STORMWATER MANAGEMENT PLAN
2007-2008 ANNUAL REPORT

CITY of MERIDEN
Meriden, Connecticut

April 2009

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1.0 INTRODUCTION

On December 8, 1999, the U.S. Environmental Protection Agency (USEPA) promulgated Phase II of its National Pollution Discharge Elimination System (NPDES) stormwater regulations. Phase I of the USEPA stormwater program established regulations for stormwater discharges from municipal separate storm sewer systems (MS4s) in municipalities with populations of 100,000 or greater, construction activities disturbing five or more acres of land, and ten categories of industrial facilities. The Phase II Final Rule expands the Phase I program by requiring smaller communities with MS4s in urbanized areas to implement programs and practices to control polluted stormwater runoff through the use of NPDES permits.

The City of Meriden is one of 130 municipalities in Connecticut that are located either completely or partially within an urbanized area. These communities were mandated to seek permit coverage with the Connecticut Department of Environmental Protection's (CT DEP) Phase II Stormwater Program. CT DEP issued the final *General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems* (General Permit) on January 9, 2004.

Compliance with the MS4 permit was a two-part process. The first part (Part A – General Permit Registration) was the submission of a registration form including primarily administrative information and basic mapping. The CT DEP issued the City of Meriden a General Permit for Stormwater – Small Municipal Separate Storm Sewer Systems (#GSM000038) on April 13, 2004. A copy of the permit is included as Appendix A. The second part of the process is the submission of a Stormwater Management Plan (SWMP) which was received by the CT DEP on July 8, 2004. The SWMP addresses how the City will comply with the six minimum control measures required by the NPDES permit. These six minimum measures include:

1. Public Education and Outreach
2. Public Participation/Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-Construction Runoff Control
6. Good Housekeeping/Pollution Prevention

As required by the MS4 General Permit, this combined Annual Report for calendar years 2007 and 2008 (years 4 and 5 of the permit) outlines the City's compliance with the permit, provides an assessment of the appropriateness of the identified best management practices and the City's progress towards achieving the implementation of each minimum control measure, provides copies of all monitoring data which may have been collected and analyzed, summarizes stormwater activities the City plans to undertake during the next reporting cycle, and outlines any change in identified measurable goals, implementation dates, or other changes.

The General Permit expired on January 8, 2009. A new General Permit has not yet been issued, nor has the previous permit been reissued. As such, Meriden will assume that compliance with the expired General Permit is sufficient to meet Phase II requirements until further guidance is issued by CT DEP. As such, Meriden will continue to implement its

stormwater management program following the SWMP that it prepared in 2004 and the requirements of the expired general permit.

1.1 Total Maximum Daily Load

CT DEP has prepared and finalized a Total Maximum Daily Load (TMDL) for the Quinnipiac River Regional Basin on June 8, 2008. The TMDL is required since water bodies in this watershed, including Harbor Brook, Misery Brook, Quinnipiac River, and Sodom Brook, have exceeded the allowable levels of bacteria based on their designated uses. As required by the Clean Water Act, a TMDL presents the maximum quantity of pollutant that can be discharged while still meeting water quality standards, or in the case of this TMDL, the presented values are the required reductions in bacteria discharges that must be met. TMDLs are required to be implemented through Phase II Stormwater Management Plans.

On behalf of the City, Fuss & O Neill submitted comments on the TMDL to CT DEP during the statutory comment period. The City is working to incorporate the requirements of the TMDL into its SWMP.

2.0 PUBLIC EDUCATION AND OUTREACH

2.1 Education to the Public

Development and disbursement of stormwater-related educational materials is a continuous process undertaken by the City of Meriden. To date, the City, in partnership with other governmental agencies, businesses, concerned citizens and non-profit organizations such as the Quinnipiac River Watershed Association (QRWA), has extended its public education and outreach efforts to include:

1. Brochures on environmental topics protecting stormwater such as:

    - Bristol Resource Recovery Facility Operating Committee and Tunxis Recycling Operating Committee, *Household Hazardous Product Disposal Information,* and *Recycling Guide.*

    - Meriden Department of Health & Human Services, *Storm Drain: Where Does the Water Go?*

    - Quinnipiac River Watershed Association made several informational documents describing stream quality and benthic organisms, pesticides, riparian health, and other subjects. Documents include *Stream Biosurveys, Environmental Risks of Pesticides in a Residential Setting,* and *Thickets and Edges.*

2. Newsletters to raise public awareness such as:

    - Meriden Department of Health Semi-Annual Newsletter –"Food For Thought" (See Appendix B) For example, the January 2006 newsletter included the following articles:

- *New Requirements for Food Service Facilities.* This article described the new DEP General Permit regarding Fats, Oils, and Grease (FOG) , as well as approved solutions for compliance
- *Storm Drain: Where Does the Water Go?* This article explained the difference between storm drains and sanitary sewers. It described how no treatment is provided for stormwater discharges, and how all wastewaters should be disposed in a sanitary sewer.
- *Safe and Clean Water is Everyone's Responsibility.* This article explained how auto fluids, leaves, and dog feces should be properly disposed, and how incidental littering can result in stormwater pollution.

- Meriden's Water Division Annual Water Quality Report. Although drinking water is the primary focus, sections of the flyer describe how humans affect the quality of water and water conservation tips. See Appendix B for a copy of the 2007 Report.

3. Articles in the local newspaper, *People's Press*, regarding environmental efforts in the community. One article, *Storm Drain: Where Does It Go?,* produced by the Department of Health and Human Services, was submitted to this publication and to the *Record Journal*.

4. Monthly City Meetings, many of which pertain to stormwater and flood control and allow for monthly public comment on the City's activities and programs such as Phase II.

5. The City of Meriden received the recently published Connecticut Department of Education (CTDOE) *Core Science Curriculum Framework*. This curriculum includes educational units discussing "Land and Water Interactions," "Water Quality," the shaping effects of water, how water moving across and through the earth carries with it the products of human activities, how humans can improve water quality, and the accumulation of mercury, phosphates and nitrates in river, lakes, and oceans and its effects on water quality.

6. The City formed an anti-litter committee in 2006 called Clean Sweep Meriden. The committee, which is operated through the City's Youth Services Division is working to install no-litter signs on highway entrances and exits. As of July, 2006, approximately 30 anti-litter signs were installed in the City.

7. The City health department continued a Fats, Oils, & Grease educational campaign in 2007 and 2008, wherein the City reaches out to restaurants and requires updating grease traps units within 60 to 90 days following a change in ownership.

8. The City has acquired 7,000 storm drain markers to be applied to its approximately 7,100 catch basins. The markers, which are being installed by the Department of Public Works, inform residents that storm drains discharge to local waters without treatment.

9. In 2008, the City completed a revision of its Plan of Conservation and Development, the development process of which involved numerous public meetings and hearings.

Copies of selected materials and the CT DOE curriculum available in 2007 and 2008 are included in Appendix B.

2.2 Education Materials Distributed

The brochures and newsletters outlined in Section 2.1 have been distributed to citizens in Meriden. The *Household Hazardous Product Disposal Information* is available at the Department of Public Works administrative offices.

The 2005-2006 Stormwater Annual Report was made available to the public for review. No requests to view the report were received. The 2007-2008 report will also be made available for public review prior to submission to DEP.

2.3 Workshops/Meetings Attended

Several workshops and meetings have been held to raise community awareness and involvement in the City's Stormwater Management Program. One such meeting was held by the City of Meriden and Fuss & O'Neill, Inc. on November 25, 2008 in preparing the City's Stormwater Management Plan.

2.4 Miscellaneous

In Year 1 of the permit, the stewardship of Dossin Beach was passed to the QRWA from the City. This area will be used for on-land and in-the-water (kayak & canoes) educational classes for primarily school age children. The first phase of the Quinnipiac River Gorge Trail was completed during Years 2 and 3 of the permit. This phase includes a 1.2 mile section of trail along the Quinnipiac River. The City was in the process of authorizing a design firm to begin the next phase of the trail from Gray Bridge to Kohl Ave. The final outcome of the project will include a trail system throughout the City. Associated with this long-term land lease, the City moved the dog pound that existed on this land, relocating it away from its prior location, which was in close proximity to a waterbody.

The QRWA also held a Canoe Race and annual clean up along the Quinnipiac River. There were many environmental awareness and educational components of these events.

2.5 Modifications to Plan

There are no modifications to the public education component of the Stormwater Management Plan under consideration at this time.

2.6 Activities Planned for 2009

Although the General Permit has expired, Meriden will continue its programs through 2009 to ensure compliance with EPA's Phase II program. Activities planned include:

- Stormwater related articles in the Meriden Department of Health newsletter, including those directed at the Food Services industry and cooking oil management.

- Continue to collaborate with the local newspaper in order to publish future environmental articles in the *People's Press*.
- The City will continue to integrate topics in the recently published *Core Science Curriculum Framework,* including those related to water quality, into its school curriculum.
- Ensure that the Linear Trail program continues. The program includes walking trails and educational resources along the Quinnipiac River and within the Quinnipiac Gorge. The program is being subsidized by Federal funds passing through the City.

3.0 PUBLIC PARTICIPATION

3.1 Public Meetings Conducted

- *Phase II Stormwater Management Plan Meeting.* City of Meriden and Fuss & O'Neill, Inc., November 25, 2008.
- *Public Phase II Workshop.* The City of Meriden retained Fuss & O'Neill, Inc. to conduct a public workshop pertaining to the Phase II stormwater program and the Stormwater Management Plan that was prepared to meet CT DEP general permit requirements. This meeting was advertised on June, 26, 2004 in the *Record Journal*. See Appendix C for a copy of the public notice.
- *Monthly City Meetings.* Many of these meetings include issues pertaining to stormwater and flood control. Meetings include the Inland Wetlands and Watercourses Commission meetings.
- *City Code Walk.* These monthly meetings are performed by the Mayor, department heads, and members of the public, who walk inner city neighborhoods and look for areas of improvement (litter, evidence of pollution, maintenance issues, drainage issues etc.). These walks have been performed since 1994. The walks cover 525 acres of the City core via 20 miles of roadway.

3.2 Notices Published

- A public notice will be issued when this Stormwater Annual Report is made available to the Public.

A copy of the Notice is included in Appendix C.

3.3 Public Events

The following activities were conducted in Meriden in years 4 and 5 of the General Permit:

- QWRA Canoe Races.
- Monthly Mayor's City Code Walks
- Mayor's Cleanup in both 2007 and 2008, including one that occurred on October 18, 2008.

- Clean-ups by the Anti Litter Committee (Clean Sweep Campaign) throughout the City, including State Street, Center Street, Lake Street, Camp Street, Cook Ave., Hanover and Orange Avenues, Crown Street, Grove Street, Lewis Ave., Olive Street, Miller Street, North Wall Street, Twiss Street, the intersection of Hall and Old Colony, West Main Street, the railroad tracks near the Amtrak station, and highway ramps. In many cases, the City provided the bags, gloves, safety vests, and pick-up of collected trash. In addition, the city provided a free day of disposal for bulky waste items such as chairs, beds, toys, air conditioners, etc. In 2007, the cleanup day and pep rally occurred on April 14, 2007.
- QWRA Annual River Clean ups – during these annual events a significant quantity of material was been removed from the river. Although specific quantities are not available for 2007 and 2008, in 2004 approximately 16,000 lbs of material was removed from the watershed by hundreds of volunteers. Efforts were collaborated throughout the watershed, unaffected by City lines. The municipalities in the watershed shared in the cost of the disposal (approximately $10,000). Pfizer also contributed to the event by donating t-shirts.

3.4 Web Site

The City of Meriden's web site is currently ready to accept links to other web pages and to City documents (such as the Stormwater Management Plan and Annual Reports). It should be noted that the Quinnipiac River Watershed Association's watershed information, programs, and other educational items can be accessed at www.qrwa.org.

3.5 Modifications to Plan

There are no modifications to the public education component of the Stormwater Management Plan under consideration at this time.

3.6 Activities Planned for 2009

Although the General Permit has expired, Meriden will continue its programs through 2009 to ensure compliance with EPA's Phase II program. Activities planned include:

- The City will continue to work with the partnership of governmental agencies, businesses, concerned citizens and non-profit organizations such as the QRWA and school system to participate in their environmental work as well as to sponsor and support clean up projects and environmental events.
- In 2009, the Linear Trail program, the long term lease of Dossin Beach to QWRA from City ownership and the development of environmental education classes at these locations will continue. The program is being subsidized by Federal funds passing through the City.
- In 2009, the City will provide links to the Stormwater Management Plan, annual reports (upon completion), and other water quality related information on the City's website.

4.0 ILLICIT DISCHARGE DETECTION/ELIMINATION

4.1 Illicit Discharge Investigation Activities

The City of Meriden has formalized a process and procedures for logging and responding to complaints associated with illicit discharges. The City has incorporated procedures that include detection information received from the Meriden Board of Health and other government and citizen groups and agencies.

Citizens that wish to report illicit discharges call the Mayor's Hotline, which then contacts the appropriate department. The complaints are recorded by the Department of Parks and Public Works in a log as they are detected and reported. The log will include but is not limited to the following information:

- Location
- Type
- Date Identified
- Identified By
- Estimated Flow
- Scheduled for Repair/Action

The log will be kept in the Department of Public Works administrative offices located at 142 East Main Street, Meriden, Connecticut. The information will be accessible to the public during normal business hours Monday through Friday. The Department's clerical staff will be responsible for accepting and recording public written or telephone complaints for potential illicit discharges. These complaints will be referred through the Department of Public Works to field personnel for proper assessment and correction (as necessary).

The Department of Public Works Engineering Services clerical staff will also receive and record illicit discharge detection information received from the Mayor's hotline, Board of Health, QRWA, and website. This is currently a public bulletin board on the City's website allowing citizens to post questions. These postings are read by MIS staff and directed to the appropriate department. In the case of stormwater questions/concerns, the Department of Public Works would be notified. The questions posted are answered directly on the website so all web visitors have access to the information.

The City has completed mapping stormwater outfalls within the City. As the outfalls are mapped, any discharge present is evaluated to determine if an illicit discharge could be occurring. The form that was used to identify and describe each outfall is included in Appendix D. Appendix G presents a map of the identified outfalls. The City is planning to map the storm drainage piping network to identify the sources of drainage discharged via each outfall.

4.2 Illicit Discharge Removal Activities

Once a suspected illicit discharge has been detected and logged, the Department of Public Works, in conjunction with the Meriden Board of Health, Water Pollution Control, or other

governmental agencies, as appropriate, will take necessary actions to diagnose and eliminate the discharge as necessary. The actions taken to correct and/or eliminate the illicit discharges will then be recorded in a log that will include the following information:

- Location
- Type
- Date Removed
- Removed By
- Cost

Two illicit discharges of pollutants to stormwater were detected during Years 2 and 3 of the Permit. In one instance, a restaurant discharged used cooking grease into a catch basin. The incident was reported to the Meriden Department of Health and Human Services, which required the restaurant to clean the affected infrastructure. Connecticut DEP was notified of the incident.

In the second incident, a local plating shop discharged hexavalent chromium waste into a brook within Meriden. The Meriden Department of Fire and Emergency Services responded to this incident, which resulted in a DEP audit of the facility.

The Meriden Health Department received 12 sewage-related complaints in 2007 and 8 in 2008.

Additionally, two contaminated site cleanup projects are ongoing in Meriden. These include the Factory H cleanup project on Cook Ave at the southern entrance to Meriden's central business district. The other is the demolition and reuse of an abandoned mall, potentially to become an urban center park.

4.3 Modifications to Plan

There are no modifications to the Illicit Discharge component of the Stormwater Management Plan under consideration at this time.

4.4 Activities Planned for 2009

Although the General Permit has expired, Meriden will continue its programs through 2009 to ensure compliance with EPA's Phase II program. Activities planned include:

- The City will continue to work with the partnership of governmental agencies, businesses, concerned citizens and non-profit organizations such as the QRWA to develop programs to detect and eliminate illicit discharges.
- The Meriden Department of Public Works will continue its efforts with the Meriden Department of Health and other City agencies to assess, and improve if necessary, the process and procedures for logging and responding to complaints associated with illicit discharges. The public will primarily continue to use the Mayor's Hotline to make complaints known to City staff.
- Additional pipe outfalls in the city of all sizes and any illicit discharges found will be added to the City's GIS system as they are identified. In addition to mapping the

outfalls, the Outfall Inventory Form found in Appendix D will be used to document the condition and characteristics of the outfall.

- The City will begin mapping storm drainage lines to complete a drainage pipe network in GIS.
- The City's Code and regulations will be reviewed and revised, if necessary, to ensure illicit detection and elimination requirements are being met, that the City has the ability to find and remove illicit discharges, and for necessary changes to comply with the SWMP and the MS4 General Permit.

5.0 CONSTRUCTION SITE RUNOFF CONTROLS

5.1 Construction Plans Reviewed

The Administrative Development Review Board reviews all construction plans for new construction, redevelopment projects, and/or alterations. During 2007, the Inland Wetlands and Watercourses Commission (IWWC) reviewed 12 applications, and the Planning Commission reviewed 12 site plans and 10 subdivisions. In 2008, IWWC reviewed 19 applications, and the Planning Commission reviewed 9 site plans and 3 subdivisions. Review and approvals included review of erosion and sediment control plans for consistency with the *2002 Connecticut Guidelines for Erosion and Sediment Control*.

5.2 Construction Sites Inspected

On-site inspections are made by Engineering and Planning Department staff throughout the construction process (approximately weekly) to ensure compliance with the City's Soil Erosion and Sediment Control Ordinance. Sites were also inspected with regarding the approved construction plans. Enforcement actions were taken when necessary and all items/concerns were addressed by the site contractors or developers.

5.3 Modifications to Plans

There are no modifications to the Construction Site Runoff component of the Stormwater Management Plan under consideration at this time.

5.4 Activities Planned for 2009

Although the General Permit has expired, Meriden will continue its programs through 2009 to ensure compliance with EPA's Phase II program. Activities planned include:

- Continue inspections and enforcement of current regulations, review regulations to consider including provisions for controlling construction wastes such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary wastes at the construction site that may cause adverse impacts to water quality.

- Construction plan submission and site inspection activity will be recorded in a log that will include the following information:

    - Name
    - Site
    - Type
    - Name of Department(s) that Reviewed
    - Certification that Plans Meet City Code
    - Date Reviewed
    - Date Commences
    - Date Inspected

- The City will continue to log the number (per permit year) of construction plan submittals, construction startups, and construction inspections and report these numbers in their Phase II annual report.
- The City's regulations will be reviewed relative to soil erosion and sedimentation control requirements, and to ensure that construction projects resulting in land disturbance of greater than 1 acre will be tracked for compliance. The City's regulations will be reviewed for necessary changes to comply with the SWMP and the MS4 General Permit.

6.0 POST CONSTRUCTION STORMWATER MANAGEMENT

6.1 Plan Review

During 2007, the Inland Wetlands and Watercourses Commission (IWWC) reviewed 12 applications, and the Planning Commission reviewed 12 site plans and 10 subdivisions. In 2008, IWWC reviewed 19 applications, and the Planning Commission reviewed 9 site plans and 3 subdivisions. Reviews for stormwater management issues are based on guidance contained in the *2004 Connecticut Stormwater Quality Manual*, as amended.

6.2 Structures Installed

It is unknown the exact number of stormwater control structures that were installed during 2007 and 2008 including detention basins, water quality basins, gross particle separators, dry basins, and underground detention systems. Developers are required to put a maintenance agreement in the City's land records for all structural stormwater controls installed as part of a construction or reconstruction project. These agreements also require the owner to maintain and retain records of all maintenance activities on their structure(s).

In 2005 and 2006, the City began the process of acquiring land for regional stormwater detention facilities at Harbor Brook, a process that was completed in 2008. This project will provide flood control and stormwater treatment for an area of common flooding problems. Parcel acquisition included two parcels on Barr Road and one parcel on Pomeroy Road. The City also began the bidding process for new river crossings in the area.

During Years 2 and 3 of the Permit, the City installed new deep sump, double catch basins on Douglas Drive. Other new catch basins with deep sumps are located on Crown Street, Eastview Terrace, and Preston Ave. Additionally, the City constructed a new middle school that is equipped with underground stormwater detention vaults.

Other than stormwater retention and treatment devices that have been installed as part of City projects, the City has not yet assumed responsibility for the maintenance of privately installed stormwater structures. These structures are instead maintained by homeowner associations.

The City requires that maintenance agreements and details regarding stormwater controls for a project to be filed with the land records for the parcels affected.

6.3 Structures Inspected

The structural control measures noted above were inspected during and after completion for compliance with the approved plans.

6.4 Modifications to Plan

There are no modifications to the Post Construction component of the Stormwater Management Plan under consideration at this time.

6.5 Activities Planned for 2009

Although the General Permit has expired, Meriden will continue its programs through 2009 to ensure compliance with EPA's Phase II program. Activities planned include:

- The City of Meriden will continue to develop procedures for addressing post construction BMPs for all residential and commercial projects. Construction site inspection activity will be recorded in a log that will contain the following information:
    - Project
    - Site
    - Type Structure
    - Date Installed
    - Date Inspected
- The City will log the number (per permit year) of stormwater structures installed in the City and report this number in their Phase II annual report.
- The City's regulations will be reviewed relative to post construction stormwater management requirements, and to ensure that construction projects resulting in land disturbance of greater than 1 acre will be tracked for compliance. The City's regulations will be reviewed for necessary changes to comply with the SWMP and the MS4 General Permit.

7.0 POLLUTION PREVENTION/GOOD HOUSEKEEPING

7.1 Employee Training Conducted

Meriden Fire Department response staff members are trained for hazardous materials at the operational level, including 92 career and 16 volunteer response personnel. All other personnel are trained to the Awareness level, including 4 in the Fire Marshall's office and 12 non-response volunteers. More than twenty fire fighters are certified at the technician level. These firefighters can provide technical expertise and be hazardous materials team leaders. The Department responds to hazardous material incidents at the operational level, which allows Department staff to properly use spill containment equipment including booms, pads, meters, and sand.

When responding to an incident, Fire Department staff uses the assistance of the Department of Environmental Protection Oil and Spill Response Division for technical and regulatory assistance. During years 4 and 5 of the permit, Meriden Fire Department responded to 64 spills of flammable or combustible liquids and 57 oil spills. Spills that exceed reporting thresholds are reported to DEP and/or other agencies as applicable.

