



DEP Quality Assurance Requirements for Water Sample Collection and Field Testing Drinking Water, Surface Water, Wastewater

Aquatic Ecology and Quality Assurance
Section

Water Quality Standards Program



Today's Agenda

- 8:30 Introductions and Course Expectations
- 8:45 QA Rule/Documentation/Decontamination/Field QC & Field sampling
- 9:15 ***Break!***
- 9:30 Water Sampling Procedures & Requirements
- 10:45 ***Another Break!!***
- 11:00 Field Testing Calibration & Verification
- 12:15 **LUNCH (on your own)**
- 1:30 Hands-on Rotation #1
- 2:30 ***Last Break***
- 2:45 Hands-on Rotation #2
- 4:00 Course Wrap-up (in classroom)



Introduction – Who are you?

- **Which Division?**

- DEAR
- DWRM
- DWM
- OER
- Other?

- **Sampling Disciplines**

- Drinking Water
 - Facility operators
- Groundwater
- Surface Water
- Wastewater
 - Facility Operators



This introductory course will....

- Provide an overview to help you navigate and use the DEP SOPs to your advantage.
- Give you an opportunity to expand on what you already know, ask questions, and interpret SOP requirements.
- Provide hands-on training to learn or improve technique.

This course will *NOT*....

- Serve as an alternative to reading the SOPs.
- Make you an instant expert.

The SOPs are a valuable and authoritative resource:

- ***Details and quick reference for correct procedures***
- ***Look-up tables for specific information***





Your obligations for this course

AEQAS wants to help you learn!

- **You are expected to:**
 - Participate throughout the day
 - Stay engaged with the course material
 - Ask questions if something is not understood
 - Ask for help interpreting SOP requirements for a sampling scenario
- **The instructors will ask you to participate**
 - Try to answer questions asked of the class
 - Volunteer for hands-on activity when asked
 - Participate if called on!

Please!

Limit side conversations with your neighbors during instruction
Minimize phone use during the course



62-160, Florida Administrative Code: What does the DEP QA Rule require?

- Use DEP SOPs found at DEP website
(Revision Date: January 2017)
 - Pre-approval for alternative field procedures
 - Create and retain mandatory documentation
 - Follow preservation & holding times
 - Submit to audits
- *Applies to all data providers to DEP



Where to find the SOPs



<https://floridadep.gov/dear/quality-assurance/content/dep-sops>

To receive updates, subscribe to
eNewsletter

For QA questions, contact:
quality_assurance@floridadep.gov



DEP-SOP-001/01

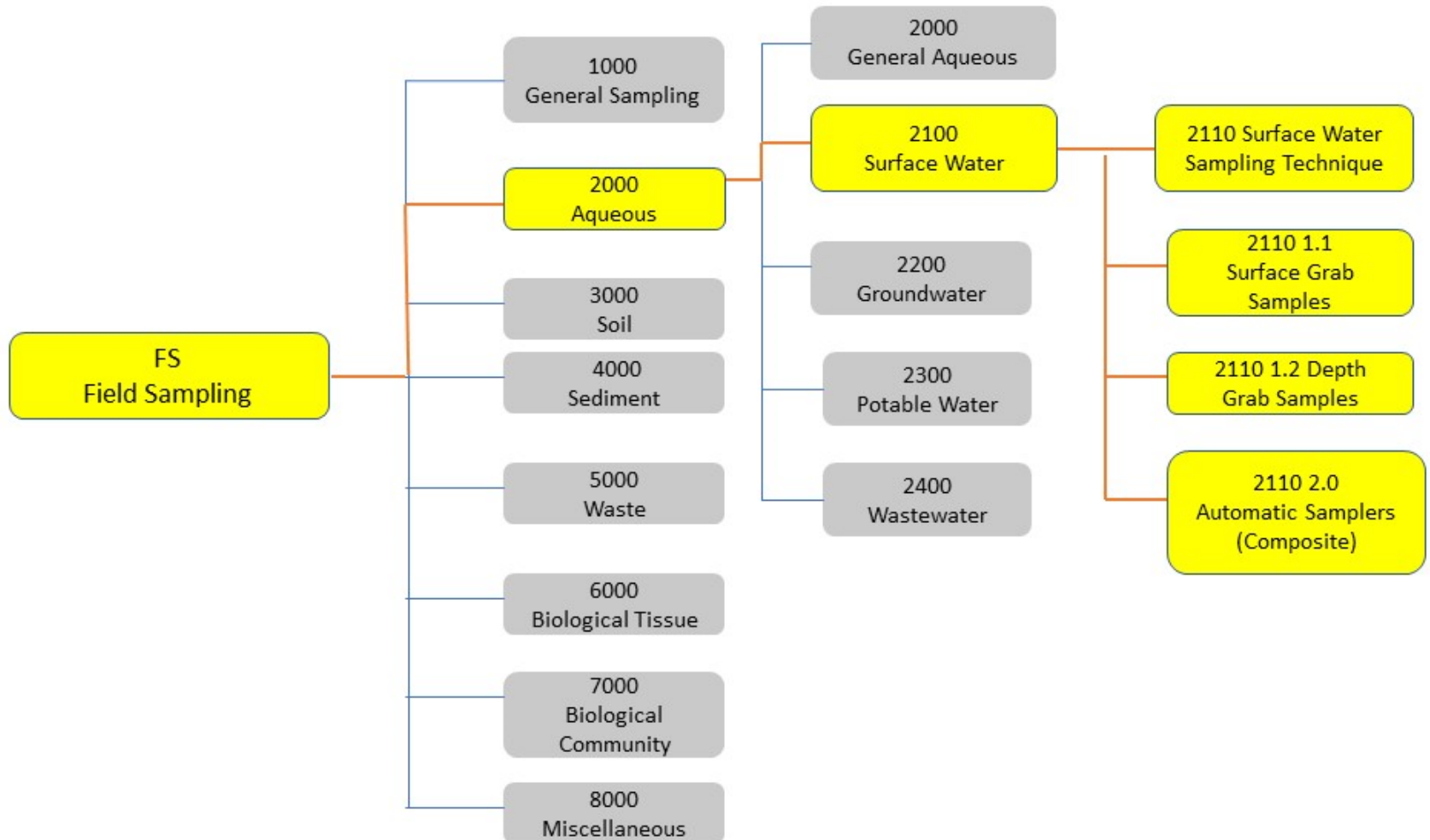
Naming Conventions for Field SOPs

- FA Administrative & Quality Systems
- FC Field Cleaning
- FD Documentation
- FM Mobilization & Laboratory
- FQ Quality Control
- FS Sampling Procedures
- FT Field Testing



DEP-SOP-001/01

SOP Design





FA 3000

Quality Manual



Includes quality assurance
policies and procedures for your
specific organization or program

- **See requirements in FA 3300**



FA 4000

Auditing



Any data provider may be audited by DEP!

Find Example Checklists for Selected SOPs:

- FA 1000 Appendix and QA audit webpage

<https://floridadep.gov/dear/quality-assurance/content/data-review-and-audits>

- DEP SOPs are audit criteria
 - Basis for checklists for performance and documentation



FD 1000 Documentation



There are universal requirements as well as specifics for each type of documentation.



FD 1000

Some universal documentation requirements

- Sign or initial all documentation.
- Record enough information so that interpretations are not required.
- Do not erase or obliterate errors on records. Make corrections with a line through the error so that it is still legible. Initial the marked error and its correction.
- Clearly link documentation with the associated sample or measurement.
- Keep electronic or hard copies of all documentation for a minimum of 5 years after the date of generation or completion of the documentation.



Some universal documentation requirements (cont'd.)

- Keep records of original and reduced or manipulated data
- Electronic records are equivalent to paper records
 - Electronic copies intended to replace original records must contain the same information as the original records



FD 1000

Good Documentation Habits

“When in doubt, write it down”





*Sometimes cows happen.
Make sure it's documented.*





FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION STRATEGIC MONITORING PROGRAM FIELD SHEET

January 2019

Data Qualified?

Yes / No

WIN Station Name:

Date:

(mm/dd/yyyy)

WIN/ Field ID:

WBID:

Latitude:

(Decimal Degrees)

County:

ORG ID:

Longitude:

(Decimal Degrees)

Receiving Body of Water:

RQ-

Sampling Team Members					WQ Measurements	Sample Collection	Documentation	Preservation	Preservation Check

Sampling Equipment		
☐ Sample Container	☐ Van Dorn	☐ Pole
☐ Carboy	☐ Syringe	
☐ Dipper	☐ Other	
Depth Measured with		
Equipment ID		

Collection Method		
☐ Wading	☐ Canoe/Kayak	
☐ From Shore	☐ Electric Motor	
☐ Other	☐ Gasoline Motor	

Water Level: Dry/ Pooled/ Low / Normal / High / Flooded		Meter ID#		Matrix: Fresh / Marine / DI	
Photos: Yes / No		Flow: No Flow / Intestinal / Flowing / NA		Tide: Rising/ Falling/ Slack/ NA	
				Tide Times: High Low	

- EXAMPLE FIELD SHEET
- Collects required details about sample method, samplers, and site



FD 1000

➤ Notes and footer for additional information

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
STRATEGIC MONITORING PROGRAM FIELD SHEET

Date Qualified? ☐ Yes ☐ No

WIN Station Name: _____ Date: _____
 WIN Field ID: _____ WBID: _____ Latitude: _____
 County: _____ ORG ID: _____ Longitude: _____
 Receiving Body of Water: _____

Sampling Equipment
☐ Van Bore ☐ Pole
☐ Siphon ☐ Syringe
☐ Dipper ☐ Other _____
 Depth Measured with _____
 Equipment ID: _____

Collection Method
☐ Wading ☐ Canoe/Kayak
☐ From Shore ☐ Electric Motor
☐ Other _____

Water Level: Dry / Pooled / Low / Normal / High / Flooded
Matrix: Fresh / Marine / D /

Time Zone	Time	Flow: No Flow / Intermittent / Flowing / NA		DO (mg/L)	DO (%SAT)	pH	Salinity (PPT)	Sp COND (µmhos/cm)	Temp (°C)
		Total Depth (m)	Sample Depth (m)						

Biological Samples Collected: None NA SCI BPS Algae ID LVS LVI Other: _____

SEID ID Numbers: SEID ID: _____ NA ID: _____ BPS ID: _____ Macrophyte ID: _____

Parameter Suite	Parameter Methods	Preservation	Lot#	Expiration	pH Check
Preserved Nutrients	☐ NH ₄ ☐ NH ₄ -N ☐ NO ₃ ☐ NO ₃ -N ☐ NO ₂ ☐ NO ₂ -N	☐ Ice ☐ N/A			☐ < 2
Metals	☐ ARSENIC ☐ BARIUM ☐ CADMIUM ☐ CHROMIUM ☐ COPPER ☐ IRON ☐ LEAD ☐ MANGANESE ☐ MERCURY ☐ MOLYBDENUM ☐ NICKEL ☐ SILICA ☐ SILICIC ACID ☐ ZINC	☐ Ice ☐ N/A			☐ < 2
Filtered Nutrients	☐ NH ₄ -N ☐ NH ₄ ☐ NO ₃ -N ☐ NO ₃ ☐ NO ₂ -N ☐ NO ₂ ☐ P ☐ PHOSPHATE ☐ SILICA ☐ SILICIC ACID	☐ Ice ☐ N/A			☐ < 2
Chlorophyll	☐ CHLOROPHYLL ☐ CHLOROPHYLL ☐ CHLOROPHYLL ☐ CHLOROPHYLL ☐ CHLOROPHYLL	☐ Ice ☐ N/A			☐ < 2
Phytoplankton	☐ PHYTOPLANKTON ☐ PHYTOPLANKTON ☐ PHYTOPLANKTON ☐ PHYTOPLANKTON ☐ PHYTOPLANKTON	☐ Ice ☐ N/A			☐ < 2
Macroinvertebrates	☐ MACROINVERTEBRATES ☐ MACROINVERTEBRATES ☐ MACROINVERTEBRATES ☐ MACROINVERTEBRATES	☐ Ice ☐ N/A			☐ < 2
Periphyton	☐ PERIPIHYTON ☐ PERIPIHYTON ☐ PERIPIHYTON ☐ PERIPIHYTON	☐ Ice ☐ N/A			☐ < 2
Microbiology	☐ MICROBIOLOGY ☐ MICROBIOLOGY ☐ MICROBIOLOGY ☐ MICROBIOLOGY	☐ Ice ☐ N/A			☐ < 2
Molecular	☐ MOLECULAR ☐ MOLECULAR ☐ MOLECULAR ☐ MOLECULAR	☐ Ice ☐ N/A			☐ < 2
Toxicology	☐ TOXICOLOGY ☐ TOXICOLOGY ☐ TOXICOLOGY ☐ TOXICOLOGY	☐ Ice ☐ N/A			☐ < 2
Pesticides	☐ PESTICIDES ☐ PESTICIDES ☐ PESTICIDES ☐ PESTICIDES	☐ Ice ☐ N/A			☐ < 2

