
**NATIONAL POLLUTANT DISCHARGE
ELIMINATION SYSTEM**

**NEW CASTLE COUNTY MS4
Permit No. DE 0051071**

**submitted by
NEW CASTLE COUNTY DEPARTMENT OF SPECIAL SERVICES
as Lead Permittee**

**JOINT ANNUAL REPORT FOR CALENDAR YEAR
2010**

**Volume 2 of 2
DeIDOT Report and Appendices**

Permittees

New Castle County Department of Special Services
Delaware Department of Transportation
The Village of Arden
The Village of Ardentown
The Village of Ardencroft
The Town of Bellefonte
The City of Delaware City
The Town of Elsmere
The Town of Middletown
The Town of Newport
The City of New Castle
The Town of Odessa
The Town of Townsend
The City of Wilmington



Submitted May 1, 2011

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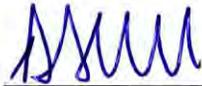
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CERTIFICATION

I certify under penalty of perjury that this document and all attachments are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations. As to the identified portions of this document for which I cannot personally verify their truth and accuracy, I certify as Delaware Department of Transportation's official having responsibility for the persons who, acting under my direct instruction, made the verification that this information is true, accurate, and complete.



Brian Urbanek, Asst. Director, Statewide Support Services
Delaware Department of Transportation
800 Bay Road
Dover, DE 19903
(302) 760-2536

Program Summary and Projection of Work

The objective of the Delaware Department of Transportation NPDES Program is to reduce stormwater pollutants from the co-permittees' municipal separate storm sewer system to the maximum extent practicable. This is accomplished through the implementation of a comprehensive stormwater pollution prevention and management program as contained in the NPDES Permit No. DE 0051071 effective May 1, 2001 and EPA Consent Decree effective December 14, 2001.

The Delaware Department of Transportation and New Castle County entered into an Interjurisdictional Agreement for the purposes of identifying duties and responsibilities under the Consent Decree and the stormwater NPDES permit. If any task listed requires consultant services, DelDOT and the County will share all costs equally. \$2.07 million of operational funding was appropriated by DelDOT to implement program elements of NPDES (Table A). This annual report covers NPDES activities from January 1, 2010 through December 31, 2010.

The purpose of this review and update is to summarize major activities to date through year 2010 and provide a projection of work for calendar year 2011. Work projections for 2011 are provided at the end of this section in Table B.

The following projects have been initiated as a result of the NPDES permit:

Storm Drain Inventory and Inspection

The storm drain inventory and inspection program began in August 2001 with DelDOT signing Agreement No. 1131 with URS Corporation for a period of five years. By the end of their agreement term, URS inspected 45,551 storm system structures and swales and culverts. Other work included inventory and inspection of stormwater BMPs and installation of storm drain markers.

Supplemental Agreement 1354-1 with KCI Technologies is being developed to continue the storm system inventory and inspection with the following tasks:

- Continue new inspections of storm sewer in New Castle County;
- Focus effort on Kent and Sussex Counties in an effort to complete the entire state.
- BMP inspections
- Submit work orders, as necessary, on BMPs and storm sewer system

Injunctive Relief

DelDOT has fulfilled its obligation under the Consent Decree to complete the I-95 Stormwater Project. Please see Annual Report 2001, Volume 3, Appendix U for a complete report and photographic documentation of the I-95 Additional Injunctive Relief Stormwater Controls. The components are identified below:

- Ditches – DelDOT replaced concrete channels with riprap at 18 locations and replaced 8 concrete ditches with vegetated ditches. DelDOT will provide maintenance of these ditches during the term of the Consent Decree.
- Shallow marshes – DelDOT designed and constructed two shallow marshes along I-95 as bioretention areas. DelDOT will provide maintenance of these ditches during the term of the Consent Decree.
- Stone check dams – DelDOT designed and constructed 7 stone check dams along I-95. DelDOT will perform regular inspections and maintenance during the term of the Consent Decree.
- Biofiltration swales – DelDOT has constructed biofiltration swales along I-95 as per the Consent Decree. DelDOT will conduct annual inspections and provide maintenance.

Pesticides, Herbicides and Fertilizers

DelDOT's NPDES Program and the Roadside Environmental Section are working together to develop long-term pesticide reductions strategies, including:

- Guardrail Inventory – An inventory of all guardrail sections in the state was completed in 2009 and updated through 2010. A small professional services agreement will be executed in 2011 to collect data on new guardrail installations and continue to update the existing database. The data are being used by DelDOT to identify areas where guardrail herbicide application can be reduced or eliminated.
- Guardrail Vegetation Management pilot study – DelDOT and the University of Delaware continued this study in 2010 to test alternative vegetation management strategies for guardrail (including two types of weed block material, hand trimming and low-grow fescue) to reduce or eliminate herbicide application. If feasible alternatives are found, we hope to use them in environmentally sensitive areas to replace, or reduce, use of herbicides on guardrails.
- A study of the impacts of mowing median turf grass at different heights upon water quality and turf quality. Improvement of turf quality may result in reduction of weeds and invasives, thus reducing the need for herbicide applications.
- The Enhancing Delaware Highways (EDH) Program developed an Integrated Roadside Vegetation Management Manual:
(http://deldot.gov/information/pubs_forms/manuals/edh/index_em.shtml)
- Improved record keeping

Illicit Discharge and Improper Disposal Program

Per agreement with New Castle County, DelDOT is responsible for the illicit discharge detection and elimination (IDDE) program within the DelDOT-owned portion of the stormwater conveyance system. Our dry-weather screening program uses a numerical rating system for water quality parameters in dry weather flow, which provides an index that determines which outfalls are targeted for follow-up evaluation. KCI Technologies, Inc., performs this work for DelDOT. 277 outfalls were screened. No dry weather flow was observed during any of these screening inspections.

In calendar year 2010, a total of 277 DelDOT-owned outfalls were screened in New Castle County. No dry weather flow was observed during any of these inspections.

During 2010, 16 potential illicit discharges (PIDs) in New Castle County were either reported to the DelDOT NPDES Program or discovered during KCI's MS4 inspection. Each was investigated by KCI crews, and follow-up action was taken where appropriate.

DelDOT also continued a public education program to help eliminate improper disposal and dumping into storm drains. Whenever evidence of improper dumping is discovered, either through routine inspections or citizen complaints, the entire community is canvassed with educational door hangers.

Sweeping Program

DelDOT is continuing its 4:2:1 frequency on primary, secondary, and tertiary roads. More frequent sweeping occurs on interstate highways. No new sweepers were purchased in 2010.

Snow and Ice Program

DelDOT has upgraded its existing fleet with ground speed spreader controls, plow balance valves and apply the techniques of anti-icing and pre-wetting in an effort to reduce overall salt usage. New trucks will be fully equipped with ground speed spreader controls and plow balance valves.

We met with representatives from "Geomelt," a sugar beet-based product for ice and snow control. We tentatively plan to pilot a study to qualitatively assess the effectiveness of this or a similar product, do a cost analysis, and contact other states to determine if this would be a viable product in Delaware.

Storm Event Monitoring Program

The wet weather storm event monitoring required under the Phase I permit was intended to identify, investigate and address selected water quality parameters of storm water runoff from five outfall locations identified in the Permit Application, representing four developed land use classifications: highway, commercial, industrial and residential.

The wet weather monitoring requirement at the five prescribed outfalls in New Castle County was fully completed by the County and DelDOT in 2009. Therefore, no additional samples were collected in 2010.

BMP Inspection and Maintenance

DelDOT annually inspects its BMP facilities for functionality. BMPs are graded A-D depending on condition. KCI completed the annual inspection of 130 New Castle County BMPs in 2010. BMPs are evaluated and placed on contract for maintenance as needed and as money permits. Maintenance functions are performed by the Districts or through contractors specializing in noxious and invasive species control, or maintenance of specific BMP types. We are under contract with Weeds, Inc. to control noxious and invasive species. A stormwater pond contract is being developed for BMPs in need of more major maintenance, with work scheduled to begin in spring 2011.

BMP Monitoring Program

DelDOT continues its BMP performance monitoring and assessment program. This includes wet weather monitoring of stormwater outfalls and BMPs (both structural and nonstructural), as well as chemical and biological monitoring of streams that are impacted by stormwater discharges from DelDOT BMPs. In addition to the work performed by KCI Technologies, DelDOT is also partnering with the University of Delaware on BMP monitoring projects.

During calendar year 2010, DelDOT's BMP monitoring program included the following projects:

1. Performance and maintenance study of Delaware sand filters
2. Monitoring of biofiltration practices
3. Study of pollutant removal by grassed highway side slopes
4. Stream turbidity measurements at construction sites
5. Monitoring of BMP outfalls at DelDOT maintenance facilities
6. Study of guardrail vegetation control alternatives
7. Study of the impacts of various mowing height practices

TMDL Compliance

DelDOT has been proactive in preparing for compliance with statewide TMDLs, in anticipation of both a new Phase I permit and future watershed Pollution Control Strategies. The Department's current and projected activities in this area include the following:

- Participation in the AASHTO Stormwater Management Community of Practice (CoP), in which state DOT's share information on emerging issues, including TMDL compliance.
- Coordination with DNREC in development of new statewide stormwater regulations.

- Assistance to DNREC in development of a Watershed Implementation Plan (WIP) for the Chesapeake Bay TMDLs.
- A BMP performance and assessment program to provide data on the effectiveness of DelDOT's BMPs in reducing pollutants targeted by TMDLs.
- Collaboration with the DNREC Watershed Assessment Section on database, monitoring and reporting needs for TMDL models and WLA compliance. This includes a monitoring component to determine reductions provided by grassed buffers in highway rights of way.
- Proactive coordination and planning with the County to get a head start on watershed implementation plans, monitoring plans and public education plans that we anticipate will be required by the new Phase I permit.

Retrofits

DelDOT initiated, worked on, and/or completed the following stormwater retrofits in 2010:

1. *Ham Run stream restoration:* Restoration of approximately 500 LF of stream using natural channel techniques, creating two wetland floodplains/stormwater wetlands and creating a filter strip along Duncan Road prior to draining into the relocated stream. In 2010, JMT worked on final plans, additional hydraulic analysis to account for attenuation by floodplain creation and model parapet impact, and began preparation of Environmental Compliance Plans.
2. *Blackbird Creek stream restoration:* DelDOT is working with DNREC on this project and has prepared a conceptual design for restoration of 1,600 linear feet of a main tributary and three tributary branches to Blackbird Creek using natural channel techniques and creation of a wetland floodplain. To protect the integrity of Blackbird Landing Road, DelDOT has agreed to stabilize the areas immediately adjacent to the creek prior to beginning any stream restoration. JMT completed conceptual plans and submitted to DNREC partners.
3. *Leatherman's Run Retrofit Scoping* –In 2010, JMT worked on preparing conceptual design for stream restoration BMP along Leatherman's Run between I-95 and Chapman Road. A new design firm was hired in 2010, and they will continue design and planning for this project.
4. *Harrington maintenance facility:* Improvements include replacing the existing dry pond with a wet pond and forebay, creating bioswales and a concrete wash pad. The project was advertised for construction in December 2009 and completed in November 2010.

Construction Site Runoff

- Effective 2008, Section 110 of DelDOT's Standard Specification, Erosion, Sediment Control and Water Pollution was significantly rewritten to improve E&S inspections, reporting and compliance.
- Initiated performance evaluations of CCR's using an objective evaluation form.
- Developing agreement to have third party consultants perform CCR inspections and reporting in lieu of contractors. He agreement should begin in early- to mid-2011.

Public Education and Outreach

DelDOT's public education program includes the following accomplishments for calendar year 2010:

- Partnered with the Appoquinimink River Association for public education and outreach.
- DelDOT is continuing the "Door hanger campaign," begun in 2006, as an educational tool to neighborhoods where illicit disposal are reported.
- Initiated the "Delaware Livable Lawns" fertilizer reduction program.
- Active participation in the newly formed Delaware Association for Environmental Education.
- DelDOT staff participated in the following public outreach events:
 - Delaware Rural Water Association – we exhibited our display board and graphics and touch screen stormwater slide show;
 - Technology Students Association – served as judges on environmental and engineering projects.
 - Delaware State Fair – we exhibited our display board and graphics and touch screen stormwater quiz.

Table A. FY 2011 budget.

FY 2011 Budget - Operational Money

VENDOR	DESCRIPTION	
Beginning Balance	NPDES	2,070,000.00
Total Available		2,070,000.00
Storm Drain System Inspection and Maintenance		
KCI		
	Agreement 1354	569,527.65
	Supplemental agreement, Task 16 through June 30, 2011	233,000.00
Subtotal		802,527.65
Monitoring Activities		
KCI		
	Agreement 1495	550,000.00
Subtotal		550,000.00
Industrial Compliance and Permitting		
DNREC	NOIs	3,200.00
PIG	spill kits and decks	500.00
Subtotal		3,700.00
Public Education & Outreach		
Appoquinimink River Association	Agr. 1478; public education/outreach; fertilizer education campaign	15,000.00
Graphics & Printing	For the following activities: activity booklets door hangers tip cards; 13,000 for Partnership project in St. Jones	10,000.00
	new game development	20,000.00
2011 Harrington Fair		
DIB	promotional items	10,000.00
De. Rural Water Assn.	annual dues	250.00
Subtotal		55,250.00
Staff Training		
Whitman Requardt	finish E & S manual Printing	20,000.00 10,000.00
DWRA	conference fee	250.00
WEFTEC	registration	925.00
Subtotal		31,175.00
Equipment		
Office Depot	office equipment binders and tabs for annual reports	500.00 100.00
	field manuals	200.00
Subtotal		800.00
Retrofits		
JMT	Agreement 1412; Retrofit design agreement for wash water and stormwater	41,773.45 9,582.30
Parsons Brinckerhoff	Agreement 1526 - new retrofit design agreement	75,000.00
Suntree	replacement booms and units (catch basin inserts) add'l booms	2,710.00 2,000.00
Subtotal		131,065.75
Stormwater BMP Maintenance		
Weeds, Inc.	Noxious/Invasive Roadside contract to treat stormwater BMPs beginning spring 2010	12,000.00
	stormwater pond maintenance contract	400,000.00
Subtotal		412,000.00
IRVM/Pesticide Reduction		
Univ. of Delaware	guardrail study - experimental research for weed block mowing study	13,560.00 36,102.00
		19,500.00

Table A. FY 2011 budget.

FY 2011 Budget - Operational Money

VENDOR	DESCRIPTION	
Wallace/Montgomery	Guardrail Inventory	12,866.00
	chemical costs for Roadside Environmental spraying	675.00
Subtotal		82,028.00
Beginning Balance	NPDES Capital	
sand filter maintenance	general cleaning of all sand filters (sediment chambers & partial sand/gravel) and Anchorage forebay	95,000.00
Subtotal		95,000.00

Table B. Projection of Work to be performed during Calendar Year 2011.

Storm Drain Inventory and Inspection

- Focus system inventory and inspection outside permitted boundaries in Kent and Sussex Counties in an effort to complete the entire state.
- Continue statewide annual BMP inspections.
- Make modifications, as necessary, to the NPDES map viewer.

Monitoring

- Continue all of the current monitoring projects into 2011.
- Continue to enter BMP data into International Stormwater BMP database.
- We also plan to install GPS units on some of the DelDOT sweepers to assist with tracking and reporting pollutant removal.
- Hire a consultant to assist with developing a water quality monitoring management plan to fulfill the needs of the new Phase I permit.
- Assess future monitoring needs for TMDL compliance.

Pesticide, Herbicide and Fertilizer Program

- Continue to update the guardrail inventory used in development of a pesticide reduction strategy; continuously review DelDOT projects for any addition of guardrail or new end treatments.
- Continue guardrail research project with University of Delaware – research pilot study to test several treatments under guardrail in development of a pesticide reduction strategy.
- Purchase spill-decks for pesticide storage as needed.
- Purchase pesticide responder kits for spray vehicles as needed.

Construction Site Erosion and Sediment Controls

- Implement revised Standard Specification 110, Erosion, Sediment Control and Water Pollution. Modifications to this section include:
 - Mandatory pre-construction meeting specifically to discuss E & S controls.
 - Execute two agreements to have a third party CCR perform weekly E&S inspections in lieu of contractor staff.
 - Stronger actions to gain compliance.
 - Better details on division of responsibilities.
 - Contractor responsible for fines if as a direct result of the contractor's refusal to implement and maintain the required erosion and sediment control, fails to supply a Site Reviewer, or fails to routinely perform E&S inspections, complete the E & S Reports and correct deficiencies identified in the E & S Reports.
 - Annual CCR performance evaluations.

Snow/Ice Program

- Utilize new technologies:

- Continue to retrofit existing trucks with new ground speed controls to reduce salt application.
- Anti-icing application prior to snow/ice event to reduce overall salt application.
- Pre-wetting salt with liquid de-icers to increase effectiveness of salt.
- Continue to retrofit existing trucks with plow balance valves on snow plow blades to reduce road damage thereby reducing particles that can enter waterways.
- Literature review to evaluate alternative deicers such as Agriculture Byproducts.
- Pilot study to qualitatively assess beet-based products for snow/ice control.

Drainage Program

- Financially support Districts for repair and maintenance of the storm drain system in New Castle County through their open-end drainage contracts.
- Continue to submit and repair work orders resulting from storm system inspections; consultant will prioritize work orders before submitting to Maximo.

Public Education, Outreach & Training

- Continue partnership with the Appoquinimink River Association in development of education and outreach programs.
- Launch “Delaware Livable Lawns” project.
- Participate in outreach events: Delaware Rural Water Association Conference and Delaware State Fair.
- Continue planning for the Public Education needs of the new Phase I permit.
- Continue to serve on the Delaware Association for Environmental Education (DAEE) board of directors and executive committee.

Staff training

- Develop and distribute stormwater pollution prevention bulletins to all DelDOT maintenance yards on a semi-annual basis.
- Continue requiring new DelDOT maintenance staff to view stormwater pollution videos.
- Require DelDOT staff to annually view Spill Prevention Control and Countermeasures (SPCC) videos.
- Train DelDOT staff on the use of the NPDES stormwater system map viewer.

BMP Inventory and Inspection Program

- Inspect DelDOT owned BMPs; generate work orders as needed.

- Identify stormwater pond maintenance needs resulting from annual inspection as needing erosion control or sediment removal; develop and award contract.
- Treat noxious and invasive vegetation as needed using contractor services.

Retrofits

- Ham Run stream restoration: Prepare final construction plans.
- Blackbird Creek stream restoration: Repair erosion along roadside prior to stream restoration; partner with DNREC and University of Delaware on 1,500' stream restoration.

Maintenance Yards

- Review and update Pollution Prevention Plans (PPPs) and Spill Prevention Control and Countermeasures (SPCC) plans as necessary.
- Continue quarterly wet and dry weather inspections and annual inspections.
- Continue semi-annual wet weather sampling of outfalls.

SWPP&MP Assessment

This section is an annual review of the current SWPP&MP. Program elements included here describe substantive program improvements and recommendations for program modifications.

DelDOT Work Orders on the Storm Sewer System

DelDOT's inspection consultants report deficient components of the storm sewer system for submittal into our work order system, Maximo. We recently added a feature in our NPDES map viewer database that allows the user to highlight work orders so maintenance supervisors can more efficiently plan daily work schedules for crews. If multiple work orders are in close proximity, this simple feature will save on mobilization and MOT costs.

Best Management Practices (BMPs)

BMP Inspections

DelDOT and KCI Technologies revised the "Best Management Practices Field Inspection Manual." We use the manual to identify stormwater ponds in need of maintenance and contract preparation. We then verify in the field the proposed maintenance/retrofit recommendations.

Some of our maintenance problems could be avoided and overall maintenance costs reduced if we had a routine schedule for vegetation maintenance. We are working towards developing an automatic work order generation in our Maximo database. A work order will automatically be generated where the BMP resides so district staff can do annual mowing/vegetation control. This will reduce more costly clearing and grubbing paid to a contractor.

Assessment of BMP Performance

As discussed in last year's annual report, we are continuing to assess what DelDOT's most important BMP performance data needs will be as we transition into a new Phase I permit. Several draft versions were sent to us by DNREC in 2010, and the monitoring requirements in each were different. Thus, we will not know exactly what is required until the final draft is issued for public comment. We do know, however, that an important goal of the SWPP&MP developed for the new Phase I permit will be compliance with TMDL waste load allocations (WLAs). Thus we feel that future monitoring efforts must be focused on collection of data needed to assess progress toward meeting the WLAs.

In order to facilitate this transition to meeting the requirements of the next permit, we have met several times this year with staff from the DNREC Watershed Assessment Section to discuss database, monitoring and reporting needs for WLA compliance. We have also continued to share BMP and monitoring data with DNREC for use in their TMDL models and have discussed future coordination of monitoring efforts. Projects conducted in 2010 transitioned the

focus of the DelDOT monitoring program towards assessment of the performance of “Green Technology” BMPs, because we know that these data are needed for future reporting and modeling efforts. We also see a need to collect more quantitative data on pollutant loads removed by maintenance practices such as street sweeping and storm drain/pipe cleaning and have begun planning for new projects in this area. In addition, we intend to seek advice and assistance from consulting firms experienced in developing monitoring plans for other Phase I permittees in the mid-Atlantic region.

Pesticide, Herbicide, Fertilizer

DelDOT’s Roadside Environmental section manages PHF applications applied by contractors and DelDOT staff. The NPDES Program has the responsibility to develop programs and implement controls through training, policy changes resulting from research, development of SOPs, education, etc. to reduce the pollutants associated with their application and to track trends that can document anomalous spikes in usage or declines in usage due to implementation of programs.

We have implemented several pesticide reduction programs as described below:

1. Guardrail pilot study – DelDOT currently treats approximately 310 miles of guardrail with herbicide. We developed a program in conjunction with the University of Delaware to investigate methods to reduce the use rates of pesticides and carriers used to treat guardrail vegetation without compromising safety and aesthetics. We selected and applied several treatment methods along several guardrail sections to compare the effectiveness, ease of implementation, aesthetics, cost and longevity. Treatments included weed control barriers, low-growing vegetation and hand-cutting existing vegetation. Herbicides will be used on treatment plots as a measure against non-chemical treatments. Based on data collected, we have eliminated one weed block manufacturer treatment and added a new type that will be tested in 2011.
2. Guardrail inventory – Treating guardrail accounts for a significant percentage of DelDOT’s herbicide treatment program. The NPDES Program saw guardrails as a relatively simple way to reduce herbicide usage. Our consultant inventoried all guardrails statewide and collected attribute data that included material under guardrail and surrounding landscape and environmental features. We are currently developing an agreement to maintain and update this statewide guardrail inventory. We receive notification of new projects and review as-built plans for the addition of new guardrail. A list is compiled and sent to our guardrail consultant on a quarterly basis. This continuous and routing process saves the department money by not having to repeat the entire statewide inventory every several years.
3. Record keeping – Last year we began keeping records of herbicide quantities to establish baseline herbicide usage. We are continuing to record our annual usage (Tables 5-1a and 5-1b). By tracking herbicide quantities we hope to be able to identify the cause of spikes or declines in usage and use the data to assess pesticide reduction programs we have implemented.

Construction Site Runoff

Erosion and sediment control at DeIDOT construction sites falls under the purview of the Division of Transportation Solutions (DOTS). However, the NPDES Program, through its permit and consent decree, is responsible for ensuring E & S control compliance. The NPDES Program staff assessed the E & S program in 2010 and is working toward modifying the way we conduct erosion and control inspections:

Currently, the contractor provides the CCR for major construction jobs. This has proven to be, on occasion, ineffective. Reports are not completed weekly or after storm events and often contractors do not provide a daily crew to maintain and/or correct deficiencies for E & S. We therefore are in the process of establishing two agreements to hire third party CCR consultants to manage the daily erosion and sediment inspection duties in lieu of the contractor. The consultant will also have the authority to hire a third party contractor, at the prime contractor's expense, to correct E&S deficiencies if the prime contractor refuses.

Public Education

The NPDES Section contracts with several non-profit organizations to assist with development of education and outreach programs. The Partnership for the Delaware Estuary, the Appoquinimink River Association (ARA) and the Delaware Nature Society has specialties in watershed and water quality education. Partnering with these organizations has proven to an effective means of expanding our limited staff resources in a cost effective manner. With many watersheds facing TMDLs for nutrients and bacteria, we decided to pilot an outreach effort in a two-phased approach to commercial lawn care companies and property owners as well as a pet waste campaign to reduce bacteria. We therefore executed an agreement with the ARA to (1) develop an educational/outreach campaign to reduce fertilizer application through certification of commercial lawn care companies, and (2) a pet waste campaign to reduce bacteria from pet waste.

Part of our public outreach effort is participating in public events. Because we have limited budget and staff, we focus on large, multi-day events where there is substantial foot traffic. The biggest event each year is the Delaware State Fair where we participate for 10 days. We developed an interactive touch screen water quality game that tracks the number of times the game is played. Each participant receives a high-quality prize that displays our stormwater website. We assessed the pre- and post event number of site visits and found no significant difference concluding that the free giveaways had no impact on increasing public interest in visiting our website. Although we feel there is a benefit of the face-to-face interaction, and prizes help attract participation, we have reduced the quality and quantity of prizes as a cost saving measure.

For 2011, we plan to focus our educational display and game on our new initiative, Delaware Livable Lawns. We will work with the Livable Lawns committee and the University of Delaware to develop a static display on fertilizer reduction and extend that theme to an interactive game. We are trying a more targeted approach that we think may have a greater impact than offering a broad array of stormwater education.

Dry weather screening and Illicit Discharge Elimination

Very few illicit connections have been found over the years through dry weather screening. Most of the illicit discharges or connections that actually have been confirmed as such either were discovered either through routine MS4 maintenance inspections or were reported to the NPDES Section by maintenance staff or the public. Our door-hanger campaign in communities with reported or suspected illicit discharges or dumping into storm drains continues to be an effective public education tool.

A dry weather screening program will be required in the new Phase I permit, so we are beginning to assess how our current IDDE program can be revised to make it more effective and efficient.

1. MS4 Structural Controls

Requirement:

DelDOT shall operate and maintain the MS4 and any structural controls incorporated into the system to reduce the discharge of pollutants (including floatables) to the maximum extent practicable as described in the Application page iv-6, Part 5 (iv) A1, Permit page 5, Part II.A.1. and Consent Decree page 11, Part II 17.

Performance:

A. Stormwater Conveyance Systems

The NPDES Section uses consultant services to inventory and inspect the entire DelDOT-owned system. From these inspections, work orders are generated for repair or maintenance.

DelDOT uses in-house forces and contractors to maintain its stormwater conveyance system.

Drainage Maintenance Contracts

DelDOT uses district maintenance personnel and contractors to maintain the stormwater conveyance system in New Castle County. This work insures the proper operation of the stormwater system and will reduce the pollutants that are carried to waterways. Each of the two districts in NCCo., North and Canal, has its own drainage contract with an annual budget of \$1 million. As necessary, the NPDES Program adds additional money to drainage contracts to repair and maintain the storm sewer system.

This work has three components, (1) open system drainage, (2) closed system drainage, and (3) ponding problems. The open drainage system represents general work to control erosion and cleaning and reshaping of ditches. The stabilization of ditches reduces the amount of sediment that enters the local stream and waterways. Closed drainage represents the underground system that includes pipes, manholes, inlets, catch basins and outfalls. Maintenance includes repairs on misaligned or deteriorating pipes, deteriorating catch basins, sink holes, clogged pipes, etc. Drainage problems reported by citizen complaints are also programmed into the drainage contract.

Storm Sewer System Inventory and Inspection

DelDOT executed Agreement #1354 with KCI Technologies on November 29, 2006 for a five year term to continue the inventory and inspection program begun in 2001. All respective parts of the stormwater conveyance system will be inventoried on a five or ten-year cycle priority schedule. This prioritization schedule is based on a final recommendations report developed by DelDOT and URS Corporation that determine appropriate inspection frequencies for purposes of long term monitoring (See Annual Report 2006, Volume 2 of 2, Appendix C). This work includes: drainage inlets, manholes, associated piping, stream channels, ditches, pipes and storm drains, and identifying which drainage inlets function as catch basins. Catch basin, as defined in the Consent Decree, is a special type of drainage inlet that provides water quality treatment. As part of this contract, a comprehensive GIS database was developed that enables users to view the entire stormwater system, corresponding inspection data and pictures.

The following bulleted list describes the current status of the agreement for calendar year 2010:

- Total of 2,845¹ storm system structures inspected.
- KCI completed the annual inspection of 208² BMPs.
- Completed the NPDES map viewer.

Please refer to Appendix A for a summary report prepared by KCI Technologies on the Storm Drain Inventory/Inspection Project.

Work Orders

Work orders are generated when DelDOT staff or their consultant determines if repair or maintenance is required. A work order is created and entered into Maximo, DelDOT's work order database. They are ranked on scale of 1-5 depending on the severity of the problem. Maintenance supervisors then review and determine if the work order will be completed by DelDOT personnel or contractors.

The NPDES section and the Districts met with KCI in early 2009 to develop consistency in ranking. In 2010, KCI documented 409 storm system deficiencies resulting in Maximo work orders.

