Goals of Water Quality Monitoring:

- Identify the reasons for water quality testing and type of tests to be done
- Describe the activities carried out around the ponds to reduce nutrient loading and pollution
- Present the water quality testing results completed by Pembroke Watershed Association on Furnace, Oldham, Stetson, Little Sandy Bottom, and Hobomock ponds in 2007
- Provide an analysis of 3 years of data collection and provide recommendations for improvement of water quality within the Pembroke watershed

Current Problems Impacting Pembroke Ponds:

- **Eutrophication:** excessively high nutrient loads of Phosphorus and Nitrogen exist, resulting in algae blooms (some toxic to animals) and weed growth. Sources include animal and human waste, fertilizers, sewage, and sediment loads, and muck in pond bottoms. Waters subject to eutrophication are cloudy (turbid) and green or brown in color, often with bad odor.

- **Sedimentation:** sediment run-off from roads, storm drains, lawns, beach areas, land development projects, reduces water depth and increases water temperature. Winter road sanding and loss of vegetative barriers near the water increase sediment loading. Furnace Pond average depth is 5 feet.

- **Agricultural impacts:** cranberry bog water use, particularly bog effluent returns high in phosphorus, and possible pesticide run-off.

- **Non-point source run-off:** of nutrients in fertilizers and soaps, human and animal wastes, oil, grease, toxic chemicals and pesticides toxic to aquatic life, via storm drains, land development, streets and driveways, human activities. This is an important source of pollution, much of it controllable.

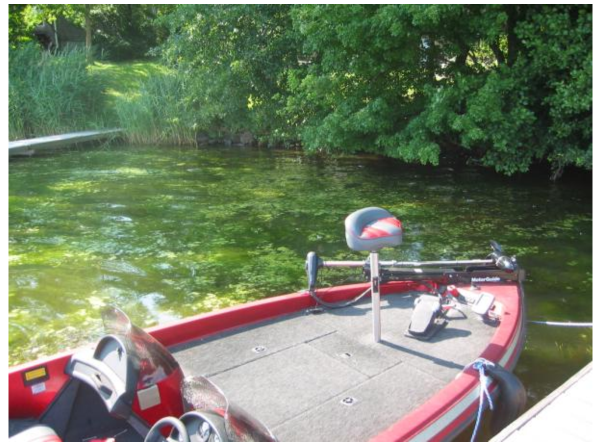
- **Loss of riparian vegetation and bank stabilization:** waterfront stripped of buffer zones, trees, and aquatic plants, which impacts aquatic and wildlife habitats, encourages erosion of existing shoreline, increases non-point source pollution via run-off and provides no filtration of pollution.

- **Stream alterations via dams:** for bog cultivation or herring management, may lead to stagnation of water, enhanced effects of eutrophication, and alters natural habitats.

- **Septic failures:** This problem occurs occasionally and may exist in home sites very close to the water.

- **Conflicts in usage of the water:** water is drawn off to Brockton water supply, irrigation for the bogs, water front homeowners use, and public use

What was the problem in 2007?



Eutrophication:

- 90% of Massachusetts ponds have symptoms of eutrophication.

- Phosphorus and Nitrogen loads stimulate the growth of algae, which cloud the water and limit light diffusion. This halts the growth of native grasses and plants in the water, and permits growth of noxious weeds. The habitat for fish and native insects is altered, and algae growth has been identified as a major threat to the diversity and health of native fish populations in the northeast. Both night time plant respiration and algae decomposition reduce the available oxygen in the water. Furnace and Oldham have experienced low dissolved oxygen levels.

- Furnace, Oldham, and Stetson ponds have evidence of significant eutrophication.

- All Pembroke ponds suffer from non-point source pollution. It is the position of the Pembroke Watershed Association that an action plan be developed with the Town of Pembroke to reduce the level of non-point source pollution within the watershed.

Value of Pembroke's Ponds:

- Aesthetic beauty: unique to Pembroke is the number of great ponds within the town, providing tremendous natural beauty.
- Part of the valuable South Coastal Watershed, and contributes to the Mass Bay estuary. Stetson Pond is part of the Taunton River Watershed.
- Natural resource: drinking water, irrigation for cranberry bogs and homes.
- Town well water recharge from the ponds.
- Aquatic and wildlife habitats.
- Unique natural features: herring spawning grounds in Oldham and Furnace.
- Recreational resource for the town, including town beaches and fishing access.
- Additional tax revenue from waterfront properties.

Value of testing and monitoring:

- Provides a credible and ongoing method of collecting information about the health of the ponds and the watershed that feeds it.
- Documents observations, sampling, and analysis of data/information utilizing methods supported by Mass. water watch, DEP, and other government agencies.
- Creates a long term monitoring data set to determine impact of actions and restoration efforts. Long term monitoring demonstrates greater validity than short term, and multi-year sampling reduces the likelihood of inaccurate analysis due to testing bias.
- Testing and monitoring can be used to substantiate cost benefit ratios of restorative plans.
- Restorative action planning: The PWA volunteer water quality program permits trending of conditions of five of Pembroke's Ponds. In late 2007 a Quality Assurance Project Plan was completed by a team of PWA volunteers. This was tremendously important to the PWA, permitting use of our data by the state and serious consideration for grants at the state and federal level for restorative action.

2005-2007 Land-based Efforts to Improve Water Quality:

- Reviewed the 1993 and 2001 Pond surveys as a basis for water quality management plan

- Utilized the Mass Water Watch website and DEP publications and classes through COLAP and the Rivernet Association to develop a knowledge base, obtain protocols and formats for surveying and documenting results.

- Conducted an overall pond survey to determine primary problems and create an action plan for 4 ponds. Hobomock pond completed their pond survey later in 2005 and presented their findings to the PWA.

- Identified Best Management Practices and worked with the town government to strive to implement these: DPW, Conservation Commission, and Selectmen were used as contacts and were very supportive of the efforts of the PWA.

- Provided BMP education to the public through presentations at PWA meetings, at the library, and via the news, and developed liaison with the schools.

- Established collaborative relationship with NSRWA, Jones River Watershed Association, and Watershed Action Alliance.

- Held annual pond clean-up days to remove debris from the shoreline/pond edges.

- Requested that the DPW use the street sweeper be used to remove sand and debris from the roads in the spring and again in the summer around streets which directly impact the ponds.

- Asked that the town clean the storm drains directly draining into the pond, increase the number of storm drains, and consider adopting newer retrofit and LID methods of reducing non-point source pollution.

- Placed signs at boat ramps to encourage clean-up of boats after removal from the ponds

- Catch basin stenciling was begun at all pond storm drain sites. This project will be ongoing, with the intent of stenciling storm drains at higher elevations and in neighborhoods, all of which drain into the ponds.

- Studied the impact of residential development on the buffering capacity of the shoreline. The findings are included in this report.

- Installed dog watching stations to provide plastic bags to dog walkers for waste removal

- Participated in a grant to demonstrate LID: rain garden development, pervious paving at Oldham Pond Town landing. Kiosks will be placed at the Town Hall and Oldham Pond Town Landing to continually update the public of PWA activities and ecological/environmental awareness activities.

Best Management Practices for Water Quality Preservation is Buffer Zones:

Storm water run-off + pollutants = poor water quality!

- **Create and Maintain Vegetated Buffer Zones**: establish and maintain trees, bushes, perennials, sedges, and aquatic plants, next to the water, on hills, in all areas with run-off, to improve filtration capacity, maintain habitats. 90% of run-off will be captured by a well planned buffer zone and 80% of pollutants will be removed by the plants.

- **Native plantings:** within the waterfront 100 foot zone. Native plants don't require fertilizing or watering once established.

- **Remove exotic invasive plants:** destroys native habitats

- **Curve** ramps, walkways, grass or dirt paths to avoid run-off straight down to the water.

- **Avoid phosphorus based fertilizers:** try to avoid all fertilizers and use organic products which are environmentally friendly whenever possible.

- **Rain gardens** and **rain barrels:** to catch and filter runoff and conserve water.

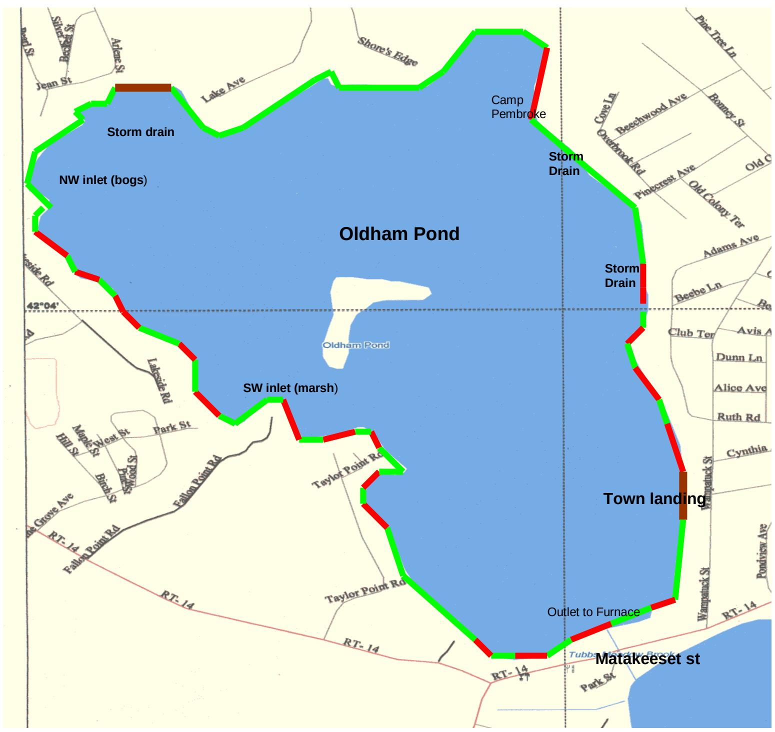
- **LID efforts**, such as pervious pavements, new storm drain designs, and enviro-friendly landscape designs. Storm drain management cannot be emphasized enough!

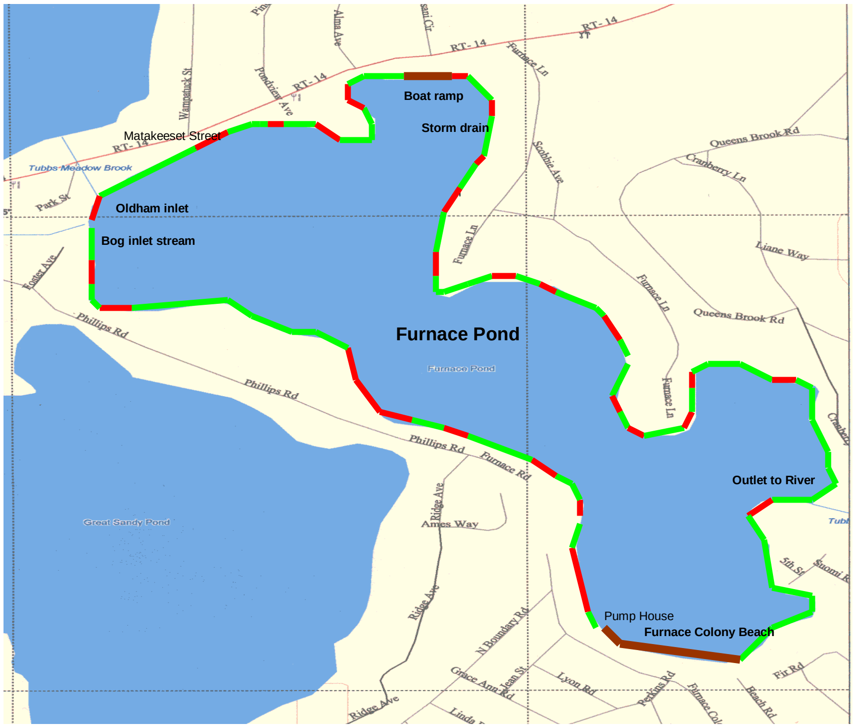
- **Support by-laws:** that improve water-quality and best management practices, and support efforts that improve water quality and natural landscaping.

Shoreline Pond surveys

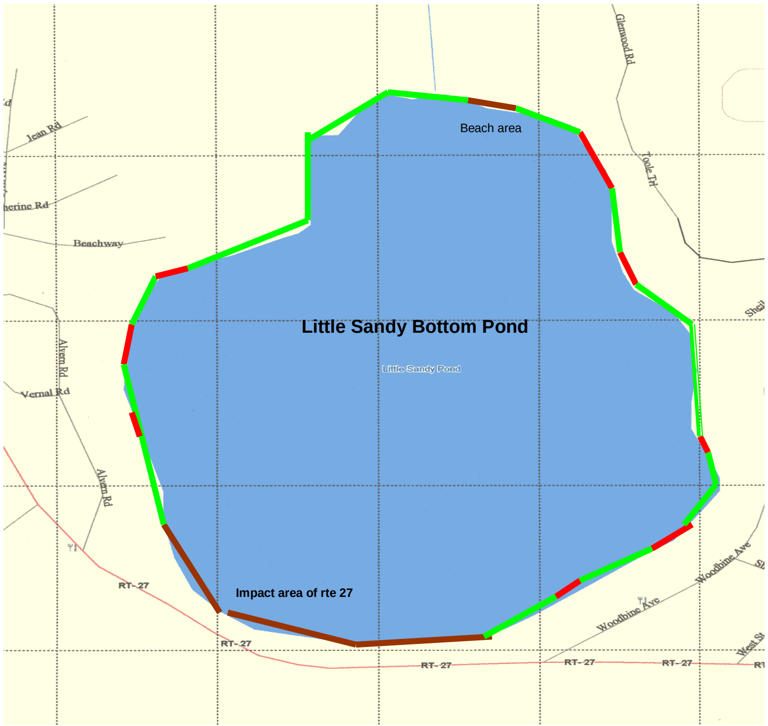
- The following slides indicate the approximate degree of suburban development at each of the ponds, including buffer zones, impervious public ramps, and impact of roads.

- ___: buffered areas
- ___: no buffer zone
- ___: public unbuffered areas




Boat ramp
Storm drain
Matakeeset Street
Oldham inlet
Bog inlet stream
Furnace Pond
Outlet to River
Pump House
Furnace Colony Beach


Blueberry lane beachfront
Bog inlet
Storm Drain
Stetson Pond
Hill with Ramp
Hill with ramp
Main Road
Outlet to Chaffin
Boat Ramp
and beach



Buffered and Unbuffered Areas Around the Ponds

(conservative estimates)

Pond	**Public Unbuffered**	**Private Unbuffered**	**Buffered**
Oldham	7%	38%	55%
Furnace	10%	35%	55%
Stetson	5%	30%	65%
LSB	17%	18%	65%

Pembroke Watershed Association: Water based testing

Using Google Earth view of our ponds we have included our testing sites, marked in yellow, on each of the ponds. Site identification includes our identifier and the 1988 survey identifier for the same site. We utilized GPS coordinates to determine and standardize our sites.

Map One: overall map that shows all of the ponds

Map Two: Oldham Pond

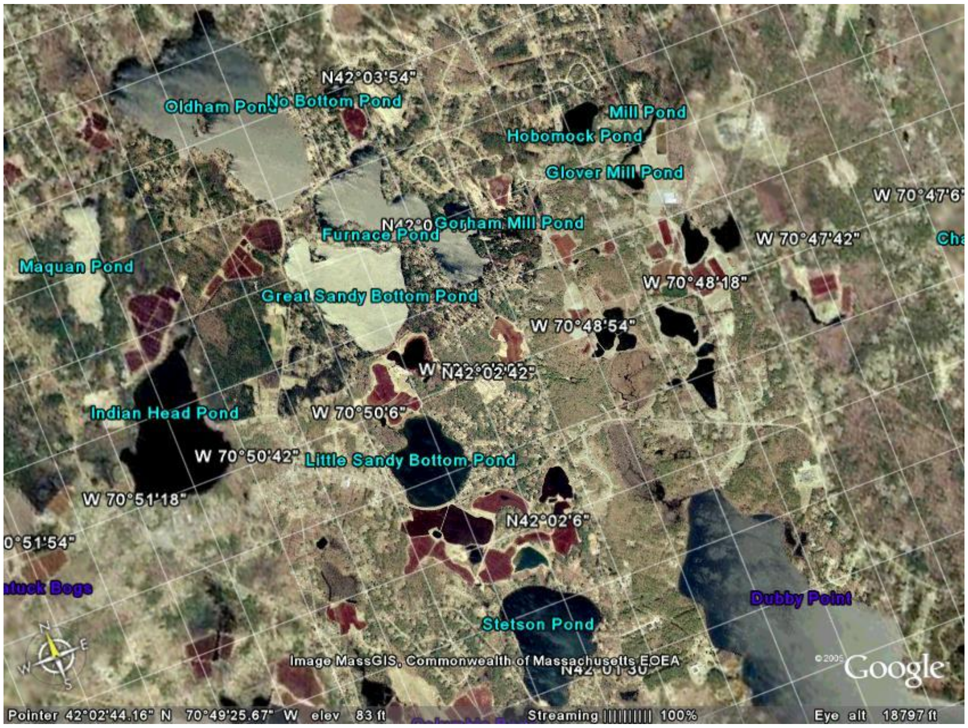
Map Three: Furnace Pond

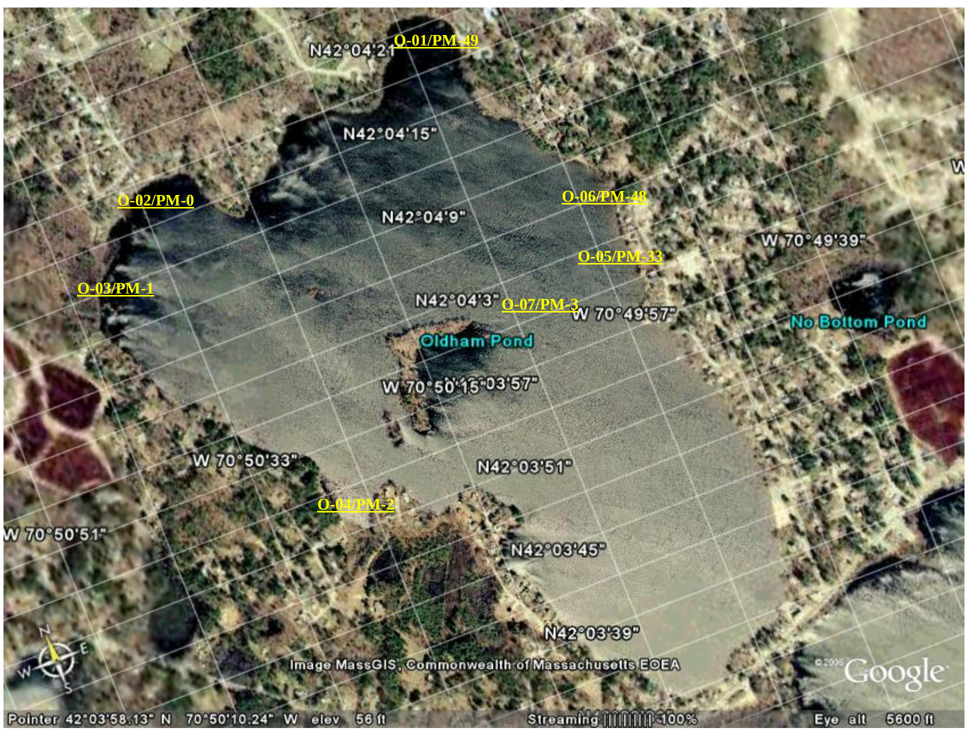
Map Four: Stetson Pond

Map Five: Little Sandy Bottom Pond

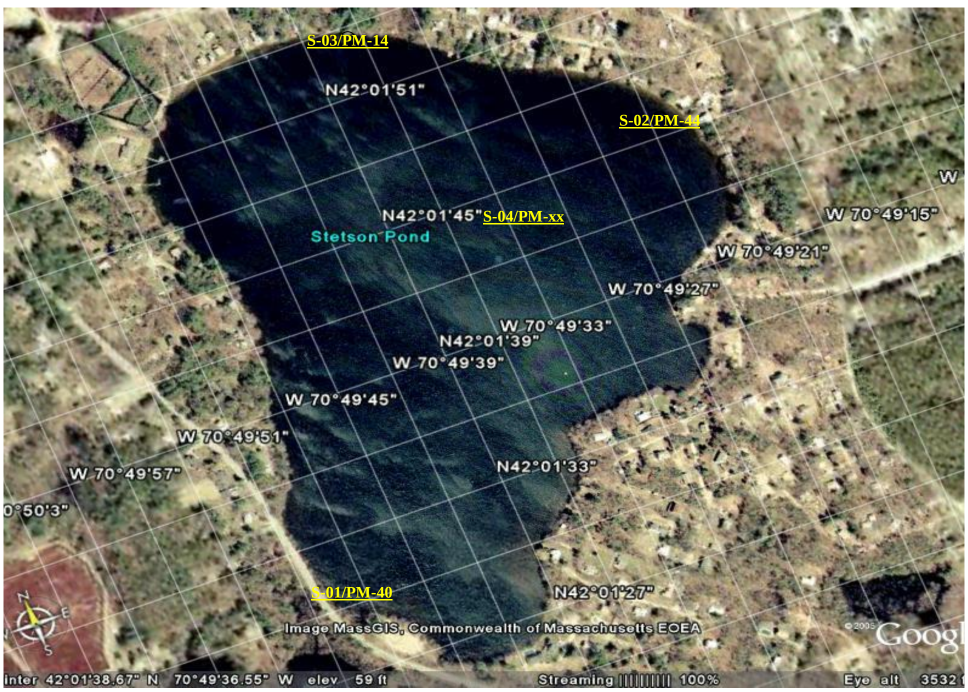
Map Six: Hobomock Pond

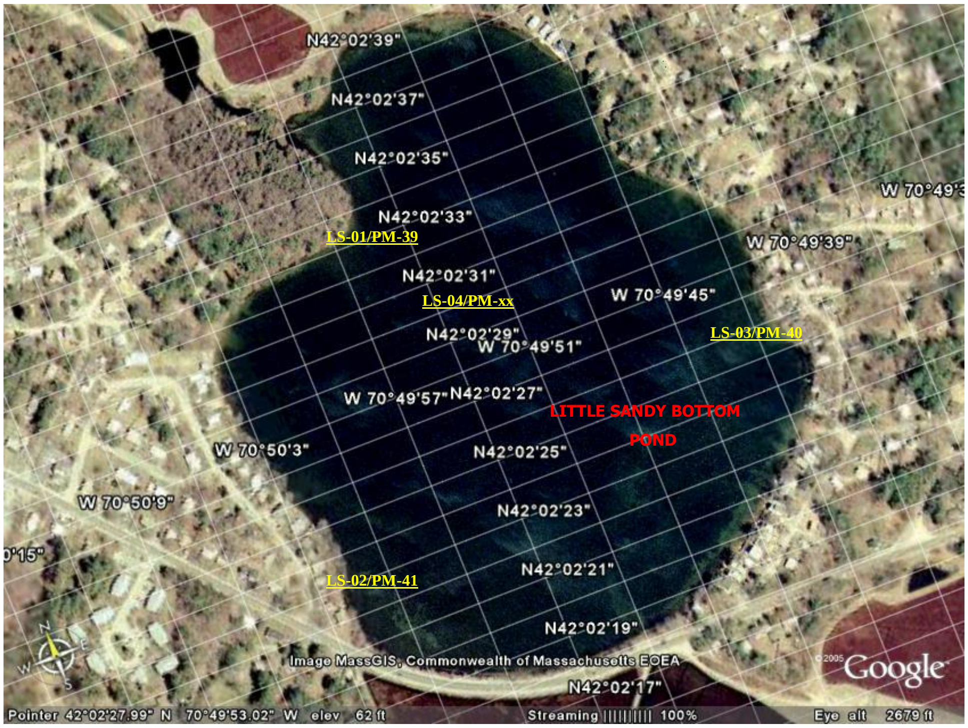
Test sites are identified in yellow on the Google Earth Maps

