple locations within the same day, perform calibration check at each subsequent sampling site. Field stabilization criteria revised for consistency with EPA Groundwater Sampling Guidelines.	T

Revision No. *(Enter current revision number, beginning with Rev.0)*	Effective Date *(DCC inserts effective date for revision)*	Description of Changes *(List specific changes made since the previous revision)*	Type of Change *(Technical [T] or Editorial [E])*
IPC-3	1/11/11	IPC-3 supersedes IPC-1 and IPC-2. Clarification to calibration of field parameter instruments to make sure instruments are calibrated in similar conditions to sample media. Option included to contact STR or Technical lead for direction. Compliance Checklist, Attachment 9, for sample parameter stabilization was developed for record keeping. Requirement to purge less than 5 gpm was removed from Section 4.3.4.	T

ATTACHMENT 1	
SOP-5232-1 **EQUIPMENT AND SUPPLIES CHECKLIST FOR GROUNDWATER SAMPLING**	Records Use Only

Section 1: General Checklist for All Ground Water Sampling

-Field Logbook, Groundwater Sampling Log, Chain of Custody Forms, Plan of the Day, relevant IDW's & SOP's

-Roll-up Tables, Chairs, Shade Shelter, Historical Sampling Paperwork, Well Completion Information

-Radio, Cellphones, Pagers, appropriate Keys

-1st Aid Kit, Eyewash, Fire Extinguisher, appropriate PPE

-Tool Box with Pipe Wrenches, Crescent Wrenches, Socket Wrenches, assorted other tools

-Ladder with Sump Pump & Hose (for 3000 gal purge containers), Carboys, Buckets

-Extension Cord, Computer with appropriate transducer connections, Inverter

-Manual Water Level Tape and Well Collar if necessary

-YSI multimeter and spare with Flow-Through Cell, Turbidimeter, Flow-meter

-Action Packer fully stocked with Nitrile Gloves, Wyp-alls, Polyethylene flexible tubing, Chain of Custody tape, DI Squirt Bottle, 0.45 micron filters, Pippettes, pH Test Strips, Ziplock Bags, Duct Tape, Teflon Tape

-Assorted Preservatives (acids & bases)

-Cooler with blue ice

-Sampling Apparatus (specific to each pump type, see Attachments 3-8)

-Power System (specific to each pump type, see Attachments 3-8)

ATTACHMENT 2

SOP-5232-2

GROUNDWATER SAMPLING LOG

Records Use Only

Los Alamos NATIONAL LABORATORY EST. 1943

GroundWater Sampling Log

Project: IFWGMP	**LSD:** ft. msl	**Well Diameter:** inches	**Date:**
Canyon:	**Water Level:** ft. msl	**Top of Screen:** ft. bgs	**Notes:**
Well No:	***TD:**	**Bottom of Screen:** ft. bgs	
Sampling Device:	***DTW:**	**Water Column:** ft	
Measuring Point:	**Drop Pipe:** gal.	**1CV:** gal.	
*** Completion Depth:**		**3CV:** gal.	**Baski Packer Pressure**
Sampling Personnel:			**Before:** psi
[* ft. BTOC / BTIC / BGS / MSL]	Note height of TOC/TIC on MP for Alluvials		**After:** psi

DTW = (LSD - Water Level)......**Water Column =** (TD - DTW).....**Drop Pipe =** (DTW x Drop Pipe Diameter Multiplier)

1CV = (Water Column x Well Diameter Multiplier)..... **3 CV =** (1CV x 3)

TIME	**pH**	**TEMP**	**SPEC COND**	**DO**	**Turb**	**ORP**	**Water Level***	**Discharge**	**NOTES**
MST / DST	stu	°C	µs/cm	mg/l	ntu	mV	ft ______	**Rate** (gpm)	

	WASTE		
	Contact: gal.	**Drum#**	*Purge: Formation water purged prior to sampling.
	***Purge Water:** gal.	**Drum#'s**	NOT drop pipe volume.
	Total Waste Water: gal.		NOT water during sampling.

ATTACHMENT 3	
SOP-5232-3 **ELECTRIC GEAR-DRIVEN SUBMERSIBLE PUMP SYSTEM**	Records Use Only Los Alamos NATIONAL LABORATORY EST.1943

1. PURPOSE AND SCOPE

This attachment describes the process for setting up, operating, and securing the electric Gear-driven Submersible Pump system used in groundwater sampling activities.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Many deep regional groundwater-monitoring wells at the Laboratory are sampled using an electric Gear-driven Submersible Pump system, commonly referred to as a GSP, which is operated with either a 240- or 480-volt portable generator, depending on the specific model.

2.2 Precautions

Review any special electrical, mechanical, biological, or chemical conditions that are present for the well being sampled. These should be reviewed with the Groundwater Technical Lead prior to starting the sampling event.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1 System Startup and Operation of a GSP		
Field Team Member	1.	Connect the trailer-mounted large generator to the pump control box, using the appropriate power cord (usually 480 V).
	2.	Install sampling tree into drop pipe. Do not overtighten with a wrench. Ensure the valve on the sampling tree is open.
	3.	Install flow-meter to end of sampling tree. Connect end of sampling apparatus to purge water container with hose.
	4.	Install in-line flow-though cell, using flexible polyethylene tubing to connect cell to sampling tree discharge units (valve and hose barbs).
	5.	Start the large generator (refer to ENV-WQH-SOP-014, Large Generator Use for Pumping). Throw the circuit breaker to allow a live connection.
	6.	Start the pump by flipping the control box circuit breaker to ON, turning the dial on the control box, and pushing the START button. An audible click should be heard.

Field Team Member (continued)	7.	Adjust the flow rate using the valve in the discharge line. Flow rate should be adjusted so that excessive drawdown does not occur. Drawdown should not reach the top of the screened interval.