B. Stormwater Collection and Conveyance Complaint System

The Governors Surface Water Task Force recommended that an assistance program be created to aid each individual with his/her unique drainage or stormwater issue. Once an individual's information has been logged into the system the concern will automatically be forwarded to the proper agency. This program has a telephone number and email address to allow individuals to express their concerns (see Annual Report 2007, Figure 1-1). This provides one central point of contact when seeking solutions to the public's concerns.

When a complaint is called directly into DelDOT, information is gathered that includes location, problem, caller's name and phone number, etc. Once the information is documented, a work order request is generated and entered into DelDOT's Maximo database system. The complaint is investigated and the Operations Supervisor determines what type of repair is necessary. The work is assigned to the appropriate Maintenance District for repair. If no work is needed (no problem found during investigation) a courtesy call is returned to the complainant and the results of the investigation are explained.

C. Maintenance Inspection of Completed Stormwater Facilities

DelDOT has an annual requirement to inspect its constructed best management practice (BMP) devices, structures and stormwater management facilities. The purpose of this statewide program is to: (1) inventory, inspect, measure water quality performance, identify noxious

¹ This number only reflects New Castle County inspections. Most effort in 2010 was spent inventorying and inspecting structures in Kent and Sussex Counties in an effort to complete the entire DelDOT-owned MS4 storm sewer system statewide.

² BMPs with an outstanding work order were not inspected.

and/or invasive species and maintain functionality of DeIDOT's stormwater BMPs such as stormwater ponds, sand filters, bioinfiltration trenches, etc., (2) maintain a comprehensive database, (3) coordinate with the Districts on the submittal of work orders as needed, and (4) provide technical assistance and guidance to the Department regarding appropriate maintenance strategies for stormwater BMPs.

A field inspection manual and forms were developed to effectively perform field inspections to evaluate BMP performance and identify maintenance requirements. The procedures outlined in this manual assist DeIDOT with decisions on inspection, maintenance, repair, and retrofit of BMP facilities. Overall performance and functionality are graded A-D. Table 1-1 describes the 2010 rating summary by each maintenance district.

Table 1-1. 2010 BMP Inspection Ratings Summary.

BMP TYPE	TOTAL NO.	A	B	C	D
NORTH DISTRICT	49	19	28	2	0
CANAL DISTRICT	81	32	43	6	0
CENTRAL DISTRICT	27	11	11	5	0
SOUTH DISTRICT	51	41	9	1	0
TOTAL NO.	208	102	92	14	0

BMPs are evaluated and placed on contract for maintenance as needed and as money permits. Maintenance functions are performed by the Districts or through contractors specializing in noxious and invasive species control, or maintenance of specific BMP types such as StormFilter[®] and BaySaver[®]. We are under contract with Weeds, Inc. to control noxious and invasive species. Additionally, DeIDOT identified stormwater BMPs in need of more major maintenance. A stormwater pond contract is being developed with work scheduled to begin in spring 2011 as detailed below.

Stormwater Pond Contracts

In 2010 we maintained six stormwater BMPs conduct in need of more major repairs to include sediment excavation, slope stabilization, forebay and check dam construction, etc. (Table 1-2). We selected C rated BMPs with the goal of improving their rating to A.

We are in the process of developing a stormwater BMP contract for major repair/maintenance to be executed in the spring of 2011. We have identified 16 BMPs in need of maintenance. Repairs will include sediment excavation, slope stabilization, forebay and check dam construction, etc. The estimate for maintenance is \$400,000.

D. BMP Performance Monitoring and Assessment

The NPDES permit requires DeIDOT to monitor the performance of existing stormwater structural controls and BMPs. During calendar year 2009, DeIDOT's BMP monitoring program included the following projects:

1. Performance and maintenance study of Delaware sand filters

2. Monitoring of biofiltration practices
3. Study of pollutant removal by grassed highway slide slopes
4. Stream turbidity measurements at construction sites
5. Monitoring of BMP outfalls at DelDOT maintenance facilities
6. Study of guardrail vegetation control alternatives
7. Study of the impacts of various mowing height practices

See Section 13 (“Monitoring”) and Section 16 (“Pollution Prevention at the Maintenance Facilities”) of this report for a full description of each of these projects and monitoring results.

E. Bridge Maintenance

DelDOT’s Bridge Division is federally mandated and follows the Code of Federal Regulations (23 CFR 650.3). DelDOT normally inspects bridges every 24 months or less depending on condition. If a bridge is in a degraded condition, inspection will occur more frequently. Inspectors use a “Structure Inventory and Appraisal Sheet” (see Annual Report 2001, Volume 3, Appendix D) found in the “Recording and Coding Guide for the Structure, Inventory and Appraisal of the Nation’s Bridges.” The structural integrity of the bridge is evaluated on a scale of 0-9, where a score of 0 describes a failed condition. If repairs are necessary a report is sent to the appropriate Maintenance District where a work order is generated for the repair. Channel and Channel Protection is Item #61 on DelDOT’s “Structure Inventory and Appraisal Sheet.” This item describes the physical conditions associated with flow of water through the bridge such as stream stability and the condition of the channel, riprap, slope protection, etc. The inspector assesses visible signs of excessive water velocity that may affect undermining of slope protection, erosion of banks, and realignment of the stream. Accumulation of drift and debris on the superstructure and substructure is noted on the appraisal sheet. Item 61 is coded on a scale of 0 to 9. Coding of zero means that the bridge is closed due to channel failure and code 9 means that there are no noticeable deficiencies that affect the condition of the channel. Stream channels are inspected when the bridges are inspected at the same two- year interval. In 2010, DelDOT inspected 683 bridges.

Table 1-2. 2010 BMP Maintenance.

BMP No.	BMP Type	Problem	2010 Maintenance Action	Previous Rating	Post Rating	Est. Cost
101	Wet pond	Repair outflow condition; erosion; excess sediment	topsoil, seed and blanket, riprap; excavate sediment	C		\$35,289.00
120	Dry pond	Excess sediment; erosion	topsoil, seed and blanket, riprap; excavate sediment	C		\$15,800.00
128	Wet pond	Excess sediment/debris; ditch partially blocked; erosion	topsoil, seed and blanket, riprap; excavate sediment	C		\$8,060.00
131	Wet pond	Erosion; inflow pipe partially blocked	Riprap; soil retention blanket; clear pipe	C		\$2,307.00
188	Dry pond	Excess sediment	Excavate sediment; riprap; topsoil and seed	C		\$5,207.00
Rt.48	Bioswale	Erosion	Topsoil and seed			\$2,711.00
TOTAL						\$69,374.00

2. New Development and Significant Redevelopment

Requirement: DelDOT shall utilize a comprehensive master planning process to develop, implement, and enforce controls to reduce the discharge of pollutants from areas of new development and significant redevelopment. DelDOT shall review watershed assessment reports, relevant wasteload allocations, Total Maximum Daily Load (TMDL), or Pollution Control Strategies and develop a schedule for maintenance or retrofit of structural controls. DelDOT shall assess the water quality impacts of its existing and ongoing development planning activities. DelDOT shall construct and implement BMPs necessary to protect water quality. Additionally, DelDOT shall budget at least \$150,000 per year for storm water management retrofit projects as described in the Application page iv-15, Part 5 (iv) A2, Permit page 7, Part II.A.2. and Consent Decree page 16, Part II 18.

Performance:

A. Assessment and Planning

- DelDOT has adopted Mobility Friendly Design Standards (see Annual Report 2001, Volume 3, Appendix F) for subdivision and minor collector Subdivision Street. These standards, among other things, are roadway design standards that promote low-impact development strategies such as landscaped areas and narrower pavement widths that support the Statewide Long Range Transportation Plan.
- DelDOT's considers water quality when it completes a Categorical Exclusion Evaluation (CEE) report when reviewing new projects.
- DelDOT is a delegated agency under DNREC's State of Delaware Erosion and Sediment Control Program for land disturbance greater than 5000 sq. ft.
- DelDOT's Subdivision Manual regulates development in Delaware that will be turned over for State Maintenance. Before a subdivision is accepted, a DelDOT Inspector inspects the structural integrity of the stormwater system and the pipes are scoped using Closed Circuit Television. If defects are discovered the contractor is responsible for repairs. This ensures the structure is free of defects, joints are watertight, pipes are sediment free, etc.
- Advancements in technology have aided DelDOT's snow fighting practices. Improvements were initiated that achieve DelDOT's objectives of increasing our level of service, establishing more cost effective and efficient practices, and reducing the impact on the environment and infrastructure. Snow and ice removal strategies include ground speed spreader controls, anti-icing, pre-wetting, brine production, and plow balance valves. Reduction in overall salt usage is a benefit resulting from these new strategies.
- As part of Enhancing Delaware Highways, DelDOT has reduced mowing along roadsides. This has several positive effects: reduction of grass clipping entering the storm drain; filtering of stormwater from roadways before it enters the storm drain; aesthetic enhancement; reduced maintenance hazards; and diverts budget resources for higher priority needs. Additionally, DelDOT developed a mowing Standard Operating Procedure. Some of the main actions implemented are:

- Mowers set to a height to 6”; this height has been shown through our research to have water quality benefits
 - Leaving 10-foot buffer strip around stormwater ponds
 - Rear-discharge mower rotary mowers
 - Medians > 40’ are mowed with a “beauty strip” leaving the center median uncut
 - Regular cleaning of mowers to reduce spread of invasive plant parts, insects and disease
- DelDOT developed a two-part Establishment and Maintenance manual. The Manual explains in detail the necessary steps to establish sustainable roadside vegetation, and manage that vegetation in an environmentally sound, aesthetically pleasing, and fiscally responsible manner. The second part of the manual, Managing Vegetation, describes strategies to minimize the use of pesticides and develop alternative control methods as specified by the NPDES permit. The manual can be viewed at:

(http://deldot.gov/information/pubs_forms/manuals/edh/index_em.shtml).

B. Retrofit

Per the Consent Decree, DelDOT is required to budget \$150,000 per year for stormwater retrofits. In calendar year 2010, DelDOT expended \$50,792.95 towards its NPDES retrofit program. Table 2-1 summarizes total costs incurred for design and construction of retrofits from 2001 – 2010. This total amounts to \$2,768,412.96.

Projects in 2010 include:

Ham Run – In 2009, JMT Engineering, the NPDES Section design engineering firm, completed a concept plan on a project to restore approximately 500 LF of stream using natural channel techniques, creating two wetland floodplains/stormwater wetlands and creating a filter strip along Duncan Road prior to draining into the relocated stream. Included in the channel restoration is realignment of the channel within the property owned by DelDOT so as to provide a better approach alignment into the existing culvert under Greenbank Road. In 2010, JMT worked on final plans, additional hydraulic analysis to account for attenuation by floodplain creation and model parapet impact, and began preparation of Environmental Compliance Plans.

Blackbird Creek - DelDOT is working with DNREC on this project consisting of preparing a full plan design for restoration of a main tributary and three (3) tributary branches to Blackbird Creek using natural channel techniques and creation of a wetland floodplain and protect DelDOT’s road. To protect the integrity of Blackbird Landing Road, DelDOT has agreed to stabilize the areas immediately adjacent to the creek prior to beginning any stream restoration. JMT completed conceptual plans and submitted to DNREC partners.

Leatherman’s Run Retrofit Scoping – JMT Engineering is collecting and reviewing all available studies provided by the DelDOT NPDES group including but not limited to BMP retrofit recommendation reports, stream assessments, watershed studies, and all available hydrologic, hydraulic, geomorphic, benthic, lentic and pollutant assessment and/or monitoring information to provide retrofit recommendations. Following review of this information, site visits may be conducted for selected sites. In some cases, gathering of additional information

such as determination of site location within the watershed, estimate of site impervious areas, the location of environmental features, property information, utilities, cultural resources other existing studies, etc. may be necessary in order to prepare final recommendations. In 2010, JMT worked on preparing conceptual design for stream restoration BMP along Leatherman's Run between I-95 and Chapman Road.

Harrington maintenance facility vehicle wash retrofit – RK&K, the NPDES Section design engineering firm, completed the design for Harrington maintenance facility. Improvements include replacing the existing dry pond with a wet pond and forebay, creating bioswales and a concrete wash pad. The project was advertised for construction in December 2009 and completed in November 2010.

Table 2-1. Cost Summary for DelDOT Retrofits, 2001 – 2010.

Project Design/Construction	2001	2002	2003	2004	2005
Retrofit Design Cost	\$ 82,000.00	\$1,775.00	\$ 86,315.00	\$ 51,510.00	\$104,000.00
SR 273/SR7 Park & Ride sandfilter	\$ 90,000.00				
I-95 Service Plaza: - Bioretention/Sandfilter/Stormfilter - Baysaver				\$411,000.00	\$165,000.00
Storm drain inserts			\$ 33,000.00	\$ 90,000.00	\$ 20,024.00
Appoquinimink River retrofit inventory				\$ 10,000.00	
Bear maintenance facility construction					
Leatherman's Run retrofit planning			\$ 5,792.33	\$ 32,798.45	\$ 52,838.63
TOTAL COST	\$172,000.00	\$1,775.00	\$125,107.33	\$595,308.45	\$341,862.63

Table 2-1 (cont.). Cost Summary for DelDOT Retrofits, 2001 – 2010.

Project Design/Construction	2006	2007	2008	2009	2010
Retrofit Design Cost	\$ 97,481.47	\$ 27,253.18	\$167,695.61	\$ 63,447.78	\$ 44,834.12
SR 273/SR7 Park & Ride sandfilter					
Storm drain inserts				\$ 6,710.00	\$ 5,958.83
Appoquinimink River retrofit inventory					
Bear maintenance facility construction	\$531,702.14				
Middletown maintenance facility construction				\$292,983.35	
Leatherman's Run retrofit planning	\$ 48,952.93	\$ 54,811.88		\$ 52,011.30	
TOTAL COST	\$678,136.54	\$ 82,065.06	\$167,695.61	\$415,152.43	\$ 50,792.95

3. Roadways

Requirement: DelDOT shall operate and maintain public streets, roads, and highways, in such a manner as to reduce, to the maximum extent practicable, the discharge of pollutants as described in the Application page iv-30, Part 5(iv) A3, Permit page 7, Part II.A.5. and Consent Decree page 18, Part II 19.

Performance:

The following programs described below are ways the Department manages and minimizes transport of pollutants associated with road repair and maintenance activities:

A. Road Repair and Maintenance

There are various ways in which the Department maintains the roadways that help reduce the discharge of pollutants. Routine maintenance and improvements reduce the pollutants coming from the roadway in several ways. The patching of potholes and sealing of cracks reduces the amount of pavement that will break away and be transported into the nearest waterway. Repairing potholes will also decrease the wear and tear on vehicles, thus reducing the fluids, miscellaneous sediments, and tire particles that could be dislodged from vehicles.

All road projects are required to follow the Delaware Sediment and Stormwater Regulations. Projects designated as minor, medium or major shall have an approved sediment and stormwater management plan. Medium and major projects must also have a site reviewer who is a Certified Construction Reviewer (CCR).

B. Spills on Roadways

DelDOT follows the manual of Standard Operating Procedures developed for responding and managing spills on the roadways classified as **Category E, Type E-1** incidents (Traffic Hazards, Fuel, Oil or other HAZMAT spills on or near the roadway). Most DelDOT vehicles have been equipped with spill kits in the event of an accidental spill or as a first responder to a vehicle accident; employees have been trained how to respond to spills and protection of water quality.

C. Sweeping Program

DelDOT's sweeping program reduces pollutants by maintaining the cleanliness of the roadway. The street sweeping program includes the roadways, shoulder, intersections, and toll plaza lanes on primary, secondary and tertiary roads. The roadways are swept on the following cycle: roads with ADT (Average Daily Traffic) greater than 20,000 are swept 4 times a year, roads with ADT between 5,000 and 20,000 are swept 2 times a year and roads with ADT less than 5,000 are swept once a year. The current fleet of sweepers in New Castle County consists of 8 mechanical sweepers and 11 regenerative air vacuum sweepers.

DelDOT's draft NPDES permit requires DelDOT to quantify the expected pollutant load reductions from all controls (e.g. sweeping) to meet the TMDL (Total Maximum Daily Load) and Waste

Load Allocation goals. To help meet this requirement, DelDOT's Equipment Management Section is developing a contract to install GPS units in sweepers to pilot a study to:

1. Track sweeper routes to ensure the required sweeping frequency on primary, secondary, and tertiary roads is met per the SWMP;
2. Obtain estimates of pollutant load reductions resulting from sweeping to meet the TMDL and WLA goals as required by the NPDES permit.

NPDES Program staff will evaluate and optimize the sweeping program so we get maximum pollutant removal for the least amount of cost by determining what roads, if any, can be excluded from sweeping (e.g. sweep only curb and gutter roads, subdivisions, beach resorts, interstates, etc.)

D. Litter Control Programs

DelDOT maintenance staff and prison crews

DelDOT's maintenance staff and prison crews help reduce the discharge of floatables to the MS4 through routine pick up of trash and debris from the roadways, medians and right-of-way. DelDOT staff is also responsible for removal of dead animals and clean up of illegal dump sites from the roadside.

Adopt-a-Highway

Adopt-a-Highway is a cooperative program between DelDOT's Division of Public Relations and volunteers to reduce litter along State roadways and subsequent discharge to waters of the State. This program supplements effort by DelDOT's maintenance forces to control litter. The volunteer groups are required to collect litter a minimum of twice per year and submit activity reports following each cleanup for inclusion in the program. Each group maintains approximately two miles of roadway. DelDOT maintains an Adopt-a-Highway website (www.deldot.gov) and submits press releases to solicit volunteers. There are currently 774 volunteer groups statewide maintaining 1,548 lane miles. In 2010 Adopt-a-Highway crews picked up 5,944 bags of trash from Delaware highways.

Roadside Clean-up

DelDOT held its sixth annual "Imagine a Litter Free Delaware" cleanup day along roads, highways and community areas in October 2010.

TrashStoppers

DNREC's campaign is an outward appeal to the public for help in stopping illegal trash dumping along Delaware roadways to stop illegal dumping of garbage, debris, and hazardous wastes.

The "TrashStoppers" program relies upon the placement of numerous surveillance cameras. Since the surveillance cameras were deployed in 2009, 14 arrests have been made on 16 illegal dumping charges, all resulting in convictions with guilty pleas.

E. Snow and Ice Program

Effective salt management practices can help reduce the amount of road salt that enters the environment. This translates into savings for DelDOT, protection against liability, and minimization of impacts of salt on our environment. DelDOT has many practices in place, both for the roadway and all maintenance facilities.

DelDOT has developed and instituted advanced snow fighting practices that began during the 2004-2005 winter season to include ground speed spreader controls, anti-icing, pre-wetting, and plow balance valves. These advanced techniques in snow and ice removal help DelDOT meet its goal of improved service to customers, reduce the impact to the infrastructure, and conserve salt which helps meet the goals of the NPDES Program by reducing the impact on the environment:

- Ground speed spreader controls provide accurate control of material usage.
- Anti-icing is the application of liquid deicers (Salt Brine) to road surfaces prior to a precipitation event to prevent the formation or development of bonded snow and ice. The Department presently has eleven units of 1300-gallon capacity and six units of 1800-gallon capacity that slide into the bed of a dump truck.
- Pre-wetting adds moisture to salt to “jump start” the melting action of the salt and causes the salt to stick to the road and prevent scatter or bouncing.
- Plow balance valves decreases the amount of weight that the plow cutting edge bears on the road surface decreasing damage to the road surface.

Salt application rates can vary depending on storm conditions, but the goal is 100 - 400 pounds of salt per lane mile as recommended by AASHTO. The rate is achieved by calibrating the equipment annually and sending maintenance personnel to a one-day seminar provided by The Salt Institute. The seminar instructs on proper salt application procedures and quantities balanced with safety and environment.

All salt stored at the maintenance facilities is under roof. Only during loading and unloading does the potential exist for salt to enter the stormwater system. DelDOT is following the salt management practices established by the “Statewide Salt Best Management Practices for DelDOT Maintenance Yards” plan developed for area maintenance facilities (see Annual Report 2004, Appendix U).

4. Flood Management

Requirement: DelDOT shall assess and minimize to the maximum extent practicable, the impacts of any flood control projects on receiving water quality as describe in the Application page iv-38, Part 5(iv) A4, Permit page 7, Part II.A.4. and Consent Decree page 19, Part II 20.

Performance: DelDOT does not have a regional flood control program and does not undertake flood control projects. DelDOT's only responsibility is maintenance of existing tide gates and mill pond outfalls. Should DelDOT become involved in any flood control project in the future, consideration will be given to incorporating water quality control measures.

5. Pesticides, Herbicides and Fertilizers

Requirement: DelDOT shall implement controls to reduce, to the maximum extent practicable, the discharge of pollutants related to the application of pesticides, herbicides, and fertilizers by the co-permittee's employees or contractors to public rights of way, parks, and other municipal property or facilities. In addition, the co-permittees shall implement programs to encourage reductions in the discharge of pollutants associated with the commercial application and distribution of pesticides, herbicides and fertilizers as described in the Application page iv-45, Part 5(iv) A6, Permit page 7, Part IIA.5. and Consent Decree page 19, Part II 21.

Performance:

All herbicide applications that are applied to DelDOT rights-of-way by contract applicators are reviewed prior to the award to the lowest bidder to insure that selected herbicides are labeled for the intended use, and that when feasible, a herbicide is selected that can be applied at a low-use rate. This review frequently reduces the total load of herbicide applied to DelDOT's rights-of-way.

DelDOT does not routinely fertilize its roadsides. The only nutrients applied to DelDOT's rights-of-way come as a result of leaving grass clippings on the ground after mowing. Degradation of this vegetative material results in the slow release of organic constituents that are mineralized to plant nutrients by microorganisms and subsequently available to turfgrasses. This natural process results in minimal leaching of nutrients. Also this practice results in minimal surface runoff of nutrients from ground with a slope of 3 horizontal to 1 vertical or less.

Fertilizers are used in establishing turfgrasses from seed on freshly prepared bareground. This is generally done under contract with a firm using a hydroseeder. DelDOT's specifications require that 50% of the nitrogen product be a slow release form of ureaformaldehyde. The amount of nitrogen applied is 78 kg/ha. Phosphorous pentoxide is applied at 47 kg/ha of available P that is the sum of water soluble and citrate-soluble phosphate. Potassium oxide is applied at 31kg/ha of water soluble potash. In all cases areas that are seeded are covered with a recommended mulch.

Pesticides applied on DelDOT's rights-of-way are done according to label recommendations that are on the product and filed with EPA at the time of product registration. Pesticides applied on DelDOT's rights-of-way are done by contractors that are certified Delaware pesticide applicators. DelDOT employees that apply pesticides to DelDOT's rights-of-way are certified Delaware pesticide applicators or work under the supervision of a DelDOT employee that is a certified Delaware pesticide applicator. Typically, the only pesticides applied by DelDOT fall under the category of herbicides. DelDOT, however, may use other pesticides such as insecticides under certain circumstances.

DelDOT employees take required training courses that serve as credit toward renewal of their Delaware pesticide applicators license. Roadside Environmental Specialists attend conferences and working sessions on pest control technologies that are open to all DOT employees. Opportunities to use reduced amount of pesticides by using

new low rate pesticides, adjuvants or surfactants that can enhance efficacy of pesticides and thus reduce rate, or alternatives to chemicals that are cost effective and efficacious are often topics of various sessions these specialists attend.

We began implementing several programmatic initiatives as part of the NPDES pesticide reduction strategy:

1. *Guardrail Inventory* – DelDOT has the responsibility of maintaining a 4' clear zone around the guardrail for both public safety and structural integrity via mowing, hand trimming and herbicides. We executed an agreement with Wallace Montgomery & Associates, LLP in May 2008 to inventory all guardrails statewide. The project was completed in June 2009 and inventoried 310 guardrail miles. Attributes collected included material under guardrail, guardrail type, surrounding environmental features and identification of sensitive/no spray zones. The inventory and attributes collected will be used in development of a pesticide reduction strategy to limit the use of herbicides, particularly around environmental sensitive areas (e.g. streams, wetlands, drinking supply, etc.). Since DelDOT is continually upgrading, replacing, or adding new guardrail, we are developing a new agreement to update and maintain DelDOT's existing guardrail inventory database. The consultant will compile a field-verified inventory of the new and modified guardrail sections on all DelDOT-maintained roadways in Delaware, to include GPS location data for the beginning and end of each section. At least twice per year, DelDOT's NPDES Section will provide information to the consultant on the locations of new guardrail installations. These will be integrated into the existing guardrail inventory database.
2. *Guardrail Vegetation Management pilot study* – DelDOT and the University of Delaware developed a controlled research study to test the effectiveness of treatment types under guardrail for weed control. Two types of weed block material, asphalt, low-grow fescue and natural growth with periodic trimming will be monitored against a control. The results of this study will determine if these materials are effective at reducing herbicide application and can be used in specific locations such as environmental sensitive areas and drinking water supply reservoirs. We have extended this study through the 2011 growing season to monitor additional types of weed block material and the low-grow fescue plots. A detailed summary report is found in Section 13-C6 of this report.
1. *Training* – In addition to the required training for pesticide license renewal, DelDOT holds or attends periodic training to further educate staff. In 2010, DelDOT Roadside Environmental staff attended two workshops.
2. *Record keeping and pesticide usage* – Contractors and DelDOT applicators are required to submit records of spraying activities to DelDOT's Environmental Roadside Section. The NPDES Program has begun tracking and reporting herbicide quantities to establish baseline herbicide usage (Tables 5-1a and 5-1b). By tracking herbicide quantities we will be able to identify the cause of spikes or declines in usage and use the data to assess pesticide reduction programs we have implemented.

Table 5-1a. 2009-2010 Contractor Herbicide Spray Totals for New Castle County.

Guardrail, Islands, Signposts – *Includes SR1 in Kent County

Year	Rate	Gallons Used	Acres Treated
2009	87.5 gal/acre	68620	784.2
2010	87.5 gal/acre	73290	837.6

Noxious weed (Canada thistle, Phragmites, cattail) treatment - *Includes SR1 in Kent County and NPDES BMPs

Year	Rate	Gallons Used	Acres Treated
2009	100gal/acre	9800	98.0
2010	100gal/acre	12025	125.0

Brush treatment

Year	Rate	Gallons Used	Acres Treated
2009	4 gal/acre	3440	860.0
2010	4 gal/acre	885	221.2

Table 5-1b. 2009-2010 District in-house Herbicide Spray Totals for New Castle County.

Brush treatment

Year	Rate	Gallons Used	Acres Treated
2009	N/A	N/A	N/A
2010	100 gal/acre	131.7	1.3

6. Illicit Discharge and Improper Disposal

Requirement:

The co-permittees shall: (1) implement a facility inspection program (*New Castle County only*), (2) implement an on-going program to detect illicit discharges and improper disposal into the storm sewer, (3) implement procedures to limit infiltration of seepage from sanitary sewers, and (4) implement a public education program on proper management and disposal of an array of organic and inorganic materials. These requirements are described in the Application page iv – 30, Part 5(iv) A6, Permit page 7, Part II.A.5., Consent Decree page 19, Part II 22.

Performance:

Per agreement with New Castle County, DelDOT is responsible for the illicit discharge detection and elimination (IDDE) program within the DelDOT-owned portion of the stormwater conveyance system. Similarly, New Castle County manages their IDDE program that includes outfalls of their ownership. DelDOT contracted with KCI Technologies, Inc. (under Agreement No. 1495) to perform the dry weather screening for DelDOT-owned outfalls.

DelDOT has the responsibility of eliminating illicit connections to its portion of the MS4. DelDOT first tries to effect these eliminations through administrative action. KCI is instructed to send the potential violator a “Notice of Potential Illicit Discharge” letter. The letter describes the illicit discharge and instructs the resident to eliminate the discharge within 30 days. A follow-up inspection is conducted after the 30-day period. If the illicit discharge is still present, DelDOT’s NPDES Section will send a second letter stating if the discharge/illegal connection has not been eliminated or removed after the 30-day period, the enforcement branch of the Department of Natural Resources and Environmental Control (DNREC) will be notified. If that is unsuccessful, we can use police action through DNREC. DelDOT established a Memorandum of Agreement on August 20, 2001 with DNREC to utilize Environmental Protection Officers in the enforcement of the permit. A copy of the MOA was included in Annual Report 2001.

In calendar year 2010, a total of 277 DelDOT-owned outfalls were screened in New Castle County. The dry weather screening procedure is described more fully in Section 13 of this report. No dry weather flow was observed during any of these inspections.

During 2010, 16 potential illicit discharges (PIDs) in New Castle County were either reported to the DelDOT NPDES Program or discovered during KCI’s MS4 inspection activities (Table 6-1). Each was investigated by KCI crews, and follow-up action was taken where appropriate. Educational door-hangers were distributed in three of these communities to discourage future dumping into storm drains. Additional information regarding the PIDs is provided in KCI’s 2010 Outfall Screening Report (Appendix C).