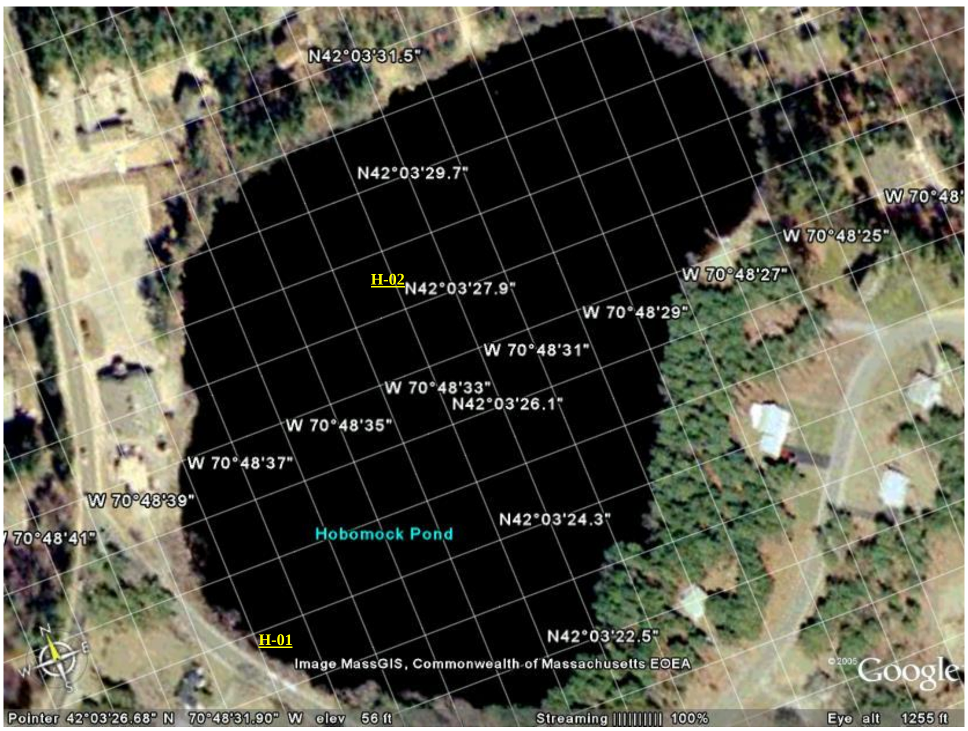

N42°03'54"
Oldham Pond
No Bottom Pond
Mill Pond
Hobomock Pond
Glover Mill Pond
W 70°47'6"
Gorham Mill Pond
Furnace Pond
W 70°47'42"
Maquan Pond
W 70°48'18"
Great Sandy Bottom Pond
W 70°48'54"
N42°02'42"
Indian Head Pond
W 70°50'6"
W 70°50'42"
Little Sandy Bottom Pond
W 70°51'18"
N42°02'6"
Dubby Point
Stetson Pond
Image MassGIS, Commonwealth of Massachusetts EOEA
Google
Pointer 42°02'44.16" N 70°49'25.67" W elev 83 ft
Streaming 100%
Eye alt 18797 ft


O-01/PM-49
N42°04'15"
O-02/PM-0
O-06/PM-48
N42°04'9"
W 70°49'39"
O-05/PM-33
O-03/PM-1
N42°04'3"
O-07/PM-3
W 70°49'57"
No Bottom Pond
Oldham Pond
W 70°50'33"
N42°03'51"
O-04/PM-2
W 70°50'51"
N42°03'45"
N42°03'39"
Image MassGIS, Commonwealth of Massachusetts EOEA
Google
Pointer 42°03'58.13" N 70°50'10.24" W elev 56 ft
Streaming 100%
Eye alt 5600 ft


N42°03'39"
F-03/PM-36
N42°03'33"
F-02/PM4
F-01/PM-5
FURNACE POND
N42°03'27"
W 70°49'3"
W 70°49'9"
W 70°49'15"
W 70°49'21"
W 70°49'27"
F-07/PMxx
N42°03'21"
W 70°49'33"
W 70°49'39"
F-06/PM-8
F-04/PM-9
Gorham
W 70°49'45"
W 70°49'51"
W 70°49'57"
N42°03'15"
F-05/PM-xx
N42°03'9"
Image MassGIS, Commonwealth of Massachusetts EOEA
Google
Streaming |||||||||| 100%


S-03/PM-14
N42°01'51"
S-02/PM-44
N42°01'45"
S-04/PM-xx
Stetson Pond
W 70°49'15"
W 70°49'21"
W 70°49'27"
W 70°49'33"
N42°01'39"
W 70°49'39"
W 70°49'45"
W 70°49'51"
W 70°49'57"
N42°01'33"
S-01/PM-40
N42°01'27"
Image MassGIS, Commonwealth of Massachusetts EOEA
Streaming |||||||||| 100%


N42°02'39"
N42°02'37"
N42°02'35"
W 70°49'3
N42°02'33"
LS-01/PM-39
W 70°49'39"
N42°02'31"
LS-04/PM-xx
W 70°49'45"
N42°02'29"
W 70°49'51"
LS-03/PM-40
W 70°49'57"
N42°02'27"
LITTLE SANDY BOTTOM
POND
W 70°50'3"
N42°02'25"
W 70°50'9"
N42°02'23"
0'15"
N42°02'21"
LS-02/PM-41
N42°02'19"
Image MassGIS, Commonwealth of Massachusetts EOEA
Google
N42°02'17"
Pointer 42°02'27.99" N 70°49'53.02" W elev 62 ft
Streaming 100%
Eye alt 2679 ft


N42°03'31.5"
N42°03'29.7"
W 70°48'
W 70°48'25"
W 70°48'27"
H-02
N42°03'27.9"
W 70°48'29"
W 70°48'31"
W 70°48'33"
N42°03'26.1"
W 70°48'35"
W 70°48'37"
W 70°48'39"
70°48'41"
Hobomock Pond
N42°03'24.3"
H-01
N42°03'22.5"
Image MassGIS, Commonwealth of Massachusetts EOEA
Google
Pointer 42°03'26.68" N 70°48'31.90" W elev 56 ft
Streaming 100%
Eye alt 1255 ft

GPS Coordinates for Test sites

Oldham Pond				
PWA	**1988**			
O-01	**PM-49**	**Camp Pembroke**	**42.04.330 N**	**70 50.048 W**
O-02	**PM-0**	**Hal's Pipe - off of Arlene Street**	**42.04.257 N**	**70 50.505 W**
O-03	**PM-1**	**Inlet in NE Hanson - Stream From Bogs**	**42.04.158 N**	**70 50.610 W**
O-04	**PM-2**	**SE Inlet in Hanson - off of Marshes**	**42.03.904 N**	**70 50.426 W**
O-05	**PM-33**	**Culvert off of Adams Avenue Beach**	**42.04.180 N**	**70.49.936 W**
O-06	**PM-48**	**Pipe entering from Cove Road**	**42.04.221 N**	**70.50.032 W**
O-07	**PM-3**	**S/E Side of Monument Island (Deep)**	**42.03.984 N**	**70.50.079 W**
Furnace Pond				
PWA	**1988**			
F-01	**PM-5**	**Bog Stream Inlet**	**42.03.500 N**	**70 49.920 W**
F-02	**PM-4**	**Inlet from Oldham**	**42.03.530 N**	**70 49.914 W**
F-03	**PM-36**	**Betty's Pipe**	**42.03.629 N**	**70 49.529 W**
F-04	**PM-9**	**Outlet to River**	**42.03.219 N**	**70 49.199 W**
F-05	**PM-xx**	**Furnace Colony Beach**	**42.03.039 N**	**70.49.348 W**
F-06	**PM-8**	**Brian's Point**	**42.03.275 N**	**70.49.490 W**
F-07		**Deep Hole (Dissolved Oxygen)**	**42.03.282 N**	**70.49.459W**
Stetson Pond				
PWA	**1988**			
S-01	**PM-12.**	**Bog Inlet**	**42.01.882 N**	**70 49.779W**
S-02	**PM-44**	**East Storm Drain**	**42.01.741N**	**70 49.330 W**
S-03	**PM-14**	**Outlet to Chaffen**	**42.01.501 N**	**70 49.823 W**
S-04		**Deep Hole (Dissolved Oxygen)**	**42.01.710 N**	**70 49.493 W**
Little Sandy Pond				
PWA	**1988**			
LS-01	**PM-39**	**West Storm Drain**	**42.02.495 N**	**70 50.055 W**
LS-02	**PM-41**	**South Storm Drain**	**42.02.323 N**	**70 49.97 W**
LS-03	**PM-40**	**East Storm Drain**	**42.02.401 N**	**70 49.678 W**
LS-04		**Deep Hole (Dissolved Oxygen)**	**42.02.474 N**	**70 49.810 W**
Hobomock Pond				
PWA				
H-01		**Drain area from Hobomock Street**	**42.03.393 N**	**70 548.618 W**
H-02		**Deep Hole (Dissolved Oxygen)**	**42.03.439 N**	**70 48.551 W**

In 2006 site adjustments were made due to excessive weed growth in shallow areas.

What are we testing for?

- **Nitrogen -** is a fundamental nutrient and is required by all living plants and animals for building proteins
  Measured in mg/liter
  - Natural range is between 0.1 and 2 mg/l
  - For concentrations >5 mg/l negative impact is certain

- **Phosphorus -** is normally scarce in a <u>normal</u> aquatic environment, is necessary for plant growth, and is abundant on land.
  Measured in mg/liter
  - Concentration should be between .01 and .1 mg/l
  - For concentrations >.05 mg/l impact is light
  - For concentrations >.10 mg/l negative impact is certain

- Note: marked increase in Nitrogen or Phosphorous loads in a pond will encourage the proliferation of algae fueling an overpopulation of bacteria that eat the decomposing algae. Less light diffuses through the water, impacting aquatic plant life. Aquatic life and algae compete for dissolved oxygen, and oxygen levels will plummet, resulting in eutrophic conditions and loss of habitat.

- **Turbidity:** The amount of suspended solids in the water.
  - Measured in NTU (Nephelometric Turbidity units)
  - Level should be between 1.0 and 10.0 NTU
  - Turbidity directly effects transparency (clarity) of the water

- **Dissolved Oxygen (DO):** The amount of oxygen in the water
  - Measured in mg/liter
  - Fish need a DO level >6.0 for warm water species, >7.0 for cold water species
  - DO levels will be higher near the surface due to wind effects, therefore should be measured at a minimum depth of 4 feet

- **pH and Alkalinity:** ability of water to handle acid and basic solutions
  - A pH of 7.0 is neutral, a higher pH means alkaline, a lower pH means acidic.
  - Pond water pH should range between 6.5 and 8.5
  - Alkalinity refers to the ability of the body of water to neutralize incoming acids from precipitation or discharges. Low alkalinity indicates low buffering ability.
  -

- **Secchi Disk Transparency:** directly relates to turbidity, measures clarity.
  - Measured in feet
  - Water clarity: how far down can a Secchi disc be seen.
  - Expected depth should be > 10 feet, with high water quality exceeding 16 feet

Determination of Test Sites: (need modification of bullet size and type)

- The 1988-1993 and 2001 Diagnostic Feasibility studies were used as guides to start our testing program.
- Test locations were originally determined by the pond captains in 2005 after a thorough analysis of each pond consisting of:
  - A tour by boat to determine those locations that appeared to require further study, utilizing a GPS to mark the various sites
  - A walk around conducted on land to further assist in determining where we needed to test.
  - The feasibility studies from 1993 and 2001.
  - Pond maps were then utilized to make the final determination of where we would test.
  - When feasible sites were matched to previous studies.
  - Minimum of 3 foot depth for sampling
- Testing sites were modified in both the 2006 and 2007 seasons based on environmental conditions and the ongoing development of a Quality Assurance Project Plan. The goal of testing will be to determine the overall health of the pond and to spot check areas of concern.

Testing Protocol: (Charlie review and revise)

- Testing procedures were developed utilizing methods suggested in
  - "Testing the Waters" published by the River Network and
  - "Putting Together a Watershed Management Plan
    - A Guide to Watershed Partnerships" published by Mass DCR
  - State review and recommendations of the PWA Quality Assurance Project Plan in development

- A test criterion was developed and testing forms were created based on sample forms shown in the publications. The forms were modified to capitalize on things we learned in 2005. Tests are documented and required forms are completed
  - A water sample form was created to be used at each site/location. Forms included all parameters
    - Previous days weather conditions and rainfall amounts
    - Water Height as measured for each pond
    - Air & water Temperature
    - Conditions at each site: water use, wave action, odor, water color, weeds, algae, bottom condition, depth
  - A separate form was created for Dissolved Oxygen

- Testing requirements were chosen by the Water Quality Committee after determining what tests were to be conducted based on pond surveys

- Water Quality sampling training was broken down into several procedures, Volunteers were trained on land first and then by actually doing a live test. 2 or 3 volunteers were trained at one time
  - Setting up and calibrating the DO meters
  - Taking the actual sample

  - Using the Secchi Disk and View Scope
  - Obtaining additional required information
  - Filling in the paperwork

- Water quality Co-Chairs went through additional training to be certified as instructors. A total of 5 instructors and 22 Volunteers have been trained.

Test Equipment

- We assembled a Secchi Disk and a view scope to measure water clarity

- We purchased a Hydrolab Quanta by Hach to measure
    - Dissolved Oxygen
    - Turbidity
    - Temperature
    - Depth
    - Salinity
    - pH
    - Specific Conductance

- Devices for capturing water samples were assembled based on the actual sample bottles used.

- GPS were obtained to verify test site locations

Data Collection Methods

- We tested for:
  - Dissolved Oxygen, pH, Turbidity, Specific Conductance and salinity - utilizing a Hach Quanta meter we purchased.
  - Secchi Disk transparency - Utilizing a Secchi Disk and a View Scope
  - We obtained a grab sample for each site and that sample was then sent to Analytical Balance labs for analysis.
  - We requested analysis for:
    - Ammonia
    - Alkalinity
    - Chloride
    - Total Phosphorus
    - OrthoPhosphorus
    - K Nitrogen
    - Nitrates
    - Nitrites
    - Total Nitrogen - calculated from K nitrogen, Nitrates and Nitrites

- Analytical Balance labs, 422 West Grove Street, Middleboro MA performed the required laboratory testing

- Chain of custody rules were followed and adhered to. We utilized Analytical Balance chain of custody forms.

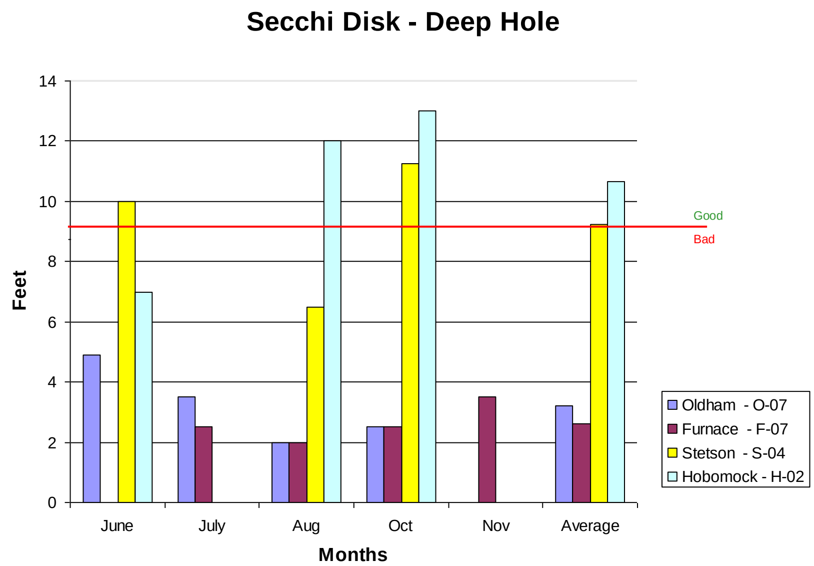
Testing locations and Schedule:

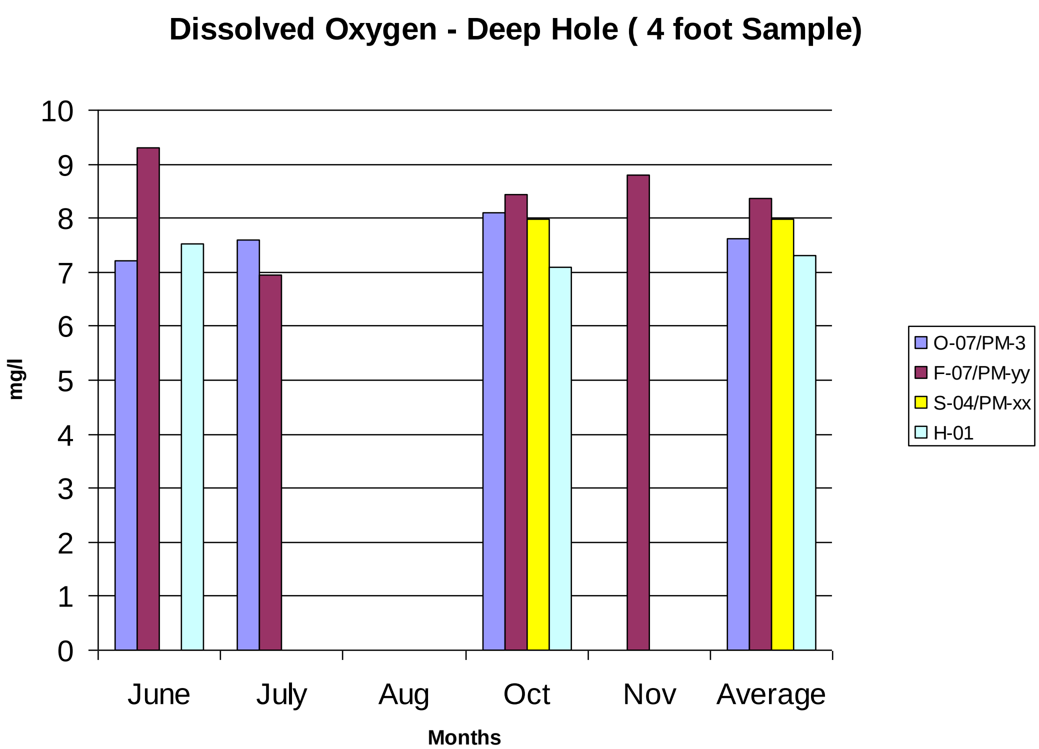
- **Secchi Disk Transparency at "Deep Hole"**
  - Oldham - June, July, Aug, Oct.
  - Furnace - June, July, Aug, Oct., Nov.
  - Stetson – June, Aug., Oct.,
  - Hobomock – June, Aug., Oct.
- **Dissolved Oxygen at Deep Hole (4 feet)**
  - Oldham - June, July, Aug, Oct.
  - Furnace - June, July, Aug., Oct., Nov.
  - Stetson – July, Aug., Oct, Nov.
  - Hobomock – June, Aug, Oct
- **pH, Turbidity, Total Nitrogen, Total Phosphorus**
  - Oldham - (6 test sites) - June, July, Aug., Oct.
  - Furnace - (6 test sites) - June, July, Aug., Oct., Nov.
  - Stetson - (3 test sites) - June, Aug, Oct, Nov.
  - Hobomock - (1 test site) - June, Aug., Oct.

