Water Quality Monitoring Directions

Water Quality Monitoring Background

BEMP began collecting water quality data from all five groundwater wells at several BEMP sites along with the adjacent river and ditch in 2004. This dataset includes field measurement of dissolved oxygen (DO), pH, temperature, turbidity, and conductivity, as well as samples collected for concentrations of anions. In more recent years, BEMP has added sampling for *Escherichia coli* (*E. coli*), and a suite of pharmaceuticals and personal care products (PPCPs), polychlorinated biphenyls (PCBs), and organochlorine pesticides. In general, water quality sampling is done three times a year: during spring snow-melt run off (around May), during mid growing season and monsoon rains (around July/August), and after the agricultural season has ended (November).

Water quality data are an important part of monitoring ecosystem health. For example, high levels of *E. coli* can cause risk to human health for downstream users of river water. Dissolved oxygen levels of the groundwater can give us a sense of groundwater-river connectivity; we expect DO to rise in groundwater after peak spring runoff at sites with high connectivity. Conductivity of the groundwater is a useful parameter for land managers, because high conductivity is not conducive to the survivorship of cottonwood pole plantings.

Sources

Field protocols for collecting water quality data follow those set forth by US Fish and Wildlife Service in the water-quality assessment of the Middle Rio Grande.

Field protocols for collecting *E. coli* samples:
2007 NMED/SWQB Standard Operating Procedure for Data Collection (https://www.env.nm.gov/swqb/documents/swqbdocs/MAS/SOP/2007/SWQB-MASStandardOperatingProcedures2007.pdf). These procedures were amended slightly, to accommodate changes such as taking one photo per site instead of four.

Protocol for collection of PCB and PPCP samples is based off protocol set forth by the Eurofins Laboratory:
http://www.eurofinsus.com/media/16002/nonvolatile-analytes-water-sampling.pdf (for collection of organochlorine pesticides/PCBss and pesticides),
http://www.eurofinsus.com/media/16003/ppcp-sampling-instructions.pdf (for collection of PPCPs).

Additionally, BEMP staff members were trained by the NM Environment Department (NMED) Surface Water Quality Monitoring Bureau Monitoring Team Lead Scott Murray and NMED Quality Assurance Officer Jodey Kougioulis in collecting and handling water quality samples and assessing instrument accuracy.

Water Quality Monitoring Materials

Meters:

- YSI Model 30 handheld salinity, conductivity, and temperature system
- LaMotte 2020 we/wi turbidimeter
- YSI 550A Dissolved Oxygen Instrument
- Mettler Toledo SevenGo pH meter SG2
- barometer
- water level meter (beeper)
- air temperature thermometer (i.e. kestrel)
- camera

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Pumping Equipment:

- 2 Geotech Geopump Peristaltic Pump Series II
- Geotech Silicone tubing, size 15 (0.19" ID)—one 5 m tube and one 3 m extension tube, with a connecting piece
- 2 camping seats
- Two 5-gallon buckets with 5 gallons marked off at 1 gallon increments
- Two 800ml plastic beakers, each with a binder clip to attach them to the bucket
- folding table
- batteries for pumps

Back-up Equipment:

- instruction manuals for meters
- extra batteries for meters
- extra vial for turbidimeter
- 2 extra batteries for Geopumps
- pH calibration solution packets
- extra gloves
- extra 800ml plastic beaker
- binder clips
- extra pH probe cap
- sharpies
- For *E.coli* sampling: extra bottles, baggies, labels, chain of custody forms

Datasheets, etc.:

- Schedule for the week
- Stack of groundwater data sheets (separated onto 2 separate clipboards)
- river and ditch data sheets (on a 3rd clipboard)
- several sharpies, including ones with a fine tip
- site maps
- small trash bag
- dry erase board and marker
- Permits and keys
- BEMP car magnets

Wading Equipment:

- lifejackets/personal flotation devices (PDFs) – 1 per person, and preferably ones with pockets
- waders – 1 per person

Sampling Equipment:

- powderless nitrile gloves for sample collection
- Sufficient number of sample bottles for *E. coli* (these come from the state lab and have thiosulfate in them), along with the red tape and plastic bags they provide
- glass bottle of deionized (DI) water for *E. coli* blank and duplicate sample
- Official vials from Eurofins for PPCPs and organochlorine pesticides/PCBss
- Sufficient number of 20 ml disposable scintillation vials for anion collection
- Sufficient number of syringe filters-cellulose acetate, 25mm, 0.45 µm
- 60 mL syringe without needle
- Ziplock bag for used filters
- Long-handled dipper (cup on a stick!)

