Appendices

Support Documents

The following documents are available in the Support Documents component of the SCEI Web Site

- SCEI Riverwatch Handbook – Program Background
- SCEI Riverwatch Handbook – Tool Use Guide
- SCEI Site Request Form
- SCEI Water Sampling Data Sheet
- SCEI Kit Inventory

Water Quality Testing (Oak Hammock Marsh document)

The following document is that provided by Oak Hammock Marsh in support of their Riverwatch Kit. The document includes reference to the significance of the specific tests used in the program.

Water Quality Testing

Oak Hammock Marsh is participating in “Riverwatch", a Red River Basin Monitoring Program which began in Minnesota in 1995.

Today, the program is being implemented in North Dakota and Manitoba through a partnership between the MN Pollution Control Agency, the ND Department of Health, the Red River Watershed Management Board and Oak Hammock Marsh. The basin wide program provides hands-on "real world" science opportunities for students, teachers and citizens participating in the program and is designed to provide leadership experiences and greater awareness and understanding of baseline water quality in the Red River Basin.

There are currently 34 schools participating basin wide in the River Watch Monitoring Program (27 in Minnesota, 7 in North Dakota and 3 in Manitoba). Participating schools monitor with scientific equipment at 2-16 predetermined sites along selected rivers and streams.

Water sampling is done on a regular basis; usually once a month throughout the open water season. During the winter period, River Watch Teams assemble data and prepare for their local River Watch Forums. River Watch Forums bring students, teachers and local organizations and resource managers together to hear student teams present the results from the monitoring season.

Oak Hammock’s role is to encourage schools to participate in the program, to train the teachers on how to use the equipment, and to loan it out when schools go out to monitor.

Sampling is done monthly from spring run-off (April) to fall freeze-up (November) as safety considerations allow. A schedule of sampling dates is set up at the beginning of the year. Sampling dates should be at approximately the same time each month. On sampling dates the samples should be collected from each site at approximately the same time of day to keep everything as uniform as possible from one month to the next.

The River Watch website offers help on selecting sites, datasheets, and other background information (http://www.tri-college.org/watershed/riverwatch/index.htm).

Site Selection

Oak Hammock, the schools, and the province of Manitoba will work together to select sampling sites. According to the River Watch guidelines the site must characterize both the water quality and biological diversity of the stream and identify the sources and types of pollutants affecting it. Several important factors to consider are: 1) mixing characteristics; 2) presence of tributaries; 3) presence of potential discharge; 4) suitability for flow measurement; 5) accessibility/safety, and 6) suitability for biological monitoring. Information used in the site selection process is obtained from maps, onsite assessments, and community recommendations of potential pollution sources.

The following criteria are used to select collection sites:

- Above and below known or suspected point (e.g. wastewater treatment plants) and non-point (e.g. feedlots) pollution sources.
- Above, below and at the mouth of major tributaries.
- At areas of public use for water contact recreation (e.g. swimming areas).
- At habitat areas of sensitive species (e.g. spawning areas important to trout and other cold water species).
- Away from the banks and in the main river current. A good way to accomplish this is to sample from bridges or boats. When this is not possible, locate the sampling site next to the bank where homogeneous mixing of the water occurs, such as on the outside bend of a river.
- Variability of flow patterns caused by artificial physical structures such as dams, weirs, and wing walls must be considered in sample site location. These structures may influence the representative quality of the water.
- Where the river is accessible and sampling is safe. Steep, slippery or eroding banks or sites where landowner permission cannot be obtained should be avoided.
- Representativeness of the water quality of the reach being analyzed.
- Suitability for flow measurements.
- Suitability for biological measurements.

Schools are responsible for obtaining landowner permission, parent permission, and for any safety equipment required (e.g. life jackets, safety vest, etc.).

Equipment List

- SONDE unit
- Turbidity meter (whole kit)
- LaMotte water sampler
- Transparency tube
- Flow meter
- Graduated-weighted rope (17m)
- Tape measure (30m)
- GPS unit
- Anomometer