In years 2 and 3 of the permit, three Fire Department staff members received "cameo" training, which is a computer aided spill response method that allows the operator to predict the flow of pollutants in the environment (e.g., air, water) and thereby react to a spill and evacuate residences (as necessary) in a more directed and effective manner.

As a result of implementing a Stormwater Pollution Prevention Plan (SWPPP) and Spill Prevention, Control and Countermeasure (SPCC) Plan for the Central Maintenance Garage, the garage employees received training and are equipped to address incidental oil or petroleum spills with on-site spill response resources. In Year 1, United Waste Oil Recovery was hired to provide education to the garage's employees regarding spill response, containment, clean up, hazard assessment, and hazardous conditions. Department personnel maintained the training during the remaining years of the permit.

7.2 Street Sweeping

The City continues to sweep all streets at a minimum frequency of once each year beginning in the spring to remove winter road sand and other debris. There is a large effort in the early spring to sweep all roads in the City, and then one City sweeper and operator continues to sweep for the entirety of the spring, summer, and fall months. The additional sweeping focuses on downtown and low-lying areas (high sediment accumulation). All City roads typically are swept at least once annually.

In addition, the City uses a mixture of 75% sand and 25% salt for application during winter storms. The mix reduces the quantity of sand used for snow removal, reducing sediment discharge to receiving waters.

During Years 4 and 5, 189 miles of roads were swept at least once (once per year), representing 100% of City roadways. A significant quantity of material was removed from City streets during this process. Approximately 1,800 tons of sand and salt were applied during the winter leading into Year 4 of the permit (the winter of 2006/2007) and in the winter of 2007/2008,

approximately 4,100 tons were applied. During street sweeping in 2007, approximately 1,000 tons of sweepings were collected, and in 2008, approximately 2,000 tons were collected.

During Years 4 and 5, all street sweepings were properly disposed. Previously, street sweepings were disposed at the City's landfill, which is now closed. Currently, this material is transported to New Britain for landfill disposal under an existing contract.

7.3 Snow Removal

In Year 2, the City completed the re-roofing of the municipal salt dome. The City continues to use environmentally responsible sand/salt application practices. As stated above, the City of Meriden applied 1,800 tons of sand and salt during the winter of 2006/2007 and 4,100 tons of sand and salt during the winter of 2007/2008 (and removed a significant percentage of this material through the City's street sweeping efforts).

The City purchased a new brine maker in 2007/2008 to assist in snow removal. The brine maker reduces the quantity of sand and salt required during snow removal. Additionally, the sand and salt mix used is 25% salt to reduce sediment discharge to receiving waters.

When there is an excessive amount of snow, the city hauls snow to a designated storage area (the "Hub"). Snow was stored at this location during the winter of 2007/2008. Snow is not deposited into any waters or wetland areas.

7.4 Catch Basin Cleaning

The City cleans catch basins and drainage lines during the spring, summer, and fall each year. In Year 4, the City purchased a new vacuum truck that can be operated with one operator. During Years 4 and 5, 800 tons and 1,500 tons of catch basin cleanings were collected, respectively. The catch basin cleaning effort primarily occurred between March and October, resulting in the collection of winter debris as well as portions of the fall leaf waste. The City's goal is to clean all publicly-owned catch basins within the City each year.

In addition to general cleaning, numerous catch basins were rebuilt or otherwise repaired by the City (many of the City's catch basins are being replaced with deep-sump catch basins, as described in Section 6.2). In some cases, an entirely new catch basin structure was inserted to replace the existing basin.

During Years 4 and 5, catch basin sediments were properly disposed of at the New Britain landfill as described in Section 7.2.

7.5 Construction Activities

The Highway Department used erosion and sediment controls as necessary for city construction projects. These controls were properly installed and maintained throughout the duration of the projects.

7.6 Complaint Responses

Complaints to the City regarding the general housekeeping of municipal facilities are directed to the appropriate department for investigation and response. Requests from the public are usually received in the early spring for prompt sweeping of winter road sand and cleaning of catch basins. The Department received no calls regarding "good housekeeping" of its roadway facilities in Years 4 and 5.

7.7 Spill Response Activities

All significant spills are handled by the Meriden Fire Department. CT DEP is notified of these situations as they happen. The Fire Department has a tactical unit that is prepared to respond to hazardous spills within the City. From the beginning of 2007 through 2008, the Fire Department responded to 64 incidents involving spills or leaks of combustible and flammable liquids and 57 oil spills. Spills are reported to the DEP Oil and Chemical Spill Division, as necessary, which, in turn, responds as appropriate. Other City staff did not participate in any significant spill response activities during Years 4 or 5.

Both the Highway Department facility and Central Maintenance Garage maintain spill containment supplies including speedi-dry, absorbent pads, and containment booms within the facilities. Underground storage tanks (USTs) at the Central Maintenance Garage and Police Station have been equipped with leak detection systems.

7.8 Transfer Station

Managerial oversight of the City's Transfer Station falls under the jurisdiction of the Highway Department. All municipal residential bulk waste is received by the Transfer Station before being hauled to a certified facility for disposal. During several weekends throughout the year, the City waives the cost to the residents to utilize the transfer station. Freon is removed from all items containing it by a certified company prior to final disposal.

7.9 Municipal Recycle

The City continues to promote City-wide residential materials recycling. All residential recyclables are picked up (curb-side) by a City-hired contractor in the inner tax district and by hired private haulers in the outer tax district.

7.10 Household Hazardous Waste Collection

In conjunction with other communities within the Bristol Resource Recovery Facility Operating Committee and Tunxis Recycling Operating Committee, there are several free household hazardous waste disposal events and electronic waste (E-waste) disposal events available to Meriden residents. Events are advertised in the local newspaper and brochures are available at the Department of Public Works, Engineering Division, and are posted within City Hall. Additional information is available on the organization's website. In 2007 and 2008, 94 and 80 Meriden residents disposed of material through the hazardous waste collection events, respectively. Additionally, 19 and 8 vehicles disposed of E-waste during these events during 2007 and 2008, respectively.

7.11 Municipal Facility Inspection

The City performs routine inspections of its facilities to maintain them in a neat and orderly condition. The Highway Department performs weekly inspections and cleaning of their facilities. The Central Maintenance Garage foreman conducts weekly inspections. At the Central Garage, the foreman completes a checklist that addresses waste management areas, secondary containment, oil/water separator, and waste streams. Inspection records are maintained by the foreman in his office as part of the SWPPP/SPCC implementation program.

United Waste Oil Recovery prepared a waste management plan that documents the waste streams within the Central Garage Facility and recommends management measures for these waste streams.

CT DEP inspected the Central Maintenance Facility in Year 1, and the recommendations of the inspection are being implemented as labor and funding become available. No enforcement actions (no citations) were taken by CTDEP as a result of the inspection.

7.12 Modification to Plan

There are no modifications to the Pollution Prevention/Good Housekeeping component of the Stormwater Management Plan under consideration at this time.

7.13 Activities Planned for 2009

Although the General Permit has expired, Meriden will continue its programs through 2009 to ensure compliance with EPA's Phase II program. Activities planned include:

- The Highway Department will install a vehicle wash rack in 2009. The wash rack will allow the City to wash its fleet vehicles while avoiding wash runoff.
- Document pertinent maintenance/cleaning operations.
- The Highway Department will maintain a list of complaints that it receives regarding road and highway maintenance concerns.
- The City plans to construct a new transfer station in 2009.
- Complete development of Training Program and conduct employee training.
- Perform preliminary work in locating and mapping outfalls and other components of stormwater drainage system.
- Put illicit discharge record system in place. Maintain records of complaints and actions taken.
- Continue facility and municipal outfall monitoring program.
- Follow up on any problems identified through outfall monitoring program.

8.0 ANNUAL STORMWATER MONITORING

The CT DEP Phase II General Permit requires annual stormwater monitoring of at least two outfalls from each of three land uses (industrial, commercial, and residential) for a total of six (6) outfall locations. Monitoring parameters, procedures, and storm event criteria are described in the General Permit.

The City has selected sampling outfalls based on the land use(s) within the drainage areas of the outfalls as well as practical considerations including accessibility and proximity to other sampling locations. A field sampling plan describing the sampling objectives, outfall locations, sampling parameters, and monitoring procedures for the annual monitoring program is included as Appendix E. City staff collected outfall samples for 2007 and 2008. Outfall locations may be modified for future sampling events. Monitoring results are included in Appendix F.

APPENDIX A

GENERAL PERMIT FOR STORMWATER –SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEMS (#GSM000038) –CITY OF MERIDEN

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

TOTAL P.01

Certificate of Registration

Issued To:

CITY OF MERIDEN

For The

STORMWATER - SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEMS

General Permit

Permit No. GSM000038

Arthur J. Rocque, Jr.

Commissioner

Facility Information
MERIDEN, CITY OF
MS4 PERMIT
MERIDEN CT 06450

Application No.: 200401130
Issue Date: 13-APR-04
Exp. Date: 08-JAN-09
Site No.: 80-266

APPENDIX B

EDUCATION MATERIALS

Together We Can Safeguard Our Water Supply

The Water Division is constantly checking water quality

Through the federal Safe Drinking Water Act (SDWA), the U.S. Environmental Protection Agency (U.S. EPA) sets national limits for hundreds of substances in drinking water and also specifies various treatments that water systems must use to remove those substances. The Meriden Water Division continually monitors for these substances, using sophisticated equipment and advanced procedures.

The public has a part to play too

The SDWA requires that we provide you with detailed information on water quality each year. We are happy to do this, because customers who are informed are our best allies in supporting improvements necessary for the long-term health of our water system. And remember – our City Council meetings are open to the public. You are always welcome to attend and to voice your views on our drinking water. For information on meeting times and location, please contact the City Clerk at (203) 630-4030. For more information about contaminants and potential health effects, call the U.S. EPA's Safe Drinking Water Hotline at 800-426-4791.

Water Conservation Tips

Conservation is an important first step in preserving our water supply. Using these measures can also save you money by reducing your water and sewer bills. Here are a few suggestions.

Conservation measures you can use inside your home:

- Fix leaking faucets, pipes, and toilets.
- Install water-saving devices in faucets, toilets and appliances.
- Replace high-water-use fixtures.
- Wash only full loads of laundry.
- Do not use the toilet for trash disposal.
- Take shorter showers.
- Do not let the water run while shaving or brushing teeth.
- Run the dishwasher only when full.

You can conserve outdoors as well:

- Water the lawn and garden in the early morning or evening.
- Use mulch around plants and shrubs.
- Repair leaks in faucets and hoses.
- Use water-saving nozzles and sprinkler heads.
- Use water from a bucket to wash your car and save the hose for rinsing.

City of Meriden, Connecticut

2007 Annual Water Quality Report

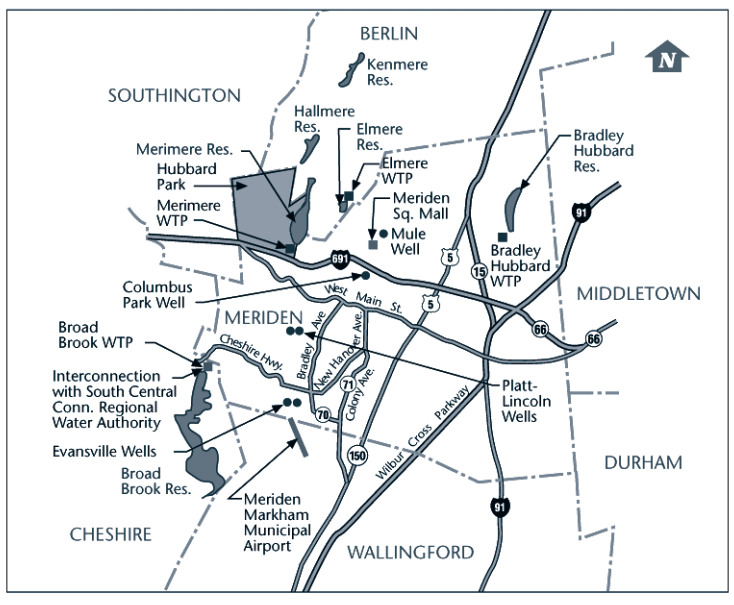
In 2007, water supplied by the Meriden Water Division met or surpassed all federal and state standards. See inside for the results of our tests on a wide range of contaminants.

This annual "consumer confidence report" also includes information on topics such as where our water comes from, what is being done to improve the water system, and how you can help preserve our water supply.

Meriden Water Division Answers Your Drinking Water Questions

Q-Where does my water come from?

A-Water supplied to you from the Meriden Water Division actually has several different sources. Each of these sources is shown on the map below. These sources include four reservoirs on the Meriden-Berlin town line, the Broad Brook Reservoir on the Meriden-Cheshire town line, the Bradley-Hubbard Reservoir in the northeast corner of Meriden, and six groundwater wells located throughout the City. Depending on system requirements, the City also purchases water from the South Central Connecticut Regional Water Authority. Water from the reservoirs is treated at one of Meriden's four water treatment plants. Water from each well is treated at each individual well field. After water is treated, it is distributed to city homes and businesses through a vast network of underground pipelines.



Q-What is being done to improve the system?

A-The Meriden Water Division is constantly trying to enhance both the quality and taste of your water. We do this through maintenance and capital improvement projects.

Routine maintenance such as water main flushing is performed to clean the pipes of iron and other deposits that accumulate over time. Capital improvement projects also can improve the water. We continue to undertake capital improvement projects to improve our infrastructure and storage systems.

Q-Why does the taste and odor of my water vary?

A-Water naturally varies in taste and odor at different times of the year and will vary due to different sources. Typically, taste and odor compounds in water sources are more common during the summer. Because Meriden utilizes different sources based on the need and time of the year, certain customers will notice the different tastes and odors as the sources and seasons change. Taste and odor changes do not pose any health concerns.

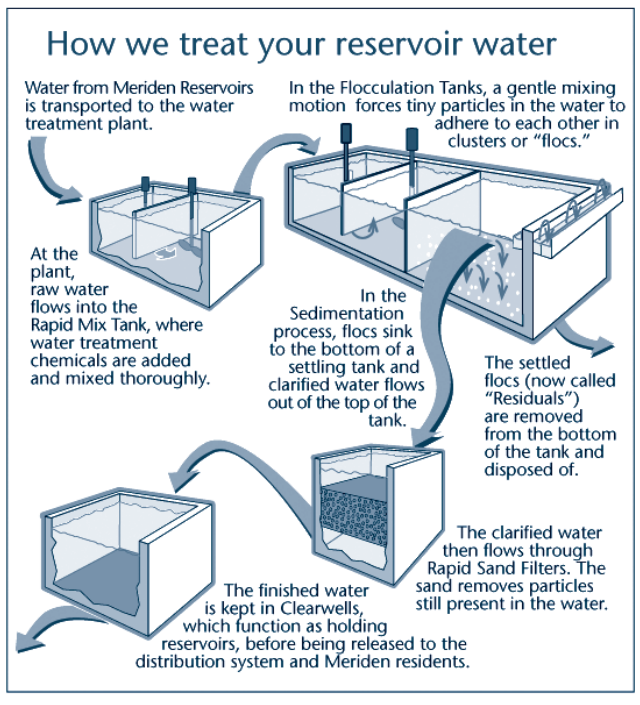
Q-Could there be lead in my water?

A-Lead has not been detected in the frequent tests we run on finished water at our treatment plants. The Meriden Water Division adds a phosphate-based corrosion inhibitor that aids in reducing lead and copper corrosion in the distribution system. Regularly monitored levels of the corrosion inhibitor were consistently within the range desired for corrosion control. The addition of this chemical helps to provide the safest drinking water possible.

Even though we use a corrosion inhibitor, it is possible that lead can leach from common household plumbing fixtures. Older homes are more likely to have fixtures that contain lead. To minimize exposure to lead in your tap water, run the water until it is cold (about 30 to 60 seconds) if it has been standing in the pipes for more than six hours.

Q-Does our water contain fluoride?

A-Fluoride is added to your water to help prevent tooth decay. Levels of fluoride are consistently within limits set by state and federal regulation.



What's In My Water? - Meriden Water-Quality Analysis

Contaminant	Date Tested	Unit	MCL	MCLG	Maximum Detected Level	Range Detected	Major Sources	Violation
Inorganic Contaminants								
Copper	2007	mg/l	AL=1.3	1.3	0.024	0.001-0.024	Corrosion of household plumbing systems; erosion of natural deposits	No
Fluoride	2007	mg/l	4.0	4.0	1.21	0.42-1.21	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	No
Nitrate	2007	mg/l	10	10	3.6	<0.05-3.6	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	No
Barium	2007	mg/l	2	2	0.168	0.006-0.168	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	No
Chlorine	2007	mg/l	4	4	2.3	0.05-2.3	Water additive used to control microbes	No
Sodium	2007	mg/l	AL = 28 (1)	NR	137	4.21-137	Stormwater runoff containing road salt	No (1)
Antimony	2007	mg/l	0.006	0.006	0.004	<0.003-0.004	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	No
Iron	2007	mg/l	NR	0.3 (2)	0.012	0-0.012	Naturally occurring	No
Manganese	2007	mg/l	NR	0.05 (2)	0.476	0-0.476	Naturally occurring	No
Sulfate	2007	mg/l	NR	250 (2)	40	6.6-40	Naturally occurring	No
Chloride	2007	mg/l	NR	250 (2)	190	4.2-190	Water additive used to control microbes	No
Asbestos	2000 (3)	mfl	7	7	0.53	ND – 0.53	Decay of asbestos cement in water mains; erosion of natural deposits	No
Radioactive Contaminants								
Alpha emitters	2005 (4)	pci/l	15	0	6.8	ND – 6.8	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	No
Radium (combined)	2005 (4)	pci/l	5	0	1.3	ND – 1.3	Erosion of natural deposits	No
Uranium	2005 (4)	pci/l	30	0	3.5	ND – 3.5	Erosion of natural deposits	No
Microorganisms								
Turbidity (point of entry)	2007	NTU % > 0.3 NTU	1(5) 5%(5)	NR NR	0.941 3.6%	0.03-0.941 0-3.6%	Soil Runoff	No
Volatile Organic Contaminants								
Total TTHM	2007	ug/l	80 (6)	NR	38	28-38	Byproduct of drinking water disinfection	No
Total HAAS	2007	ug/l	60 (6)	NR	32	20-32	Byproduct of drinking water disinfection	No
Tetrachloroethylene	2007	ug/l	5	0	1.8	<0.5-1.8	Discharge from factories and dry cleaners	No
Dibromochloromethane	2007	ug/l	NR	60	4.8	<0.5-4.8	Byproduct of drinking water disinfection	No
Bromodichloromethane	2007	ug/l	NR	0	9.8	<0.5-9.8	Byproduct of drinking water disinfection	No
Bromoform	2007	ug/l	NR	0	0.95	<0.5-0.95	Byproduct of drinking water disinfection	No
Chloroform	2007	ug/l	NR	70	28	<0.5-28	Byproduct of drinking water disinfection	No
Dichloroacetic acid	2007	ug/l	NR	0	21	<1.0-21	Byproduct of drinking water disinfection	No
Trichloroacetic acid	2007	ug/l	NR	20	24	<1.0-24	Byproduct of drinking water disinfection	No

We are pleased to report that during the past year, the water delivered to your home or business complied with, or did better than, all state and federal drinking water requirements. Each year we analyze thousands of water samples for bacteria, turbidity, inorganic contaminants, lead and copper, nitrate, volatile organic contaminants, total trihalomethanes, and synthetic organic contaminants. For your information, we have listed in the table on the left the substances that were detected in our drinking water during the year. Although all of the substances listed are under the Maximum Contaminant Level (MCL) set by U.S. EPA, we believe it is important that you know exactly what was detected and how much of the substance was present in the water.

Notes To Table

(1) Although sodium does not have a MCL, the State requires that the water supplier provide notification to customers of levels exceeding 28.0 ppm. Therefore, if levels of sodium were recorded from a supply source in your area you were previously provided notification of the event. Elevated levels of sodium encountered are believed to be caused by road salt.

(2) The EPA has established these National Secondary Drinking Water Regulations (NSDWRs) for contaminants that may cause cosmetic or aesthetic effects in drinking water. These standards are recommendations, not requirements, but the City of Meriden strives to comply with them.

(3) Asbestos is not tested for every year; the most recent results available are given.

(4) Radioactive contaminants are not tested for every year; the most recent results available are given.

(5) Turbidity: As of January 1, 2002, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.

(6) As of January 1, 2002, these standards refer to running annual averages. Data from the last three quarters of 2006 is included in figuring these averages.

Key To Table

AL = Action Level
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
NTU = Nephelometric Turbidity Units
ND = non-detectable
NR= Not Regulated
mg/l = milligrams per liter
ug/l = parts per billion, or micrograms per liter
TT = Treatment Technique
pci/l = Picocuries per liter
mfl = Million fibers per liter
cfu/mL = bacterial colonies per milliliter
n/a = not applicable
TTHM = trihalomethanes
HAAS = haloacetic acids

Understanding Contaminants

To ensure that tap water is safe to drink, U.S. EPA prescribes regulations limiting the amount of certain contaminants in water provided by public water systems. U.S. Food and Drug Administration regulations establish limits for contaminants in bottled water, which must provide the same protection for public health. Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of these contaminants does not necessarily indicate that the water poses a health risk.

The sources of both tap and bottled drinking water include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water from these sources travels over the surface of the land or through the ground, it can acquire naturally occurring minerals (which in some cases could be radioactive) and substances resulting from the presence of animals or from a wide variety of human and industrial activities. Substances that may be present in source water include:

Inorganic Contaminants, such as salts and metals, which can be naturally occurring or may result from such things as urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, or mining. This category of contaminants also includes the pesticides and herbicides used primarily in agriculture.

Radioactive Contaminants, which can be naturally occuring or may be the result of oil and gas production and mining activities.

Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations or wildlife.

Volatile Organic (and Synthetic) Contaminants, which are typically by-products of industrial processes and petroleum production, and may also come from gas stations, urban stormwater runoff, and septic systems.

As the table above demonstrates, the Meriden Water Division removes these contaminants prior to distribution. Meriden water meets or surpasses all state and federal drinking water requirements.

