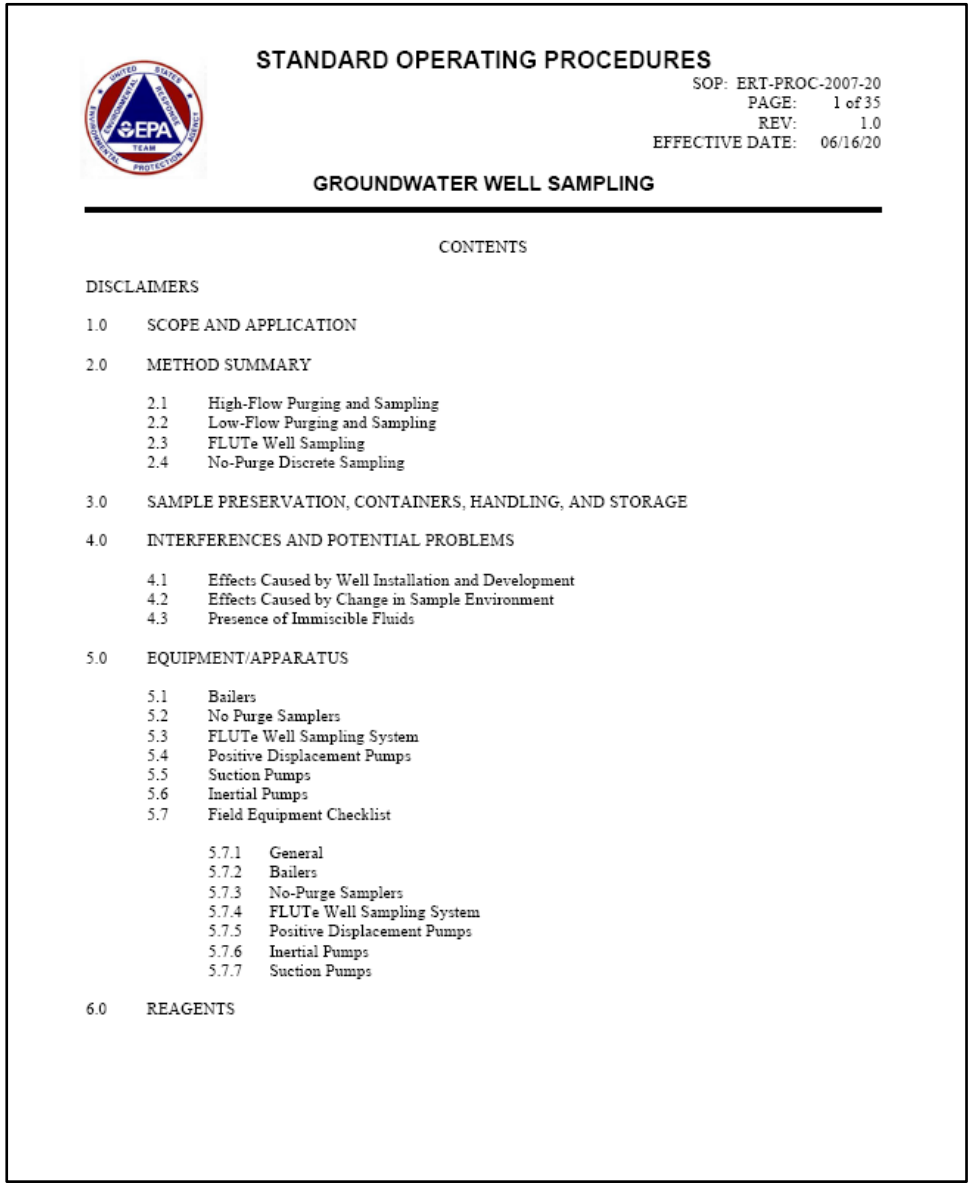
Groundwater Well Sampling

ERT SOP # 2007

Provides general information on how to collect groundwater samples from wells for field screening and laboratory analysis.