- Compass
- Thermometer (2)
- Digital camera
- Distilled water
- Wash bottle
- Tap water
- Membranes for dissolved O_2 probe
- O_2 probe solution
- pH 10 solution
- pH 7 solution
- Conductivity calibrator solution
- Copy of data file (diskette)
- Copy of datasheet
- Copy of instructions (laminated)
- Calibration work sheet
- Map of site
- Marsh monster sheet (2)
- Animal Tracks of Manitoba by Ian Sheldon & Tamara Eder
- Manitoba Wayside Wildflowers by Linda Kershaw
- Water and Wetland Plants of the Prairie Provinces by Heinjo Lahring
- Manitoba Birds by Andy Bezener & Ken DeSmet
- Amphibians and Reptiles of Manitoba by William Preston
- Healthy Water, Healthy People – Testing Kit Manual
- Healthy Water, Healthy People – Water Quality Educators Guide
- Marshworld
- Pond Life
- Towel
- Spare Batteries – 8 AA, 4 C, 2AAA
- Scissors
- Vinyl gloves (5 pairs)
- Throw bag
- First aid kit
- Emergency blanket

The first step when ready to sample is to calibrate the equipment. Oak Hammock Marsh employees will do the calibration before going to the school.

Taking measurements

The students can be separated into groups and each assigned different measurements. One student can be assigned the role of recorder. One group could measure depth, width and temperature, one could collect the water sample, another could use the turbidity tube, another the SONDE unit, another the Turbidity meter, and one could do the visual survey of the site (flora and fauna).

Pictures of the site (including vegetation) should be taken each time sampling is done as it may change through out the seasons or over years. The pictures should be taken from the same location each time (record location on data sheet). Be sure to record picture number, date, and topic for each picture taken.

Data should be transcribed to Excel spread sheet (provided) and then emailed to ohmic@ducks.ca. The results will be compiled from all the participating schools in Manitoba and will be forwarded to the Red River Basin Institute to become part of a larger Red River Watershed database.

The students can also research and write a paper on the watershed that is being sampled so that they better understand where the water comes from and where it is going. Oak Hammock Marsh would appreciate receiving a copy of any papers. They can be emailed to ohmic@ducks.ca.

- GPS co-ordinates
  - Use GPS unit
  - Turn unit on (Red button with light bulb)
  - Let unit sit at Satellite page until it has acquired 3 or 4 satellites (up to 10 minutes)
  - When the Satellite page change to the Position page enough satellites will have been acquired
  - Press the Mark key to save the Waypoint (your current position)
  - Highlight the name field and press Enter
  - Rename the Waypoint to an abbreviation of your school's name
  - Record the abbreviation on data sheet
  - Record reading on data sheet
  - Turn GPS unit off
- Air temperature
  - Use thermometer
  - Hold by handle at chest height, away from body, and wait 2 minutes
  - Record reading on data sheet
- Wind speed
  - Use anomometer
  - Hold at chest height, away from body, facing into wind
  - Record reading on data sheet

- Percent cloud cover
  - Done by looking and estimating cloud cover
  - Record on data sheet
- Wind direction
  - Use compass
  - Hold at chest height, away from body, facing into wind
  - Record reading on data sheet
- Stream condition
  - Done by looking at water and making a judgement call

- Choose one from each column
- Choices are:

• N = normal	• SW = swift	• C = clear
• L = low	• SL = slow	• M = muddy
• H = high	• MO = moderate	• O = other

- Record on data sheet

- Stream width
  - Use tape measure
  - Start on one bank and measure directly across to other side
  - If wider than length of tape measure add together multiple measurements
  - Record on data sheet
- Water depth/water level
  - Use graduated-weighted rope and tape measure
  - Make sure weight is firmly attached
  - Drop to surface of water
    - Hold rope at a set point (e.g. top of railing – be sure to record this so that next time same point can be used)
    - Pull rope up and compare to tape measure
  - Drop to bottom of water body
    - Hold rope at the set point
    - Pull rope up and compare to tape measure
  - Subtract the first reading from the second and that will be your depth
  - Record on data sheet
  - For water level gauge type record TD (tape-down from elevated elevation method)
- Water sample
  - Use LaMotte water sampler
  - Open tube ends and hook to centre
  - Close outlet tube
  - Triple rinse it with site water
  - Rope has markings on it every foot. Knowing the depth try and sample at **mid-depth**.
  - Lower unit down to mid-depth.
  - Release trigger and weight should close it (may need extra weight if flow is strong – salmon fishing weight).
  - Pull unit out of water and be ready with transparency tubes.
  - For Sampling Device record AS (Automatic Sampler)
  - For Sampling Type record G (Grab)
- Recreational suitability
  - Done by looking at water in Transparency tube
  - Choose the description that best fits
  - Choices are:

1	Beautiful, could not be better
2	Very minor aesthetic problems: excellent for body-contact recreation

3	Body-contact recreation and aesthetic enjoyment slightly impaired
4	Recreation potential and level of enjoyment of the stream substantially reduced (would not swim but boating/canoeing is okay)
5	Swimming and aesthetic enjoyment of the stream nearly impossible

- Record on data sheet

- Appearance
  - Done by looking at water in Transparency tube
  - Choose the description that best fits
  - Choices are:

1	Clear	Crystal, clear, transparent water
2	Milky	Not quite clear, cloudy white or gray
3	Foamy	Natural or from pollution
4	Tea-coloured	Clear but tea-coloured due to wetland or bog influences
5	Muddy	Cloudy brown due to high sediment levels
6	Green	Might indicate excess nutrients released in to the stream
7	Green or Muddy	Either extensive floating scum or strong foul odour

  - Record on data sheet
- Transparency
  - Use tube
  - Using the outlet tube on the LaMotte water sampler start to fill tube slowly
  - With your back to the sun
  - Fill your tube until you can not see the pattern on the bottom
  - Release water out of tube slowly until you can just make out the pattern.
    - Record depth
  - Release more water until the pattern is clearly visible (i.e. you can see the screw I the middle of the pattern)
    - Record depth
  - Calculate the average of the two depths (this gives you an idea of how far down you can see)
- Turbidity
  - Use meter and water from LaMotte water sampler
  - Triple rinse the sample vial with distilled water
  - Fill vial with sample water
  - Handle vials only by the top to minimize dirt, scratches, and fingerprints in the light path.
  - Clean the outside with a Kim-wipe
  - Apply a small bead of silicone oil just below the white diamond
  - Wipe with a soft, lint-free cloth
  - Place the vial in the cell compartment so the diamond on the vial is lined up with the mark on the instrument

    - Turn machine on
    - Press READ
    - Close cover
    - Leave for 30 to 40 seconds
    - Record the value (units are in ntu – nephelometric turbidity units)
    - Empty vial
    - Triple rinse with distilled water
    - Turn meter off
- Chemical tests
    - Will collect water and send samples to a lab
    - Still working out how this will work
- pH
    - Use SONDE unit
    - Hook up cable
    - Turn on machine (green button)
    - Lower probe into water
    - Leave there until readings stabilize (may be as long as 5 minutes)
    - Reading will show up on screen
    - Record reading
- Conductivity
    - Use SONDE unit
    - Hook up cable
    - Turn on machine (green button)
    - Lower probe into water
    - Leave there until readings stabilize (may be as long as 5 minutes)
    - Reading will show up on screen
    - Record reading
- Dissolved oxygen
    - Use SONDE unit
    - Hook up cable
    - Turn on machine (green button)
    - Lower probe into water
    - Leave there until readings stabilize (may be as long as 5 minutes)
    - Reading will show up on screen
    - Record reading
    - Turn SONDE unit off
- Water temperature
    - Use SONDE unit
    - Hook up cable
    - Turn on machine (green button)
    - Lower probe into water
    - Leave there until readings stabilize (may be as long as 5 minutes)
    - Reading will show up on screen
    - Record reading
- Wildlife
    - Record all field observations on the sheet

  - Should include: location, vegetation status (leaf out, cropping, harvest), land use, erosion, mammals, birds, aquatic invertebrates, plants, etc.
  - Record all that you see as you are collecting
- Stream flow
  - Use flow meter
  - Are measuring stream velocity
  - Assemble all rods including the one with the impeller
  - Insert the jack plug into the socket. Tighten the locking collar with fingers (**Do not over-tighten** – just finger tight)
  - Inserting the jack plug turns the meter ON
  - The value should read 0 at this time
  - To take a reading flick the switch down (start position) and hold for 60 seconds (use stop watch)
  - Stop the counter by flicking the switch up to the centre (neutral position)
  - Record the number on data sheet (in notes field for stream flow measurement)
  - To convert number to water velocity (in m/s) use the following formula
    - Water velocity (V) m/s = (0.000854C) + 0.05
    - Where C is the number counted in one minute
  - Record this number on data sheet
  - Zero the display by flicking the switch to the up position (reset) and gently move the impeller until display reads zero
  - Take rods apart, take jack plug out, and store unit
- Quality Assurance
  - Record n/a on data sheet unless water is being taken for chemical analysis
  - If water is being collected for chemical analysis record the type of duplication (usually a second water sample is taken and Field dup (FD) is recorded)