Regulated Contaminants

Meriden Water Division tests for a large number of contaminants, though only detected contaminants are noted. Every regulated contaminant that we detected in the water is listed in the water-quality table above. In 2007, the Meriden Water Division's drinking water met or surpassed all federal and state drinking water standards.

Unregulated Contaminants

Meriden Water Division tested for Cryptosporidium in 2007 and the results are available as required.

The Meriden Water Division also utilizes a phosphate-based corrosion inhibior as part of a lead and copper control program. The Division regularly monitors orthophosphate total levels; during 2007, levels ranged from 0.7 mg/l to 1.74 mg/l.

Health Matters

The presence of contaminants in drinking water does not necessarily indicate that the water poses a potential health threat.

A few contaminants, like copper, are in fact essential nutrients at appropriate, very low concentrations. However, some people who drink water that contains copper in excess of the EPA's Action Level could experience gastrointestinal distress over a relatively short period of time. Over many years, ingesting water that contains copper in excess of the Action Level could lead to liver or kidney damage. People with Wilson's disease should consult their personal doctor about their water consumption.

Lead is also a concern. Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight deficits in attention span and learning abilities. Adults who drink water containing lead in excess of the action level over many years could develop kidney problems or high blood pressure.

Some people may be more vulnerable to contaminants in drinking water than is the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium are available from the Safe Drinking Water Hotline (800-426-4791).

Source Water Assessment

Source Water Assessment Reports were completed by the Department of Public Health, Drinking Water Division for the Meriden Water Division. The assessment report can be found on the DPH's website: http://www.dir.ct.gov/dph/Water/SWAP/community/CT0800011.pdf. The assessment found that the public drinking water sources have susceptibility to potential sources of contamination, low for the reservoir sources, and ranging from moderate to high for the groundwater sources.

FOOD 4 THOUGHT

CITY OF MERIDEN, DEPARTMENT OF HEALTH January 2006

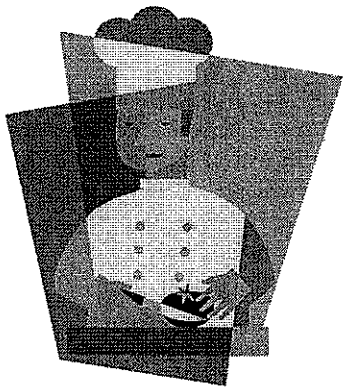
HAPPY NEW YEAR!

The Meriden Health Department would like to welcome Stephen Civitelli to the staff. He is replacing Elizabeth (Liz) Davidson who left last year to work closer to home.

NEW REQUIREMENTS FOR FOOD SERVICE FACILITIES

Two new requirements that food service facilities must comply with have been passed by the State and have gone into effect.

On September 30, 2005 a new DEP General Permit went into effect regarding fats, oils and grease (FOG) generated in food service establishments. As of that date, all new class 3 and 4 food service facilities must be constructed in accordance with the general permit. Food service establishments that change ownership will be required to comply within 60 days of the date of sale. All facilities that are currently operating with no change of owner and are not located in a problem area as determined by the Water Pollution Control Authority will have until July 1, 2011 to come into compliance with this general permit. See the attached DEP fact sheet pertaining to this general permit requirement.



There are currently two approved grease trap/interceptor solutions.

You can install an external in-ground grease trap/interceptor (min. 1,000 gallon) that handles only the waste water generated in the kitchen and is sized to handle the maximum daily flow over a 24 hour period. The other solution is to install an automatic grease recovery unit immediately downstream from each fixture or multiple fixtures listed in the general permit. These fixtures include pot sinks, pre-rinse sinks, soup kettles or similar devices, wok stations, floor drains or sinks into which kettles may be drained, automatic hood wash units, dishwashers without pre-rinse sinks, and any other sink or fixture that are likely to allow fats, oils and grease to be discharged.

The other requirement that was recently passed by the Connecticut General Assembly was Public Act No. 05-134 concerning restaurant safety. Section 1 of this legislation applies to all food service establishments, which includes school food service operations, and provides the following:

Not later than October 1, 2005, each food service establishment in the state shall acquire a sign that describes how to recognize the signs of choking and that addresses appropriate procedures to be taken if a patron of a food service establishment is choking. Such sign shall be conspicuously displayed in such food service establishment within an area where food operators and any other employee of a food service establishment can readily view such sign, and such food operators and employees of such food service establishment shall become familiar with the contents of such sign. Nothing in section shall be construed to apply to any catering food service establishment or any itinerant food vending establishment.

The law does not specify which choking poster needs to be displayed, but the poster must describe how to recognize the signs of choking and the necessary steps to be taken if someone is choking.

Where To Purchase Signs?

You can purchase signs addressing choking for $1 from the Meriden Health Dept. located at 165 Miller Street, (203) 630-4226, or ask your inspector during your next inspection. Also, signs can be purchased for $1 from the American Red Cross located at 144 So. Main St., Wallingford or call (203) 265-6721.

STORM DRAIN: WHERE DOES THE WATER GO?

Do you know the difference between a "storm drain" and a "sewer drain?"

Most people don't realize that these are two separate systems. The sewer drain carries sewage from your house and is processed and treated at the Water Pollution Control Facility. The large circular plates you see in the middle of the street are actually manhole covers for the sewer lines.

Storm drains or catch basins are the open or grated drains you see at the sides of the road by the curb. These drains collect all the water run-off from the street to help in flood control. The big difference between these systems is that this water is NOT processed or treated. This water goes directly to streams, brooks and rivers. Some of these water sources are actually part of the public drinking water system.

Many people ask "so why put a storm drain in areas that have the potential to directly pollute our waterways?" The answer is that the storm drains are designed to reduce the potential for road flooding, including parking lots and highways. It is the responsibility of all residents to protect the water, both drinking and recreational.

How do we do this? Simple, don't put anything directly into the storm drains that could pollute the water. Do not dump mop water in the rear driveway/yard or in storm drains, dispose of this waste in your mop sink or toilet. Do not wash food service equipment outside. All the waste that is generated from this process must go into a sanitary sewer system. Some other examples include waste oil or other auto fluids generated from routine car maintenance, leaves, litter and dog feces. These items are also called "non-point source pollution."

SAFE AND CLEAN WATER IS EVERYONE'S RESPONSIBILITY

So what do you do with your auto fluids, leaves and dog feces? Auto fluids and yard waste should be properly recycled. Contact the Public Works Dept. (630-4259) concerning the location and operation times of the landfill. Dog feces should be bagged and placed with your normal household garbage. Teach young children not to throw gum wrappers or other litter into the street. What should you do if you see someone dumping in a catch basin? First, try to educate the person who may not realize dumping can pollute the water. Also, contact the Health Department (630-4226) so that we may educate the person dumping. If that person continues to dump, legal action may be taken. You should also contact the Public Works Department if you notice a catch basin in need of cleaning.

REMEMBER... WE ARE JUST A PHONE CALL AWAY 630-4226.

Meriden Health Department

Environmental Health Section

165 Miller Street

Meriden, CT 06450

630-4226

Beth Vumbaco, R.N., M.S.
Director of Health & Human Services

Scott Bryden, R.S.
Environmental Health Administrator

Brad Parandes, R.S.
Carrie Buckley, R.S.
Stephen Civitelli, B.S
Environmental Health Sanitarians

Linda Tschupp
Environmental Secretary

Meriden Clean-Sweep Day

Saturday
April 14, 2007
11:30am-1:30pm

Join Meriden residents, community organizations, and businesses for some spring cleaning in Meriden!

Meet at City Hall at 11:00am for a clean-up "pep rally" and:

- Sign-in to get your t-shirt! *(Available to youth participants on a first-come, first-serve basis by pre-registration)*
- Pick up clean-sweep supplies. *(Bags and disposable gloves)*
- Pick up safety tips and instructions for your clean-sweep crew.
- And after the clean-up, join us for a lunch celebration at 2:00!

PRE-REGISTRATION DEADLINE: Wednesday, April 11, 2007

Call 630-4238 or email *lcrown@ci.meriden.ct.us* to pre-register your clean-sweep team and location

Sponsored by the *Take Pride Meriden* anti-litter committee
www.cityofmeriden.org

*****Please note: This is not a bulky waste pick-up day. No bulky waste will be picked up curb side on this day.***

Core Science Curriculum Framework

An Invitation for Students and Teachers to Explore Science and Its Role in Society

INTRODUCTION

I. A Vision for Connecticut Science Education in the 21st Century

To articulate a vision to guide 21st century science education in Connecticut, the Connecticut State Department of Education engaged in discussions with science educators, school administrators, and university and corporate scientists. The consensus drawn from these discussions was that school science education should support the development of scientific literacy in all students, as well as motivate more students to pursue careers in science, technology and engineering. Science literacy, in the view of Connecticut science educators, is a combination of understanding major science concepts and theories, using scientific reasoning, and recognizing the complex interactions between science, technology and society.

Based on this vision, the department developed a new **Core Science Curriculum Framework**. This framework articulates the main conceptual themes and content standards that **all** students are expected to learn in their elementary, middle and high school science classes. Further, the framework describes the specific performances that will be assessed on the statewide science assessments.

What Is Meant By A "Core" Curriculum?
Since the current body of scientific knowledge represents the cumulative work of scientists over hundreds of years, it is unreasonable to expect K-12 students to learn it all. Therefore, Connecticut's Core Science Curriculum Framework describes *some* of the major science concepts that all students in Connecticut schools can reasonably be expected to learn in order to develop and expand their scientific literacy. This framework does not attempt to spell out all of the science, mathematics and technology goals that can be included in a school science curriculum. Rather, it describes a baseline for what all Connecticut students should know by the end of Grade 10.

Decisions regarding the main science themes and the sequencing of the content standards were guided by the *National Science Education Standards* (National Research Council, 1996), *Project 2061 Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993), and Connecticut science educators. School districts may choose to go beyond the scope of these core concepts, but **all** students should have opportunities to learn the content expressed in this framework.

How Does The Framework Promote Scientific Literacy?
Being scientifically literate requires that a person have an essential understanding of key science ideas, along with a fluency in the language and terms used to describe them. The core curriculum articulated through the framework identifies the key ideas and levels of understanding that all students are expected to reach. Throughout the PreK-Grade10 core framework, fundamental concepts from the life, physical and earth sciences are woven together in order to support the holistic understanding required of a scientifically literate individual.

Scientific literacy requires the ability to apply critical thinking skills when dealing with science-related issues. The framework was designed to target the age-appropriate critical thinking – or inquiry – skills that should be infused in the learning of each of the content standards. Further, in limiting the number of content standards required to be taught, the framework allows for the implementation of a hands-on/minds-on science program in which students and teachers have time for in-depth explorations that build an understanding of the way in which scientific knowledge is created, validated and communicated.

A scientifically literate person is able to transfer knowledge of the academic theories and principles of science to practical applications in the real world. To support this concept, Connecticut's Core Science Curriculum Framework is structured around these key real-world issues and technologies, rather than around the subdisciplines of the life, physical and earth sciences.

Scientific literacy also implies having the capacity to pose and evaluate arguments based on evidence and to apply logical conclusions from such arguments. Language arts and mathematics are the communication vehicles that people use to convey, critique and evaluate science-related ideas. Therefore, language arts and mathematics learning expectations are included in the framework as integral components of science learning.

In short, a foundation in scientific literacy prepares students to be confident and capable lifelong learners who are equipped with the skills needed to access, understand, evaluate and apply information in various contexts. Regardless of their academic standing, **all** students should have access to a rich and challenging science curriculum that will promote scientific literacy, while inspiring and supporting advanced study and science-related careers.

II. Role of the Connecticut Core Science Curriculum Framework

The science framework has three main roles:

1. **To articulate the core science ideas, knowledge and skills that all Connecticut students should learn.** Based upon significant science understandings and abilities defined in the *National Science Education Standards* and the *Project 2061 Benchmarks for Science Literacy*, this framework describes a conceptual scope and sequence to guide school districts and science educators in the development of their own science programs. The content standards for each grade level are based on conceptual connections among ideas in the life, physical and earth sciences, and related social and technological applications. District curriculum developers have flexibility to reorganize the content standards by grade level, so long as all students have opportunities to learn the content standards prior to taking the *Connecticut Mastery Test* (CMT) in Grades 5 and 8, and the *Connecticut Academic Performance Test* (CAPT) in Grade 10. Districts may include more content in their science programs, but the framework content standards express the *minimum* that should be learned by all students in Grades PreK to 10.

   In addition to the life, physical and earth science standards, the Core Science Curriculum Framework includes standards and expected performances for inquiry and for science and technology in society. Inquiry performances include the abilities to apply science process skills, as well as the abilities to read and write science-related texts, search scientific databases and use mathematics to make sense out of data. The science and technology in society standards deal with applications of science to everyday and global issues, and reflect content and issues described in *Standards for Technological Literacy* (International Technology Education Association, 2000).

2. **To define the knowledge, abilities and understandings that students are expected to demonstrate on the statewide science assessments.** Whereas content standards provide broad guidelines for the development of the core curriculum, expected performances identify the specific knowledge and skills selected from the core curriculum for which students will be accountable on statewide science assessments. Expected performances express the *maximum* that all students will be expected to demonstrate on the CMT and CAPT science assessments.

3. **To influence the way science is taught and assessed.** Among the factors guiding the selection and organization of the framework's content were its potential to attract and hold the interest of students and inspire them to continue learning about science. While the framework defines key science concepts and skills, it does not dictate how to help students achieve these learning goals. The ways in which districts develop learning units and specific lesson plans will have a significant influence on students' attitudes toward science learning. Given opportunities for meaningful and authentic science experiences that incorporate the expected performances included in the framework, it is hoped that many students will develop the enthusiasm, interest and confidence to continue their science studies and pursue science-related careers. An enrichment science program designed to meet the needs of these advanced students, with suggested content standards for courses in biology, chemistry, physics and earth science, is found in the Appendix to this framework. Enrichment standards that are not included in high school Strands I through V will not be measured on the CAPT.

DEVELOPMENTAL ORGANIZATION OF CORE SCIENCE CURRICULUM FRAMEWORK

PreK-2:	Development of *wonder* about the natural world and the ability to observe, describe and apply basic process skills
Grades 3-5:	Development of *descriptions* of basic natural phenomena and the ability to perform simple experiments and record accurate data
Grades 6-8:	Development of basic *explanations* for natural phenomena, and the ability to ask good questions and apply experimental procedures to collect and analyze data
Grades 9-10:	Development of *interest* in global issues and the ability to collect, analyze and use data to explore and explain related science concepts

ENRICHMENT CURRICULUM

Development of *deep understanding* of science concepts and principles; preparation for future studies and/or careers

CONCEPTUAL STRUCTURE OF FRAMEWORK

The science framework is organized around 11 conceptual themes and guiding questions in the earth, life and physical sciences, with suggested explorations of science-related questions and issues. Each theme is addressed by several content standards and related concepts that spiral through the grades, each time being treated with greater depth and breadth, in accordance with developmental appropriateness for the students. The content standards for Grades 9 and 10 are further organized around five topical strands. Strands I, II and III are related to the physical sciences, while Strands IV and V are related to the life science.

Listed below are the conceptual themes and guiding questions, together with the content standards in each of the grade levels, that contribute to students' eventual abilities to respond to the guiding questions.

I. Inquiry – How is scientific knowledge created and communicated?

- Scientific Inquiry **(PK-2, 3-5, 6-8 and 9-10)**
- Scientific Literacy **(PK-2, 3-5, 6-8 and 9-10)**
- Scientific Numeracy **(PK-2, 3-5, 6-8 and 9-10)**

II. Properties of Matter – How does the structure of matter affect the properties and uses of materials?

- Properties of Objects **(K.1)**
- Properties of Materials **(2.1)**
- States of Matter **(3.1)**
- Elements, Compounds and Mixtures **(6.1)**
- Chemical Reactions **(9.4)**
- Carbon Compounds **(9.5)**

III. Energy Transfer and Transformations – What is the role of energy in our world?

- Electricity and Magnetism **(4.4)**
- Sound and Light **(5.1)**
- Energy and Work **(7.1)**
- Energy Conservation and Transformation **(9.1)**
- Electrical Forces **(9.2)**

IV. Forces and Motion – What makes objects move the way they do?

- Position and Motion of Objects **(1.1)**
- Forces and Motion **(4.1)**
- Forces and Motion **(8.1)**

V. Matter and Energy in Ecosystems – How do matter and energy flow through ecosystems?

- Food Chains **(4.2)**
- Ecosystems **(6.2)**

VI. Structure and Function – How are organisms structured to ensure efficiency and survival?

- Needs of Living Things **(1.2)**
- Life Cycles of Animals **(1.3)**
- Life Cycles of Plants **(2.2)**
- Responses to Stimuli **(5.2)**
- Human Body Systems **(7.2)**
- Cell Structure and Function **(10.1)**

VII. Heredity and Evolution – What processes are responsible for life's unity and diversity?

- Characteristics of Living Things **(K.2)**
- Adaptations **(3.2)**
- Reproduction and Heredity **(8.2)**
- Genetics **(10.4)**
- Evolution **(10.5)**

VIII. The Changing Earth – How do materials cycle through the Earth's systems?

- Properties of Soils **(2.3)**
- Properties of Rocks and Minerals **(3.3)**
- Cycles of Matter in Earth's Systems **(9.7)**

IX. Energy in the Earth's Systems – How do external and internal sources of energy affect the Earth's systems?

- Weather Patterns **(K.3)**
- Land and Water Interactions **(4.3)**
- Weather and Seasons **(6.3)**
- The Changing Earth **(7.3)**

X. Earth in the Solar System – How does the position of Earth in the solar system affect conditions on our planet?

- Earth, Moon and Sun **(5.3)**
- The Solar System **(8.3)**

XI. Science and Technology in Society – How do science and technology affect the quality of our lives?

Shelters **(K.4)**
Measuring Tools **(1.4)**
Food Resources **(2.4)**
Conservation of Materials **(3.4)**
Batteries, Bulbs and Magnets **(4.4)**
Optical Technologies **(5.4)**
Water Quality **(6.4)**
Food Technology **(7.4)**
Building Bridges **(8.4)**
Energy and Power Technologies **(9.3)**
Polymers **(9.6)**
Human Environmental Impacts **(9.8, 9.9)**
Living with Microorganisms **(10.2)**
Biotechnology **(10.3)**
Human Population Growth **(10.6)**

USERS' GUIDE TO CORE SCIENCE CURRICULUM FRAMEWORK

The intent of this framework is to describe a core body of science knowledge that all students are expected to learn; knowledge that is assessed at the elementary, middle and high school levels. Although the framework introduces concepts from the life, physical and earth sciences at each grade level, schools may choose to design yearly courses that focus on one science discipline at a time, based on the needs of students and available instructional resources.

The framework is structured with the following components:

- **CONTENT STANDARDS** (the left-hand column of each page) are narrative statements of science concepts that guide the development of a rich and rigorous curriculum. They are marked with an identification code indicating the grade level and standard number (e.g., 3.2) and appear in bold type.

  Content standards include the following:
  - A **conceptual theme,** followed by an overarching **guiding question** (e.g., *Properties of Matter – How does the structure of matter affect the properties and uses of materials?*)
  - The **content standard**, a broad conceptual statement, identified with a numerical code that serves as a general learning goal for a unit of study.
  - One or two **supportive concepts**, identified with bullets, that provide more specific information about the focus of the learning unit.

- **EXPECTED PERFORMANCES** (the right-hand column of each page) identify the specific knowledge and abilities from the broader curriculum that will be assessed on the statewide tests given at Grades 5, 8 and 10.

- **SCIENTIFIC INQUIRY, LITERACY AND NUMERACY** standards, although described separately for Grades PK-2, 3-5, 6-8 and 9-10, are intended to be learned, practiced and assessed within the context of learning the science content described for each grade level.

- **UNDERSTANDING THE IDENTIFICATION CODES**

  - Each content standard is identified by a two-digit code (e.g., 2.3): The first digit refers to the grade level (second grade in the example), and the second digit identifies one of the four content standards for each grade level (standard 3 in the example).
  - Expected performances are identified by a letter (A, B, C or D) and a sequenced numeral (1 through 45) that indicates the number of expected performances within each gradespan:

A = Grades PK-2 (includes 24 expected performances)

B = Grades 3-5 (includes 25 expected performances)

C = Grades 6-8 (includes 30 expected performances)

D = Grades 9-10 (includes 45 expected performances)

Content Standards and Expected Performances

Core Science for Grades PreK-2

THE STANDARDS FOR SCIENTIFIC INQUIRY, LITERACY AND NUMERACY ARE INTEGRAL PARTS OF THE CONTENT STANDARDS FOR EACH GRADE LEVEL IN THIS CLUSTER.

Grades PreK-2 Core Scientific Inquiry, Literacy and Numeracy *How is scientific knowledge created and communicated?*	
Content Standards	**Expected Performances**
SCIENTIFIC INQUIRY ◆ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena. **SCIENTIFIC LITERACY** ◆ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science. **SCIENTIFIC NUMERACY** ◆ Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.	**A INQ.1** Make observations and ask questions about objects, organisms and the environment. **A INQ.2** Use senses and simple measuring tools to collect data. **A INQ.3** Make predictions based on observed patterns. **A INQ.4** Read, write, listen and speak about observations of the natural world. **A INQ.5** Seek information in books, magazines and pictures. **A INQ.6** Present information in words and drawings. **A INQ.7** Use standard tools to measure and describe physical properties such as weight, length and temperature. **A INQ.8** Use nonstandard measures to estimate and compare the sizes of objects. **A INQ.9** Count, order and sort objects by their properties. **A INQ.10** Represent information in bar graphs.