3.2 System Shutdown - GSP

Field Team Member	1.	Stop the pump by turning the dial on the control switch to stop and flipping the circuit breaker to OFF.
	2.	Ensure the valve in the sampling tree is open so that water can drain into the drop pipe.
	3.	Turn the generator off, throw circuit breaker to OFF, and disconnect battery.
	4.	Disconnect power cord and sampling apparatus.
	5.	Lock and secure well.

ATTACHMENT 4	
SOP-5232-4 **BLADDER PUMP SYSTEM**	Records Use Only

1. PURPOSE AND SCOPE

This attachment describes the process for setting up and operating the bladder pump systems used in groundwater sampling activities.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Most shallow alluvial monitoring wells at the Laboratory are equipped with either Monoflex Isomega bladder pumps or QED bladder pumps dedicated to each well. The bladder pump parts that are in contact with formation water are constructed of Teflon.

Bladder pumps are used to sample alluvial monitoring wells. During operation, the bladder pump fills with water through a screen inlet and ball valve, expanding the bladder. The introduction of nitrogen gas into the pump chamber causes the bladder to collapse, forcing the water into the sample discharge line. A pressure of 0.45 psi per foot of depth is required to lift a sample to the surface. The pump is operated via the QED control box, although the portable QED backpack controller may also be used.

2.2 Precautions

2.2.1 Operation of a bladder pump requires the use of pressurized gas cylinders. Operators should be familiar with Laboratory Implementation Requirement (LIR) 402-1200 Pressure, Vacuum, and Cryogenic Systems, and Laboratory Implementation Guideline (LIG) 402-1200, Compressed Gases, to be aware of hazards and recommended safety practices before setting up and operating a pressure system for the bladder pump system.

2.2.2 When working on or around pressure systems, operators must adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield.
- Wear safety shoes and leather gloves.
- Use warning signs and mark or label pressure vessels and systems to identify the operating pressure and contents.
- Handle and store gas cylinders safely.
- Avoid temperature extremes, which can cause pressure changes and component failure.
- Store cylinders that are not necessary for the current work in a safe location outside the work area.
- Never work on a pressure system under pressure; depressurize the system and use lockout/tagout, if appropriate.

- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify your supervisor.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1 System Setup – Bladder Pump System

Field Team Member	1.	Ensure the nitrogen tank is secured in the vehicle.
	2.	Install the low pressure regulator setup on the nitrogen tank, tightening with a crescent wrench. The setup includes the following: • regulator with two gauges • manual vent valve • pressure relief valve set to 150 psi • quick connect coupling. [NOTE: Regulator, hoses, pump controller, and well assembly have been pre-fabricated. DO NOT remove or change coupling, valves, whip restraints, quick connects, or any other components of the pressure system in the field.]
	3.	Connect pressure hose to the quick connect coupling on the regulator setup and secure hose with whip restraint.
	4.	Connect the other end of the pressure hose to the QED control box.
	5.	Connect the QED control box to the well head assembly.

3.2 System Pressurization – Bladder Pump System

Field Team Member	1.	Ensure the T-screw on the pressure regulator is loose but do not unthread all the way out.
	2.	Ensure the vent valve is closed.
	3.	Gently open the gas cylinder valve and check for leaks.
	4.	Fully open the gas cylinder valve.
	5.	Adjust the regulator T-screw until the regulator pressure reads at the proper pump operating pressure, as defined in Section 3.3, Item 3 below.
	6.	Leak test all of the fittings, quick connects and hose connections. The leak test should be conducted at the proper pump operating pressure, as defined in Section 3.3 Item 3 below.

3.3 System Operation – Bladder Pump System

Field Team Member

1. Ensure all hose and gas cylinder connections are secure and functional.

2. Determine the proper pump operating pressure as follows:

   - Multiply the total depth of the well in feet by 0.5 psi.
   - Add 10–15 psi to obtain the operating pressure.

   For example, pumping from a 100 foot deep well:

   $$100 \text{ feet} \times 0.5 = 50 \text{ psi lift} + 10 - 15 \text{ psi} = 60 - 65 \text{ psi operating pressure}$$

3. Set the pressure on the regulator to calculated value. Ensure QED control box pressure matches regulator pressure.

4. Adjust the timers to four cycles per minute on the QED. This is usually the optimal setting.

   - The pump pressure timer controls the amount of time the pump is pressurized and pumping water to the surface. If the time setting is too short, the pump will not have sufficient time to empty.
   - The pump vent timer controls the amount of time the pump is allowed to vent. If the time setting is too short, the pump will not have sufficient time to completely fill.

3.4 System Shutdown – Bladder Pump System

Field Team Member

1. Shut off the QED control box.
2. Shut off the gas cylinder valve.
3. Vent the system to the atmosphere.
4. Disconnect all hoses.
5. Lock and secure well.

ATTACHMENT 5	
SOP-5232-5 **BENNETT PUMP SYSTEM**	Records Use Only

1. PURPOSE AND SCOPE

This attachment describes the process for setting up, operating, and securing the Bennett pump system used in groundwater sampling activities.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Many intermediate wells are equipped with the Bennett pump system. In addition, regional and intermediate wells that lack a pumping system can be sampled with a portable Bennett pump system (See Attachment 8). The Bennett pump system is pressure-actuated. The system can provide depth-discrete groundwater samples from a single subsurface stratigraphic horizon from a converted borehole or well. The Bennett pump consists of a piston activated with pressurized gas through a Teflon tube, a second Teflon tube that returns groundwater to the surface, and a third Teflon tube for gas exhaust. The wellhead is set up to facilitate installation of a pressure transducer and obtain water levels without disturbing the dedicated components of the Bennett pump system. Refer to Figure C-1, Well Plate Schematic, at the end of this attachment.