Data Storage:

- 1 medium cooler for ice bath, with a thermometer
- 1 small cooler with ice bath for bringing E.coli samples into the NM State Labs
- Plastic bags for: E.coli, anions, PPCP samples, and PCB and pesticide samples

Extra:

- Hand sanitizer
- 2 small towels for drying vials

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Pre-field prep

Obtain sample vials

From the New Mexico State Labs:

-obtain enough *E. coli* sampling bottles for the number of samples to be collected throughout the week (include a few extra bottles in case some are lost or damaged),

-obtain enough red labels for each sample (with a few extras),

- obtain chain of custody forms (copies of the form can be made after basic info is filled in).

From Eurofins: obtain the correct number of vials for PPCP and organochlorine pesticides/PCBs samples (EPA 505). Officially, the PPCP sample tests are called @DX_ABI_NEG (endocrine disruptors negative mode) and @DX_ABI_POS (endocrine disruptors positive mode), and the organochlorine pesticides/PCBs sample test is called @ML505 C.

The week prior to water quality monitoring

-Label all sampling vials with site name and date the sample will be collected per the schedule.

- Place all sampling vials into one of the four large bags corresponding to the day of the week (Mon – Thurs) they will be used.

-Calibrate all equipment and record the calibrations in the calibration notebooks.

-Check the DO meter to ensure the membrane is not dried out (replace it if it is), and the sponge at the end of the calibration chamber is moist. The meter, while probe is in its calibration chamber, should read about 80%.

The morning of a collection day

-Turn on DO meter before going to the field (it needs at least 10 min to stabilize).

-Grab the bag of sampling vials needed for that day.

-Take readings with pH meter in standard solutions and calibrate if necessary.

-Calibrate turbidimeter daily.

-Create an 'ice slurry' bath in both coolers (50% ice, 50% water).

-Place the cooler thermometer into the ice slurry. We use an inside/outside thermometer, so the sensor that usually would go outside the house goes inside the cooler. This way, the internal temperature of the cooler can be read from the outside of the cooler.

General Directions

Sites are monitored from south to north.

All time is written in 24-hour format (ex: 14:01 instead of 2:01)

Wading into the river requires at least two people

Dates are written in this format: dd-mmm-yyyy (ex: 08-Dec-2016)

River monitoring:

1. Once arriving at the site, gather all the appropriately labeled sample bottles for that site (all bottles should say the site name, and date of collection).
2. Put on waders and PFDs. Put turbidity vial and all necessary sample vials into zipper pockets of a PFD.
3. Place the pH, DO, and conductivity meters, syringe (for anions), into a 5 gallon bucket to take into the river.

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4. Bring the datasheet and clipboard, kestrel, and camera to the bank of the river.
5. Record time of arrival at site, site name, and data collectors' names on data sheet.
6. Take a photo upstream along the bank of the river while someone holds the dry erase board with the date, "BEMP," site name, and arrival time written on it.
7. Record the following field observations: water appearance, weather, the number of upstream waterfowl, unusual odors, and watershed or in-stream activities.
8. Place the kestrel in the shade and record the temperature when it stabilizes.
9. At least 2 people should wade into the center of the main flow of the river (thalweg) where good mixing occurs, while a 3rd person remains on the bank to record the data. Do not wade into the river past the top of your waders – be safe! If flow is too strong and it doesn't feel safe, samples may be taken from the shore of the river using the long-handled dipper. Make sure to include this information on the data sheet as field notes.
10. Place DO, conductivity, and pH sensors into the water. *Note:* The **DO probe must be held in water upstream of people and any obstructions because turbulence increases DO**.
11. From the pH meter, read pH and temperature.
12. From the conductivity meter, read conductivity, specific conductance, and temperature.
13. From the DO meter, read DO in mg/l and %, as well as the water temperature.
14. Fill up the turbidity vial and then dump the water. Repeat this two more times (so that the vial has been rinsed three times) and then fill the vial to the fill line.
15. Record all the data on the field data form, following methods found in section 5.2 "Field Data Documentation in the SOPs" (NMED/SWQB 2007).

Obtaining anion samples:

1. Write the sampling time on the datasheet, and make sure all the information on the vial matches the information on the datasheet.
2. Using the syringe, suck water from the river. Rinse the syringe out three times using the water from the river.
3. Fill syringe after it has been thoroughly rinsed and attach filter to syringe. Push plunger to empty filtered water into sampling vial. Minimum amount of sample to be obtained is 15ml. If more than one filter is needed to obtain sample, use another filter.
4. Check to make sure that the vial is tightly closed by turning it up and down and around.