STANDARD OPERATING PROCEDURES

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GROUNDWATER WELL SAMPLING

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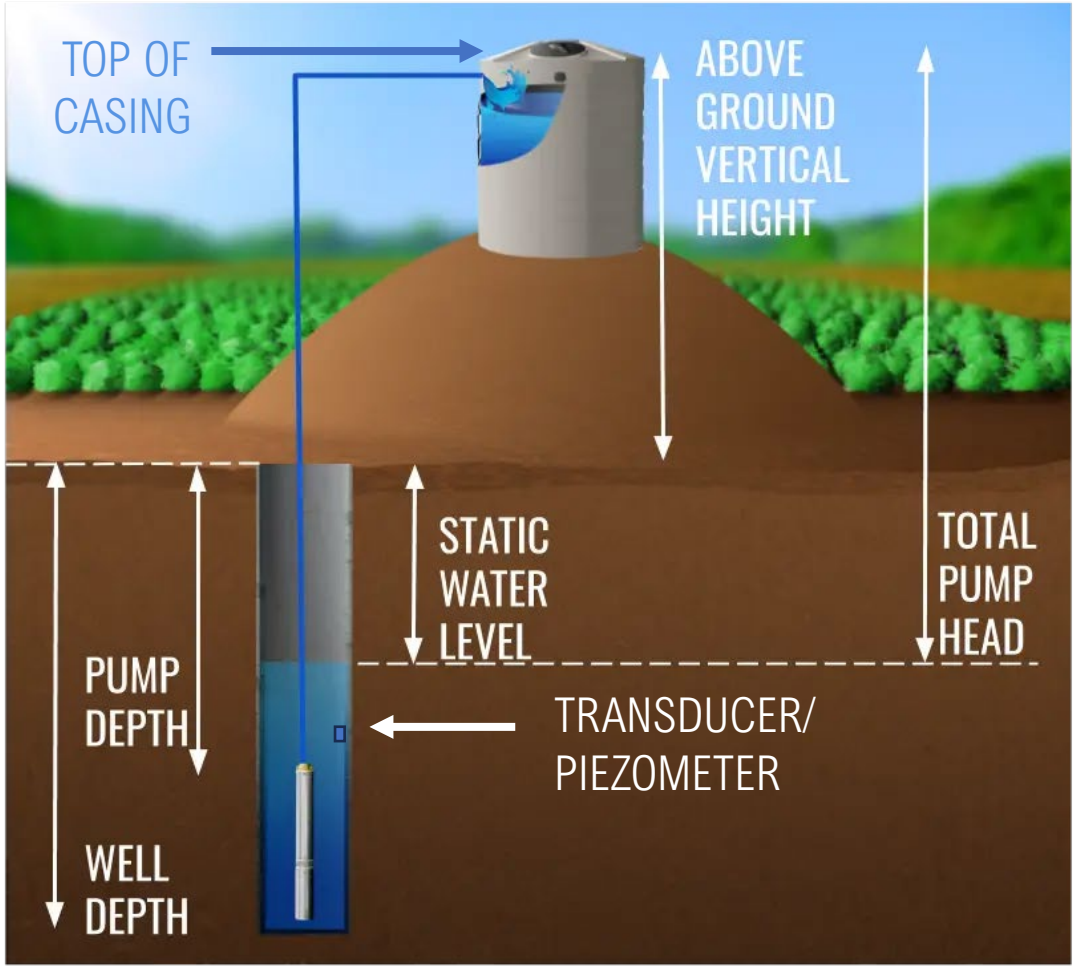
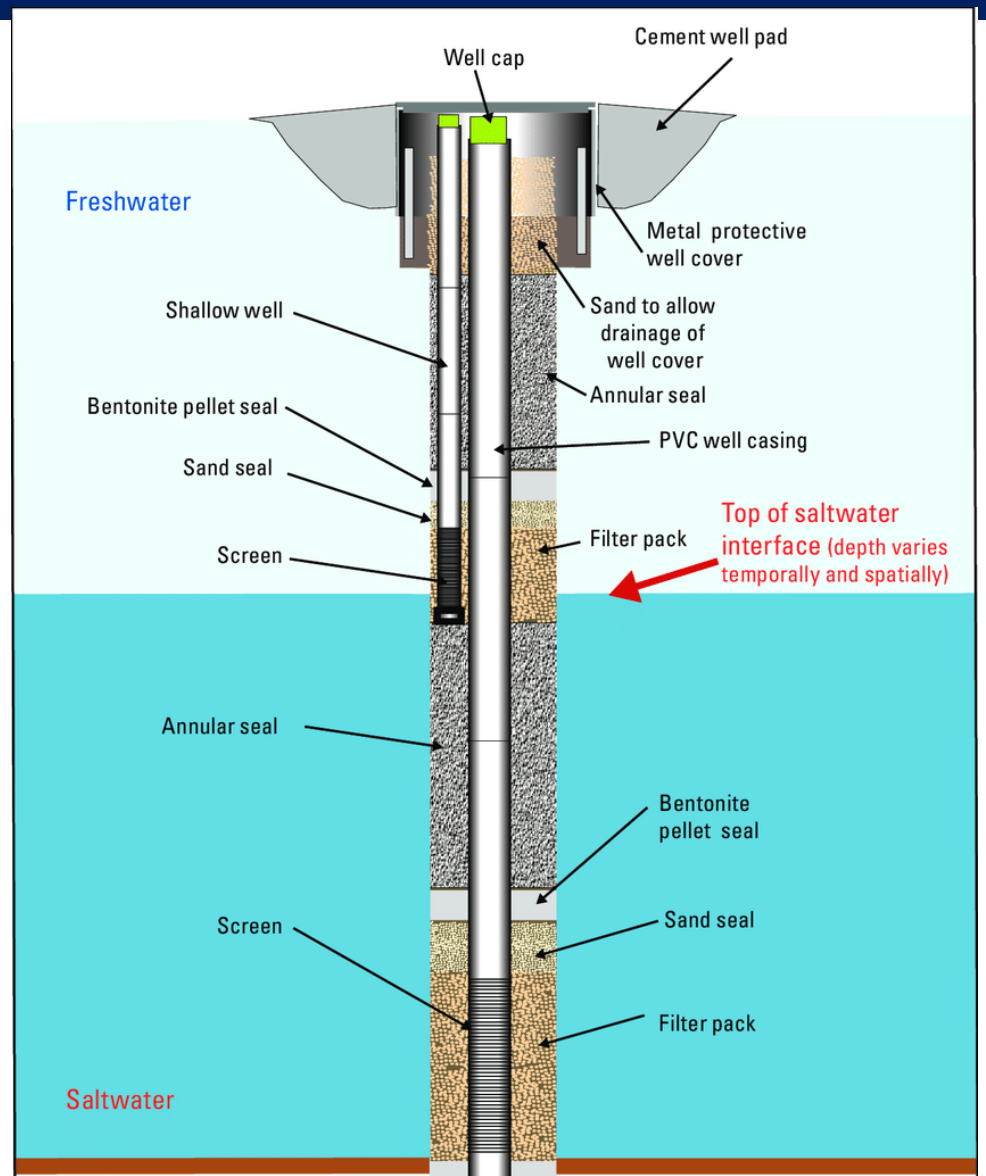
Well Components and Terminology