Phytoplankton ☐ PHYTOPLANKTON ☐ PHYTOPLANKTON ☐ PHYTOPLANKTON ☐ PHYTOPLANKTON

Place Label Here

Signature: _____ Date: _____

LIMS EVENT ID: _____ WIN Import ID: _____

Enter Field Parameters, Verify Station ID In LIMS DMT: _____ QC Station ID, Field Parameters In LIMS DMT: _____

Scan/Save Field Sheets _____ Migrate Data to WIN: _____ Verify Data In WIN: _____

(Initials/Date) (Initials/Date) (Initials/Date)

Notes:

Place Label Here

Signature:

Date:

LIMS EVENT ID: _____ WIN Import ID: _____

Enter Field Parameters, Verify Station ID In LIMS DMT: _____ QC Station ID, Field Parameters In LIMS DMT: _____

Scan/Save Field Sheets _____ Migrate Data to WIN: _____ Verify Data In WIN: _____

(Initials/Date) (Initials/Date) (Initials/Date)

*Matrix Codes (Insert prefix): **SW** = Surface Water **GW** = Groundwater **DW** = Drinking Water **WW** = Wastewater **O** = Other: _____

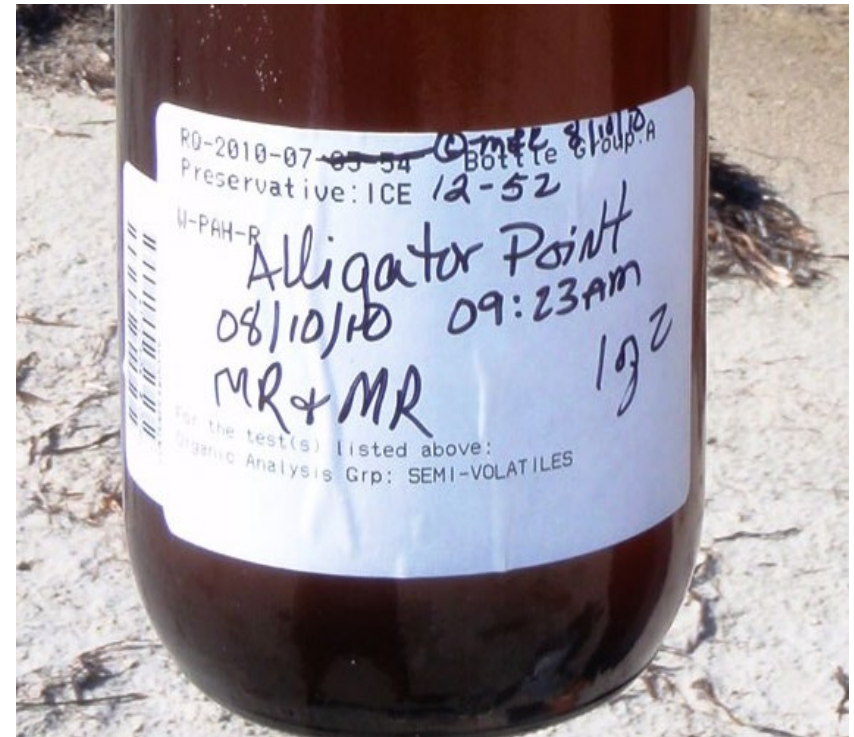
**PRESERVATIVES: 1 ml added unless otherwise noted



FD 1000

Link bottles to records

- Unique bottle ID
 - Must link to:
 - Site or source ID
 - Date
 - Time (≤ 48 hr hold time)
 - Analytes
 - Preservation
 - QC sample type (if applicable)
 - Multiple containers for same analyte/group ("1 of 2", "2 of 2", etc.)

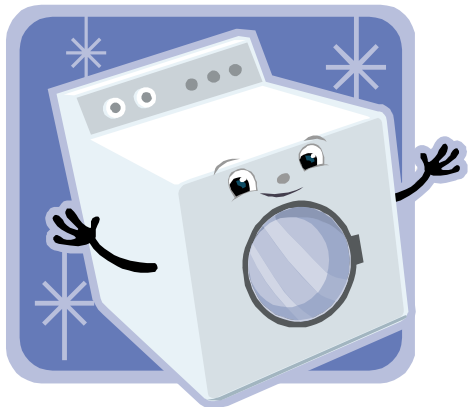




FC 1000

“Performance-Based” Cleaning

- Demonstrate effective cleaning with blanks
- See Table FC 1000-1



Cleaning to meet a performance specification (no detections in field-QC blanks) rather than following a rigid, required procedure



FQ 1000

Quality Control Samples

Optional

- Duplicates or Replicates
- Split Samples

Required

- Sampling QC Blanks

Your DEP SOP tells you which analytes require QC blanks to be taken.



FQ 1000

Why use blanks?



- Monitor sampling environment, container/equipment cleaning, preservatives, analyte-free water, and storage and transport conditions.
- Show that samples have not been contaminated by the sampling process.
- Ensure that samples are representative of the sampling source and not biased by a contamination error.



FQ 1000

Analytes That Do Not Require Blanks

- Microbiological (e.g. viruses, bacteria, protozoa)
- Toxicity (e.g. whole effluent toxicity)
- Field Parameters (e.g., pH, Sp. Cond., DO, TRC)
- Radon
- Algal Growth Potential
- Biologicals (e.g. chlorophyll)
- Biological Community (e.g. SCI)
- Physical and Aggregate Properties (e.g. color, hardness, turbidity)
- Biochemical Oxygen Demand



FQ 1214

Field Blanks



Analyte-free water collected directly into a sample bottle at the sampling site.



Equipment Blanks

Analyte-free water collected by rinsing the sampling equipment at the sampling site.



Collect *before* using pre-cleaned equipment
Collect *after* cleaning equipment in the field



FQ 1213

Trip Blanks (VOCs Only)

VOC vials filled with analyte-free water accompany the empty vials and real VOC samples through the entire sampling trip.

- **Remain unopened** until analysis
- Minimum of 1 vial per VOC cooler and trip.
- Multiple sites in same cooler OK, if all samples and trip blank analyzed by the same lab.



FQ 1230, FS 2110, FS 2430

Autosampler Equipment Blanks

- Tubing and composite containers are *intermediate devices* used for sample collection

*Collect equipment blanks by pumping analyte-free water through **entire clean sample tubing assembly installed in autosampler***

- *Frequency of tubing assembly blanks:*
 - *5% of tubing changes (recommended if routinely changed at each site visit) or with each tubing change (recommended if changed infrequently), whichever is less*
 - *At least annually (if applicable)*
- *Collect composite container blanks per FQ 1000*
 - *Frequency: per 5% of samples collected, over project or permit duration (e.g., 5-year permit cycle)*
 - *At least one container blank annually (if applicable)*



Blank Collection Frequency

- Field & Equipment Blanks
 - **Minimum of 1 blank annually** for each *required* analyte/matrix combination
 - **5%** of total number of samples collected for each combination *over the life of the project* as applicable
- Trip Blanks
 - VOCs require a trip blank with every sampling trip
 - Trip blank(s) in each transport container/ice chest



FM 1000

Field Planning and Mobilization

- Not a required SOP
- Working with Labs
- Trip Planning
- Equipment and Supply Preparations
- General Field Equipment Checklists

FA 1000, FC 1000, FD 1000, FM 1000, FQ 1000



Questions so far?

QA Rule/Documentation/Decontamination/Field QC



General Considerations for Sampling

- Understand sampling plan and Data Quality Objectives
- Collect a representative sample
- Maintain the integrity of the sample
- Complete all documentation





FS 1003

What about Wearing Gloves?

Required For:

- Hazardous samples
- Trace analyses
- Handling sample contact equipment

Change Gloves :

- Between sampling points or sources
- If glove is torn or becomes contaminated

Don't touch sample, lip or interior of sample container or cap with gloves

Properly dispose of used gloves





FS 2000

FS 2000 General Aqueous Sampling

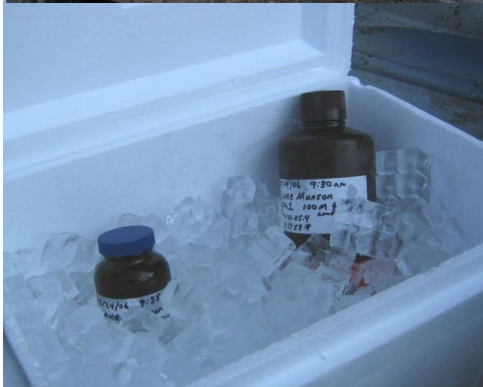
- Grab and Composite Samples
- Filtration and Preservation Procedures
- Instructions for Specific Analyte Groups
 - VOCs
 - Metals
 - Cyanide
 - Extractables
 - Bacteria
 - Oil & Grease
 - Others





FS 2000 & 2001

What about Preservation?



- Dechlorinate and/or filter (if applicable) **before** preserving
- Preserve per tables in FS 1000 Appendix (matrix-specific)
- Treat, preserve (and filter) **within 15 minutes of collection**
- Submerge samples in ice to cool & transport at required temperature
- Check pH of pH-preserved samples (see check frequencies in FS 2000) with **narrow range pH paper** (including pre-preserved containers)
- **Don't dip pH paper into the sample**
- pH checks not required for VOCs
- Carry and add extra preservative if required by pH check
- Avoid excess preservative (can dilute sample or cause analytical problems)
- Use refrigeration or ice for automatic samplers



FS 2004

Collecting VOC Samples

- Teflon-coated silicone cap liner (septum)
- Prevent contamination from fuel sources
- Do not open VOC vial until ready to fill
- No aeration or agitation of sample
- Reduce flow: pumps 100-400 mL/min; faucets ≤ 100 mL/min
- Dechlorinate per SOP instructions and restrictions
- Do not overfill pre-preserved vials
- Do not pour sample into vial cap
- No headspace in VOC vial after collection
- Do not re-open vials to refill or to remove bubbles (≤ 5 mm total bubble diameter OK)



Water level slightly
above top of vial
prior to capping





FS 2006

Sampling for Hydrocarbons (Oil & Grease, TRPH, FL-PRO)

- Do not skim surface of water (unless required by sampling plan)
- Do not pre-rinse bottles with sample
- Do not use automatic samplers
- Preserve with sulfuric or hydrochloric acid and chill



FS 2005

Sampling for Bacteria



- Sterilized containers required
- Use dechlorinating agent (if applicable)
- Thoroughly rinse any intermediate devices
- Keep fingers away from container opening
- Cool immediately with wet ice
 - *See allowance in DEP SOPs (FS 2000 and FS 2300) for sterilizing taps and spigots of questionable condition*





FS 2100

FS 2100 Surface Water Sampling

- Sampling representativeness
- Autosampler deployment
- Common manual sampling procedures
 - Direct grab sample
 - Intermediate sampling devices
 - Depth sampling



Sampling Strategies for Surface Water and Wastewater Locations

Collect:

- Least to most contaminated
 - Downstream to upstream
 - Bow of the boat
- Upwind and away from fuel sources
- Upstream and away from body
- Don't suspend bottom material into water column
- Sample water before collecting sediments

Consider:

- Representative sampling points (sampling plan)
 - Location relative to artificial structures (potential bias)
 - Flow characteristics of sample source (potential bias)
 - Heterogeneity or homogeneity of sample source (potential bias)
- Permit-specific sampling points (e.g., wastewater)



Sampling in Shallow Water

- Don't collect if <10 cm deep
- Use extreme caution to not disturb sediment
- *Intermediate device* such as a dipper or peristaltic pump may help to prevent a sediment plume
 - Especially for low- or no-flow condition



FS 2100

Your sample should be **REPRESENTATIVE** of the water body you are sampling

The water to the right is not flowing and is isolated from the stream bed.
NOT REPRESENTATIVE





FS 2000, FS 2110, FS 2420 & FS 2430

Grab Samples

A snapshot in time

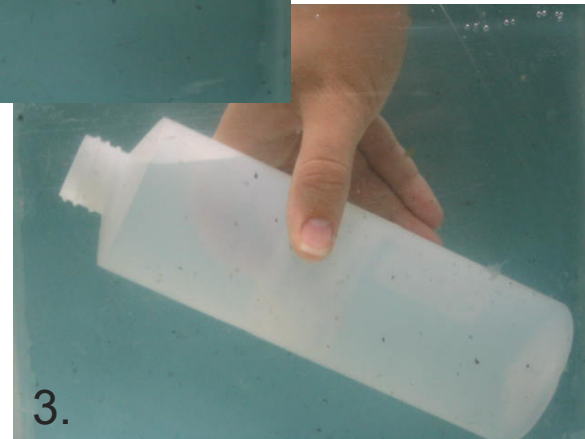
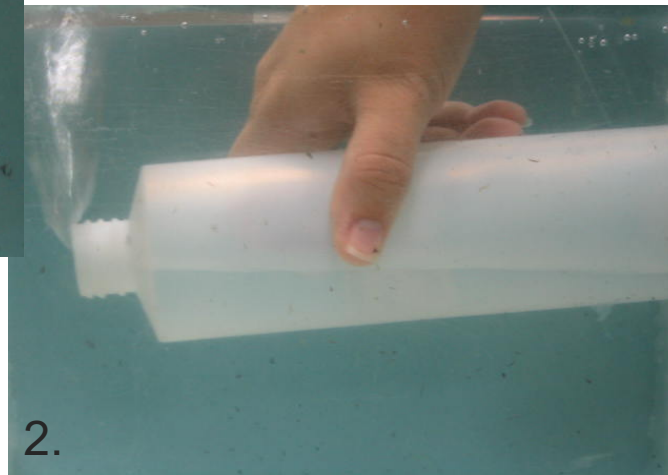
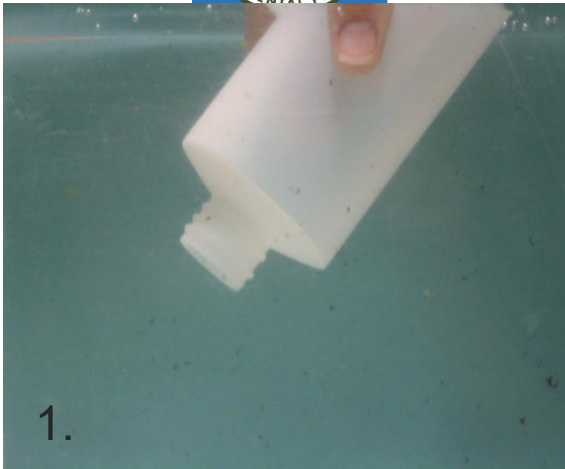
Discrete sample collected over a period of time not exceeding 15 minutes for all analyte groups and containers.





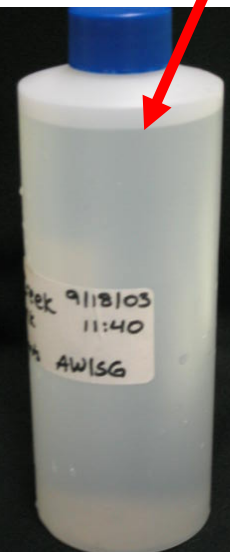
Direct Grab Technique

(Surface Sample)



- Avoid skimming
- Collect within 1st foot
- May use pole extension

Leave Head space





FS 2110 & FS 2430

Grabs Using Sample Container or Other Intermediate Device

Direct grab into sample container is preferred....

But some sampling scenarios may require an intermediate device:

- Pre-preserved containers
- Depth sampling
- Sites that are otherwise inaccessible

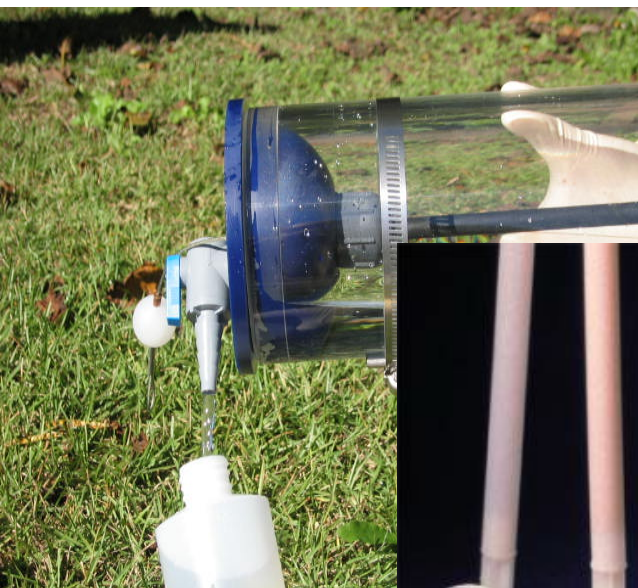




FS 2110 & FS 2430

Intermediate Devices

Equipment selection depends on project objectives and analyte groups....



Depth Sampler



Dipper



Sample container as intermediate



Pump and Tubing



Questions?

General Sampling/Aqueous Sampling/Surface Water



FS 2200 Groundwater Sampling

- Equipment Selection
- Measuring Water Level in Monitoring Wells
- Calculating Required Purge Volume
- Placement of Purging Devices in the Well
- Stabilization Parameter Measurement
- Purging Completion Criteria
- Purging & Sampling Techniques for Monitoring Wells
- Purging & Sampling Wells with Installed Plumbing
- Purging & Sampling Remediation Installations

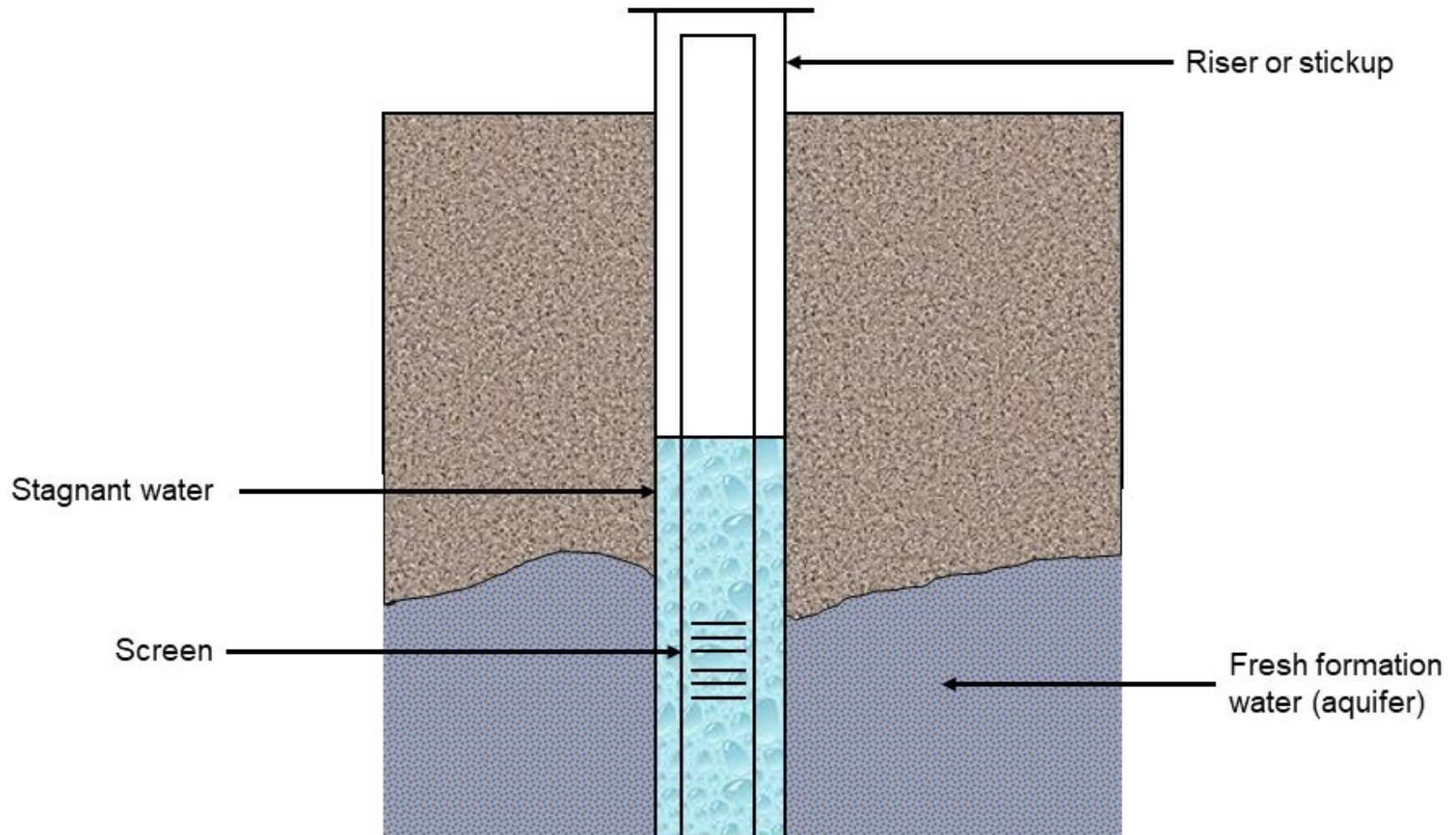


Monitor Wells





Standard well



Simplified well diagram without pump or tubing



FS 2200

Purging & Sampling Groundwater

Specifications to ensure:

Representative sample

- Collect fresh formation (aquifer) water
- No cross contamination
- Proper placement of purging devices

Appropriate equipment

- Bailers are not recommended
- Proper purging completion
- Stable field measurements per SOP

[illegible]

SAMPLED BY (PRINT) / AFFILIATION:	SAMPLER(S) SIGNATURE(S)						SAMPLING INITIATED AT:	SAMPLING ENDED AT:		
PUMP OR TUBING DEPTH IN WELL (feet):	TUBING MATERIAL CODE:			FIELD-FILTERED: Y N Filtration Equipment Type:			FILTER SIZE: _____ µm			
FIELD DECONTAMINATION: PUMP Y N				TUBING Y N (replaced)			DUPLICATE: Y N			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION (including wet ice)				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH				
REMARKS:										
MATERIAL CODES:							AG = Amber Glass; CG = Clear Glass; HOPE = High Density Polyethylene; LOPE = Low Density Polyethylene; PP = Polypropylene;			
B = Silicone; T = Teflon; O = Other (Specify)										
SAMPLING EQUIPMENT CODES:							AAP = After (Through) Peristaltic Pump; B = Baler; BP = Bladder Pump; ESP = Electric Submersible Pump; RFP = Reverse Flow Peristaltic Pump; M = Straw Method (Tubing Gravity Drain); O = Other (Specify)			

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** $\pm 0.2^\circ\text{C}$ **Specific Conductance:** $\pm 5\%$ **Dissolved Oxygen:** all readings $\leq 20\%$ saturation (see Table FS 2200-2); optionally, $\pm 0.2\text{ mg/L}$ or $\pm 10\%$ (whichever is greater) **Turbidity:** all readings $< 20\text{ NTU}$; optionally $\pm 5\text{ NTU}$ or $\pm 10\%$ (whichever is greater)