The Bennett pump operates by pressurized gas (nitrogen) which does not come in contact with the groundwater sample. Components of the pump that make contact with the sample fluids are composed of inert materials; namely, stainless steel and Teflon.

2.2 Precautions

2.2.1 Operation of a Bennett pump requires using pressurized gas cylinders. Operators should be familiar with LIR 402-1200, Pressure, Vacuum, and Cryogenic Systems, and LIG 402-1200, Compressed Gases, to be aware of hazards and recommended safety practices before setting up and operating a pressure system for operating the Bennett pump system.

2.2.2 When working on or around pressure systems, operators should adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield.
- Wear safety shoes and leather gloves while handling pressurized gas tanks.
- Handle and store gas cylinders safely.
- Avoid temperature extremes, which can cause pressure changes and component failure.
- Store cylinders that are not necessary for the current work in a safe location outside the work area.
- Never work on a pressure system under pressure. Depressurize the system and use lockout/tagout when appropriate.

- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify supervisor.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1	**System Setup –Bennett Pump System**	
Field Team Member	1.	Ensure the nitrogen tank is secured in the vehicle or a stanchion.
	2.	Install the regulator setup on the nitrogen tank, tightening with a wrench. The setup includes the following: • Regulator with two gauges • Manual vent valve • Pressure relief valve set to 200 psi • Quick connect coupling.
	3.	Connect pressure hose to the quick connect coupling on the regulator and secure hose with whip restraint.
	4.	Connect the other end of the pressure hose to the quick connect coupling on the well head landing plate.
	5.	Remove the protective stainless steel cap from the water discharge line and set the cap aside where it will not be misplaced.
	6.	Remove the protective stainless steel cap from the exhaust discharge line and set the cap aside where it will not be misplaced.
	7.	Secure a stainless steel sampling elbow with two discharge units (valve & hose barb) to the water discharge outlet by tightening the stainless-steel connector on the bottom of the sample elbow.
3.2	**System Pressurization – Bennett Pump System**	
Field Team Member	1.	Ensure the T-screw on the pressure regulator is loose but do not unthread all the way out.
	2.	Check the vent valve is closed.
	3.	Gently crack open the nitrogen gas cylinder valve and check for leaks.
	4.	Fully open the nitrogen gas cylinder valve.
	5.	Adjust the regulator T-screw until the regulator pressure reads 100 psi.

Field Team Member	6.	Leak test all of the fittings, quick connects, and hose connections.

3.3 System Operation –Bennett Pump System

Field Team Member	1.	Ensure all pressure system connections are secure and functional.
	2.	Adjust the pressure from the gas cylinder going into the pump to adjust the pumping speed. A pressure of 100 to 120 psi is usually sufficient to run the Bennett pump at any depth.
	3.	Determine if the pump has started cycling by noting if a gas flow is exiting the gas exhaust outlet.
	4.	If the pump is determined not to be cycling, the pressure should be slowly increased until the pump starts cycling.

3.4 System Shutdown – Bennett Pump System

Field Team Member	1.	Turn off the gas supply valve at the top of the nitrogen cylinder.
	2.	Open the manual vent valve on the safety manifold and drain the nitrogen gas from the line until the pressure regulator reads near zero psi.
	3.	Disconnect the black pressure hose from the pump by removing the quick connect coupling at the gas inlet on the landing plate. Disconnect the regulator setup.
	4.	Disconnect the sample elbow from the water discharge outlet at the landing plate.
	5.	Complete the disassembly of the system.
	6.	Replace the stainless-steel cap on the water discharge outlet at the landing plate, and replace the stainless-steel cap on the gas exhaust outlet at the landing plate.
	7.	Lower the water level in the water discharge tubing to a depth that is sufficient to prevent freezing by using the 20 foot ¼-inch-outside-diameter (OD) nylon freeze prevention line as follows: • Insert the ¼-inch-OD nylon freeze prevention line while decontaminating with a DI-soaked paper towel into the water discharge tubing to the stop at the end of the freeze prevention line. • Remove the freeze prevention line from the water discharge tubing, while decontaminating with a DI-soaked paper towel. • The displaced water will lower the water level in the water discharge tubing sufficiently below the freezing line.