In addition to the PID’s summarized in KCI’s report, DelDOT also investigated a report from DelDOT personnel of petroleum odors coming from a storm drain at the newly renovated Delaware Welcome Center on Interstate 95. Because extensive subsurface contamination was discovered and remediated during construction of the new service plaza, this issue was turned over to DelDOT’s Hazmat consultant, Tetra Tech, for investigation. Tetra Tech performed a Phase II Environmental Investigation in the area surrounding the catch basin, including chemical

analysis of stormwater runoff and subsurface soil samples, to try to determine the source of the vapors. All analytical results were low or below detection limits and no source could be found for the odors that were reported. The odors did not persist, and the investigation was closed. A copy of the assessment report from Tetra Tech is include here as Appendix D.

In an effort to encourage Delaware citizens to dispose of hazardous household materials properly, the DeIDOT NPDES Section helped publicize Delaware Solid Waste Authority (DSWA)'s Household Hazardous Waste Collection Program. This included distribution of DSWA brochures that announced the dates and locations of collections in each county.

Another public outreach program aimed at eliminating illegal dumping of trash, debris and hazardous wastes along the state's highways, is DNREC's "Trashstopper" Program. The public is asked to notify DNREC about any roadways or streets used for illegal dumping so the sites can be put under surveillance by digital cameras now effectively used for identifying trash dumpers. The public is also asked to identify the trash dumpers who are caught in the act in photos posted on the DNREC web site as part of the TrashStoppers campaign (<http://www.awm.delaware.gov/Enforcement/Pages/TrashStoppers.aspx>).

Table 6-1. Summary of potential illicit discharges into the DeIDOT MS4 investigated in New Castle County.

Date	Structure	Neighborhood/ Address	Issue	Investigation Results	Determination
01/18/10 03/02/10 06/25/10	3200804071 311737	Outfall to BMP 241 /Rt. 7	01/18/10: Dark green stain on outfall pipe leading to BMP 241 pond; outfall discharge clear; dead fish directly in front outfall pipe. 03/02/10: no dead fish; foam present in front outfall. 06/25/10 Revisit	01/18/10: Sampled, tested within acceptable parameter levels. 03/02/10: Sampled, tested high for detergents. 06/25/10: Sampled ,tested high for detergents.	Continue to monitor/ Revisit site.
03/02/10	71506	Todd Estates/42 Lynchfarm Dr.	Pet waste in catch basin.	Pet waste on grate and in catch basin.	Distributed 25 doorhangers; Re-visit site.
03/02/10	74702	Brookside Park/ 30 McCord Dr.	Dry weather flow.	Sampled, tested within acceptable parameter levels.	No further action.
03/02/10	71075	Brookside Park/Intersection McCord Dr./ Matthews Rd	Dry weather flow.	Sampled, tested within acceptable parameter levels.	No further action.
03/08/10	74839	Todd Estates/ 23 Garrett Rd.	Resident reported neighbor dumping leaves in catch basin.	Catch basin 75% full leaves.	Distributed 16 doorhangers; Re-visit site
04/07/10	16374	Minquadale East/920 Hazeldell Ave.	Garbage dumped in catch basin.	No garbage in catch basin. Garbage observed along curb throughout neighborhood.	No further action.
04/07/10	71994	East Burn Acres/ 2004 Carol Dr.	Motor oil on roadway.	Parked vehicle leaking oil.	Provided doorhanger; No further action.
06/02/10	2684	Newkirk Estates/ 117 Phyllis Dr.	Drain hose in manhole 74285 upstream of outfall.	Confirmed hose in manhole; no active flow from hose or to outfall.	No further action.
06/02/10	1364	Chestnut Hill Estates/Old Ogletown Rd.	Dry weather flow.	Sampled tested within acceptable parameter levels.	No further action.
06/02/10	2256	Bellevue Manor/ 715 Woodsdale Dr.	Dry weather flow.	Sampled tested within acceptable parameter levels.	No further action.

Date	Structure	Neighborhood/ Address	Issue	Investigation Results	Determination
06/18/10 06/23/10	95458	2572 Red Lion Rd.	Possible illegal sewage connection; sewage smell; toilet paper.	Sample tested above recordable limits for detergents; ammonia levels within parameter limits. 3" pipe in wall of catch basin; prior URS inspection flow with soap suds.	Referred to DNREC by DeIDOT. DNREC capped illegal hook up after finding dye in pipe. Warrants pending for homeowners arrest.
08/03/10	77010, 77011	Casho Mill Rd./ Julie Ln.	Hot mix material in catch basin.	77010: Filled with hot mix blocking outflow pipe completely. 77011: No evidence of hot mix.	KCI field crew removed enough hot mix to allow positive flow; could not remove all due to hardening.
08/31/10	13	Lambeth Riding/ 404 Wesley Circle	Dry weather flow.	Flow due to underground stream outfalling into creek bed; no sample tested.	No further action.
08/31/10	5143	Lambeth Riding/ 504 Lambeth Place	PVC pipe in side wall of concrete pipe connecting to catch basin; flow observed from PVC pipe collecting in catch basin.	Sampled tested within acceptable parameter levels; could not find flow source.	Re-visit site.
11/01/10	11712- 11721	Mendenhall Village/ Lamplighter Way	Report of grass clipping dumping in catch basin.	No evidence of grass clippings in any catch basins on Lamplighter Way.	Re-visit site.
11/01/10	New structure	316 Pigeon Point Rd.	DeIDOT reported greenish substance in/around area of new inlet pipe.	No evidence of substance.	Re-visit site.

7. Spill Prevention and Response

Requirement: DelDOT shall implement a program to prevent, contain, and respond to spills that may discharge into the MS4 as described in the Application page iv-59, Part 5(iv) B2, Permit page 9, Part II.A.7., Consent Decree page 20, Part II 23.

Performance:

DelDOT's Transportation Management Center (TMC) is a department wide facility that coordinates operations and shares information among its own personnel as well as various other transportation and public safety-related agencies, serving as the transportation interface among all such agencies in the state. They operate 24-hours per day/7 days per week. They serve as the central communication point for DelDOT during major incidents, special events, and emergencies, and coordinates transportation management activities with other agencies. The TMC has special instrumentation that has been used to develop incident management capability.

The type of incident detected or called in will have a direct effect on the notification process and steps that must be taken in order to be able to respond, assist, and document the incident in an expeditious manner. Incidents have been classified into one of seven categories, and then into sub-categories that further specify the type of incident that has occurred. These categories are listed below:

Category A: Accidents (Emergency)

Category B: Vehicle Fire (Emergency)

Category C: Disable Vehicles (Emergency)

Category D: Police Activity (Emergency)

Category E: Traffic Hazards (Emergency)

Category F: Roadway and Signal Operations (Traffic)

Category G: Delay or Congestion (Traffic)

In June 2001, the TMC developed a manual of Standard Operating Procedures (SOP) that acts as a guideline for handling incidents and systems problems; as a training tool/resource for new employees and as a reference guide for the operations staff. *Category E: Traffic Hazards (Emergency)*, of the SOP describes the notification and documentation procedure involving fuel, oil or other HAZMAT spills on or near the roadway (see Annual Report 2001, Volume 3, Appendix J).

In the event of a spill such as fuel, oil, or HAZ-MAT, the TMC is required to notify the respective police agency since they are responsible for arranging for the particular traffic hazard to be removed. Generally, the police will contact the following agencies: Fire Board, DNREC (Department of Natural Resources and Environmental Control), tow company, and all other agencies that are required to attend such incidents.

In the event of a non-hazardous materials spill DelDOT mobilizes, responds and directs the clean up effort to prevent the material from entering the storm drain system or receiving waters. DelDOT purchased 450 vehicle spill kits for minor oil and/or pesticide spills. If the spill is of questionable material, DelDOT uses procedures as describe for HAZ-MAT spills.

In addition to the TMC's Standard Operating Procedures, the NPDES Program has completed the Spill Prevention Control and Countermeasures Plans for DelDOT facilities that met the above ground storage tank minimums. These plans bring DelDOT into compliance with EPA's Oil Pollution Prevention regulations (40 CFR Part 112) contained within the Clean Water Act.

During our annual inspections of the maintenance facilities, we determine if additional spill decks, kits or other spill prevention equipment or supplies are needed. The NPDES section funds these purchases.

We completed an agreement with CSERT (The Center for Emergency Response Training, Inc.) to develop three videos: (1) *SPCC Regulatory Requirements* - acquaints DelDOT personnel with the regulatory requirements of the Spill Prevention Control and Countermeasures (SPCC) plan, NPDES Permit program and other regulatory initiatives in designated DelDOT facilities; (2) *Spill Response & Emergency Procedures* and *Roadside Events* - trains DelDOT employees on the proper procedures for responding to facility and non-facility (roadway) based emergency events. Videos have been distributed to each maintenance facility and personnel are required to view them annually.

8. Industrial and High Risk Runoff

This section pertains to New Castle County only. See Section 8 of New Castle County's annual report for details.

9. Construction Site Runoff

Requirement: DelDOT shall implement a program to reduce, to the maximum extent practicable, the discharge of pollutants from construction sites. DelDOT shall continue to administer a sediment and erosion control program in accordance with Delaware's Sediment and Storm Water Regulations and to notify applicable construction contractors of the NPDES requirements. DelDOT shall continue to implement a program to inspect construction projects for compliance with Delaware's Sediment and Storm Water Regulations and where applicable, requirements of the MS4 NPDES permit as described in the Application page iv-72, Part (iv) D, Permit page 10, Part II.A.9. and Consent Decree page 23, Part II 27.

Performance:

In Delaware, construction site runoff is controlled under State law, which has been in effect since 1990. The State Law (7 Del. C., ch. 40) meets or exceeds the requirements of the NPDES MS4 permit. The erosion and sediment control and stormwater management programs of DelDOT are managed by the Division of Transportation Solutions (DOTS). This program was delegated to DelDOT in 1991 by the Department of Natural Resources and Environmental Control (DNREC) and was to implement three of the five components of the Delaware Sediment and Stormwater Regulations (see Annual Report 2001, Volume 3, Appendix K). These components are: review and approval of construction plans, review of construction sites, and inspection and maintenance of completed stormwater management facilities. Inspection and maintenance of completed stormwater management facilities is covered in section 1. MS4 Structural Controls. The delegation is reviewed every three years. DelDOT received delegation extension through June 30, 2012.

Enforcement of construction site erosion and sediment controls is accomplished through each construction contract. Section 110 of the Delaware Department of Transportation Standard Specifications lays out a progressive step-wise approach to gaining compliance with approved plans, regulations, and laws. This section was significantly rewritten to demonstrate positive movement toward improving the Erosion & Sediment Program (see Annual Report 2007, Appendix D). The following items summarize the major changes:

1. Contractor required to provide CCR and must submit name at the time of bid and must conduct E & S reviews jointly with a member of DelDOT's construction staff.
2. Required pre-construction meeting specifically designed to address E & S compliance.
3. Better defined division of responsibilities among site reviewers, contractor engineer, project engineer, stormwater engineer
4. Strengthening of actions to gain compliance
5. Environmental Compliance Supervisor – regularly tracks and reviews the Certified Construction Reviewer reports submitted on a weekly basis from

Notice of Intent (NOI) to Notice of Termination (NOT) and annually assess CCR's performance.

We are pursuing an agreement to hire two consulting firms to perform the weekly CCR inspections in lieu of contractor provided CCRs as described in number 1 above. This will improve compliance with the required weekly and rain event reporting. The consultant will also have the authority to hire a third party contractor to correct E&S deficiencies if the prime contractor refuses.

The Environmental Protection Agency (EPA) has proposed new turbidity effluent guidelines. Construction sites that have greater than 10 acres of disturbed area would be required to maintain turbidity levels at, or below, 280 NTU for all storms events up to the 2-yr frequency. Owners/operators would be required to monitor the discharge from their sites to ensure compliance. However, the ruling was challenged and EPA was sued. The EPA discovered after promulgation that the data used to calculate the numeric limit was misinterpreted. The Agency initiated a stay for the numeric limit for turbidity until June 30, 2011, so that the limit can be recalculated.

10. Total Maximum Daily Load (TMDL)

Requirement: DelDOT shall comply with any MS4 NPDES permit requirement developed in accordance with relevant wasteload allocation contained in any final TMDL or, as applicable, with any Pollution Control Strategy developed to implement that TMDL as described in the Consent Decree page 24, Part II 28.

Performance:

Table 10-1 identifies the approved TMDLs in New Castle County that specify waste load allocations (WLAs) for MS4 discharges. In addition, the U.S. Environmental Protection Agency established the Chesapeake Bay TMDL for sediment, nitrogen and phosphorus in December 2010. This will impact some watersheds in New Castle County.

DelDOT is being proactive in preparing for compliance with statewide TMDLs, in anticipation of both a new Phase I permit and future watershed Pollution Control Strategies. The Department's activities in this area during calendar year 2010 include the following:

- DelDOT is an active participant in the American Association of State Highway and Transportation Officials (AASHTO) Stormwater Management Community of Practice (CoP), which was established recently to create a forum where DOT practitioners can share information on emerging issues, research data needs, and innovative stormwater quality compliance solutions. TMDL compliance currently is a priority focus area for the CoP. Multi-state conference calls on these issues occur frequently.
- DNREC is finalizing new regulations for stormwater for the State of Delaware. The new regulations include design requirements for meeting TMDL and Pollution Control Strategy mandates. DelDOT's NPDES and Stormwater sections have been working with DNREC on this effort, and our design staff and consultants will be trained to ensure compliance with the regs.
- DelDOT staff assisted DNREC with development of a Watershed Implementation Plan (WIP) for the Chesapeake Bay TMDLs.
- DelDOT has an active BMP performance and assessment program that is described in detail in Section 13 of this report. One of the objectives of this program is to provide data on the effectiveness of the BMPs under study in reducing pollutants targeted by TMDLs adopted for Delaware watersheds. This will allow DelDOT to conduct an analysis of the existing BMPs being implemented and select the most appropriate supplemental BMPs, if necessary, to achieve the numeric WLAs. In 2010, DelDOT tasked KCI Technologies with determining drainage areas of all BMPs and major outfalls. These data are needed for pollutant loading calculations. KCI completed drainage area delineations for major outfalls and Best Management Practices (BMPs) in New Castle County. These drainage area calculations were completed for New Castle County. For Kent and Sussex Counties, the drainage area delineation process is on-going. KCI completes BMP drainage areas as the MS4 information becomes available. QA/QC is performed on the drainage areas prior to database upload. Completed drainage areas are included on the DelDOT NPDES Map Viewer.

- KCI Technologies is also assisting DelDOT with modeling and monitoring to determine pollutant reductions provided by roadside grassed buffer strips and cloverleaf infields. DNREC has agreed to allow credit for these toward WLAs if we can demonstrate that they provide significant reductions in sediment , nitrogen and/or phosphorus.
- DelDOT NPDES Program staff have met several times with staff from the DNREC Watershed Assessment Section to discuss database, monitoring and reporting needs for WLA compliance. KCI Technologies worked with the DNREC to compile a database of DelDOT BMPs, drainage areas and associated pollutant reductions for the Delaware Chesapeake Bay WIP. We anticipate that these same tools will be used to report and track progress toward meeting WLA's in other state watersheds. We have shared BMP and monitoring data with DNREC for use in their TMDL models and have discussed future coordination of monitoring efforts.
- The most recent draft of the new Phase I permit for New Castle County and DelDOT includes requirements for development of watershed infrastructure plans, a monitoring plan and a public education plan. DelDOT and the County began in 2010 to coordinate and work on some of these. This should allow us to move forward more quickly when the final permit is actually issued.

Table 10-1. List of New Castle County waterbodies with approved TMDLs and MS4 waste load allocations.

Waterbody with Approved TMDLs	Pollutant Addressed by Approved TMDL	MS4 Wasteload Allocation Specified in Approved TMDL		
		Baseline Load	TMDL Load (Reduce to)	Load Reduction (Percent) (Reduce by)
Appoquinimink River Dissolved Oxygen and Nutrients (updated December 2003) Bacteria (December 2006)	Total Nitrogen	See Table 4-1 of approved TMDL for baseline loads and TMDL loads presented by subbasin		60%
	Total Phosphorus	See Table 4-1 of approved TMDL for baseline loads and TMDL loads presented by subbasin		60%
	Bacteria	34 CFU/100 mL (geomean of 1997-2005 load for fresh water)	28.6 CFU/100 mL (geomean)	16% (fresh water portion)
		116 CFU/100 mL (geomean of 1997-2005 load for marine water)	100 CFU/100 mL (geomean)	68% (marine water portion)
Army Creek TMDL Analysis for the Watersheds of Army Creek, Red Lion Creek, and Dragon Run Creek, Delaware (August 2006)	Total Nitrogen	18.4 kg/day	11.0 kg/day	7.4 kg/day (40%)
	Total Phosphorus	1.54 kg/day	0.93 kg/day	0.61 kg/day (40%)
	Bacteria	3.0E+10 CFU/day	1.38E+10 CFU/day	54%
Blackbird Creek	Total Nitrogen	175.2 lb/day	105.1 lb/day	70.08 lb/day (40%)
Blackbird Creek	Total Phosphorus	19.4 lb/day	11.64 lb/day	7.76 lb/day (40%)

Waterbody with Approved TMDLs	Pollutant Addressed by Approved TMDL	MS4 Wasteload Allocation Specified in Approved TMDL		
		Baseline Load	TMDL Load (Reduce to)	Load Reduction (Percent) (Reduce by)
Watershed Proposed TMDLs (August 2006)	Bacteria	2.34E+11 CFU/day	4.67E + 10 CFU/day	80%
Christina River Basin	Total Nitrogen	224.96 kg/day (See Appendix C of TMDL report for baseline loads by municipality and subbasin)	216.57 kg/day	4%
Christina River Nutrient and Low Dissolved Oxygen High-flow TMDL (September 2006)	Total Phosphorus	14.718 kg/day (See Appendix C of TMDL report for baseline loads by municipality and subbasin)	14.509 kg/day	1%
Christina River Bacteria and Sediment TMDL (September 2006)	Bacteria	See Tables 4-1 and 4-2 on pages 4-5 and 4-6 of TMDL report for baseline and TMDL loads by subbasin and municipality		92.91%
Delaware River TMDLs for PCBs for Zones 2-5 of the Delaware Tidal River (December 2003)	PCBs	0.327 kg/yr (estuary zone 5)	0.5922 mg/day (estuary zone 5)	
Dragon Run Creek	Total Nitrogen	60.3 kg/day	36.2 kg/day	24.1 kg/day (40%)
	Total Phosphorus	3.21 kg/day	1.93 kg/day	1.28 kg/day (40%)

Waterbody with Approved TMDLs	Pollutant Addressed by Approved TMDL	MS4 Wasteload Allocation Specified in Approved TMDL		
		Baseline Load	TMDL Load (Reduce to)	Load Reduction (Percent) (Reduce by)
TMDL Analysis for the Watersheds of Army Creek, Red Lion Creek, and Dragon Run Creek, Delaware (August 2006)	Bacteria	3.8E+10 CFU/day	2.96E+10 CFU/day	22%
Naamans Creek TMDLs Analysis for Naamans Creek (October 2005)	Total Nitrogen	128 lb/day	128 lb/day	Capped at baseline load (0%)
	Total Phosphorus	9 lb/day	9 lb/day	Capped at baseline load (0%)
	Bacteria (Average flows associated with each quartile available in Table 5-2 on p. 27 of TMDL report)	7.1E+09 CFU/day (1 st quartile)	4.1E+09 CFU/day (1 st quartile)	42%
		8.1E+10 CFU/day (2 nd quartile)	7.9E+09 CFU/day (2 nd quartile)	90%
		3.1E+10 CFU/day (3 rd quartile)	1.5E+10 CFU/day (3 rd quartile)	54%
		6.3E+11 CFU/day (4 th quartile)	1.4E+11 CFU/day (4 th quartile)	78%
Red Lion Creek TMDL Analysis for the Watersheds of Army Creek, Red Lion Creek, and Dragon Run Creek, Delaware (August 2006)	Total Nitrogen	91.7 kg/day	55 kg/day	36.7 kg/day (40 %)
	Total Phosphorus	2.80 kg/day	1.68 kg/day	1.12 kg/day (40%)
	Bacteria	6.5E+10 CFU/day	3.38E+10 CFU/day	48%
Smyrna River	Total Nitrogen	280 lb/day	168.0 lb/day	40%

Waterbody with Approved TMDLs	Pollutant Addressed by Approved TMDL	MS4 Wasteload Allocation Specified in Approved TMDL		
		Baseline Load	TMDL Load (Reduce to)	Load Reduction (Percent) (Reduce by)
Smyrna River Watershed Proposed TMDLs (August 2006)	Total Phosphorus	20.29 lb/day	12.18 lb/day	40%
	Bacteria	3.06E+11 CFU/day	7.66E+10 CFU/day	75%
Shellpot Creek TMDLs Analysis for Shellpot Creek (October 2005)	Total Nitrogen (See Table 4-1 and 4-2 in TMDL report)	89.4 lb/day	89.4 lb/day (load from upstream sub-watershed, reaches 1-3)	Capped at baseline load (0%)
		19.2 lb/day	12.5 lb/day (load from downstream sub-watershed, reaches 4-5)	35%
	Total Phosphorus (See Table 4-1 and 4-2 in TMDL report)	5.7 lb/day	5.7 lb/day load from upstream sub-watershed, reaches 1-3)	Capped at baseline (0%)
		2.0 lb/day	1.3 lb/day (load from downstream sub-watershed, reaches 4-5)	35%
	Bacteria (Flow ranges and average flows associated with each quartile available in Table 5-1 on p. 31 of TMDL report)	3.0E+09 CFU/day (1 st quartile)	2.3E+09 CFU/day (1 st quartile)	25%
		3.5E+10 CFU/day (2 nd quartile)	4.4E+09 CFU/day (2 nd quartile)	88%
		7.2E+10 CFU/day (3 rd quartile)	8.1E+09 CFU/day (3 rd quartile)	89%
		3.0E+11 CFU/day (4 th quartile)	4.0E+10 CFU/day (4 th quartile)	84%

11. Public Education

Requirement: DelDOT shall within six months of entry of the Decree, implement a program to promote, publicize, and facilitate public reporting of illicit discharges having negative impacts on water quality on the MS4 and the proper management of an array of organic and inorganic materials as described in the Application page iv-72, Part 5 (iv) B3, Permit page 11, Part II.A.10. and Consent Decree page 20, Part II 24.

Performance:

A public education program was developed within six months of the effective dates as outlined in the NPDES permit and consent decree. The following public education/outreach activities occurred during calendar year 2010:

- We are continuing our door hanger campaign to residents in subdivisions where an illicit discharge or illegal dumping activity was discovered or reported as part of our outreach program to residents. The front side of the door hanger lists the date and type of pollutant found and what water body affected. On the back, the door hanger describes stormwater pollution and guidelines to reduce pollution at the home or workplace (see Annual Report 2007, Volume 2 of 2, Figure 11- 3). We distributed 42 door hangers in 2010 to residential neighborhoods where a potential illicit discharge was discovered. This program also helps meet the public education requirements of Part II.A.6. *Illicit Discharges and Improper Disposal* of the NPDES Permit.
- DelDOT developed a new stormwater website (www.deldot.gov/stormwater). A “Report a Problem” link allows the public to email or call to report illegal discharges or dumping and stormwater maintenance problems. In 2010, Google Analytics reported an average of about 276 visits per month (range 190-349).
- As part of the storm drain inventory and inspection (Section 1.A.), KCI Technologies is continuing to label each inlet with a storm drain marker that carries a water quality message.
- DelDOT distributed several hundred activity booklets and restaurant placemats to schools and the general public that highlight stormwater pollution, the water cycle and watersheds.
- “Delaware Livable Lawns” Project:

DelDOT executed an agreement with the Appoquinimink River Association (ARA) to lead and execute an education and outreach program to provide information to the public on ways to reduce nonpoint source pollution. We have developed an educational/outreach campaign to reduce fertilizer application by changing watershed residents’ lawn care practices. The “Delaware Livable Lawns Program” certifies lawn care companies that follow environmentally-friendly best practices in fertilizer application while educating homeowners on these best practices. The goal of the program is to reduce fertilizer runoff from residential lawns. Phase I of the program targets commercial lawn care companies recognizing them for environmentally friendly lawn care plans (e.g. soil tests, organic products, low or no nitrogen fertilizers, only fall applications, annual reporting, distribution of educational

materials, etc.) while also meeting homeowners' needs and educating them on best practices. Once the results are analyzed, the team is ready to introduce the program to lawn care professionals and gather their feedback and reactions to it.

We participated in a focus group workshop to gather feedback from commercial lawn care companies on the benefits and/or negative consequences of the program. As a result of these focus groups, the team will have a better idea of how to adjust the Delaware Livable Lawns Program to increase the likelihood of a successful implementation.

In Phase II of the program, we will be targeting individuals in housing developments to be demonstration lawns for various types of fertilizer applications and organic products.

- A second project we completed was a pet waste campaign to reduce bacteria from pet waste. Many watersheds are facing Total Maximum Daily Load (TMDL) regulations for bacteria and nutrients. We used DNREC's dog license data base to target residents in the geographic region south of Middletown in New Castle County and send them a portable pet waste bag container called "Bags-on-Board." This product clips onto a leash and holds approximately 15 bags for pet waste clean-up. An educational tip card will also accompany the container. We mailed 900 to southern New Castle County residents. In addition, we distributed 6,355 "Bags-on-Board" to the following: three veterinarian clinics, two SPCA facilities, the Delaware Humane Association, one doggie daycare facility, and three public events.
- We are partnering with our co-permittee, New Castle County, to begin development of our education/outreach management plan for the next NPDES permit. We executed an agreement with the University of Delaware to investigate cost effective social marketing options that are feasible in Delaware to meet the minimum general public "impressions" required by the new permit. This project proposes to assist the co-permittees in achieving the education requirements of the permit and making these efforts more effective and meaningful for New Castle County, DelDOT and the six municipalities regulated under the permit.

Additional work accomplished by the ARA is documented in their 2010 annual progress report (Appendix E).

- DelDOT staff have been active participants in the founding and development of the Delaware Association for Environmental Education (DAEE). The DelDOT NPDES Environmental Scientist serves on the Board of Directors, assists the group with its communications and outreach, and served on the planning committee for DAEE's first annual statewide conference, which was held in February 2010.
- The NPDES Program has a 10' display board and graphics as well as an interactive kiosk for use at outreach events. In 2010 we participated in the following events:
 - Delaware Rural Water Association – NPDES staff participated in this 2-day event.
 - Delaware State Fair – NPDES staff participated for 10 days and evenings.
 - The Delaware Green Fest, held on the Legislative Mall in Dover.

- NPDES staff served as judges in the Technology Students Association (TSA) State Conference in April.

12. Training

Requirement: DelDOT shall, within six months of entry of the Consent Decree, initiate training for their respective and appropriate personnel on storm water controls, on the storm water management measures established under the MS4 permit, and on specific requirements for implementing all relevant aspects of the Consent Decree as described on page 24, Part II 29 of the Consent Decree.

Performance:

The following is a list of training workshops and conferences attended by DelDOT staff and training material produced in calendar year 2010:

- All statewide district maintenance staff is required to view the following videos as part of Pollution Prevention Plans: Stormwater Contamination & Spill Prevention, Vegetative Control & Pollution Prevention, and Facility & Vehicle Maintenance.
- All maintenance staff are required to view videos as part of the Spill Prevention Control and Countermeasures Plans. The three topics include: SPCC regulatory requirements, spill response and emergency procedures and roadside events.
- NPDES staff are members of the Nonpoint Source Advisory Committee and attend the annual workshop.
- The following training/workshops were attended by NPDES or DOTS stormwater staff:
 - Winter workshop. February 2010: Carol Sullivan gave presentation on BMP/outfall maintenance relative to protection of wetlands and receiving waters and on proper E&S controls regarding slope protection and use of blanket.
 - March 16, 2010: Marine Debris -- A federal, state and local look into opportunities for action
 - March 25, 2010 – Chesapeake Bay TMDL webinar: modeling
 - March 25, 2010 – “Best Practices in Addressing NPDES and Other Water Quality Issues in Highway System Management: Results of a U.S. Domestic Scan Tour”
 - November 4, 2010 Maximo training
- The Roadside Environmental Section staff attended various courses and workshops for re-certification, pesticide credits, and ISA (International Society of Arboriculture) credits including:
 1. Horticulture Industry and Expo: January 2010
 2. Ornamental and Turf Workshop: November 2010

13. Monitoring

Requirements: The co-permittees shall implement a wet weather and dry weather monitoring program, and an industrial and high-risk runoff monitoring program as described in the Permit page 11, Part II.A.11. and Consent Decree page 20, Part II 22b. DeIDOT shall also monitor the performance of and discharge from existing structural controls (BMPs), in accordance with Permit page 6, Part II.A.1.a.

Performance:

During calendar year 2009, DeIDOT's monitoring activities included the following components:

- Dry weather screening of stormwater outfalls
- BMP performance monitoring

Each of these components is described in more detail below.

A. Dry Weather Screening

DeIDOT is responsible for illicit discharge detection and elimination (IDDE), including inventory of new outfalls and dry weather outfall screening, within the DeIDOT-owned portion of the stormwater conveyance system. The dry weather screening and tracking of potential illicit discharges and connections continues to be conducted for DeIDOT by KCI Technologies.