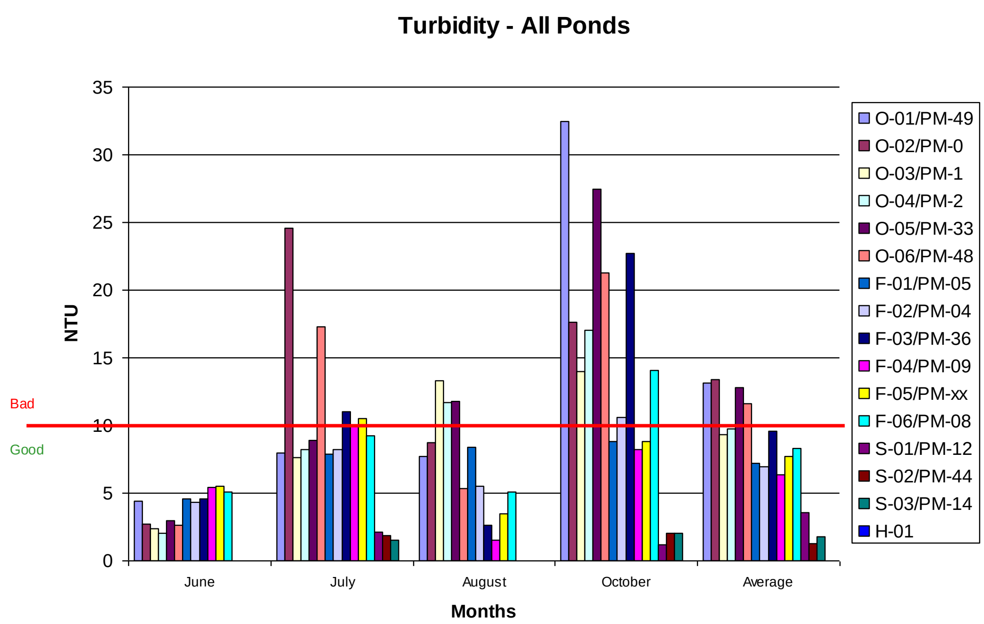
  –

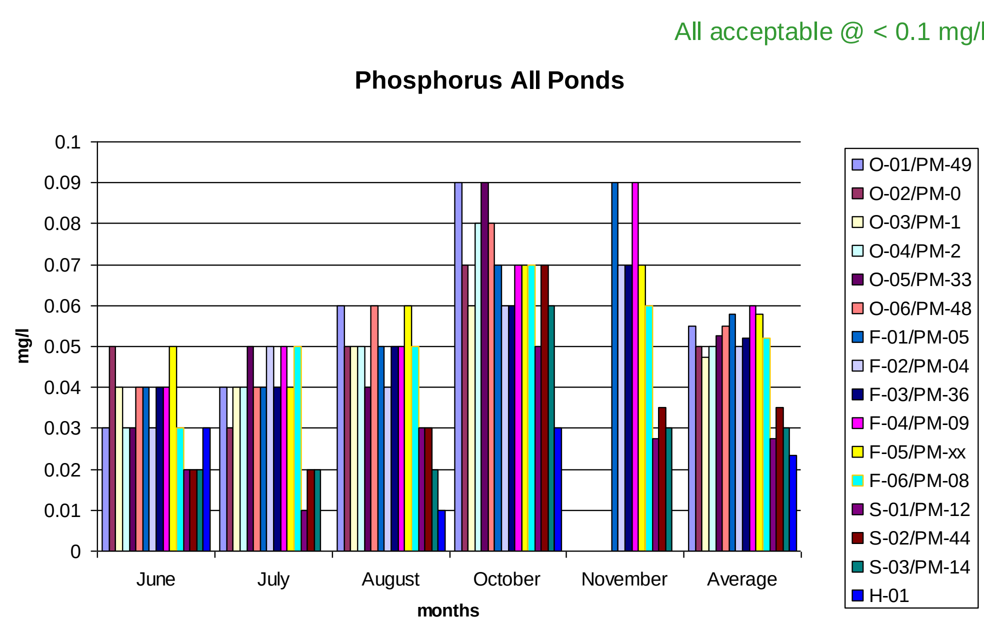
Adjustments in the schedule or actual testing sites on each pond were made based on weather, availability of boats to conduct testing, and availability of testing equipment that was functional and accurate.

Testing results for 2007 are provided for each pond. Following the 2007 results are the 3 year trends in areas of concern: Nitrogen, Phosphorus, Choride, Temperature, and Dissolved Oxygen.

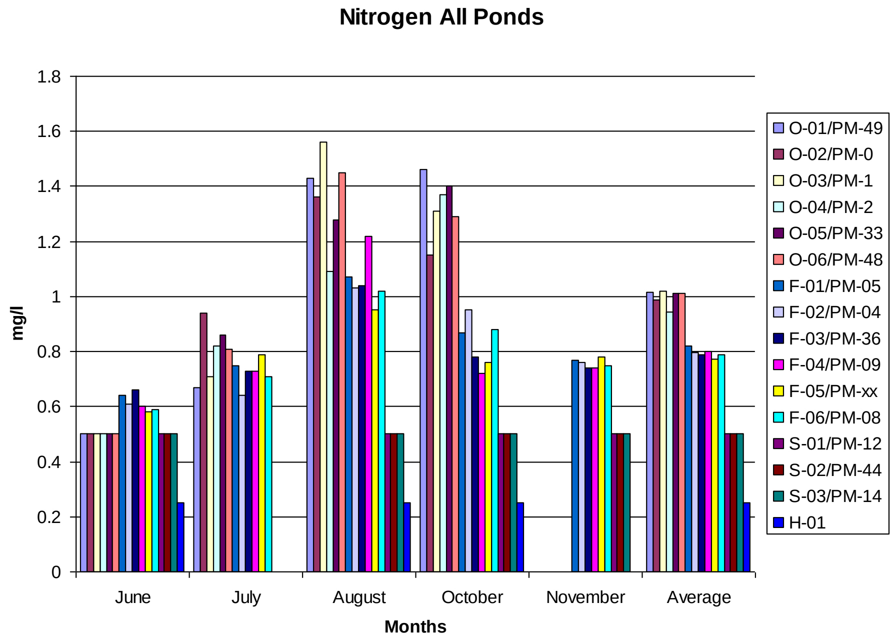

Secchi Disk - Deep Hole
Feet
14
12
10
8
6
4
2
0
June
July
Aug
Oct
Nov
Average
Months
Good
Bad
Oldham - O-07
Furnace - F-07
Stetson - S-04
Hobomock - H-02


Dissolved Oxygen - Deep Hole (4 foot Sample)
mg/l
10
9
8
7
6
5
4
3
2
1
0
June
July
Aug
Oct
Nov
Average
Months
O-07/PM-3
F-07/PM-yy
S-04/PM-xx
H-01

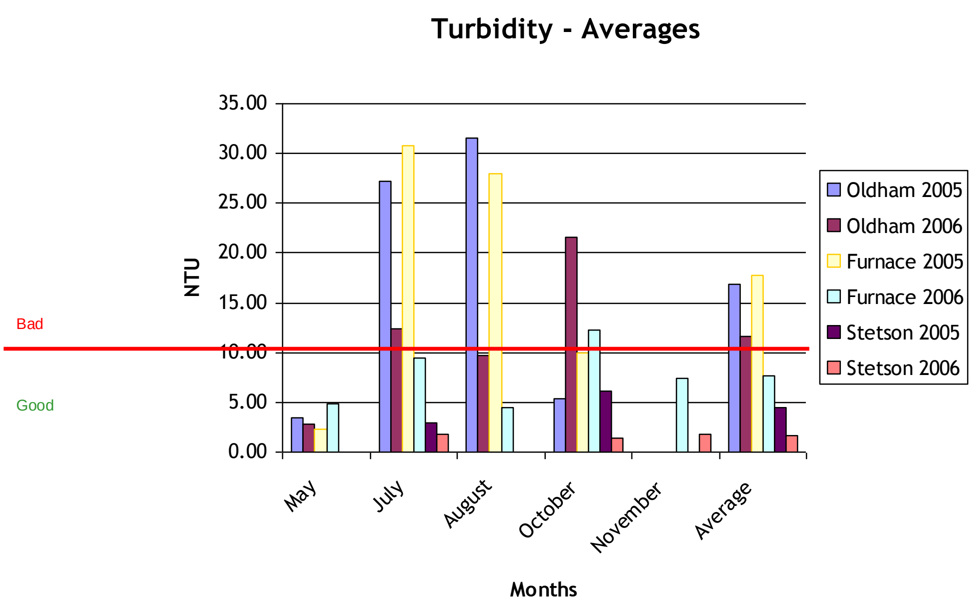

Turbidity - All Ponds
35
30
25
20
15
10
5
0
NTU
Bad
Good
June
July
August
October
Average
Months
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08
S-01/PM-12
S-02/PM-44
S-03/PM-14
H-01

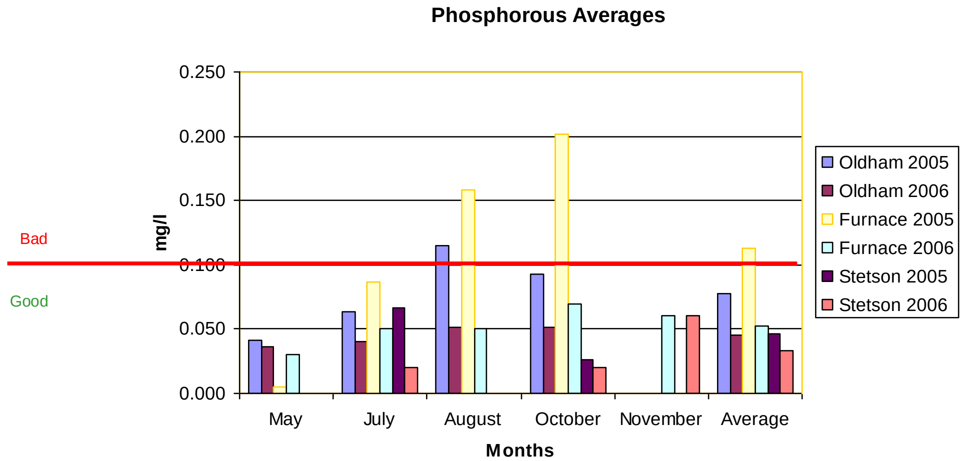

All acceptable @ < 0.1 mg/l
Phosphorus All Ponds
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
mg/l
June
July
August
October
November
Average
months
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08
S-01/PM-12
S-02/PM-44
S-03/PM-14
H-01

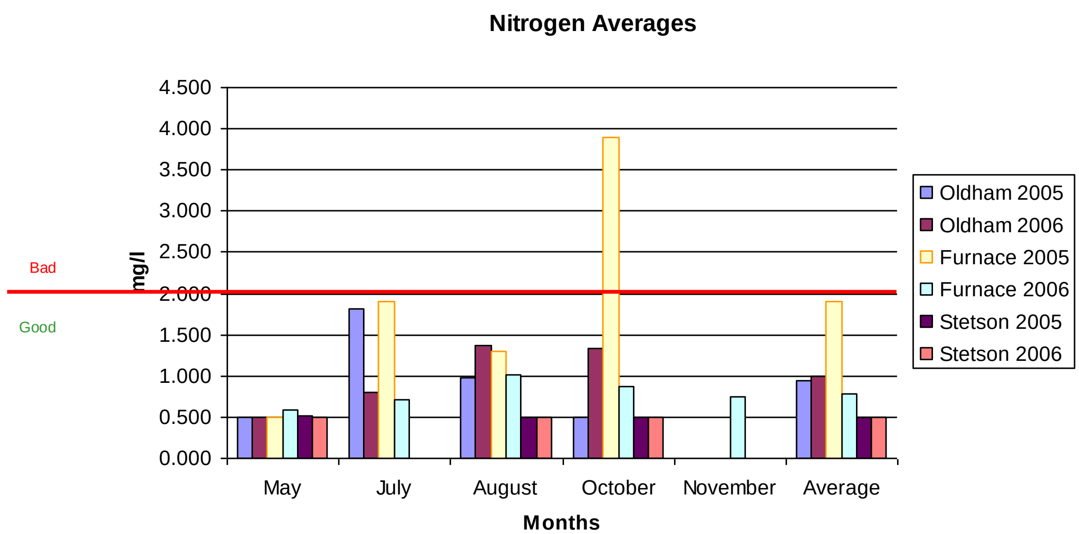
All acceptable @ < 2.0 mg/l

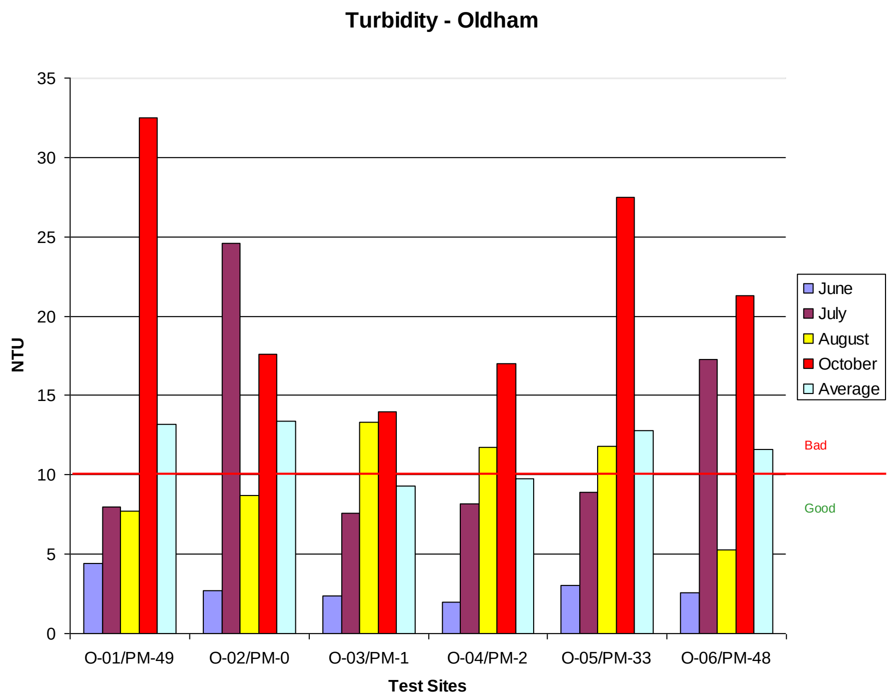


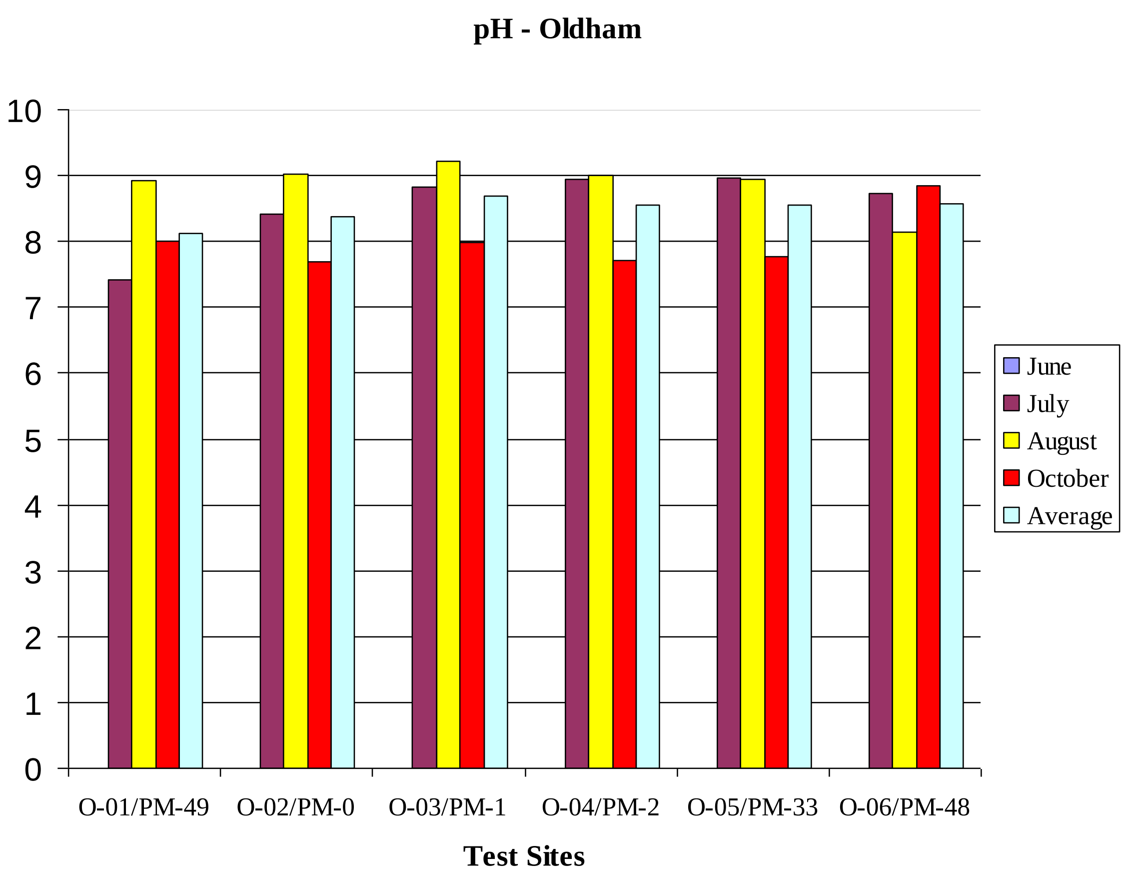
We averaged 2005 and 2006 results for comparison for Turbidity, Phosphorous and Nitrogen

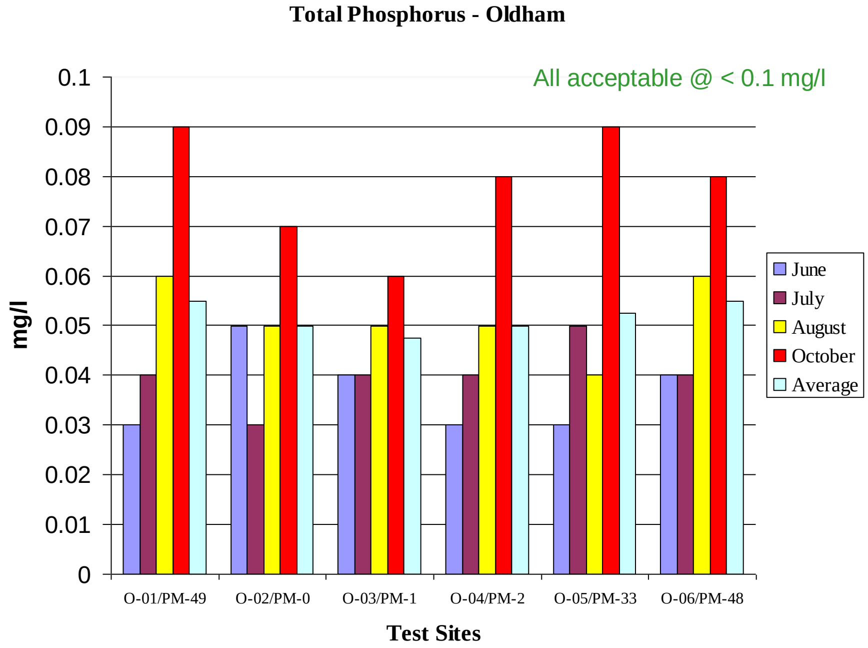


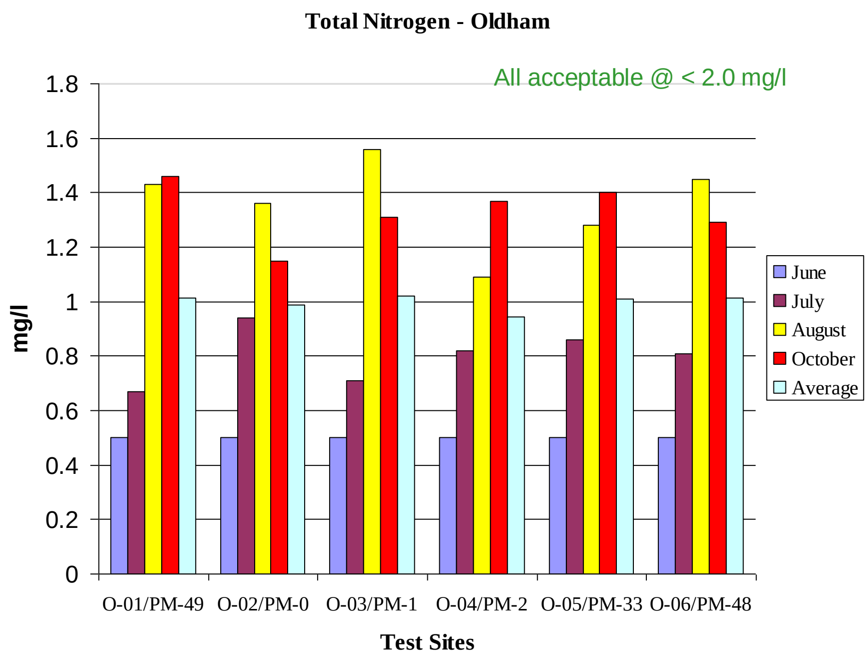

Phosphorous Averages
0.250
0.200
0.150
0.100
0.050
0.000
mg/l
Bad
Good
May
July
August
October
November
Average
Months
Oldham 2005
Oldham 2006
Furnace 2005
Furnace 2006
Stetson 2005
Stetson 2006