FS 2213

General Purging Procedures

- Avoid dropping anything to the bottom of well
- Ensure proper pump or tubing placement in well and record placement depth
- Measure water level frequently during purging and stabilize drawdown with pump rate
- Purge required minimum volumes
- Measure parameters at proper frequency
- Satisfy purge completion criteria
- Document, document, document





Purging Completion Criteria

Use a flow-through container to measure stabilization criteria

- Three consecutive Measurements
 - Temperature: $\pm 0.2^{\circ}\text{C}$
 - pH: ± 0.2 Standard Units
 - Specific Conductance: $\pm 5.0\%$ difference
 - Dissolved Oxygen: $\leq 20\%$ Saturation
 - Turbidity: ≤ 20 NTU
- Or: Three Consecutive Measurements:
 - Temperature: $\pm 0.2^{\circ}\text{C}$
 - pH: ± 0.2 Standard Units
 - Specific Conductance: $\pm 5.0\%$ difference
 - Dissolved Oxygen: ± 0.2 mg/L or $\pm 10\%$, whichever is greater
 - Turbidity: ± 5 NTU or $\pm 10\%$, whichever is greater



EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME (only fill out if applicable)											
- gallons + (			gallons/foot X			feet) +			gallons = gallons		
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 8			FINAL PUMP OR TUBING DEPTH IN WELL (feet): 28			PURGING INITIATED AT: 0834		PURGING ENDED AT: 0924		TOTAL VOLUME PURGED (gallons): 20	
TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) $\mu\text{mhos/cm}$ or $\mu\text{S/cm}$	DISSOLVED OXYGEN (circle units) mg/L or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ODOR (describe) ORP
0834	0	0	0.4	25.92	7.41	24.89	561	9.9 0.82	0.86	Clear	-151
0852	7.2	7.2	0.4	25.62	7.25	24.22	563	2.2 0.18	0.80	Clear	-171
0856	1.6	8.8	0.4	25.25	7.33	24.14	549	2.0 0.17	0.74	Clear	-180
0903	2.8	11.6	0.4	25.07	7.36	24.16	543	1.9 0.16	0.71	Clear	-183
0910	2.8	14.4	0.4	24.95	7.38	24.18	543	1.9 0.15	0.70	Clear	-188
0917	2.8	17.2	0.4	24.98	7.39	24.20	544	2.0 0.17	0.71	Clear	-186
0924	2.8	20.0	0.4	25.01	7.37	24.22	545	1.9 0.16	0.71	Clear	-184
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88											
TUBING IN SIDE DIA. CAPACITY (Gal/ft): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											
PURGING EQUIPMENT CODES: B = Baller; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)											

SAMPLING DATA

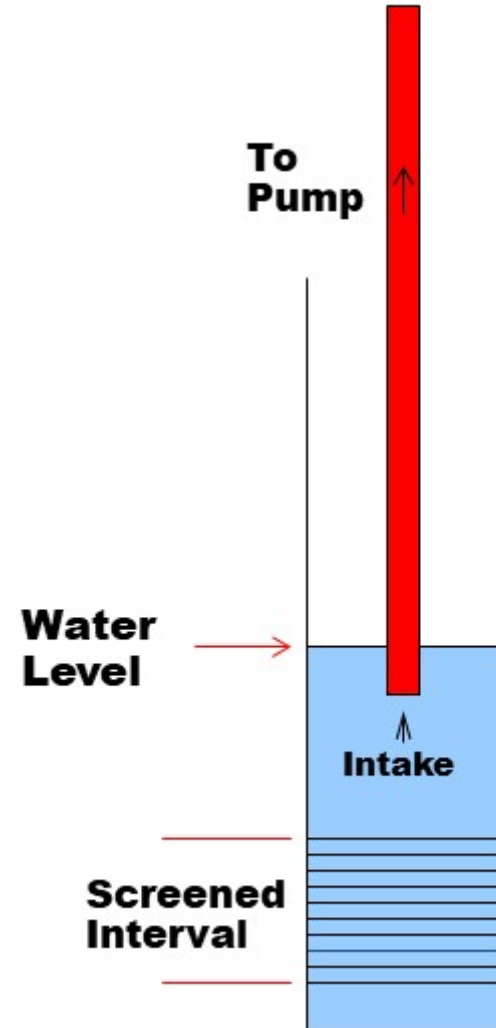
SAMPLED BY (PRINT) / AFFILIATION: SIS Team 2				SAMPLER(S) SIGNATURE(S):			SAMPLING INITIATED AT: 0925		SAMPLING ENDED AT: 0945		
PUMP OR TUBING DEPTH IN WELL (feet): 28				TUBING MATERIAL CODE: HDPE			FIELD-FILTERED: Y N Filtration Equipment Type:		FILTER SIZE: _____ μm		
FIELD DECONTAMINATION: PUMP Y N				TUBING Y N (replaced)			DUPLICATE: Y N				
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD		SAMPLING EQUIPMENT CODE		SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH					
	1	AG	1L	Na2SO4, Ice	1.2 gr	3	1,4-Dioxane				
	2	AG	1L	Ice			BNAs				
	1	PE	1L	Ice			Cl, SO4, TDS				
	1	PE	1L	HNO3, Ice	1	2	Hg, ICPMS, ICP				
	1	PE	125ml	H2SO4, Ice	1	2	NH3, NO2NO3				
	2	AG	1L	Ice			Pest NP				
	2	AG	1L	Ice			PSCL-PCB				
	1	PE	125ml	ZnAc-NaOH	2	11	Sulfide				
	4	CG	40ml	HCl, Ice			VOCs				
REMARKS:											



Conventional Purge

FS 2212 & FS 2213

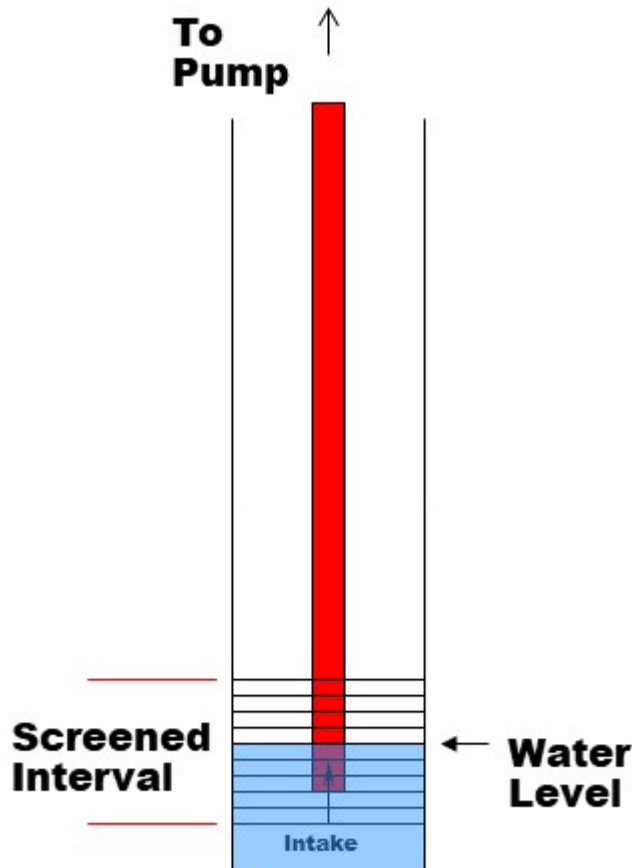
- Intake placed at the top of water column
- Calculate well volume
- Purge one well volume
- Measure stabilization parameters no sooner than each $\frac{1}{4}$ well volume interval
- Purge at least $1\frac{1}{2}$ well volumes





Partially Submerged Screen

FS 2212 & FS 2213

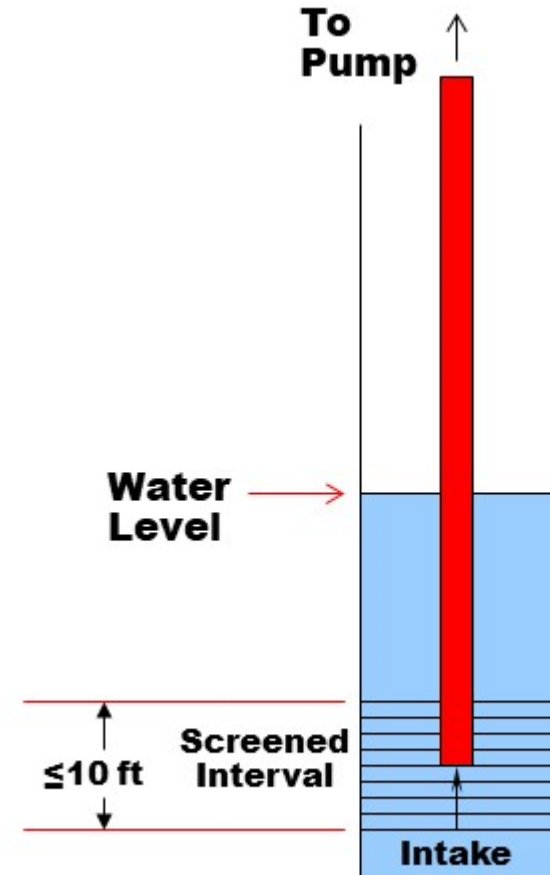


- Intake placed at $\frac{1}{2}$ distance
- between top of water column and
- bottom of screen
- Calculate well volume
- Purge one well volume
- Measure stabilization parameters
- Collect additional measurements
- no sooner than every 2 minutes



Minimized Purge Volumes

- Well screen length ≤ 10 feet
- Configuration used for both purging and sampling
- Intake or pump placed at mid-screen
- Calculate equipment volume
- Purge one equipment volume
- Measure stabilization parameters
- Collect additional measurements no sooner than every 2 minutes
- Purge a minimum of 3 equipment volumes

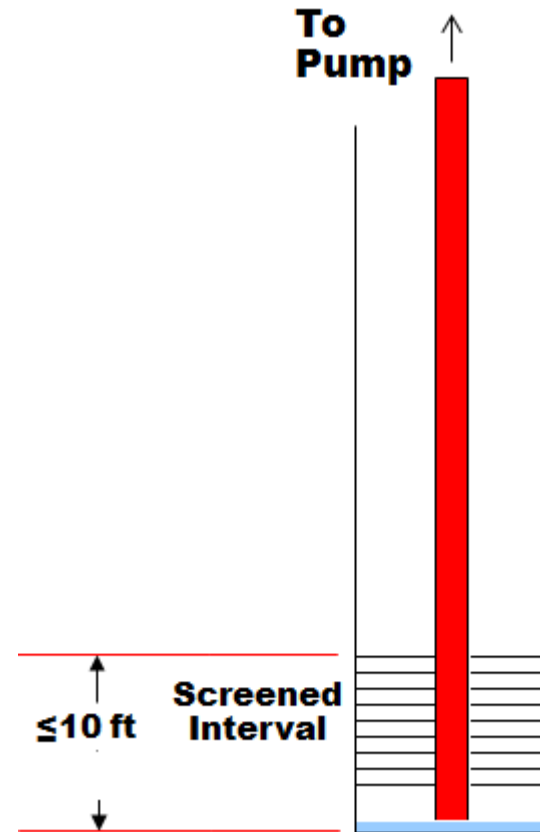




FS 2212 & FS 2213

Purging and Sampling Low-Recharge Wells or Wells That Go Dry

- Minimize equipment volume
- Use same equipment for purging and sampling
- Place intake at mid-screen depth
- Purge < 100 mL/min
- Purge 2 equipment volumes
- Measure parameters just before sampling
- Keep pump at the purge position
- Keep pumping rate the same (unless purged dry)
- Collect samples immediately after purging (or after dry recharge)





FS 2200

Groundwater Scenarios

Important considerations also discussed for:

- Can't achieve purging completion criteria
- Purging low-recharge wells
- Maximum time between purging and sampling
- Sampling wells with installed plumbing



FS 2212

Maximum (Default) Purge Volumes When Purging Completion Criteria Can't Be Achieved

- 5 well volumes (conventional purge)
or
5 screen interval volumes
(minimized purge)
only if:
 - Stabilization measurements fail
 - Proper techniques verified
- One fully dry purge
 - Only for low recharge at < 100 mL/min pump rate



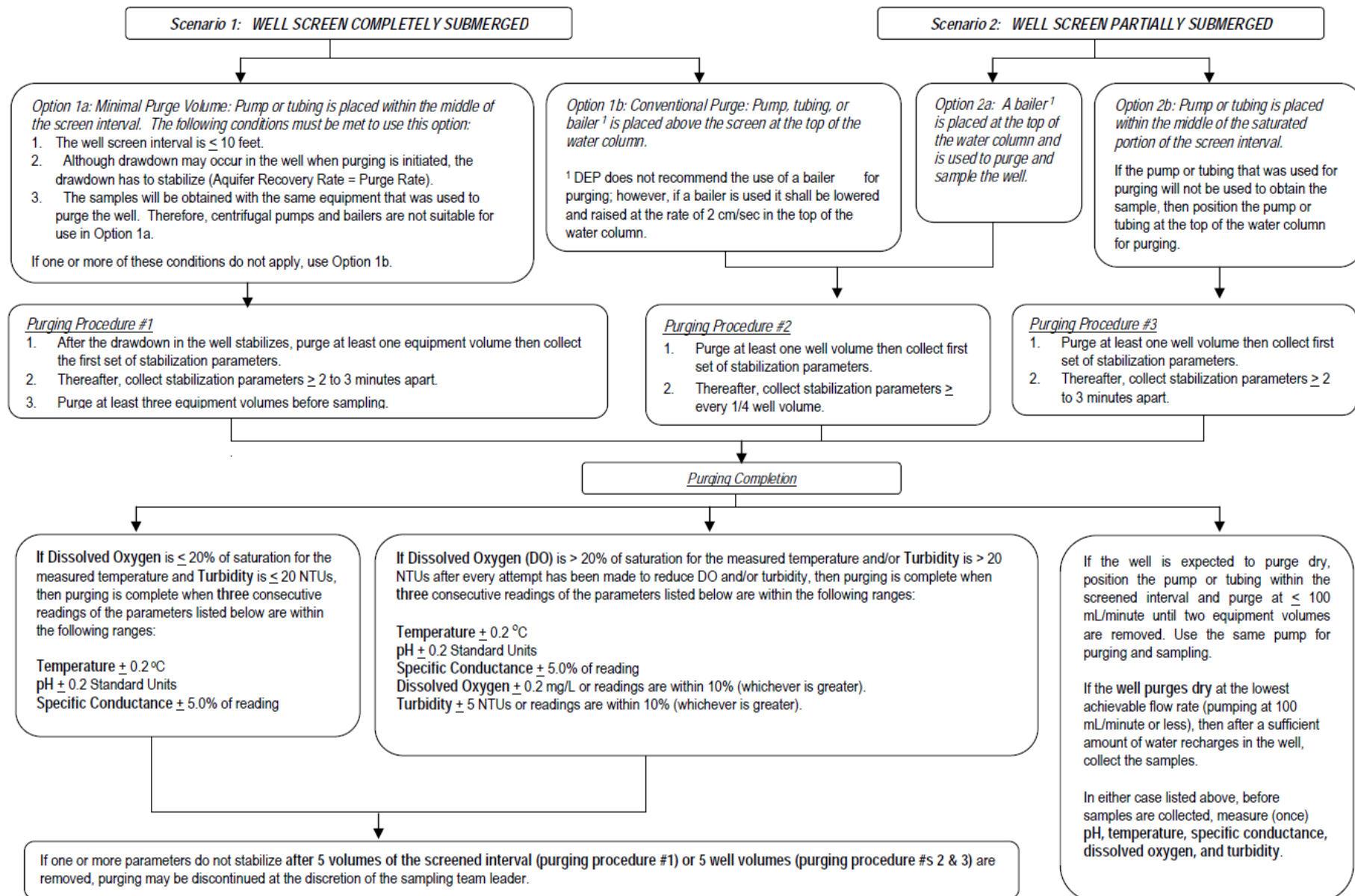


Maximum Time Between Purging & Sampling

- Dry-purge wells sampled immediately after sufficient recharge & parameter measurement
- Re-measure parameters > 1 hour after purging
- Re-purge if parameters $> 10\%$ of original
- All samples collected within 6 hours of purging

Use Ground Water Sampling Flow Chart for Monitor Well Scenarios

DEP-SOP-001/01
FS 2200 Groundwater Sampling





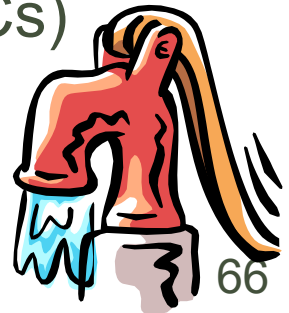
Sample Preservation

- Following the collection of your samples, properly preserve the sample according the protocol and immediately place the samples on wet ice so that when submitted to the laboratory, will be $4\pm 2^{\circ}\text{C}$.



Purging & Sampling Wells with Installed Plumbing

- Purge and sample from tap between well head and pressure tank or at point closest to pump
- Remove hoses, aerators and filters between sample tap point and pump, if possible
- Purge volume of pressure tank, lines and spigot
- For **intermittently** pumping systems, flush stagnant volume of system until stabilization is achieved per FS 2212, section 3
- Reduce flow to ≤ 500 ml/min (≤ 100 mL/min for VOCs)
- Collect samples directly into sample containers





Typical Private Supply Wells with Pressure Tanks





Large Public Use and
Municipal Supply Wells





FS 2221

Collecting Organic Samples With Peristaltic Pump

Through Pump Head Technique for VOCs

- Maximum of 1 ft. of new silicone tubing in pump head
- Do not use LDPE drop or delivery tubing
- Maximize sampling flow rate within 100-400 mL/min
- Disconnect all devices from delivery tubing
- Minimize turbulence or aeration
- Fill VOC containers last, if multiple analytes collected
 - Collect VOCs **first** for low-recharge wells with excessive drawdown or dry purge conditions

SITE NAME: Former Speedway # 9814		SITE LOCATION: 765 South Broad Street Brooksville, FL	
WELL NO: MW-24	SAMPLE ID: MW-24	DATE: 12-21-11	

PURGING DATA

WELL DIAMETER (inches):	TUBING DIAMETER (inches): 1.5	WELL SCREEN INTERVAL DEPTH: 75 feet to 95 feet	STATIC DEPTH TO WATER (feet): 85.73	PURGE PUMP TYPE OR BAILER: ESP							
WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY (only fill out if applicable) = (95 feet - 85.73 feet) X 0.16 gallons/foot = 1.49 gallons											
EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME (only fill out if applicable) = gallons + (gallons/foot X feet) + gallons = gallons											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 87.50	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 88.50	PURGING INITIATED AT: 12:29	PURGING ENDED AT: 12:44	TOTAL VOLUME PURGED (gallons): 2.06							
TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) $\mu\text{mhos/cm}$ or $\mu\text{S/cm}$	OXYGEN (circle units) mg/L or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ODOR (describe)
12:43	1.50	1.50	0.14	87.57	8.62	25.12	79	1.30	19.3	NONE	NONE
12:42	0.28	1.78	0.14	87.59	8.54	25.09	79	1.26	16.7	NONE	NONE
12:44	0.28	2.06	0.14	87.59	8.49	25.06	78	1.26	17.7	NONE	NONE
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0008; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016 PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)											

From
GW SOP
Table FS
2200-2

TEMP deg C	DO SAT.	mg/L 20%
23.0	8.578	1.716
23.1	8.562	1.712
23.2	8.546	1.709
23.3	8.530	1.706
23.4	8.514	1.703
23.5	8.498	1.700
23.6	8.482	1.696
23.7	8.466	1.693
23.8	8.450	1.690
23.9	8.434	1.687
24.0	8.418	1.684
24.1	8.403	1.681
24.2	8.387	1.677
24.3	8.371	1.674
24.4	8.356	1.671
24.5	8.340	1.668
24.6	8.325	1.665
24.7	8.309	1.662
24.8	8.294	1.659
24.9	8.279	1.656
25.0	8.263	1.653
25.1	8.248	1.650
25.2	8.233	1.647
25.3	8.218	1.644
25.4	8.203	1.641
25.5	8.188	1.638

Things to check

- Well #/sample Id
- Well volume calculation (1.5 well vol* 1.48=2.22gals. Did not meet SOP min purge vol.)
- Proper pump/tubing placement per FS 2200 purge scenario (DEPTH!)
- Minimum vol. purged between stabilization measurements. (1/4 well volume= 0.37 gals)
- Verify minimized drawdown
- Check/verify stabilization criteria are met, using last 3 sets. (At the bottom of GW log)
- Compare DO to Saturation table FS 2200-2.



Questions? General Sampling/Aqueous Sampling/Surface Water



FS 2000, 2110, 2410, 2422, 2430

Composite Sample

A sample collected over time, taken either by continuous sampling or by mixing discrete samples. Composite samples reflect the average characteristics during the compositing period, using timed or flow-proportional compositing methods

Do not collect Composite Samples (unless required in permit) for:

- Cyanide
- Residual Chlorine
- Dissolved constituents in field filtered samples(SRP, metals, etc.)
- Microbiological
- Volatile Organic Compounds
- FL- PRO
- Dissolved oxygen and dissolved gases
- Un-ionized ammonia
- pH
- Specific conductance
- TRPHs
- Temperature
- Oil and Grease
- Total Phenols





Cleaning and Replacement (see manufacturer's manual also)

Tubing

- Inspect at each site visit
- Replace discolored tubing
 - Use new* or pre-cleaned tubing (delivery and pump)
 - New tubing for each installation (EPA Region 4 SOP)*
 - Teflon delivery tubing if organic analytes (EPA Region 4 SOP)*
 - Tubing material choices per FS 1000 equipment tables for collected analytes
 - Recommend replace every six months, with loss of elasticity, algal growth, or other degradation
- Recommended cleaning in FC 1000
 - Field cleaning not recommended



Composite sample containers

- Recommended cleaning in FC 1000 (field or lab/base of operations)
- Container materials per FS 1000 (Table FS 1000-4)



FS 2430 - Autosamplers

Set-up and Inspection

(see manufacturer's manual also)

Autosampler & tubing placement

- Elevate above sample point (25 feet or less)
- Taut tubing run with no kinks, bends, twists
 - Inspect tubing for pooling of sample or restricted flow
 - Tubing and intake/strainer placement must be at correct location and depth (per permit, or in a position for representative sampling)
 - Use conduit or other support for tubing (installation should prevent potential contamination from support structures)
- Secure autosampler against tampering (lock, housing, tamper seals, etc)
- Protect against weather extremes (insulation, reflective paint, etc)



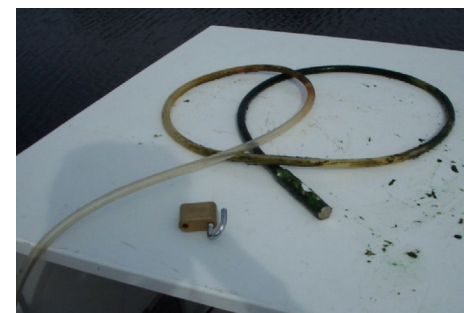
Programming

- Follow manufacturer instructions for autosampler (and flow meter/pacer)
- Sample collection settings programmed according to permit, or per project sampling design
 - Programming must ensure that enough total volume is collected for all analytes and lab sample containers required