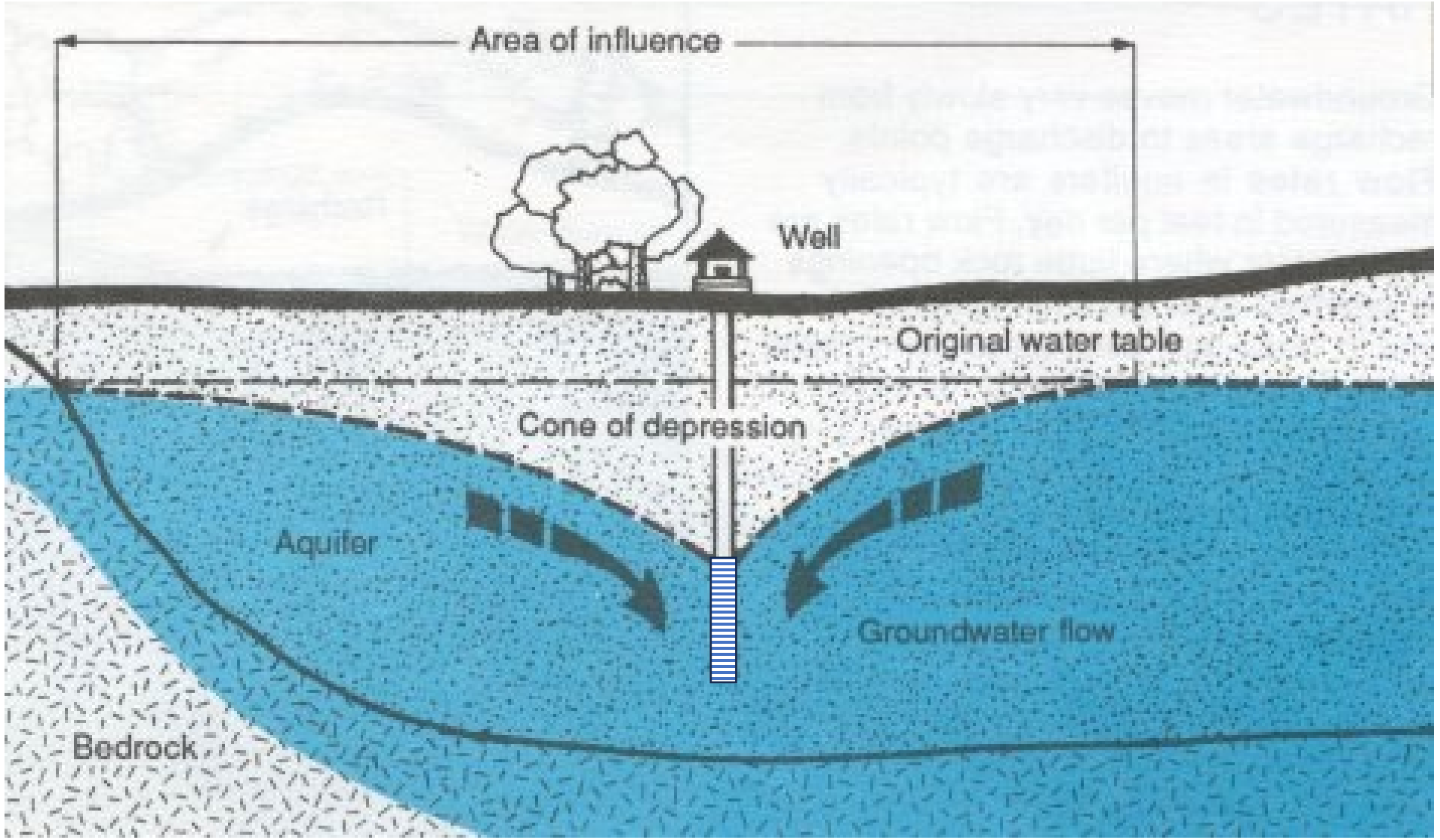


Well Components and Terminology



Nested Well

Well Components and Terminology



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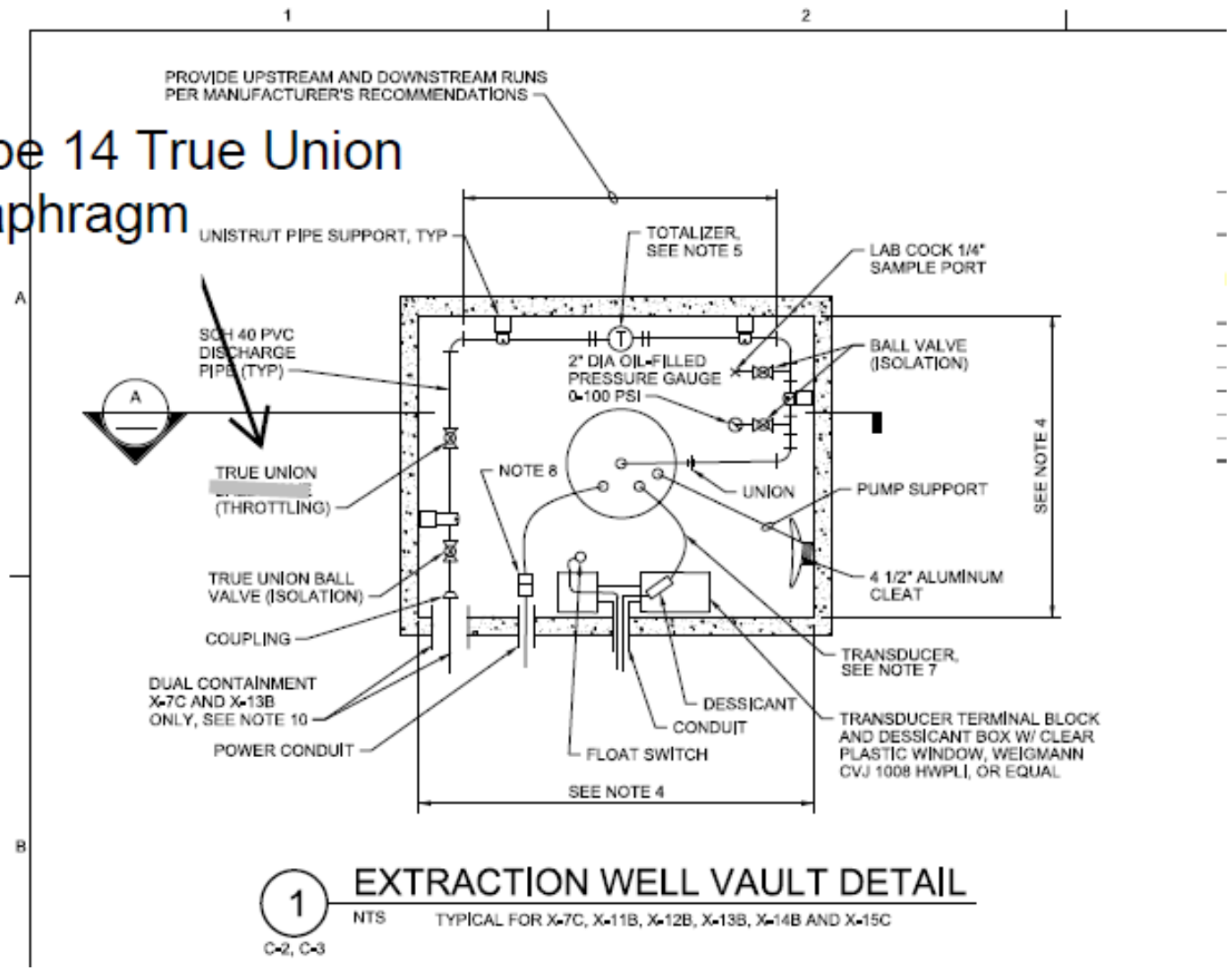

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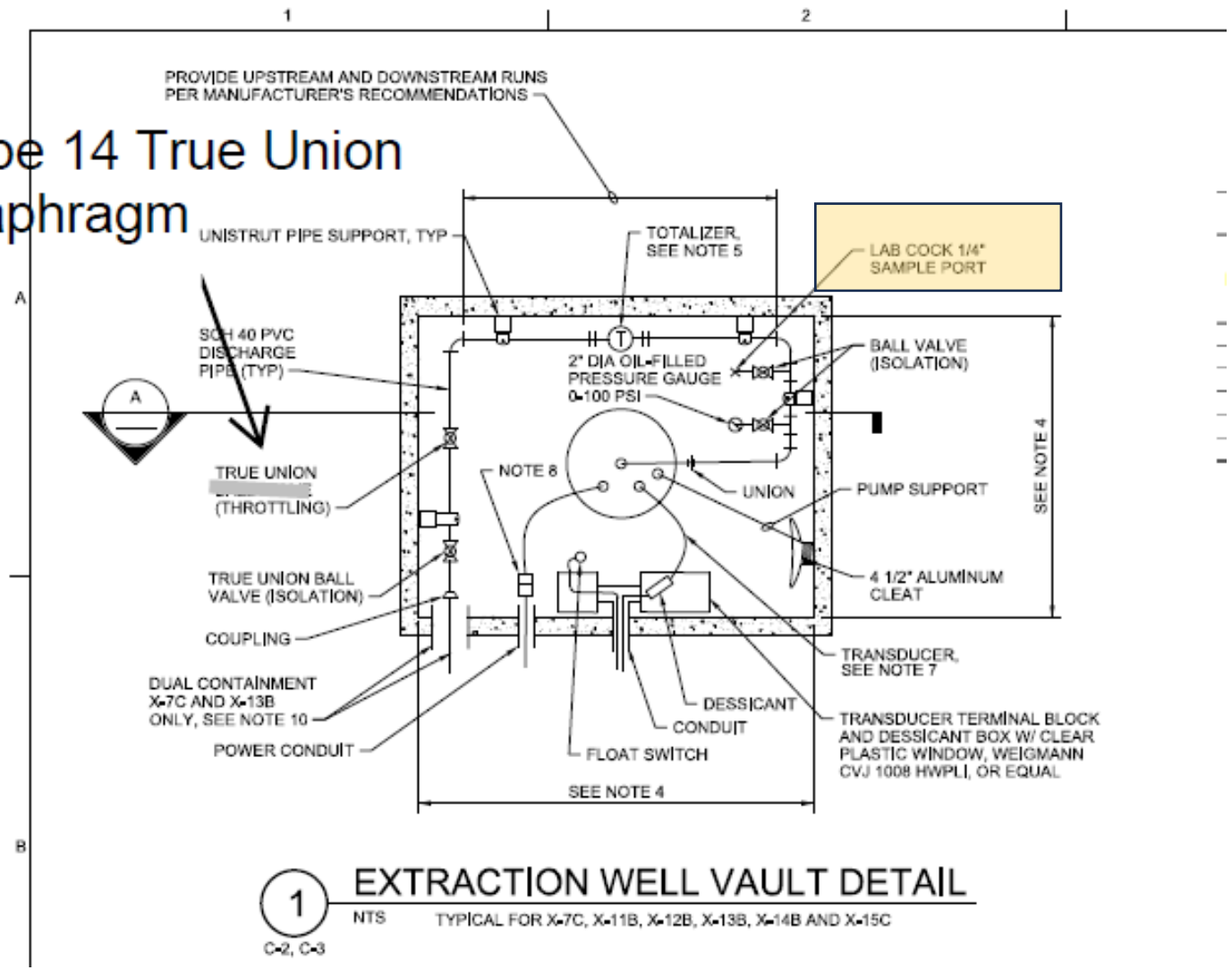
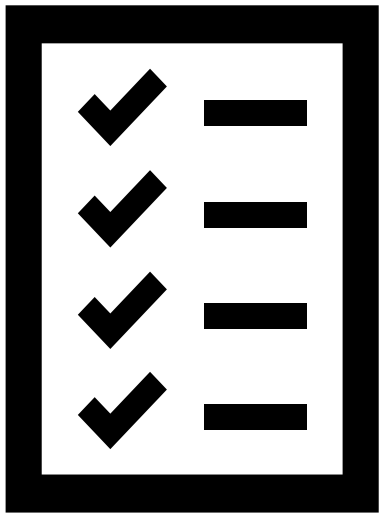