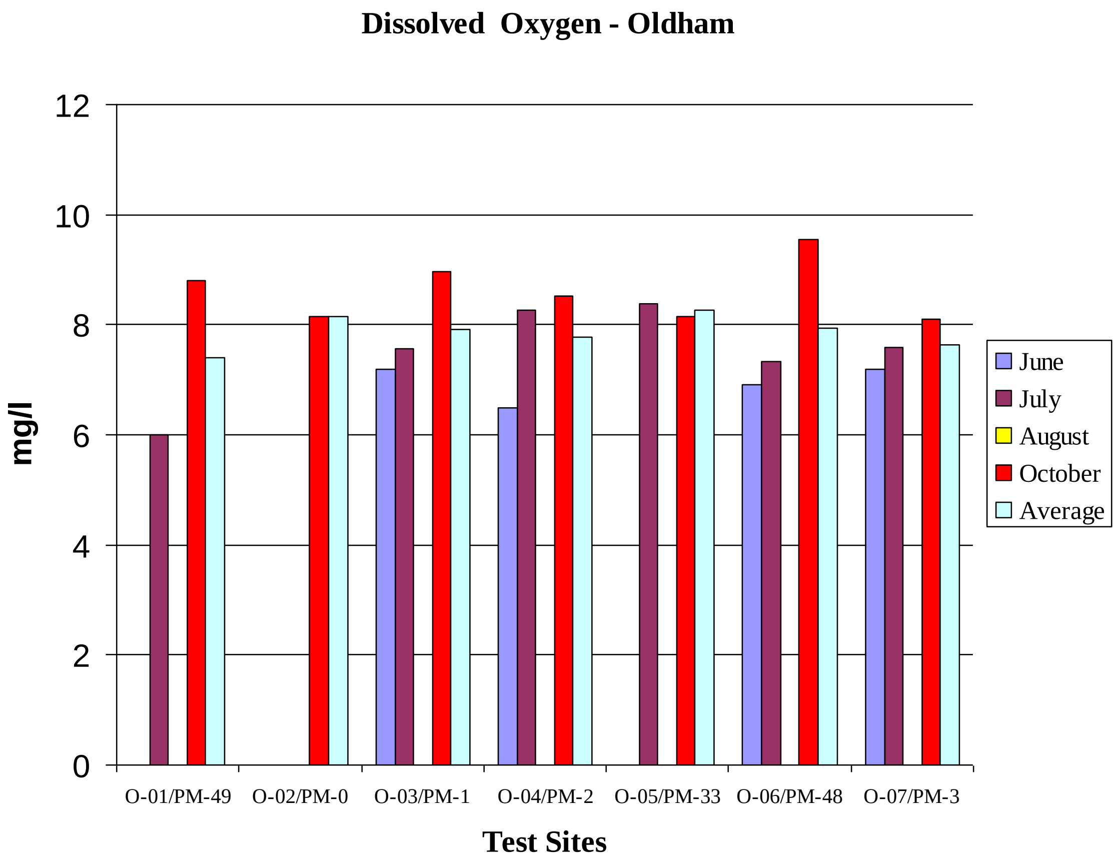

Nitrogen Averages
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
mg/l
Bad
Good
May
July
August
October
November
Average
Months
Oldham 2005
Oldham 2006
Furnace 2005
Furnace 2006
Stetson 2005
Stetson 2006

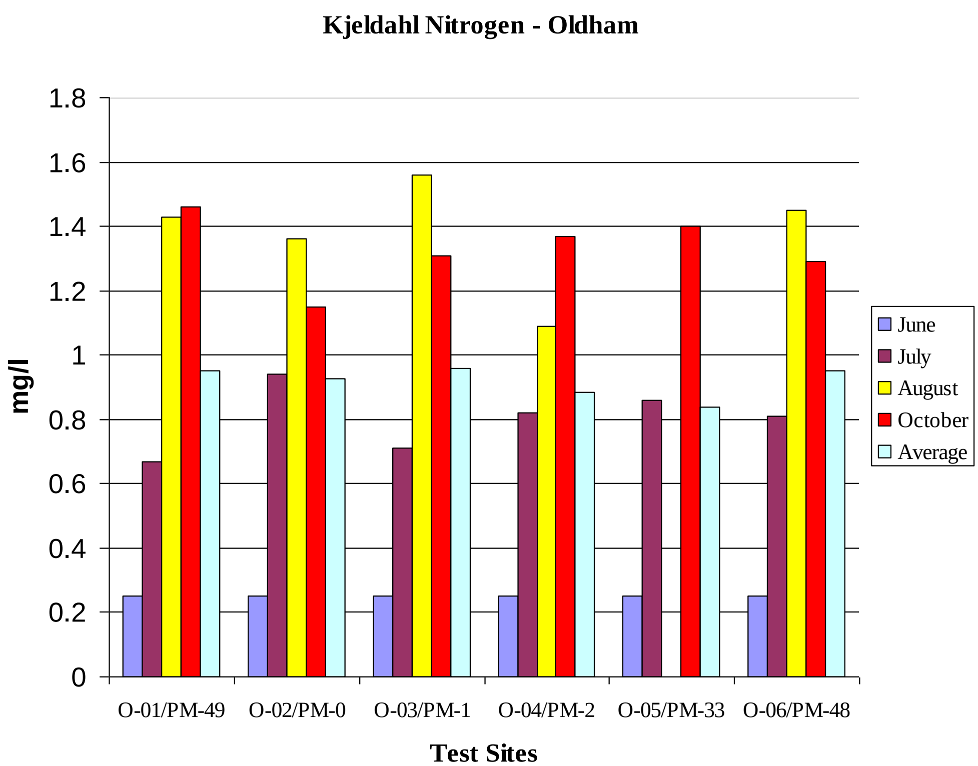

Turbidity - Oldham
NTU
35
30
25
20
15
10
5
0
June
July
August
October
Average
Bad
Good
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
Test Sites

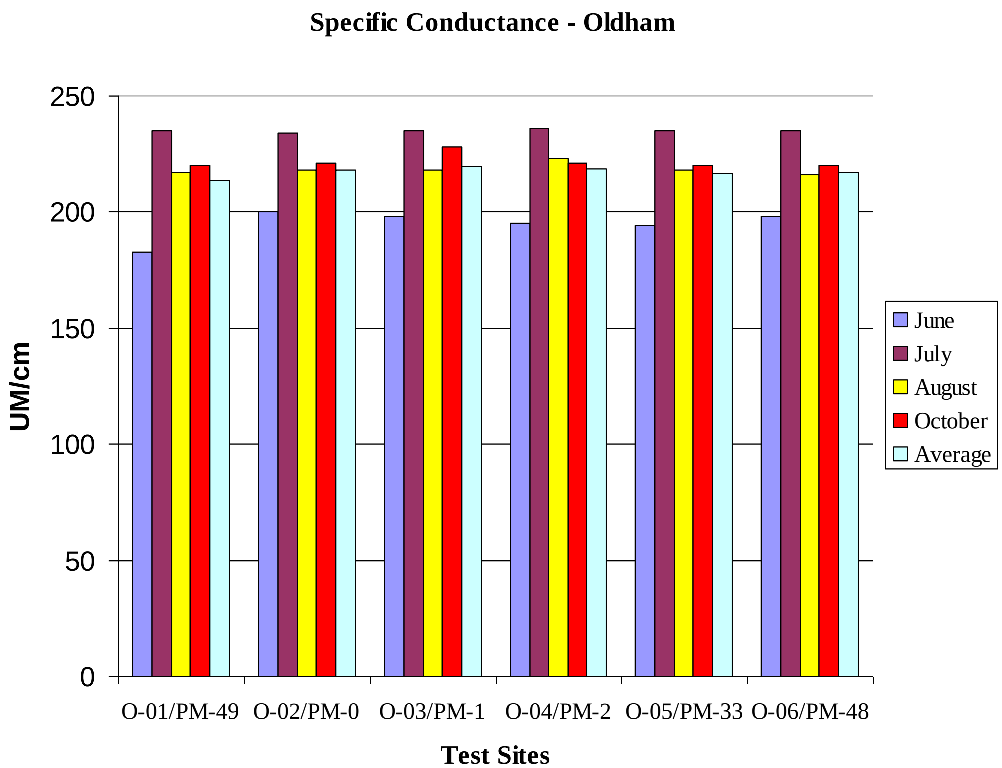

pH - Oldham
10
9
8
7
6
5
4
3
2
1
0
June
July
August
October
Average
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
Test Sites

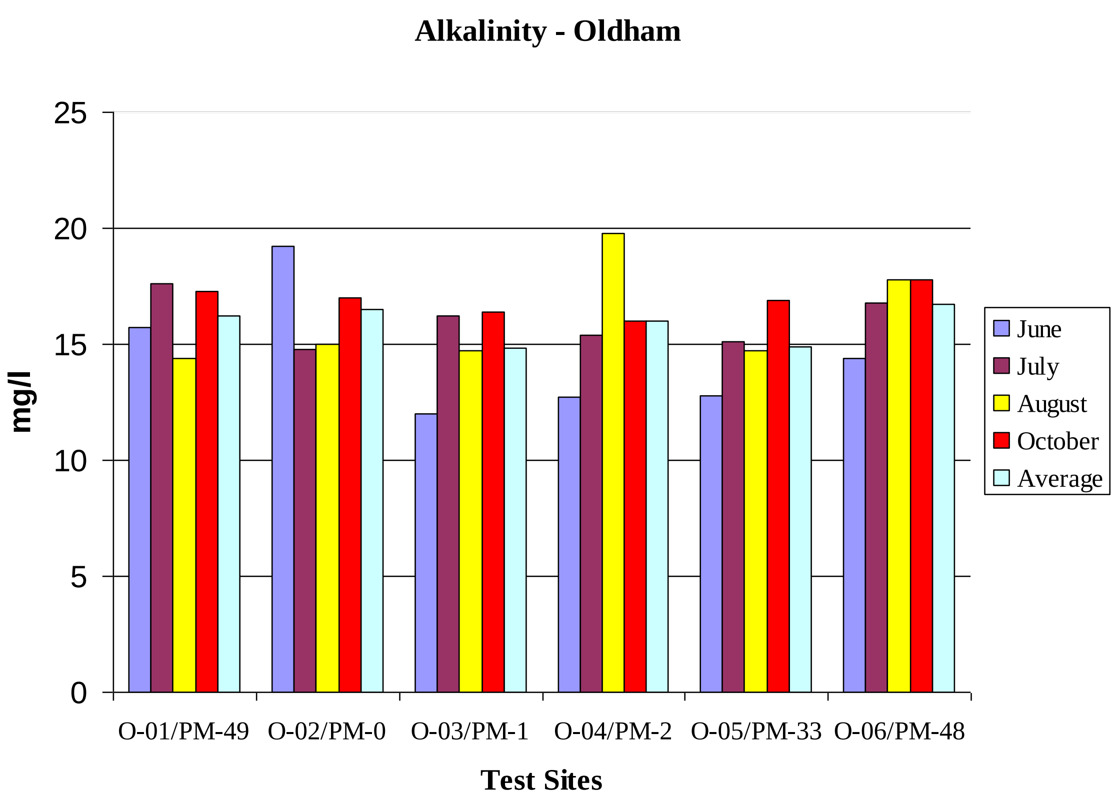

Total Phosphorus - Oldham
All acceptable @ < 0.1 mg/l
mg/l
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
Test Sites
June
July
August
October
Average

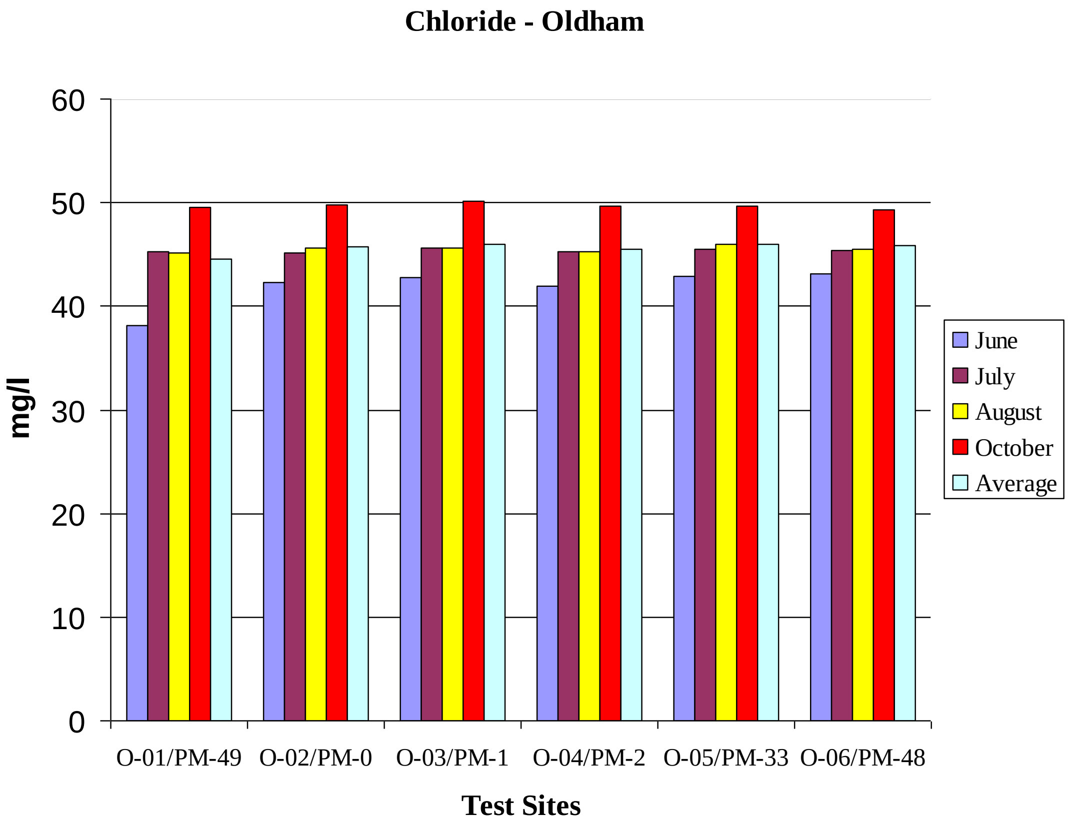

Total Nitrogen - Oldham
All acceptable @ < 2.0 mg/l
mg/l
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
Test Sites
June
July
August
October
Average

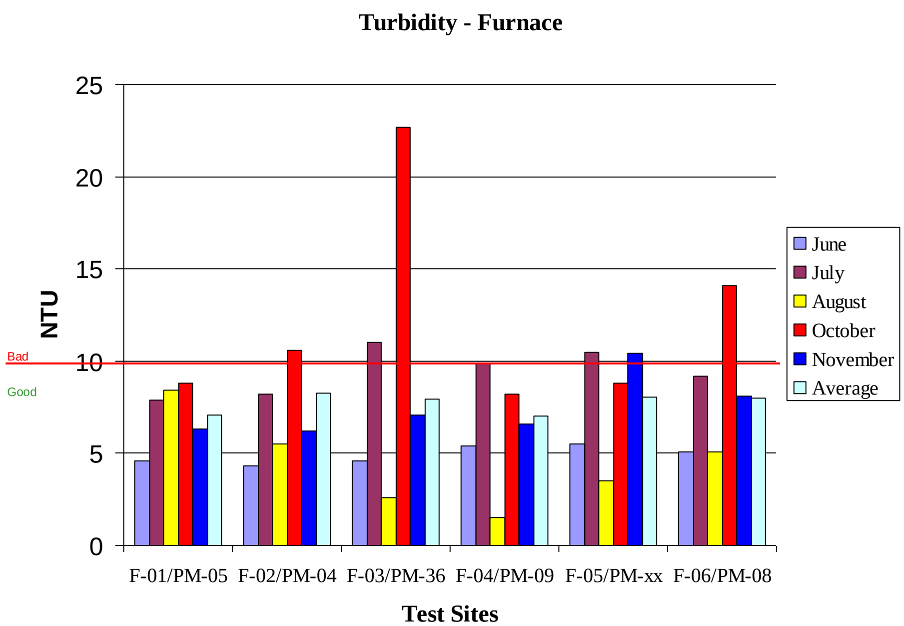

Dissolved Oxygen - Oldham
12
10
8
6
4
2
0
mg/l
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
O-07/PM-3
Test Sites
June
July
August
October
Average

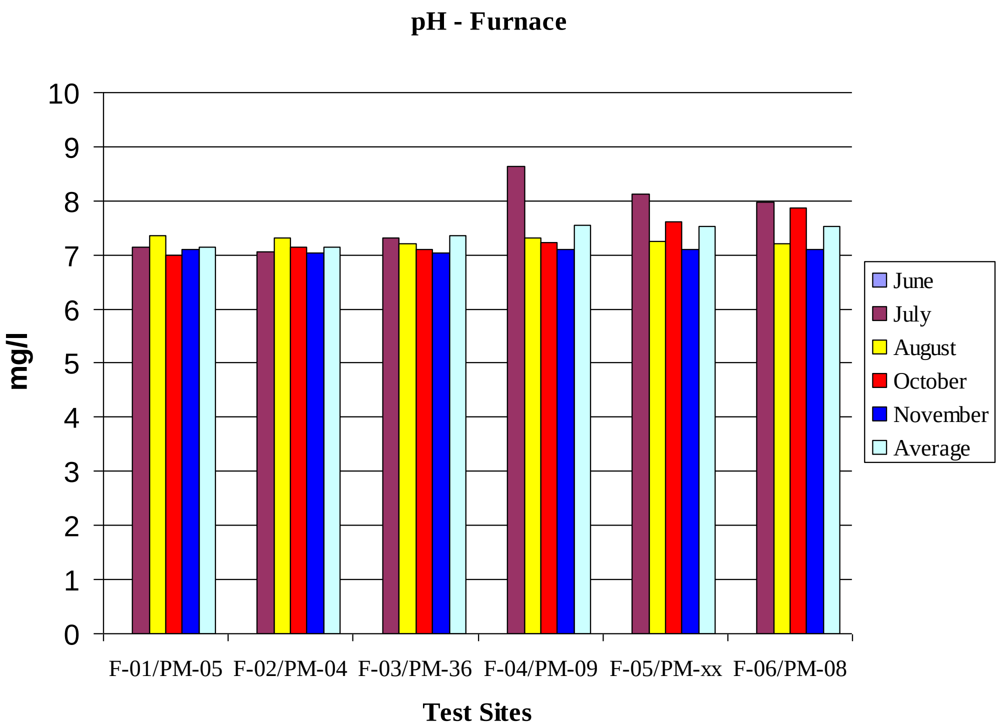

Kjeldahl Nitrogen - Oldham
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
mg/l
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
Test Sites
June
July
August
October
Average


Specific Conductance - Oldham
250
200
150
100
50
0
UM/cm
June
July
August
October
Average
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
Test Sites

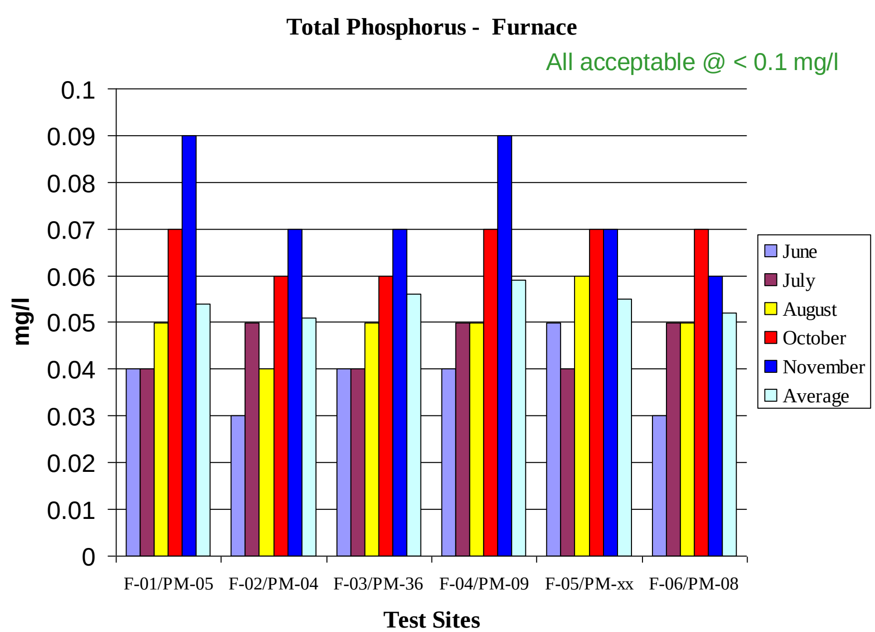

Alkalinity - Oldham
25
20
15
10
5
0
mg/l
June
July
August
October
Average
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
Test Sites