The dry weather screening protocol was the same as that used in previous years. When dry weather flow is observed, a "Dry Weather Flow Evaluation" is performed in two stages: an initial screening at the time of first observation and a follow-up re-screening performed 4 to 24 hours later. Where appropriate, this includes flow rate estimation, field screening of discharge water quality using LaMotte stormwater sampling kits, and upstream visual review and evaluation. A numerical rating system for discharge water quality parameters provides an index that determines which outfalls are targeted for follow-up evaluation. Once an illicit discharge is confirmed, our consultant is responsible for tracking it to the source and taking the initial step in effecting its elimination. This may include: (1) referring it to the appropriate municipality; or (2) going to the source and informing the polluter verbally and in writing to remove the illicit connection with a time limit to comply. The consultant will conduct a follow-up investigation. If the connection is not removed, enforcement action can be initiated.

All of the known DeIDOT outfalls in New Castle County were screened during the first 5-year term of the permit. After that first round of screenings was completed, KCI Technologies went back and re-screened all outfalls that previously had had dry-weather flow and also continued to inspect and screen new outfalls that were not captured in the initial inventory. In calendar year 2010, our efforts were focused on reinspecting older parts of the MS4 in New Castle County and completing the MS4 inventory and inspection in Kent and Sussex Counties. As these inspections and reinspections are done, each outfall within that part of the system is screened for dry weather flow. If flow is noted after 72 hours of no rain, KCI collects samples to look for potential illicit connections or discharges. If rain has occurred within the previous three days, and the flow is clear, then the outfall is re-checked after 72 hours.

In calendar year 2010, a total of 277 outfalls were screened in New Castle County. All of these outfalls were DelDOT-owned. No dry weather flow was observed during any of these inspections.

Additional information on DelDOT's Illicit Discharge Detection and Elimination (IDDE) program during 2010 is provided in Section 6 of this report.

B. Storm Event Monitoring

The wet weather storm event monitoring required under the Phase I permit was intended to identify, investigate and address selected water quality parameters of storm water runoff from five outfall locations identified in the Permit Application, representing four developed land use classifications: highway, commercial, industrial and residential.

The wet weather monitoring requirement at the five prescribed outfalls in New Castle County was fully completed by the County and DelDOT in 2009. Therefore, no additional samples were collected in 2010.

C. BMP Performance Monitoring and Assessment

The NPDES permit requires DelDOT to monitor the performance of existing stormwater structural controls and BMPs. During calendar year 2010, DelDOT's BMP monitoring program included the following projects:

1. Performance and maintenance study of Delaware sand filters
2. Monitoring of biofiltration practices
3. Study of pollutant removal by grassed highway side slopes
4. Stream turbidity measurements at construction sites
5. Monitoring of BMP outfalls at DelDOT maintenance facilities
6. Study of guardrail vegetation control alternatives
7. Study of the impacts of various mowing height practices

Projects 1 through 5 were conducted with assistance from KCI Technologies under Agreement 1351 and 1495. Projects 6 and 7 were performed by the University of Delaware, using funding contributed by the DelDOT NPDES Program.

Each of the different BMP monitoring projects is described below in greater detail.

1. Performance and Maintenance Study of Delaware Sand Filters

In late 2006, we began a study to assess maintenance requirements for the numerous Delaware sand filters that have been installed by DelDOT in roadways, transit facilities, and Park-and-Ride lots. These encompass a number of different designs, and the various units receive a wide variety of drainage and pollutant loads. The goal of this study is to determine a maintenance plan and schedule for each of the sand filter types owned by DelDOT, dependent upon its design, location, land use drainage, and pollutant loads. This was the fifth year of the study.

Four sand filter units currently are part of the study, representing land use settings

(commercial, roadway, and parking lot) and different sand chamber designs. One filter unit that was previously included (Chapman Maintenance Yard) was suspended from study in 2009. This was detailed in last year's annual report. A new sand filter, located at Kennett Pike, was added to the study in 2010. Currently the study includes the sand filters at the following locations:

- Route 273 / Route 7 Park-and-Ride Lot (DelDOT BMP #46)
- Lancaster Pike (DelDOT BMP #72)
- Wilmington Delaware Transit Corporation (DTC) Bus Facility
- Kennett Pike (DelDOT BMPs #364-430)

All are being monitored in order to more fully understand the key parameters that affect long-term performance and to develop a standardized inspection and maintenance protocol for DelDOT that will ensure that all of our sand filters continue to provide the maximum water quality treatment. Quarterly wet- and dry-weather field observations are performed. In addition, this year we instrumented two of the sand filters with ISCO automated samplers, allowing us to add water quality data to the criteria used to assess the performance of these BMPs.

KCI's 2010 end-of-year report on this project is included here as Appendix F. It details the results of the quarterly monitoring of each sand filter, as well as water quality data collected.

Each of the sand filters under study has had unique issues, due to differences in design and pollutant loading.

- The unit at the Rtes. 273/7 Park and Ride lot receives only modest input of sediment and organic matter, and it has continued to perform well with little to no maintenance.
- Since the DSF study began, we have observed a build-up of leaf litter and organic debris in the sediment and sand chambers of BMP 72 on Lancaster Pike. This is due to the large amount of deciduous vegetation in the surrounding residential area, which deposits leaf litter and organic debris into the roadway and ultimately accumulates in the DSF. This group of sand filters is located on a sloped stretch of roadway; BMP 72 is at the top of slope and is the first to receive runoff. This filter unit has shown signs of maintenance needs, compared to those located further down the slope, because it receives the heaviest burden of organic debris and pollutants. Wet weather monitoring has shown that this sand filter performs well at removing suspended solids from runoff. Dissolved constituents were not significantly reduced. All of the sand filters on Lancaster Pike will be fully maintained in 2011.
- The sand filter at the Wilmington DTC site receives greater inputs of hydrocarbons than the others, and our core sample analyses indicate that more regular replacement of the sand bed media may be needed there. DTC is responsible for maintenance of this unit, and the filter is regularly cleaned out. The DTC sand filter was instrumented with an automated stormwater sampler and three wet weather events were collected in 2010. Because observations of other sand filters has indicated that the placement of a stone layer on top of

the sand bed may reduce clogging, KCI Technologies has recommended that the Wilmington DTC sand filter also be installed according to this sand bed design the next time it is cleaned. We are working with DTC to try to do this and will compare monitoring results after the change.

2. Monitoring of Biofiltration Practices

DelDOT requires that all stormwater management measures in its projects be designed in accordance with the latest version of the Delaware Sediment and Stormwater Regulations. In accordance with these regulations, the preferred options for water quality protection are “Green Technology BMP’s.” Other practices generally are considered only after preferred practices have been eliminated for engineering or hardship reasons. “Green Technology” BMPs are practices that achieve stormwater management objectives by applying the principles of filtration, infiltration and storage most often associated with natural vegetation and undisturbed soils, while minimizing a reliance on structural components. These practices include, but are not limited to, vegetative filtration, riparian buffer plantings, bio-retention areas, vegetative flow conveyance, as well as recharge and surface storage in undisturbed natural areas.

As a result, a large proportion of the new BMPs being added to the DelDOT inventory are biofiltration swales. These BMPs are easy to incorporate into a linear highway right-of-way and also are relatively easy and inexpensive to maintain. The DelDOT NPDES Program feels that more data is need on the pollutant removal efficiency of the types of bioswales and other Green Technology BMPs installed by the Department. Therefore a new project was begun to study these practices.

Although the DelDOT inventory includes many bioswales, finding one that met all of our criteria for wet weather monitoring proved challenging. After review of the DelDOT Master BMP Inventory and KCI field inspection data, it was determined that water quality monitoring would be conducted at BMP 104, a bioswale along Valley Road and Lancaster Pike in New Castle County (see Location Map). This bioswale provides treatment for stormwater runoff from Lancaster Pike.

Five storms were sampled at this site during 2010. The data from these wet weather events are summarized in Appendix G. Results have so far been very inconsistent, with no significant changes in pollutant loadings seen so far. We intend to continue to monitor the BMP during 2011 and modify the sampling protocol, if needed, to obtain more reliable results.

3. Study of Pollutant Removal by Grassed Highway Buffers

Studies conducted recently in several other states have demonstrated that existing vegetated areas adjacent to highways can provide some stormwater quality treatment, even though they are not designed for that function. Compliance with TMDL waste load allocations (WLAs) in New Castle County will require future reporting of both current stormwater pollutant loadings and future load reductions. Therefore we believe that better quantification of pollutant removal efficiencies of grassed side slopes, medians and buffers adjacent to roadways is needed. These data can then be incorporated into TMDL

models and reporting. In addition, DelDOT is interested in identifying minimum design requirements of grassed buffers needed to obtain substantial pollutant reduction.

A test site located in front of the Odessa Maintenance Yard on Route 299 was selected to monitor the performance of a grassed side slope in removing pollutants from roadway runoff. Several attempts were made to collect runoff samples at the site during 2010, but these were unsuccessful due to equipment installation issues. KCI is developing alternative sampling options for 2011.

We have also added a modeling component for the Route 299 site. Delineation of grass side slope treatment areas receiving roadway runoff along I-95 has been completed. The delineation of similar areas on SR 1 is in progress. The data from our wet weather monitoring will be used to calibrate the SWMM model.

Additional details of this study are included in Appendix G.

4. Stream Turbidity Measurements at Construction Sites

In order to monitor the performance of construction site BMPs, the DelDOT NPDES section recently installed in-stream, continuous water quality monitors upstream and downstream of two DelDOT construction sites. KCI Technologies installed and maintains the monitoring equipment at both locations, in addition to continually evaluating the water quality data. The solar-powered YSI water quality data loggers are equipped to monitor the following parameters: dissolved oxygen, turbidity, pH, temperature, and conductivity. Real-time data are transferred to an EcoNet Data Acquisition System, which can be viewed on the internet.

One set of YSI sondes was placed in Leatherman's Run at the Interstate service plaza site during its redevelopment, which was completed in the summer of 2010. Those sondes are still in place. The other set of sondes was installed at the Elkton Road overpass of the Christina River in December 2010. The Elkton Road project includes pavement reconstruction, additional turn lanes, reduction of Elkton Road between Apple Road and Delaware Avenue from four lanes to two, new sidewalks and curbs ramps, bike lanes, and utility improvements. Its estimated completion date is September 2012. A report describing the setups in more detail is included in Appendix H.

Data from the two YSI monitoring systems is evaluated on a weekly basis. DelDOT is notified of unusual parameter levels or other equipment issues as they occur.

At the Leatherman's Run site, downstream turbidity spikes were detected several times. These were primarily traced to pumping operations with inadequate E&S controls. In each case, the project engineer and CCR were notified, and additional BMPs were implemented.

5. Study of Alternatives for Managing Vegetation Under Guardrails

In 2008, we began a study to investigate alternative vegetation management strategies for guardrail and sign posts. Vegetation management of some kind is necessary to keep guard rails from being obstructed by vegetation. Currently growth of vegetation

under and around these structures is controlled by annual applications of herbicide. The goal is to find ways to reduce the use of pesticides used to treat guardrail vegetation without compromising safety and aesthetics. The study is being performed by Dr. Susan Barton and Valann Budischak of the University of Delaware Department of Plant and Soil Sciences.

Treatments being evaluated include weed control barriers, chemicals, low-growing vegetation, and hand cutting of existing vegetation. They are being compared based on effectiveness, ease of implementation, aesthetics, cost and longevity. Test locations were selected to represent typical roadway settings in which guardrails are utilized.

In April and May of 2008, twenty-four guardrail plots were established on Delaware roadsides (Route 13 S between route 72 & Route 1, Route 7 near RR bridge, and Route 13 near airport). Treatments included three formulations of herbicide, two weed barriers, handtrimming, pavement, low fescue turf and a control. There are three replications of most treatments. Selected test locations are a representative subset of the types of roadway settings in which guardrails are utilized.

Test sites were monitored and data taken throughout the growing seasons. The investigators record on a scale of 1-5 each plot's compliance with DelDOT guardrail standards and the weed level present. They also record predominant weed species. For the low fescue plots, percent cover of turfgrass is recorded. Each plot is photographed with each data collection visit. In 2010, test sites were monitored and data was taken four times.

At the end of the 2010 growing season, we felt that sufficient data had been collected on herbicide treatments and pavement plots. In August 2010, a decision was made to suspend herbicide treatments and focus on establishing low fescue vegetation, installing universal weed barrier from road edge to guardrail (to eliminate weed growth at edge of pavement), installing a new type of rubber weed barrier and treating the remaining plots with hand trimming. In early September, all sites were visited and plots marked. They will be monitored through 2011.

6. Study of the Impacts of Differing Mowing Height Practices

DelDOT mowing policy calls for roadside utility turfgrass to be routinely maintained at 6 inches height. However in actuality, roadside turf is often mowed to a height of approximately 2 inches throughout the state. The general public often perceives shorter grass to be more attractive. And maintenance crews often feel that mowing the turf shorter is easier and more efficient.

In addition to the potential water quality benefits of taller turf, DelDOT's Roadside Environmental Section and the University of Delaware Enhancing Delaware Highways (EDH) team believe that mowing at a minimum of 6 inches height results, over the long term, in healthier turf with fewer weeds and invasive species. In order to test this, we began a study in 2009 to evaluate the longer term impacts of mowing turf areas in highway rights of way at different heights. The study is being conducted by a team led

by Dr. Susan Barton of the University of Delaware's Department of Plant and Soil Sciences.

This study is observing and collecting data on turf grass condition and weed content of routinely mowed turf at the recommended six inch height and at the current two inch height. Plots are maintained in two locations—SR 1 at the Milford bypass in Kent County (6 plots) and Interstate-95 medians in New Castle County (6 plots). Each plot is approximately 200 feet. At each location, three plots are being mowed to a height of 6 inches, and three plots mowed to a height of 2 inches.

In 2010, plots were mowed six times during the growing season. The mowing sites were visited three times to collect data. Each treatment was documented with photographs. Notations were made on weeds present, clippings and level of turf decline. Photographs were taken documenting that matted clippings often lay on the closely mowed treatment plots, excluding light and causing turf grass injury. This injury often results in dead patches that allow weed incursion. The final result is a degraded turf grass condition.

It is still difficult to see species composition changes in the amount of time this turf has been managed with 2- and 6-inch mowing. There was already a significant weed population in the turf (at the start of the experiment) so it will be hard to document increased weeds with the 2-inch height. Nevertheless, we intend to continue monitoring the plots for one additional growing season.

7. Monitoring of BMP Outfalls at DelDOT Maintenance Facilities

DelDOT also performs wet weather monitoring at selected maintenance yard outfalls, in compliance with its industrial permits. See Section 16 of this report ("Pollution Prevention at Maintenance Facilities") for details on this.

14. Supplemental Environmental Project

This section pertains to New Castle County only. See Section 14 of New Castle Counties annual report for details.

15. Additional Injunctive Relief

Requirement: Within one year from the date of entry of the Consent Decree, DelDOT shall complete a stormwater retrofit project for a 5.58 mile long section of I-95 incorporating water quality considerations in design and construction of its stormwater management structures as described in the Consent Decree page 25, Part III 30.

Performance: This project is complete. See Annual Report 2001, Volume 3, Appendix U for a complete report and photographic documentation of the I-95 Additional Injunctive Relief Stormwater Controls.

16. Pollution Prevention at the Maintenance Facilities

A. Pollution Prevention Plans

DelDOT's NPDES Program manages a Stormwater Pollution Prevention Program (SWPPP) at all 16 DelDOT maintenance facilities. Development, implementation, and maintenance of the SWPPP provides the maintenance yards with the tools to reduce pollutants contained in stormwater discharges and comply with the requirements of Delaware's "Regulations Governing Storm Water Discharges Associated with Industrial Activity." The program includes a written plan, timeline for plan implementation, inspection schedules, training and monitoring requirements, and proper storage and housekeeping measures. Each SWPPP has a pollution prevention team with designated responsibilities to carry out the plan.

B. Inspections

Pollution Prevention Plan Team members are required to conduct quarterly inspections during dry and wet weather events to look for evidence of stormwater contamination. These inspections began in October 2003 and continued through the 2010 calendar year.

C. Spill Prevention, Control and Countermeasures (SPCC)

DelDOT hired BrightFields, Inc. to assist the Department in complying with EPA's Oil Pollution Prevention regulations (40 CFR 112) contained within the Clean Water Act. An SPCC Plan discusses how the maintenance facility conforms to oil spill prevention and containment procedures. Each SPCC Plan is unique to the facility. Brightfields, completed a full investigation and developed site-specific plans for maintenance facilities that met the above ground storage minimums requiring a SPCC plan. All plans were completed and distributed in 2007. Because of the addition of new above ground storage tanks at Harrington and Cheswold maintenance facilities, Brightfields recently also prepared SPCC plans for these areas, and they were implemented in 2008.

D. Training

The NPDES Program, with assistance from the Center for Safety & Emergency Response Training (CSERT), developed six training videos for our maintenance staff. The videos provide training on protection of stormwater quality in the following areas:

1. Facility and vehicle maintenance
2. Stormwater contamination and spill prevention
3. Vegetation control and pollution prevention on public roads and highways
4. The regulatory requirements of the Spill Prevention Control and Countermeasures (SPCC) plans developed for each maintenance yard
5. Spill response and emergency procedures
6. The proper procedures for responding to facility and non-facility (roadway) based emergency events.

Each maintenance facility has copies of the videos, and current DelDOT personnel and new hires are required to view them. In addition, the NPDES Program also prepares training

posters on elements of the PPP and SPCC Plans and distributes them to the yards several times per year.

E. Monitoring

The Pollution Prevention Plans currently require wet weather stormwater monitoring at four maintenance facilities. These facilities were chosen as representative of the 16 facilities located throughout the state. The four yards are: Kiamensi, Bear, Cheswold, and Harrington.

Monitoring was conducted during 2010 at each of the other four pond outfalls. Sampling techniques were performed in accordance with the Environmental Protection Agency (EPA) *Stormwater Sampling Guidance Document*, EPA 833-B-92-001 (July 1992). Semi-annual samples were collected once in each of the following six-month periods: January through June, and July through December.

The wet weather monitoring protocol includes 72 hours of antecedently dry conditions, minimum predicted rainfall depth of 0.10 inches, and two full days of standard maintenance yard operations since the last rainfall event. A first flush sample was collected within 30 minutes from the first noticeable flow, and delivered to the laboratory for analysis of total suspended solids, surfactants, chloride, pH, and total petroleum hydrocarbons: gasoline and diesel range organics. Measurements of flow, air temperature, water temperature, pH and turbidity were recorded on-site at the time of sample collection.

Table 16-1 displays the first flush concentrations measured during 2010 for all parameters at each of the four sites.

The total suspended solids (TSS) levels measured in the August 2010 sample collected at the Cheswold yard outfall (548 mg/L) exceeded the benchmark value of 100 mg/L. Operations at the yard were investigated shortly after the test results were received in order to determine the source(s) of the excess sediment discharge. The facility supervisor attributed the excess sediment load to intensive ditch cleaning activities that took place during that week. Higher than normal amounts of mud were washed from dump trucks at the yard. NPDES are following up to see if additional BMPs are needed.

Chloride levels at pond outfalls were somewhat higher than usual in the winter samples. January through March of 2010 saw abnormally severe winter storms, with several feet of snowfall and continual emergency operations. Once the storm period passed, chloride levels returned to normal background levels.

F. Vehicle Wash Water Plan

In July of 2005, DelDOT submitted a report entitled *Statewide Vehicle Wash Water Practices for DelDOT Maintenance Yards* (see Annual Report 2005, Volume 2 of 2, Appendix Z) to DNREC. This report outlined the Department's proposal for treating vehicle wash water on-site at our sixteen (16) maintenance facilities. Our goal was to develop options to treat vehicle wash water and stormwater to acceptable levels before it exits our site and enters receiving waters. To meet this objective we developed a stormwater "treatment train" at each maintenance facility. This method incorporates multiple Best Management Practices (BMPs) to treat wash water to the maximum extent practicable. In several cases, existing practices, together

with proposed policy changes and employee training, were sufficient to treat the vehicle wash water. In other cases, there is a need to design and construct retrofits at the facilities.

In the 2009 Annual Report we detailed the two Maintenance Yard stormwater retrofits that had been completed. One was at the Middletown Maintenance Yard and the other was at the Talley Maintenance Yard. In 2010 construction was completed at our Harrington Maintenance Yard.

The Harrington Maintenance Yard Retrofit was completed in November 2010. A vehicle wash pad with a sediment screen was constructed. The runoff from the wash pad drains to a forebay which in turn drains to a wet pond. (The existing dry pond was converted to a wet pond to provide added water quality benefits.) In addition to the vehicle wash area, a 150 foot long bioswale with a four foot wide flat bottom was constructed downstream of the stockpile storage area in order to capture sediment and other pollutants. Improvements include replacing the existing dry pond with a wet pond including a forebay, creating bioswales and a concrete wash pad with sediment screen.

Table 16-1. 2010 wet weather monitoring results from DelDOT maintenance facility BMP outfalls. The samples were collected once in each of the following six-month periods: January through June, and July through December. All results are reported in mg/L.

PARAMETER	KIAMENSI		BEAR		CHESWOLD		HARRINGTON	
	03/12/10	10/14/10	03/12/10	10/14/10	01/17/10	08/12/10	01/17/10	10/14/10
Total Suspended Solids	72	6	18	34	36	548*	37	11
Surfactants, MBAs	0.89	0.11	0.17	0.16	0.16	0.42	0.10	0.05
Chloride	18,100	695	4530	83.7	7460	90.4	9000	98.8
TPH-Gasoline Range Organics	0.025	0.32	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
TPH-Diesel Range Organics	1.80	0.20	0.50	0.10	1.70	0.40	0.70	0.10
pH	7.38	7.78	8.27	7.85	8.28	8.19	8.33	7.47

*Exceeds benchmark value.

Benchmark Values:

TSS – 100 mg/L

Surfactants – 1.0 mg/L

Chlorides – no benchmark exists

Oil and Grease – 15 mg/L

pH – 6 to 9 s.u.

Appendix A. KCI Technologies storm drain inventory and inspection project summary report for 2010.



DELDOT AGREEMENT 1354
STATEWIDE MS4 / BMP INVENTORY & INSPECTION
2010 ANNUAL REPORT

The following is a summary of work performed by KCI Technologies, Inc. (KCI) and Century Engineering, Inc. (CEI) from January 1 to December 31, 2010 on the Delaware Department of Transportation's (DelDOT) Agreement 1354. Notice to Proceed for this 5-year open-end contract was granted on December 20, 2006.

A. PROJECT MANAGEMENT

In 2010, KCI conducted five project status meetings and three miscellaneous meetings. KCI submitted to DelDOT a *2009 Agreement 1354 Annual Report* and a *2009 Annual BMP Inventory & Inspection Report*, as well as several Memorandums related to the Agreement.

Five project status meetings were held with DelDOT, KCI, and CEI to discuss work completed and outstanding issues (**Table 1**). KCI distributed an agenda at least two days prior to each meeting and prepared meeting minutes for each meeting within 48 hours, including an Action Item List highlighting necessary actions, responsible parties, and target completion dates. These meetings have been highly effective in coordinating with DelDOT, identifying potential issues, and resolving issues in a timely manner.

KCI conducted eight internal field staff meetings to discuss scheduling and to identify data collection issues (**Table 1**). The purpose of the internal meetings was to provide an opportunity for field crews to share their experiences with other field crews and to develop the most efficient and consistent inspection methodology. Additional internal meetings were held with KCI's Technology Services staff to discuss and schedule the final refinements to the NPDES Map Viewer according to DelDOT's comments.

Three additional meetings were held to discuss specific issues related to the Best Management Practices (BMPs) (**Table 1**). The topic of two of these meetings with DNREC was the translation of DelDOT BMP data from ESRI GeoDatabase format to NEINE XML format, as required by the United States Environmental Protection Agency (USEPA). The third meeting was between DelDOT and KCI BMP inspection staff to review BMP maintenance needs in the field. **Table 1** summarizes all project-related coordination meetings in 2010.

Table 2 lists the deliverables transmitted in 2010. A majority of these deliverables related to BMP inspections and reports. Other deliverables pertinent to Agreement 1354 are included in DelDOT's *Agreement 1495 Environmental Water Quality Monitoring 2010 Annual Report*, also prepared by KCI, including outfall screening and illicit discharge investigations, some of which originated from the Agreement 1354 inventory and inspection.

**TABLE 1
 COORDINATION MEETINGS**

Project Status	Internal Status	Miscellaneous	
02/17/10 (#31)	01-28-10	DeIDOT BMP Field	03/10/10
04/15/10 (#32)	03-08-10	DeIDOT/DNREC/KCI BMP Data Translation	04/06/10
06/17/10 (#33)	03-29-10	DNREC/KCI BMP Data Translation Conference Call	07/12/10
10/07/10 (#34)	04-20-10		
11/22/10 (#35)	04-26-10		
	06-08-10		
	07-15-10		
	12-07-10		

**TABLE 2
 DELIVERABLES**

Date	Deliverable
01/23/10	Draft 2009 Agreement 1354 Report
01/25/10	Draft 2009 Annual BMP Report
02/18/10	2/16/10 Additional Maintenance Work Order Recommendations Memo
03/10/10	Final 2009 Annual BMP Report
11/22/10	Hard Drive with Revised SWM Report PDF Files
11/23/10	BMP Retrofit Recommendations List

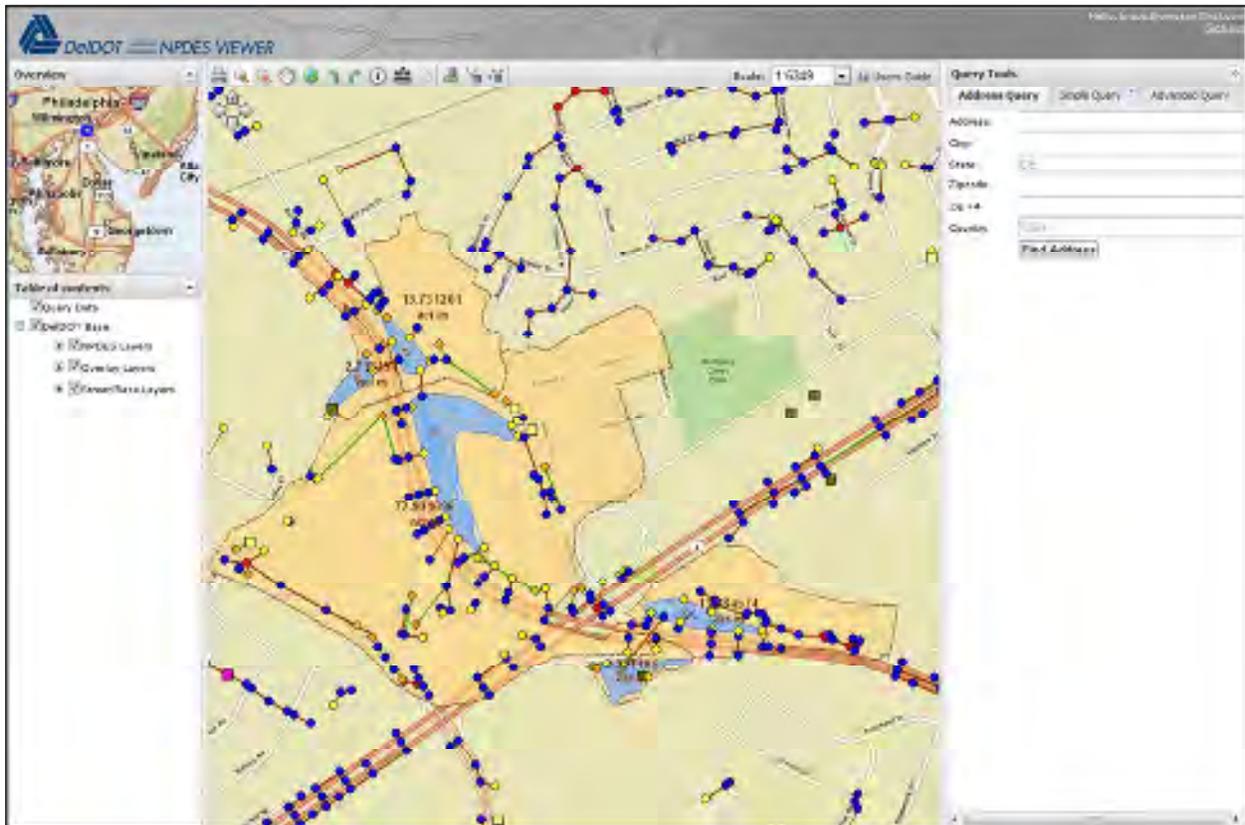
B. DATABASE MANAGEMENT

In 2007, KCI's Technology Services division developed a field application using advanced hardware, redesigned the existing Database structure to allow for re-inspections, migrated all existing data into the new Database design, and began development of a new field application to fit the new Database design.

In 2008, KCI's Technology Services division completed the development of the Field Application, Version 2 and developed a Web-based Map Viewer to replace and upgrade DelDOT's existing Map Viewer. In 2009, DelDOT expressed a desire for KCI to simplify the Map Viewer, especially the querying capabilities.