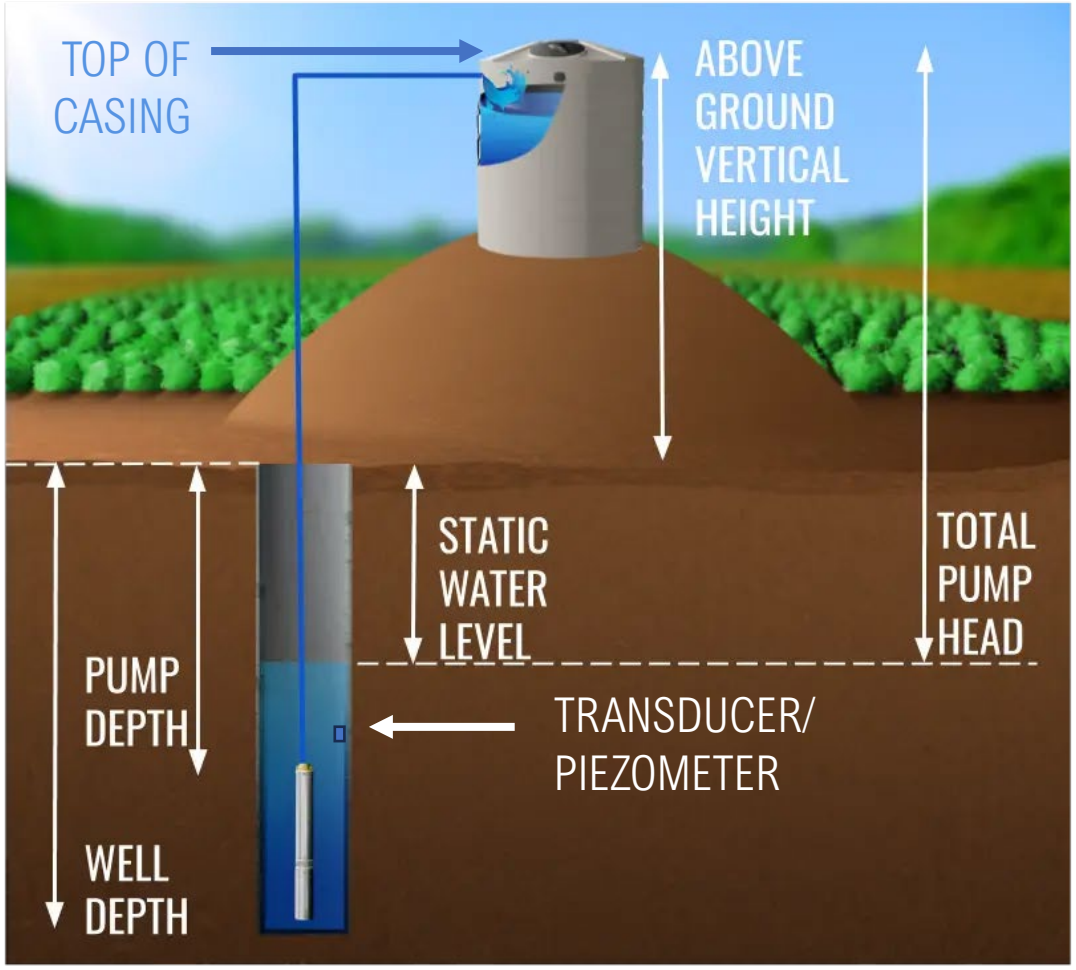
Procedures-Preparation

Pre-Field Preparation



- Determine extent of sampling, sampling methods, and equipment required.
- Obtain necessary equipment. Decontaminate and check working order of all equipment.
- Obtain the correct well-lock keys.
- Obtain proper access to private property including water rights.

Types of Measurements



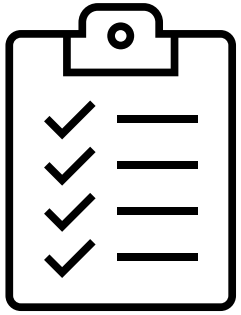
Depth

- **Water Level:** Measure distance from water surface to the referenced measuring point (Top of Casing is typical).
- Water Level may be measured by a transducer/piezometer.

- **Well Depth:** Measure the total depth of the well.

Groundwater Well Sampling Methods

Overview



Groundwater well methods include:

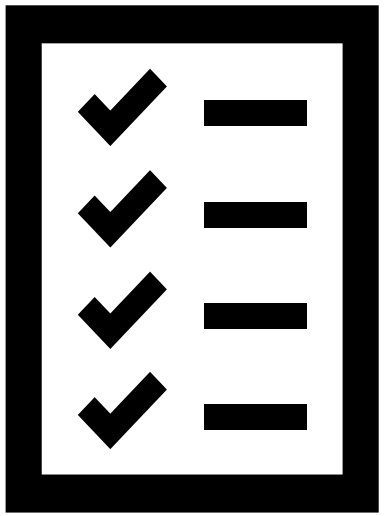
- Operational
- Purging Methods:
  - High-Flow Purging and Sampling
  - Low-Flow Purging and Sampling
  - FLUTe Well Sampling
- No-Purge Discrete Sampling
  - Diffusion
  - Grab

Groundwater Well Sampling Methods
Overview

Operational Sampling

- If a well is already in consistent operation, you can sample a well output through the sampling port in the well vault.
- Record pumping rate, discharge volume, water level, and groundwater parameters.
- This is representative of the water coming out of the well during operation and is a method that could be used on wells such as drinking water wells.