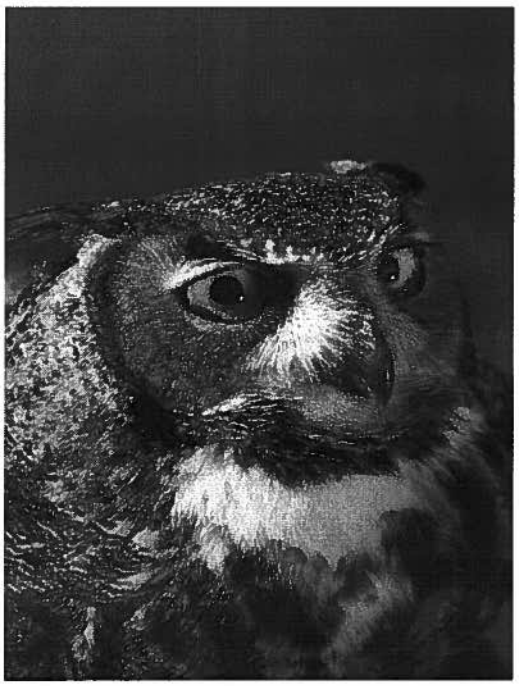
PreK-Kindergarten Core Themes, Content Standards and Expected Performances	
Content Standards	**Expected Performances**
Properties of Matter – How does the structure of matter affect the properties and uses of materials? **K.1 - Objects have properties that can be observed and used to describe similarities and differences.** ♦ Some properties can be observed with the senses, and others can be discovered by using simple tools or tests.	**A 1.** Use the senses and simple measuring tools, such as rulers and equal-arm balances, to observe common objects and sort them into groups based on size, weight, shape or color. **A 2.** Sort objects made of materials such as wood, paper and metal into groups based on properties such as flexibility, attraction to magnets, and whether they float or sink in water. **A 3.** Count objects in a group and use mathematical terms to describe quantitative relationships such as: same as, more than, less than, equal, etc.
Heredity and Evolution – What processes are responsible for life's unity and diversity? **K.2 - Many different kinds of living things inhabit the Earth.** ♦ Living things have certain characteristics that distinguish them from nonliving things, including growth, movement, reproduction and response to stimuli.	**A 4.** Describe the similarities and differences in the appearance and behaviors of plants, birds, fish, insects and mammals (including humans). **A 5.** Describe the similarities and differences in the appearance and behaviors of adults and their offspring. **A 6.** Describe characteristics that distinguish living from nonliving things.
Energy in the Earth's Systems – How do external and internal sources of energy affect the Earth's systems? **K.3 - Weather conditions vary daily and seasonally.** ♦ Daily and seasonal weather conditions affect what we do, what we wear and how we feel.	**A 7.** Describe and record daily weather conditions. **A 8.** Relate seasonal weather patterns to appropriate choices of clothing and activities.
Science and Technology in Society – How do science and technology affect the quality of our lives? **K.4 - Some objects are natural, while others have been designed and made by people to improve the quality of life.** ♦ Humans select both natural and man-made materials to build shelters based on local climate conditions, properties of the materials and their availability in the environment.	**A 9.** Describe the types of materials used by people to build houses, and the properties that make the materials useful.

Grade 1 Core Themes, Content Standards and Expected Performances	
Content Standards	**Expected Performances**
Forces and Motion – What makes objects move the way they do? **1.1 - The sun appears to move across the sky in the same way every day, but its path changes gradually over the seasons.** ♦ An object's position can be described by locating it relative to another object or the background. ♦ An object's motion can be described by tracing and measuring its position over time.	**A 10.** Describe how the motion of objects can be changed by pushing and pulling. **A 11.** Describe the apparent movement of the sun across the sky and the changes in the length and direction of shadows during the day.
Structure and Function – How are organisms structured to ensure efficiency and survival? **1.2 - Living things have different structures and behaviors that allow them to meet their basic needs.** ♦ Animals need air, water and food to survive. ♦ Plants need air, water and sunlight to survive.	**A 12.** Describe the different ways that animals, including humans, obtain water and food. **A 13.** Describe the different structures plants have for obtaining water and sunlight. **A 14.** Describe the structures that animals, including humans, use to move around.
Structure and Function – How are organisms structured to ensure efficiency and survival? **1.3 - Organisms change in form and behavior as part of their life cycles.** ♦ Some organisms undergo metamorphosis during their life cycles; other organisms grow and change, but their basic form stays essentially the same.	**A 15.** Describe the changes in organisms, such as frogs and butterflies, as they undergo metamorphosis. **A 16.** Describe the life cycles of organisms that grow but do not metamorphose.
Science and Technology in Society – How do science and technology affect the quality of our lives? **1.4 - The properties of materials and organisms can be described more accurately through the use of standard measuring units.** ♦ Various tools can be used to measure, describe and compare different objects and organisms.	**A 17.** Estimate, measure and compare the sizes and weights of different objects and organisms using standard and nonstandard measuring tools.

Grade 2 Core Themes, Content Standards and Expected Performances	
Content Standards	**Expected Performances**
Properties of Matter – How does the structure of matter affect the properties and uses of materials? **2.1 - Materials can be classified as solid, liquid or gas based on their observable properties.** ♦ Solids tend to maintain their own shapes, while liquids tend to assume the shapes of their containers, and gases fill their containers fully.	**A 18.** Describe differences in the physical properties of solids and liquids.
Structure and Function – How are organisms structured to ensure efficiency and survival? **2.2 - Plants change their forms as part of their life cycles.** ♦ The life cycles of flowering plants include seed germination, growth, flowering, pollination and seed dispersal.	**A 19.** Describe the life cycles of flowering plants as they grow from seeds, proceed through maturation and produce new seeds. **A 20.** Explore and describe the effects of light and water on seed germination and plant growth.
The Changing Earth – How do materials cycle through the Earth's systems? **2.3 - Earth materials have varied physical properties which make them useful in different ways.** ♦ Soils can be described by their color, texture and capacity to retain water. ♦ Soils support the growth of many kinds of plants, including those in our food supply.	**A 21.** Sort different soils by properties, such as particle size, color and composition. **A 22.** Relate the properties of different soils to their capacity to retain water and support the growth of certain plants.
Science and Technology in Society – How do science and technology affect the quality of our lives? **2.4 - Human beings, like all other living things, have special nutritional needs for survival.** ♦ The essential components of balanced nutrition can be obtained from plant and animal sources. ♦ People eat different foods in order to satisfy nutritional needs for carbohydrates, proteins and fats.	**A 23.** Identify the sources of common foods and classify them by their basic food groups. **A 24.** Describe how people in different cultures use different food sources to meet their nutritional needs.

Content Standards and Expected Performances

Core Science for Grades 3-5



THE STANDARDS FOR SCIENTIFIC INQUIRY, LITERACY AND NUMERACY ARE INTEGRAL PARTS OF THE CONTENT STANDARDS FOR EACH GRADE LEVEL IN THIS CLUSTER.

Grades 3-5 Core Scientific Inquiry, Literacy and Numeracy *How is scientific knowledge created and communicated?*		
Content Standards	**Expected Performances**	
SCIENTIFIC INQUIRY ♦ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena. **SCIENTIFIC LITERACY** ♦ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science. **SCIENTIFIC NUMERACY** ♦ Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.	**B INQ.1**	Make observations and ask questions about objects, organisms and the environment.
	B INQ.2	Seek relevant information in books, magazines and electronic media.
	B INQ.3	Design and conduct simple investigations.
	B INQ.4	Employ simple equipment and measuring tools to gather data and extend the senses.
	B INQ.5	Use data to construct reasonable explanations.
	B INQ.6	Analyze, critique and communicate investigations using words, graphs and drawings.
	B INQ.7	Read and write a variety of science-related fiction and nonfiction texts.
	B INQ.8	Search the Web and locate relevant science information.
	B INQ.9	Use measurement tools and standard units (e.g., centimeters, meters, grams, kilograms) to describe objects and materials.
	B INQ.10	Use mathematics to analyze, interpret and present data.

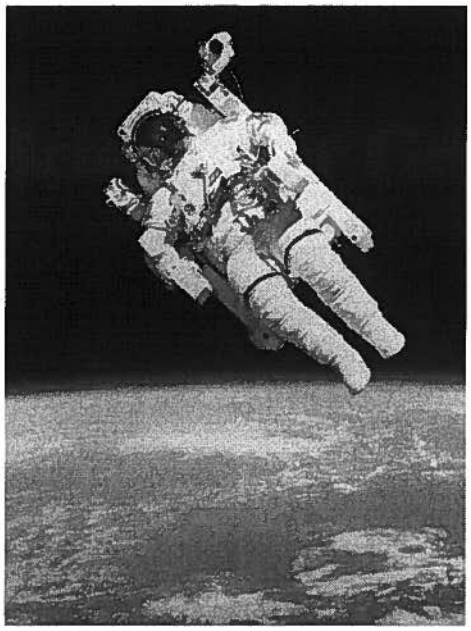
Grade 3 Core Themes, Content Standards and Expected Performances	
Content Standards	**Expected Performances**
Properties of Matter – How does the structure of matter affect the properties and uses of materials? **3.1 - Materials have properties that can be identified and described through the use of simple tests.** ♦ Heating and cooling cause changes in some of the properties of materials.	**B 1.** Sort and classify materials based on properties such as dissolving in water, sinking and floating, conducting heat, and attracting to magnets. **B 2.** Describe the effect of heating on the melting, evaporation, condensation and freezing of water.
Heredity and Evolution – What processes are responsible for life's unity and diversity? **3.2 - Organisms can survive and reproduce only in environments that meet their basic needs.** ♦ Plants and animals have structures and behaviors that help them survive in different environments.	**B 3.** Describe how different plants and animals are adapted to obtain air, water, food and protection in specific land habitats. **B 4.** Describe how different plants and animals are adapted to obtain air, water, food and protection in water habitats.
The Changing Earth – How do materials cycle through the Earth's systems? **3.3 - Earth materials have different physical and chemical properties.** ♦ Rocks and minerals have properties that may be identified through observation and testing; these properties determine how earth materials are used.	**B 5.** Describe the physical properties of rocks and relate them to their potential uses. **B 6.** Relate the properties of rocks to the possible environmental conditions during their formation.
Science and Technology in Society – How do science and technology affect the quality of our lives? **3.4 - Earth materials provide resources for all living things, but these resources are limited and should be conserved.** ♦ Decisions made by individuals can impact the global supply of many resources.	**B 7.** Describe how earth materials can be conserved by reducing the quantities used, and by reusing and recycling materials rather than discarding them.

Grade 4 Core Themes, Content Standards and Expected Performances	
Content Standards	**Expected Performances**
Forces and Motion – What makes objects move the way they do? **4.1 - The position and motion of objects can be changed by pushing or pulling.** ♦ The size of the change in an object's motion is related to the strength of the push or pull. ♦ The more massive an object is, the less effect a given force will have on its motion.	**B 8.** Describe the effects of the strengths of pushes and pulls on the motion of objects. **B 9.** Describe the effect of the mass of an object on its motion.
Matter and Energy in Ecosystems – How do matter and energy flow through ecosystems? **4.2 - All organisms depend on the living and non-living features of the environment for survival.** ♦ When the environment changes, some organisms survive and reproduce, and others die or move to new locations.	**B 10.** Describe how animals, directly or indirectly, depend on plants to provide the food and energy they need in order to grow and survive. **B 11.** Describe how natural phenomena and some human activities may cause changes to habitats and their inhabitants.
Energy in the Earth's Systems – How do external and internal sources of energy affect the Earth's systems? **4.3 - Water has a major role in shaping the Earth's surface.** ♦ Water circulates through the Earth's crust, oceans and atmosphere.	**B 12.** Describe how the sun's energy impacts the water cycle. **B 13.** Describe the role of water in erosion and river formation.
Energy Transfer and Transformations – What is the role of energy in our world? **4.4 - Electrical and magnetic energy can be transferred and transformed.** ♦ Electricity in circuits can be transformed into light, heat, sound and magnetic effects. ♦ Magnets can make objects move without direct contact between the object and the magnet.	**B 14.** Describe how batteries and wires can transfer energy to light a light bulb. **B 15.** Explain how simple electrical circuits can be used to determine which materials conduct electricity. **B 16.** Describe the properties of magnets, and how they can be used to identify and separate mixtures of solid materials.

Grade 5 Core Themes, Content Standards and Expected Performances	
Content Standards	**Expected Performances**
Energy Transfer and Transformations – What is the role of energy in our world? **5.1 - Sound and light are forms of energy.** ◆ Sound is a form of energy that is produced by the vibration of objects and is transmitted by the vibration of air and objects. ◆ Light is a form of energy that travels in a straight line and can be reflected by a mirror, refracted by a lens, or absorbed by objects.	**B 17.** Describe the factors that affect the pitch and loudness of sound produced by vibrating objects. **B 18.** Describe how sound is transmitted, reflected and/or absorbed by different materials. **B 19.** Describe how light is absorbed and/or reflected by different surfaces.
Structure and Function – How are organisms structured to ensure efficiency and survival? **5.2 - Perceiving and responding to information about the environment is critical to the survival of organisms.** ◆ The sense organs perceive stimuli from the environment and send signals to the brain through the nervous system.	**B 20.** Describe how light absorption and reflection allow one to see the shapes and colors of objects. **B 21.** Describe the structure and function of the human senses and the signals they perceive.
Earth in the Solar System – How does the position of Earth in the solar system affect conditions on our planet? **5.3 - Most objects in the solar system are in a regular and predictable motion.** ◆ The positions of the Earth and moon relative to the sun explain the cycles of day and night, and the monthly moon phases.	**B 22.** Explain the cause of day and night based on the rotation of Earth on its axis. **B 23.** Describe the monthly changes in the appearance of the moon, based on the moon's orbit around the Earth.
Science and Technology in Society – How do science and technology affect the quality of our lives? **5.4 - Humans have the capacity to build and use tools to advance the quality of their lives.** ◆ Advances in technology allow individuals to acquire new information about the world.	**B 24.** Compare and contrast the structures of the human eye with those of the camera. **B 25.** Describe the uses of different instruments, such as eye glasses, magnifiers, periscopes and telescopes, to enhance our vision.

Content Standards and Expected Performances

Core Science for Grades 6-8



THE STANDARDS FOR SCIENTIFIC INQUIRY, LITERACY AND NUMERACY ARE INTEGRAL PARTS OF THE CONTENT STANDARDS FOR EACH GRADE LEVEL IN THIS CLUSTER.

Grades 6-8 Core Scientific Inquiry, Literacy and Numeracy *How is scientific knowledge created and communicated?*	
Content Standards	**Expected Performances**
SCIENTIFIC INQUIRY ◆ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena. ◆ Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation. ◆ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists. **SCIENTIFIC LITERACY** ◆ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science. ◆ Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media. **SCIENTIFIC NUMERACY** ◆ Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.	**C INQ.1** Identify questions that can be answered through scientific investigation. **C INQ.2** Read, interpret and examine the credibility of scientific claims in different sources of information. **C INQ.3** Design and conduct appropriate types of scientific investigations to answer different questions. **C INQ.4** Identify independent and dependent variables, and those variables that are kept constant, when designing an experiment. **C INQ.5** Use appropriate tools and techniques to make observations and gather data. **C INQ.6** Use mathematical operations to analyze and interpret data. **C INQ.7** Identify and present relationships between variables in appropriate graphs. **C INQ.8** Draw conclusions and identify sources of error. **C INQ.9** Provide explanations to investigated problems or questions. **C INQ.10** Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Grade 6 Core Themes, Content Standards and Expected Performances	
Content Standards	**Expected Performances**
Properties of Matter – How does the structure of matter affect the properties and uses of materials? **6.1 - Materials can be classified as pure substances or mixtures, depending on their chemical and physical properties.** ♦ Mixtures are made of combinations of elements and/or compounds, and they can be separated by using a variety of physical means. ♦ Pure substances can be either elements or compounds, and they cannot be broken down by physical means.	**C 1.** Describe the properties of common elements, such as oxygen, hydrogen, carbon, iron and aluminum. **C 2.** Describe how the properties of simple compounds, such as water and table salt, are different from the properties of the elements of which they are made. **C 3.** Explain how mixtures can be separated by using the properties of the substances from which they are made, such as particle size, density, solubility and boiling point.
Matter and Energy in Ecosystems – How do matter and energy flow through ecosystems? **6.2 - An ecosystem is composed of all the populations that are living in a certain space and the physical factors with which they interact.** ♦ Populations in ecosystems are affected by biotic factors, such as other populations, and abiotic factors, such as soil and water supply. ♦ Populations in ecosystems can be categorized as producers, consumers and decomposers of organic matter.	**C 4.** Describe how abiotic factors, such as temperature, water and sunlight, affect the ability of plants to create their own food through photosynthesis. **C 5.** Explain how populations are affected by predator-prey relationships. **C 6.** Describe common food webs in different Connecticut ecosystems.
Energy in the Earth's Systems – How do external and internal sources of energy affect the Earth's systems? **6.3 - Variations in the amount of the sun's energy hitting the Earth's surface affect daily and seasonal weather patterns.** ♦ Local and regional weather are affected by the amount of solar energy these areas receive and by their proximity to a large body of water.	**C 7.** Describe the effect of heating on the movement of molecules in solids, liquids and gases. **C 8.** Explain how local weather conditions are related to the temperature, pressure and water content of the atmosphere and the proximity to a large body of water. **C 9.** Explain how the uneven heating of the Earth's surface causes winds.
Science and Technology in Society – How do science and technology affect the quality of our lives? **6.4 - Water moving across and through earth materials carries with it the products of human activities.** ♦ Most precipitation that falls on Connecticut eventually reaches Long Island Sound.	**C 10.** Explain the role of septic and sewage systems on the quality of surface and ground water. **C 11.** Explain how human activity may impact water resources in Connecticut, such as ponds, rivers and the Long Island Sound ecosystem.

Grade 7 Core Themes, Content Standards and Expected Performances	
Content Standards	**Expected Performances**
Energy Transfer and Transformations – What is the role of energy in our world? **7.1 - Energy provides the ability to do work and can exist in many forms.** ◆ Work is the process of making objects move through the application of force. ◆ Energy can be stored in many forms and can be transformed into the energy of motion.	**C 12.** Explain the relationship among force, distance and work, and use the relationship (W=F x D) to calculate work done in lifting heavy objects. **C 13.** Explain how simple machines, such as inclined planes, pulleys and levers, are used to create mechanical advantage. **C 14.** Describe how different types of stored (potential) energy can be used to make objects move.
Structure and Function – How are organisms structured to ensure efficiency and survival? **7.2 - Many organisms, including humans, have specialized organ systems that interact with each other to maintain dynamic internal balance.** ◆ All organisms are composed of one or more cells; each cell carries on life-sustaining functions. ◆ Multicellular organisms need specialized structures and systems to perform basic life functions.	**C 15.** Describe the basic structures of an animal cell, including nucleus, cytoplasm, mitochondria and cell membrane, and how they function to support life. **C 16.** Describe the structures of the human digestive, respiratory and circulatory systems, and explain how they function to bring oxygen and nutrients to the cells and expel waste materials. **C 17.** Explain how the human musculo-skeletal system supports the body and allows movement.
Energy in the Earth's Systems – How do external and internal sources of energy affect the Earth's systems? **7.3 - Landforms are the result of the interaction of constructive and destructive forces over time.** ◆ Volcanic activity and the folding and faulting of rock layers during the shifting of the Earth's crust affect the formation of mountains, ridges and valleys. ◆ Glaciation, weathering and erosion change the Earth's surface by moving earth materials from place to place.	**C 18.** Describe how folded and faulted rock layers provide evidence of the gradual up and down motion of the Earth's crust. **C 19.** Explain how glaciation, weathering and erosion create and shape valleys and floodplains. **C 20.** Explain how the boundaries of tectonic plates can be inferred from the location of earthquakes and volcanoes.
Science and Technology in Society – How do science and technology affect the quality of our lives? **7.4 - Technology allows us to improve food production and preservation, thus improving our ability to meet the nutritional needs of growing populations.** ◆ Various microbes compete with humans for the same sources of food.	**C 21.** Describe how freezing, dehydration, pickling and irradiation prevent food spoilage caused by microbes.

Grade 8 Core Themes, Content Standards and Expected Performances	
Content Standards	**Expected Performances**
Forces and Motion – What makes objects move the way they do? **8.1 - An object's inertia causes it to continue moving the way it is moving unless it is acted upon by a force to change its motion.** ♦ The motion of an object can be described by its position, direction of motion and speed. ♦ An unbalanced force acting on an object changes its speed and/or direction of motion. ♦ Objects moving in circles must experience force acting toward the center.	**C 22.** Calculate the average speed of a moving object and illustrate the motion of objects in graphs of distance over time. **C 23.** Describe the qualitative relationships among force, mass and changes in motion. **C 24.** Describe the forces acting on an object moving in a circular path.
Heredity and Evolution – What processes are responsible for life's unity and diversity? **8.2 - Reproduction is a characteristic of living systems and it is essential for the continuation of every species.** ♦ Heredity is the passage of genetic information from one generation to another. ♦ Some of the characteristics of an organism are inherited and some result from interactions with the environment.	**C 25.** Explain the similarities and differences in cell division in somatic and germ cells. **C 26.** Describe the structure and function of the male and female human reproductive systems, including the process of egg and sperm production. **C 27.** Describe how genetic information is organized in genes on chromosomes, and explain sex determination in humans.
Earth in the Solar System – How does the position of Earth in the solar system affect conditions on our planet? **8.3 - The solar system is composed of planets and other objects that orbit the sun.** ♦ Gravity is the force that governs the motions of objects in the solar system. ♦ The motion of the Earth and moon relative to the sun causes daily, monthly and yearly cycles on Earth.	**C 28.** Explain the effect of gravity on the orbital movement of planets in the solar system. **C 29.** Explain how the regular motion and relative position of the sun, Earth and moon affect the seasons, phases of the moon and eclipses.
Science and Technology in Society – How do science and technology affect the quality of our lives? **8.4 - In the design of structures there is a need to consider factors such as function, materials, safety, cost and appearance.** ♦ Bridges can be designed in different ways to withstand certain loads and potentially destructive forces.	**C 30.** Explain how beam, truss and suspension bridges are designed to withstand the forces that act on them.

Content Standards and Expected Performances

Core Science for Grades 9-10

THE STANDARDS FOR SCIENTIFIC INQUIRY, LITERACY AND NUMERACY ARE INTEGRAL PARTS OF THE CONTENT STANDARDS FOR EACH GRADE LEVEL IN THIS CLUSTER.