Chloride - Oldham
60
50
40
30
20
10
0
mg/l
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
Test Sites
June
July
August
October
Average


Turbidity - Furnace
25
20
15
10
5
0
NTU
Bad
Good
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08
Test Sites
June
July
August
October
November
Average

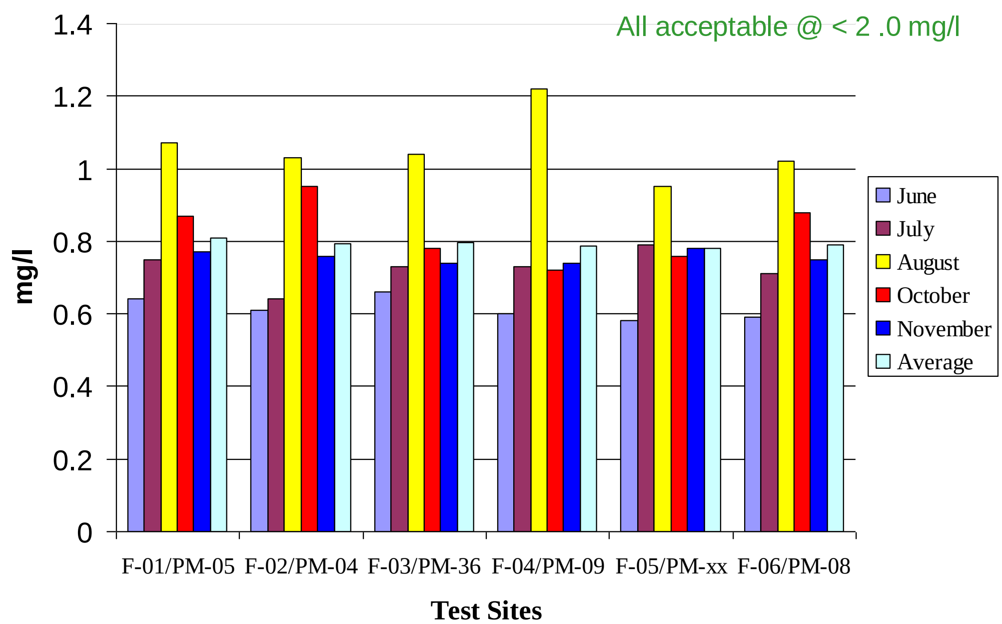


pH - Furnace
10
9
8
7
6
5
4
3
2
1
0
mg/l
June
July
August
October
November
Average
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08
Test Sites

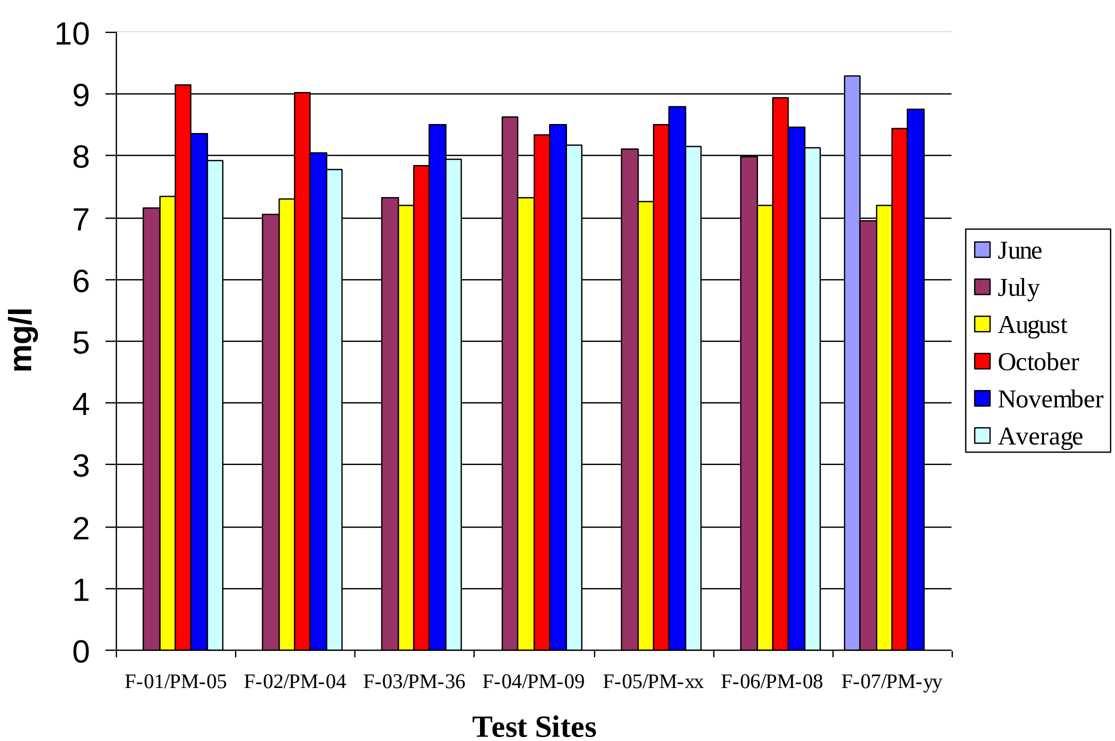


Total Phosphorus - Furnace
All acceptable @ < 0.1 mg/l
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
mg/l
June
July
August
October
November
Average
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08
Test Sites