In 2010, KCI completed the refinements to the Map Viewer including simplifying querying and report creation for BMPs, conveyances and structures, and adding a drainage area layer for BMPs and Major Outfalls. In addition, KCI developed a *Map Viewer User's Guide* to assist with the use of the viewer.

In 2011, KCI expects to assist DelDOT in formal training sessions to educate DelDOT design and maintenance staff on the use of the Map Viewer.



2010 DELDOT NPDES MAP VIEWER

C. BEST MANAGEMENT PRACTICE (BMP) INVENTORY AND INSPECTION

In early 2011 under separate cover, KCI will submit the *2010 Annual BMP Inventory & Inspection Report*. The 2010 Annual Report will summarize the inspections for each BMP and provide recommended actions for BMPs in four categories:

- BMPs requiring **MAINTENANCE** by DelDOT maintenance staff (Maintenance Work Orders),
- BMPs requiring **INVASIVE SPECIES** to be eradicated by third party contractor,
- BMPs requiring **CONTRACTED WORK** by a third party contractor, and
- BMPs requiring **RETROFIT** evaluations by DelDOT’s Stormwater Quality Program staff.

BMPs will be assigned a summary rating based on the recommended actions identified during the inspections. These ratings are defined in **Table 3**. In 2010, KCI inspected only those BMPs that were rated A and B in 2009. BMPs rated C and D are being scheduled for maintenance as part of a separate DelDOT maintenance contract. **Table 4** summarizes the BMP inspections conducted in 2010 by KCI and CEI.

**TABLE 3
OVERALL BMP RATING SYSTEM**

Rating	Description
A	No Performance Issues BMP with No Issues affecting performance.
B	Minor Maintenance BMP with Minor Maintenance required; repaired by DelDOT maintenance district or third party invasive spray contractor.
C	Major Maintenance BMP with Major Maintenance required; repaired by third party contractor.
D	Retrofit BMP with Retrofit requirements; BMP is failing; needs to be redesigned or re-built with input from DelDOT Stormwater Quality Program.

**TABLE 4
2010 BMP INSPECTIONS**

District	Total BMPs Inspected	Total A's	Total B's	Total C's	Total D's
North	49	19	28	2	0
Canal	81	31	43	6	0
Central	27	10	12	5	0
South	51	42	9	1	0
TOTAL	208	102	92	14	0

D. NEW CASTLE COUNTY RE-INSPECTION

KCI began re-inspection of DeIDOT’s MS4 in New Castle County subdivisions in February 2008, based on KCI’s Agreement 1354 Subdivision Re-inspection Schedule (**Table 5**). The re-inspection schedule is based on a 5- and 10-year re-inspection cycle for subdivisions according to the acceptance date of the subdivisions. The subdivisions planned for re-inspection in 2009 (subdivisions accepted from 1951-1965) were completed in March 2010. In October 2010, DeIDOT requested that KCI dedicate both KCI field crews to Kent County Initial Inventory and Inspection work. KCI expects to complete the 1951-1965 subdivisions after initial inspections are completed in Kent and Sussex Counties. **Table 6** summarizes the Re-inspection work completed in 2010, which included 59 subdivisions and 2,818 structures.

**TABLE 5
SUBDIVISION RE-INSPECTION SCHEDULE**

Year	Subdivisions	Cycle	Re-inspect?	Date Completed
1	Database Re-design	--	--	December 2007
2	1935-1950	5	Yes	December 2008
3	1951-1965	5	Yes	May 2010
4	1966-1980	5	Yes	25% Complete*
5	1981-1995	10	Yes	
5	1996-2005	10	No	--

* In October 2010, all KCI and CEI Field Crews were dedicated to Kent/Sussex Counties for Initial Inventory and Inspection.

**TABLE 6
2010 RE-INSPECTION TOTALS**

Month (2010)	Number of Subdivisions	Number of Structures
January	5	371
February	1	104
March	6	365
April	7	441
May	13	315
June	5	254
July	16	535
August	2	284
September	2	109
October	2	40
November	0	0
December	0	0
TOTAL	59	2,818

E. NEW CASTLE COUNTY INITIAL INVENTORY AND INSPECTION

KCI continued Initial Inventory and Inspection work in New Castle County in 2010. This included performing Initial Inventory and Inspection work at subdivisions recently accepted by DeLDOT. KCI performed Initial Inventory and Inspection at two subdivisions for a total of 27 structures (**Table 7**).



New Castle County Initial Inventory and Inspection

**TABLE 7
 2010 INITIAL INVENTORY / INSPECTION TOTALS
 NEW CASTLE COUNTY**

Month (2010)	Subdivisions	Structures
February	2	27
TOTAL	2	27

F. KENT / SUSSEX COUNTIES INITIAL INVENTORY AND INSPECTION

CEI continued Initial Inventory and Inspection work in Kent and Sussex Counties in 2010. KCI continued with one field crew in Kent County until October 2010, when DelDOT requested that KCI's second field crew also begin work in Kent County. The KCI/CEI Team inventoried and inspected 41 subdivisions and 296 miles of non-subdivision roadways, for a total of 11,689 structures in Kent and Sussex Counties (**Table 8**).



Kent County Initial Inventory and Inspection

**TABLE 8
2010 INITIAL INVENTORY / INSPECTION TOTALS
KENT / SUSSEX COUNTIES**

Month (2010)	Subdivisions	Non-Subdivision Roadway Miles	Structures
January	2	17.5	1,144
February	7	8.9	613
March	17	24.6	1,142
April	2	25.5	975
May	2	16.1	664
June	4	18.4	910
July	2	26.7	749
August	4	31.5	846
September	1	24.5	864
October	0	41.4	1,251
November	0	33.9	1,218
December	0	27.4	1,313
TOTAL	41	296.4	11,689

G. 2010 MAINTENACE WORK ORDERS

Storm drain system deficiencies identified by KCI and CEI field inspection staff are submitted into DeLDOT’s maintenance work order system (MAXIMO). MAXIMO delivers the work order to the appropriate maintenance district, lists the concern, identifies a remedial action, and rates the concern (minor to severe). Any issues related to safety (i.e., missing or broken catch basin grate) are considered Immediate Action concerns, and the appropriate maintenance district staff is notified as soon as these safety issues are identified. **Table 9** documents the deficiencies in the storm drain system identified during the inspection process in 2010.

**TABLE 9
 2010 IDENTIFIED MAINTENANCE WORK ORDERS (NO.)**

Type	NCC	Kent	Sussex
Structures	133	86	15
Conveyances	209	120	10
BMPs	65	10	8
Immediate Action	2	3	0
TOTAL	409	219	33



Maintenance Work Order for Conveyance Pipe

H. STATEWIDE INVENTORY SUMMARY

Tables 10, 11 and 12 summarize the number of BMPs, Structures and Conveyances contained in the DeIDOT NPDES Database.

**TABLE 10
STATEWIDE STRUCTURES (NO.)**

Category	NCC	Kent	Sussex
Inlet	43,166	14,481	2,608
Outfall	8,017	7,473	1,751
Manhole	5,162	726	25
Swale End	4,622	2,458	187
TOTAL	60,967	25,138	4,571

**TABLE 11
STATEWIDE CONVEYANCES (LF)**

Type	NCC	Kent	Sussex
Open	2,194,569	4,630,954	481,888
Closed	4,657,471	1,275,132	172,679
TOTAL	6,852,040	5,906,086	654,567

**TABLE 12
STATEWIDE BMP (NO.)**

Type	NCC	Kent	Sussex
Check Dam	6	0	0
Bio-swale	36	7	39
Bio-retention	5	0	1
Dry Pond	44	4	2
Filter Strip	1	2	0
Infiltration Basin / Trench	4	1	0
Sand Filter	66	1	1
Sediment Forebay	4	0	3
Wet Pond	75	25	7
Wet Pond / Wetland	5	0	0
TOTAL	246	40	53

Appendix B. Herbicide usage by contractors and districts.

Appendix C. Herbicide usage by contractor and districts.

Guardrail, Islands, Signposts – *Includes SR1 in Kent County

Product (gallons)

	Diuron(Pounds)	Diuron 4L(Liquid)	Aqua Cap	Journey	Picloram	Picloram+D	Glyphosate	Bulls Eye	Competitor	MSO	Surfac820
2009	2,196.5	144.0	123.9	105.6	58.7	----	70.4	21.4	60.7	44.2	15.7
2010	2,497.2	-----	86.5	99.0	50.8	28.2	125.7	7.5	----	45.6	74.3

Canada thistle treatment - *Includes SR1 in Kent County

Product (gallons)

	Milestone	Overdrive	Bullseye	MSO
2009	3.6	2.0	4.1	16.3
2010	2.9	1.6	3.3	13.2

Phragmites treatment

Product (gallons)

	Habitat	Glyphosate	Bullseye	MSO	46-0-0(lbs)	Heat
2009	----	----	----	----	----	----
2010	0.03	81.9	1.7	10.2	10.2	0.03

Brush treatment - *Includes SR1 in Kent County

Product (gallons)

	Tordon K	Milestone	Escort	Surfac 820	Thinvert	Krenite	Habitat
2009	10.9	1.1	0.18	7.4	98.0	98.0	3.1
2010	3.3	0.3	0.05	2.0	17.0	17.0	0.5

Brush treatment - *Includes SR1 in Kent County

Product (gallons)

	Tordon K	Milestone	Escort	Surfac 820	Thinvert	Krenite	Habitat
2009	10.9	1.1	0.18	7.4	98.0	98.0	3.1
2010	3.3	0.3	0.05	2.0	17.0	17.0	0.5

Appendix C. KCI Technologies 2010 Outfall Screening Summary Report.



**DELDOT AGREEMENT 1495
WATER QUALITY MONITORING
OUTFALL SCREENING
2010 ANNUAL REPORT**



As part of the Delaware Department of Transportation's (DelDOT) National Pollutant Discharge Elimination System (NPDES) General Permit Program Regulations Governing Stormwater Discharge, KCI Technologies, Inc. was contracted to conduct dry weather outfall inspection and monitoring of DelDOT-owned storm drain outfalls in New Castle County. Other activities conducted under this task included: Investigation of Potential Illicit Discharges (PIDs) and NPDES Flyer Awareness Distribution.

A. OUTFALL SCREENING & POTENTIAL ILLICIT DISCHARGES

In 2010, 1,109 outfalls were screened as part of the inventory, inspection and re-inspection tasks under Agreement 1354.

In 2010, 17 Potential Illicit Discharges (PIDs) were investigated. **Table 1** lists those PIDs that had dry weather flow discharge and the testing results, as well as PIDs that were investigated and determined to have no follow-up requirements. Detailed correspondence, field investigation information and documentation regarding PIDs are provided in **Appendix A. Table 1** indicates the corresponding **Appendix A** tab divider number (1-17) for each PID listed.



Outfall Screening



*PID: Red Lion Road
Illegal Connection*



*PID: East Side Village
15667 Walker Drive
Potential Sewage Flow*

TABLE 1
2010 POTENTIAL ILLICIT DISCHARGE DETERMINATIONS *

Date (Chrono. Order)	Structure	Neighborhood/ Address	Issue Reported By	Issue	Investigation Results	Determination	Appendix A Tab No.
01/18/10 03/02/10 06/25/10	32008040 71311737	Outfall to BMP 241/Rt. 7	Agr 1354 Field Crew	01/18/10: Dark green stain on outfall pipe leading to BMP 241 pond; outfall discharge clear; dead fish directly in front outfall pipe. 03/02/10: no dead fish; foam present in front outfall. 06/25/10 Revisit	01/18/10: Sampled tested within acceptable parameter levels. 03/02/10: Sampled tested high for detergents. 06/25/10: Sampled tested high for detergents.	Continue to monitor/ Revisit site.	1
03/02/10	71506	Todd Estates/42 Lynchfarm Dr.	Agr 1354 Field Crew	Pet waste in catch basin.	Pet waste on grate and in catch basin.	Distributed 25 doorhangers; Re-visit site.	2
03/02/10	74702	Brookside Park/ 30 McCord Dr.	Agr 1354 Field Crew	Dry weather flow.	Sampled tested within acceptable parameter levels.	No further action.	3
03/02/10	71075	Brookside Park/Intersection McCord Dr./ Matthews Rd	Agr 1354 Field Crew	Dry weather flow.	Sampled tested within acceptable parameter levels.	No further action.	4
03/08/10	74839	Todd Estates/ 23 Garrett Rd.	Agr 1354 Field Crew	Resident reported neighbor dumping leaves in catch basin.	Catch basin 75% full leaves.	Distributed 16 doorhangers; Re-visit site	5
04/01/10	52010030 1153011	East Side Village/15667 Walker Dr.	Agr 1354 Field Crew	Dry weather flow; strong odor of sewage; visual waste.	Confirm report. Specific source of discharge not found.	Notified DNREC Failing Septic Division.	6
04/07/10	16374	Minquadale East/920 Hazeldell Ave.	Agr 1354 Field Crew	Garbage dumped in catch basin.	No garbage in catch basin. Garbage observed along curb throughout neighborhood.	No further action.	7
04/07/10	71994	East Burn Acres/ 2004 Carol Dr.	Agr 1354 Field Crew	Motor oil on roadway.	Parked vehicle leaking oil.	Provided doorhanger; No further action.	8
06/02/10	2684	Newkirk Estates/ 117 Phyllis Dr.	Agr 1354 Field Crew	Drain hose in manhole 74285 upstream of outfall.	Confirmed hose in manhole; no active flow from hose or to outfall.	No further action.	9

Date (Chrono. Order)	Structure	Neighborhood/ Address	Issue Reported By	Issue	Investigation Results	Determination	Appendix A Tab No.
06/02/10	1364	Chestnut Hill Estates/Old Ogletown Rd.	Agr 1354 Field Crew	Dry weather flow.	Sampled tested within acceptable parameter levels.	No further action.	10
06/02/10	2256	Bellevue Manor/ 715 Woodsdale Dr.	Agr 1354 Field Crew	Dry weather flow.	Sampled tested within acceptable parameter levels.	No further action.	11
06/18/10 06/23/10	95458	2572 Red Lion Rd.	Resident/ DeIDOT	Possible illegal sewage connection; sewage smell; toilet paper.	Sample tested above recordable limits for detergents; ammonia levels within parameter limits. 3" pipe in wall of catch basin; prior URS inspection flow with soap suds.	Referred to DNREC by DeIDOT. DNREC capped illegal hook up after finding dye in pipe. Warrants pending for homeowners arrest.	12
08/03/10	77010, 77011	Casho Mill Rd./ Julie Ln.	City of Newark/ DeIDOT	Hot mix material in catch basin.	77010: Filled with hot mix blocking outflow pipe completely. 77011: No evidence of hot mix.	KCI field crew removed enough hot mix to allow positive flow; could not remove all due to hardening.	13
08/31/10	13	Lambeth Riding/ 404 Wesley Circle	Agr 1354 Field Crew	Dry weather flow.	Flow due to underground stream outfalling into creek bed; no sample tested.	No further action.	14
08/31/10	5143	Lambeth Riding/ 504 Lambeth Place	Agr 1354 Field Crew	PVC pipe in side wall of concrete pipe connecting to catch basin; flow observed from PVC pipe collecting in catch basin.	Sampled tested within acceptable parameter levels; could not find flow source.	Re-visit site.	15
11/01/10	11712- 11721	Mendenhall Village/ Lamplighter Way	DeIDOT	Report of grass clipping dumping in catch basin.	No evidence of grass clippings in any catch basins on Lamplighter Way.	Re-visit site.	16
11/01/10	New structure	316 Pigeon Point Rd.	DeIDOT	DeIDOT reported greenish substance in/around area of new inlet pipe.	No evidence of substance.	Re-visit site.	17

* Detailed correspondence, field investigation information and documentation regarding PIDs are provided in **Appendix A.**

B. NPDES FLYER AWARENESS DISTRIBUTION

The purpose of the NPDES flyer awareness distribution (doorhangers) is to inform the public and increase awareness of illegal dumping of pollutants into the surrounding storm sewer systems. Doorhangers were distributed to those areas where suspected illegal discharge/dumping had occurred, as observed by the general public and/or field crews performing storm drain inventories. In 2010, 42 doorhangers were distributed in two neighborhoods in New Castle County, as summarized in **Table 2**.

**TABLE 2
2010 DOORHANGER DISTRIBUTION**

Date	Neighborhood	ADC Map /	Waste Type	Water-body	No. Hangers
03/11/10	Todd Estates II	11/B10	Yard/Pet Waste	Christina River	41
04/07/10	East Burn Acres	11/G3	Motor Oil	White Clay Creek	1



C. MAJOR OUTFALL & BEST MANAGEMENT PRACTICES DRAINAGE AREAS

KCI completed drainage area delineations for major outfalls and Best Management Practices (BMPs) in New Castle County (**Tables 3 and 4**, respectively). For Kent and Sussex Counties, the drainage area delineation process is on-going. KCI completes BMP drainage areas as the MS4 information becomes available. QAQC is performed on the drainage areas prior to database upload. Completed drainage areas are included on the DelDOT NPDES Map Viewer.

**TABLE 3
MAJOR OUTFALL DRAINAGE AREAS DELINEATED**

Outfalls	North District	Canal District	Central District	South District	TOTAL	Chesapeake Bay Watershed
	260	241	25	0	541	

D. NEXT STEPS

KCI's goal for 2011 is to complete the delineation of drainage areas for all major outfalls in Kent and Sussex Counties, and the delineation of drainage areas for all DelDOT-owned BMPs throughout the state. In addition, KCI will continue to provide as-needed outfall screening activities in 2011. This includes investigating dry weather flow and potential illicit discharges at outfalls and storm drain structures discovered by KCI field crews, DelDOT maintenance staff or the public.

**TABLE 4
BMP DRAINAGE AREAS DELINEATED**

CHESAPEAKE BAY WS

BMP NUMBER	BMP TYPE	DRAINAGE AREA
145	Dry Pond	X
146	Dry Pond	X
180	Wet Pond	X
213	Wet Pond	X
221	Wet Pond	X
248	Bioretention	X
405	Bioswale	X
406	Bioswale	X
407	Bioswale	X
408	Bioswale	X
409	Bioswale	X
410	Bioswale	X
411	Bioswale	X
412	Bioswale	X
413	Bioswale	X
414	Bioswale	X
415	Bioswale	X

TOTAL COMPLETED 17

NORTH - NC COUNTY

BMP NUMBER	BMP TYPE	DRAINAGE AREA
6	Wet Pond	X
20	Dry Pond	X
21	Wet Pond	X
22	Dry Pond	X
23	Dry Pond	X
24	Dry Pond	X
25	Dry Pond	X
26	Bioswale	X
27	Bioswale	X
28	Dry Pond	X
30	Dry Pond	X
31	Wet Pond	X
32	Bioswale	X
33	Dry Pond	X
34	Bioswale	X
35	Sed Forebay	X
48	Wet Pond	X
49	Infil Trench	X
51	Bioswale	X
52, 54 - 73	Sand Filter	X
75	Bioswale	X
76	Wet Pond	X
78	Wet Pond	X
79	Dry Pond	X
80	Bioswale	X
82	Dry Pond	X
104	Bioswale	X
105	Wet Pond	X
142	Wet Pond	X
143	Wet Pond	X
182	Wet Pond	X
183	Dry Pond	X
184	Bioswale	X
192	Bioretention	X
194	Wet Pond	X
198	Wet Pond	X
199	Wet Pond	X
217	Wet Pond	X
218	Wet Pond	X
223	Wet Pond	X
224	Wet Pond	X
225	Dry Pond	X
229	Bioswale	X
230	Dry Pond	X
232	Filter Strip	X
233	Sed Forebay	X
234	Wet Pond	X
235	Wet Pond	X
239	Wet Pond	X
240	Wet Pond	X
241	Wet Pond	X
244	Wet Pond	X
245	Bioretention	X
253	Sh Marsh	X
254	Sh Marsh	X
313	Sed Forebay	X
314	Sed Forebay	X
354	Check Dam	X
355	Check Dam	X
357	Check Dam	X
358	Check Dam	X
359	Check Dam	X
360	Check Dam	X
364 - 397		X
421 - 430	Sand Filter	X
433	Bioretention	X
434	Wet Pond	X
435	Bioretention	X
436	Wet Pond	X
437	Bioretention	X
438	Wet Pond	X

TOTAL COMPLETED 133

**TABLE 4
BMP DRAINAGE AREAS DELINEATED**

CANAL - NC COUNTY

BMP NUMBER	BMP TYPE	DRAINAGE AREA
2	Infil Basin	X
3	Dry Pond	X
9	Wet Pond	X
11	Wet Pond	X
12	Wet Pond	X
13	Wet Pond	X
14	Wet Pond	X
15	Wet Pond	X
16	Wet Pond	X
19	Dry Pond	X
37	Bioswale	X
38	Dry Pond	X
39	Wet Pond	X
40	Wet Pond	X
41	Wet Pond	X
42	Wet Pond	X
43	Wet Pond	X
44	Wet Pond	X
46	Sand Filter	X
84	Dry Pond	X
85	Dry Pond	X
86	Dry Pond	X
87	Wet Pond	X
88	Wet Pond	X
89	Wet Pond	X
90	Wet Pond	X
91	Wet Pond	X
92	Dry Pond	X
93	Bioswale	X
95	Wet Pond	X
96	Wet Pond	X
97	Wet Pond	X
98	Wet Pond	X
99	Wet Pond	X
100	Wet Pond	X
101	Wet Pond	X
102	Dry Pond	X
107	Bioswale	X
108	Wet Pond	X
111	Wet Pond	X
118	Dry Pond	X
119	Infil Trench	X
120	Dry Pond	X
121	Dry Pond	X
122	Dry Pond	X
123	Dry Pond	X
124	Dry Pond	X
125	Dry Pond	X
127	Wet Pond	X
128	Wet Pond	X
129	Dry Pond	X
130	Wet Pond	X
131	Wet Pond	X
132	Dry Pond	X
133	Dry Pond	X
134	Dry Pond	X
135	Dry Pond	X
136	Dry Pond	X
137	Wet Pond	X
138	Dry Pond	X
139	Wet Pond	X
140	Dry Pond	X
141	Wet Pond	X
147	Bioswale	X
148	Bioswale	X
149	Bioswale	X
150	Bioswale	X
151	Bioswale	X
152	Bioswale	X
153	Bioswale	X
154	Bioswale	X

CANAL - NC COUNTY

BMP NUMBER	BMP TYPE	DRAINAGE AREA
155	Bioswale	X
156	Bioswale	X
160	Bioswale	X
162	Bioswale	X
163	Bioswale	X
166	Dry Pond	X
171	Wet Pond	X
173	Wet Pond	X
179	Wet Pond	X
181	Wet Pond	X
185	Wet Pond	X
186	Wet Pond	X
187	Wet Pond	X
188	Dry Pond	X
189	Wet Pond	X
190	Dry Pond	X
191	Wet Pond	X
193	Dry Pond	X
196	Dry Pond	X
202	Wet Pond	X
219	Wet Pond	X
221	Wet Pond	X
222	Wet Pond	X
237	Bioswale	X
238	Bioswale	X
242	Wet Pond	X
311	Bioswale	X
319	Infil Trench	X
398	Dry Pond	X
399	Dry Pond	X
400	Dry Pond	X
431	Dry Pond	X
432	Bioswale	X
464	Bioretention	X

**TOTAL
COMPLETED**

105

**TABLE 4
BMP DRAINAGE AREAS DELINEATED**

CENTRAL - KENT COUNTY

BMP NUMBER	BMP TYPE	DRAINAGE AREA
5	Wet Pond	X
7	Wet Pond	X
8	Wet Pond	X
10	Dry Pond	X
17	Wet Pond	X
18	Wet Pond	X
29	Wet Pond	X
77	Wet Pond	X
81	Wet Pond	X
83	Wet Pond	X
94	Dry Pond	X
106	Infil Basin	X
167	Wet Pond	
176	Sand Filter	X
177	Dry Pond	X
178	Dry Pond	X
197	Bioswale	X
203	Wet Pond	X
204	Wet Pond	X
205	Wet Pond	X
206	Wet Pond	X
207	Wet Pond	X
208	Wet Pond	X
209	Wet Pond	X
210	Wet Pond	X
211	Wet Pond	X
212	Wet Pond	X
216	Bioswale	X
243	Dry Pond	X
246	Wet Pond	X
312	Bioswale	X
328	Bioswale	X
329	Dry Pond	X
401	Filter Strip	
402	Bioswale	
403	Bioswale	
404	Bioswale	
439	Wet Pond	X
487	Filter Strip	
488	Wet Pond	

TOTAL COMPLETED 33

SOUTH - SUSSEX COUNTY

BMP NUMBER	BMP TYPE	DRAINAGE AREA
47	Bioswale	
103	Bioswale	
126	Sed Forebay	X
145	Dry Pond	X
146	Dry Pond	X
168	Sand Filter	X
174	Bioswale	
180	Wet Pond	X
200	Wet Pond	X
201	Wet Pond	X
213	Wet Pond	X
226	Wet Pond	
227	Bioswale	
228	Bioswale	
236	Wet Pond	
247	Wet Pond	
248	Bioretention	X
295	Sed Forebay	
296	Sed Forebay	
405	Bioswale	X
406	Bioswale	X
407	Bioswale	X
408	Bioswale	X
409	Bioswale	X
410	Bioswale	X
411	Bioswale	X
412	Bioswale	X
413	Bioswale	X
414	Bioswale	X
415	Bioswale	X
489	Bioswale	
490	Bioswale	
491	Bioswale	
492	Bioswale	
493	Bioswale	
494	Bioswale	
495	Bioswale	
496	Bioswale	
497	Bioswale	
498	Bioswale	
499	Bioswale	
500	Bioswale	
501	Bioswale	
502	Bioswale	
503	Bioswale	
504	Bioswale	
505	Bioswale	
506	Bioswale	
507	Bioswale	
508	Bioswale	
509	Bioswale	
510	Bioswale	
511	Bioswale	

TOTAL COMPLETED 20

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 3200804071311737
Outfall to BMP 241
Route 7 Bear

Illicit Discharge Incident Tracking Sheet

Date: 1/18/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: 1354 Field Crew
Subdivision: None
County: New Castle
ADC Map No./Grid: 15-K1

Incident Location

Primary Location Description

- Storm drain
- In Stream
- Stormwater Pond
- Outfall
- Along bank
- Upland
- Other _____

Outfall / inlet ID# : 320080407131737

Closest street address: Across from 454 Bear Christiana Road

Watershed name: Christina River Impacted Stream name:

Nearby landmark: Bear Maintenance Yard

Narrative description of location

Outfall is located on the east side of BMP 241.

Description of problem

Visual

- Oil / Oil sheen
- Paint
- Algae
- Cloudy
- Anti-freeze
- Yard waste
- Soap
- Flotables (toilet paper, etc.)
- Dead fish
- Flow -----> Precipitation in last 48-hours? Yes / No
- Other _____

Odor

- Sewage
- None
- Sulfide ("rotten egg")
- Gas/oil
- Other (describe) _____

Narrative description/comments of problem

1/18/10 - Outfall 320080407131737 had a dark green stain on the outfall pipe leading into BMP 241. Outfall discharge is clear, dead fish directly in front of outfall pipe.

3/2/10 - Re-investigation of outfall, no dead fish, foam in front of outfall.
investigation of outfall, sample tested high for detergents.

6/25/10 - Re-

Plan of Action (check all that apply)

- Sample
- Contact DNREC
- Contact NPDES Manager
- Photos
- Door hangers
- GPS Coordinates
- Other (describe)

Follow-up Action

Continue to monitor/re-visit site.



MEMORANDUM

TO: Randy Cole
Marianne Walsh, PhD
DelDOT Stormwater Quality Program

FROM: Ryan Coleman

DATE: January 25, 2010

SUBJECT: **Potential Illicit Discharge**
Outfall # 320080407131737 into BMP 241
DelDOT Agreement 1495
KCI Project 0203019G

The purpose of this Memo is to summarize the most recent investigation of a Potential Illicit Discharge (PID) at an outfall flowing into BMP 241 along Route 7 near Bear (**Figure 1**). This same outfall had been previously investigated for a PID in 2007. No sign of discharge was observed at that time.

During the 2009 Annual BMP Inspections, Agreement 1354 KCI field crew observed signs of illicit discharge at BMP 241 and reported such to the Agreement 1495 KCI field crew for further investigation. Upon inspection of the BMP and outfall on January 18, 2010, the Agreement 1495 field crew determined that there were indications of a PID. There was a dark green stain on the outfall pipe that dumps into the pond (**Figure 2**). There was active dry weather flow from the outfall, which was clear in color. The field crew also noticed a large amount of dead fish directly in front of the outfall pipe (**Figures 3 & 4**).

The drainage to the pond is believed to originate from a nearby, fenced-off, secure facility that is owned by First USA Bank. Further investigation is required to determine whether the facility property is responsible for all drainage to the pond, or if some drainage is from DelDOT-owned property.

A grab sample was collected from the outfall and analyzed by the field crew. The sample did not test above acceptable parameter levels. There is a possibility that the fish kill was a result of extremely cold temperatures and frozen water. KCI will revisit the site in March to test the outfall discharge.

