FS 2200 Audit Checklist

To use this field audit checklist effectively, the auditor must be familiar with FS 2200 (Groundwater Sampling) in "DEP Standard Operating Procedures for Field Activities", (DEP-SOP-001/01)

Well head inspection and water level measurement

Standing water present in the wellhead was removed.

Water levels were measured to the nearest 0.01 foot.

The well bottom was not sounded with the measuring tape.

General purging procedures

Well volume was correctly determined.

Equipment volume was correctly determined.

The pump, tubing or bailer was not allowed to drop to the bottom of the well.

Depth to groundwater was measured at frequent intervals during purging.

The placement of the pump or tubing intake was correctly determined according to the position of the water level in relation to the well screen interval and the purging procedure used.

The placement depth of the pump or tubing intake was recorded for each instance of positioning.

Purging with bailers

The bailer was lowered and raised at the rate of 2 cm/sec into the top of the water column.

The clean bailer was kept in protective wrap until just before use or was decontaminated immediately prior to use.

At least one well volume was removed prior to measuring stabilization parameters.

At least ¼ well volume of additional water was purged from the well prior to each subsequent (successive) measurement of stabilization parameters.

A minimum total of at least 1½ well volumes was purged prior to collecting samples.

General procedures for purging with a pump

Drawdown was stabilized so that the pumping rate matched the formation recharge rate.

Purging minimal (equipment) volumes with a pump from the middle of a fully submerged well screen interval

- The well screen interval (length) was <10 feet.
- The pump or tubing intake was placed within the middle of the screen interval.
- A minimum total of at least 3 equipment volumes was purged.
- The purging pump was also used to collect the samples.

Purging from the top of the water column with a pump

- The pump or tubing was placed at the top of the water column above the submerged well screen and a minimum total of 1½ well volumes was purged.
- The pump or tubing was placed at the top of the water column in the partially submerged well screen interval and a total of at least one well volume was purged prior to commencing measurement of stabilization parameters.

Purging in the middle of the partially submerged screen interval with a pump

- The pump or tubing was placed within the middle of the submerged portion of the screen interval and a minimum total of at least one well volume was purged prior to commencing measurement of stabilization parameters.

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- The purging pump was also used to collect the samples.

Frequency of measurement for purge stabilization parameters

A flow cell was used to measure stabilization parameters during pumping.

Downhole measurements were used for wells purged by bailing.

If the well was purged from the top of the water column above a fully submerged screen, at least one well volume was purged prior to commencing purge stabilization measurements and at least ¼ well volume was purged at the stabilized pumping rate between consecutive purge stabilization measurements.

If the well was purged from the top of the water column in a partially submerged screen interval, at least one well volume was purged prior to commencing purge stabilization measurements and at least 2 minutes of continuous purging at the stabilized pumping rate elapsed between consecutive purge stabilization measurements.

If the well was purged from the middle of a fully submerged screen interval, at least one equipment volume was purged prior to commencing purge stabilization measurements and at least 2 minutes of continuous purging at the stabilized pumping rate elapsed between consecutive purge stabilization measurements.

Determination of purging completion

Three (3) consecutive measurements of the three parameters listed below were within stated limits

- Temperature: ±0.2° C
- pH: ±0.2 standard pH units
- Specific Conductance: ± 5.0% of reading

Measured dissolved oxygen and turbidity were below the following thresholds.

- DO <20% saturation at the measured temperature
- Turbidity <20 NTU

For wells where DO and turbidity thresholds could not be met for justified reasons, consecutive measurements were within the above stated limits for pH, conductivity and temperature; and, DO and turbidity measurements were within the following stated limits.

- DO: ±0.2 mg/L or 10%, whichever is greater
- Turbidity: ±5 NTUs or 10%, whichever is greater

For wells failing to meet stabilization criteria after five (5) well volumes, testing instrumentation, calibrations, purging flow rate, flowcells and all tubing connections were determined to be functional and acceptable for measuring stabilization parameters.

Dry-purged wells were purged only once according to FS 2212, section 3.7

Purging Low Permeability Wells

The well was known to purge dry due to low formation permeability and the samplers determined that the well could not be purged according to FS 2212 and FS 2213.

Very small diameter Teflon, PE or PP tubing and the smallest possible pump chamber and flow cell volumes were used. Low density polyethylene (LDPE) tubing was not used for VOC collection.

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The pump tubing wall was thick enough to minimize oxygen transfer.

The pump or tubing intake was placed within the well screen interval.

The purging flow rate was <100 mL/min.

Pump rate was adjusted to minimize drawdown.

A minimum total of at least 2 equipment volumes was purged before stabilization parameters were measured and samples were collected.

Temperature, pH, conductivity, DO and turbidity were measured once immediately prior to collecting the samples during stabilized pumping after at least 2 equipment volumes were purged.

The same pump was used to purge and collect the samples.

Collecting samples from Low Permeability Wells

The same pump and tubing was used to purge and collect the samples.

The purge position of the pump or tubing intake was maintained throughout sample collection.

The stabilized purge pumping rate was maintained throughout sample collection unless pumping was ceased to allow formation recharge.

Samples were collected immediately after purging was completed while continuing a stabilized pumping rate or as soon as sufficient recharged sample water was available.

Maximum elapsed times between purging and sampling

Stabilization parameters were re-measured if the start of sample collection began more than one hour after completion of purging.

The well was re-purged if the second set of stabilization measurements exceeded the original measurements by more than + 10%.

Dry-purged wells were allowed to recharge after one purge before measuring stabilization parameters and collecting samples.

Samples were collected within 6 hours of purging completion.

General Requirements for Sample Collection Equipment

Pumps were decontaminated or replaced between wells.

Pump tubing was decontaminated or replaced between wells.

Reusable bailers were decontaminated between wells.

Material construction of pumps, tubing and bailers conformed to requirements of Tables FS 1000-1 through FS 1000-3 and Table FS 2200-1 for the analytes collected.

Collecting samples with pumps

Collection of volatile organic compound (VOC) samples with peristaltic pumps either employed the “straw technique” for collection from the well or was conducted through no more than one foot of silicone tubing installed in the pump roller head, according to the requirements and restrictions for tubing and flow rate specified in FS 2200. Low density polyethylene (LDPE) tubing was not used for VOC collection.

Collecting samples with bailers

Bailers were used to collect samples under the conditions specified in Table FS 2200-3.

The bailer was lowered and raised at the rate of 2 cm/sec into the top of the water column.

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VOC samples were poured or drained into sample vials with no aeration or agitation.

Samples for sulfites, sulfides or hydrogen sulfide were poured or drained into sample vials with no aeration or agitation.

Filtering groundwater samples for metals

The metals sample filtration procedure was preapproved by the DEP project manager for the site or project.

A 0.45 µm filter was used for filtering constituents other than metals.

A 1µm in-line filter was used for filtering metal samples.

All oxygen (air) was flushed from the in-line filter and any connected tubing prior to sample filtration.

The equipment configuration for filtering metals conformed with prohibitions in FS 2225 Section 1.

Purging and sampling wells with in-place plumbing, air strippers or other plumbed remedial systems

The purging and sampling point was located upstream of storage or pressure tanks where possible.

Hoses, aerators and filters removed were removed prior to purging and sampling where possible.

The plumbed system was purged at the selected purge point (valve or spigot) until the purge completion criteria listed in FS 2212 section 3 were met.

Air strippers and other remedial systems were purged for a minimum of one minute.

The flow rate was reduced to less than 500 mL/minute (1/8"" stream) or approximately 0.1 gal/minute before collecting samples.