Autosampler Function Check

- Measure minimum volume collected
 - Verify minimum 100 mL collection volume
 - Lift height (head) should not affect volume collected
 - Minimum volume should be adjustable manually or automatically
- Check flow meter/pacer functioning
- Check programmed purge/sample collection functioning
 - Verify pre-rinse and purge for each sample collection cycle
 - Pump speed should not allow solids to settle in tubing
 - At least 2 ft/sec (EPA Region 4 SOP)
 - Velocity is also a function of tubing diameter
 - Use at least 0.25 inch I.D. tubing
- Look for bubbles from tubing during pump test (all water purged from line)
- Follow manufacturer's suggested checks, diagnostics and maintenance



Inspect tubing and strainer



Composite Sample Preservation and Holding Time

During Composite Collection Period

- If cooling required for analytes per FS 1000 preservation tables:
 - Use packed ice or refrigerated autosampler
 - Can be difficult to maintain required temperature

Composite Sample Retrieval

- **Start of holding time depends on composite collection period:**
 - 24 hours or less – holding time begins at the end of the composite period (i.e., after collection of last sample)
 - Exceeds 24 hours – holding time begins at first sample collection
- **Thoroughly mix composite sample** prior to transferring to lab bottles
- **Any additional preservation** must occur within 15 minutes of end of composite period (i.e., after last sample collected)
 - Preservation and holding times per FS 1000 tables (Table FS 1000-4)



Wastewater Sampling

- Composite vs. grab samples
- Autosampler deployment
- Common manual sampling procedures
 - Similar to surface water techniques
- Sampling from spigots
- Biosolids sampling
- Cryptosporidium & Giardia



Wastewater Sample Location

- Representativeness
- Permit-Specified
 - Outfall
 - Tap
 - Receiving Body
- Placement
 - Well-mixed Area
 - Center of Flow (Greatest Velocity)
 - Avoid Obstructions



FS 2450

FS 2450 *Cryptosporidium* and *Giardia* Wastewater Sampling

- Use EPA method 1623
- Follow bacteriological sampling restrictions in FS 2005



FS 2440

FS 2440: Biosolids



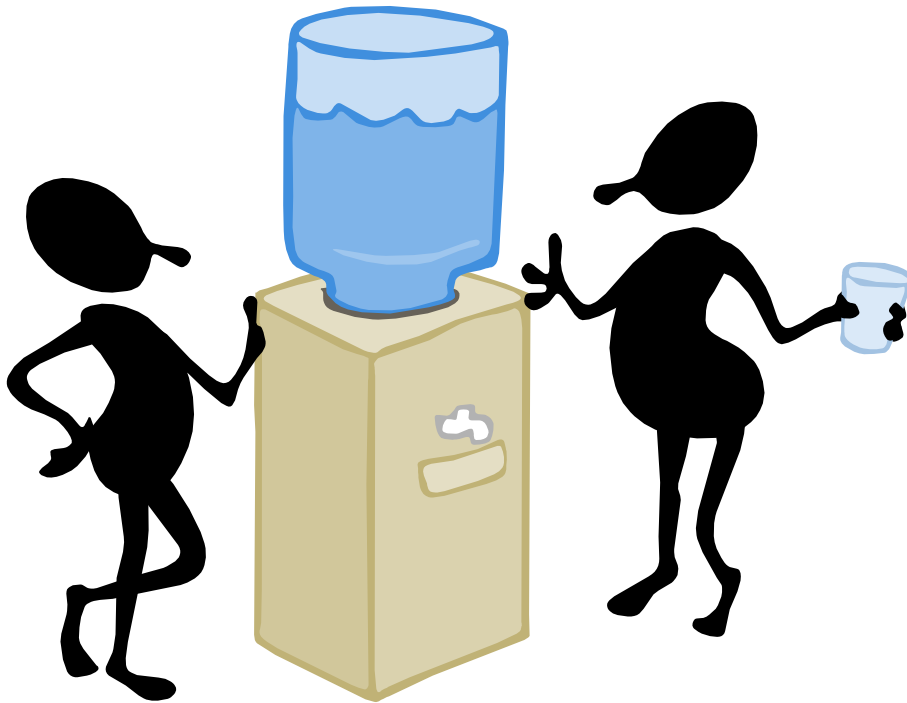
Important considerations for:

- Sampling techniques and containers
- Safety precautions
- Compositing
- Transporting infectious waste
- **Collect samples per rule (62-640 F.A.C.), permit or sampling plan requirements**



FS 2300 Drinking Water

*Important
considerations for:*



- Drinking Water Wells
- Lead and Copper Rule
- Supply Systems
- Microbiologicals



FS 2310

Sampling Drinking Water Wells



- Purge and Sample Spigot Closest to the Well
- Remove Hoses, Aerators and Filters
- Purge Spigot and Lines
- Reduce Flow to 500 mL/minute to Collect Samples
 - 100 mL/minute or less for VOCs



FS 2320

Sampling Supply Systems

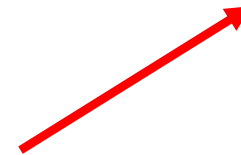
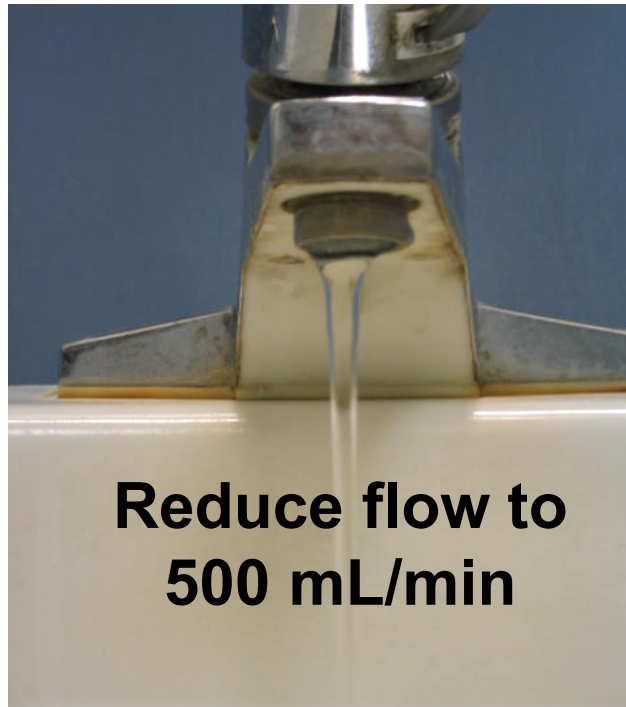
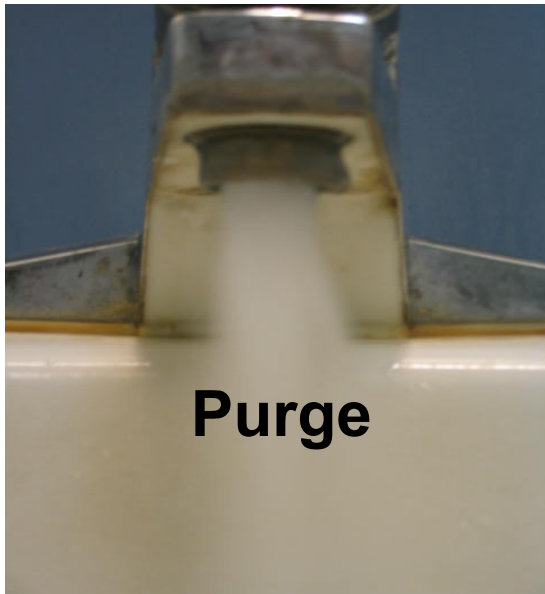


- Sample at Designated Sample Port
- Flush Lines and Port
 - 2 to 5 minutes or as required
- Reduce Flow to 500 mL/minute
 - 100 mL/min or less for VOCs
- Dechlorinate Sample if Necessary



FS 2310, 2320

Sampling Taps and Spigots





FS 2310

Sampling VOCs from taps and spigots



**Reduce flow to
 ≤ 100 mL/min**



FS 2310

Lead and Copper Rule

- Collect from kitchen or bathroom
- Use cold water tap
- Do not use system for six hours before sampling
- Collect first flush into sample container
- Acid-preservation may be delayed up to 14 days





Wastewater or Drinking Water Questions?

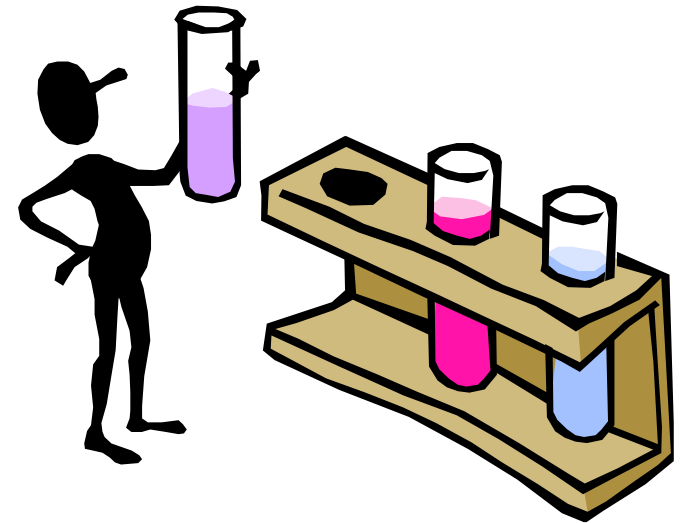


DEP SOPs - Field Testing

FT 1000 – FT 2000 Field Testing

Collecting data in the field

- Calibration of instruments
- Verification of instruments
- Documentation





Concepts to master:

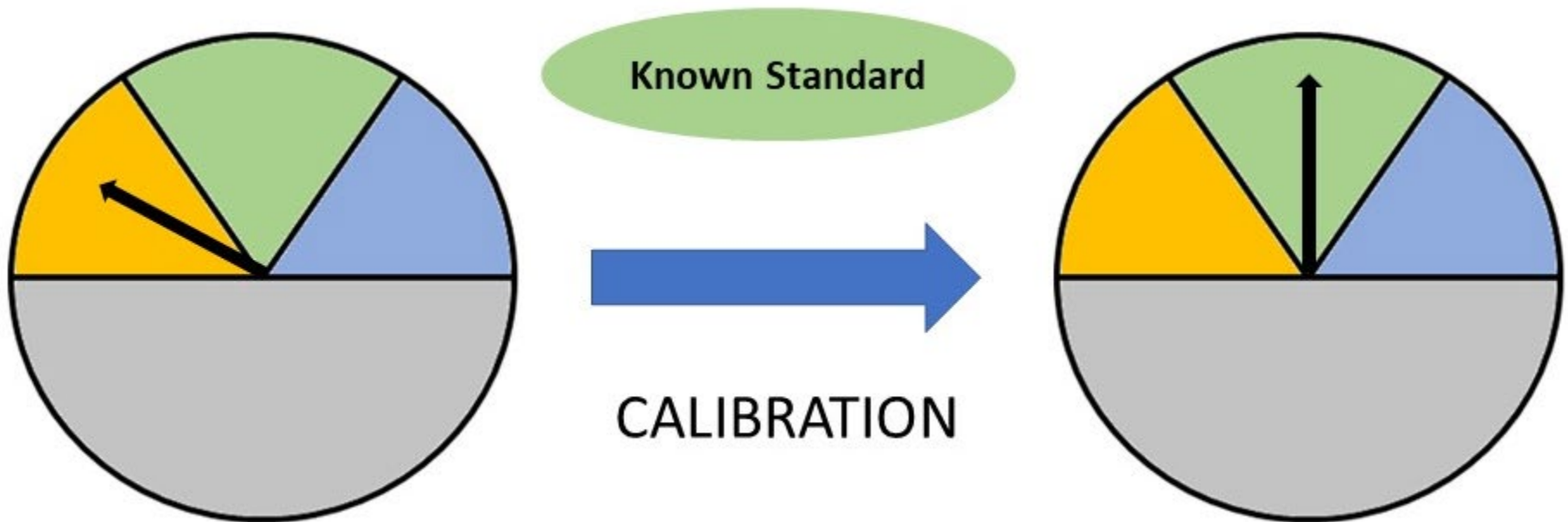
- Calibration
 - Initial Calibration (IC)
- Verification
 - Initial Calibration Verification (ICV)
 - Continuing Calibration Verification (CCV)
- Chronological bracket
- Quantitative bracket
- Acceptance criteria



FT 1000

Calibration:

Changing the reading of an instrument by setting it to a known standard.