Scope and Application
Purging and Sampling



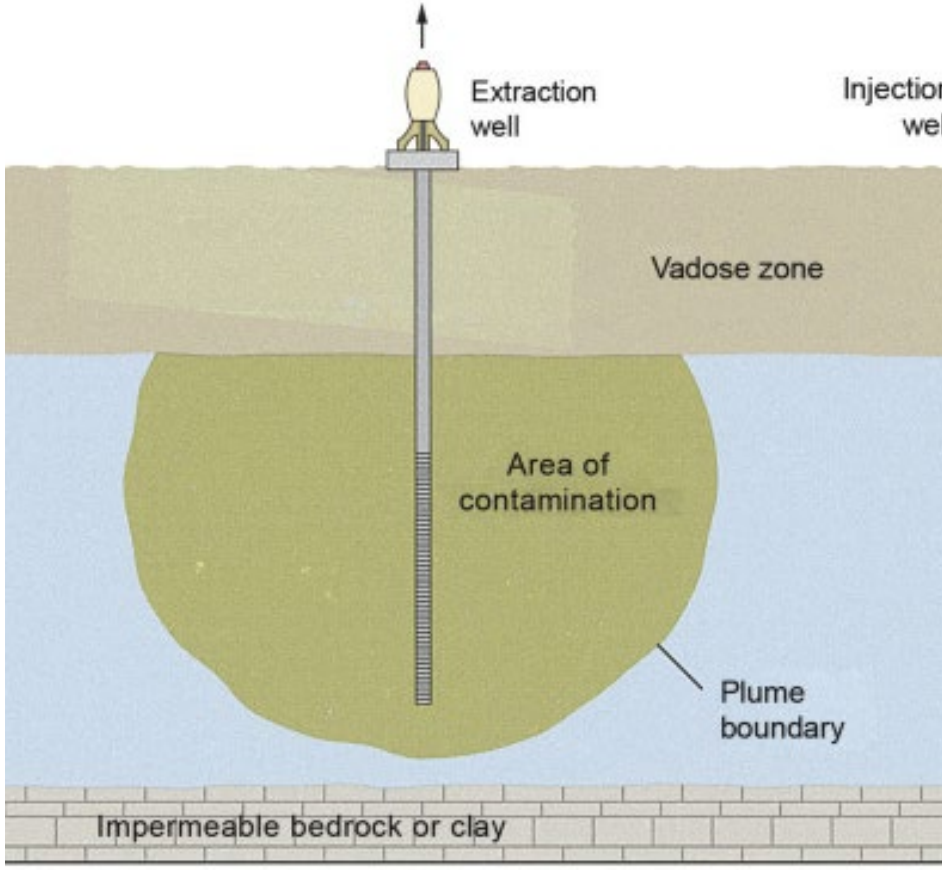
- Objective: Consistent and representative sampling of the groundwater wells.
- Using Purging Prior to Sampling:
  - Samples collected after purging are representative of the groundwater in the surrounding aquifer.
  - Purging refers to removing water from the well such that water is pulled into the well from the surrounding aquifer.

Scope and Application
Groundwater Well Sampling

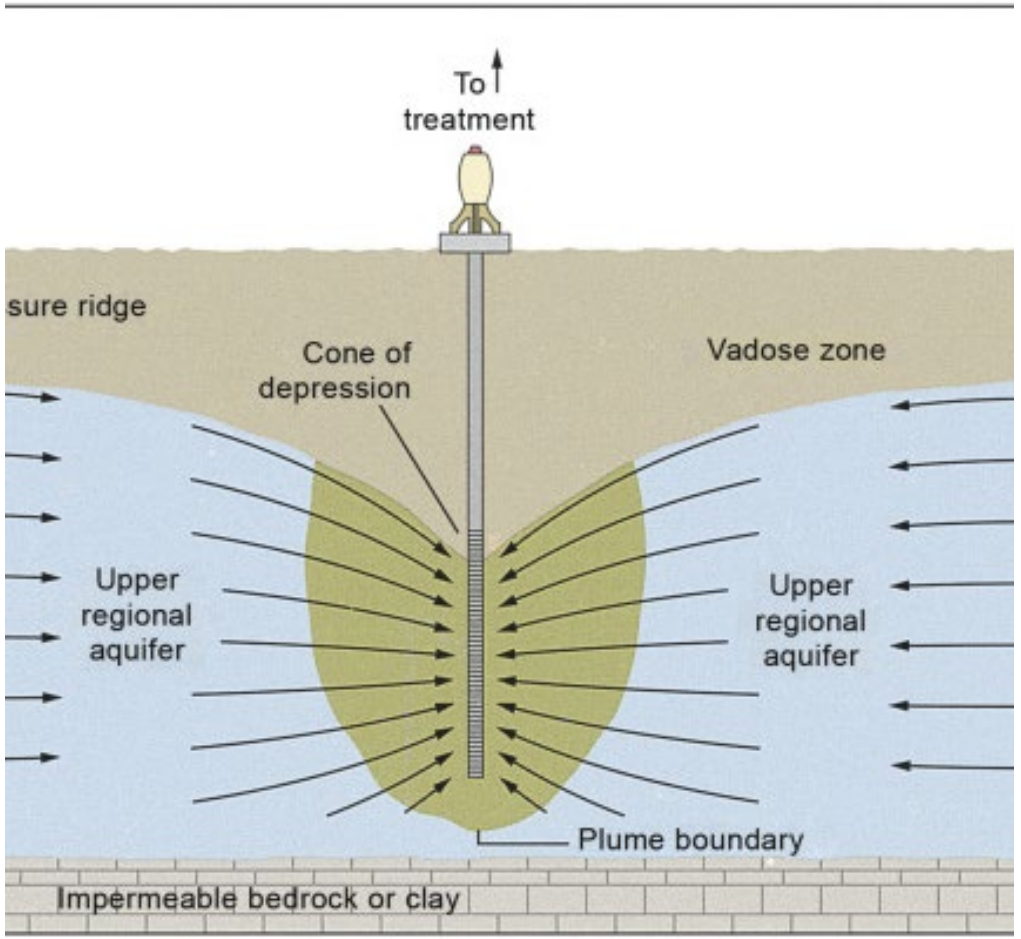
- Historically, a **high-flow** purging method has been used for groundwater sampling.
- In the mid-1990s, **low-flow** (low stress) purging, and sampling evolved using low pumping rates.
- **No-purge sampling devices**, which began to appear in the late 1990s and early 2000s, enabled collecting a sample without pumping or purging prior to sampling.
- **The purging and sampling method should be chosen to suit the groundwater well and the target analytes.**

Scope and Application
Purging and Sampling

High-Flow Purging



Before Pumping



During Pumping

Groundwater Well Sampling Methods
High-Flow Purging and Sampling

High-Flow Purging and Sampling

- Three well volumes of standing groundwater are purged at high flow prior to sampling.
- Record pumping rate, discharge volume, water level, and groundwater parameters.
- Stabilization of groundwater parameters indicates that the water is representative of the aquifer.
- May produce large volumes of purge water depending on well diameter and depth.