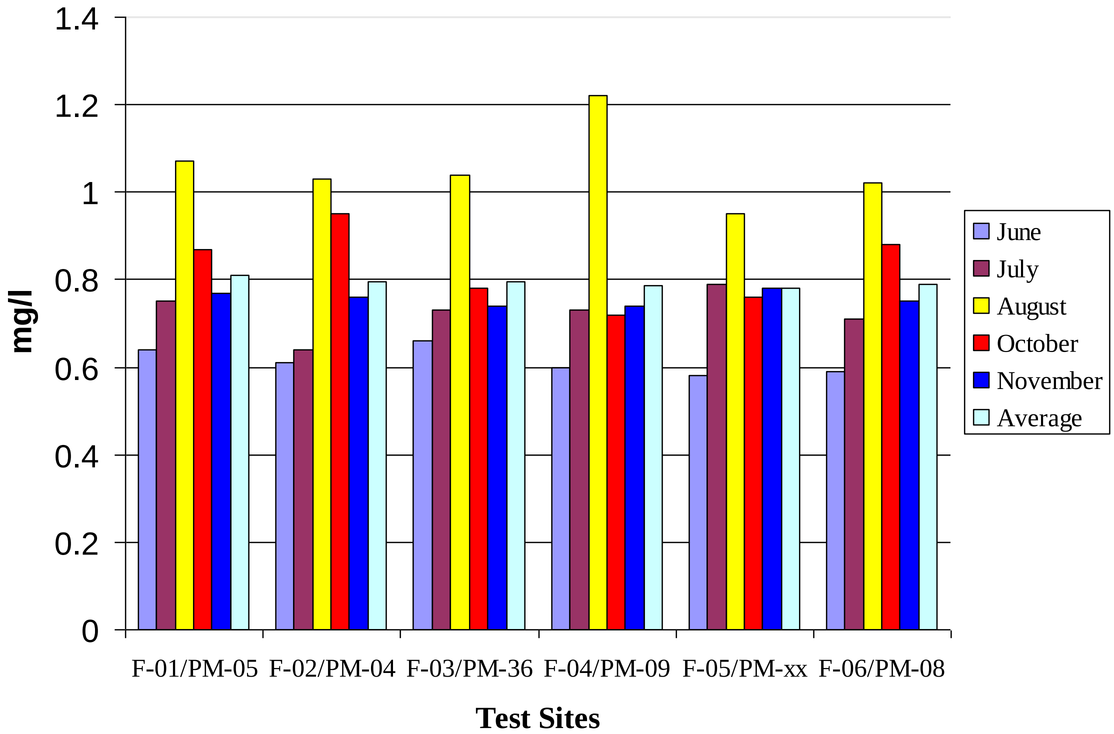
Total Nitrogen - Furnace



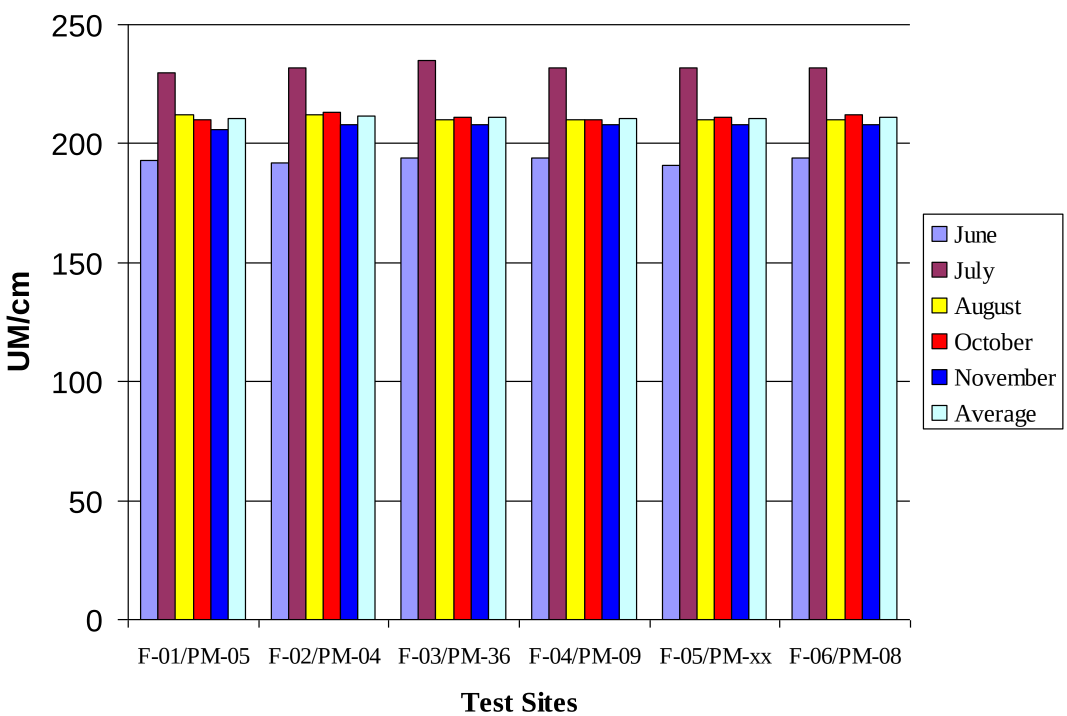
Dissolved Oxygen - Furnace



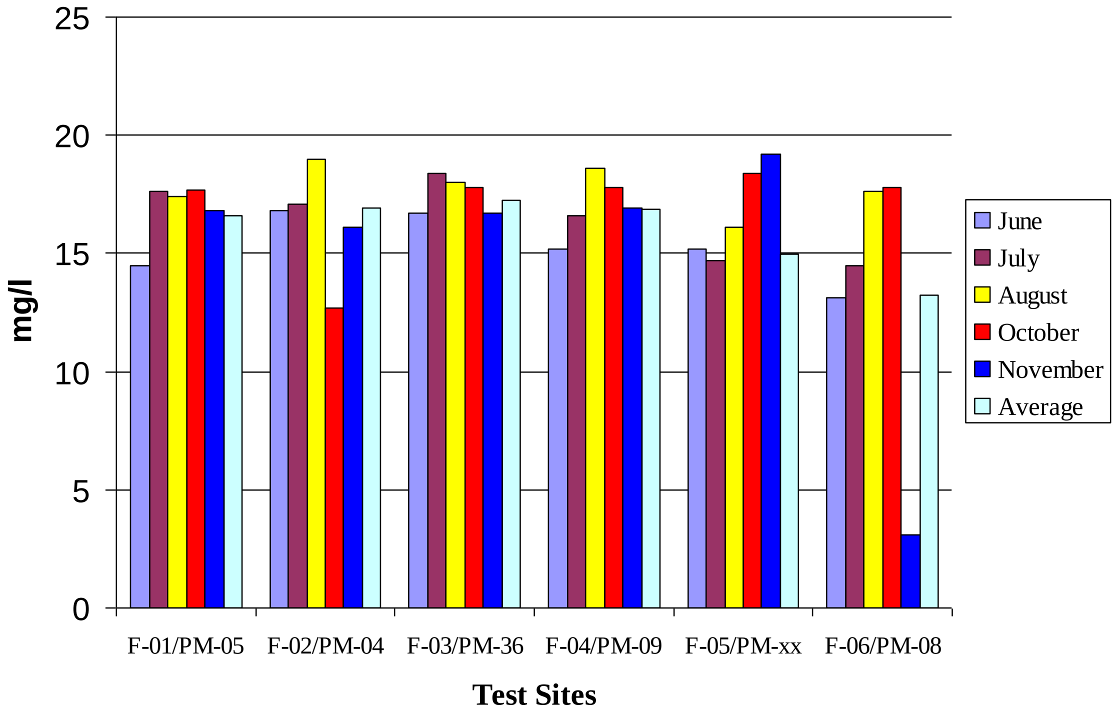
Kjeldahl Nitrogen - Furnace



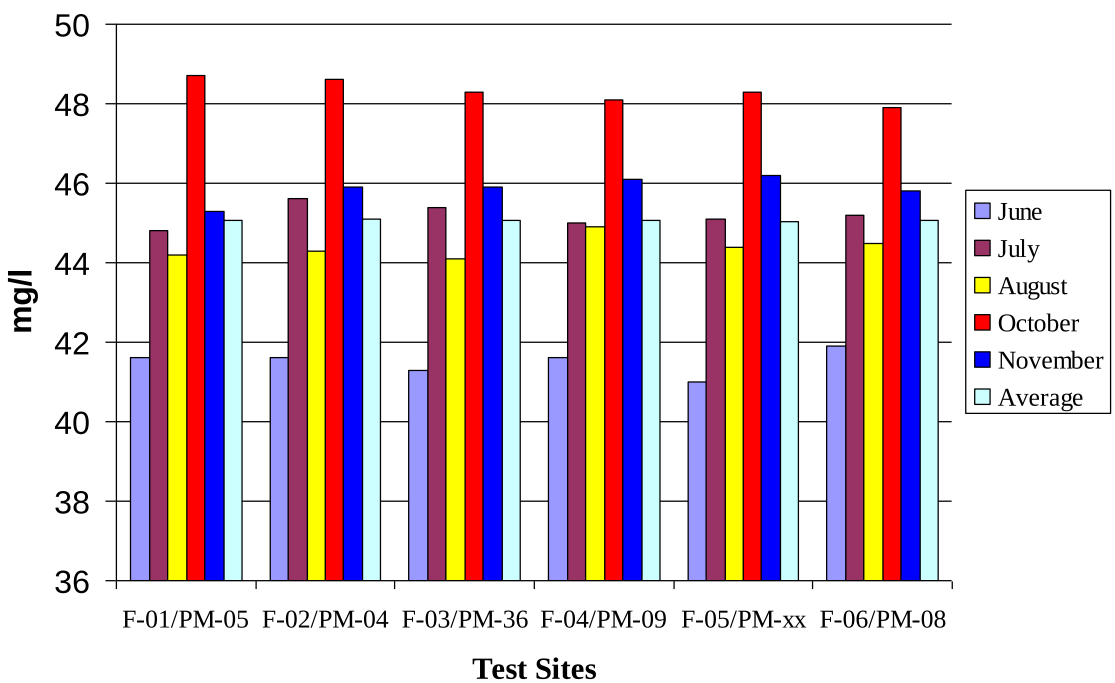
Specific Conductance - Furnace

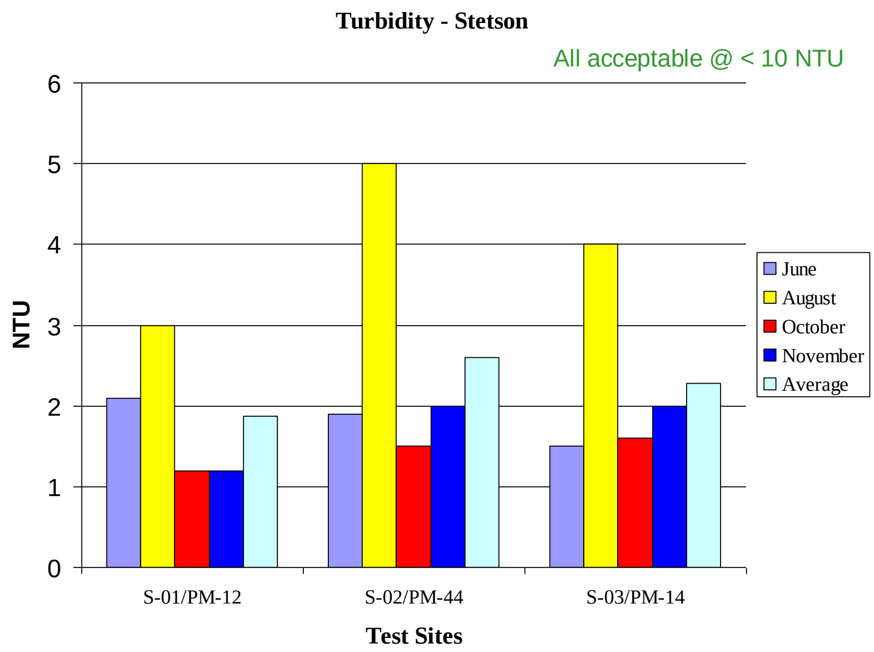


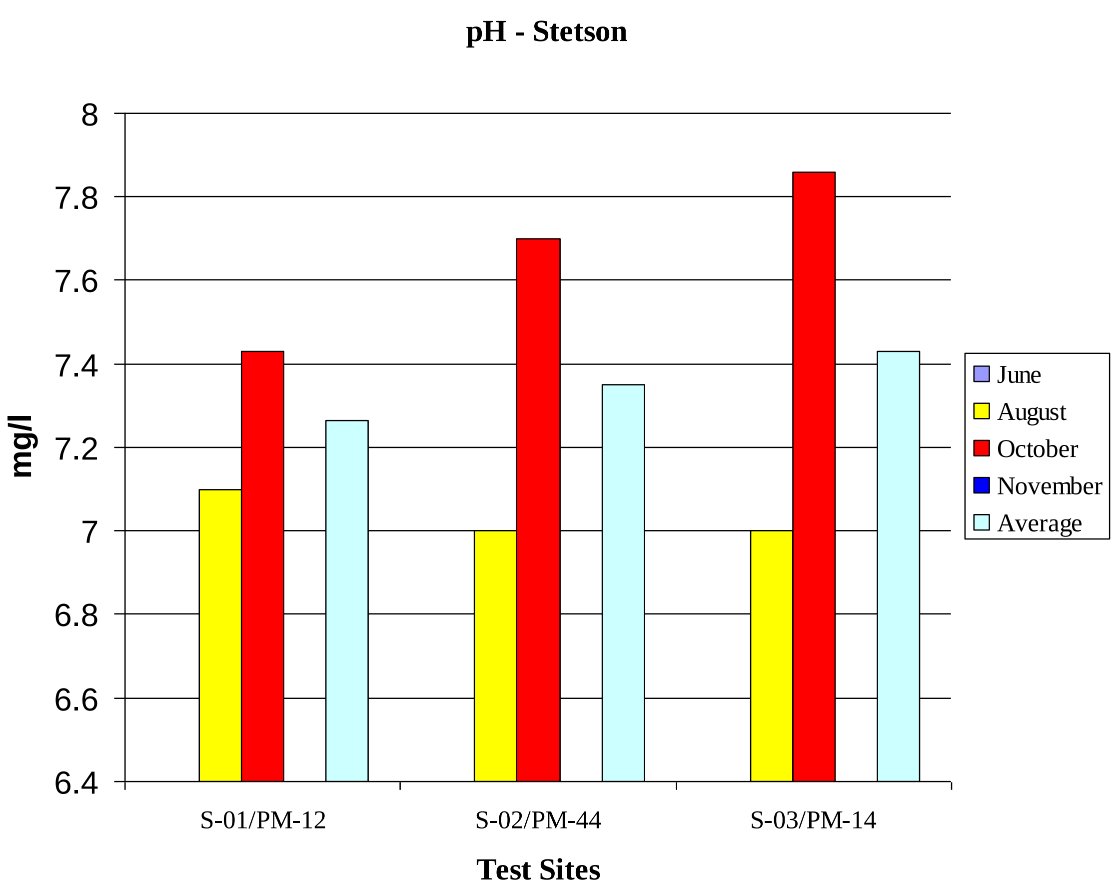
Alkalinity - Furnace

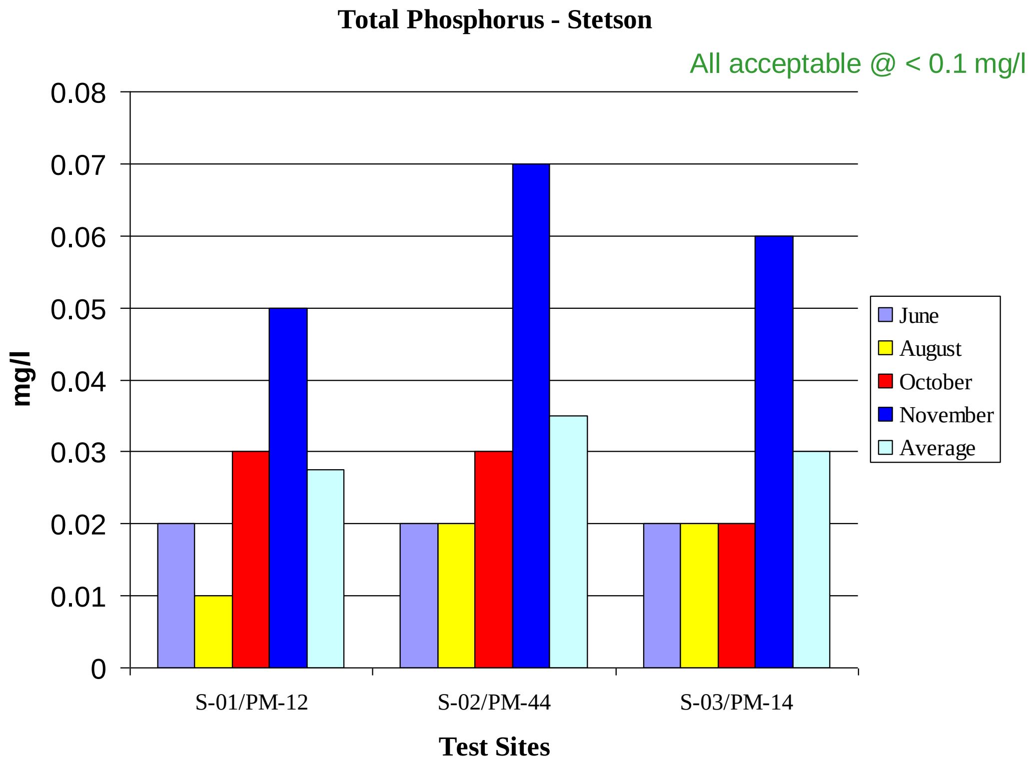


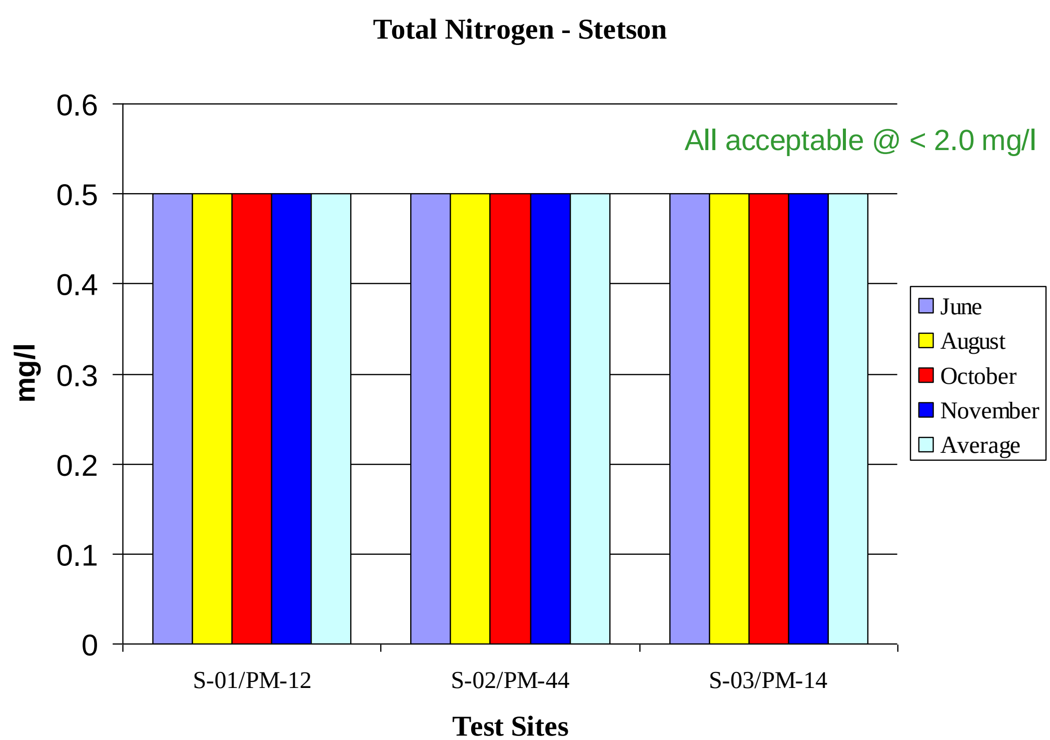
Chloride - Furnace

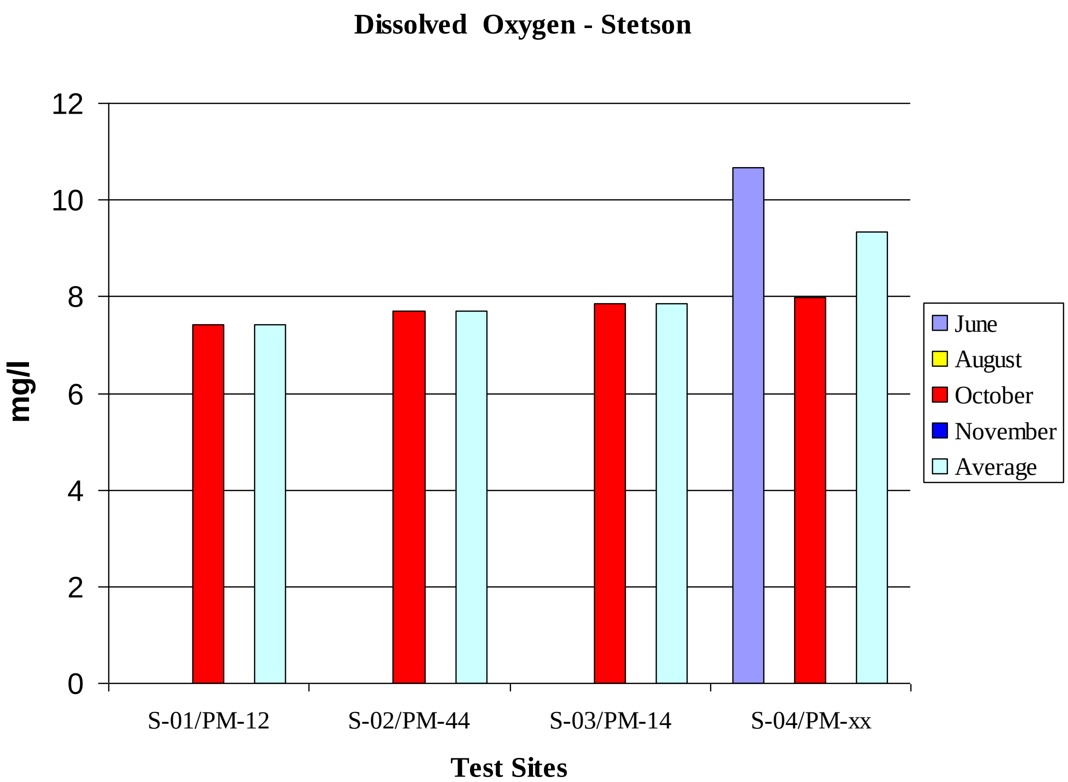


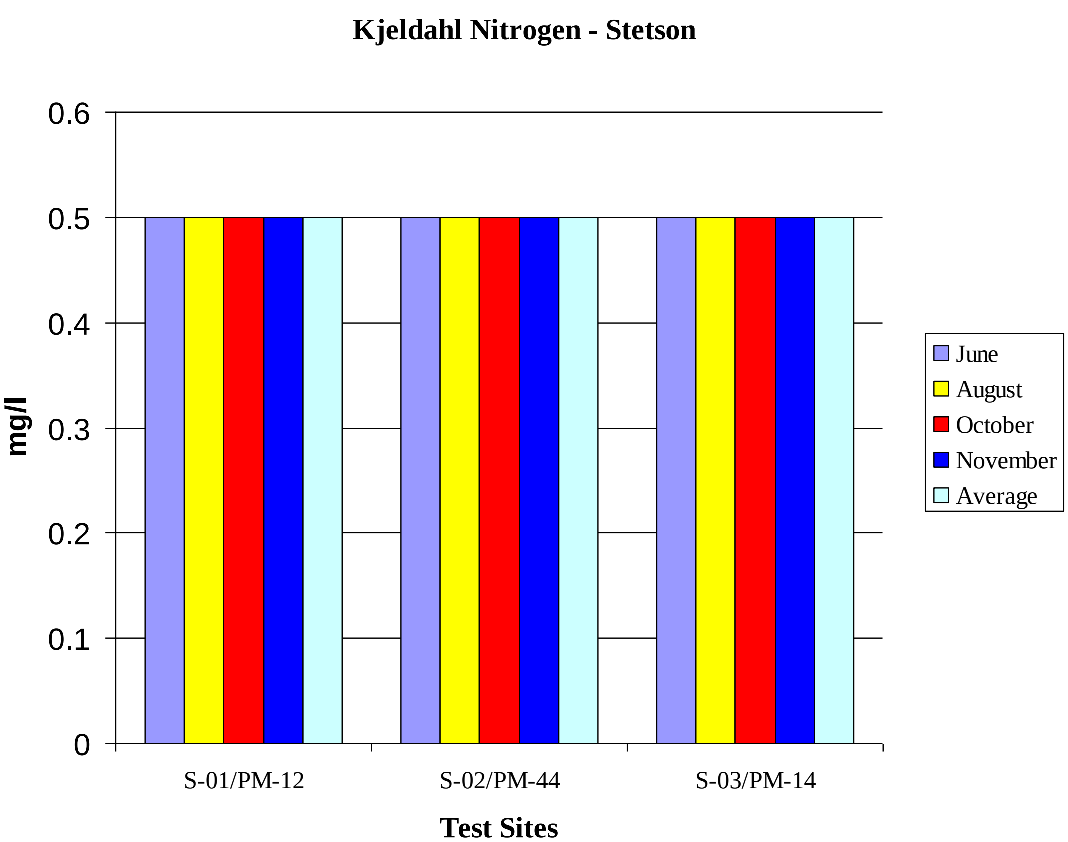

Turbidity - Stetson
All acceptable @ < 10 NTU
NTU
6
5
4
3
2
1
0
June
August
October
November
Average
S-01/PM-12
S-02/PM-44
S-03/PM-14
Test Sites


pH - Stetson
mg/l
8
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
June
August
October
November
Average
S-01/PM-12
S-02/PM-44
S-03/PM-14
Test Sites

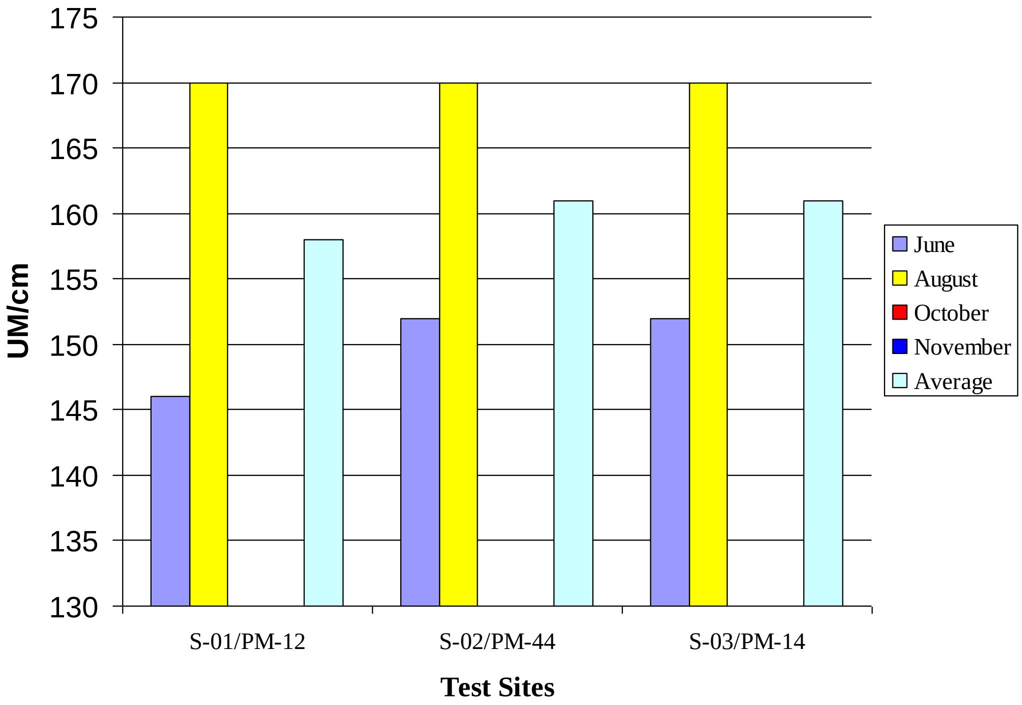

Total Phosphorus - Stetson
All acceptable @ < 0.1 mg/l
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
mg/l
June
August
October
November
Average
S-01/PM-12
S-02/PM-44
S-03/PM-14
Test Sites


Total Nitrogen - Stetson
All acceptable @ < 2.0 mg/l
0.6
0.5
0.4
0.3
0.2
0.1
0
mg/l
June
August
October
November
Average
S-01/PM-12
S-02/PM-44
S-03/PM-14
Test Sites

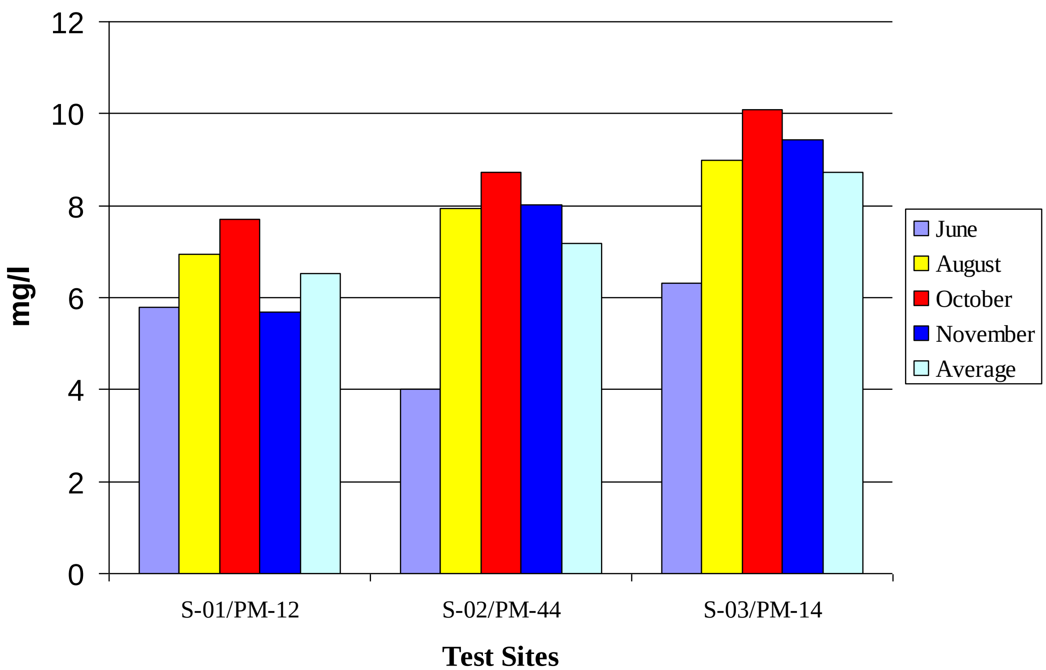

Dissolved Oxygen - Stetson
12
10
8
6
4
2
0
mg/l
S-01/PM-12
S-02/PM-44
S-03/PM-14
S-04/PM-xx
Test Sites
June
August
October
November
Average


Kjeldahl Nitrogen - Stetson
0.6
0.5
0.4
0.3
0.2
0.1
0
mg/l
S-01/PM-12
S-02/PM-44
S-03/PM-14
Test Sites
June
August
October
November
Average