The outfall was re-investigated on March 2, 2010 and a grab sample was collected for analysis. There were no more dead fish around the outfall as in the early investigation. The field crew noticed foam in front of the outfall (**Figure 5**) and the water sample tested high for detergents at **0.7 mg/L**. The outfall will be monitored in April at which point a determination will be made on whether further investigation is needed at this site.

No action take as per discussion with DelDOT.



Figure 1. Location Map

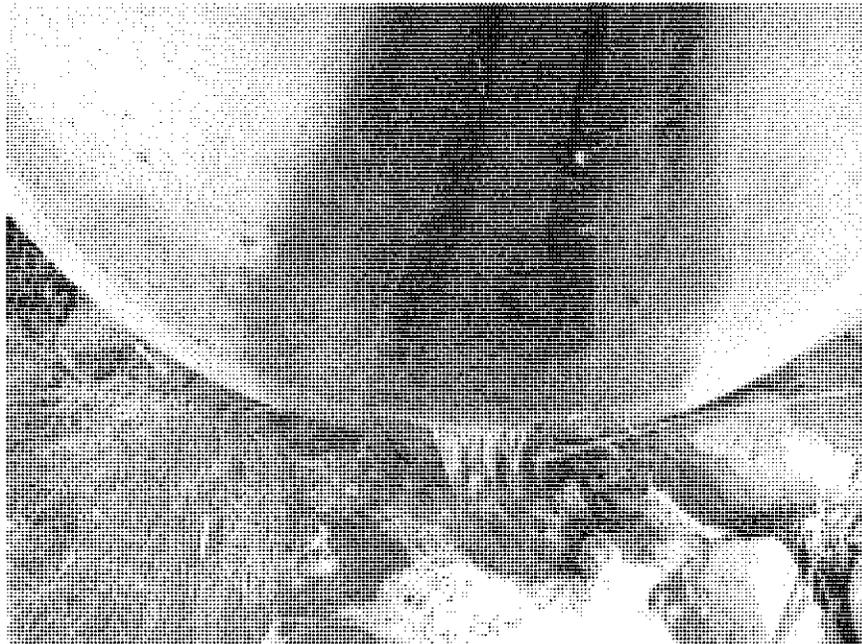


Figure 2. Stained Outfall Pipe



Figure 3. Fish Kill 1

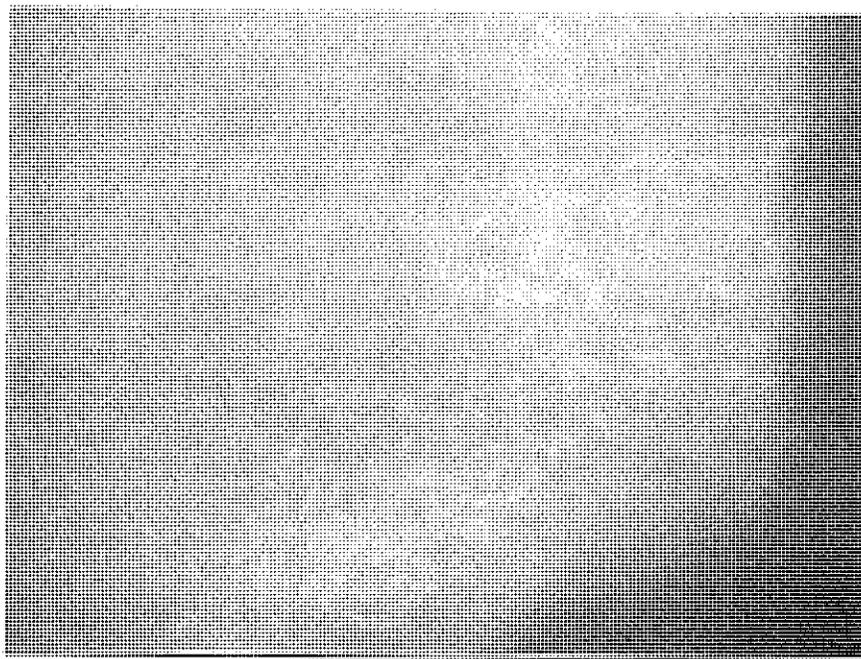


Figure 4. Fish Kill 2

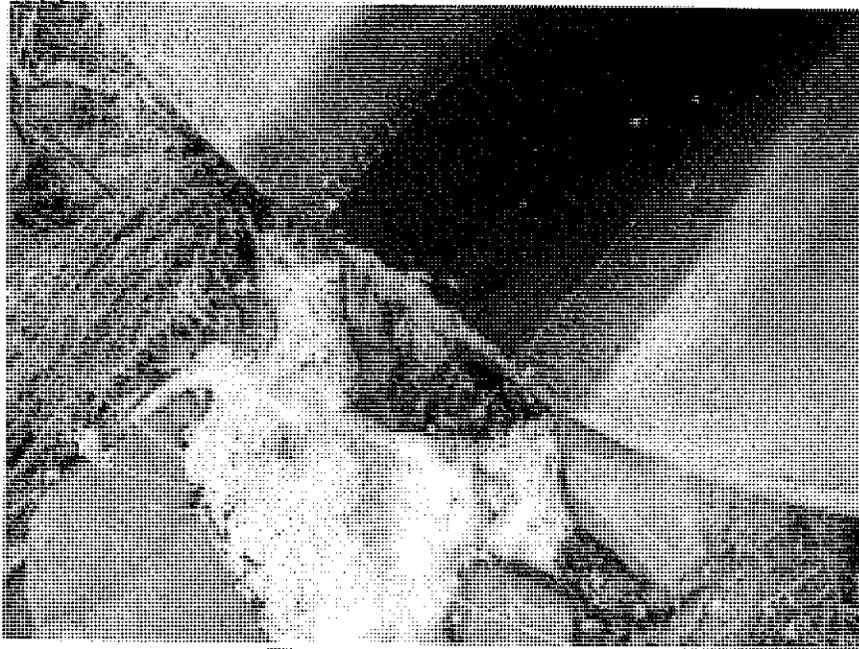
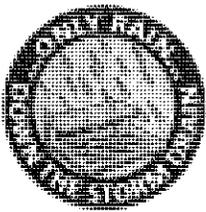


Figure 5. Foam at Outfall



**DELDOT AGREEMENT 1495
POTENTIAL ILLICIT DISCHARGE FIELD DATA SHEET**



Structure/Outfall ID Number: RJ 7 Fish Kill

Address/Location Description: _____

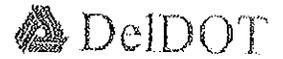
Outfall Data	
Digital picture? (Y/N):	Y
Camera Number:	ES-1
Picture Number:	
Personnel:	RC / JN
Date (MM/DD/YY):	6/25/10
Time:	11:30 a.m.
Date of Last Rain >0.10" (MM/DD/YY):	
Follow Up Screen Date (MM/DD/YY):	
Follow Up Field Screen Time:	
Outfall Dimensions (in):	
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	
Outfall Type (CMP, RCP, PVC, Other):	
Flow Observed? (Y/N):	
Follow Up Flow Observed? (Y/N):	
Flow Source	
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	N
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	N
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	
Algae Growth? (Y/N):	Y
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	N
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	C
Specific Land Use:	

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4				
Water Temperature (Fahrenheit):		70.0			
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	7.42			
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0.05			
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0			
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	>1.0			
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0			
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; ≥3.0 mg/L=4	> 3.0			
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	12.22			
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	B			
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	N			

FIELD SKETCH



DELDOT NPDES FY 08 AGREEMENT 1351 – TASK 11.OS
RE-VISIT DUFFIELD OUTFALLS FIELD DATA SHEET



Duffield Outfall ID Number: R111P 191

Outfall Data	
Digital picture? (Y/N):	Yes
Camera Number:	ES-1
Picture Number:	
Personnel:	PC/1/E
Date (MM/DD/YY):	11/1/04
Time:	1:30 pm
Date of Last Rain >0.10" (MM/DD/YY):	11/1/04
Follow Up Screen Date (MM/DD/YY):	3/2/05
Follow Up Field Screen Time:	pm
Outfall Dimensions (in):	
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	Round
Outfall Type (CMP, RCP, PVC, Other):	RCP
Flow Observed? (Y/N):	Y
Follow Up Flow Observed? (Y/N):	Y
Flow Source	
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	Normal
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	None
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	None
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	Other: green lumps in pipe
Algae Growth? (Y/N):	None / Yes 2nd visit in 04
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	None
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	CIP
Specific Land Use:	

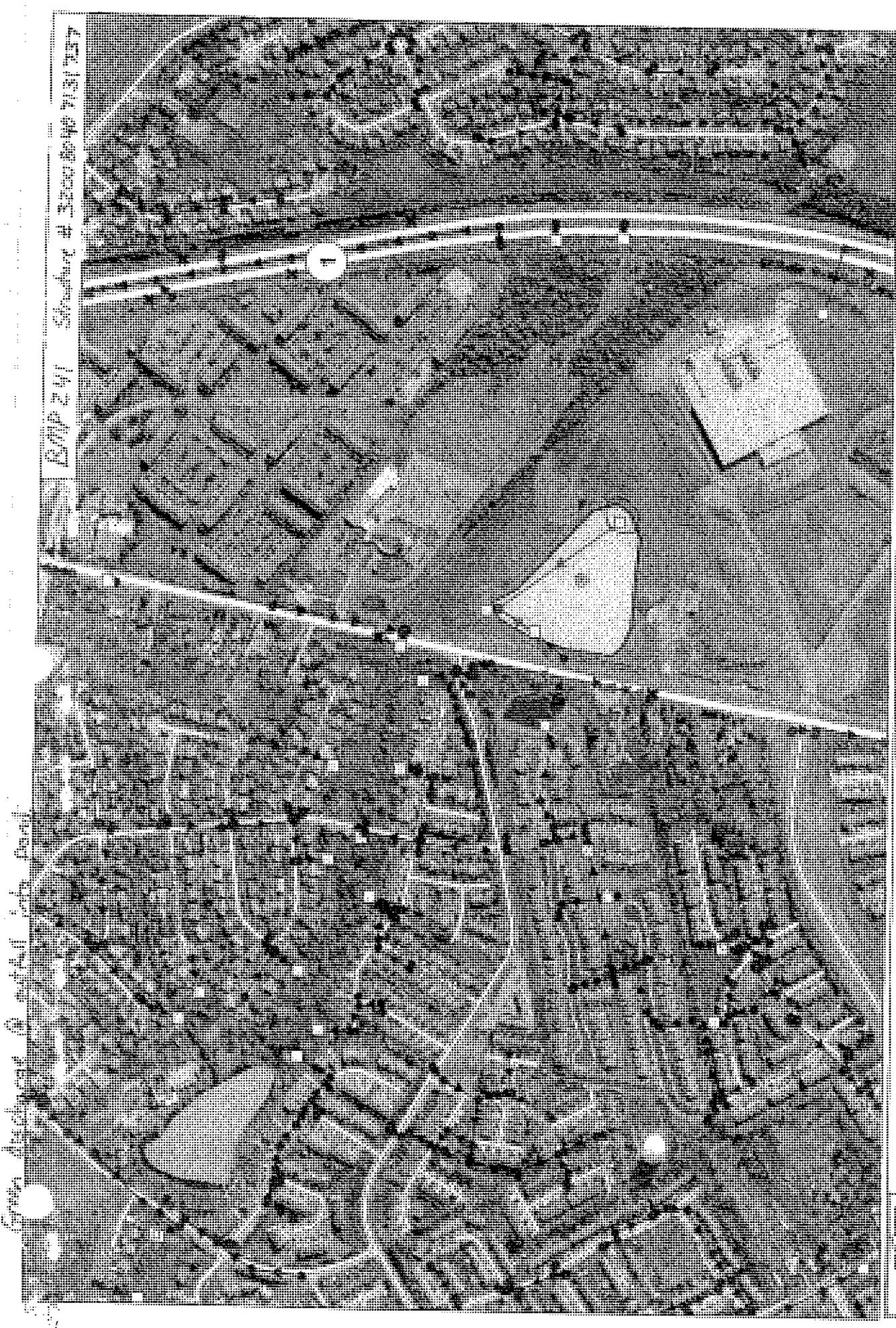
R111P
4/1/05
3:30pm

No Actin, See Memo

		Result 1	Val.	Result 2	Val. 2	
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4					
Water Temperature (Farenheit):		51		47.7		49.1
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	7.27		7.27		7.27
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0		0		0
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0		0		0
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	0.1		0.7		0.35
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0		0		0
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; >3.0 mg/L=4	0.4		0.6		0.4
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	5.88		3.73		0.79
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	Clear		C		Clear
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	None		0 Foam @ outfall		None

* Large number of dead fish seen around outfall 1st time on 7-1.

FIELD SKETCH



Sewer System # 33008040 7/31/2017
 BMP 2-VI

NPDES Inventory Map

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 71506
42 Lynchfarm Drive
Todd Estates

Illicit Discharge Incident Tracking Sheet

Date: 3/2/10 **Logged by:** **Contact #:** **Incident ID:** 010-00

Caller contact information: 1354 Field Crew	Subdivision: Todd Estates
	County: New Castle
	ADC Map No./Grid: 11-B10

Incident Location

Primary Location Description

<input checked="" type="checkbox"/> Storm drain	<input type="checkbox"/> Outfall	<input type="checkbox"/> Other _____
<input type="checkbox"/> In stream	<input type="checkbox"/> Along bank	
<input type="checkbox"/> Stormwater pond	<input type="checkbox"/> Upland	

Outfall / inlet ID#: 71506

Closest street address: 42 Lynchfarm Drive

Watershed name: Christina River Impacted Stream name:

Nearby landmark: George V. Kirk Middle School

Narrative description of location

Catch basin is located on the side of street at 42 Lynchfarm Drive

Description of problem

Visual

- | | |
|--|---|
| <input type="checkbox"/> Oil / Oil sheen | <input type="checkbox"/> Soap |
| <input type="checkbox"/> Paint | <input type="checkbox"/> Flotables (toilet paper, etc.) |
| <input type="checkbox"/> Algae | <input type="checkbox"/> Dead fish |
| <input type="checkbox"/> Cloudy | <input type="checkbox"/> Flow -----> Precipitation in last 48-hours? Yes / No |
| <input type="checkbox"/> Anti-freeze | <input checked="" type="checkbox"/> Other <u>Pet Waste</u> |
| <input type="checkbox"/> Yard waste | |

Odor

- | | | |
|---------------------------------|---|----------------------------------|
| <input type="checkbox"/> Sewage | <input type="checkbox"/> Sulfide ("rotten egg") | <input type="checkbox"/> Gas/oil |
| <input type="checkbox"/> None | <input checked="" type="checkbox"/> Other (describe) <u>pet waste</u> | |

Narrative description/comments of problem

During 1354 re-inspections the crew noticed pet waste that was placed in the catch basin. Signs saying "beware of dog" were seen on the property at 42 Lynchfarm Drive, which is the closest property to the catch basin.

Plan of Action (check all that apply)

- | | | |
|--|--|---|
| <input type="checkbox"/> Sample | <input type="checkbox"/> Contact DNREC | <input checked="" type="checkbox"/> Contact NPDES Manager |
| <input checked="" type="checkbox"/> Photos | <input checked="" type="checkbox"/> Door hangers | <input type="checkbox"/> GPS Coordinates |
| <input type="checkbox"/> Other (describe) | | |

Follow-up Action

25 OXN 12/1/05

Conduct a follow-up inspection to ensure no more pet waste is being dumped in the basin.



MEMORANDUM

TO: KCI Files

FROM: Ryan Coleman

DATE: March 8, 2010

SUBJECT: Todd Estates PID, 42 Lynchfarm Drive
Catch Basin No. 71506
Agreement 1495 / KCI Project 0203019G

The purpose of this Memo is to summarize the investigation of an illicit discharge in Todd Estates at 42 Lynchfarm Drive.

While performing Agreement 1354 Re-inspections, a KCI field crew came across a potential illicit discharge (PID) in a catch basin located at 42 Lynchfarm Drive in Todd Estates. While performing inspections the crew noticed what appeared to be pet waste dumped in a catch basin. The PID was reported to the Agreement 1495 KCI field crew responsible for investigating PIDs.

Upon inspection of the catch basin on March 2, 2010 it was noted that the structure had pet waste on the grate and in the basin. The pet waste appeared to be purposely placed in the basin. The closest house to the catch basin, 42 Lynchfarm Drive, had signs on the fence warning of a dog on the property. Pictures were taken of the PID and other catch basins in the area were inspected. The other basins in the immediate area appear to be clear of pet waste.

On March 11, 2010 KCI distributed 25 door hangers to the residents in the immediate vicinity of the PID on Lynchfarm Drive.

KCI plans to do a follow up investigation of the site to verify all dumping of pollutants has ceased.



Figure 1. Landscape

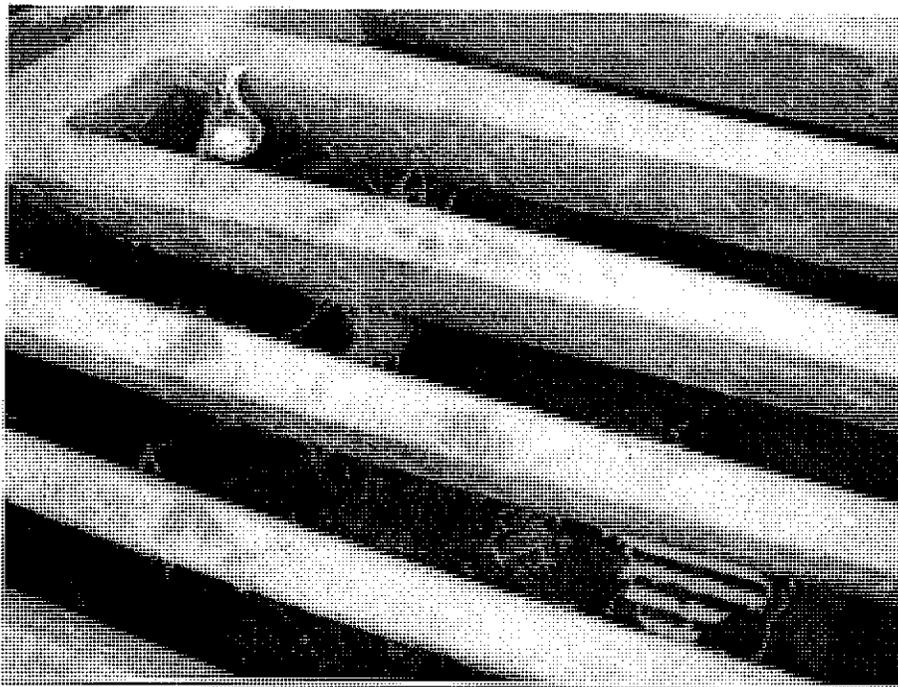
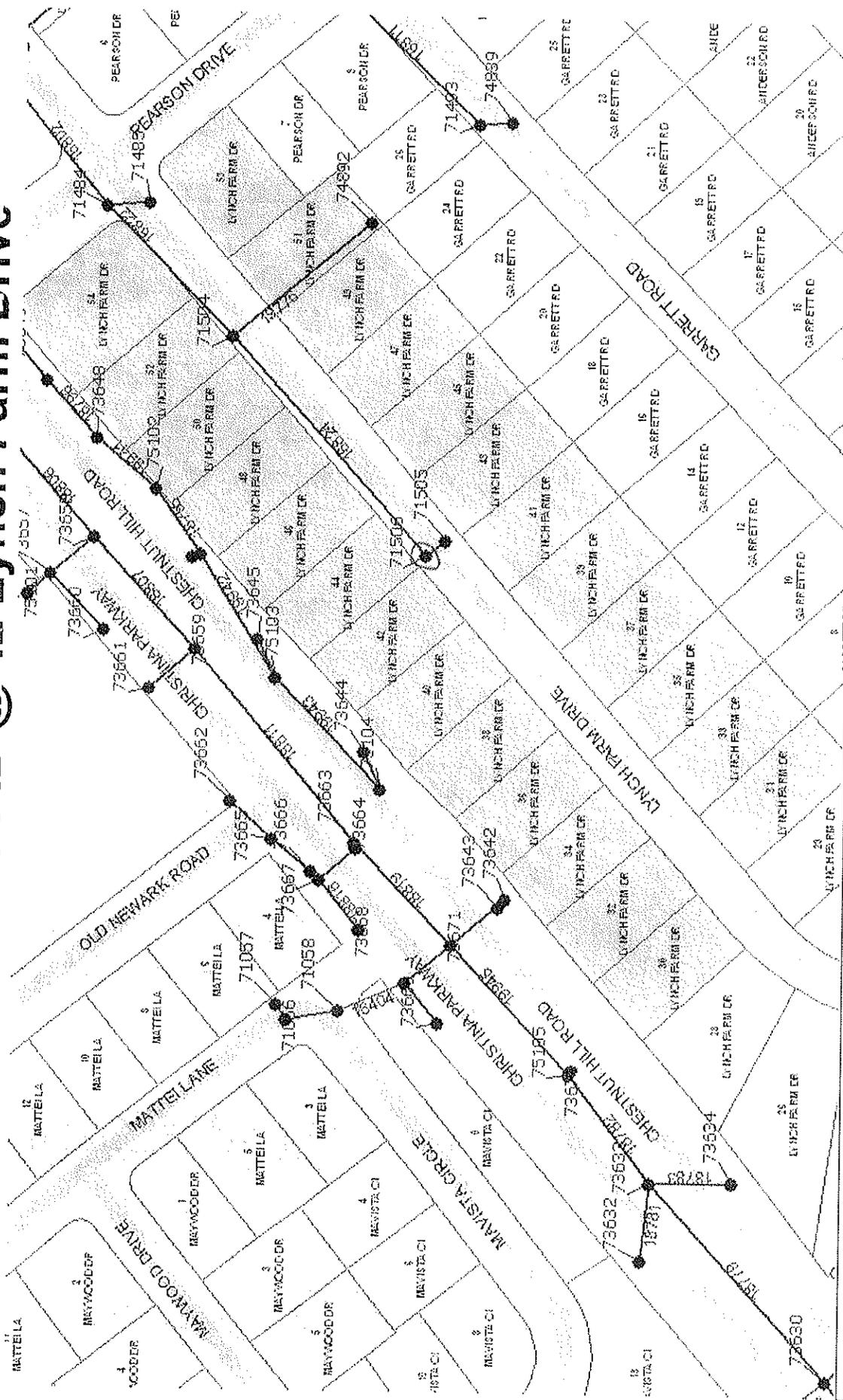


Figure 2. Structure View

Odd Estates PID @ 42 Lynch Farm Drive





NPDES
Inventory Map



<ul style="list-style-type: none"> INLET MANHOLE OUTFALL RISER 	<ul style="list-style-type: none"> CULVERT SWALE END JUNCTION BOX DUMMY NODE 	<ul style="list-style-type: none"> SWALE VERTEX Ditch Pipe Hydraulic Connection 	<ul style="list-style-type: none"> Bay Saver Biofiltration Biofiltration & Bioretention Bioretention Dry Pond 	<ul style="list-style-type: none"> Filter Strip Infiltration Basin / Trench Sand Filter Sediment Forebay Storm Filter 	<ul style="list-style-type: none"> Wet Pond / Wetland
--	--	---	---	---	---

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 74702
30 McCord Drive
Brookside Park

Illicit Discharge Incident Tracking Sheet

Date: 3/2/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: 1354 Field Crew Subdivision: Brookside Park
County: New Castle
ADC Map No./Grid: 11-A9

Incident Location

Primary Location Description
 Storm drain Outfall Other Manhole
 In Stream Along bank
 Stormwater Pond Upland

Outfall / inlet ID# : 74702

Closest street address: 30 McCord Drive

Watershed name: White Clay Creek Impacted Stream name:

Nearby landmark:

Narrative description of location

Manhole is located in the sidewalk in front of house.

Description of problem

Visual

- | | |
|--|--|
| <input type="checkbox"/> Oil / Oil sheen | <input type="checkbox"/> Soap |
| <input type="checkbox"/> Paint | <input type="checkbox"/> Flotables (toilet paper, etc.) |
| <input type="checkbox"/> Algae | <input type="checkbox"/> Dead fish |
| <input type="checkbox"/> Cloudy | <input checked="" type="checkbox"/> Flow -----> Precipitation in
last 48-hours? Yes / No |
| <input type="checkbox"/> Anti-freeze | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Yard waste | |

Odor

- | | | |
|--|---|----------------------------------|
| <input type="checkbox"/> Sewage | <input type="checkbox"/> Sulfide ("rotten egg") | <input type="checkbox"/> Gas/oil |
| <input checked="" type="checkbox"/> None | <input type="checkbox"/> Other (describe) _____ | |

Narrative description/comments of problem

Dry Weather Flow was observed.

Plan of Action (check all that apply)

- | | | |
|--|--|--|
| <input checked="" type="checkbox"/> Sample | <input type="checkbox"/> Contact DNREC | <input type="checkbox"/> Contact NPDES Manager |
| <input checked="" type="checkbox"/> Photos | <input type="checkbox"/> Door hangers | <input type="checkbox"/> GPS Coordinates |
| <input type="checkbox"/> Other (describe) | | |

Follow-up Action

Samples tested within acceptable parameter levels. No further action needed.



DELDOT NPDES FY 08 AGREEMENT 1351 – TASK 11.05
RE-VISIT DUFFIELD OUTFALLS FIELD DATA SHEET



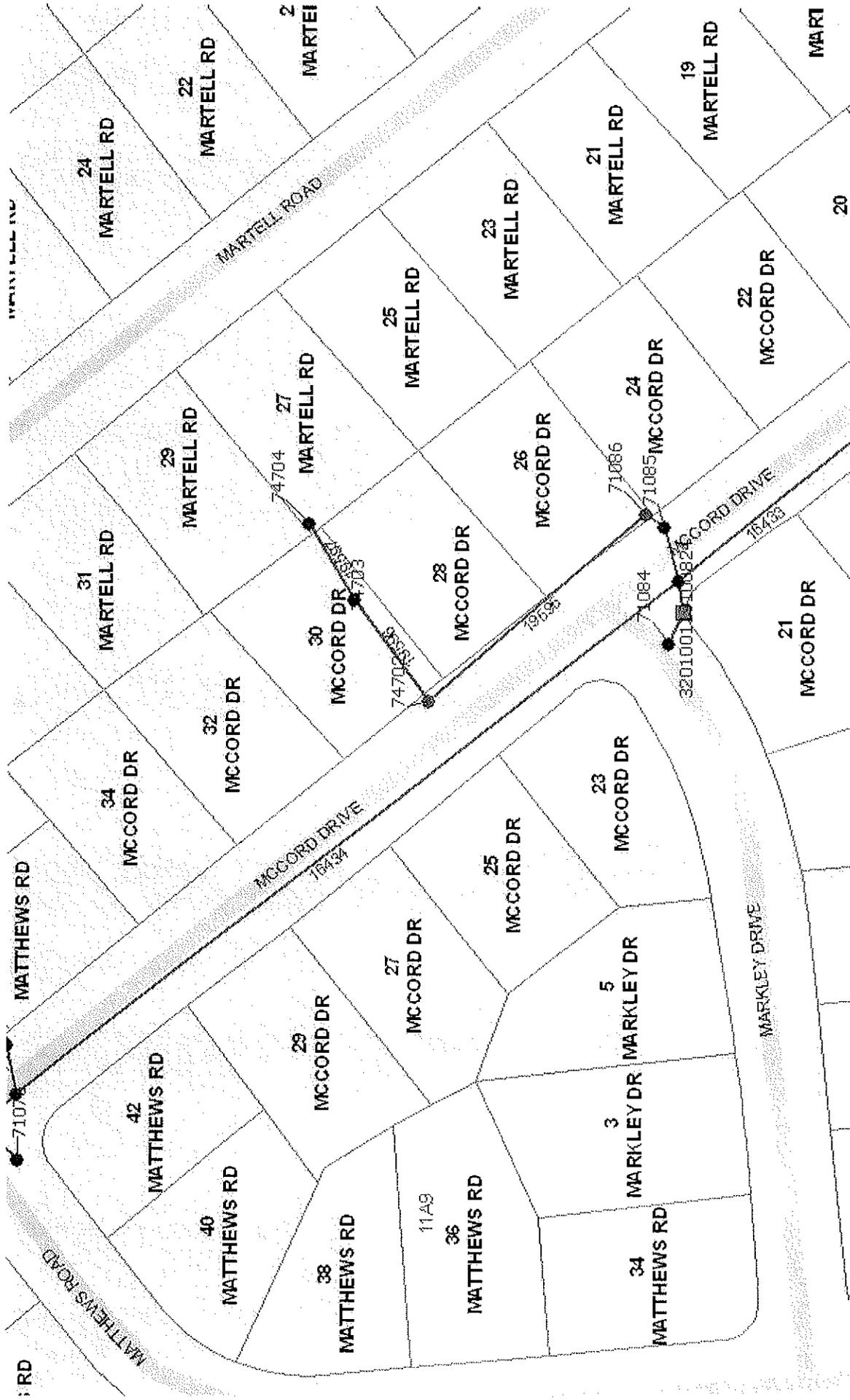
Duffield Outfall ID Number: 50 McLeod rd + RD 74702

Outfall Data	
Digital picture? (Y/N):	Y
Camera Number:	
Picture Number:	
Personnel:	Chris/Ryan C.
Date (MM/DD/YY):	3/2/10
Time:	10:00am
Date of Last Rain >0.10" (MM/DD/YY):	
Follow Up Screen Date (MM/DD/YY):	3/2/10
Follow Up Field Screen Time:	9:00am
Outfall Dimensions (in):	Manhole
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	N/A
Outfall Type (CMP, RCP, PVC, Other):	N/A
Flow Observed? (Y/N):	Y
Follow Up Flow Observed? (Y/N):	Y
Flow Source	
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	N
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	N
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	G (petroleum)
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	N
Algae Growth? (Y/N):	N
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	N/A
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	Res.
Specific Land Use:	Neighborhood

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4				
Water Temperature (Fahrenheit):		45.8°		47	
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	8.34		8.34	
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0		0	
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0.1		0.1	
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	0.35		0.35	
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0		0	
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; >3.0 mg/L=4	0.15		0.15	
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	7.3		7.3	
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	C		C	
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	N		N	

FIELD SKETCH

Brooksie Park PID



NPDES Inventory Map
1 in. = 72 ft.