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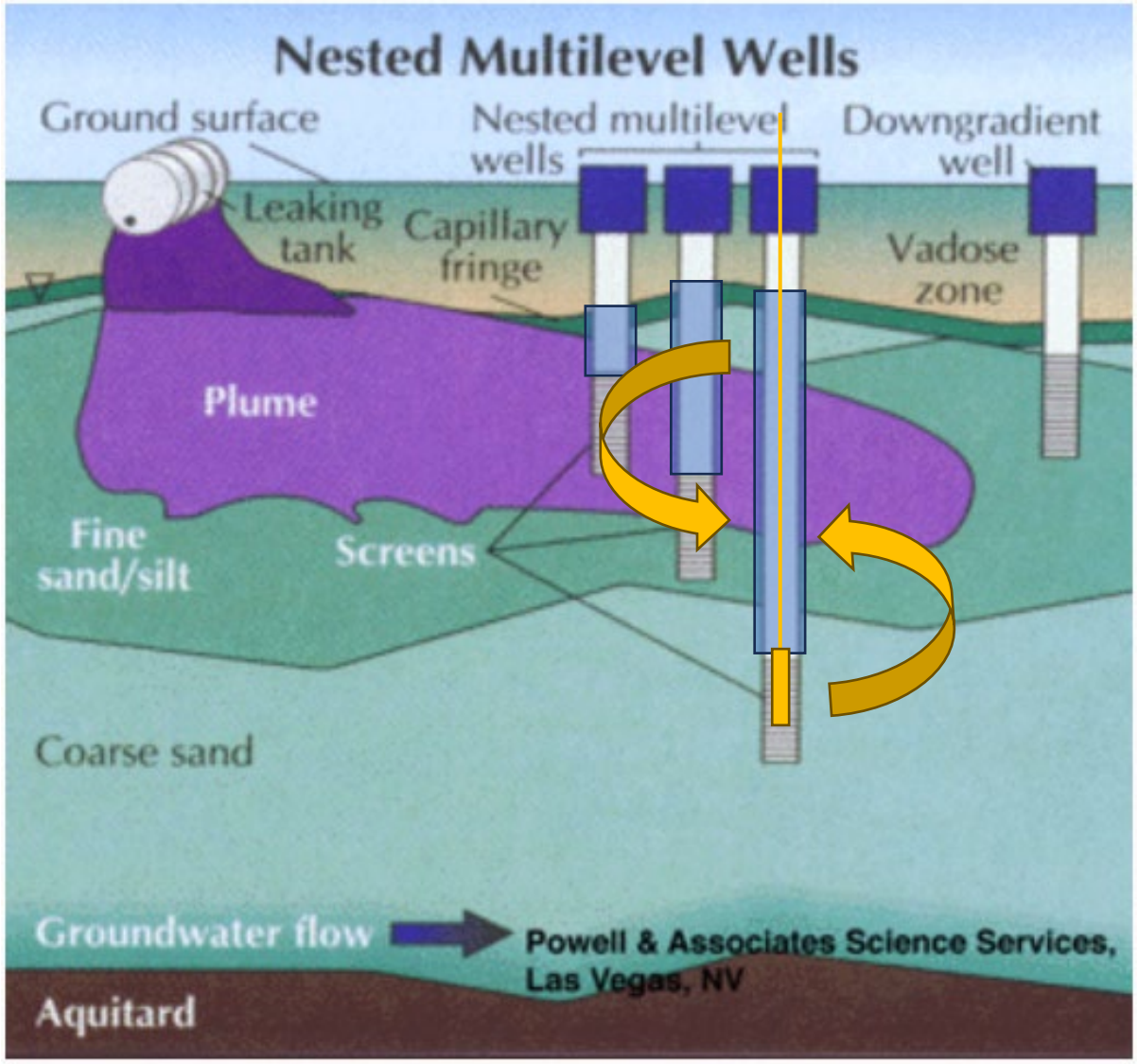
Scope and Application
Purging and Sampling

High-Flow Purging



The screened interval is going to give you the best idea of what is in the aquifer.
The blue volume above the screen is what you want to purge if you are pumping.

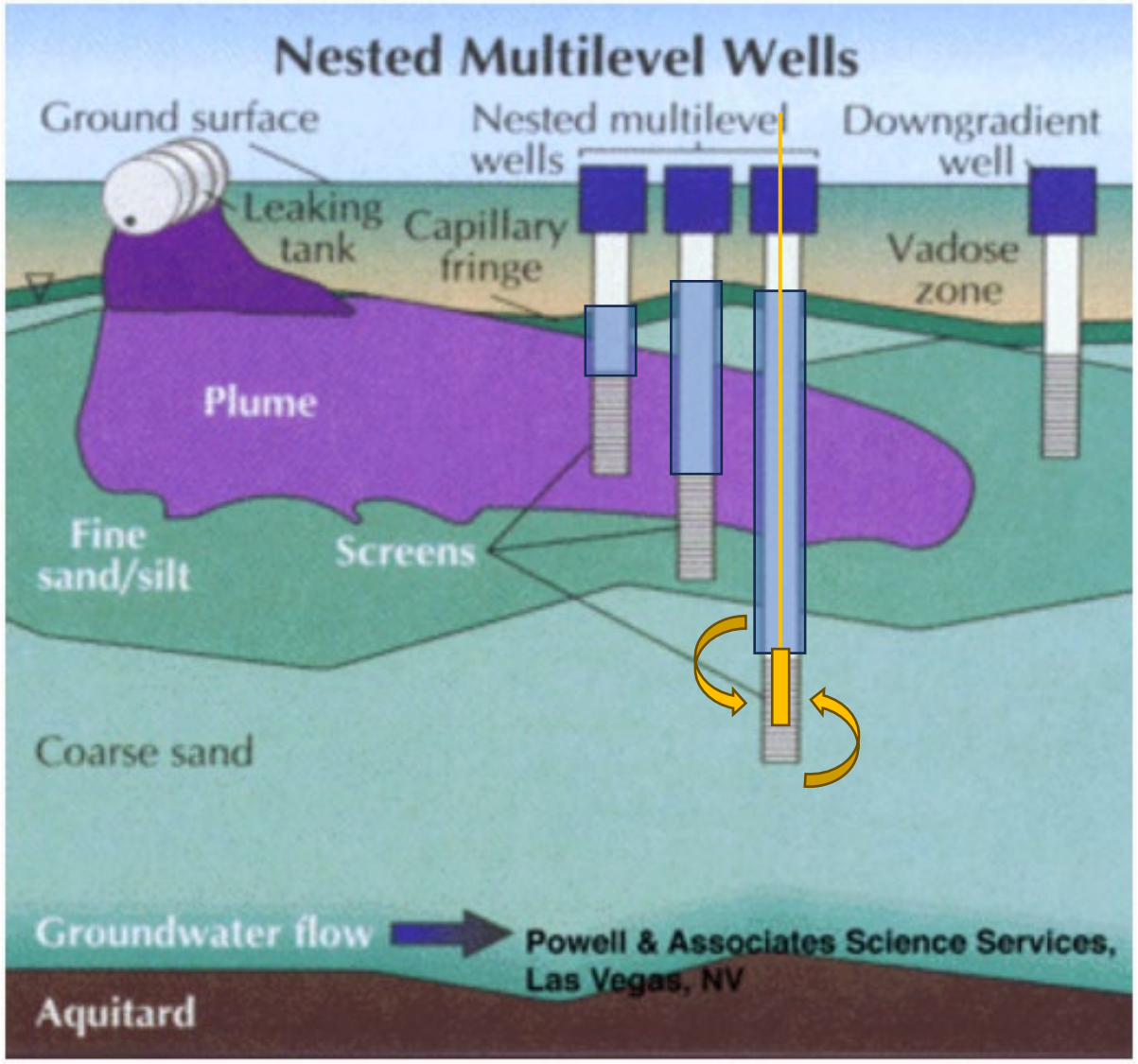
Groundwater Well Sampling Methods
Low-Flow Purging and Sampling

Low-Flow Purging and Sampling

- Limits the purge water volume removed. This decreases the drawdown around the well, as well as aeration and turbidity of the water.
- Flow rates generally less than one liter per minute.
- Pump intake is positioned in zone of highest contamination, or the midpoint of screened length.
- Groundwater parameters (pH, electrical conductance, temperature, turbidity, DO, ORP) are monitored for stability to indicate when sampling may commence.