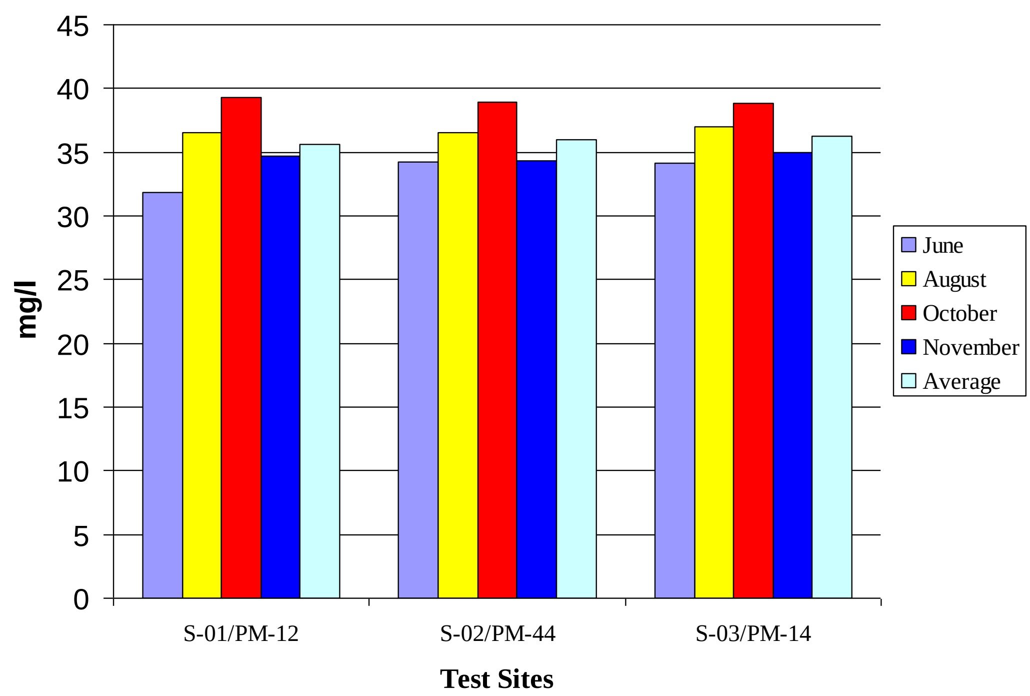
Specific Conductance - Stetson



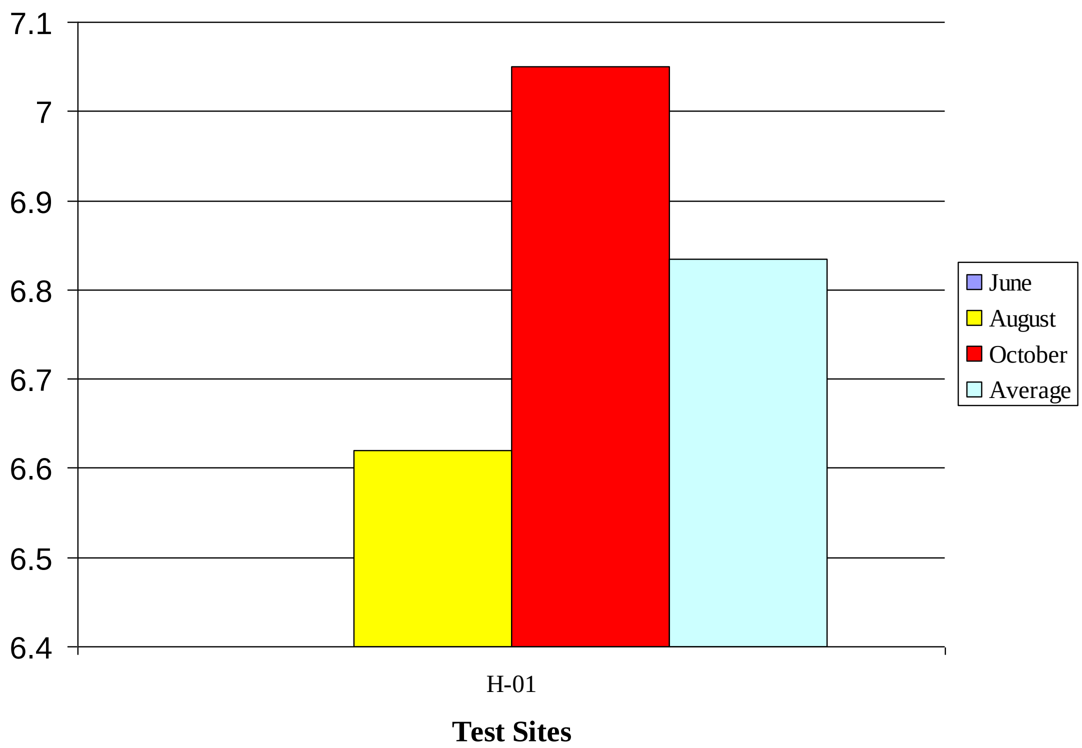
Alkalinity - Stetson

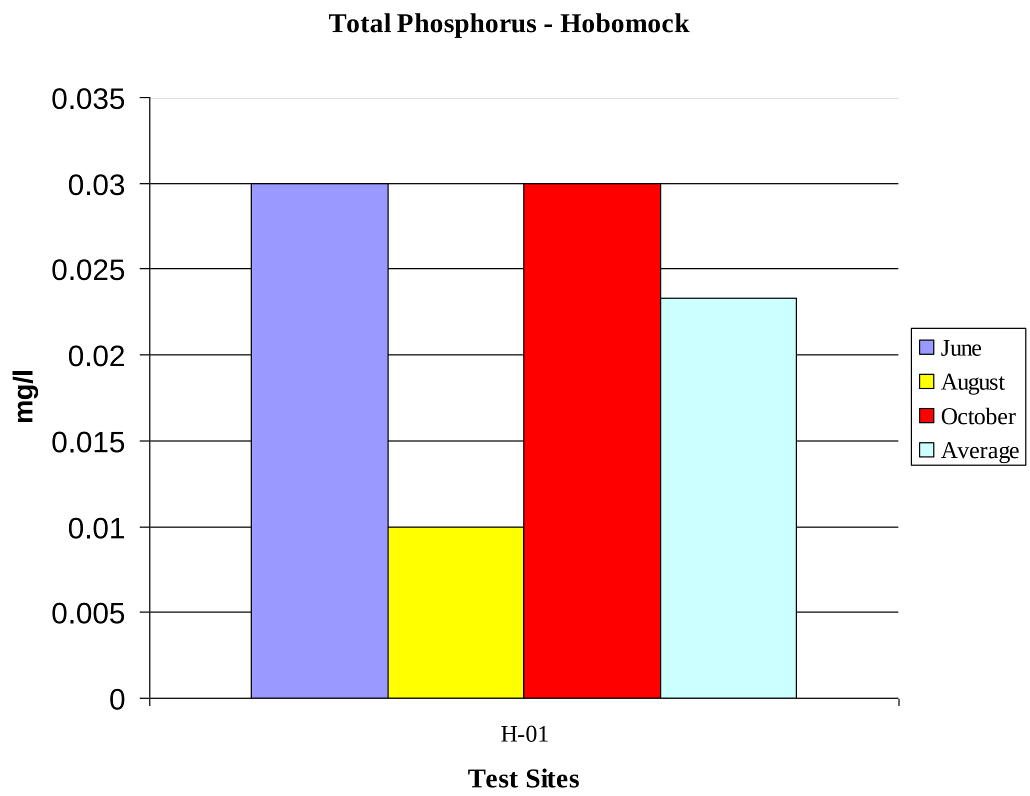


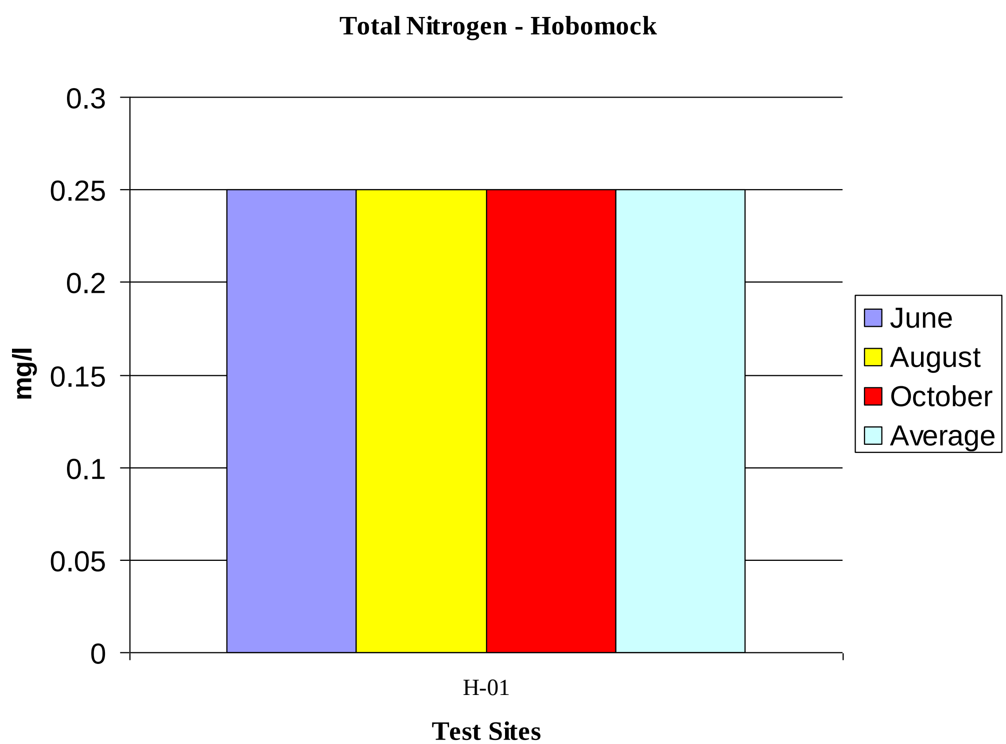
Chloride - Stetson

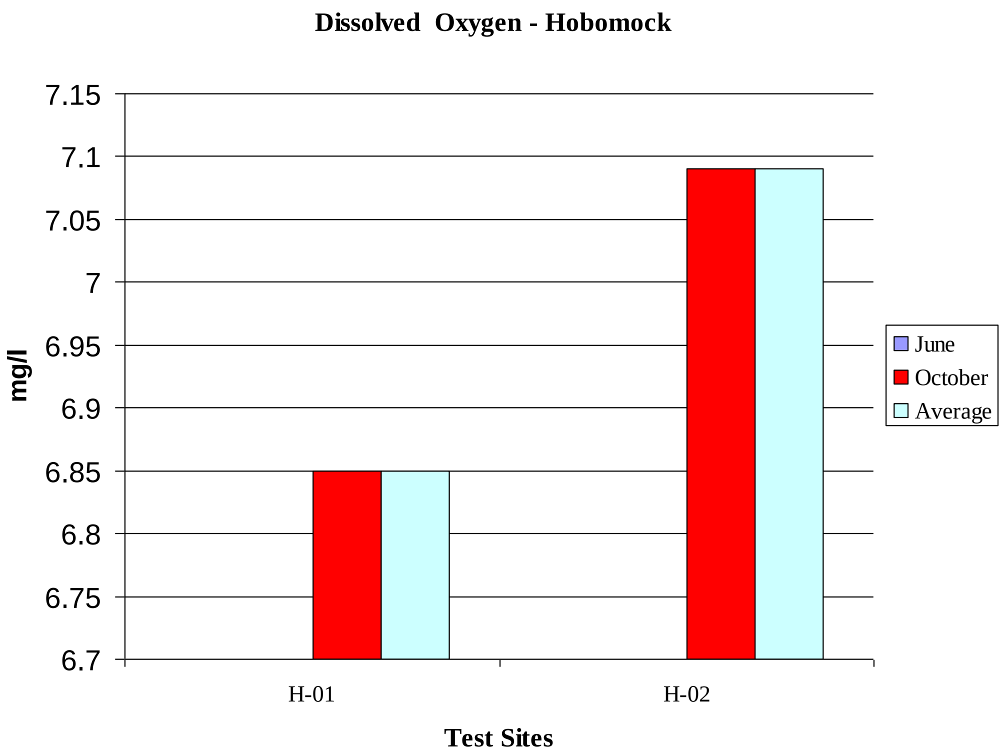


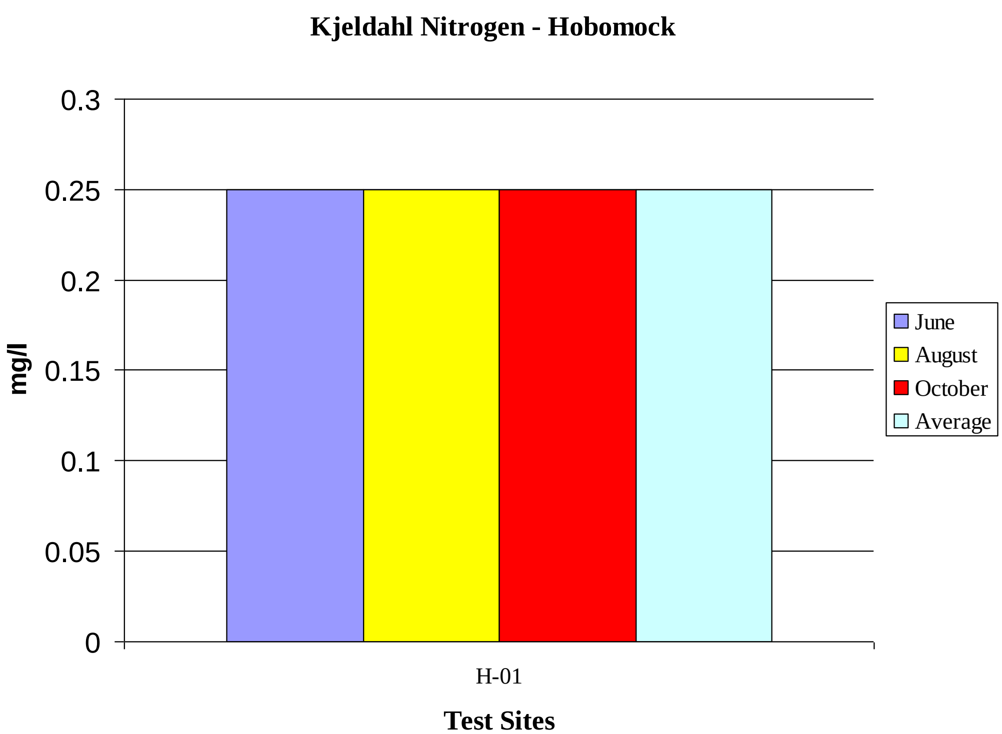
pH - Hobomock



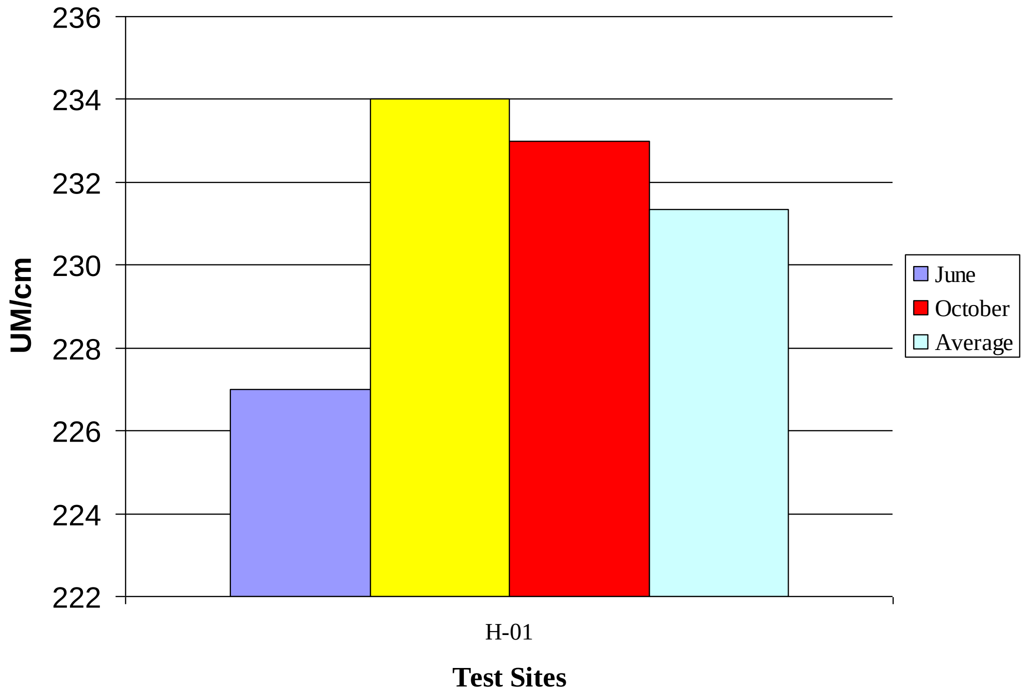

Total Phosphorus - Hobomock
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
mg/l
June
August
October
Average
H-01
Test Sites


Total Nitrogen - Hobomock
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/l
June
August
October
Average
H-01
Test Sites

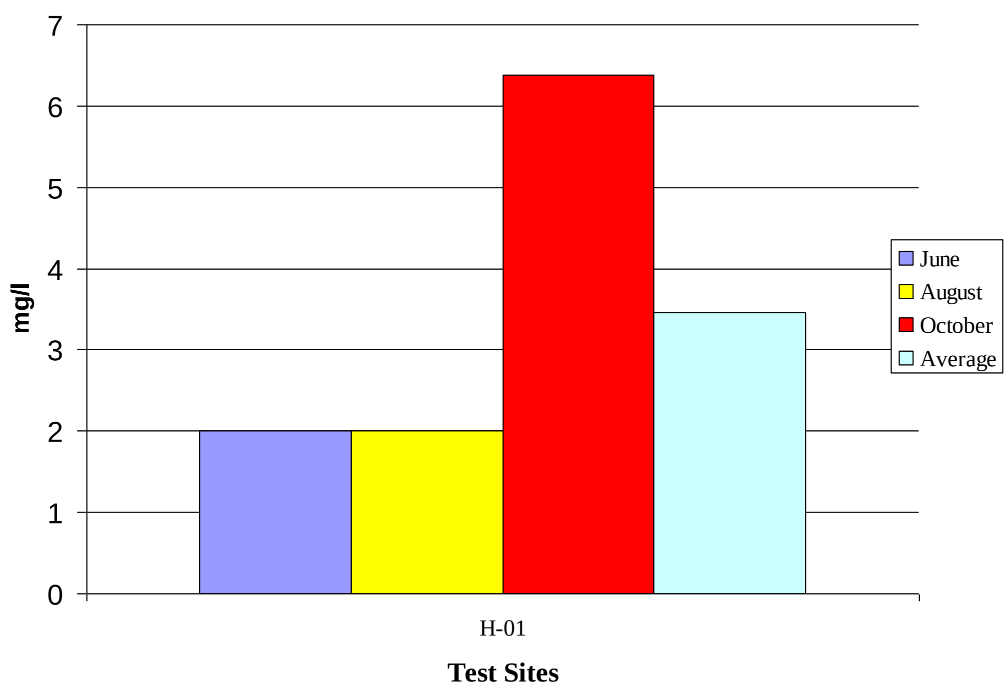

Dissolved Oxygen - Hobomock
7.15
7.1
7.05
7
6.95
6.9
6.85
6.8
6.75
6.7
mg/l
H-01
H-02
Test Sites
June
October
Average

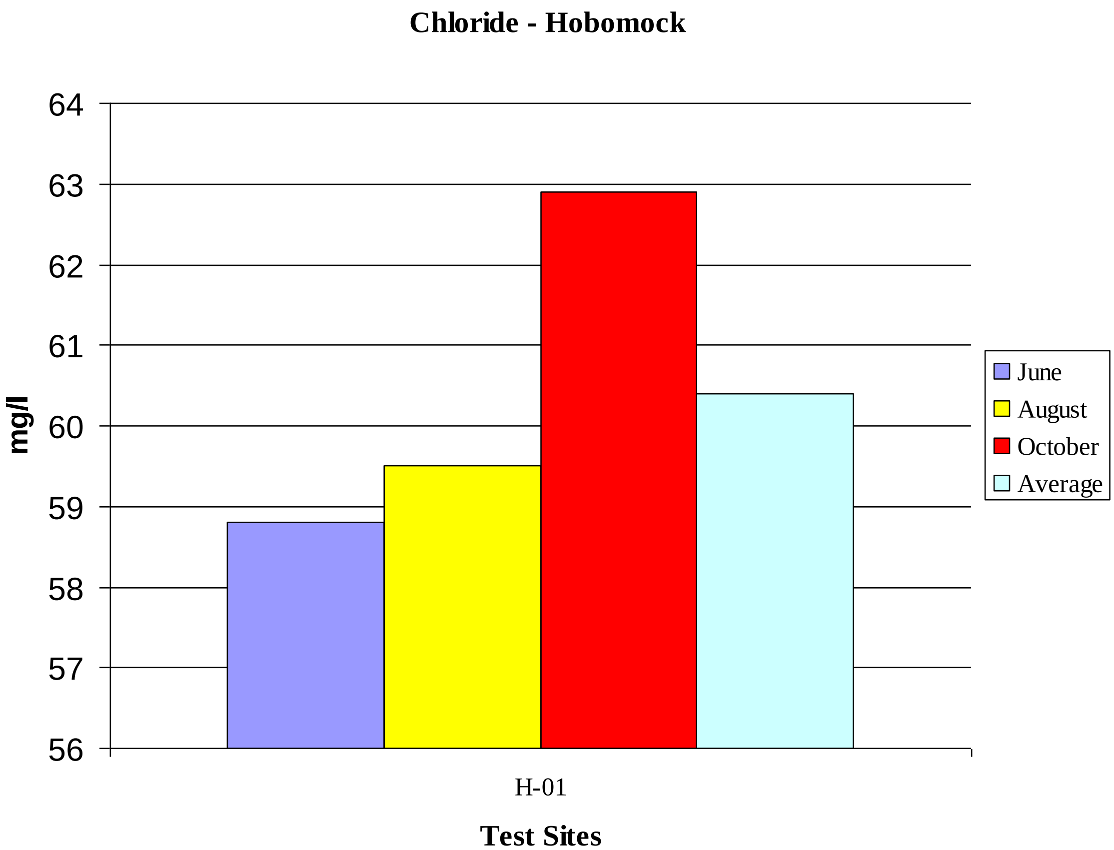

Kjeldahl Nitrogen - Hobomock
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/l
H-01
Test Sites
June
August
October
Average

Specific Conductance - Hobomock



Alkalinity - Hobomock




Chloride - Hobomock
64
63
62
61
60
59
58
57
56
mg/l
June
August
October
Average
H-01
Test Sites

Summary of 2006 results:

Physical Characteristics of Pond water:

During the summer months we recorded the presence of algae at testing sites:

- Furnace: July-5%, August – 100%, October >75% , November:1 site >75% and the remaining sites 10 – 25%
- Oldham: July 5-10%, August 5-25%, October > 75%
- Stetson: 10%- 15% in October
- Hobomock: None

Furnace had 1 documented site in August with blue-green algae (toxic), and all sites producing either a thin or very thick 100% green coating.

Oldham Pond had extensive heavy weed growth in shallow water during the latter months. Test sites were relocated a considerable distance to avoid testing in heavy weeds. Algal blooms were primarily surface level.

Furnace Pond had water temperatures exceeding 85 degrees at multiple sites in August, with excessive algae growth. The high temperatures were due to a lack of overhead canopy that is usually provided by trees and an average depth of less than 5 feet.

Stetson experienced a proliferation of filamentous algae which was released to the surface in October after the return of bog effluent into the pond. This was a new algal finding in Pembroke ponds.

Physical findings demonstrate continued Eutrophication of Furnace and Oldham ponds, with extensive algae blooms, and additional impacts observed in Furnace and Stetson in the fall, relating to Bog effluent returns.

Chemical Findings:

All of the ponds exhibit some degree of water quality disturbance, however, Furnace and Oldham ponds continue to show deterioration and require immediate attention.

The primary problems found through chemical testing were:

- elevated turbidity
- low Secchi disc readings
- Excessive weed growth in shallow waters, especially on Oldham
-

Summary of three year trends of Chemical and Physical Analysis of Water Quality for the 5 Pembroke Ponds:

Recommendations: Furnace Pond

- Furnace is a category 5 severely impaired pond, with 10 feet of muck holding a tremendous amount of reactive phosphorus. This means that even with no additional source of phosphorus the pond will continue to deteriorate rapidly.

- Furnace experienced extensive algae blooms, weed overgrowth, invasive species of weeds, intermittent low dissolved oxygen levels (with 2 major fish kills in 2004, none in 2005or 2006), further loss of depth (average depth 5 feet, max depth 8.5 feet), increased temperature which impairs the fish habitat.

- Gorham Mill pond, the Furnace pond outlet, has become a shallow, algae and weed choked swamp, evidenced by the increase in amphibious species, minimal fish, and high mosquito breeding areas due to stagnation. This is the fate of Furnace Pond within a very short time unless action is taken to restore the depth, remove the phosphorus sources (muck, non-point source and bog effluent), increase the buffer zones, and insist on best management practices (street sweeping, storm drain management) around the pond and in the watershed.

- Loss of Furnace Pond will result in loss of recharging some of the wells upon which our drinking water supply is maintained, the ultimate loss of Oldham which drains into Furnace, loss of tax revenue from waterfront property, health issues related to mosquito infestations, the loss of the Herring run which is dependent upon a continuous water connection from Oldham to the Herring run, and bog water use, and a major recreational resource to the town of Pembroke.

- It is our continued recommendation that Furnace Pond and Gorham Mill Pond be dredged, and per the recommendations from the 1993 feasibility study and our current findings, this is absolutely necessary for the survival of these ponds.

- Long term monitoring of land based and water based water quality will be paramount to determine the success of the action plan to restore and preserve Furnace Pond.