Obtaining *E. coli* samples:

1. A sample collection will be taken for *E. coli* sampling following methods in section 11.0 "Bacteriological Sampling in the SOPs" (NMED/SWQB 2007).
2. Take sample upstream from body, and keep arms and equipment away from the upstream area where you are taking the sample so as not to contaminate the sample. Sample is to be taken from "centroid of flow, if the stream visually appears to be completely mixed from shore to shore. Centroid is defined as the midpoint of that portion of the stream width that contains 50 percent of the total flow" (NMED/SWQB 2007). "**Do not rinse the containers** and … do not remove the lids until immediately before sampling" (NMED/SWQB 2007). The inside is sterile & contains the necessary sodium thiosulfate. Take one sample at "centroid", DO NOT RINSE BOTTLE, DO NOT OVERFILL: pour off any excess immediately so that the bottle is filled to just **below** the faint sample line (which is just below the shoulder of the bottle). "Fill containers by submersing in flowing water and fill exactly to the 100 ml line. Decant excess water

immediately…" (NMED/SWQB 2007).
3. Place bottle into snapped pocket of PFD and note time of collection on datasheet.
4. If needed, obtain the blank sample. Open sample bottle and pour deionized water into bottle, just below sample line. Put bottles back into snapped pockets of PFD.

Obtaining organochlorine pesticides/PCBss and PPCPs samples:
organochlorine pesticides/PCBss:

1. Ensure the label is correct.
2. Wearing new, clean, powderless nitrile gloves, open the sample vial and use the water on the top of the water column to fill the vial to the top. **DO NOT RINSE THE VIAL**—simply fill it up. *Note:* at all times, avoid touching the lids of the vials, especially the inside.
3. A convex meniscus must exist on the top of the vial to ensure no air bubbles are in the vial. If this is not the case, use the lid of the vial to drip water on to the top of the vial until there is a convex meniscus.
4. Tightly seal the vial with the lid. Repeat these steps for all four vials
5. Write time of collection on the datasheet.

PPCPs:
Be sure to follow the guidelines listed in the PPCP Sample Collection Protocols (#3). This describes which products to avoid consuming/using the day of sampling.

1. Ensure the label is correct.
2. Wearing new, clean, powderless nitrile gloves, open the sample vial away from your body and DO NOT BREATHE ON OR RINSE THE VIAL—simply fill it up using the water on the top of the water column *Note:* at all times, avoid touching the lids of the vials, especially the inside.
3. A convex meniscus must exist on the top of the vial. If this is not the case, use the lid of the vial to drip water on to the top of the vial until there is a convex meniscus.
4. Tightly seal the vial with the lid. Repeat these steps for the next vial.
5. Write time of collection on the datasheet.
6. Back at the vehicle:

Back at the vehicle:

1. Dry all sampling vials with a towel
2. Label PPCP, PCB and pesticide vials with the time of collection
3. Label *E.coli* samples with time of collection and initials of who collected it. Label and affix the red vial tape across the top of the bottle and onto both sides to ensure vial has not been opened since the collection.
4. Place all samples into Ziploc bags and into the cooler
5. Record any specific sample information, notes, or missing parameters on the datasheet
6. Remove the turbidity vial from the PFD and wipe glass with cloth to remove fingerprints and any water that may be on it. Obtain a reading from the turbidimeter and record data on datasheet

<u>Groundwater Well Monitoring</u>
Pump Set-up:

1. At each well, note the date, site, well, and names of data collectors on the datasheet.
2. Beep the well (see monthly monitoring protocol for more in-depth directions) and then turn the

beeper off and let the probe hit the bottom of the well to measure total well depth.

3. Insert tubing into well until it hits the bottom and then pull it up from the bottom about 15 cm. Thread tubing through Geopump and put other end of tubing into plastic beaker, through the metal loop of the binder clip to hold it in place. *Note*: make sure the bucket is tilted slightly so that the water that overflows from the plastic beaker will fall into the bucket.
4. Make sure the Geopump is off, and then attach the Geopump power clamps to the battery (black to black and red to red). Make sure the direction switch is set to the correct direction and the rpm gauge is set to the highest setting (unless you will be leaving the pump for a while, then set it to pump more slowly).
5. Empty the bucket completely, and attach the plastic beaker to the inside of the top using the binder clip (see image 1).
6. Switch the Geopump lever to the on position to begin pumping and make sure the water is being pumped into the plastic beaker. *Note: at this point, avoid touching the water inside the plastic beaker because salts or other contaminants may be introduced from your hand into the water – this could potentially impact the analyses*.
7. The minimum amount of water to be pumped into the bucket is at least 1 gallon. Sampling may begin after the one gallon has been purged. *Note:* This protocol has changed. Prior to 2008, five gallons of groundwater were pumped before sampling began.