Verification

- Ensures that instrument is measuring samples accurately
- Instrument calibrations are not always reliable or stable due to drift or other errors
- Establishes *chronological and quantitative brackets* for the sample measurements



FT 1000

Initial Calibration Verification (ICV):

- Instrument or calibration is checked immediately following initial calibration (IC) and before testing environmental samples by measuring a known standard as *if* it were a sample.
- Compare to *acceptance criterion* for that parameter.
- If ICV fails, immediately recalibrate instrument.
 - Perform new ICV after recalibration



FT 1000

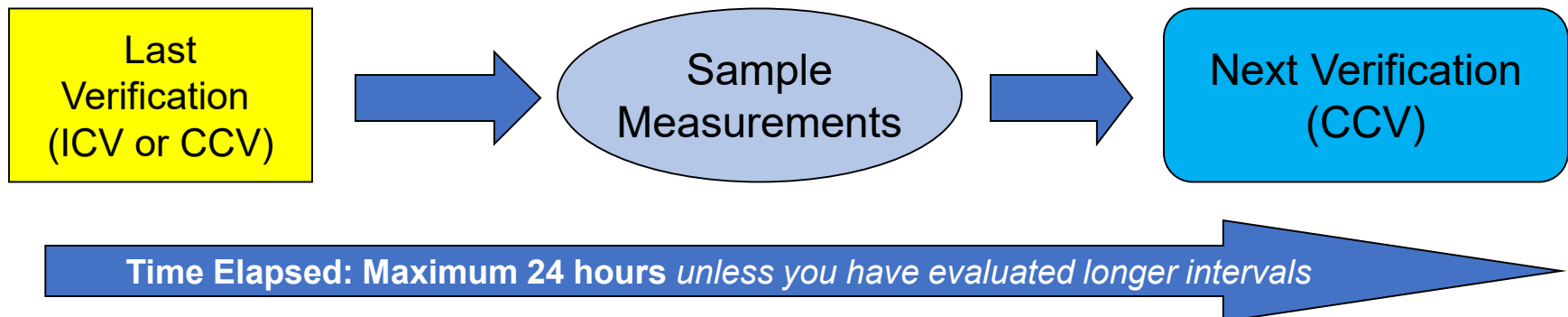
Continuing Calibration Verification (CCV):

- Instrument or calibration is verified by measuring a known standard as *if* it were a sample before and/or after environmental samples are measured
 - All verifications performed after the ICV are CCVs
- Accept/reject instrument reading based on the *acceptance criterion* for that parameter



Chronological Bracket:

- The instrument is verified before (ICV or CCV) and after (CCV) sample measurements using a known standard
 - Accept/reject instrument readings for ICV or CCV based on the *acceptance criterion* for that parameter

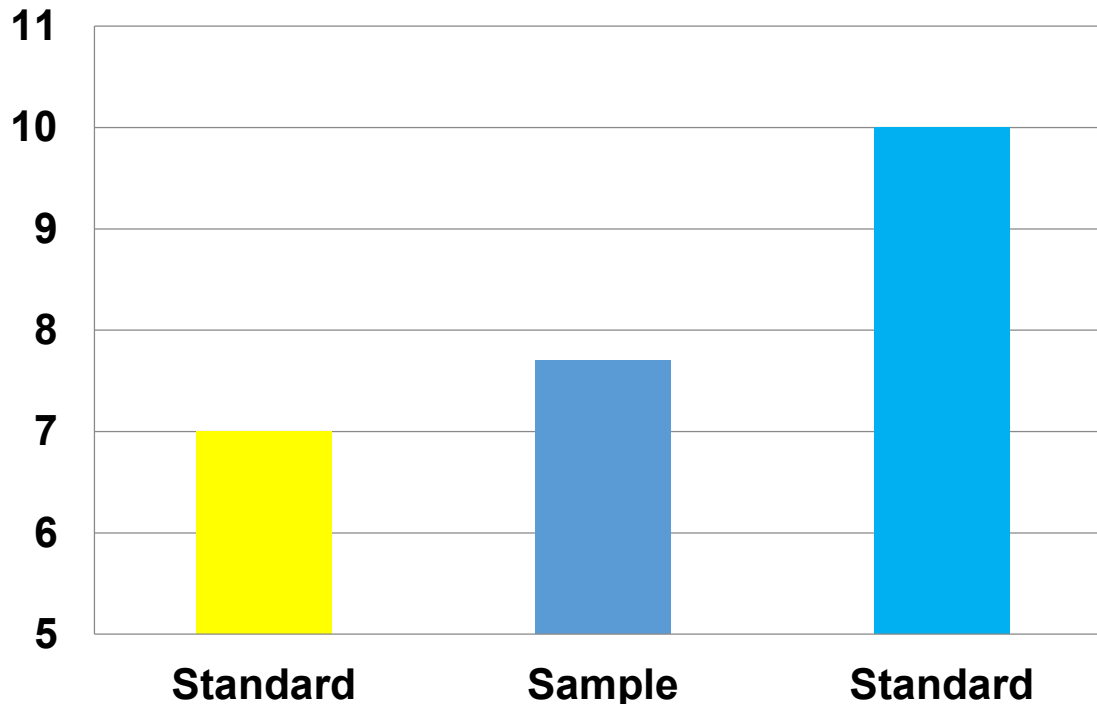




FT 1000

Quantitative Bracket

- Choose two (or more) standards that bracket the range of environmental sample measurements





From Table FT 1000-1: Field Testing Acceptance Criteria

Parameter	Acceptance Criteria
pH (FT 1100)	± 0.2 Standard pH Units of buffer, or more stringent program criteria
Specific Conductance (FT 1200)	$\pm 5\%$ of standard value
Temperature (FT 1400)	$\pm 0.5^{\circ}\text{C}$ of NIST-traceable value (with correction factors) Verification over range of applicable values
Dissolved Oxygen (FT 1500)	± 0.3 mg/L of theoretical value (see Table FT 1500-1)
Turbidity (FT 1600)	0.1-10 NTU: $\pm 10\%$ of standard value 11-40 NTU: $\pm 8\%$ of standard value 41-100 NTU: $\pm 6.5\%$ of standard value >100 NTU: $\pm 5\%$ of standard value
Total Residual Chlorine (FT 2000)	0.995 calibration curve correlation coefficient $\pm 10\%$ of primary standard value $\pm 10\%$ of secondary standard value Color comparator: $\pm 10\%$ of primary standard value



What if verification falls outside acceptance criteria?

- Repeat verification under same conditions (see FT 1000)
- If verification still fails, record data as an estimate (“J” qualifier code)
- Perform new calibration (IC) for next sample measurements or
 - Remove meter from service (if needed)



FT 1000

Extending the Verification Range

Sample value outside of original quantitative bracket?



Measure additional verification standard

Pass

Fail

Accept sample data

1. Repeat verification
2. "J" sample data if it fails



Questions?

FT 1000



DEP SOPs - Field Testing

FT 1100 – FT 2000 **Field Testing SOPs**

- **pH**
- **Specific Conductance**
- **Temperature**
- **Dissolved Oxygen**
- **Turbidity**
- **Residual Chlorine**
- **Salinity**
- **Transparency (Light Penetration)**
- **Continuous Monitoring**
- **Water Flow**



DEP SOPs - Field Testing

"FT-series" (FT 1100 – FT 2000) Individual Test Methods Contents

- Instrument specifications
- Calibration standard specifications
- Preparation instructions for calibration standards
- Calibration and verification procedures
- Sample measurement procedures
- Calculations (if required)
- Documentation requirements
- Literature references (where specified)



FT 1200

Specific Conductance

- Conductivity: **1-point calibration** (typically)
 - 100 μ mhos standard sufficient for lower end of quantitative bracket (standards at lower values not required)
 - If sample values < 100, only 100 μ mhos standard required for verification
- Ensure stable temperature prior to calibration, verification or sample measurement
- High-conductivity residue from previous sample will affect subsequent sample measurement
- Rinse probe between standards



FT 1200

FT 1200 Specific Conductance



Rinse probe with deionized water



Ensure stable temperature

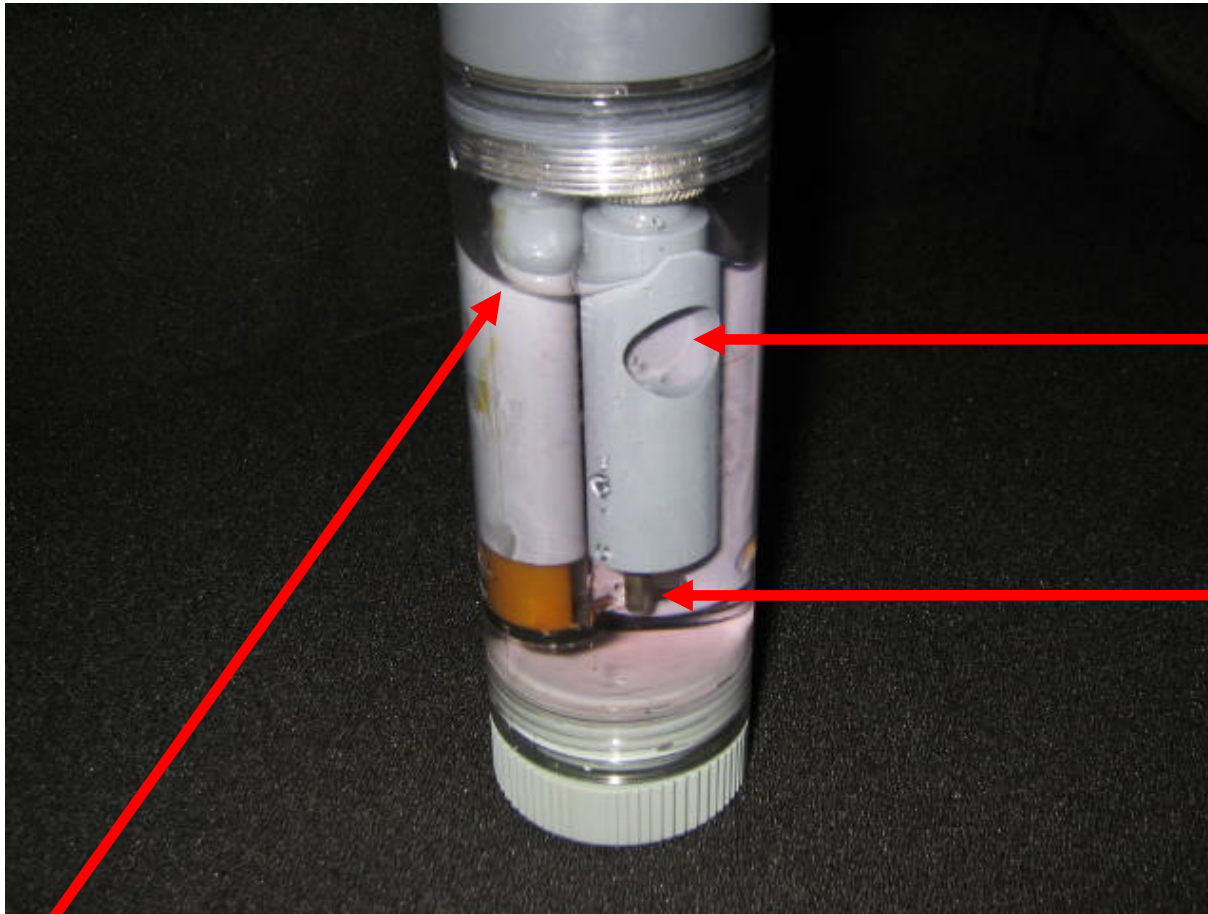


Rinse probe with aliquot of standard and discard



FT 1200

FT 1200 Specific Conductance



**Vent hole
(no
bubbles)**

**Ensure
temperature
sensor is
submersed**

Ensure probe is completely submersed with sample or standard



FT 1100

pH

- Calibrate with a minimum of 2 standards (2-point), with pH 7 standard first
- Rinse probe between standards
- Verify with at least one standard