DeIDOT

N

●	INLET	◇	SWALE VERTEX	□	CULVERT
●	MANHOLE	—	Ditch	◇	SWALE END
○	OUTFALL	—	Pipe	■	JUNCTION BOX
■	RISER	—	Hydraulic Connection	■	DUMMY NODE
■	Bay Saver	■	Filter Strip	■	Wet Pond / Wetland
■	Biofiltration	■	Infiltration Basin / Trench	■	Wet Pond / Wetland
■	Biofiltration & Bioretention	■	Sand Filter	■	Wet Pond / Wetland
■	Bioretention	■	Sediment Forebay	■	Wet Pond / Wetland
■	Dry Pond	■	Storm Filter	■	Wet Pond / Wetland

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

➤ Structure 71075

Intersection of Matthews Road & McCord Drive

Brookside Park



DELDOT NPDES FY 08 AGREEMENT 1351 – TASK 11.05
 RE-VISIT DUFFIELD OUTFALLS FIELD DATA SHEET



Duffield Outfall ID Number: *Intersection of Matthews & McLeod*

Outfall Data	
Digital picture? (Y/N):	Y
Camera Number:	ES-1
Picture Number:	
Personnel:	RC CB
Date (MM/DD/YY):	3/2/10
Time:	11 am
Date of Last Rain >0.10" (MM/DD/YY):	
Follow Up Screen Date (MM/DD/YY):	
Follow Up Field Screen Time:	
Outfall Dimensions (in):	
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	R
Outfall Type (CMP, RCP, PVC, Other):	RCP
Flow Observed? (Y/N):	Y
Follow Up Flow Observed? (Y/N):	
Flow Source	
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	N
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	N
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	N
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	N
Algae Growth? (Y/N):	N
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	N
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	Res. Industrial
Specific Land Use:	Neighboring lot

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4				
Water Temperature (Fahrenheit):		42°			
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	7.16			
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0			
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4				
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	0.43			
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0			
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; ≥3.0 mg/L=4	0			
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	4.24			
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	6			
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	N			

FIELD SKETCH

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 74839
23 Garrett Road
Todd Estates

Illicit Discharge Incident Tracking Sheet

Date: 3/8/16 **Logged by:** **Contact #:** **Incident ID:** 2010-01

Caller contact information: 1354 Field Crew
 Subdivision: Todd Estates
 County: New Castle
 ADC Map No./Grid: 11-B10

Incident Location

Primary Location Description
 Storm drain Outfall Other _____
 In stream Along bank
 Stormwater pond Upland

Outfall / inlet ID#: 74839

Closest street address: 23 Garrett Road

Watershed name: Christina River Impacted Stream name:

Nearby landmark: George V. Kirk Middle School

Narrative description of location

Catch basin is located on the side of street at 23 Garrett Road

Description of problem

Visual
 Oil / Oil sheen Soap
 Paint Flotables (toilet paper, etc.)
 Algae Dead fish
 Cloudy Flow -----> Precipitation in
 Anti-freeze last 48-hours? Yes / No
 Yard waste Other _____

Odor
 Sewage Sulfide ("rotten egg") Gas/oil
 None Other (describe) _____

Narrative description/comments of problem

During 1354 re-inspections a resident of the neighborhood told the crew that his neighbor at 23 Garrett Road was placing leaves in the storm drain. Upon inspection it was noted that the catch basin was full of leaves and the pipe in the basin could not be seen.

Plan of Action (check all that apply)

Sample Contact DNREC Contact NPDES Manager
 Photos Door hangers GPS Coordinates
 Other (describe)

Follow-up Action

16 DOOR HANGERS

Conduct a follow-up inspection in the fall to assure no more yard waste has been deposited in the catch basin.



MEMORANDUM

TO: KCI Files

FROM: Ryan Coleman

DATE: March 8, 2010

SUBJECT: Todd Estates PID, 23 Garrett Road
Catch Basin No. 74839
Agreement 1495 / KCI Project 0203019G

The purpose of this Memo is to summarize the investigation of an illicit discharge in Todd Estates at 23 Garrett Road.

While performing Agreement 1354 Re-inspections, a KCI field crew came across a potential illicit discharge (PID) in a catch basin located at 23 Garrett Road in Todd Estates. While performing inspections the crew was approached by a resident of the neighborhood who stated that his neighbor was dumping leaves in the catch basin. The PID was reported to the Agreement 1495 KCI field crew responsible for investigating PIDs.

Upon inspection of the catch basin on March 2, 2010 it was noted that the basin was 75 percent full of leaves. The leaves appear to be blocking flow in the catch basin since the pipe is not visible. Pictures were taken of the PID and other catch basins in the area were inspected. The other basins in the immediate area appear to be clear of leaves and debris.

On March 11, 2010 KCI distributed door hangers to 16 houses in the immediate vicinity of the PID.

KCI plans to do a follow up investigation of the site to verify all dumping of pollutants has ceased.

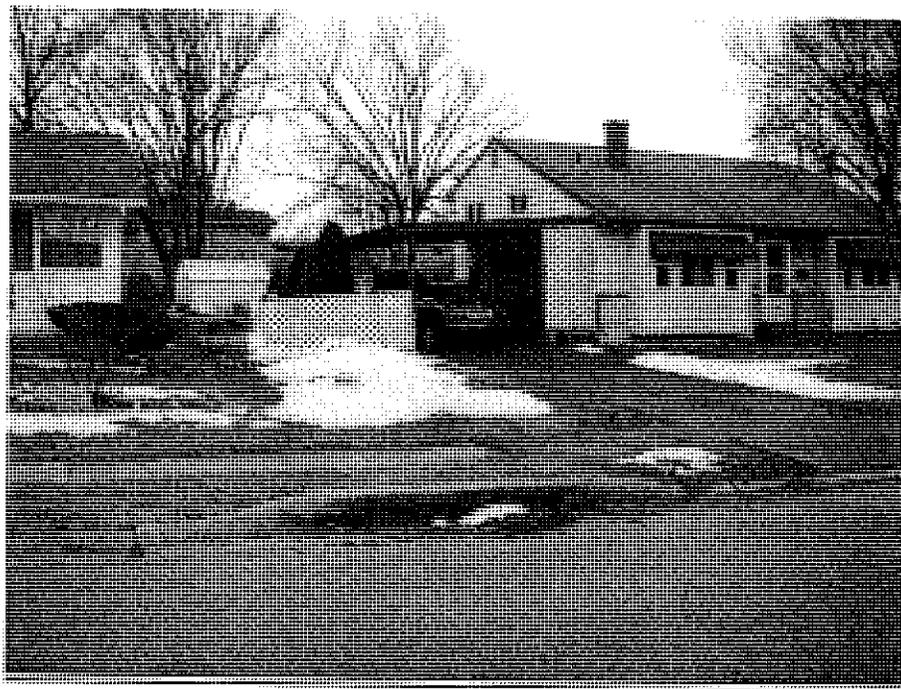
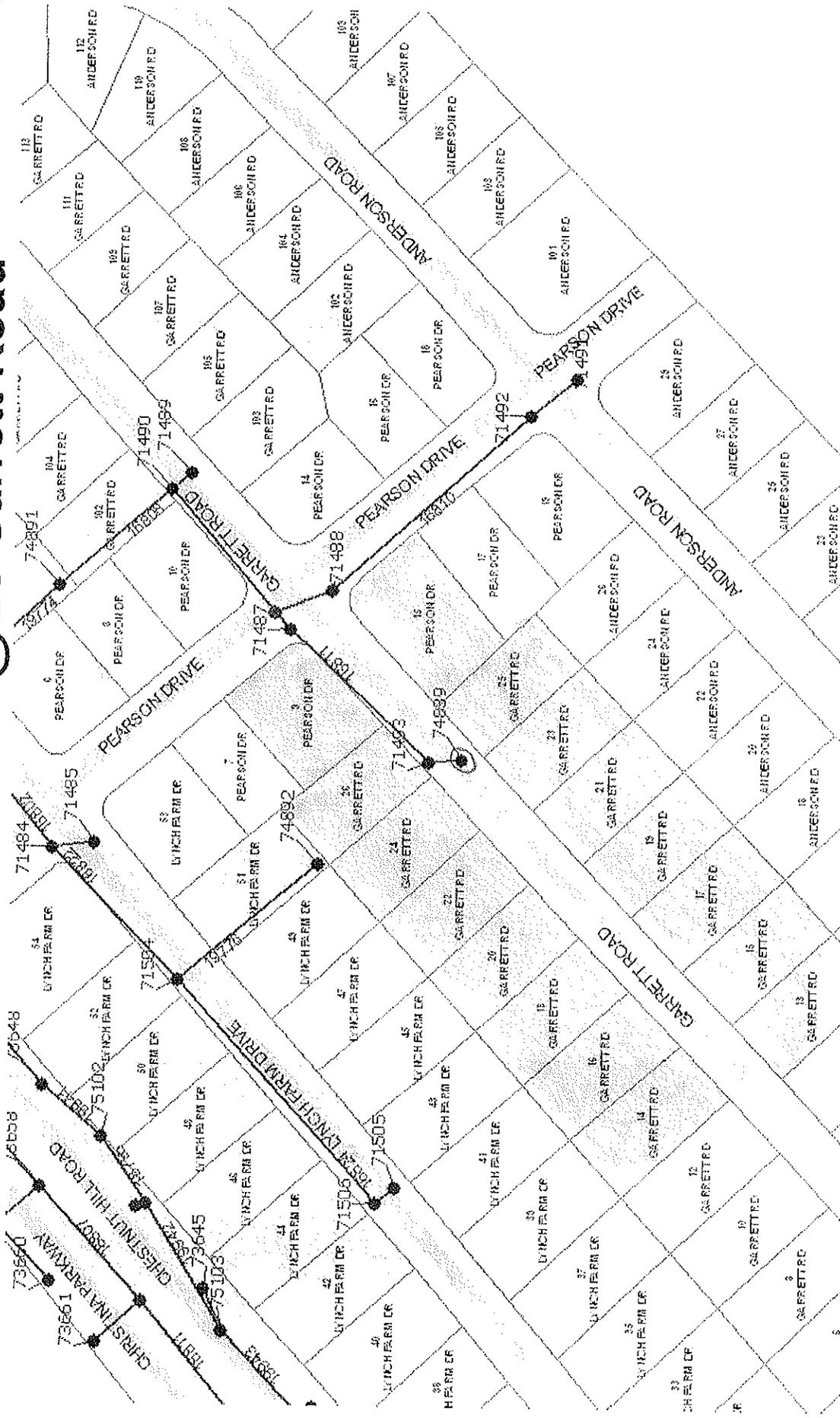


Figure 1. Landscape



Figure 2. Structure View

Todd Estates PID @ 23 Garrett Road



NPDES
Inventory Map

N

DeIDOT

INLET MANHOLE OUTFALL RISER	CULVERT SWALE END JUNCTION BOX DUMMY NODE	SWALE VERTEX Ditch Pipe Hydraulic Connection	Bay Saver Biofiltration Biofiltration & Bioretention Bioretention Dry Pond	Filter Strip Infiltration Basin / Trench Sand Filter Sediment Forebay Storm Filter	Wet Pond / Wetland
--------------------------------------	--	---	--	--	--------------------

Stormwater Pollution Found in Your Area!

This is not a citation.

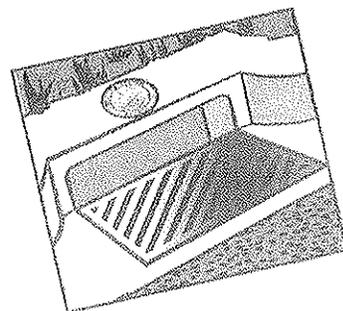
Date: _____

This is to inform you that our staff found the following illegal pollutants in the storm sewer system in your neighborhood.



It is illegal to put any of these items in the storm drain, punishable by a minimum \$1000 fine:

- Motor oil/filters
- Antifreeze/transmission fluid
- Paint
- Solvent/degreaser
- Cooking grease
- Detergent
- Home improvement waste (concrete, mortar)
- Pet waste
- Yard waste (leaves, grass, mulch)
- Excessive dirt and gravel
- Trash
- Pesticides and fertilizers
- Other _____



The pollutants were found at:
23 Garrett Rd. Todd Estates

This storm sewer leads directly to:
Christina River



Delaware Department
of Transportation

If you have any information regarding this or any other illegal discharge of pollutants, please call:
1-800-652-5600
dotpr@state.de.us

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 520100301153011
15667 Walker Drive
East Side Village

Illicit Discharge Incident Tracking Sheet

Date: 3/11/2010 Logged by: J. Littlejohn Contact #: 302-462-1074 Incident ID: 2010-03

Caller contact information:
 Logged during routine drainage inventory

Subdivision: East Side Village
 County: Sussex
 ADC Map No./Grid: 16 F5

Incident Location:

Primary Location Description

- | | | |
|--|-------------------------------------|--|
| <input type="checkbox"/> Storm drain | <input type="checkbox"/> Outfall | <input checked="" type="checkbox"/> Other <u>In roadside swale</u> |
| <input type="checkbox"/> In stream | <input type="checkbox"/> Along bank | |
| <input type="checkbox"/> Stormwater pond | <input type="checkbox"/> Upland | |

Outfall / inlet ID# :

Closest street address: 15667 Walker Drive
 Milton, DE 19968

Watershed name: Broadkill River Impacted Stream name: Broadkill River

Nearby landmark: Septic sand mound on swale.

Narrative description of location

In swale that runs along north property line of 15667 Walker Drive. Swale runs from along Walker Drive into woods behind property.

Description of problem

Visual

- | | |
|--|---|
| <input type="checkbox"/> Oil / Oil sheen | <input type="checkbox"/> Soap |
| <input type="checkbox"/> Paint | <input checked="" type="checkbox"/> Flotables (toilet paper, etc.) |
| <input checked="" type="checkbox"/> Algae | <input type="checkbox"/> Dead fish |
| <input checked="" type="checkbox"/> Cloudy | <input checked="" type="checkbox"/> Flow -----> Precipitation in last 48-hours? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> |
| <input type="checkbox"/> Anti-freeze | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Yard waste | |

Odor

- | | | |
|--|---|----------------------------------|
| <input checked="" type="checkbox"/> Sewage | <input type="checkbox"/> Sulfide ("rotten egg") | <input type="checkbox"/> Gas/oil |
| <input type="checkbox"/> None | <input type="checkbox"/> Other (describe) _____ | |

Narrative description/comments of problem

Strong sewage odor and visual waste observed. Septic mound directly upstream. No direct connection between septic and swale observed, however effluent appears to be leaching into swale from septic mound.

Plan of Action (check all that apply)

- | | | |
|---|---|---|
| <input checked="" type="checkbox"/> Sample | <input checked="" type="checkbox"/> Contact DNREC | <input checked="" type="checkbox"/> Contact NPDES Manager |
| <input checked="" type="checkbox"/> Photos | <input type="checkbox"/> Door hangers | <input checked="" type="checkbox"/> GPS Coordinates |
| <input type="checkbox"/> Other (describe) _____ | | |

Follow-up Action

Photos and GPS coordinates taken. Suggest notification of NPDES manager, sampling to determine nature of effluent, and possible notification of DNREC to address potentially failing septic system.



MEMORANDUM

TO: Randy Cole
Marianne Walch, PhD
DelDOT Stormwater Quality Program

FROM: Ryan Coleman

DATE: April 7, 2010

SUBJECT: Agreement 1495 / KCI Project 0203019G
East Side Village PID - 15667 Walker Drive
Structure ID # 520100301153011

The purpose of this Memorandum is to summarize the investigation of a potential illicit discharge (PID) in the community of East Side Village, at 15667 Walker Drive, located in Sussex County.

While performing Agreement 1354 Inspections, a CEI field crew came across a PID in a swale located behind 15667 Walker Drive in East Side Village. The crew noticed a strong odor of sewage coming from a swale, which contained a cloudy discharge with algae and visible waste. The PID was reported to the Agreement 1495 KCI field crew responsible for investigating PIDs.

The Agreement 1495 KCI field crew inspected the swale on April 1, 2010, and noticed a strong odor of sewage coming from the swale. There was no evidence of active flow in the swale, although there were areas of ponding water in the swale and at the outfall (see attached photographs). The septic mound near the swale was inspected and showed no signs of seepage. The discharge appears to be coming from the residence beside the property that contains the septic mound. The illicit discharge seems to originate near the top of the swale, although no evidence of the source was found. This appears to be a septic issue because no evidence of direct connections or dumping was found in the swale.

A sample was collected from the swale outfall and tested on-site. Parameter levels were above detectable limits for detergents and ammonia. Because of the supporting evidence of an illicit discharge with no obvious source, KCI will discuss the next step(s) to be taken with DelDOT at the April 15, 2010 Project Status Meeting.



Figure 1. Landscape



Figure 2. Swale Discharge



DELDOT NPDES FY 08 AGREEMENT 1351 – TASK 11.OS
 RE-VISIT DUFFIELD OUTFALLS FIELD DATA SHEET

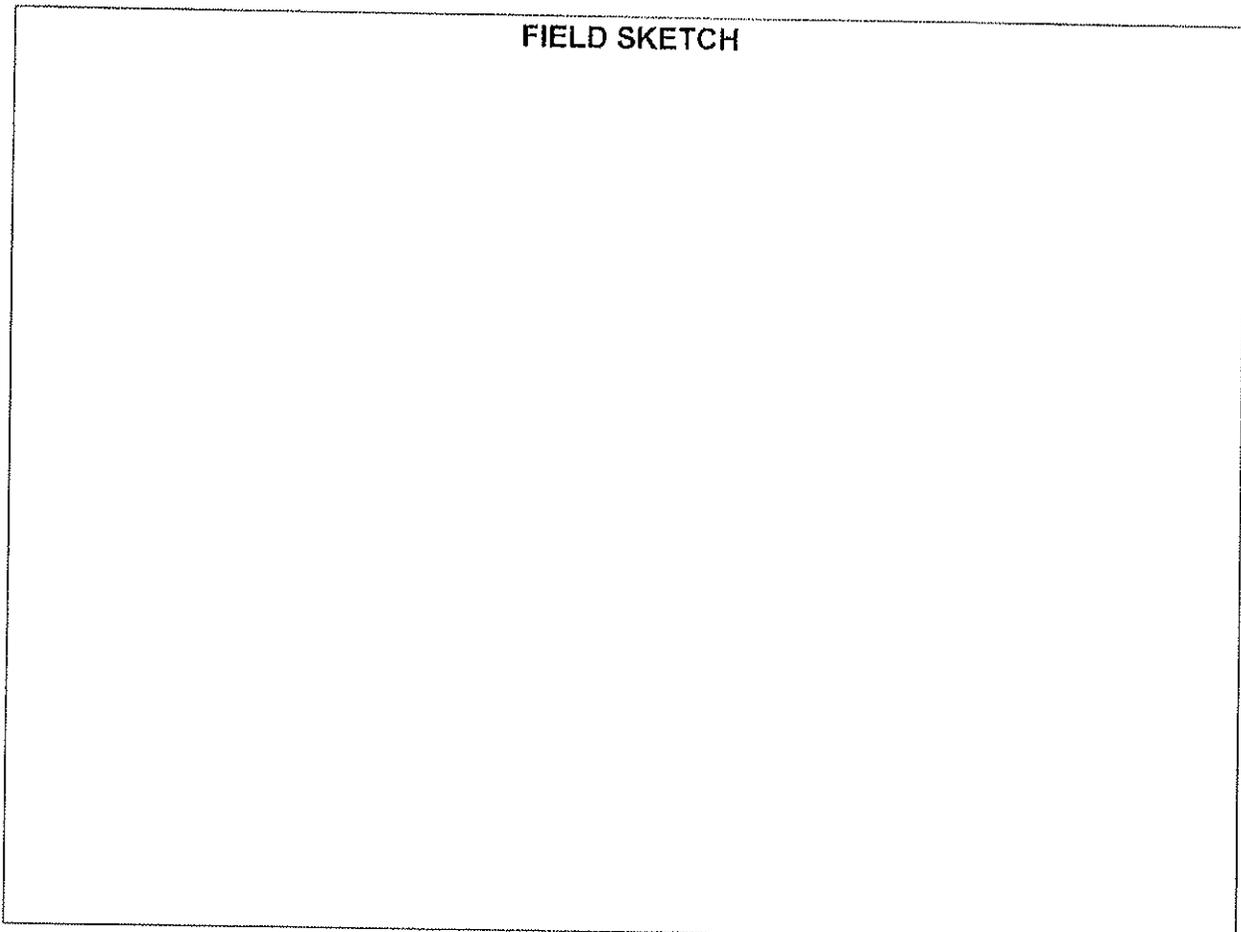


Duffield Outfall ID Number: Eastside Village 15637 Walker Dr
Map 16 FS Sussex

Outfall Data	
Digital picture? (Y/N):	Yes
Camera Number:	ES-1
Picture Number:	-
Personnel:	RC, CB
Date (MM/DD/YY):	4/1/10
Time:	12:30 pm
Date of Last Rain >0.10" (MM/DD/YY):	3/30/2010
Follow Up Screen Date (MM/DD/YY):	
Follow Up Field Screen Time:	
Outfall Dimensions (in):	-
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	Swale
Outfall Type (CMP, RCP, PVC, Other):	Swale
Flow Observed? (Y/N):	N, Pooled water
Follow Up Flow Observed? (Y/N):	
Flow Source	Unknown
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	NA
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	N
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	S
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	N
Algae Growth? (Y/N):	Y
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	N
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	R
Specific Land Use:	Neighbor hood

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4	N/A	-		
Water Temperature (Fahrenheit):		56.8	-		
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	7.34			
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0			
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0			
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	>1.3	4		
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0	-		
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; ≥3.0 mg/L=4	7.3	4		
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	4.45	0		
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	G	1		
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	S	4		

FIELD SKETCH



OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 16374
920 Hazeldell Avenue
Minquadale East

Illicit Discharge Incident Tracking Sheet

Date: 4/7/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: 1354 Field Crew Subdivision: Minquadales East
County: New Castle
ADC Map No./Grid: 13-D5

Incident Location

Primary Location Description
 Storm drain Outfall Other
 In Stream Along bank
 Stormwater Pond Upland

Outfall / inlet ID# : 16374

Closest street address: 920 Hazeldell Avenue

Watershed name: Delaware River Impacted Stream name:

Nearby landmark:

Narrative description of location

Description of problem

Visual

- Oil / Oil sheen Soap
- Paint Flotables (toilet paper, etc.)
- Algae Dead fish
- Cloudy Flow -----> Precipitation in
- Anti-freeze last 48-hours? Yes / No
- Yard waste Other _____

Odor

- Sewage Sulfide ("rotten egg") Gas/oil
- None Other (describe) _____

Narrative description/comments of problem

KCI field crews observed no evidence of trash dumped into structure 16374. KCI did observe trash along the curb throughout the neighborhood.

Plan of Action (check all that apply)

- Sample Contact DNREC Contact NPDES Manager
- Photos Door hangers GPS Coordinates
- Other (describe)

Follow-up Action

No further action required.



MEMORANDUM

TO: Randy Cole
Marianne Walch, PhD
DelDOT Stormwater Quality Program

FROM: Ryan Coleman

DATE: April 12, 2010

SUBJECT: Agreement 1495 / KCI Project 0203019G
**Minquadale East PID – 920 Hazeldell Avenue
Structure ID #16374**

The purpose of this Memorandum is to summarize the investigation of a potential illicit discharge (PID) in the community of Minquadale East, located at 920 Hazeldell Avenue.

The DelDOT Stormwater Quality Program contacted KCI to investigate a possible PID at 920 Hazeldell Avenue in Minquadale East. The complaint was made by the resident at 927 Hazeldell Avenue, who reported that the neighbor was dumping trash into a catch basin.

The Agreement 1495 KCI field crew inspected the area on Wednesday April 7, 2010 and noticed trash lying along the curb (**Photo 1**). There was no evidence of trash being dumped in any of the catch basins near 920 Hazeldell Avenue (**Photo 2**). The catch basins appeared to be particularly clean for the amount of trash lying along the street.

Given that there are no signs of trash being dumped into the drainage system, KCI recommends that no further action be taken with this PID. It is recommended that this location is periodically checked to ensure that illicit dumping has not taken place.



Photo 1
Curb

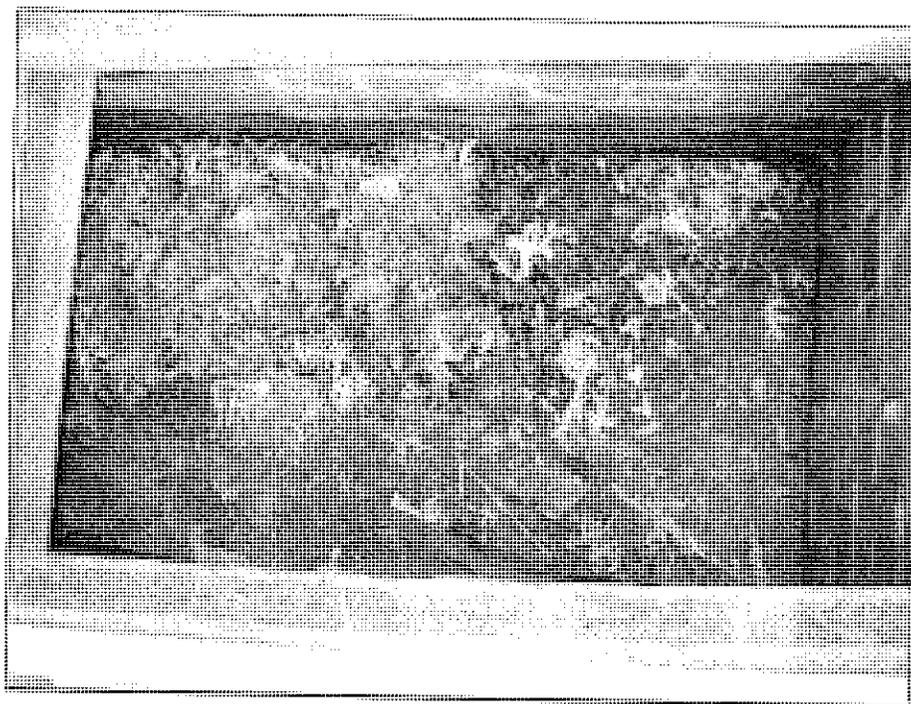


Photo 2
Catch Basin

Minquadale East PID





**NPDES
Inventory Map**
1:1,500



<ul style="list-style-type: none"> ● INLET ○ MANHOLE ○ OUTFALL ■ RISER 	<ul style="list-style-type: none"> □ CULVERT ◇ SWALE END ■ JUNCTION BOX ■ DUMMY NODE 	<ul style="list-style-type: none"> ◇ SWALE VERTEX — Ditch — Pipe — Hydraulic Connection 	<ul style="list-style-type: none"> ■ Bay Sever ■ Biofiltration ■ Biofiltration & Biotretention ■ Biotretention ■ Dry Pond 	<ul style="list-style-type: none"> ■ Filter Strip ■ Infiltration Basin / Trench ■ Sand Filter ■ Sediment Forebay ■ Storm Filter 	<ul style="list-style-type: none"> ■ Wet Pond / Wetland
--	--	---	--	--	--

No action required

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 71994
2004 Carol Drive
East Burn Acres

Illicit Discharge Incident Tracking Sheet

Date: 4/6/10 **Logged by:** 1354 Crew **Contact #:** KCI **Incident ID:** 2-010-047

Caller contact information: 1354 Inspection Crew Subdivision: East Burn Acres
 County: New Castle
 ADC Map No./Grid: 11 G3

Incident Location

Primary Location Description

- | | | |
|--|-------------------------------------|--|
| <input type="checkbox"/> Storm drain | <input type="checkbox"/> Outfall | <input checked="" type="checkbox"/> Other <u>Roadway, leading to catch basin</u> |
| <input type="checkbox"/> In stream | <input type="checkbox"/> Along bank | |
| <input type="checkbox"/> Stormwater pond | <input type="checkbox"/> Upland | |

Outfall / inlet ID# : 71994

Closest street address: 2004 Carol Drive

Watershed name: White Clay Creek Impacted Stream name: White Clay Creek

Nearby landmark: Intersection of Meadowood Drive and Kirkwood HWY

Narrative description of location

This PID is located in East Burn Acres off of Kirkwood Highway. The oil stains are located in front of the residence located at 2004 Carol Drive. There is a second stain, which is not as major, located up the street at 2010 Carol Drive.