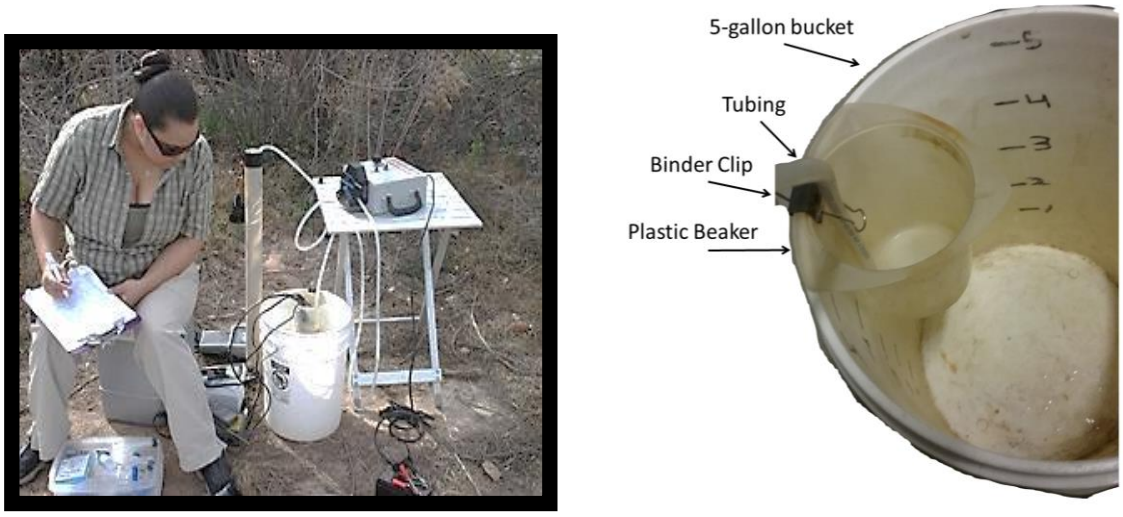

Image 1: Set up for pumping wells

Obtaining Field Parameters:

8. Place DO, conductivity, and pH sensors into the beaker. *Note:* avoid direct sunlight on the screens of the meters, as they can get damaged.
9. After purging at least one gallon (as measured by the marks in the bucket), and when the DO meter has stabilized, take a DO reading in mg/L and % and also record temperature.
10. From the pH meter, read pH and temperature.
11. From the conductivity meter, read conductivity, specific conductance, and temperature.

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12. Use the water flowing out from the plastic beaker and into the bucket to fill up the turbidity vial, and then dump the water. *Do not put your hand into the beaker of water to obtain a water sample for turbidity*. Repeat this two more times (so that the vial has been rinsed three times) and then fill the vial to the fill line. Wipe glass with cotton cloth to remove fingerprints and any water that may be on it. Make sure the cloth doesn't leave dust behind on the vial as well. Obtain a reading from the turbidimeter and record the data.
13. Take air temperature reading in the shade.

Obtaining a sample for anions and/or organochlorine pesticides/PCBss:
-PCB's and pesticides - follow the instructions above under "River monitoring" but in this case use water overflowing from the plastic beaker.
- Anions- Using the syringe, suck water up from the beaker and squirt it out three times to ensure proper rinsing. Follow the instructions above under "River monitoring" to gather sample.

Visit all sample sites, repeating all procedures as necessary.

Citizen Science Oversight
BEMP is a citizen science organization and students often assist with water quality data collection. To ensure data quality, BEMP staff members oversee the involvement of the students. Quality is controlled by assuring that students are:
- setting up the groundwater pumps correctly
-writing down the data correctly and in the correct location on the data sheets
-correctly reading the instruments while gathering field parameters
-labeling vials with all the proper information
Due to the sensitive nature of *E. coli*, PCB and pesticide, and PPCP sampling, these samples are taken by BEMP staff members only.

Double check before leaving field

- Are all sample vials labeled correctly and submerged in the ice bath?
- Is all the equipment in the vehicle?
- Are all the datasheets filled out completely? If there is a blank, is there a description as to why that blank exists?
- Check the schedule, were all the necessary samples taken at the appropriate sample locations?

Data storage

1. ***E. coli* samples need to be delivered to the New Mexico State Labs within 6 hours of collection and by 4:00 pm.** Each sample is handed over with the appropriate chain of custody form, signed and dated, as specified in the SOPs (NMED/SWQB 2007) and QAPP (NMED/SWQB 2010).
2. All other samples go to UNM and are placed into the refrigerator (***not the freezer or glass vials will break***).
    a. Anion samples must be delivered to the UNM Geo/Analytical Chemistry Laboratory (213 Northrop Hall) within 48 hours of collection.
    b. Maximum holding time for PCB and pesticide samples is 7 days. This means that samples collected on Monday and Tuesday need to be sent out to the laboratory on that Tuesday evening. Samples collected on Wednesday and Thursday should be sent out that

Thursday evening. Follow the instructions for proper packing and mailing listed in the references above.

c. PPCP samples must be sent to Eurofins as soon as possible after all samples are collected. Follow the instructions for transport listed in the references listed above. PPCPs maximum holding time is 30 days.

This procedure document has been approved by _____

Date _____