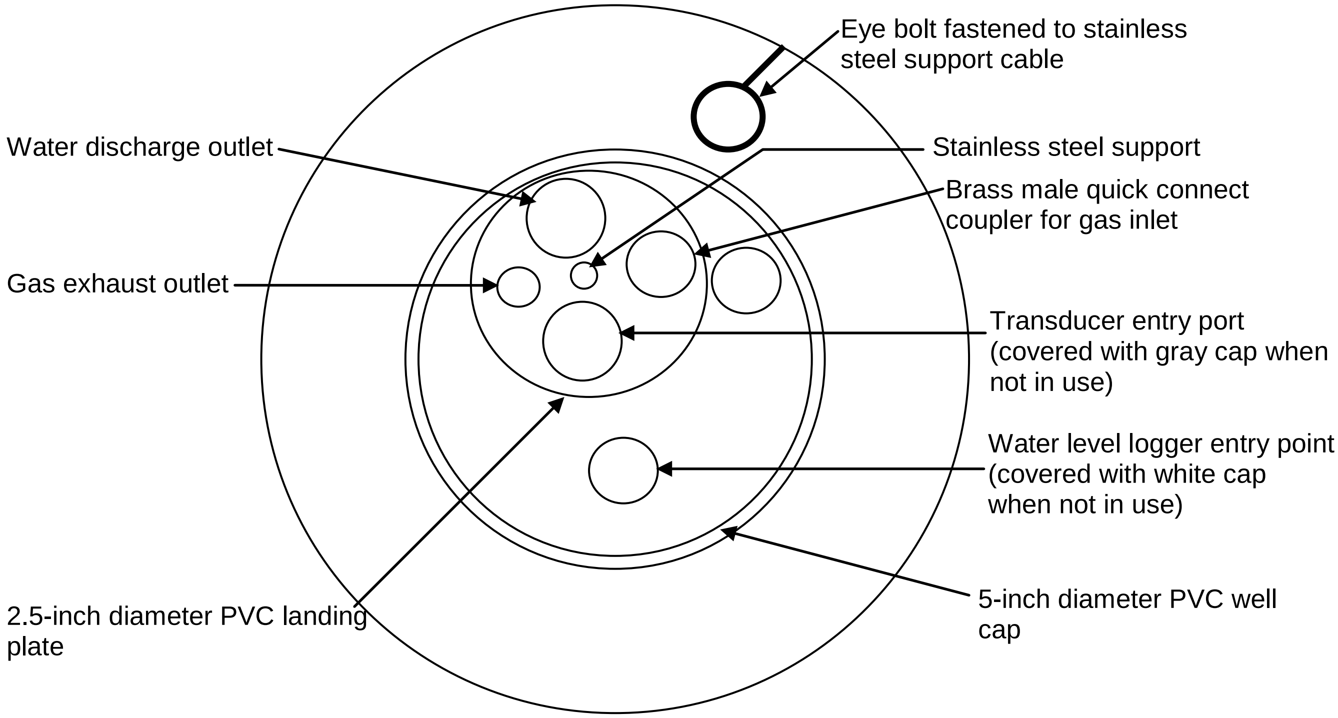

Figure C-1. Well Plate Schematic.

ATTACHMENT 6	
SOP-5232-6 **BASKI PUMPING SYSTEM**	Records Use Only

1. PURPOSE AND SCOPE

This attachment describes the process for groundwater sampling using the Baski pumping system.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

The Baski dual-valve pumping system relies on two access port valves (APV) to sample two screened intervals in a well using a single electric gear-driven submersible pump (GSP). The APVs are pneumatic valves that are opened and closed based on differential pressure. Each APV remains closed as a result of pressure from the inflated packer that separates the screened intervals. The APV is opened from the surface by overcoming this pressure using nitrogen gas pumped in through a ¼-inch nylon tube. The GSP is isolated from the regional groundwater at its installed depth by a sealed shroud. When either APV is opened, hydrostatic pressure causes the shroud to fill through the drop pipe from the selected screened interval.

2.2 Precautions

2.2.1 Operation of the Baski pumping system requires the use of pressurized gas cylinders. Operators should review LIR 402-1200, Pressure, Vacuum, and Cryogenic Systems, and LIG 402-1200, Compressed Gases, to be aware of hazards and recommended safety practices prior to setting up and operating a pressure system for operating the Baski pumping system.

2.2.2 When working on or around pressure systems, you must adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield.
- Wear safety shoes and leather gloves when moving nitrogen cylinders.
- Use warning signs and mark or label pressure vessels and systems to identify the operating pressure and contents.
- Restrict access to high-pressure areas.
- Handle and store gas cylinders safely.
- Avoid temperature extremes, which can cause pressure changes and component failure.
- Store cylinders that are not necessary for the current work in a safe location outside the work area.
- Never work on a pressure system under pressure. Depressurize the system and use lockout/tagout when appropriate

- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify the supervisor.

2.2.3 Operation of the Baski pumping system requires the use of a large generator. Ensure the precautions in ENV-WQH-SOP-014, Large Generator Use for Pumping, are observed.

2.2.4 Prior to sampling any well with a Baski sampling system, the packer pressure must first be assessed and recorded in accordance with the packer maintenance table referenced in SOP-5260, "Pressure Monitoring of Packer Systems in Monitoring Wells". If the packer pressure is below the minimum packer pressure in the table, contact the appropriate LANL or SUBCONTRACTOR personnel responsible for maintaining packer pressure in accordance with SOP 5260 (i.e. the "packer pressure team") to request further assessment, and notify the groundwater technical leader or project manager.

Note: *Packer re-pressurization may only be conducted by personnel trained to do so in accordance with SOP-5260. Sampling personnel may not adjust the packer pressure without formal training to SOP-5260.*

2.2.5 If packer pressure is below the minimum packer pressure in the Packer Maintenance Table, personnel from the packer pressure team shall assess and adjust the pressure in the packer as necessary, and the water level data from each screen must be downloaded and evaluated to determine whether cross flow has occurred.

2.2.6 If water level data confirm that no cross flow has occurred, sampling may continue as planned. If water level data indicate cross flow has occurred, the groundwater technical leader may request that sampling be postponed until cross flow has been removed

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1	**System Setup – Baski Pumping System**	
Field Team Member	1.	Mobilize a large portable generator to the well site in accordance with ENV-WQH-SOP-014.
	2.	Observe packer pressure and record in Groundwater Sampling Log (Attachment 2). Confirm that observed pressure is above "Minimum Packer Pressure" and "Action Pressure" as stated in SOP-5260, Attachment A.
	3.	Determine from which screened interval the sample will be taken.
	4.	Connect computer to transducer for screen to be sampled.
	5.	Install the safety manifold to the regulator on the nitrogen tank. The regulator must be able to handle either 450 psi or 750 psi, depending on the setup. The safety manifold includes the following: • A Swagelok series QC4 stainless-steel male quick connect fitting • Manual vent valve • Pressure bleed valve • Fill valve • Connection to nitrogen tank regulator.