Recommendations: Oldham Pond:

- Oldham Pond is a category 4 impaired pond, and is experiencing significant Eutrophication. Chemical analysis of the water demonstrated some sites with water quality in worse condition than Furnace. Oldham has greater depth and water volume, which probably explains why the pond has not demonstrated the degree of algae blooms or biological degradation found in Furnace. The muck is as deep, and has high loads of reactive phosphorus, which is the primary phosphorus source, along with old northeast cranberry bog streams. Camp Pembroke re-engineered its septic system and that source of pollution shouls no longer exist. Oxygen levels have been a problem, and in 2004 there were fish kills on Oldham. Non-point source contamination needs to be addressed, particularly with storm drain management, beach erosion and drainage, and need for buffer zones in public areas.

- In 2006 Oldham pond did not have high levels of nutrients, however the pond was overcome with heavy weed growth in almost all shallow areas

- The survival of Oldham is also dependent on restoration of Furnace. Loss of Oldham would be tragic, resulting in loss of a primary recreational resource for the community, loss of the Herring spawning site, tax revenues from water-front homes, loss of some of Pembroke's wells that would not be recharged, and a habitat for many species.

- It is our recommendation that following the dredging of Furnace, that some form of dredging must follow on Oldham Pond for both Furnace and Oldham to survive and as the most cost effective long term solution to restoration.

- Long term monitoring of both land based and water based testing of the ponds is mandatory to determine the success of actions taken to restore and preserve Oldham and Furnace Ponds. Therefore we recommend chemical testing at a regular interval for the foreseeable future.

Recommendations: Stetson, Little Sandy Bottom, and Hobomock Ponds:

- Stetson Pond: results demonstrate that Stetson has relatively good depth and clarity, and has one large source of phosphorus loading that must be checked: the cranberry bog effluent that is returned to Stetson in the fall. Utilization of best management practices to reduce non-point source pollution particularly among homeowners, improvement in storm drain management, and management of the cranberry bog effluent would keep Stetson in good shape. Close monitoring for invasive weeds is important.

- Little Sandy Bottom Pond: 2005 results show that the pond is in good shape, and needs a preservation plan to keep it that way. The removal of the bog effluent a few years ago has improved the water quality results (comparing 1993 to current test results), showing that reducing phosphorus loading can improve water quality. Little Sandy Bottom Pond needs buffer zones put in at route 27 and the old beach front area and attention to best management practices, storm drains, and run-off.

- Hobomock: results show that water quality is good, but weeds are over-abundant and clarity is a problem. Best management practices, close monitoring for invasive weeds, and possibly weed application may be needed for preservation. This pond needs monitoring, and no action is recommended at this time.

Goals for 2007:

- Complete a QAPP to validate our methods and processes of measuring water quality and utilize our results in obtaining grant money to fund restoration projects.
- Utilize funding from a grant submitted by NSRWA to create a rain garden at Oldham Pond town landing and build a kiosk to promote water quality education.
- Reduce the number of testing sites, if feasible, based on QAPP.
- Begin a storm drain project: location by GPS, assess condition, and stencil. Our 2007 goal is to complete the circumference of Furnace pond.
- Collaborate with CEI and the DPW in a dredging feasibility study of Furnace Pond, planned to start in April 2007.

Pembroke Watershed Association Water Quality Team, 2005-2006

Co-Chairs of Water Quality Committee: Charlie Banks and Patti McCabe

Pond Captains:

Furnace: Patti McCabe
Oldham: Charlie Banks
Little Sandy Bottom: Arthur Boyle
Stetson: Jim McClarnon and Fred Baker.

Certified instructors for volunteer water quality training:
Jerry Fusco, Charlie Banks, Patti McCabe, Jim McClarnon, Deb Tranberg

Certified volunteer water samplers: 5 Instructors and 22 Volunteers

- Oldham Pond
  - Charlie Banks
  - Hal Johnson
  - Dudley Sepeck
  - Robert Buckley
  - Peter Metcalf
  - Norm Shepherd
  - Ray Palumbo
- Furnace Pond
  - Jerry Fusco
  - Patti McCabe
  - Chuck McCabe
  - Ray Holman
  - Scott MacInnes
  - Brian Shea
  - Deb Tranberg
  - Erin Sullivan
- Stetson Pond
  - Robert Shannon
  - Mitchell Cahill
  - Fred Baker
  - David Spaulding
  - Jim McLarnon
  - Mitch Cahill
- Little Sandy Bottom Pond
  - Arthur Boyle
  - Steven Downing
  - Becky Paul
- Hobomock Pond
  - Howard League
  - Andy Key
  - Jason Potrykus

Storm Drain Stencil Project:

- Patti McCabe, Scotty MacInnes, Cindy Champagne: Furnace
- Mitch Cahill: Stetson
- Andy Key and Miles Prescott: Hobomock
- Kathy Hanson: Oldham

Addendum - Raw data
Oldham Pond

Oldham

pH			(S.U)	DET	0.14	
	June	July	August	October		Mean
O-01/PM-49		7.41	8.92	8.01		6.085
O-02/PM-0		8.41	9.02	7.69		6.28
O-03/PM-1		8.83	9.22	7.99		6.51
O-04/PM-2		8.94	9.01	7.72		6.4175
O-05/PM-33		8.96	8.95	7.76		6.4175
O-06/PM-48		8.72	8.14	8.85		6.4275

Turbidity		NTU	DET	0.25	
	June	July	August	October	Mean
O-01/PM-49	4.4	8	7.7	32.5	13.15
O-02/PM-0	2.7	24.6	8.7	17.6	13.4
O-03/PM-1	2.4	7.6	13.3	14	9.325
O-04/PM-2	2	8.2	11.7	17	9.725
O-05/PM-33	3	8.9	11.8	27.5	12.8
O-06/PM-48	2.6	17.3	5.3	21.3	11.625

Phosphorus, Total		(ug/l)	DET	0.01	
	June	July	August	October	Mean
O-01/PM-49	0.03	0.04	0.06	0.09	0.055
O-02/PM-0	0.05	0.03	0.05	0.07	0.05
O-03/PM-1	0.04	0.04	0.05	0.06	0.0475
O-04/PM-2	0.03	0.04	0.05	0.08	0.05
O-05/PM-33	0.03	0.05	0.04	0.09	0.0525
O-06/PM-48	0.04	0.04	0.06	0.08	0.055

Total Nitrogen		(mg/l)	DET	0.5	
	June	July	August	October	Mean
O-01/PM-49	0.5	0.67	1.43	1.46	1.015
O-02/PM-0	0.5	0.94	1.36	1.15	0.9875
O-03/PM-1	0.5	0.71	1.56	1.31	1.02
O-04/PM-2	0.5	0.82	1.09	1.37	0.945
O-05/PM-33	0.5	0.86	1.28	1.4	1.01
O-06/PM-48	0.5	0.81	1.45	1.29	1.0125

Dissolved Oxygen		mg/l			
	June	July	August	October	Mean
O-01/PM-49		6		8.81	3.7025
O-02/PM-0				8.14	2.035
O-03/PM-1	7.2	7.57		8.97	5.935
O-04/PM-2	6.5	8.26		8.53	5.8225
O-05/PM-33		8.37		8.14	4.1275
O-06/PM-48	6.9	7.33		9.56	5.9475
O-07/PM-3	7.2	7.59		8.1	5.7225

Kjeldahl, Nitrogen		(mg/l)	DET	0.05	
	June	July	August	October	Mean
O-01/PM-49	0.25	0.67	1.43	1.46	0.9525
O-02/PM-0	0.25	0.94	1.36	1.15	0.925
O-03/PM-1	0.25	0.71	1.56	1.31	0.9575

O-04/PM-2	0.25	0.82	1.09	1.37	0.8825
O-05/PM-33	0.25	0.86	1..28	1.4	0.8367
O-06/PM-48	0.25	0.81	1.45	1.29	0.95

Specific Conductance		um/cm	DET	0.5	
	June	July	August	October	Mean
O-01/PM-49	183	235	217	220	213.75
O-02/PM-0	200	234	218	221	218.25
O-03/PM-1	198	235	218	228	219.75
O-04/PM-2	195	236	223	221	218.75
O-05/PM-33	194	235	218	220	216.75
O-06/PM-48	198	235	216	220	217.25

Alkalinity			DET	4	
	June	July	August	October	Mean
O-01/PM-49	15.7	17.6	14.4	17.3	16.25
O-02/PM-0	19.2	14.8	15	17	16.5
O-03/PM-1	12	16.2	14.7	16.4	14.825
O-04/PM-2	12.7	15.4	19.8	16	15.975
O-05/PM-33	12.8	15.1	14.7	16.9	14.875
O-06/PM-48	14.4	16.8	17.8	17.8	16.7

Chloride		(mg/l)	DET	10	
	June	July	August	October	Mean
O-01/PM-49	38.1	45.3	45.2	49.6	44.55
O-02/PM-0	42.3	45.2	45.6	49.8	45.725
O-03/PM-1	42.8	45.6	45.6	50.1	46.025
O-04/PM-2	41.9	45.3	45.3	49.7	45.55
O-05/PM-33	42.9	45.5	46	49.7	46.025
O-06/PM-48	43.1	45.4	45.5	49.3	45.825

<u>Stetson</u>

pH		(S.U)			
	June	August	October	November	Mean
S-01/PM-12			7.43		2.477
S-02/PM-44			7.7		2.567
S-03/PM-14		7.86	7.86	5.240	

Turbidity		(mg/l)			
	June	August	October	November	Mean
S-01/PM-12	2.1	3	1.2	1.2	1.875
S-02/PM-44	1.9	5	1.5	2	2.600
S-03/PM-14	1.5	4	1.6	2	2.275

Total Nitrogen		(mg/l)			
	June	August	October	November	Mean
S-01/PM-12	0.5	0.5	0.5	0.5	0.500
S-02/PM-44	0.5	0.5	0.5	0.5	0.500
S-03/PM-14	0.5	0.5	0.5	0.5	0.500

Phosphorus, Total		(ug/l)			
	June	August	October	November	Mean
S-01/PM-12	0.02	0.01	0.03	0.05	0.028
S-02/PM-44	0.02	0.02	0.03	0.07	0.035
S-03/PM-14	0.02	0.02	0.02	0.06	0.030

Dissolved Oxygen

	June	August	October	November	Mean
S-01/PM-12			7.43		1.858
S-02/PM-44			7.7		1.925
S-03/PM-14			7.86		1.965
S-04/PM-xx	10.68		7.99		

Kjeldahl, Nitrogen (mg/l)

	June	August	October	November	Mean
S-01/PM-12	0.5	0.5	0.5	0.5	0.500
S-02/PM-44	0.5	0.5	0.5	0.5	0.500
S-03/PM-14	0.5	0.5	0.5	0.5	0.500

Specific Conductance um/cm

	June	August	October	November	Mean
S-01/PM-12	146	170			79.000
S-02/PM-44	152	170			80.500
S-03/PM-14	152	170			80.500

Alkalinity

	June	August	October	November	Mean
S-01/PM-12	5.78	6.94	7.7	5.69	6.528
S-02/PM-44	4	7.94	8.72	8.01	7.168
S-03/PM-14	6.32	9	10.1	9.43	8.713

Chloride (mg/l)

	June	August	October	November	Mean
S-01/PM-12	31.8	36.5	39.3	34.7	35.575
S-02/PM-44	34.2	36.5	38.9	34.3	35.975
S-03/PM-14	34.1	37	38.8	35	36.225

Furnace

pH (S.U) DET 0.14

	June	July	August	October	November	Mean
F-01/PM-05		7.15	7.35	6.99	7.1	5.72
F-02/PM-04		7.06	7.31	7.15	7.04	5.71
F-03/PM-36		7.32	7.2	7.11	7.03	5.73
F-04/PM-09		8.63	7.32	7.22	7.1	6.05
F-05/PM-xx		8.12	7.26	7.62	7.09	6.02
F-06/PM-08		7.98	7.2	7.86	7.1	6.03

Turbidity (mg/l) DET 0.25

	June	July	August	October	November	Mean
F-01/PM-05	4.6	7.9	8.4	8.8	6.3	7.20
F-02/PM-04	4.3	8.2	5.5	10.6	6.2	6.96
F-03/PM-36	4.6	11	2.6	22.7	7.1	9.60
F-04/PM-09	5.4	9.9	1.5	8.2	6.6	6.32
F-05/PM-xx	5.5	10.5	3.5	8.8	10.4	7.74
F-06/PM-08	5.1	9.2	5.1	14.1	8.1	8.32

Phosphorus, Total (ug/l) DET 0.01

	June	July	August	October	November	Mean
F-01/PM-05	0.04	0.04	0.05	0.07	0.09	0.06
F-02/PM-04	0.03	0.05	0.04	0.06	0.07	0.05

F-03/PM-36	0.04	0.04	0.05	0.06	0.07	0.05
F-04/PM-09	0.04	0.05	0.05	0.07	0.09	0.06
F-05/PM-xx	0.05	0.04	0.06	0.07	0.07	0.06
F-06/PM-08	0.03	0.05	0.05	0.07	0.06	0.05

Total Nitrogen			(mg/l)	DET	0.5	
	June	July	August	October	November	Mean
F-01/PM-05	0.64	0.75	1.07	0.87	0.77	0.82
F-02/PM-04	0.61	0.64	1.03	0.95	0.76	0.80
F-03/PM-36	0.66	0.73	1.04	0.78	0.74	0.79
F-04/PM-09	0.6	0.73	1.22	0.72	0.74	0.80
F-05/PM-xx	0.58	0.79	0.95	0.76	0.78	0.77
F-06/PM-08	0.59	0.71	1.02	0.88	0.75	0.79

Dissolved Oxygen						
	June	July	August	October	November	Mean
F-01/PM-05		7.15	7.35	9.15	8.36	6.40
F-02/PM-04		7.06	7.31	9.02	8.06	6.29
F-03/PM-36		7.32	7.20	7.84	8.50	6.17
F-04/PM-09		8.63	7.32	8.33	8.50	6.56
F-05/PM-xx		8.12	7.26	8.50	8.79	6.53
F-06/PM-08		7.98	7.20	8.94	8.47	6.52
F-07/PM-yy	9.30	6.95	7.20	8.44	8.75	8.13

Kjeldahl, Nitrogen			(mg/l)	DET	0.1	
	June	July	August	October	November	Mean
F-01/PM-05	0.64	0.75	1.07	0.87	0.77	0.82
F-02/PM-04	0.61	0.64	1.03	0.95	0.76	0.80
F-03/PM-36	0.66	0.73	1.04	0.78	0.74	0.79
F-04/PM-09	0.60	0.73	1.22	0.72	0.74	0.80
F-05/PM-xx	0.58	0.79	0.95	0.76	0.78	0.77
F-06/PM-08	0.59	0.71	1.02	0.88	0.75	0.79

Specific Conductance			um/cm	DET	0.5	
	June	July	August	October	November	Mean
F-01/PM-05	193	230	212	210	206	210.20
F-02/PM-04	192	232	212	213	208	211.40
F-03/PM-36	194	235	210	211	208	211.60
F-04/PM-09	194	232	210	210	208	210.80
F-05/PM-xx	191	232	210	211	208	210.40
F-06/PM-08	194	232	210	212	208	211.20

Alkalinity				DET	4	
	June	July	August	October	November	Mean
F-01/PM-05	14.5	17.6	17.4	17.7	16.8	16.80
F-02/PM-04	16.8	17.1	19	12.7	16.1	16.34
F-03/PM-36	16.7	18.4	18	17.8	16.7	17.52
F-04/PM-09	15.2	16.6	18.6	17.8	16.9	17.02
F-05/PM-xx	15.2	14.7	16.1	18.4	19.2	16.72
F-06/PM-08	13.1	14.5	17.6	17.8	3.11	13.22

Chloride			(mg/l)	DET	10	
	June	July	August	October	November	Mean
F-01/PM-05	41.6	44.8	44.2	48.7	45.3	44.92
F-02/PM-04	41.6	45.6	44.3	48.6	45.9	45.20

F-03/PM-36	41.3	45.4	44.1	48.3	45.9	45.00
F-04/PM-09	41.6	45	44.9	48.1	46.1	45.14
F-05/PM-xx	41	45.1	44.4	48.3	46.2	45.00
F-06/PM-08	41.9	45.2	44.5	47.9	45.8	45.06

Little Sandy/Hobomock					
pH		(S.U)	DET	0.14	
	June	August	October		Mean
H-01		6.62	7.05		6.84
Turbidity		(mg/l)	DET	0.25	
	June	August	October		Mean
H-01					
Total Nitrogen					
	June	August	October		Mean
H-01	0.25	0.25	0.25		0.25
Phosphorus, Total					
	June	August	October		Mean
H-01	0.03	0.01	0.03		0.02
Dissolved Oxygen					
	June	August	October		Mean
H-01			6.85		2.28
Kjeldahl, Nitrogen					
	June	August	October		Mean
H-01	0.25	0.25	0.25		0.25
Specific Conductance					
	June	August	October		Mean
H-01	227	234	233		231.33
Alkalinity					
	June	August	October		Mean
H-01	2	2	6.38		3.46
Chloride					
	June	August	October		Mean
H-01	58.8	59.5	62.9		60.40

Pembroke Watershed Association
P. O. Box 368, Pembroke, MA 02359-0368

Water Sample Collection Data Sheet

Date: _________

Sampling Station # ____________________ Watershed: ________________________

Pond or River: ___Stetson__________ GPS Location: __________________ __________________

Town: Pembroke, MA Water level: ________________ft

Today's weather:____ Rainfall: _______in.

Yesterday's weather:____ Rainfall :_______in.

Day before's weather:____ Rainfall: _______in.

Site location: ____

Sample taken from: Boat, Bank, Wade, Dock, Other_________________________________

Depth at sample area: _______ft. Air temp: _________ºF Surface Water temp: _____ºF

Water Use: None, Fishing, Boating, Skiing, Swimming
Water Color: Clear, Cloudy, Milky, Foam, Brown (muddy), Grey (Silty), Green
Water Odor: None, sewage, Oil, Chlorine, Rotten egg, Other _________________________
Algal Growth: None, 5%, 10%, 15%, 20%, 25%50%, 75%, >75% Algae Color Green, Blue Green
Bottom Appearance: Not visible, Sludge, Sand, Rock, weeds, Other _________________________
Weed Growth in sample area: None visible, surface, submerged % of weeds _________
Water Characteristics: Large waves, Small Waves, Smooth, still
Current at sample area: Fast, Slow, Still

Chemistry sample: Yes no Time: _______am pm Depth _______ft. Bottle ID#_________

E-coli sample: Yes no Time :_______am pm Depth _______ft. Bottle ID#_________

DO Grab sample: Yes no Time :_______am pm Depth _______ft. Bottle ID#_________

DO Meter sample: Yes no Time: _______am pm Depth _______ft.

DO ________ mg/l __________ % Water Temp ________

Turbidity _______Conductivity ______ pH _______ Salinity ______

Secchi Disk Transparency: Yes no Time: _______am pm Depth _______ft. .

Quanta Certified tester ____ Date ___________ Time______
Print & Sign

Comments:____
____
____
____
____

Sample taker name:____ Date:________ Time:_________
Print & Sign

Witness:____ Date:________ Time:_________
Print & Sign

Pembroke Watershed Association

P. O. Box 368, Pembroke, MA 02359-0368

Dissolved Oxygen at Deep Hole

Date: _________

Sampling Station # ___________________ Watershed: _______________________

Pond or River: ___________________ GPS Location: __________________

Town: Pembroke, MA Water level: _________________ft

Today's weather: ____ Rainfall: _______in.

Yesterday's weather: ____ Rainfall: _______in.

Day before's weather: ____ Rainfall: _______in.

Site location: ____

Sample taken from: Boat, Bank, Wade, Dock, Other__________________________________

Depth at sample area: _______ft. Air temp: _________ºF Surface Water temp: _____ºF

Water Use:	None, Fishing, Boating, Skiing, Swimming
Water Color:	Clear, Cloudy, Milky, Foam, Brown (muddy), Grey (Silty), Green
Water Odor:	None, sewage, Oil, Chlorine, Rotten egg, Other ________________________
Algal Growth:	None, 5%, 10%, 15%, 20%, 25%50%, 75%, >75% Algae Color Green, Blue Green
Bottom Appearance:	Not visible, Sludge, Sand, Rock, weeds, Other _________________________
Weed Growth :	None visible, surface, submerged % of weeds ________
Water Characteristics:	Large waves, Small Waves, Smooth, still
Current at sample area:	Fast, Slow, Still

DO sample reading: _____ Mg/l ____ % Time: ______am/pm Depth__**4**__ft. Water temp ______ ⁰F

DO sample reading: _____ Mg/l ____ % Time: ______am/pm Depth__**7**__ft. Water temp ______ ⁰F

DO sample reading: _____ Mg/l ____ % Time: ______am/pm Depth__**10**_ft. Water temp ______ ⁰F

DO sample reading: _____ Mg/l ____ % Time _______am/pm Depth ____ft. Water temp ______ ⁰F

Secchi Disk Transparency: Yes no Time: _______am/pm Depth _______ft.

Comments:____

____

____

____

____

Sample taker name:____ Date:________ Time:_________

PRINT & SIGN

Witness:____ Date:________ Time:_________

PRINT & SIGN