Interpreting Results		
Parameter	**Ranges**	**What happens to wildlife**
Water temperature	>20°C	Much plant life, bass, carp, catfish, leaches, caddisflies
	12-20°C	Some plan life, trout, stoneflies, mayflies, caddisflies, water beetles
	<12°C	Trout, caddisflies, stoneflies, mayflies
Conductivity	>500ms/cm	Not suitable for certain species of fish and macroinvertebrates
	150-500ms/cm	Healthy water
	<150ms/cm	Not suitable for certain species of fish and macroinvertebrates
Dissolved oxygen	>100% (supersaturated)	Harmful to aquatic life
	>8ppm (or mg/l)	Good for aquatic life, trout, many caddisflies, and mayflies
	<5ppm (or mg/l)	Aquatic life is stressed, much algae and plant life, mosquitoes, leaches, midges If 1-2ppm (or mg/l) for a few hours fish will die
pH	>9.2	Harmful to aquatic life, bacteria can survive
	6.5-8.4	Preferred range, plants, carp, catfish, bass, snails, clams, mayflies, caddisflies
	<4.8	Harmful to aquatic life, bacteria and some plants can survive
Turbidity	>60NTU	High level
	<10 NTU	Low level, drinking water can not exceed 5NTU Ground water is usually <1NTU

Water temperature

The optimal health of aquatic organisms from microbes to fish depends on temperature. If temperatures are outside of the optimal range for a prolonged period of time, organisms are stressed and can die. For fish, the reproductive stage (spawning and egg development) is the most temperature-sensitive period. Macroinvertebrates such as insects, worms, clams, snails, and crayfish will move along the bottom to find a spot where the temperature is optimal.

The temperature of water also affects the volume of dissolved oxygen it can hold (as temperature rises the amount of dissolved oxygen the water can hold decreases), the rate of photosynthesis, the metabolic rates of aquatic organisms, and the sensitivity of organisms to pollution.

Water temperature is affected by the seasons, weather, removal of vegetation that shades the water, building of dams on rivers, discharging cooling water, discharging stormwater, and groundwater influx.

Conductivity

Conductivity is the measurement of a solution's ability to conduct an electric current. It is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, etc. These ions can affect the biological function of plants and animals.

Dissolved oxygen

Dissolved oxygen is an essential element for the maintenance of healthy lakes and rivers. Most aquatic plants and animals need a certain amount of oxygen dissolved in water to survive. The atmosphere, algae, and vascular plants are the sources of dissolved oxygen in lakes and rivers. The accumulation of organic waters depletes dissolved oxygen.

Aquatic life is put under stress when the dissolved oxygen concentrations fall below 5mg/l. If the dissolved oxygen levels falls under 2mg/l for just a few hours, large fish kills can result. Good fishing waters have a dissolved oxygen concentration around 9mg/l.

pH

Water with a pH of less than 4.8 or greater than 9.2 is harmful to aquatic life. Most freshwater fish prefer water with a pH range between 6.5 and 8.4. The pH is also a useful indicator of the chemical balance in water. A high or low pH adversely affects the availability of certain chemicals and nutrients in the water. These substances are needed by plants and some animals to survive. The pH also affects the toxicity of certain substances such as iron, lead, chromium, ammonia, and mercury.

Turbidity

Turbidity is a measure of water clarity (how far light can travel through water). The more particles suspended in a sample of water, the more difficult it is for light to travel through it and the higher the water's turbidity or murkiness. Although the suspended particles that reduce clarity can include organic particles (microbes, algae and plant particles, and animal detritus) as well as inorganic particles (silt and clay), it is usually inorganic particles that account for most of the turbidity.

Oxygen levels decrease in turbid water as they become warmer because heat is absorbed by the suspended particles (warmer water holds less dissolved oxygen) and less light reaches the plants resulting in decreased photosynthesis. Suspended particles can clog fish gills, reduce growth rates and disease resistance, and prevent egg and larval development. Settled particles can accumulate and smother fish eggs and aquatic insects on the river bottom, suffocate newly-hatched insect larvae, and make river bottom microhabitats unsuitable for mayfly nymphs, stonefly nymphs, caddisfly larvae, and other aquatic insects.

The amount of sediment and maximum particle size that is transported by moving water is related to the flow velocity of the water (stream flow). This in turn affects turbidity. For example, at a flow velocity of 1m/s silt and sand will be eroded from a streambed and transported downstream in the water column, whereas, at 0.1m/s these particles will be deposited.