	6.	Connect a pressure hose from the safety manifold to the appropriate female quick disconnect fitting (upper or lower APV) on top of the landing plate (refer to Figure D-1, Landing Plate Schematic).
Field Team Member	7.	Connect the sampling tree to the drop pipe.
	8.	Connect the outlet of the sampling tree to a flow-meter, and then connect a discharge hose to the water collection container.
	9.	Connect the electric cable from the generator to the pump control box. [NOTE: The order of the connection steps described above is not relevant to proper system functioning, and may therefore be done in whatever manner the operator sees fit.]

3.2 System Pressurization – Baski Pumping System

Field Team Member	1.	Ensure the T-screw on the pressure regulator is loose but do not unthread all the way out.
	2.	Check the manual vent valve is closed.
	3.	Check the fill valve is closed.
	4.	Gently crack open the nitrogen gas cylinder tank valve and check for leaks.
	5.	Fully open the nitrogen gas cylinder tank valve.
	6.	Leak test all the fittings, quick connects, and hose connections.
	7.	Begin pressurization of the APV by opening the fill valve while monitoring the packer pressure gauge. Increase pressure on the APV by screwing in the T-Screw. The APV will open when the pressure gauge ticks up a few (~3) psi. Cease increasing pressure when this movement is noted, and record the opening pressure in the field logbook. Each APV has a unique pressure range under which it can open. Consult the Baski Pressure table in the Logbook Front Matter.
	8.	Once the pressure gauge has ticked upwards and shows stable pressure, the pump may be turned on. Leave the fill valve open during pumping. *Note: As the drop pipe and shroud are filling with groundwater, it may be possible to hear air escaping form the vent hole in the landing plate, indicating the valve is open and groundwater is entering the shroud. This process is complete when the pressure gauge shows stable pressure.*

3.3 System Operation – Baski Pumping System

Field Team Member	1.	Turn on the generator and flip the circuit breaker [Refer to ENV-WQH-SOP-014 for details].

Field Team Member cont.	2	Flip the circuit breaker switch on the control box to ON, turn the dial on the control box, and push the Start button. An audible click should be heard.
	3	Note the time the pump was started and monitor the discharge line for flow.
	4	If water has not started flowing from the discharge line after five minutes, turn off the pump and the nitrogen tank and perform the following: • Release pressure on the APV by slowly opening the manual vent valve. • Re-pressurize to re-open the APV in accordance with Section 3.2 above ensuring sufficient pressure is applied to open the APV.

3.4 System Shutdown – Baski Pumping System

Field Team Member	1.	Stop the pump by turning the dial to stop and flipping the circuit breaker to OFF. **[WARNING: The pump must be turned off before closing the APV valve to prevent a vacuum forming at the inlet.]**
	2.	Turn off the flow from the nitrogen tank into the Baski pumping system.
	3.	Open the manual vent valve to relieve all pressure from the APV. As venting occurs, nitrogen will be expelled from the system! and a small (~3 psi) drop in pressure may be observed on the pressure gauge, as pressure in the packer re-equilibrates to pre-sampling conditions.
	4.	Observe the final packer pressure and record in Groundwater Sampling Log (Attachment 2). Confirm that the final pressure is consistent with the pressure observed prior to sampling, and remains above "Minimum Packer Pressure" and "Action Pressure" as stated in SOP-5260, Attachment A.
	5.	Once venting is complete, disconnect the pressure hose from the quick connect coupling on the landing plate. Note: *Care must be taken to ensure that system has fully vented prior to disconnecting the tube.* ***<u>Do not disconnect while system is still venting</u>.***
	6.	If the other screened interval is to be sampled, return to Section 3.1. Ensure that all screen-dependent fittings and lines are properly switched. This includes the transducer, the APV gas inlet, and the water discharge hose to the proper water container.
	7.	Turn the generator off, throw circuit breaker to OFF, and disconnect battery.
	8.	Disconnect the power cable.
	9.	Remove the safety manifold from the nitrogen tank.
	10.	Disconnect the water discharge hose from the sampling tree.

Field Team Member (cont.)	11.	Remove the sampling tree from the landing plate and ensure the PVC crossover nipple is left in place on the landing plate.
	12.	Ensure that all gauges and fittings that remain inside the well monument are below the top of the monument and close and lock the cover.
	13.	Lock and secure the well.