Grades 9-10 Core Scientific Inquiry, Literacy and Numeracy *How is scientific knowledge created and communicated?*	
Content Standards	**Expected Performances**
SCIENTIFIC INQUIRY ◆ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena. ◆ Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation. ◆ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists. **SCIENTIFIC LITERACY** ◆ Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science. ◆ Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media. **SCIENTIFIC NUMERACY** ◆ Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.	**D INQ.1** Identify questions that can be answered through scientific investigation. **D INQ.2** Read, interpret and examine the credibility and validity of scientific claims in different sources of information. **D INQ.3** Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment. **D INQ.4** Design and conduct appropriate types of scientific investigations to answer different questions. **D INQ.5** Identify independent and dependent variables, including those that are kept constant and those used as controls. **D INQ.6** Use appropriate tools and techniques to make observations and gather data. **D INQ.7** Assess the reliability of the data that was generated in the investigation. **D INQ.8** Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms. **D INQ.9** Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation. **D INQ.10** Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Grade 9 Core Themes, Content Standards and Expected Performances Strand I: Energy Transformations	
Content Standards	**Expected Performances**
Energy Transfer and Transformations – What is the role of energy in our world? **9.1 - Energy cannot be created or destroyed; however, energy can be converted from one form to another.** ♦ Energy enters the Earth system primarily as solar radiation, is captured by materials and photosynthetic processes, and eventually is transformed into heat.	**D 1.** Describe the effects of adding energy to matter in terms of the motion of atoms and molecules, and the resulting phase changes. **D 2.** Explain how energy is transferred by conduction, convection and radiation. **D 3.** Describe energy transformations among heat, light, electricity and motion.
Energy Transfer and Transformations – What is the role of energy in our world? **9.2 - The electrical force is a universal force that exists between any two charged objects.** ♦ Moving electrical charges produce magnetic forces, and moving magnets can produce electrical force. ♦ Electrical current can be transformed into light through the excitation of electrons.	**D 4.** Explain the relationship among voltage, current and resistance in a simple series circuit. **D 5.** Explain how electricity is used to produce heat and light in incandescent bulbs and heating elements. **D 6.** Describe the relationship between current and magnetism.
Science and Technology in Society – How do science and technology affect the quality of our lives? **9.3 - Various sources of energy are used by humans and all have advantages and disadvantages.** ♦ During the burning of fossil fuels, stored chemical energy is converted to electrical energy through heat transfer processes. ♦ In nuclear fission, matter is transformed directly into energy in a process that is several million times as energetic as chemical burning. ♦ Alternative energy sources are being explored and used to address the disadvantages of using fossil and nuclear fuels.	**D 7.** Explain how heat is used to generate electricity. **D 8.** Describe the availability, current uses and environmental issues related to the use of fossil and nuclear fuels to produce electricity. **D 9.** Describe the availability, current uses and environmental issues related to the use of hydrogen fuel cells, wind and solar energy to produce electricity.

Grade 9 Core Themes, Content Standards and Expected Performances Strand II: Chemical Structures and Properties	
Content Standards	**Expected Performances**
Properties of Matter – How does the structure of matter affect the properties and uses of materials? **9.4 - Atoms react with one another to form new molecules.** ♦ Atoms have a positively charged nucleus surrounded by negatively charged electrons. ♦ The configuration of atoms and molecules determines the properties of the materials.	**D 10.** Describe the general structure of the atom, and explain how the properties of the first 20 elements in the Periodic Table are related to their atomic structures. **D 11.** Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding). **D 12.** Explain the chemical composition of acids and bases, and explain the change of pH in neutralization reactions.
Properties of Matter – How does the structure of matter affect the properties and uses of materials? **9.5 – Due to its unique chemical structure, carbon forms many organic and inorganic compounds.** ♦ Carbon atoms can bond to one another in chains, rings and branching networks to form a variety of structures, including fossil fuels, synthetic polymers and the large molecules of life.	**D 13.** Explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules. **D 14.** Describe combustion reactions of hydrocarbons and their resulting by-products. **D 15.** Explain the general formation and structure of carbon-based polymers, including synthetic polymers, such as polyethylene, and biopolymers, such as carbohydrate.
Science and Technology in Society – How do science and technology affect the quality of our lives? **9.6 - Chemical technologies present both risks and benefits to the health and well-being of humans, plants and animals.** ♦ Materials produced from the cracking of petroleum are the starting points for the production of many synthetic compounds. ♦ The products of chemical technologies include synthetic fibers, pharmaceuticals, plastics and fuels.	**D 16.** Explain how simple chemical monomers can be combined to create linear, branched and/or cross-linked polymers. **D 17.** Explain how the chemical structure of polymers affects their physical properties. **D 18.** Explain the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.

Grade 9 Core Themes, Content Standards and Expected Performances Strand III: Global Interdependence	
Content Standards	**Expected Performances**
The Changing Earth – How do materials cycle through the Earth's systems? **9.7 - Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles.** ♦ Elements on Earth exist in essentially fixed amounts and are located in various chemical reservoirs. ♦ The cyclical movement of matter between reservoirs is driven by the Earth's internal and external sources of energy.	**D 19.** Explain how chemical and physical processes cause carbon to cycle through the major earth reservoirs. **D 20.** Explain how solar energy causes water to cycle through the major earth reservoirs. **D 21.** Explain how internal energy of the Earth causes matter to cycle through the magma and the solid earth.
Science and Technology in Society – How do science and technology affect the quality of our lives? **9.8 - The use of resources by human populations may affect the quality of the environment.** ♦ Emission of combustion by-products, such as SO_2, CO_2 and NOx by industries and vehicles is a major source of air pollution. ♦ Accumulation of metal and non-metal ions used to increase agricultural productivity is a major source of water pollution.	**D 22.** Explain how the release of sulfur dioxide (SO_2) into the atmosphere can form acid rain, and how acid rain affects water sources, organisms and human-made structures. **D 23.** Explain how the accumulation of carbon dioxide (CO_2) in the atmosphere increases Earth's "greenhouse" effect and may cause climate changes. **D 24.** Explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans.
Science and Technology in Society – How do science and technology affect the quality of our lives? **9.9 - Some materials can be recycled, but others accumulate in the environment and may affect the balance of the Earth systems.** ♦ New technologies and changes in lifestyle can have positive and/or negative effects on the environment.	**D 25.** Explain how land development, transportation options and consumption of resources may affect the environment. **D 26.** Describe human efforts to reduce the consumption of raw materials and improve air and water quality.

Grade 10 Core Themes, Content Standards and Expected Performances Strand IV: Cell Chemistry and Biotechnology	
Content Standards	**Expected Performances**
Structure and Function – How are organisms structured to ensure efficiency and survival? **10.1 - Fundamental life processes depend on the physical structure and the chemical activities of the cell.** ♦ Most of the chemical activities of the cell are catalyzed by enzymes that function only in a narrow range of temperature and acidity conditions. ♦ The cellular processes of photosynthesis and respiration involve transformation of matter and energy.	**D 27.** Describe significant similarities and differences in the basic structure of plant and animal cells. **D 28.** Describe the general role of DNA and RNA in protein synthesis. **D 29.** Describe the general role of enzymes in metabolic cell processes. **D 30.** Explain the role of the cell membrane in supporting cell functions.
Science and Technology in Society – How do science and technology affect the quality of our lives? **10.2 - Microorganisms have an essential role in life processes and cycles on Earth.** ♦ Understanding the growth and spread patterns of viruses and bacteria enables the development of methods to prevent and treat infectious diseases.	**D 31.** Describe the similarities and differences between bacteria and viruses. **D 32.** Describe how bacterial and viral infectious diseases are transmitted, and explain the roles of sanitation, vaccination and antibiotic medications in the prevention and treatment of infectious diseases. **D 33.** Explain how bacteria and yeasts are used to produce foods for human consumption.
Science and Technology in Society – How do science and technology affect the quality of our lives? **10.3 - Similarities in the chemical and structural properties of DNA in all living organisms allow the transfer of genes from one organism to another.** ♦ The principles of genetics and cellular chemistry can be used to produce new foods and medicines in biotechnological processes.	**D 34.** Describe, in general terms, how the genetic information of organisms can be altered to make them produce new materials. **D 35.** Explain the risks and benefits of altering the genetic composition and cell products of existing organisms.

Grade 10 Core Themes, Content Standards and Expected Performances Strand V: Genetics, Evolution and Biodiversity	
Content Standards	**Expected Performances**
Heredity and Evolution – What processes are responsible for life's unity and diversity? **10.4. - In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.** ♦ Genetic information is stored in genes that are located on chromosomes inside the cell nucleus. ♦ Most organisms have two genes for each trait, one on each of the homologous chromosomes in the cell nucleus.	**D 36.** Explain how meiosis contributes to the genetic variability of organisms. **D 37.** Use the Punnet Square technique to predict the distribution of traits in mono- and di-hybrid crossings. **D 38.** Deduce the probable mode of inheritance of traits (e.g., recessive/dominant, sex-linked) from pedigree diagrams showing phenotypes. **D 39.** Describe the difference between genetic disorders and infectious diseases.
Heredity and Evolution – What processes are responsible for life's unity and diversity? **10.5 - Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.** ♦ Mutations and recombination of genes create genetic variability in populations. ♦ Changes in the environment may result in the selection of organisms that are better able to survive and reproduce.	**D 40.** Explain how the processes of genetic mutation and natural selection are related to the evolution of species. **D 41.** Explain how the current theory of evolution provides a scientific explanation for fossil records of ancient life forms. **D 42.** Describe how structural and behavioral adaptations increase the chances for organisms to survive in their environments.
Science and Technology in Society – How do science and technology affect the quality of our lives? **10.6 - Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.** ♦ Human populations grow due to advances in agriculture, medicine, construction and the use of energy. ♦ Humans modify ecosystems as a result of rapid population growth, use of technology and consumption of resources.	**D 43.** Describe the factors that affect the carrying capacity of the environment. **D 44.** Explain how change in population density is affected by emigration, immigration, birth rate and death rate, and relate these factors to the exponential growth of human populations. **D 45.** Explain how technological advances have affected the size and growth rate of human populations throughout history.

APPENDIX

Enrichment Content Standards for High School Science

Adaptations of California Science Content Standards (on pages 31 – 40) permitted courtesy of California Department of Education, CDE Press, 1430 N Street, Suite 3207, Sacramento, CA 95814. Full text of California State standards available at: http://www.cde.ca.gov/re/pn/fd/sci-frame-dwnld.asp

High School Biology	
Content Standards	**Supportive Concepts**
Cell Biology The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.	▪ Cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings. ▪ Enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions and the pH of the surroundings. ▪ Prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure. ▪ The central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm. ▪ The endoplasmic reticulum and Golgi apparatus have a role in the secretion of proteins. ▪ Usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide. ▪ The role of the mitochondria is to make stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide. ▪ Most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.
Genetics Mutation and sexual reproduction lead to genetic variation in a population.	▪ Meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type. ▪ Only certain cells in a multicellular organism undergo meiosis. ▪ Random chromosome segregation explains the probability that a particular allele will be in a gamete. ▪ New combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization). ▪ Approximately half of an individual's DNA sequence comes from each parent. ▪ Genes on specific chromosomes determine an individual's sex. ▪ Possible combinations of alleles in a zygote can be predicted from the genetic makeup of the parents.

A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization.	▪ The probable outcome of phenotypes in a genetic cross can be predicted from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive). ▪ Mendel's laws of segregation and independent assortment are the basis of genetics. ▪ The probable mode of inheritance can be predicted from a pedigree diagram showing phenotypes. ▪ Data on frequency of recombination at meiosis can be used to estimate genetic distances between loci and to interpret genetic maps of chromosomes.
Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism.	▪ Ribosomes synthesize proteins, using tRNAs to translate genetic information in the mRNA. ▪ The sequence of amino acids in a protein can be predicted from the sequence of codons in the RNA, by applying universal genetic coding rules. ▪ Mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein. ▪ Specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves. ▪ Proteins can differ from one another in the number and sequence of amino acids. ▪ Proteins having different amino acid sequences typically have different shapes and chemical properties.
The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.	▪ Base-pairing rules are used to explain the precise copying of DNA during semiconservative replication and transcription of information from DNA into mRNA. ▪ Genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products. ▪ DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation and transformation) is used to construct recombinant DNA molecules. ▪ Exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.

Ecology Stability in an ecosystem is a balance between competing effects.	▪ Biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats. ▪ Changes in an ecosystem can result from changes in climate, human activity, introduction of nonnative species, or changes in population size. ▪ Fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration and death. ▪ Water, carbon and nitrogen cycle between abiotic resources and organic matter in the ecosystem and oxygen cycles through photosynthesis and respiration. ▪ A vital part of an ecosystem is the stability of its producers and decomposers. ▪ At each link in a food web some energy is stored in newly made structures, but much energy is dissipated into the environment as heat. ▪ The accommodation of an individual organism to its environment is different from the gradual adaptation of a lineage of organisms through genetic change.
Evolution The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time.	▪ Natural selection acts on the phenotype rather than the genotype of an organism. ▪ Alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool. ▪ New mutations are constantly being generated in a gene pool. ▪ Variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.
Evolution is the result of genetic changes that occur in constantly changing environments.	▪ Natural selection determines the differential survival of groups of organisms. ▪ A great diversity of species increases the chance that at least some organisms survive major changes in the environment. ▪ Genetic drift affects the diversity of organisms in a population. ▪ Reproductive or geographic isolation affects speciation. ▪ Fossil evidence contributes to our understanding of biological diversity, episodic speciation and mass extinction. ▪ Several independent molecular clocks, calibrated against each other and combined with evidence from the fossil record, can help to estimate how long ago various groups of organisms diverged evolutionarily from one another.

Physiology As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.	▪ The complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide. ▪ The nervous system mediates communication between different parts of the body and the body's interactions with the environment. ▪ Feedback loops in the nervous and endocrine systems regulate conditions in the body. ▪ The neurons transmit electrochemical impulses. ▪ Sensory neurons, interneurons and motor neurons all have a role in sensation, thought and response. ▪ Digestion includes the secretion of stomach acid, digestive enzymes (amylases, proteases, nucleases, lipases) and bile salts into the digestion system. ▪ The kidneys have a homeostatic role in the removal of nitrogenous wastes from the blood. ▪ The liver has a homeostatic role in detoxification and keeping the blood glucose balance. ▪ Actin, myosin, Ca2 and ATP have a role in the cellular and molecular basis of muscle contraction. ▪ Hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.
Organisms have a variety of mechanisms to combat disease.	▪ The skin provides nonspecific defenses against infection. ▪ Antibodies have a role in the body's response to infection. ▪ Vaccination protects an individual from infectious diseases. ▪ There are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections. ▪ An individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign. ▪ Phagocytes, B-lymphocytes and T-lymphocytes have a role in the immune system.

High School Earth Science	
Content Standards	**Supportive Concepts**
Earth's Place in the Universe Earth-based and space-based astronomy reveal the structure, scale and changes in stars, galaxies and the universe over time.	▪ The differences and similarities among the sun, the terrestrial planets and the gas planets may have been established during the formation of the solar system. ▪ Evidence from Earth and moon rocks indicates that the solar system was formed from a nebular cloud of dust and gas approximately 4.6 billion years ago. ▪ Evidence from geological studies of Earth and other planets suggests that the early Earth was very different from Earth today. ▪ The sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium. ▪ Asteroids and meteorites had a significant role in shaping the surface of planets and their moons and in mass extinctions of life on Earth. ▪ The solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years. ▪ Galaxies are made of billions of stars and comprise most of the visible mass of the universe. ▪ Evidence indicates that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars. ▪ Visual, radio and X-ray telescopes may be used to collect data that reveal those differences in the life cycles of stars. ▪ The "big bang" model suggests that the universe has been expanding for 10 to 20 billion years.
Dynamic Earth Processes Plate tectonics operating over geologic time has changed the patterns of land, sea and mountains on Earth's surface.	▪ Features of the ocean floor, as well as the shape and rock composition of the major plates, provide evidence of plate tectonics. ▪ Volcanic eruptions and earthquakes are the result of the movement of matter and energy within the Earth. ▪ The properties of rocks and minerals can be explained based on the physical and chemical conditions in which they were formed, including plate tectonic processes.
Energy in the Earth System Energy enters the Earth system primarily as solar radiation and eventually escapes as heat.	▪ The sun is a major source of energy for Earth and other planets. ▪ Some of the solar radiation is reflected back into the atmosphere and some is absorbed by matter and photosynthetic processes. ▪ Different atmospheric gases absorb the Earth's thermal radiation. ▪ The greenhouse effect may cause climatic changes.

Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.	▪ Differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat. ▪ The rotation of Earth influences the circular motions of ocean currents and air. ▪ Properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms. ▪ The interaction of wind patterns, ocean currents, and the distribution of land masses result in a global pattern of latitudinal bands of rain forests and deserts.
Climate is the long-term average of a region's weather and depends on many factors.	▪ Weather and climate involve the transfer of energy into and out of the atmosphere. ▪ Latitude, elevation, topography, proximity to large bodies of water, and cold or warm ocean currents affect the climate. ▪ Earth's climate has changed over time, corresponding to changes in Earth's geography, atmospheric composition and other factors, such as solar radiation and plate movement.
Biogeochemical Cycles Each element on Earth moves among reservoirs which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles.	▪ The movement of matter among reservoirs is driven by Earth's internal and external sources of energy. ▪ Carbon cycles through the reservoirs of the atmosphere, lithosphere, hydrosphere and biosphere.
Structure and Composition of the Atmosphere Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life.	▪ The atmosphere has specific thermal structure and chemical composition. ▪ The composition of Earth's atmosphere has evolved over geologic time. ▪ The origin of atmospheric oxygen is photosynthetic processes. ▪ The ozone layer in the upper atmosphere absorbs ultraviolet radiation. This layer varies both naturally and in response to human activities.

High School Chemistry	
Content Standards	**Supportive Concepts**
Atomic and Molecular Structure The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.	▪ The nucleus of the atom is much smaller than the atom, yet contains most of its mass. ▪ The quantum model of the atom is based on experiments and analyses by many scientists, including Dalton, Thomson, Bohr, Rutherford, Millikan and Einstein. ▪ The position of an element in the periodic table is related to its atomic number. ▪ The periodic table can be used to identify metals, semimetals, non-metals and halogens. ▪ The periodic table can be used to identify trends in ionization energy, electronegativity, the relative sizes of ions and atoms, and the number of electrons available for bonding. ▪ The electronic configuration of elements and their reactivity can be identified based on their position in the periodic table.
Chemical Bonds Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.	▪ Atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds. ▪ Chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, H_2CCH_2, N_2, Cl_2, and many large biological molecules are covalent. ▪ Salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction. ▪ The atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form. ▪ Lewis dot structures can provide models of atoms and molecules. ▪ The shape of simple molecules and their polarity can be predicted from Lewis dot structures. ▪ Electronegativity and ionization energy are related to bond formation. ▪ Solids and liquids held together by Van der Waals forces or hydrogen bonds are affected by volatility and boiling/melting point temperatures.
Conservation of Matter and Stoichiometry The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.	▪ Chemical reactions can be described by writing balanced equations. ▪ The quantity one mole is set by defining one mole of carbon; 12 atoms to have a mass of exactly 12 grams. ▪ One mole equals 6.02.x 1023 particles (atoms or molecules). ▪ The molar mass of a molecule can be determined from its chemical formula and a table of atomic masses. ▪ The mass of a molecular substance can be converted to moles, number of particles, or volume of gas at standard temperature and pressure. ▪ Hess's law is used to calculate enthalpy change in a reaction.

Reaction Rates Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules.	▪ The rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time. ▪ Reaction rates depend on factors such as concentration, temperature and pressure. ▪ Equilibrium is established when forward and reverse reaction rates are equal. ▪ Catalysts play a role in increasing the reaction rate by changing the activation energy in a chemical reaction.
Organic Chemistry and Biochemistry The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes and chemical properties, and provide the biochemical basis of life.	▪ Large molecules (polymers), such as proteins, nucleic acids and starch, are formed by repetitive combinations of organic monomers. ▪ The bonding characteristics of carbon result in the formation of a large variety of structures, ranging from simple hydrocarbons to complex biological molecules and synthetic polymers. ▪ Amino acids are the building blocks of proteins.

High School Physics	
Content Standards	**Supportive Concepts**
Motion and Forces Newton's laws predict the motion of most objects.	▪ When forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest. ▪ The law $F = ma$ is used to solve motion problems that involve constant forces. ▪ When one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction. ▪ Applying a force to an object perpendicular to the direction of its motion causes the object to change direction. ▪ Circular motion requires the application of a constant force directed toward the center of the circle. ▪ Newton's laws are not exact, but provide very good approximations unless an object is small enough that quantum effects become important.
Conservation of Energy and Momentum The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.	▪ Kinetic energy can be calculated by using the formula $E = (1/2)mv^2$. ▪ Changes in gravitational potential energy near Earth can be calculated by using the formula (change in potential energy) = mgh. ▪ Momentum is calculated as the product mv. ▪ Momentum is a separately conserved quantity different from energy. ▪ An unbalanced force on an object produces a change in its momentum. ▪ The principles of conservation of momentum and energy can be used to solve problems involving elastic and inelastic collisions.
Heat and Thermodynamics Energy cannot be created or destroyed although, in many processes, energy is transferred to the environment as heat.	▪ Heat flow and work are two forms of energy transfer between systems. ▪ The work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature. ▪ The internal energy of an object includes the energy of random motion of the object's atoms and molecules. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object. ▪ Most processes tend to decrease the order of a system over time, so that energy levels eventually are distributed more uniformly.

Waves Waves have characteristic properties that do not depend on the type of wave.	▪ Waves carry energy from one place to another. ▪ Transverse and longitudinal waves exist in mechanical media, such as springs and ropes, and in the Earth as seismic waves. ▪ Wavelength, frequency and wave speed are related. ▪ Sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates. ▪ Radio waves, light and X-rays are different wavelength bands in the spectrum of electromagnetic waves, the speed of which in a vacuum is approximately 3×10^8m/s, and less when passing through other media. ▪ Waves have characteristic behaviors, such as interference, diffraction, refraction and polarization. ▪ Beats and the Doppler Effect result from the characteristic behavior of waves.
Electric and Magnetic Phenomena Electric and magnetic phenomena are related and have many practical applications.	▪ The voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors and capacitors can be predicted using Ohm's law. ▪ Any resistive element in a DC circuit dissipates energy, which heats the resistor. ▪ The power in any resistive circuit element can be calculated by using the formula Power = I^2R. ▪ Charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges. ▪ Magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources. ▪ Changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors. ▪ Plasmas, the fourth state of matter, contain ions, or free electrons or both and conduct electricity.