Scope and Application
Purging and Sampling

Low-Flow Purging



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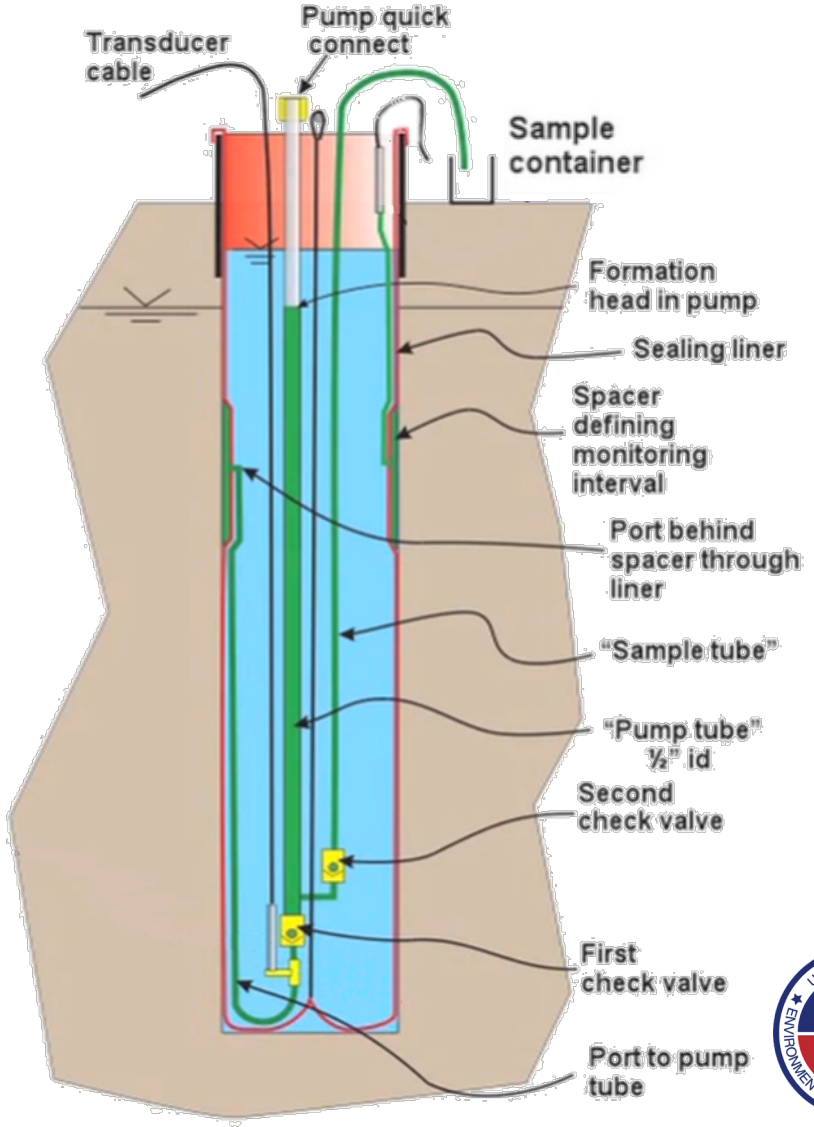
The blue volume above the screen is what you want to purge if you are pumping.

Groundwater Well Sampling Methods
FLUTe Well Sampling

FLUTe Well Sampling

- A flexible plastic liner is inserted into the well, sealing the borehole. The liner includes spacers and ports for each sampling interval.
- Each sampling interval can be purged and sampled simultaneously.



Groundwater Well Sampling Methods

FLUTe Well Sampling Equipment

FLUTe

- Sampling system consists of the liner, a manifold, valves, tubing, and a nitrogen cylinder.
- The nitrogen supply is used to pressurize a downhole air line which purges water from the sample port. After each purge, the port is allowed to recharge for 5-10 minutes. This process is repeated at least three times.
- After the final purge, wait for 10-15 minutes before sampling from the port. Move on to the next sampling port.

Advantages

- Sampled water is not subjected to pressure extremes which may change chemical makeup.
- May be able to determine if there is contaminant stratification in well.
- Multiple sampling intervals may be installed in one well.

Disadvantages

- Diameter of the well may limit the number of sampling intervals that can be sampled.
- Specialized equipment and supplies are required.

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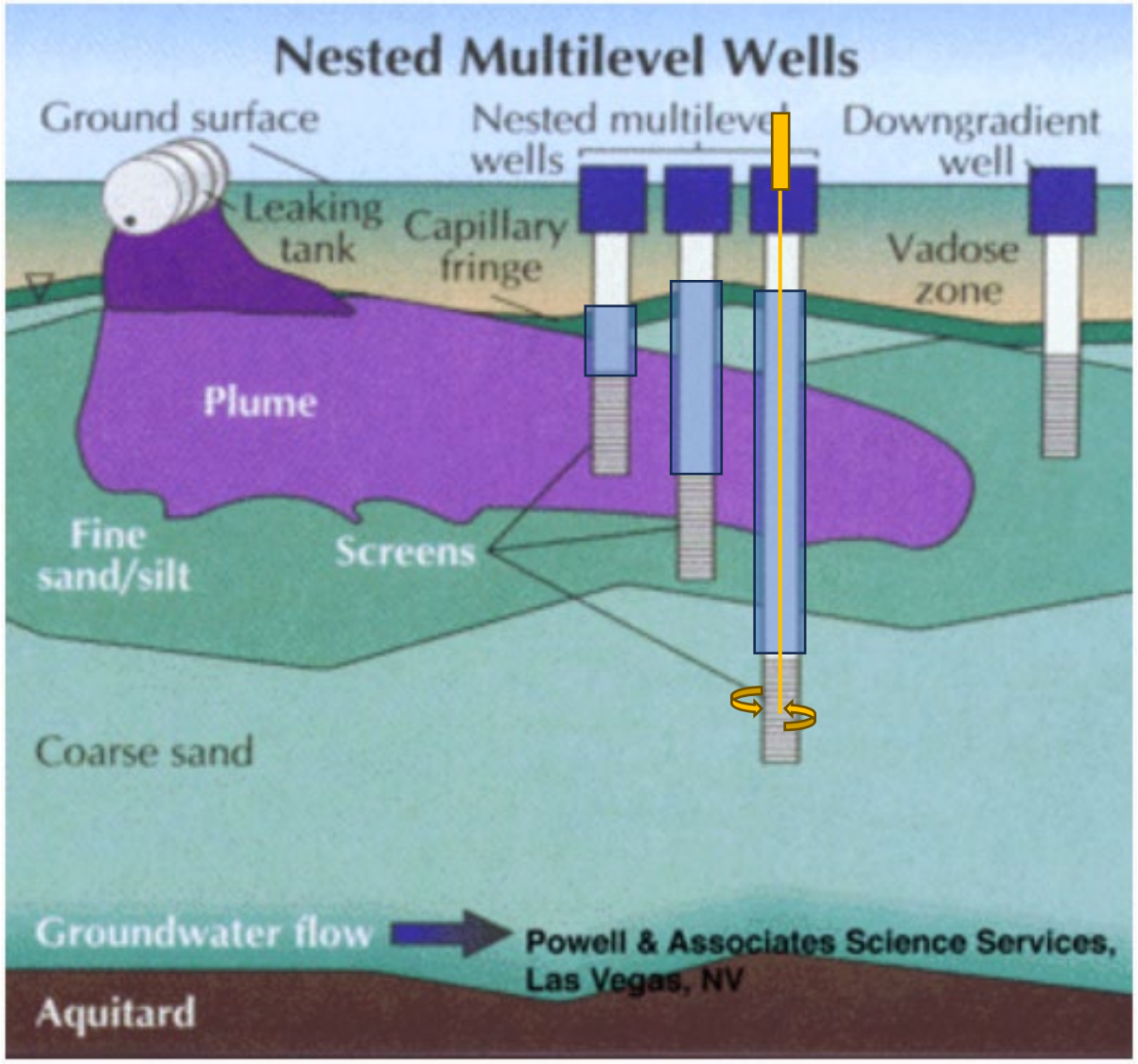
Scope and Application
Purging and Sampling