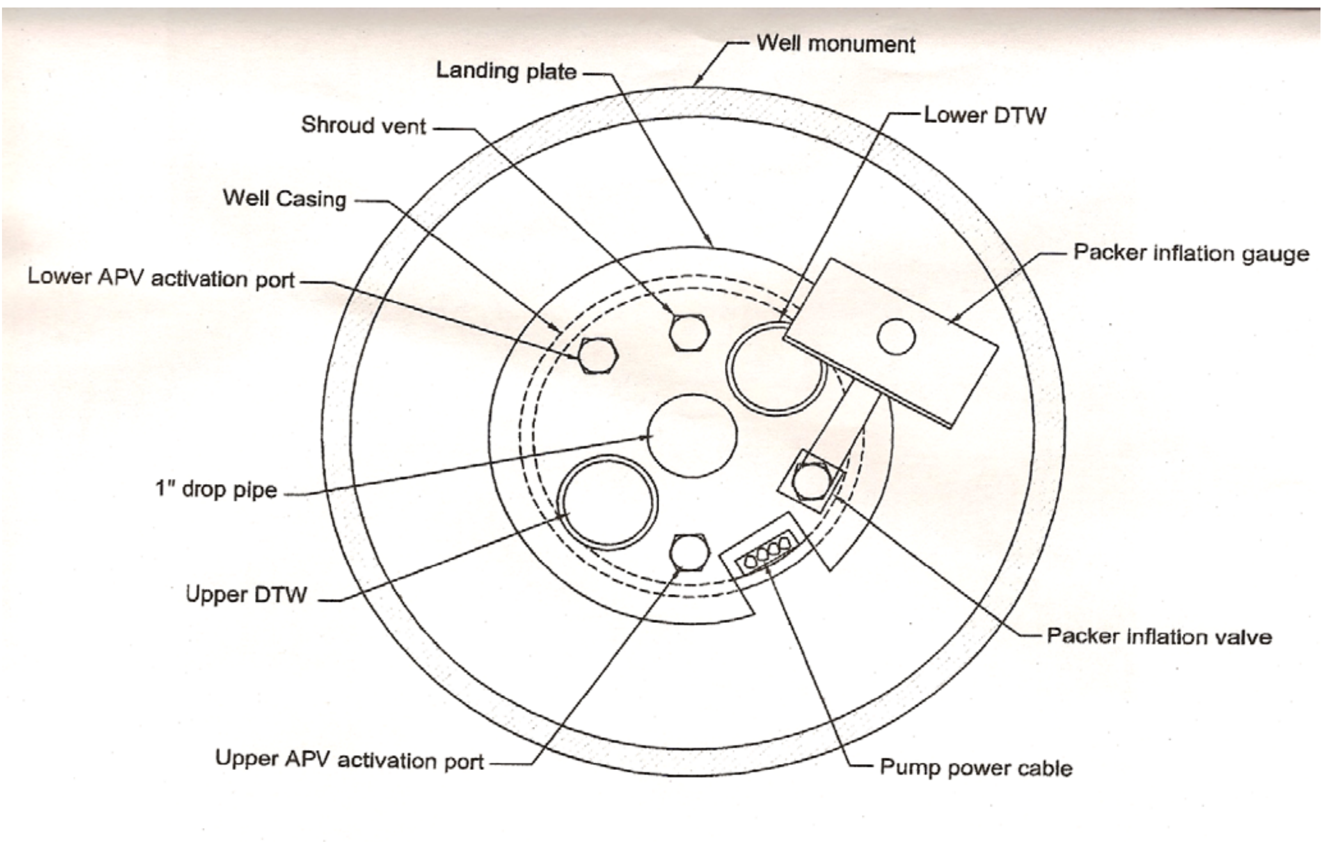

Figure D-1. Landing Plate Schematic.

ATTACHMENT 7	
SOP-5232-7 **PORTABLE BLADDER PUMP SYSTEM**	Records Use Only

1. PURPOSE AND SCOPE

This attachment describes the process for groundwater sampling using the portable bladder pump system. The specific systems pertaining to this attachment are the QED Sample Pro 1.75-inch bladder pump (SamplePro), the MP15 Control and Power pack (QED Backpack), and the MP10 Controller (QED Controller).

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Most shallow alluvial monitoring wells at the Laboratory are equipped with dedicated bladder pumps (either Monoflex Isomega or QED) constructed of Teflon. Alluvial wells that do not have dedicated pumps in place are sampled using the QED SamplePro bladder pump.. During operation, the SamplePro bladder fills with water through a screen inlet and ball valve. The introduction of carbon dioxide or nitrogen gas into the pump chamber causes the bladder to collapse, forcing the water into the sample discharge line. Venting the pump chamber allows the bladder to refill. A pressure of approximately 1 psi per foot of depth is required to lift a sample to the surface. Either the QED Backpack or the QED Controller may be used to operate the pump.

2.2 Precautions

2.2.1 Operation of a bladder pump requires the use of pressurized gas cylinders. Review LIR 402-1200 Pressure, Vacuum, and Cryogenic Systems, and LIG 402-1200, Compressed Gases, to be aware of hazards and recommended safety practices before setting up and operating a pressure system for the bladder pump system.

2.2.2 When working on or around pressure systems, the operator must adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield
- Wear safety shoes and leather gloves
- Use warning signs and mark or label pressure vessels and systems to identify the operating pressure and contents
- Handle and store gas cylinders safely
- Avoid temperature extremes, which can cause pressure changes and component failure
- Store cylinders that are not necessary for the current work in a safe location outside the work area
- Never work on a pressure system under pressure; depressurize the system and use lockout/tagout when appropriate

- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify your supervisor.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1 System Setup – Portable Bladder Pump System

Field Team Member	1.	Ensure that a sufficient number of carbon dioxide or nitrogen tanks are available.
	2.	If the well is near the vehicle, the FTL may decide to proceed with the setup for a dedicated bladder pump (see Attachment 4, 3.1 System Setup). This entails using a nitrogen tank with the QED controller. • Connect the QED controller to the SamplePro using the roving air fitting
	3.	Remote wellsites require use of the QED Backpack. This backpack houses a QED controller and a carbon dioxide tank. • Connect the backpack QED controller to the SamplePro using the roving air fitting [NOTE: The backpack QED controller may be used with nitrogen if in range of the vehicle.]
	4.	Setup/prepare SamplePro bladder pump by performing the following steps: [NOTE: Wear nitrile gloves during pump setup/preparation.] • Remove pump from protective case. • Inspect O-rings and check valves on pump head to ensure functional integrity, replace if necessary. • Install new Teflon bladder onto barb. Wells greater than 75 ft deep need bladder connector fitting attached. • Install new grab plate into head assembly. • Cut the appropriate lengths of Swagelok air tubing (opaque) and Teflon-lined polyethylene tubing (clear). Pump intake should sit within screened interval and below water level. Cut approximately 6 extra feet of tubing to facilitate purging and sampling. • Set both tubing and pump in a clean place free of potential contamination until ready to deploy.
	5.	Connect the pump controller to the Swagelok air tubing via the roving air fitting.
	6.	Insert pre-cut tubing ends into pump head and grab plate until firmly seated against O-rings. “W” indicates water line and “A” indicates air line.