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ENVIRONMENTAL RISKS OF PESTICIDES IN A RESIDENTIAL SETTING

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INTRODUCTION

One often hears that modern pesticides are environmentally friendly, and that there is no longer much need for concern since applicators are trained and pesticides are regulated by the EPA and the CTDEP Pesticide Division, especially since the real "bad actors" like DDT have been taken off the market. However, a close look at the published data on specific pesticide products as well as more general studies of pesticide persistence in the environment, points to continuing risks from residential pesticide use.[1]

Several large-scale USGS studies pesticides have detected a variety of pesticide compounds in surface waters. A Michigan study reported that pesticide concentrations frequently exceed EPA maximum contaminant levels (MCL's) in streams and small rivers (but not in large rivers) during the spring season of heavy runoff (USGS 1997).[2] This occurs in watercourses with largely suburban/urban watersheds as well as in agricultural areas. Another big study in New York State (46 sites)[3] also found comparable levels and numbers of pesticides and their breakdown products in streams in suburban/urban and agricultural settings. This is evidence on a broad scale that pesticides do not consistently remain contained in the area where they are applied and *do* reach regulated aquatic ecosystems. Numerous studies have also shown a consistent pattern of diminished diversity of benthic macroinvertebrates in streams, corresponding to the extent of development in their watersheds. [4] Pesticide runoff is often suggested as a contributing factor.

Environmental risks vary widely depending on the properties of individual pesticides, such as toxicity, solubility, half life and on the setting in which they are applied, including the terrain, soil type, and proximity of catchbasins, streams and/or wetlands; and the time of year. A USDA guidance document[5] provided data on the

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[1] Consideration of human health risks is not included here.

[2] US Dept. of the Interior. Geological Survey. 1997. *Pesticides in Surface waters*. National Water Quality Assessment (NAWQA), Pesticide National Synthesis Project. Fact Sheet FS 039-97.

[3] US Dept. of the Interior. Geological Survey. April 1997. *Pesticides in Surface waters of the Hudson River Basin, New York, and Adjacent States*. Fact Sheet FS 238-96.

[4] Morley, Sarah A. and James R. Karr December 2002. Assessing and Restoring the Health of Urban Streams in the Puget Sound Basin *Conservation Biology*.16(6) 1498-1509.

[5] USDA-NRCS National Water and Climate Center and US EPA Office of Pesticide Programs. March 2000. Conservation Buffers to Reduce Pesticide Losses.

need for stream buffers over 100 feet in width before highly soluble atrazine herbicides reached an acceptable concentration in groundwater; insoluble products were attenuated much more quickly.

The accompanying Table A12-1 lists several key pesticide properties, including toxicities, movement rating, half-life, solubility, and soil sorption coefficient for most of the active ingredients of insecticides, herbicides, and fungicides currently used in a residential setting, those readily available to homeowners as well as restricted use products, applied only by licensed landscapers. It was compiled from USDA and other Internet sources and government extension specialists. One to several brand names for each active ingredient is listed. (There are large numbers of brand names, many with several active ingredients, which keep changing.) The fine print on the pesticide container always includes the name of the active ingredients, and an Internet search for a pesticide brand name will usually provide a list of active ingredients. Refer to the end of the Residential Pesticides Properties Table A12-1 for explanatory text on toxicity ratings, the different pesticide mobility parameters, and links to the various Internet sources used in compiling the table. The following "primer" on pesticide risks will facilitate use of Table A12-1.

Pesticide Toxicity

Pesticides that do not reach wetlands and watercourses may have *indirect impacts on facultative wetland* and upland biota. Existing toxicity data (See Table A-2) shows that herbicides, insecticides, and fungicides are *often toxic to non-target organisms.* 99+% of all soil and garden invertebrates are harmless non-pests. Insects are the food-base foundation for the disturbance-tolerant wildlife community that persists in rural – residential zones and contributes to quality of life: spring peepers, songbirds, and rarely seen nocturnal creatures like the star-nosed mole also feed on invertebrates. Many songbirds that eat bird seed in winter need "bugs" in other seasons. Toxicity testing has emphasized fish and a few indicator aquatic organisms. Some data is available for additional organism groups (e.g. birds), but not for many pesticide compounds. There are wide ranges in susceptibilities among other different life forms, and testing of all potential targets is simply not practical or feasible. Subtle hormonal impacts are difficult to detect. Pesticide breakdown products may also be toxic, but only limited numbers have been tested.

Fungicides are widely variable in their toxicity ratings. Maneb is highly toxic to fish and non-toxic to bees. A widely used triazole turf fungicide (Triadimefon) is highly toxic to crustaceans – and probably also to other arthopod invertebrates, e.g. soil insects. The persistent and moderately soluble fungicide Thiabenzidole is very toxic to earthworms and moderately toxic to fish. However, Iprodine has a low toxicity rating for fish and birds, and a low movement rating. For fungicides, persistence is a key property, affecting the duration of disruption to the soil-root environment (turf fungicides) and duration of potential for harmful contact with foliage arthopods and their predators (tree/shrub fungicides).

Herbicides are generally less widely and acutely toxic than insecticides, but are usually very mobile, and are not without risk. Atrazine was among the compounds most frequently detected in Connecticut groundwater (Frink 1986).[6] This widely used agricultural herbicide is very similar to residential triazine products. Atrazine was found to affect the hormonal balance of leopard frogs at extremely low concentrations (changing males into females)[7] , which has been proposed as the reason for the rapid demise of this species in New England. The effects of other widely used triazine herbicides on other amphibians have not been systematically tested. Bensulide and Bentazon are toxic to fish and/or invertebrates. *Mode of application* affects the *quantities* used, and therefore potential risk from herbicides; for example cut-stump treatments or targeted foliar spraying of sprouts is recommended for triclopyr (Ortho-brush B-Gon) and glyphosate (in Rodeo and Roundup) by the Connecticut Invasive Plant Working Group. [8] Although these herbicides both have very low toxicity ratings for a variety of organism groups, highly targeted application limits even the potential for unforeseen subtle hormonal or chronic impacts

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[6] Frink, C.R. and L. Hankin. October 1986. *Pesticides in Groundwater in Connecticut*. Connecticut Agricultural Experiment Station Bulletin No. 839. Atrazine is an agricultural herbicide, but closely related herbicides such as Simazine are used in a non-farm setting.

[6] Research on hormonal alteration by atrazine was conducted by Tyrone Hayes at the University of California at Berkley, andwas reported in the April 2002 issue of Proceedings of the National Academy of Science. Does as low as 0.1 ppb induced feminizing changes; 3 ppb is the drinking water standard for Atrazine.

[7] Invasive Plant Management Guide on the web site of the Connecticut Invasive Plant Working Group (CIPWG) at http://www.hort.uconn.edu/cipwg/

Insecticides are formulated to control arthopods, and are therefore usually toxic to large numbers of insect species other than targeted pests. They impact major food sources for small mammals, birds, and tree frogs, both in vegetation and below ground. Even rapidly biodegradable pesticides may have longer lasting impacts due to disruption of existing communities. Most of the organophosphates and synthetic pyrethroids are also highly toxic to fish and often to birds. Seed-eating birds often consume pelletized pesticides. "Organic " alternatives with less toxic properties are included in Table A12-1. The *quantities* used influence the level of risk, which is obviously lower from application to a single infested shrub compared to treatment of a whole yard or lawn.

Pesticide Mobility

Potential for movement greatly influences the risk pesticides pose to off-site resources. Especially for the insecticides with high aquatic toxicity, this is a key property. Because broad-spectrum grub insecticides must penetrate the soil to be effective, they must have some mobility in the soil and moderate persistence, and therefore may affect not only the lawn itself, but also the soil in adjacent naturally vegetated areas. For example, Merit (with Imidochloprid) has a half-life of 48 to 190 days and moderate solubility in water. Grub insecticides and fertilizers are often applied in a *pelletized formulation*, which slows release, but is also vulnerable to being *washed downslope* during high intensity storm events. Such storms also dislodge *pesticides that adsorb strongly to soil particles*, for example diazinon, a toxic, persistent, hydrophobic organochlorine pesticide.[9] Likewise they dissolve soluble pesticides. Runoff may end up either in adjacent wetlands or setback areas, or may reach streams after flow into the street and thence into catchbasins and the storm drainage system. Several studies have shown elevated concentrations of hydrophobic organochlorine pesticides *after high surface runoff* (e.g. Hunt et al 1995[10]). Even well-designed, above-ground stormwater management systems do not have the capacity to treat most pesticides within a few days, because pesticide half lives are too long. (See Table A12-1).

Slope steepness and soils are key factors determining whether lawn runoff will infiltrate, or flow downhill as runoff. On a steep slope with shallow bedrock or hardpan, the shallow groundwater table often intersects the ground surface,

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[9] Fisheries biologists at the CT Department of Environmental Protection, have attributed several fish kills to runoff from sloping lawns in residential neighborhoods.

[10] Hunt, Anderson, Phillips, Tjeerrdema, Puckett, and deVlaming. July 1999. Patterns of aquatic toxicity in an agriculturally dominated watershed in California. *Agriculture, Ecosystems, and the Environment*. 75(1/2): 75-91.

resulting in seeps and springs[11], which reduces the *travel time* through soil and therefore the effective width of the wetland setback in filtering/transforming pesticides or other pollutants, by means of a variety of biotic and abiotic processes.[12]

Lack of movement does not necessarily mean that a product is risk free. The fungicides and insecticide formulations applied to woody ornamentals usually include adhesive additives that reduce washing off. This also means their toxic effects (and potential to harm non-target organisms) may persist *in place* for extended time periods, although risks to nearby streams is low. If a pesticide has not degraded before leaf fall, residues on leaves may still be blown to vulnerable resources.

IMPACTS MINIMIZATION

Data is available to help select pesticides with minimal risk in a particular setting, but this involves complicated, careful analysis. Many data gaps remain relating to impacts on non-target organisms and impacts of breakdown products or the effects of interactions with other pesticides. Following are four potential approaches to minimization of pesticide impacts from landscaping:

1) *A Conservative Integrated Pest Management Plan* [13] emphasizes measures to promote healthy, disease-resistant growth and biological/ cultural controls, allowing very limited pesticide use, based on careful screening of pesticide properties, using predetermined thresholds, and targeted application methods. "Emergency" pesticide selection follows the site-specific USDA (WINPST) approach, considering pesticide movement potential in relation to soil, topography, and landscape properties.

2) *Organic landscaping* is less complicated to implement, although a fully "organic" approach may not always be acceptable to residents. Guidance documents are available. [14] Both these approaches not only protect downgradient wetlands and watercourses, but also provide safe foraging

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[11] Ritter, Kochel and Miller. 1978, 1986, and 1995. *Process Geomorphology, 3rd Edition*. William C. Brown Publishers.

[12] Hemmond and Fisher. 1994. *Chemical Fate and Transport in the Environment*. Academic Press, San Diego. 337 pp.

[13] Many so-called IPM plans do in fact allow use of toxic products with potential to harm non-target organisms and fail to consider all pesticide properties, topography, soils, & local groundwater resources.

[14] *Standards for Organic Lawn Care – Practices for Design and Maintenance of Ecological Landscapes.* 2001. Organic lawn Care Committee of the Connecticut and Massachusetts Chapters of the Northeast Organic Farming Association (NOFA), PO Box 386 Northford, CT. Kimberly Stoner, PHD, Chair.

habitat for songbirds and other wildlife *within* a residential setting. Either of these approaches requires an organized residential community where landscaping is controlled by a single entity.

3) *Site design* is the appropriate approach for new projects where pesticide use by individual landowners cannot practically be regulated, e.g. a conventional subdivision with individually owned homes. Open space acquisition may be needed if resources are especially sensitive or valuable. In these situations, nearby watercourse resources (although not on-site fauna and flora) may be protected by broad setbacks to wetlands, especially where slopes are steep. Natural berms may protect resources from pesticide runoff, and low berms or grading can prevent lawn runoff from reaching storm drains, or optimally a by a “soft” street drainage system (without storm drains).

4) *Education* is a tool available to help individuals effectively use organic approaches and/or appropriately select low-risk pesticides when needed.

STREAM BIOSURVEYS

Introduction

Organic pollution in streams can result in the loss of many desirable aquatic species including fish and mussels

As human populations have grown, more and more pollution of our waters has occurred, both from point source discharges and as nonpoint or diffuse pollution. There are several categories of pollution associated with the aquatic environment (e.g. toxic pollution), but one of the most common categories is *organic pollution*. This is caused by oxygen-demanding wastes such as domestic sewage, leachate from landfills, and agricultural and urban runoff.

The natural processes of chemical oxidation and biological decomposition that occur within water-courses, consume dissolved oxygen. Decomposition of materials is a normal process in all aquatic ecosystems and is a function of decomposers such as bacteria and fungi. These organisms play an important role by metabolizing organic matter as an energy and nutrient source and use dissolved oxygen in the process.

However, serious consequences to aquatic organisms can result if the natural mechanisms that clean the water are overloaded by large influxes of organic pollution. Severe oxygen depletion can result in the loss of many desirable aquatic species including fish (e.g. trout) and mussels, and aquatic organisms such as stoneflies and mayflies.

Water Quality Testing

Traditional Methods

The long-term effects of nonpoint source pollution, such as that from urban runoff, have often been determined through chemical monitoring. In recent years, however, a growing body of literature has emerged that points to the importance of biological monitoring. Many states are now selecting biological and physical monitoring over traditional chemical monitoring in

their efforts to determine the health of aquatic ecosystems, and for watershed and landuse planning purposes.

A single sampling of stream chemical constituents only provides a snapshot of water quality

Traditional water quality sampling methods have emphasized analyses of physical and chemical parameters such as dissolved oxygen, pH, temperature, nitrates, phosphates, and others. Although useful, this approach has several limitations. There are many chemical constituents that could theoretically result in water quality degradation. Not only are some of these very expensive to analyze, but their sheer number increases the likelihood that a pollutant will not be identified. A single sample can only provide a "snapshot" of water quality on the day of sampling, and may provide no information on recent degraded conditions which have since cleared up, but whose effect upon aquatic biota may be more lasting.

Benthic Organism Sampling

Biosurvey Methods

The technique of stream benthic organism or macroinvertebrate sampling was developed more than 50 years ago to complement traditional chemical water quality approaches, as well as to provide new information not available through other methodologies. This includes information about effects from multiple stressors (e.g. chemicals, sedimentation, exotic species, etc.) arising from point sources, nonpoint sources, habitat alteration, and hydrological changes. For example, ecological responses to such disturbances can be observed at the community level of organization of benthic macroinvertebrates, offering dependable and readily observable indicators that integrate the impacts of multiple, and often subtle, stressors.

What Are Benthic Macroinvertebrates?

Benthic organisms can serve as biological indictors of water pollution

The term "benthic" means bottom-dwelling. Benthic macroinvertebrates are organisms without backbones that live in, crawl upon, or attach themselves to bottom substrates (e.g. sediments, debris, logs, plants, filamentous algae, etc.). The term "macroinvertebrate" refers to those organisms that are large enough to be viewed without the aid of a microscope and that are retained by a sieve with mesh sizes greater or equal to 200 to 600 micrometers (i.e. #30 mesh). Benthic macroinvertebrates include immature insects (larvae and nymphs), worms, crustaceans, mollusks, (clams and mussels), leeches, mites and snails. Insect larvae tend to be the most abundant macroinvertebrates in freshwater aquatic systems.

The majority of benthic macroinvertebrates are found in the riffles (i.e. erosional areas) of streams. Riffles range from uneven bedrock to cobbles to boulders. The optimum riffle area contains gravel-sized (1-inch diameter) to cobble-sized (10-inch diameter) substrate. The flow of water over these areas provides plentiful oxygen and food particles. Riffle-type organisms may also be associated with submersed or overhanging fallen woody debris. Riffle-dwellings communities are made up of macroinvertebrates that generally require high dissolved oxygen levels and clean water. Most of these

organisms are intolerant to pollution. In slow flow areas such as runs and pools (depositional areas), decomposer communities, which tolerate lower dissolved oxygen levels and higher organic matter and sedimentation, are typically more abundant. Riffle-dwelling communities are more sensitive to increasing pollution than communities in the pools or slow flowing areas of the same stream.

There are four primary feeding groups of benthic macroinvertebrates: shredders, filter collectors, grazers, and predators. Shredders such as stoneflies (*Plecoptera*) feed on plant material and some animal material, which is generally dead, and break it down into smaller particles through their feeding and digestive process. Collectors, such as caddisflies (*Trichoptera*) and blackflies (*Diptera*), feed on fine particulate matter that they filter from the water. Grazers, such as snails and beetles (*Coleoptera*), feed on algae and other plant material living on rocks and on plant surfaces. Predators such as dobsonflies (*Megaloptera*) or dragonflies (*Odonata*) feed on other macroinvertebrates. Individual species may be generalists, and fit into more than one of these groups (as opposed to specialists).

Benthic macroinvertebrates, as a group, exhibit a relatively wide range of response to chemical and physical water quality stressors (pH, temperature, dissolved oxygen, organic pollutants, heavy metals, sedimentation, etc.) and thus can serve as ***biological indicators*** of water pollution. Some organisms are tolerant of degraded water quality conditions, while others are pollution-sensitive. Many snails, worms and midge larvae belong to the former group, while the most widely recognized members of the latter group are the *Plecoptera* (Stoneflies), *Ephemenoptera* (Mayflies) and *Trichoptera* (Caddisflies).

In most cases, unpolluted streams will support a diverse population of macroinvertebrates

Some pristine streams have a low diversity of macroinvertebrate fauna because of the cold temperature and/or relatively low nutrient levels. Headwater streams may have only two or three dominant species. In most cases, however, an unpolluted stream will support a diverse population of macroinvertebrates, with pollution-sensitive species well represented. However, species diversity declines as water quality deteriorates and pollution-tolerant organisms become increasingly dominant.

Advantages of Macroinverterbrate Sampling

Plafkin et al. (1989) list several advantages of sampling stream macroinvertebrates in order to make inferences about water quality:

1. Since most stream macroinvertebrates have limited migration patterns or are sessile and spend much time clinging to rocks or the stream substrate, and do not move long distances, they are good indicators of localized water conditions.

2. Aquatic organisms integrate the effects of chemical, physical and biological parameters. Conducting an aquatic biosurvey will thus increase the likelihood that a degraded condition will be detected, if present.

3. Since most of these species have a relatively short life cycle (approximately one year), they will respond to stressors more rapidly than other longer-lived components of the community (e.g. fish).

4. Sampling techniques are rapid and inexpensive. An experienced biologist can detect degraded water conditions with only a cursory, or qualitative, examination of the macroinvertebrate community.

5. Benthic macroinvertebrates are a primary food source for fish, and as such can provide valuable information on the relative health of the fish community.

6. Benthic macroinvertebrates are common to abundant in most streams.

Sampling Methods

The simplest method of collecting stream macroinvertebrates is to inspect in-stream rocks for attached organisms, or disturb the stream substrate while placing a net downstream to gather dislodged biota in a predetermined number of sampling locations, often 11 approximately one foot square areas of substrate in the state of Connecticut. Depending upon the nature of the study, the organisms are identified to either the family, genus or species level. Family-level identification is most expeditious, and is the technique most commonly used. However, it is less precise since members of some stream macroinvertebrate families show a range of pollution tolerances, and the sensitivity of these families can only be expressed as an average (Hilsenhoff 1988).

Measuring Biological Health

The Biotic Index

A variety of useful indices or measurements (metrics) have been developed for assessing the health of streams through benthic macroinvertebrate sampling. These include: taxa richness, EPT Index or richness, percent abundance of EPT, percent dominance, percent dominance of scrapers, Hilsenhoff s Biotic Index (HBI), EPT:chironomid ratio, Pinkham and Pearson community similarity index, and many others.

Of these, and there are many, Hilsenhoff s (1988) biotic index (HBI) is one of most commonly used. Hilsenhoff developed a rapid stream biosurvey methodology that requires identification of macroinvertebrates to family-level. This method assigns a numerical score (biotic index) ranging from 0 to 10 to the most common stream macroinvertebrate taxa. The biotic index is directly related to the degree of pollution-tolerance and is based on field and laboratory responses of organisms toward organic pollution.
Approximately 100 organisms are collected and randomly sampled from a variety of habitats within the stream, including erosional and depositional areas (e.g. riffles and runs). The organisms are identified to family-level and the total number (**n**i) of each is recorded. The following formula is then used for the estimation of the Family-level Biotic Index (FBI):

$$\boldsymbol{FBI} = \frac{\Sigma\, \mathbf{n}i\ \mathbf{a}i}{N}$$

where:

ni = the number of specimens in each taxonomic group

ai = the pollution tolerance score for the taxonomic group (see Table 1)

N = the total number of organisms in the sample (usually 100).

Ideally, the Family-level Biotic Index should be calculated during several different times of a year (e.g spring, summer and fall) and compared with reference sites within the particular watershed or in the region for more accurate conclusions to be drawn.

Who Can Take This Pollution?

Introduction

It is well documented that pollution of streams reduces the number of species of the aquatic ecosystem, (i.e. species diversity), while frequently creating an environment that is favorable to only a few species (i.e. pollution-tolerant forms). Thus, in a polluted stream, there are usually large numbers of a few species, while in a clean stream there are moderate numbers of many species.

For instance, turbidity reduces light penetration and submerged aquatic plant productivity. Thus turbidity will affect those macroinvertebrates depending on plant matter for food and those that rely heavily on visual location of prey (predators). Filter feeders' filtering mechanisms may also be blocked by sediment particles associated with turbid waters. Turbidity also tends to increase temperature in waters and is often associated with higher organic decomposition. These are conditions that reduce oxygen levels and may result in impacts to many gill-breathing mayfly, stonefly, and caddisfly larvae that thrive only where there is abundant oxygen in the water. As turbidity increases - and turbidity is often associated with other pollutants such as nutrients, PAH s, and heavy metals - rock dwelling or attaching macroinvertebrates such as mayflies, stoneflies, and caddisflies, will be replaced by silt-tolerant and pollution tolerant macroinvertebrates that can tolerate low oxygen levels in the water or that can breath atmospheric oxygen. For example, rat-tailed maggots have snorkel-like breathing tubes, some snails have lungs (e.g. *Physa* spp.), and midges (chironomids) and worms (oligochaetes) have respiratory pigments which enable them to more efficiently obtain oxygen that is in low concentrations.