No-purge sampling



The screened interval is going to give you the best idea of what is in the aquifer.
The blue volume above the screen is what you want to purge if you are pumping.

Groundwater Well Sampling Methods
No-Purge Sampling

No-Purge Sampling

- Sampling using passive samplers which make it possible to collect samples without pumping or purging.
- Sampler is lowered to desired depth and then filled.
- Some samplers are designed to be left in the well for an equilibrium period, allowing for natural conditions to be re-established following the disturbance of deploying the sampler.
- Grab Samplers vs Diffusion Samplers

Groundwater Well Sampling Methods
Grab Samplers

Grab Samplers

Sampler is lowered into the well, then activated at the target depth.

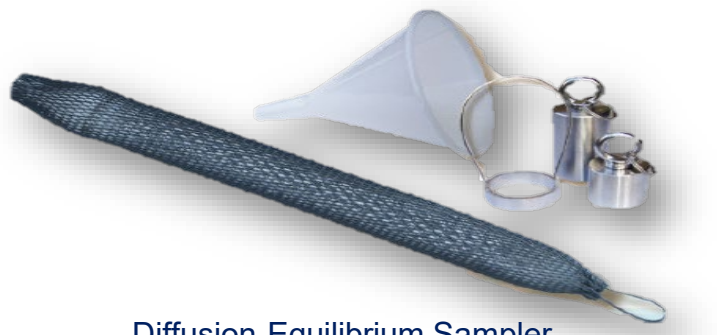
- Some of these samplers are designed to be left in the well for an equilibration period before sampling.
- Grab sampler types
  - HydraSleev
  - Snap Sampler
  - Discrete Interval Sampler
  - Kemmerer Sampler

Snap Sampler

Groundwater Well Sampling Methods
Diffusion Samplers

Diffusion Samplers

- Relies on diffusion of the analytes to attain equilibrium between the sampler and the groundwater.
- Samplers are typically closed and filled with deionized water prior to deployment. Target analytes diffuse through a membrane or through the walls of the sampler over an equilibrium period of several days to a few weeks.
- As a time-saving measure, after each sampling event, a new set of samplers may be placed in the wells for retrieval in the next sampling event.



Diffusion-Equilibrium Sampler

Sample Preservation, Containers, Handling and Storage

- Each analytical method specifies the sample container requirements, sample preservation, and holding time.
- Sampling container considerations:
  - Glass or plastic?
  - Clear or tinted for protection from light?
  - Is there a volume requirement for the method?

Sampling Container Examples

- Pesticides: Amber Glass, Teflon Lined Cap. 1 L.
- Metals: Plastic or Glass, pre-cleaned w/ acid wash. 250 mL.
- Total Petroleum Hydrocarbons: Amber Glass, pre-cleaned w/acid and solvent wash, Teflon Lined Cap. 1 L.

Sample Preservation, Containers, Handling and Storage (Continued)

Sample Preservation

- Samples should be placed in a cooler and maintained at ≤ 6 degrees Celsius and protected from sunlight.
- Addition of preservatives:
  - SVOCs, pesticides, herbicides, and PCBs usually do not require the addition of a preservative.
  - VOCs typically require preservation with hydrochloric acid.
  - Metals require pH adjustment with nitric acid to <2.
  - Cyanide requires pH adjustment with sodium hydroxide to >12

Interferences and Potential Problems

Effects Caused by Well Installation and Development:

- Definition of well development: removal of the clay and silt as well as the finer part of the aquifer directly around the well screen prior to putting the well into service.
- Samples collected from improperly developed wells, or wells with faulty filter packs or poorly grouted seals will not be representative of the groundwater aquifer.
- Newly installed wells should not be sampled for at least 24 hours after development.

Filtering

- Samples analyzed for dissolved metals require filtration.
  - Excludes silt and other fine particulates that would interfere with the analysis.
  - In-line filter and peristaltic pump is used to filter each collected sample into a new sample container.
  - A new filter and tube is used for each sample.

Special Considerations for VOCs
Overview

- The proper collection of a sample for VOC analysis requires minimal disturbance of the sample to limit volatilization. Sample retrieval equipment suitable for the collection of VOCs is:
  - Positive displacement bladder pumps
  - Some submersible pumps
  - No-purge samplers

Special Considerations for VOCs

Sampling Procedure

1. Open the sampling vial, set cap in a clean place, and collect the sample. When collecting duplicate samples; collect both samples at the same time.
2. Fill the vial to almost overflowing (zero head space). Do not let it excessively overflow. It needs to have a convex meniscus on the top of the vial before securing the cap.
3. Check that the cap has not been contaminated and place the cap directly over the top and screw down firmly. Do not over-tighten the cap.

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Special Considerations for VOCs
Sampling Procedure

4. Invert the vial and tap gently. Observe vial for at least 10 seconds. If an air bubble appears, unscrew the cap and pop the bubble or refill with more sample then re-seal. Do not collect a sample with air trapped in the vial.
5. The holding time for unpreserved samples to be analyzed for VOCs is 7 or 14 days for preserved samples.
   - Samples should be shipped or delivered to the laboratory as fast as practical in order to allow the laboratory time to analyze the samples within the holding time.
   - Ensure that the samples are stored at ≤ 4C during transport but do not allow them to freeze. The most readily available method of cooling is to use ice packed in double-sealed plastic bags (e.g. Ziploc bags).

Class Exercise 2: VOC Bottle Filling Exercise

1. Fill bottle.
2. Bottle should have no bubbles. If bubbles exist, try again.

QA/QC and Data Validation

- All equipment must be constructed of materials that do not introduce contaminants or alter the contaminants being investigated.

QA/QC and Data Validation

- Document all sample collection data, including purge method and time.
- If using non-dedicated equipment, collect rinsate (equipment) blanks to evaluate potential for cross-contamination.
- Duplicate samples may be collected to assess variability of analysis.
- Collect trip blanks if analyzing for VOCs.
- Check and calibrate equipment prior to purging and sampling.

Health and Safety

When working around VOCs:

- Avoid breathing volatiles venting from the well.
- Check the head-space of the well with a FID/PID before sampling.
- Based on air monitoring results, conduct sampling in appropriate PPE.
- Many well vaults are considered a confined space so make sure you have taken a confined space H&S class and be aware of your agency policies on confined space entry.