Field Team Member (continued)	7.	It is necessary to prepare an Equipment Rinsate Blank (EQB) before lowering the pump down the well. • Pressurize system (see section 3.2) at approximately 1 psi per foot of tubing • attach new flexible polyethylene tubing to pump intake and lower free end into bottle of DI water • begin cycling pump via pump controller • collect sample from discharge tubing • discard flexible polyethylene tubing used for EQB sampling
	8.	Attach stainless steel security cable to pump head.
	9.	Deploy pump, with attached air tubing, water tubing and security cable, slowly down the well. The security cable should always be weighted, to prevent tubing lines from tangling or disconnecting. While lowering the pump into the water decontaminate the cable and tubing lines with a paper towel and de-ionized water.
	10.	Pump should be set above sump with pump intake located near bottom of screened interval to maximize the water column. The steel cable should be clamped at the surface to ensure pump stays at desired depth.

3.2 System Pressurization – Portable Bladder Pump System

Field Team Member	1.	Ensure the T-screw on the pressure regulator is loose but do not unthread all the way out (nitrogen use only).
	2.	Ensure the vent valve is closed (nitrogen use only).
	3.	Gently open the nitrogen or carbon dioxide gas cylinder valve and check for leaks.
	4.	Fully open the nitrogen or carbon dioxide gas cylinder valve.

3.3 System Operation – Portable Bladder Pump System

Field Team Member	1.	Ensure all pressure system connections are secure and functional.
	2.	Determine the proper pump operating pressure as follows: • Multiply the vertical depth below ground surface by 1 psi and add 10 - 15 psi. For example: Sample to be evacuated at 100 feet: 50 ft × 1 = 50 psi lift + 10 - 15 psi = 60 -65 psi operating pressure
	3.	Set the tank pressure and pump to calculated value.
	4.	Cycle the pump and observe its operation. Start at four cycles per minute and put discharge line in a calibrated one liter bottle in order to determine a flow rate.

5. Adjust the pumping system, as necessary, to maximize the pumping rate.
    - If needed, increase/decrease pressure on controller and at the tank.
    - If flow rate is still far below one liter a minute the FTL may elect to increase the number of cycles per minute.

3.4 System Shutdown – Portable Bladder Pump System

Field Team Member

1. Press STOP button on controller.
2. Shut off the gas cylinder valve.
3. Vent the system to the atmosphere (nitrogen use only).
4. Disconnect all hoses and whip restraints.
5. Carefully pull pump out of well while decontaminating steel cable with DI water and paper towel.
6. Separate cable and tubing from Sample Pro.
7. Remove tubing from grab plate and add to the contact waste for that sampling event.
8. Disassemble pump and add grab-plate and bladder to contact waste. Empty bladder into purge water prior to disconnecting.
9. Decontaminate the pump and all of its components using DI water and paper towels prior to returning it to the protective case. Thoroughly dry pump and components with paper towels to prevent rust.
10. Lock and secure well.

ATTACHMENT 8	
SOP-5232-8 **PORTABLE BENNETT PUMP SYSTEM**	Records Use Only Los Alamos National Laboratory EST. 1943

1. PURPOSE AND SCOPE

This attachment describes the process for setting up, operating, and securing the portable Bennett pump system used in groundwater sampling activities.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Regional and intermediate wells that lack a pumping system can be sampled with the portable Bennett pump system. The Bennett pump system consists of a piston activated with pressurized gas through a Teflon tube, a second Teflon tube that returns groundwater to the surface and a third Teflon tube for gas exhaust. The portable Bennett pump system is mounted in a trailer. The Bennett pump and 850 feet of bundled tubing is coiled around a winch in the back of the trailer. The winch is operated with a motor which is powered by a medium-sized portable generator. The pump system is operated via a control box attached to the winch.

The Bennett pump operates by pressurized gas (nitrogen) which does not come in contact with the groundwater sample. Components of the pump that make contact with the sample fluids are composed of inert materials; namely, stainless steel and Teflon.

2.2 Precautions

2.2.1 Operation of a Bennett pump system requires using pressurized gas cylinders. Operators should be familiar with LIR 402-1200, Pressure, Vacuum, and Cryogenic Systems, and LIG 402-1200, Compressed Gases, to be aware of hazards and recommended safety practices before setting up and operating a pressure system for operating the Bennett pump system.

2.2.2 When working on or around pressure systems, operators should adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield.
- Wear safety shoes and leather gloves while handling pressurized gas tanks.
- Handle and store gas cylinders safely.
- Avoid temperature extremes, which can cause pressure changes and component failure.
- Store cylinders that are not necessary for the current work in a safe location outside the work area.
- Never work on a pressure system under pressure. Depressurize the system and use lockout/tagout when appropriate.
- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify supervisor.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1 System Setup – Portable Bennett Pump System

Field Team Member

1. An Equipment Rinsate Blank (EQB) must be prepared prior to sampling. This is typically done onsite, but occasionally is performed indoors (TA-64 South Bay) during inclement weather. In extenuating circumstances, it may be performed the day before sampling with approval from the Groundwater Technical Lead. Refer to 3.3, System Pressurization and 3.4, System Operation – Portable Bennett Pump System, for details on pump operation.

2. Load a portable medium-sized generator onto the transport vehicle and tow the portable Bennett pump trailer to the well sampling site.

3. Collect a water-level reading by taking a manual measurement in accordance with SOP-5223, Manual Groundwater Level Measurements or by taking a reading from the pressure transducer.

4. Once the water level has been measured, remove the water-level tape from the well to prevent damage while installing the pump. If a pressure transducer is installed, remove the transducer in accordance with SOP-5227, Pressure Transducer Installation, Removal and Maintenance.

5. Back up the trailer until it is within 5 ft of the well casing and open up the adjustable gooseneck on the back of the trailer. A cotter pin at the bottom of the gooseneck can be pulled out to allow the gooseneck to move up and down and in and out but NOT side to side.