Pollution *Intolerant* Macroinvertebrates

The following are some typical macroinvertebrate groups (taxa) commonly encountered in streams and that usually indicate ***good water quality***.

Mayflies

Mayfly nymphs are often the most numerous organisms found in clean streams. They are sensitive to most types of pollution, including low dissolved oxygen (less than 5 ppm), chlorine, ammonia, metals, pesticides and acidity. Most mayflies are found clinging to the undersides of rocks.

Stoneflies

Stonefly nymphs are most limited to cool, well-oxygenated streams. They are sensitive to most of the same pollutants as mayflies except acidity. They are usually much less numerous than mayflies. The presence of even a few stoneflies in a steam usually suggests that good water quality has been maintained for several months prior.

Caddisflies

Caddisfly larvae often build a portable case of sand, stones, sticks, or other debris. Many caddisfly larvae are sensitive to pollution, although a few are moderately tolerant. One family spins nets to catch drifting plankton, and is often numerous in recovery zones below sewage discharges.

Beetles

The most common beetles in streams are riffle beetles and water pennies. Most of these require swift current and an adequate supply of oxygen, and are generally considered to be clean water indicators.

Pollution *Tolerant* Macroinvertebrates

The following are some typical macroinvertebrate groups that are commonly encountered in streams and which usually indicate ***poor water quality***.

Midges

Midges are the most common aquatic flies. The larvae occur in almost any aquatic situation. Many species are very tolerant to pollution; most of these are red and are called bloodworms . Other species filter suspended food particles, and are numerous in sewage outfall recovery zones.

Worms

The segmented worms include the leeches and the small aquatic earthworms. The latter are more common, though usually unnoticed. They burrow in the substrate and feed on bacteria in the sediment. They can thrive under conditions of severe pollution and very low oxygen levels.

Sowbugs

Aquatic sowbugs are crustaceans that are often numerous in situations of high organic content and low oxygen levels. When abundant they can indicate a stream segment in the recovery stage of organic pollution.

Black Flies

Black fly larvae have specialized antennae for filtering plankton and bacteria from the water, and require a strong current. Most species are numerous in the decomposition and recovery zones of sewage outfalls and are generally indicative of at least moderate levels of organic pollution.

How have Landuses Affected the Quinnipiac River & its Tributaries?

The water quality of any waterway reflects both the landuses and the geology of its watershed (drainage area), in terms of the mix of chemical constituents, including metals, nutrients, and other pollutants of human origin.

Farms, Yards and Construction Sites

In colonial days up until the beginning of the 1900's much more of the land close to streams and rivers was cleared for farming. This meant soil and manure washed excessive nutrients into streams. Excess fertilizer and pet droppings, streamside clearing, and runoff from construction sites have similar effects. Less shade on watercourses usually means warmer water temperatures and lower dissolved oxygen levels, and fewer "sensitive" aquatic invertebrates. Riverbound Farm in Northeast Cheshire and the north part of Quinnipiac River State Park, in North Haven both had farms along the Quinnipiac River in the beginning of the century. Farming still affects water quality, especially by two major tributary streams on the east side of the watershed, Wharton Brook in Wallingford and the mid and lower Muddy River in North Haven.

Filling Wetlands

Filling wetlands in the upper watershed causes downstream flooding, and also summer low flow problems, as water storage capacity is diminished. This has happened along Harbor Brook in Meriden, and also along parts of Misery Brook in the southeast corner of Southington.

Industrial Discharges & Runoff from Impervious Surfaces

The extent of water quality impacts of point discharges from industrial landuses depends on the effectiveness of pollution regulations. Before the 1972 Clean Water Act was passed, industrial pollution was very severe along the mainstem of the Quinnipiac; only very pollution tolerant aquatic organisms could have survived. Pollutants left over from this era may still contaminate river sediment and riverside soils. Polluted ground water sometimes still seeps into waterways, especially in older manufacturing areas.

Industrial and commercial landuses and highways occupy much land area along the mainstem river, especially in Plainville, Southington, Wallingford, and in the lower watershed. Much of these areas are occupied by pavement and rooftops, which are non-absorbant. Pollutants like heavy metals, leaking vehicle fluids and fine dust from engine, tire, and road wear wash into catch basins and then into the river. Air pollution fall-out also washes off roads and roofs. Litter washes into catchbasins, though culverts, and then into streams. This nonpoint source pollution can be reduced by specially designed grassed swales, filter cartridges, and biofilter detention ponds, etc. Today, somewhat pollution—tolerantmacro-invertebrates, like midge larvae are common along the main stem Quinnipiac River, but not more pollution-sensitive creatures, like stoneflies and mayflies.

Forested Watersheds

Pollution intolerant creatures (stoneflies and mayflies) live in mostly forested cleaner upper tributaries of the Quinnipiac River, which drain off our trap rock ridges and off Mt. Southington, a granite-schist-gneiss ridge.

References:

Hilsenhoff, W. L. 1988. Rapid field assessment of organic pollution with a family-level biotic index. J. N. Am. Benthol. Soc. 7(1):65-68.

Plafkin, J. L, M. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. Rapid Bioassessment Protocols for use in streams and rivers. US EPA. EPA/440/4-89/001

Map produced by the CT DEP

Developed and produced by ***Rema Ecological Services, LLC*** of Manchester, Connecticut, on behalf of the Quinnipiac River Watershed Association, for the River Resources Educational Series, and the Adopt-the-River Programs with funding from the Community Foundation for Greater New Haven and the CT DEP through the US EPA NPS grant under Section 3.19 of the Clean Water Act. Written by George T. Logan & Sigrun N. Gadwa. Available from ***QRWA***, 99 Colony Street, Meriden, CT 06418 (203-237-2237) for $8.00 ($5.00 for QRWA members and students).

Storm Drain: Where Does the Water Go?

Do you know that difference between a "storm drain" and a "sewer drain"? Most people don't realize that these are two separate systems. The sewer drain carries sewage from your house and is processed and treated at the Water Pollution Control Facility. The large circular plates you see in the middle of the street are actually manhole covers for the sewer lines.

Storm drains or catch basins are the open or grated drains you see at the sides of the road by the curb. These drains collect all the water run-off from street to help in flood control. The big difference between these systems is that this water is NOT processed or treated. This water goes directly to streams, brooks and rivers. Some of these water sources are actually part of the public drinking water system.

Many people ask "so why put a storm drain in an areas that have the potential to directly pollute our water ways". The answer is that storm drains are designed to reduce the potential for road flooding, including parking lots and highways. It is the responsibility of all residents to protect the water, both drinking and recreational.

How do we do this? Simple: Don't' put anything directly into the storm drains that could pollute the water. Some examples include waste oil or other auto fluids generated from routine car maintenance, leaves that you remove from your property, litter and dog feces. These items are also called "non-point source pollution".

So what do you do with your auto fluids, leaves and dog feces? Auto fluids and yard waste should be properly recycled, contact your local Public Works Dept. concerning the location and operation times of recycle centers or create a backyard compost for yard debris. Dog feces should be bagged and placed with your normal household garbage. Teach young children not to throw gum wrappers or other litter into the street.

What should you do if you see someone dumping in a catch basin? First, try to educate the person, maybe they don't realize that they are polluting the water. Also contact your local health department so that we may educate the person dumping. If the person continues to dump, they may face legal action. You should also contact your local Public Works Department if you notice a catch basin in need of cleaning.

Safe and clean water is everyone's responsibility.

Submitted by: Scott Bryden, RS, MBA
Environmental Health Administrator
City of Meriden, Health Dept.

Quinnipiac River Watershed Association

Dedicated to the preservation of the Quinnipiac River and its watershed

THICKETS AND EDGES?

(Excerpt from QRWA River Resources booklet, Taking a Close Look at Stream-side Woods, 1996)

Because sunshine reaches river banks through the opening over the river,and because banks are often battered and eroded by floodwaters, they are colonized by many of the same "disturbance" or "edge" plants, which come up in a forest clearing or at the edge of a field or on exposed, bare soil. Also, past farming, logging, sand and gravel-mining, or filling and grading for roads may have left their marks, in the woods by a stream or river, as elsewhere in the watershed. Unnatural landforms (berms, ditches, or pits), walls or foundations, or debris (tailings or brush piles) are important clues to past activities. Plants' growth forms and types of seed or fruit are also helpful in reading disturbance history.

Blackberry Thicket

Disturbance communities occur throughout the watershed, from Meriden's urban stream banks, to temporarily abandoned construction sites, to hedges between Cheshire's farm fields, to fill banks along the salt marsh near State St. in Hamden. One excellent example of a disturbance community is the former Banton Street neighborhood in Quinnipiac River State Park in North Haven, abandoned and demolished by the State of Connecticut about

tweny years ago due to severe flooding. Another is the former lakebed of Community Lake in Wallingford, which has grown up since the great dam breech of 1979.

HOW DO THEY FUNCTION? A young patch of woods at a disturbed site is often written off as nearly useless. Although young woods may not appeal to hikers, they are preferred by many wildlife species like deer, ruffed grouse, and blue-winged warblers.Young woods have good protective cover and food for wildlife due to several common traits of colonizing plants: (1) bushy, fast growth in plenty of light and (2) abundant berries or seeds for good dispersal to newly disturbed areas. This is the case even for invasive, alien species like asiatic bittersweet. Many good colonizers also have function well as wildlife habitat, as colorful, if untidy, scenery, and for filtering pollutants. Dense thickets make well-hidden nest sites and offer good protection from harsh weather. Berries are important food forbirds like towhees and cardinals, some, like bayberry and sumac, linger through the winter, feeding many migrants as well. Abundant & relatively large grass & sedge seeds feed sparrows and rodents. The twigs and leafy undergrowth of a fast-growing "early successional" thicket provide plenty of browse for deer and rabbits.

Thick, low vegetation takes up nutrients and pollutants as well as mature forest, and may even be better at filtering storm water carrying sediment. In time, there will be tall, scenic trees overhanging and shading the river, providing wildlife dens, and shedding leaf litter for the aquatic food chain.

On the other hand disturbed young woods is apt to grow up into a forest with few plant species which grow poorly in bright light or spread their seeds poorly. Alien shrubs like Russian Olive and Multiflora Rose, and vines like Asiatic Bittersweet often crowd out native species. The reed phargmites also spreads rapidly in bright sun, crowding out other kinds of plants, until the woods is mature enough to provide some shade.

READING DISTURBANCE COMMUNITIES Bare soils: Are there many plants with tiny seeds that are easily blown by wind - birches and speckled alder or fluffy-seeded willows and cottonwoods? Do you notice annual plants like orange-flowered jewelweed or the nettle relative, clearweed? Annual weeds and tiny-seeded woody plants have a hard time seeding into established vegetation, but readily colonize bare soil exposed by sediment deposits, erosion on river banks, or by human disturbance. Trees with larger, winged seeds like those of maples, elms, ashes, and catalpa are good at reaching bare soil on river banks. So are heavy berry producers like silky dogwood and red-fruited sumacs. Look for traces of earth-moving like ruts or berms. To identify fill, check for a lack of natural topsoil and buried debris, but watch out

for hazardous materials!

Pastures: Do you see a tree with a rounded shape next to many pole-like ones? This is a clue that the rounded one was once growing in the open, perhaps as a shade tree in a pasture by a stream. Are there many prickly or distasteful species? Livestock and most wildlife don't graze red cedar, multiflora rose, thorny black locust, and bitter black cherry. Species like sumac and locust, which sprout from parent plant's roots, do well in former pastures, where sprouts can survive better than seedlings. Stone walls are a another sign of former farmland.

Lumbered areas and tree fall gaps: Even in mature forests logged in colonial times you can find clusters of trunks from stump sprouts of oak, hickory, and maple. Are there many light-loving heavy seed producers like birches and black cherries, which would have sprung up in a forest gap?

Back to Publications

APPENDIX C

PUBLIC NOTICES

APPENDIX D

IDDE OUTFALL INVENTORY FORM

CITY OF MERIDEN - OUTFALL RECONNAISSANCE INVENTORY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Watershed:		Outfall ID:	
Receiving Water:		Surface Water Quality Classification:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours: Last 48 hours:		
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	
Land Use in Drainage Area (Check all that apply): ☐ Industrial ☐ Commercial ☐ Ultra-Urban Residential ☐ Suburban Residential ☐ Open Space ☐ Institutional		Other: _____ Known Industries: _____	
Notes (e.g.., origin of outfall, if known):			

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☐ Circular ☐ Elliptical ☐ Box ☐ Other: _____	☐ Single ☐ Double ☐ Triple ☐ Other: _____	Diameter/Dimensions: _____	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: _____	☐ Trapezoid ☐ Parabolic ☐ Other: _____		Depth: _____ Top Width: _____ Bottom Width: _____	
☐ **In-Stream**	**(applicable when collecting samples)**				
Flow Present?	☐ Trickle ☐ Moderate ☐ Substantial *or* Estimated Flow Rate: _____ ☐ No Flow ***If No, Skip to Section 5***				
Illicit Discharge?	☐ Unlikely ☐ Potential ☐ Suspect ☐ Obvious				

Section 3: Physical Indicators for Flowing Outfalls Only (*Skip to Section 4 if not applicable)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY 1= slight, 3=severe
Odor	☐		
Color	☐		
Turbidity	☐		
Floatables (NotTrash)	☐		

Section 4: Physical Indicators for Both Flowing and Non-Flowing Outfalls (*Skip to Section 56 if not applicable)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS/CONCERNS (e.g. in need of repair)
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 5: Data Collection

Sample for the lab? ☐ Yes ☐ No	2. If yes, collected from: ☐ Flow ☐ Pool	Flow trap set? Type ☐ Yes ☐ No:

APPENDIX E

FIELD SAMPLING PLAN

FIELD SAMPLING PLAN

City of Meriden
Phase II Stormwater General Permit

Sampling Event Description: 2004 and 2005 Annual Phase II Stormwater Sampling

Projected Sampling Date: Summer 2005

Sampling Objective:

To comply with the monitoring requirements of the General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems.

Samples will be collected consistent with the General Permit; at least two outfalls apiece shall be monitored from areas of primarily industrial development, commercial development and residential development, respectively, for a total of six (6) outfalls monitored.

Sampling Locations:

Residential Land Use

- **Outfall 1:** David Drive
- **Outfall 2:** Hanover opposite Park Place

Commercial Land Use

- **Outfall 3:** East Main Street immediately east of Research Parkway
- **Outfall 4:** Cook Avenue near Summer Street

Industrial Land Use

- **Outfall 5:** End of Milk Street
- **Outfall 6:** Center Street @ Spartan Tool (adjacent to North Colony)

Parameters:

Parameters to be monitored shall be tested according to methods prescribed in Title 40, CFR, Part 136 (1990) and shall include:

- pH (SU) – of both sample and uncontaminated rainfall
- Hardness (mg/L)
- Conductivity (umos)
- Oil and Grease (mg/L)
- Chemical Oxygen Demand (mg/L)
- Turbidity (NTU)
- Total Suspended Solids (mg/L)
- Total Phosphorous (mg/L)
- Ammonia (mg/L)
- Total Kjeldahl Nitrogen (mg/L)
- Nitrate plus Nitrite Nitrogen (mg/L)
- E. Coli (col/100 mL)

Stormwater Monitoring Procedures:

Samples shall be collected from discharges resulting from a storm event that is greater than 0.1 inch in magnitude and that occurs at least 72 hours after any previous storm event of 0.1 inch or greater. Runoff events resulting from snow or ice melt cannot be used to meet the minimum annual monitoring requirements. Grab samples shall be used for all monitoring. Grab samples shall be collected during the first 6 hours of a storm event discharge. The uncontaminated rainfall pH measurement shall also be taken at this time. Samples for all discharges shall be taken during the same storm event.

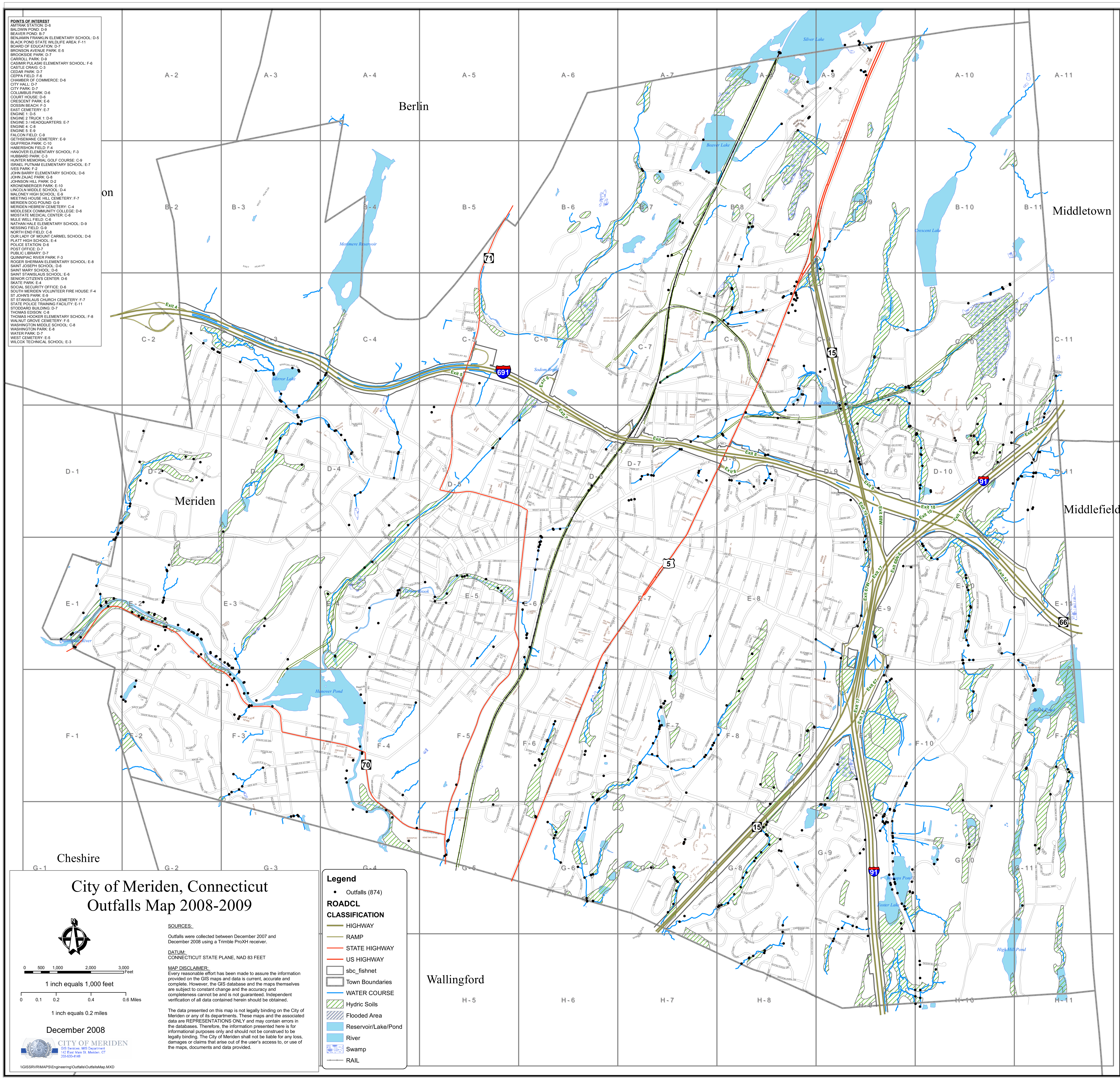
Storm event information including the date, temperature, time of start of the discharge, time of sampling, and magnitude (in inches) of the storm event sampled shall be collected for the storm events monitored.

APPENDIX F

STORMWATER MONITORING RESULTS

APPENDIX G

STORMWATER OUTFALL MAP



City of Meriden, Connecticut
Outfalls Map 2008-2009

POINTS OF INTEREST
AMTRAK STATION: D-6
BALDWIN POND: D-9
BEAVER POND: B-7
BENJAMIN FRANKLIN ELEMENTARY SCHOOL: D-5
BLACK POND STATE WILDLIFE AREA: F-11
BOARD OF EDUCATION: D-7
BRONSON AVENUE PARK: E-5
BROOKSIDE PARK: D-7
CARROLL PARK: D-9
CASIMIR PULASKI ELEMENTARY SCHOOL: F-6
CASTLE CRAIG: C-3
CEDAR PARK: D-7
CEPPA FIELD: F-6
CHAMBER OF COMMERCE: D-6
CITY HALL: D-7
CITY PARK: D-7
COLUMBUS PARK: D-6
COURT HOUSE: D-6
CRESCENT PARK: E-6
DOSSIN BEACH: F-3
EAST CEMETERY: E-7
ENGINE 1: D-5
ENGINE 2 TRUCK 1: D-6
ENGINE 3 / HEADQUARTERS: E-7
ENGINE 4: C-8
ENGINE 5: E-9
FALCON FIELD: C-9
GETHSEMANE CEMETERY: E-9
GIUFFRIDA PARK: C-10
HABERSHON FIELD: F-4
HANOVER ELEMENTARY SCHOOL: F-3
HUBBARD PARK: C-3
HUNTER MEMORIAL GOLF COURSE: C-9
ISRAEL PUTNAM ELEMENTARY SCHOOL: E-7
IVES PARK: F-2
JOHN BARRY ELEMENTARY SCHOOL: D-6
JOHN ZAJAC PARK: G-8
JOHNSON HILL PARK: D-2
KRONENBERGER PARK: E-10
LINCOLN MIDDLE SCHOOL: D-4
MALONEY HIGH SCHOOL: E-9
MEETING HOUSE HILL CEMETERY: F-7
MERIDEN DOG POUND: G-9
MERIDEN HEBREW CEMETERY: C-4
MIDDLESEX COMMUNITY COLLEGE: D-6
MIDSTATE MEDICAL CENTER: C-6
MULE WELL FIELD: C-6
NATHAN HALE ELEMENTARY SCHOOL: D-9
NESSING FIELD: G-9
NORTH END FIELD: C-8
OUR LADY OF MOUNT CARMEL SCHOOL: D-6
PLATT HIGH SCHOOL: E-4
POLICE STATION: D-6
POST OFFICE: D-7
PUBLIC LIBRARY: D-7
QUINNIPIAC RIVER PARK: F-3
ROGER SHERMAN ELEMENTARY SCHOOL: E-8
SAINT JOSEPH SCHOOL: D-6
SAINT MARY SCHOOL: D-6
SAINT STANISLAUS SCHOOL: E-6
SENIOR CITIZEN'S CENTER: D-6
SKATE PARK: E-4
SOCIAL SECURITY OFFICE: D-6
SOUTH MERIDEN VOLUNTEER FIRE HOUSE: F-4
ST JOHN'S PARK: E-9
ST STANISLAUS CHURCH CEMETERY: F-7
STATE POLICE TRAINING FACILITY: E-11
STODDARD BUILDING: D-7
THOMAS EDISON: C-8
THOMAS HOOKER ELEMENTARY SCHOOL: F-8
WALNUT GROVE CEMETERY: F-5
WASHINGTON MIDDLE SCHOOL: C-8
WASHINGTON PARK: E-8
WATER PARK: D-7
WEST CEMETERY: E-5
WILCOX TECHNICAL SCHOOL: E-3

0 500 1,000 2,000 3,000 Feet
1 inch equals 1,000 feet
0 0.1 0.2 0.4 0.6 Miles
1 inch equals 0.2 miles

December 2008

CITY OF MERIDEN
GIS Services, MIS Department
142 East Main St, Meriden, CT
203-630-4148

SOURCES:
Outfalls were collected between December 2007 and December 2008 using a Trimble ProXH receiver.