FT 1400

Temperature

- Verify field-temperature devices against NIST-traceable thermometer
- Bracket sample measurements with appropriate verification temperatures
- Verify at demonstrated time intervals
- Document all deviations from NIST thermometer verification values
- Measure samples *in situ*



FT 1500

DO Calibration & Verification

- Calibrate and verify with 100% humid air (enclosed chamber) or 100% aerated (air-saturated) water
- Ensure that the temperature is stable
- Calibration:
 - Set atmospheric pressure (760 mm Hg default)
 - Set calibration with stable DO and temperature readings
- Verification:
 - Compare meter reading to theoretical saturation (look-up table or calculation formula)
 - Acceptance criterion is ± 0.3 mg/L



Table FT 1500-1

**Table 1: Solubility of Oxygen in Water
at Atmospheric Pressure^{1,2}**

Temperature °C	Oxygen Solubility mg/L	Temperature °C	Oxygen Solubility mg/L
0.0	14.621	26.0	8.113
1.0	14.216	27.0	7.968
2.0	13.829	28.0	7.827
3.0	13.460	29.0	7.691
4.0	13.107	30.0	7.559
5.0	12.770	31.0	7.430
6.0	12.447	32.0	7.305
7.0	12.139	33.0	7.183
8.0	11.843	34.0	7.065
9.0	11.559	35.0	6.950
10.0	11.288	36.0	6.837
11.0	11.027	37.0	6.727
12.0	10.777	38.0	6.620
13.0	10.537	39.0	6.515
14.0	10.306	40.0	6.412
15.0	10.084	41.0	6.312
16.0	9.870	42.0	6.213
17.0	9.665	43.0	6.116
18.0	9.467	44.0	6.021
19.0	9.276	45.0	5.927
20.0	9.092	46.0	5.835
21.0	8.915	47.0	5.744
22.0	8.743	48.0	5.654
23.0	8.578	49.0	5.565
24.0	8.418	50.0	5.477
25.0	8.263		

1. The table provides three decimal places to aid interpolation

2. Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water-saturated air



Table FS 2200-2

Temperature: 21.6
Reading: 9.08
Theoretical: 8.812
Difference: 0.268

Table FS 2200-2
Dissolved Oxygen Saturation

TEMP	D.O.	mg/L	TEMP	D.O.	mg/L	TEMP	D.O.	mg/L	TEMP	D.O.	mg/L
deg C	SAT.	20%	deg C	SAT.	20%	deg C	SAT.	20%	deg C	SAT.	20%
15.0	10.084	2.017	19.0	9.276	1.855	23.0	8.578	1.716	27.0	7.968	1.594
15.1	10.062	2.012	19.1	9.258	1.852	23.1	8.562	1.712	27.1	7.954	1.591
15.2	10.040	2.008	19.2	9.239	1.848	23.2	8.546	1.709	27.2	7.940	1.588
15.3	10.019	2.004	19.3	9.220	1.844	23.3	8.530	1.706	27.3	7.926	1.585
15.4	9.997	1.999	19.4	9.202	1.840	23.4	8.514	1.703	27.4	7.912	1.582
15.5	9.976	1.995	19.5	9.184	1.837	23.5	8.498	1.700	27.5	7.898	1.580
15.6	9.955	1.991	19.6	9.165	1.833	23.6	8.482	1.696	27.6	7.884	1.577
15.7	9.934	1.987	19.7	9.147	1.829	23.7	8.466	1.693	27.7	7.870	1.574
15.8	9.912	1.982	19.8	9.129	1.826	23.8	8.450	1.690	27.8	7.856	1.571
15.9	9.891	1.978	19.9	9.111	1.822	23.9	8.434	1.687	27.9	7.842	1.568
16.0	9.870	1.974	20.0	9.092	1.818	24.0	8.418	1.684	28.0	7.828	1.566
16.1	9.849	1.970	20.1	9.074	1.815	24.1	8.403	1.681	28.1	7.814	1.563
16.2	9.829	1.966	20.2	9.056	1.811	24.2	8.387	1.677	28.2	7.800	1.560
16.3	9.808	1.962	20.3	9.039	1.808	24.3	8.371	1.674	28.3	7.786	1.557
16.4	9.787	1.957	20.4	9.021	1.804	24.4	8.356	1.671	28.4	7.773	1.555
16.5	9.767	1.953	20.5	9.003	1.801	24.5	8.340	1.668	28.5	7.759	1.552
16.6	9.746	1.949	20.6	8.985	1.797	24.6	8.325	1.665	28.6	7.745	1.549
16.7	9.726	1.945	20.7	8.968	1.794	24.7	8.309	1.662	28.7	7.732	1.546
16.8	9.705	1.941	20.8	8.950	1.790	24.8	8.294	1.659	28.8	7.718	1.544
16.9	9.685	1.937	20.9	8.932	1.786	24.9	8.279	1.656	28.9	7.705	1.541
17.0	9.665	1.933	21.0	8.915	1.783	25.0	8.263	1.653	29.0	7.691	1.538
17.1	9.645	1.929	21.1	8.898	1.780	25.1	8.248	1.650	29.1	7.678	1.536
17.2	9.625	1.925	21.2	8.880	1.776	25.2	8.233	1.647	29.2	7.664	1.533
17.3	9.605	1.921	21.3	8.863	1.773	25.3	8.218	1.644	29.3	7.651	1.530
17.4	9.585	1.917	21.4	8.846	1.769	25.4	8.203	1.641	29.4	7.638	1.528
17.5	9.565	1.913	21.5	8.829	1.766	25.5	8.188	1.638	29.5	7.625	1.525
17.6	9.545	1.909	21.6	8.812	1.762	25.6	8.173	1.635	29.6	7.611	1.522
17.7	9.526	1.905	21.7	8.794	1.759	25.7	8.158	1.632	29.7	7.598	1.520
17.8	9.506	1.901	21.8	8.777	1.755	25.8	8.143	1.629	29.8	7.585	1.517
17.9	9.486	1.897	21.9	8.761	1.752	25.9	8.128	1.626	29.9	7.572	1.514
18.0	9.467	1.893	22.0	8.744	1.749	26.0	8.114	1.623	30.0	7.559	1.512



FT 1500

Dissolved Oxygen



Inspect membrane



Ensure stable temperature



Vent to atmosphere

Enclose with saturated air



FT 1500

Precautions for DO Sample Measurement

- Select representative sampling point
- Ensure flow of refreshed sample around probe
- Stabilize reading before recording
- Unstable readings indicate temperature fluctuation or DO sensor malfunction
- Low readings may indicate anoxic water column near sediments
- Hydrogen sulfide damages electrode
- Measure DO *in situ only* (no intermediate container)
 - *Flow cell acceptable (e.g. groundwater measurement)*



Questions?

pH/Conductivity/Temperature/DO



FT 1600

Turbidity

- For guidance on FT 1600 Field Measurement of Turbidity go to:

<https://www.youtube.com/watch?v=Ylcczzwkqug&feature=youtu.be>



Questions?

Turbidity



FT 2000

Residual Chlorine Methods



DPD Colorimetric



DPD Color comparator
(drinking water only)

Titration



Electrode



FT 2010

DPD Chlorine Meters

- Typically done with hand-held meter
- Annual verifications with primary standards (factory-calibrated meters)
- Secondary standards for everyday use





FT 2010

Basics – DPD Chlorine Meters

- **Initial calibration verification** with *primary* standards.
 - Primary standards are made from known concentrations using laboratory techniques
 - Verify meter before first time use (factory-calibrated meters)
 - Annual verification with primary standards thereafter
- The instrument readings must be within 10% of the standard values.





FT 1000 & FT 2010

Secondary Standards for Chlorine

Use secondary standards for field verifications

- **Measure** (read) secondary standards with a calibrated meter that has been verified with primary standards
 - At least annually
 - If routine (daily or other) field verifications fail
 - If standards have been discolored or damaged
- **Assign** measured values to the secondary standards
 - Or **accept** previously assigned values
 - Measured values within $\pm 10\%$ of assigned values?
 - If not, are measured values within manufacturer's tolerances?
 - If **yes**, assign new measured values
 - If **no**, discard secondary standards





FT 2010

Residual Chlorine



Keep fingers away from
clean optical vials



Mix color reagents with sample



Rinse vial & dry exterior between samples



FT 2000

Residual Chlorine



Align index marks



Cover optical chamber prior to reading sample



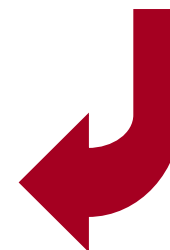
FT 2010

Residual Chlorine Example

“READ”



DPD-CHLORINE CERTIFICATE OF ANALYSIS			
	Lot	Test Value/Tolerance	Instrument Reading
BLANK	96	Zero Instrument	Zero
STD 1	82	0.18 +/- 0.02 mg/L Chlorine	
STD 2	82	0.81 +/- 0.10 mg/L Chlorine	
STD 3	82	1.42 +/- 0.11 mg/L Chlorine	
User Instrument Identification:			
Reported value to be used for MDEG calculations:			





FT 2010

DPD Color Comparator (Drinking Water Only)

- Check Comparators every 6 months with Primary Standards
- Verify Comparator - Result must be within 10% of the standard value
 - Or, plot correction curve (see FT 2000)
- Discard comparators if discolored or if SOP requirements cannot be met

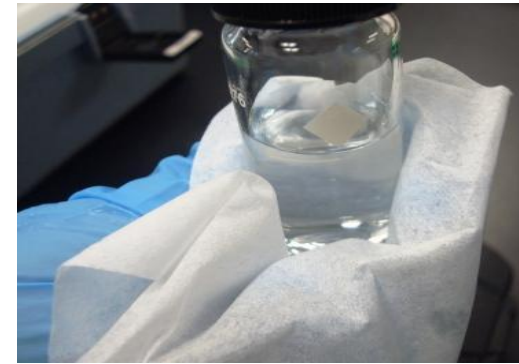




FT 2000

FT 2010 – DPD Methods – Operator Advice!

- The DPD method may not be suitable for detection required below about 0.2 mg/L
- **Primary standards** – facility lab can help
 - The DEP Central lab can also help
- **Secondary standards** – know how to check, use and store
- **Meter sample vials** – keep clean & dry, store properly, purchase new when scratched or stained (and can't be cleaned)
- **Read instrument manual!**
- **Use a timer** for timed steps in procedure
- **Color Comparator** verification failure
 - Plot correction curve per DEP SOP or
 - Replace color comparators





FT 2000

Residual Chlorine

Titration Methods for Residual Chlorine

- Used in some “on-site” facility applications
Applications include some in-line meter designs

- Follow cited methods in SOP
- “Bracketing” not required
- Standardize titrants per methods

Electrode Method (ISE) for Residual Chlorine

- May not be suitable for lower detection requirements
- Not recommended as a field method
- Follow cited procedure in DEP SOP
- Follow ISE meter manufacturer’s instructions
- Bracket sample measurements with verifications





FT 1900

Continuous Monitoring

- Calibration & verification for installed (in-line) meters
- Same calibration, verification, and bracketing rules apply
 - Calibration prior to installation or when off-line, if possible with meter design
- Daily verification with *grab sample*
 - Use *grab sample* acceptance criteria in FT 1900
 - Extended verification interval acceptable if documented
 - Maximum period between grab sample verifications is one month



FT 1900

Continuous Monitoring

- If verification fails-
 - Perform instrument maintenance and reduce time interval.
 - Perform initial calibration when instrument is taken off-line, after preventative maintenance, or immediately after verification criteria are not met.



Questions?

Chlorine/Continuous Monitoring/Calibration Logs



Submit any questions to
Quality_Assurance
@floridadep.gov