6. Move the trailer back toward the well casing until the gooseneck is lined up with the center of the casing. The pulleys on the tip of the gooseneck shall be lined up with the center of the well casing to allow the pump to enter the casing exactly in the middle.

   [NOTE: It is very important to ensure the pump is properly aligned over the center of the well to ensure the pump does not get hung up or damaged while being lowered or raised within the well housing.]

7. Fine tune the gooseneck distance from the back of the trailer by placing a bolt through the holes in the gooseneck. The holes can be found every 6 inches along the shaft.

8. Turn on the portable generator and plug in the motor for lowering and raising the pump.

   [NOTE: Ensure that the control handle on the motor is in the "OFF" position prior to powering the system.]

9. Turn on the water-level alarm located on the top of the pump unit. The switch to operate the water-level alarm is located on the control box in the front of the Bennett pump.

Field Team Member (continued)

10. Lower the pump into the well, using the up/down switch attached to the motor. One field team member should control the switch and guide the pump and tubing towards the gooseneck. A second field team member should control the pump and tubing as it is lowered in to the well. The pump and tubing must be decontaminated while they are lowered, with a DI-soaked paper towel. This will need to be changed out frequently as it will get dirty.

11. Lower the pump unit until the water-level alarm indicates when the top of the pump is under water.

12. If possible, continue lowering the pumping unit until it is submerged at least 10 feet below the water table.

13. Turn off the generator after the pump is set at the desired depth.

14. Ensure the nitrogen tank is secured.

15. Install the regulator setup on the nitrogen tank, tightening with a wrench. The setup includes the following:
    - Regulator with two gauges
    - Manual vent valve
    - Pressure relief valve set to 200 psi
    - Quick connect coupling.

16. Connect the black pressure hose to the setup and secure with a whip restraint.

17. Connect the other end of the hose to the back of the pump control box.

3.2 System Pressurization – Portable Bennett Pump System

Field Team Member

18. Ensure the T-screw on the pressure regulator is loose but do not unthread all the way out.

19. Check the vent valve is closed.

20. Gently crack open the nitrogen gas cylinder valve and check for leaks.

21. Fully open the nitrogen gas cylinder tank valve.

22. Adjust the regulator T-screw until the regulator pressure reads 100 psi.

23. Leak test all of the fittings, quick connects, and hose connections.

3.3 System Operation – Portable Bennett Pump System

1. Ensure pressure system connections are secure and functional.

2. Adjust the pressure from the gas cylinder going into the pump to adjust the pumping speed using one of the methods noted below. A pressure of 100 to 150 psi is usually sufficient to run the Bennett pump at any depth.

    - Adjust the small black knob on the control box located on the front of the Bennett pump just below the water level on/off switch. This knob is used to fine-tune the pressure going into the pump and is the preferred method. Pull up on the knob to adjust it, and push down to lock it.
    - Adjust the regulator on the nitrogen tank. This will give a coarse adjustment to the operating pressure and should be used if the method above will not give the required operation.

    On the left-hand side of the pump control pump is a discharge hose connected to a sampling tree with two discharge units (valve & hose barbs). Once the pressure is turned on and the pump begins cycling, approximately 5 gal of DI water (from the EQB) will have to be purged from the tubing before well water exits the sample tree. Note that this will not be the case if the tubing has been evacuated post-EQB.

3. If the pump is determined not to be cycling, the pressure should be gently increased until the pump starts cycling using the methods in step 2.

3.4 Removal of Portable Bennett Pump System

Field Team Member

1. Remove portable pump from the well, while decontaminating the tubing with a DI-soaked paper towel. This will need to be replaced frequently.

2. Pump tubing must be decontaminated internally. Collect decon waste separately from purge waste.

    - Mix 1 gallon of DI water with one capful of Liquinox
    - Pump soap mixture through tubing
    - Pump 10 gallon DI water to thoroughly rinse tubing
    - Note that the first 5 gallons of water to exit discharge line will be formation water, and must be disposed of as such.
    - When suds appear in discharge line, immediately switch to a new water collection device (carboy or bucket), as the water is now Decon waste and must be disposed of as such.
    - Approximately 6 gallons of Decon water will be collected when the 10 gallons of DI has been pumped. This will leave 5 gallons of DI water remaining in the pump tubing.

3. Unthread and remove water intake from bottom of Bennett pump.

Field Team Member

4. Attach brass airline fitting with black pressure hose to bottom of pump where water intake was removed.

5. Attach pressure hose to regulator.

6. Increase air pressure slowly to 100 psi to displace water from the pump discharge lines, collecting Decon water as required to comply with waste disposal for the site, until all water has been removed.

7. Lock and secure well.

ATTACHMENT 9

SOP-5232-9

Records Use Only

SOP 5232 Compliance Checklist

SOP 5232 Compliance Checklist

Well Name:______________________

Date:___________________________

Watershed/ Quarter:____

Sampling Personnel:____

Top of Screen (ft bgs/msl)	Lowest water level reached during purge (ft bgs/msl)	Water column above top of screen (ft)	Drawdown maintained above screen?	Comments:
			Y N	

Calculated 3 CV's + drop pipe (gal)	Total volume purged before sampling	CV's Purged before sampling	Minimum Purge Met?	Comments:
			Y N	

	For three consecutive readings:					
Field parameters collected at proper intervals? (HH:MM)	Turbidity <5 NTU or +/- 10%	Dissolved Oxygen +/- 0.3 mg/l	pH +/- 0.1 STU	Specific Conduct. +/- 3%	Temp +/- 0.2 °C	Comments:
Y N	Y N	Y N	Y N	Y N	Y N	

SOP Requirements Met?	Comments:
Y N	

IPC 3