DATUM:
CONNECTICUT STATE PLANE, NAD 83 FEET

MAP DISCLAIMER:
Every reasonable effort has been made to assure the information provided on the GIS maps and data is current, accurate and complete. However, the GIS database and the maps themselves are subject to constant change and the accuracy and completeness cannot be and is not guaranteed. Independent verification of all data contained herein should be obtained.

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\\GISSRVR\MAPS\Engineering\Outfalls\OutfallsMap.MXD

Legend
Outfalls (874)
ROADCL CLASSIFICATION
HIGHWAY
RAMP
STATE HIGHWAY
US HIGHWAY
sbc_fishnet
Town Boundaries
WATER COURSE
Hydric Soils
Flooded Area
Reservoir/Lake/Pond
River
Swamp
RAIL

ABBEY PARK: E-9
ADAMS ST: F-5
AKRON ST: E-6
ALANBY DR: C-2, D-2
ALCOVE ST: E-5
ALEXANDER DR: C-10, C-11, D-10
ALLEN AVE EXT: E-1
ALLEN AVE: D-1, D-2, D-3, D-4, E-2, E-3
ALLEN CT: D-4
AMES AVE: D-5
AMITY ST: B-8
ANDREA HGTS: E-2, E-3
ANDREWS ST: C-5, D-5
ANN PL: E-6
ANN ST: E-6, E-7, F-7, F-8
ANN VIEW TERR: F-7
ANTHONY TERR: G-5, G-6
ANTONIO AVE: D-4
APPLEWOOD DR: G-5
ARCH PKWY: D-7
ARCH ST: D-7
ARLINGTON ST NO: E-10, E-9
ARLINGTON ST: E-9
ARTIZAN ST: C-8
ATKINS ST EXT: D-8, D-9
ATKINS ST: D-8
ATRIUM: E-10
AVERY AVE: F-7
BACON ST: C-5, C-6
BAILEY AVE: B-6, B-7, C-6
BAKER AVE: F-3, F-4
BALDWIN AVE: D-10, D-11, D-8, D-9
BALDWIN ST: E-4, E-5, F-4
BALSAM VIEW: E-6
BAR-WILL DR: D-9
BARBERRY LA: C-3, D-3
BARR RD: F-8, F-9
BARRISTERS CT: D-6
BARTIS DR: F-4
BARTLETT ST: D-6
BEAVER LAKE RD: A-7
BEE ST: C-9, D-9, E-9
BEECHWOOD DR: C-8
BELLEVUE ST: E-4, F-4
BELMONT AVE: C-2
BELVEDERE DR: E-9
BENHAM RD: F-2
BENJAMIN ST: D-6
BETH ANN CIR: G-7, G-8
BETTS PL: A-9
BEVERLY DR: D-2
BILLARD ST: C-7
BIRCH RD: F-5
BIRCHWOOD DR: E-1, E-2, F-2
BIRDSEY AVE: E-11, F-11
BLACKSTONE ST: C-8
BLACKSTONE VLG: C-8
BLUEBERRY LA: D-3
BORIS CT: G-11
BOTSFORD ST: C-5, C-6, D-5
BOYLSTON ST NO: E-10
BOYLSTON ST: E-10, E-9
BRADLEY AVE: D-5, E-4, E-5
BRECKENRIDGE AVE: C-7
BRET DR: D-9
BRIAN CT: G-7
BRIAR LA: D-8
BRIARWOOD DR: D-8, D-9
BRIDGEFIELD COMMONS: D-10
BRIGHTON CT: G-7
BRITANNIA ST: C-7, C-8
BRITTANY CT: C-8
BROAD BRIAR: E-6
BROAD CREST COM: F-6
BROAD ST: C-8, D-7, D-8, E-6
BROAD ST 275: E-7
BROAD ST: E-7, F-6
BROAD VIEWS: F-6
BROADVALE CT: D-8
BROADVALE RD: D-8
BROADVIEW TERR: D-7, D-8
BRONSON AVE: E-5, E-6
BROOKDALE RD: F-6, F-7
BROOKLAWN DR: H-8
BROOKS ST: D-6
BROOKVIEW: E-11
BROWNSTONE RDG: D-3, D-4, E-3, E-4
BRUCE LA: F-3
BUCKINGHAM ST: E-4, E-5
BUDDING RDG: C-11
BUNKER AVE: C-8, D-7, D-8
BUNKER HILL ST: D-7
BUTLER ST: D-6
BUTTERNUT DR: C-11
BUTTERNUT LA: C-11
BUTTON ST: B-8
BYRON RD: E-1, E-2
CAHILL AVE: C-3, C-4
CAMBRIDGE ST: C-7, C-8
CAMP ST SM: F-4
CAMP ST: D-6, D-7
CANYON DR: B-9
CAPITOL AVE: D-5
CARDINAL DR: G-8
CAREY AVE: A-7
CARIATI BLVD: E-2, E-3
CARL ST: D-4
CARPENTER AVE: E-8
CARPENTER HGTS: E-8
CARRIAGE CRSNG: B-8
CARRIAGE DR EAST: G-8
CARRIAGE DR: G-8, H-8
CARRIAGE WORKS: D-7
CART PATH DR: F-9, G-9
CARTER AVE EXT: E-5
CARTER AVE: E-5
CASS ST: F-6, F-7
CASTLE DR: C-2
CATHERINE DR: B-8
CATLIN ST: D-6, D-7
CEDAR HILLS RD: D-9
CEDAR ST: D-7
CEDAR WOOD DR: G-6
CENTENNIAL AVE: D-4, E-4
CENTER ST: C-7, D-7, E-7
CHAMBERLAIN HWY: B-5, C-5, D-5
CHARLES ST SM: F-3
CHARLES ST: E-7
CHASE ST: E-4
CHATHAM DR: F-2
CHERRY HILL LA: D-8
CHERRY ST: E-6
CHESHIRE RD: F-3, G-3
CHRISTOPHER LA: F-2
CHURCH ST: D-6
CHURCHILL CHASE: F-8, F-9
CLARK ST: C-8
CLEARFIELD DR: E-10, E-11
CLEARVIEW AVE: F-6
CLIFF ST: D-6
CLINTON ST: E-8
CLOVER ST: G-8
COBBLESTONE LA: F-7
COE AVE: D-4, E-4
COE ST: C-7
COLD SPRING AVE: C-5
COLLINDALE DR: F-11, G-11
COLLINS AVE: D-7, E-7
COLLINS PKWY: E-7
COLONIAL HGTS: G-5
COLONY BROOK PK: G-5
COLONY HGTS: C-7
COLONY PL: C-7
COLONY ST: C-7, D-6, D-7
COLORADO CT: F-11
COLUMBIA PL: D-6
COLUMBIA ST: D-6
COLUMBUS AVE: E-5, F-5
CONE AVE: E-11, F-11
CONGRESS ST: F-5
CONVERSE AVE: D-8
CONVERSE CIR: D-8
CONWEL RD: E-1, E-2
COOK AVE: D-6, E-5, E-6, F-5
COOPER ST: E-6
CORNERSTONE RD: D-3
CORNWALL ST: C-6
CORPORATE CT: G-10, G-9
CORRIGAN AVE: C-4, C-5, D-4
COTTAGE ST: D-7, E-7
COUNTRY CLUB DR: C-9
COUNTRY LA: D-2
COURTNEY CT: D-10
CRAIG AVE: C-2
CRESCENT ST: E-6, E-7
CRESTWOOD DR: F-6
CRICKET DR: E-9
CROSS ST: D-6
CROWN ST EXT: F-5
CROWN ST: D-6, E-6, F-6
CROWN VLG: F-5, F-6
CURTIS ESTATES: E-7
CURTIS ST: E-7, F-6, F-7
CUTLERY AVE: F-3, F-4
CYNROSE PL: D-2
DAFFODIL LA: C-11
DAGGETT DR: D-9
DANA LA: F-2, F-3
DANIEL ST: D-4, D-5
DANIEL WAY: G-11
DAVID DR: D-9
DAVIS ST: F-6, F-7
DAYTON PL: D-7
DEBBIE DR: D-2
DEE AVE: F-3
DEER RUN RD: F-2
DEERFIELD LA: H-10
DEL TERR: D-8
DETROIT AVE: B-8
DEVON CT: G-7
DEWEY AVE: E-4, E-5
DEXTER AVE: E-8, F-7, F-8
DIVOT DR: G-9
DOGLEG DR: G-8, G-9
DOGWOOD LA: C-9
DOUGLAS DR: F-3
DOVE DR: D-4
DRAPER AVE: F-6
DRYDEN DR: E-7, F-7
DUFFY AVE: C-7
EAGLE CT: G-9
EAST MAIN ST: D-6, E-10, E-11, E-6, E-7, E-8, E-9
EAST PEAK DR: B-3, C-3
EAST RD: F-8, G-8, G-9
EAST VIEW TERR: F-6, G-6
EAST WOODLAND ST: C-7
EASTGATE CMN: E-8, E-9
EASTWOOD COMMON: F-9
EATON AVE: C-3, D-3
EDDY AVE: D-5
EDGEHILL RD: E-5
EDGEMARK ACRES: D-3, E-2, E-3
EDGEWOOD PL: C-5, D-5
EDGEWOOD ST: C-5
ELIZABETH AVE: E-8
ELIZABETH CT: D-8
ELIZABETH RD: D-8
ELLIOTT ST: E-5
ELM ST: E-6, E-7
ELMHURST AVE: E-8, F-8
ELMWOOD DR: G-8
EMPIRE AVE: A-8
ESSEX CT: G-7
EVANSVILLE AVE: F-3, F-4, G-4
EVERGREEN LA: G-7
FAIR ST: C-6
FAIRFAX AVE: D-4
FAIRMOUNT AVE: E-5
FAIRMOUNT ST: D-6
FAIRVIEW AVE: D-4
FAIRWAY DR: G-8, G-9
FALCON LA: C-7
FARM HILL RD: F-2
FARNES AVE: F-8
FAWN DR: B-7
FEDERAL ST: F-5, F-6
FERN DR: E-1, E-2
FIESTA HGTS: D-3, D-4
FINCH AVE: D-1, D-2, E-1
FLEMING RD: G-10, G-11, H-10
FLOWER ST: E-5, F-5
FOLS AVE: C-9
FOREST AVE: E-5
FOSTER CT: D-6
FOSTER ST: D-6
FOURTH ST: D-5, E-5
FOWLER AVE: D-4
FOWLER AVE EXT: D-5
FOWLER AVE: D-5
FRANKLIN ST: C-7, D-7
FRARY AVE: C-7, C-8
FREMONT ST: E-4
FULTON ST: E-10, E-9
GALE AVE: E-6, F-6
GALOPPI RD: E-6
GARDEN ST: D-5
GARDNER ST: F-6, F-7
GAY ST: C-6
GEER AVE: E-6
GENEST ST: D-8, E-8
GILBERT RD: D-8
GLADWIN PL: D-6, E-6
GLEN HILLS RD: E-4
GLEN PL: E-4
GLENVIEW RD: G-7
GODEK HILL RD: F-2
GOFF ST: C-5, D-5
GOLD ST: D-6, E-6
GOLDEN ST: C-8
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GOODWILL AVE: D-5, D-6
GRACE CT: F-6
GRACEY AVE: B-7, C-7
GRANT ST: E-6
GRAVEL ST: D-9, E-8, E-9
GRAVELINE AVE: D-4
GREEN RD: F-6
GREENBRIAR RD: G-7
GREENWAY PL: E-4
GREGORY CT: F-4
GRISWOLD ST: C-7
GROVE CT: D-6
GROVE RD: E-4, E-5
GROVE ST: D-6
GUERNEY AVE: F-4, G-4
GUIEL PL: C-7, C-8
GWEN PL: C-2
GWEN RD: C-2, D-2
GYPSY LA: F-6, G-5, G-6
HALL AVE: F-5, F-6
HALLAM ST: E-6
HAMILTON ST: D-4, D-5, E-4
HAMPSHIRE CT: G-7
HAMPSHIRE RD: E-7
HANCOCK ST: E-4
HANOVER AVE: F-4, G-4, G-5
HANOVER RD: E-4, F-4
HANOVER ST: D-6, E-4, E-5, E-6
HARBOR POND DR: C-8, D-8
HARKINS LA: E-8
HARNESS DR: F-8
HARRINGTON ST: E-4, F-4
HARRISON ST: E-6
HART AVE: E-9
HARVARD AVE: E-4, E-5
HAWTHORNE TERR: F-8
HAYES ST: E-5, F-5
HEATHER HGTS: D-10
HEINE AVE: D-8
HEMLOCK RD: E-5
HICKORY ST: D-5
HICKS AVE EXT: B-7
HICKS AVE: B-7, B-8
HICKS ST: C-7
HIDDEN GABLES : C-4, D-4
HIDDEN PINES CIR: B-7
HIDDEN VALLEY DR: B-7
HIDEAWAY MANOR: F-6
HIGBY DR: D-10
HIGH HILL RD: F-10, F-11, G-11, H-11
HIGH MEADOW LA: F-2
HIGH ST: E-7
HIGHLAND AVE: E-4, E-5
HILL ST: C-7, C-8
HILLCREST AVE: F-4, F-5
HILLCREST CONDO: C-8
HILLCREST TERR: E-7, E-8
HILLSIDE AVE: D-6
HILLSIDE ST: F-4
HILLTOP RD: A-7, B-7
HILLWOOD LA: F-6
HINMAN ST: D-7, D-8
HITCHCOCK DR: F-7, G-7
HOBART ST SM: F-3, F-4
HOBART ST: D-7, E-7
HOBSON AVE: E-5
HOLIDAY HILL RD: E-10
HOLLIS DR: C-5, D-5
HOLLOW BROOK II: D-4
HOLLY LA: E-10
HOME AVE: D-4
HORSESHOE DR: D-9
HORTON AVE: E-8
HOURIGAN DR: D-2, E-2
HOWARD AVE EXT: D-8
HOWARD AVE: D-8
HOWE ST: C-7, C-8, D-8
HUBBARD PARK DR: C-3, C-4, D-3
HUBBARD ST: C-7
HUBER AVE: E-8
HUMBERT ST: F-10, F-11
IAN DR: D-2
IDLE LA: C-6
IONE DR: G-6
ISABELLE DR: G-8, H-8
IVES AVE: F-10, G-10
IVY DR: E-10
JACKSON ST: D-7
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JAMES ST: D-6
JANET RD: F-10
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JEFFREY LA: C-2, D-2
JEPSON LA: F-2, F-3
JEROME AVE: E-8, E-9
JIMMY LA: E-8
JODI DR: D-9
JOHN GEORGE DR: F-8
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JOHNSON HGTS: D-4
JOSEPH ST: C-7
KEATS RD: E-2
KENNEDY DR: F-7
KENSINGTON AVE: C-5, C-6, C-7
KENSINGTON CT: C-6
KENSINGTON HGTS: C-7
KENSINGTON PL: C-7
KENT CT: G-7
KENT RD: F-4
KENWOOD RD: F-6
KESTEVEN CT: G-7
KIKI DR: D-5
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KIRTLAND PL: E-7
KLOCK ST: E-5
KNOB HILL RD: F-1, F-2
KNOLL RD: E-10, E-9
KNOLLFIELD RD: F-11
KNOLLWOOD DR: E-10
KRYVEL RD: D-3
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LAKE ST: D-7
LAKEVIEW ST: F-4
LAMBERT AVE: D-5, E-5
LANOUETTE ST: E-5
LANOUETTE ST EXT: F-5
LANOUETTE ST: F-5
LAUREL HGTS: E-5
LAUREL ST: E-5
LAWRENCE CT: E-7
LENORE DR: G-6
LEONARD ST: C-6
LESLIE DR: E-4, E-5
LEWIS AVE: C-6, D-5, D-6
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LIBERTY ST: D-6, D-7, E-7, E-8, E-9
LILLI LA: A-9
LIMA ST: E-6
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LINCOLN ST: D-6
LINCOLN TERR: D-6
LINDA CT: D-8, D-9
LINDEN PL: D-7
LINSLEY AVE: D-5, E-5
LIVE OAK LA: E-7
LOCKWOOD ST EXT: D-5
LOCKWOOD ST: D-5
LOCUST ST: C-8
LOIS ST: E-9
LONGMEADOW DR: F-8
LONSDALE AVE: C-9
LORI LA: D-10
LOU ANN TERR: E-8
LOUIS DR: E-8
LOURDES CT: D-5
LOWE AVE: E-10
LOYOLA RD: A-7, B-7
LUCIA DR: E-8
LYDALE PL: E-7, E-8, F-7
LYMAN AVE: F-6
LYNN DR: F-2
MADISON AVE EXT: E-5
MADISON AVE: E-5
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MALONEY AVE: C-7
MAPLE AVE EXT: E-10
MAPLE AVE: E-10
MAPLE BR: D-6
MAPLE ST: D-6
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MARINA CT: E-5, F-5
MARKHAM PL: E-7
MARLSON RD: E-10
MARSHALL RD: E-7
MATTABASSETT DR: C-10
MATTABASSETT DR: C-10
MATTABASSETT DR: D-10
MATTABASSETT: D-10
MAY ST: F-3
MAYFAIR RD: D-9
MAYFLOWER LA: C-10, C-11
MAYNARD ST: C-7
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MEADOW ST: F-3, F-4
MEADOW WAY: E-10
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MEETINGHOUSE VLG: F-7
MELODY LA: G-6
MELVILLE AVE: F-4, G-4
MERIDEN AVE: E-5
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MERIDEN WATERBURY TPK: C-2
MERIDIAN ST: E-5, E-6
MERITECH BUS PK: F-9
MERRITT PL: E-8, E-9
METACOMET DR: D-10
MICHAEL DR: C-7
MIDLAND DR: H-8
MILDRED RD: F-10, F-11
MILES PL: E-7
MILICI CIR: E-8, F-8
MILK ST: F-4
MILL ST: D-6, D-7
MILLBROOK RD: G-8, G-9, H-9
MILLER AVE: F-7, G-7, G-8
MILLER ST: D-6, D-7
MILTON DR: C-8
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MONROE ST: D-5
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MORNINGSIDE AVE: E-8
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NEW ENGLAND PK: A-9
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NEW ST: E-6, E-7
NEWBURY COMMONS: C-7
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NO COLONY RD: A-8, A-9, B-7, B-8, C-7
NO COLONY ST: C-7
NO FIRST ST: D-5
NO GEORGE ST: D-6, D-7
NO HAMPTON CT: G-7
NO MEADOW LA: D-10
NO PEARL ST: D-8, E-8
NO SECOND ST: D-5
NO SPRING ST: D-6
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NO WALL ST: C-9, D-8, D-9
NORRIE PL: E-8
NORTH AVE: D-5
NORTH CT: D-8
NORTH ST: D-5, D-6
NORTHFIELD RD: F-8
NORTHRUP RD: H-8, H-9
NORTHWOOD PL: C-7
NORWOOD ST: D-7, E-7
NOTCH RD: C-3, C-4
NOTTINGHAM CT: G-7
NUTMEG DR: C-5, D-5
OAK RIDGE DR: F-10
OAK ST EXT: E-6, F-6
OAK ST: E-6
OAKLAND CT: C-8
OBRIEN DR: G-9
OLD BALDWIN AVE: D-9
OLD COLONY RD: F-5, G-5
OLD EAST MAIN ST: E-11
OLD FARM RD: G-9, H-9
OLD GATE RD: E-2
OLD NO COLONY RD: A-8, A-9, B-8
OLD STAGECOACH CIR: C-7
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ORANGE ST: E-5, E-6
ORCHARD HILL RD: E-3
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OREGON AVE: E-4
OREGON RD: E-3, E-4, F-3
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OVERLOOK RD: F-8
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PINEHURST DR: H-8
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PLEASANT ST: D-6, E-6
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POMEROY AVE: E-10, E-9, F-10, F-9
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PRESCOTT ST: C-7, D-7
PRESTIGE DR: F-10
PRESTON AVE: D-11, E-11
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RIVERSIDE DR: E-1, E-2
ROBIN HILL RD: C-8, C-9
ROCKLEDGE DR: H-8
ROGERS DR: E-10
ROLLING HILLS DR: E-2, E-3
ROSE CIR: G-6
ROSELAND AVE: F-8
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ROSEMARY TERR: F-2
ROUND HILL RD: D-9
ROY ST: E-6
ROYAL OAK CIR: G-7, G-8, H-7
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RUSSELL RD: A-8
SACHEM CIR: D-10
SAGAMORE RD: D-9
SAGE HILL RD: F-7
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SO GROVE ST: D-6
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SO SECOND ST: D-5, E-5
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WEBB ST: F-4
WEBSTER ST: C-7, D-7
WEDGE DR: F-9
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WEST PEAK DR: B-2, B-3
WEST VIEW DR: E-10
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WESTFIELD RD: B-11, C-10, C-11, C-8, C-9
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WESTWOOD CIR: F-7
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WOODLAND HGTS: C-7
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