Description of problem

Visual

- | | |
|---|---|
| <input checked="" type="checkbox"/> Oil / Oil sheen | <input type="checkbox"/> Soap |
| <input type="checkbox"/> Paint | <input type="checkbox"/> Flotables (toilet paper, etc.) |
| <input type="checkbox"/> Algae | <input type="checkbox"/> Dead fish |
| <input type="checkbox"/> Cloudy | <input type="checkbox"/> Flow -----> Precipitation in last 48-hours? Yes / No |
| <input type="checkbox"/> Anti-freeze | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Yard waste | |

Odor

- | | | |
|--|---|----------------------------------|
| <input type="checkbox"/> Sewage | <input type="checkbox"/> Sulfide ("rotten egg") | <input type="checkbox"/> Gas/oil |
| <input checked="" type="checkbox"/> None | <input type="checkbox"/> Other (describe) _____ | |

Narrative description/comments of problem

During 1354 Re-inspections the crew noticed motor oil on the roadway near a catch basin. The stain was large and had different degrees of drying, pointing out that this was not a one time accident, but a persistent problem. A vehicle parked near the stains appeared to be leaking oil.

Plan of Action (check all that apply)

- | | | |
|--|--|---|
| <input type="checkbox"/> Sample | <input type="checkbox"/> Contact DNREC | <input checked="" type="checkbox"/> Contact NPDES Manager |
| <input checked="" type="checkbox"/> Photos | <input checked="" type="checkbox"/> Door hangers | <input checked="" type="checkbox"/> GPS Coordinates |
| <input type="checkbox"/> Other (describe) | | |

Follow-up Action

KCI plans to distribute doorhangers, then conduct a follow-up visit to the site in the future to ensure there is no fresh signs of oil.



MEMORANDUM

TO: KCI Files

FROM: Ryan Coleman

DATE: April 9, 2010

SUBJECT: East Burn Acres, 2004 Carol Drive
Catch Basin No. 71994
Agreement 1495 / KCI Project 0203019G

The purpose of this Memo is to summarize the investigation of an illicit discharge in East Burn Acres at 2004 Carol Drive.

While performing Agreement 1354 Re-inspections, a KCI field crew came across a potential illicit discharge (PID) on the roadway at 2004 Carol Drive in East Burn Acres. The crew noticed a large amount of motor oil on the roadway that appeared to be leaking from a parked car. The PID was reported to the Agreement 1495 KCI field crew responsible for investigating PIDs.

Upon inspection of the PID on April 7, 2010 it was confirmed that there was a vehicle parked along the street that was leaking a considerable amount of oil. Pictures were taken of the PID and the catch basins in the area were examined to insure no direct dumping of oil was taking place. The catch basins in the area of the oil patch appear to have no oil in them.

KCI plans to do a follow up investigation of the site to verify all dumping of pollutants has ceased.

No action was taken per DelDOT. It was determined during a regular status meeting that this PID could not be linked to a specific individual and was not considered to be direct dumping into the storm system.

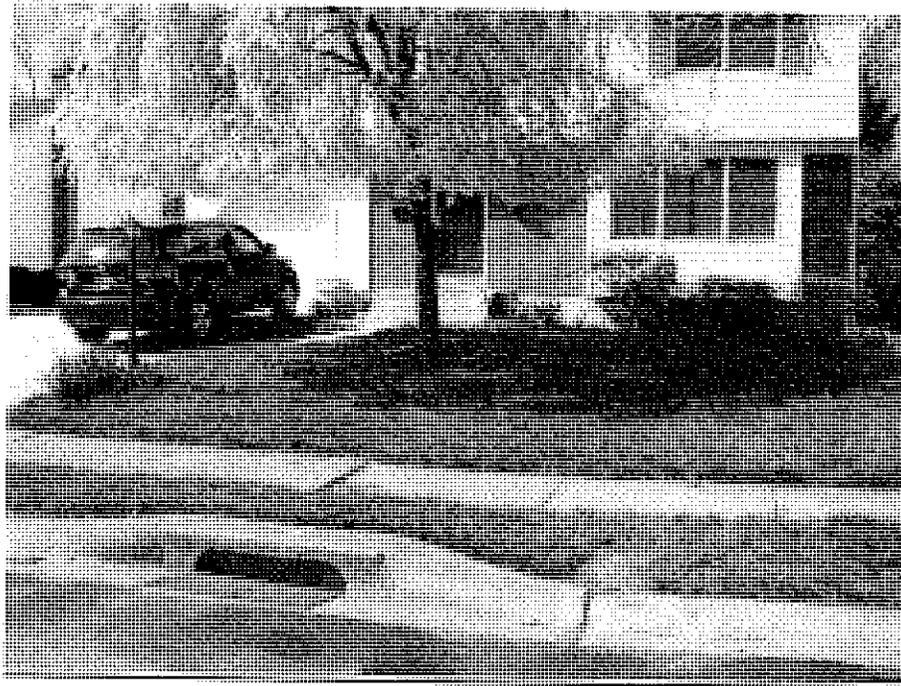
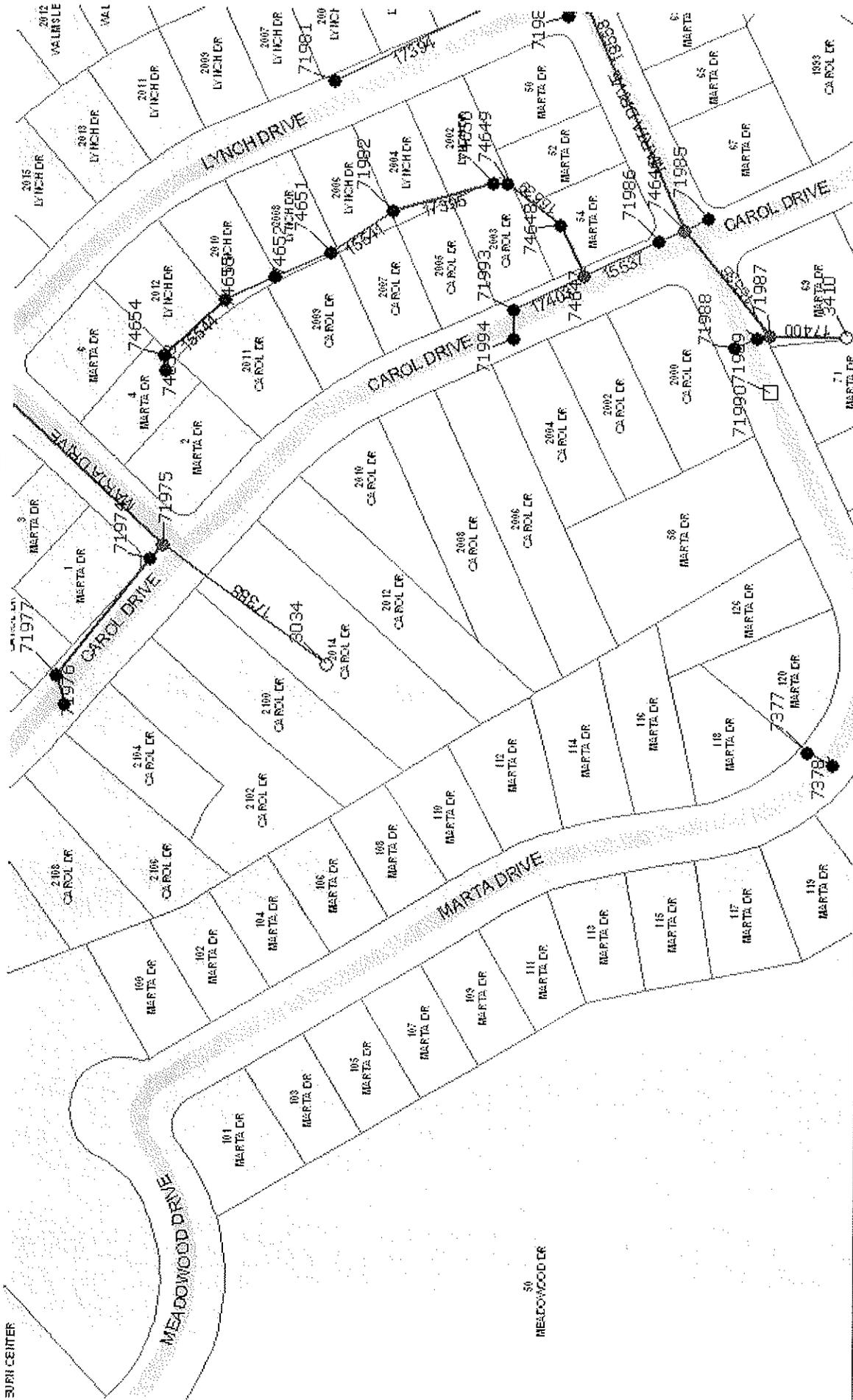


Figure 1. Landscape



Figure 2. Oil Stain

East Burn Acres PID





**NPDES
Inventory Map**
1:1,500

	INLET		SWALE VERTEX
	MANHOLE		Ditch
	OUTFALL		Pipe
	RISER		Hydraulic Connection
	CULVERT		Bay Saver
	SWALE END		Biofiltration
	JUNCTION BOX		Biofiltration & Bioretention
	DUMMY NODE		Bioretention
			Dry Pond
			Filter Strip
			Infiltration Basin / Trench
			Sand Filter
			Sediment Forebay
			Wet Pond / Wetland

Stormwater Pollution Found in Your Area!

This is not a citation.

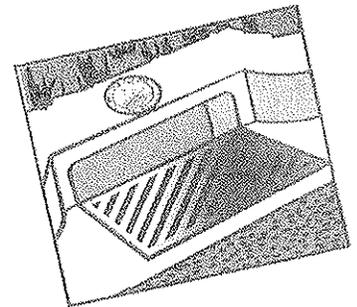
Date: _____

This is to inform you that our staff found the following illegal pollutants in the storm sewer system in your neighborhood.



It is illegal to put any of these items in the storm drain, punishable by a minimum \$1000 fine:

- Motor oil/filters
- Antifreeze/transmission fluid
- Paint
- Solvent/degreaser
- Cooking grease
- Detergent
- Home improvement waste (concrete, mortar)
- Pet waste
- Yard waste (leaves, grass, mulch)
- Excessive dirt and gravel
- Trash
- Pesticides and fertilizers
- Other _____



The pollutants were found at:
2000 Block Carol Drive
East Burn Acres

This storm sewer leads directly to:
White Clay Creek



Delaware Department
of Transportation

If you have any information regarding this or any other illegal discharge of pollutants, please call:
1-800-652-5600
dotpr@state.de.us

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 2684
117 Phyllis Drive
Newkirk Estates

Illicit Discharge Incident Tracking Sheet

Date: 4/7/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: 1354 Field Crew Subdivision: Newkirk Estates
County: New Castle
ADC Map No./Grid: 11-D5

Incident Location

Primary Location Description
 Storm drain Outfall Other
 In Stream Along bank
 Stormwater Pond Upland

Outfall / inlet ID# : 2684

Closest street address: 117 Phyllis Drive

Watershed name: White Clay Creek Impacted Stream name:

Nearby landmark:

Narrative description of location

Description of problem

Visual

- Oil / Oil sheen
- Soap
- Paint
- Flotables (toilet paper, etc.)
- Algae
- Dead fish
- Cloudy
- Flow -----> Precipitation in
- Anti-freeze
- last 48-hours? Yes / No
- Yard waste
- Other _____

Odor

- Sewage
- Sulfide ("rotten egg")
- Gas/oil
- None
- Other (describe) _____

Narrative description/comments of problem

KCI field crews observed a drain hose in Structure 74285 upstream of outfall. No active flow was observed from the hose or at Structure 2684.

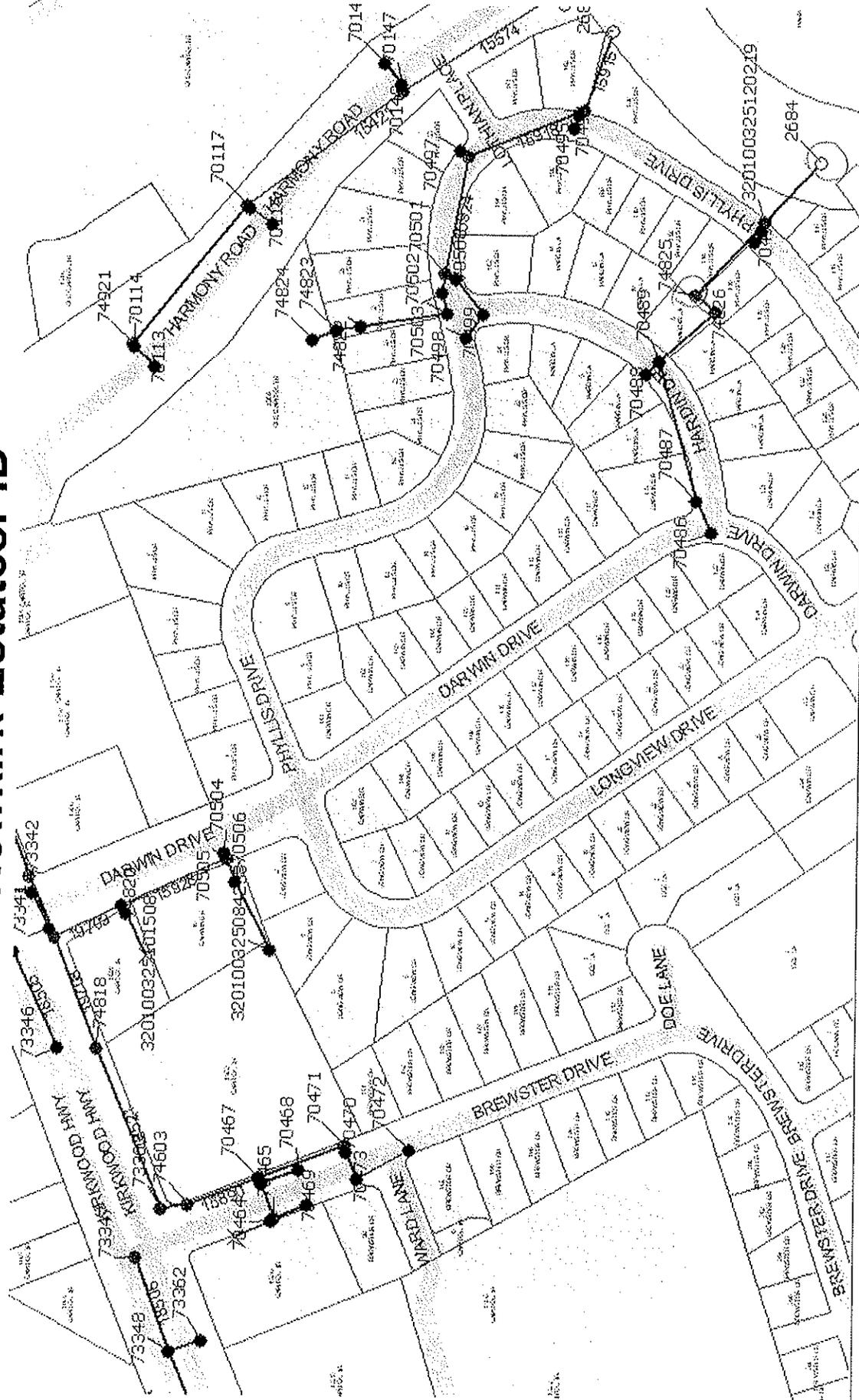
Plan of Action (check all that apply)

- Sample
- Contact DNREC
- Contact NPDES Manager
- Photos
- Door hangers
- GPS Coordinates
- Other (describe)

Follow-up Action

No further action required.

Newkirk EstatesPID





**NPDES
Inventory Map**
1:2,500



<ul style="list-style-type: none"> ● INLET ○ MANHOLE ○ OUTFALL ○ RISER □ CULVERT ◇ SWALE END ■ JUNCTION BOX ■ DUMMY NODE 	<ul style="list-style-type: none"> ◇ SWALE VERTEX — Ditch — Pipe — Hydraulic Connection 	<ul style="list-style-type: none"> ■ Bay Saver ■ Biofiltration ■ Biofiltration & Bioretention ■ Bioretention ■ Dry Pond 	<ul style="list-style-type: none"> ■ Filter Strip ■ Infiltration Basin / Trench ■ Sand Filter ■ Sediment Forebay ■ Storm Filter ■ Wet Pond / Wetland
--	---	--	--

Flow from Swimming Pool, No flow upon investigation

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 1364
Old Ogletown Road
Chestnut Hill Estates

Illicit Discharge Incident Tracking Sheet

Date: 6/2/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: 1354 Field Crew
Subdivision: Chestnut Hill Estates
County: New Castle
ADC Map No./Grid: 11-C8

Incident Location

Primary Location Description
 Storm drain Outfall Other
 In Stream Along bank
 Stormwater Pond Upland

Outfall / inlet ID# : 1364

Closest street address: Old Ogletown Road

Watershed name: White Clay Creek Impacted Stream name:

Nearby landmark:

Narrative description of location

Roadway outfall along Old Ogletown Road by Chestnut Hill Estates.

Description of problem

Visual
 Oil / Oil sheen Soap
 Paint Flotables (toilet paper, etc.)
 Algae Dead fish
 Cloudy Flow -----> Precipitation in
 Anti-freeze last 48-hours? Yes / No
 Yard waste Other _____

Odor
 Sewage Sulfide ("rotten egg") Gas/oil
 None Other (describe) _____

Narrative description/comments of problem

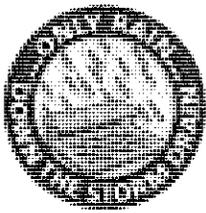
KCI field crews observed dry weather flow.

Plan of Action (check all that apply)

Sample Contact DNREC Contact NPDES Manager
 Photos Door hangers GPS Coordinates
 Other (describe)

Follow-up Action

Sample tested within acceptable parameter levels. No further action required.



**DELDOT AGREEMENT 1495
POTENTIAL ILLICIT DISCHARGE FIELD DATA SHEET**



Structure/Outfall ID Number: 1364

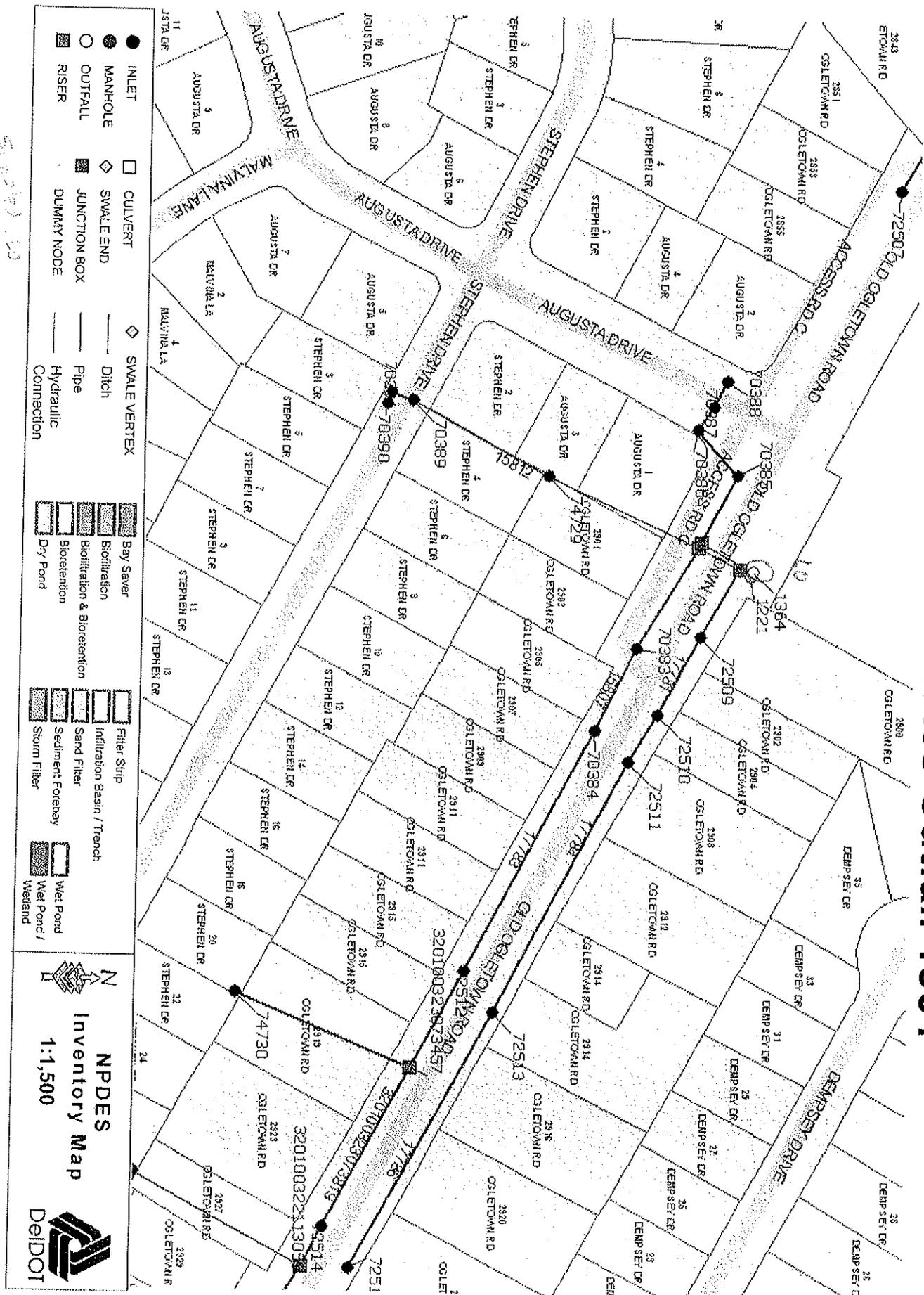
Address/Location Description: Chestnut Hill Estates Old Ogletown Rd.

Outfall Data	
Digital picture? (Y/N):	Y
Camera Number:	ES-1
Picture Number:	
Personnel:	RC, RB
Date (MM/DD/YY):	6/2/10
Time:	9 am
Date of Last Rain >0.10" (MM/DD/YY):	
Follow Up Screen Date (MM/DD/YY):	
Follow Up Field Screen Time:	
Outfall Dimensions (in):	
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	
Outfall Type (CMP, RCP, PVC, Other):	
Flow Observed? (Y/N):	
Follow Up Flow Observed? (Y/N):	
Flow Source	
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	N
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	N
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	N
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	N
Algae Growth? (Y/N):	N
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	N
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	R
Specific Land Use:	

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4				
Water Temperature (Fahrenheit):		75			
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	7.56			
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0			
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0			
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	0.3			
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0			
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; >3.0 mg/L=4	0.5			
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	4.61			
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	C			
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	N			

FIELD SKETCH

Chestnut Hill Estates Outfall 1364



OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 2256
715 Woodsdale Drive
Bellevue Manor

Illicit Discharge Incident Tracking Sheet

Date: 6/2/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: 1354 Field Crew
Subdivision: Bellevue Manor
County: New Castle
ADC Map No./Grid: 9-E4

Incident Location

Primary Location Description

- Storm drain Outfall Other
 In Stream Along bank
 Stormwater Pond Upland

Outfall / inlet ID#: 2256

Closest street address: 715 Woodsdale Drive

Watershed name: Naamans Creek Impacted Stream name:

Nearby landmark:

Narrative description of location

Description of problem

Visual

- Oil / Oil sheen Soap
 Paint Flotables (toilet paper, etc.)
 Algae Dead fish
 Cloudy Flow -----> Precipitation in
 Anti-freeze last 48-hours? Yes / No
 Yard waste Other _____

Odor

- Sewage Sulfide ("rotten egg") Gas/oil
 None Other (describe) _____

Narrative description/comments of problem

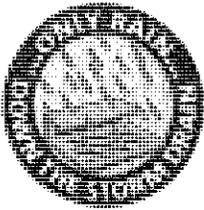
KCI field crews observed dry weather flow.

Plan of Action (check all that apply)

- Sample Contact DNREC Contact NPDES Manager
 Photos Door hangers GPS Coordinates
 Other (describe)

Follow-up Action

Sample tested within acceptable parameter levels. No further action required.



**DELDOT AGREEMENT 1495
POTENTIAL ILLICIT DISCHARGE FIELD DATA SHEET**



Structure/Outfall ID Number: 2256

Address/Location Description: Bellevue Manor, Woodsdale Dr 715

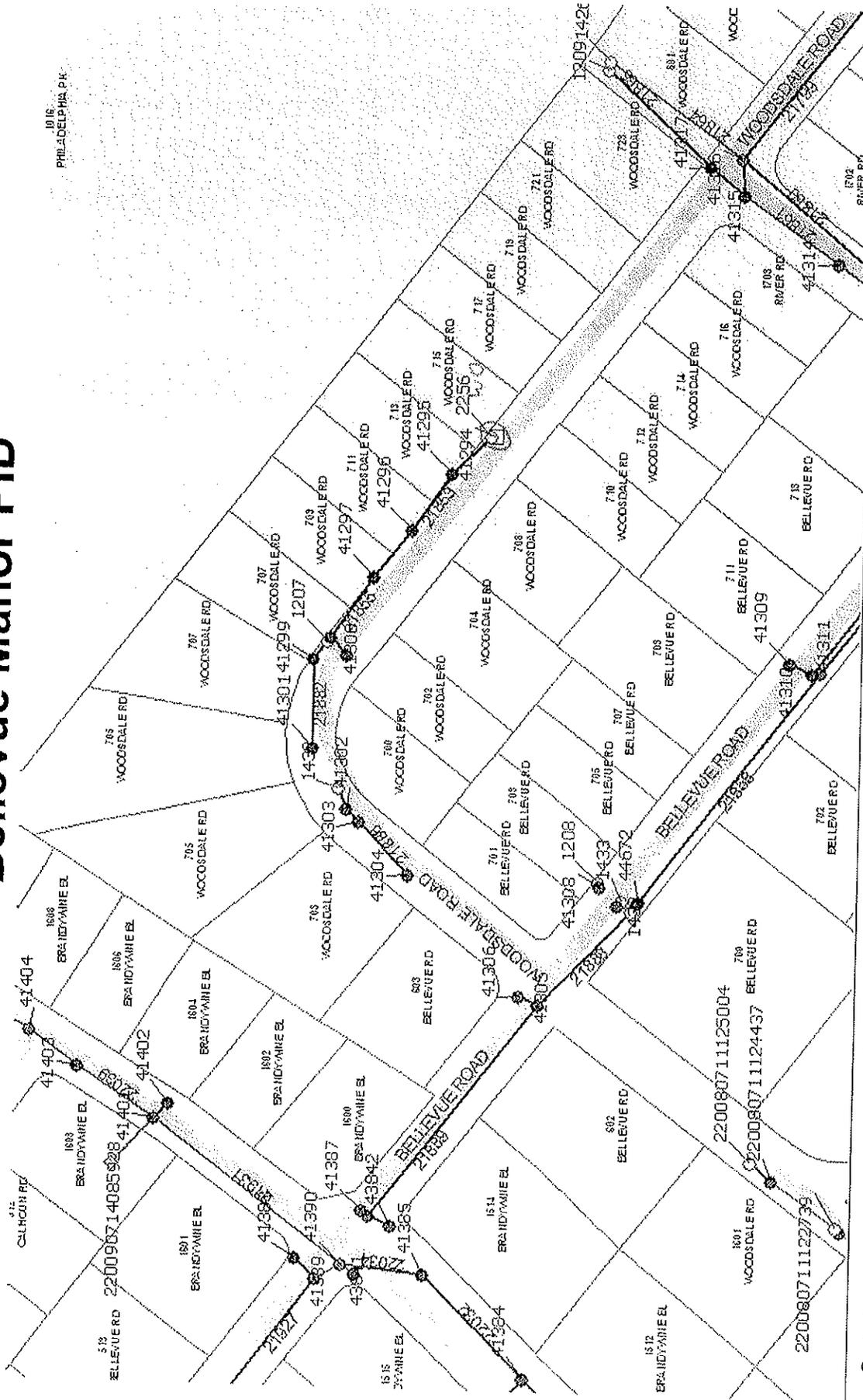
Outfall Data	
Digital picture? (Y/N):	Y
Camera Number:	ES-1
Picture Number:	
Personnel:	RC, BB
Date (MM/DD/YY):	6/2/10
Time:	9:30 am
Date of Last Rain >0.10" (MM/DD/YY):	
Follow Up Screen Date (MM/DD/YY):	
Follow Up Field Screen Time:	
Outfall Dimensions (in):	
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	
Outfall Type (CMP, RCP, PVC, Other):	
Flow Observed? (Y/N):	Y
Follow Up Flow Observed? (Y/N):	
Flow Source	
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	N
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	N
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	N
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	N
Algae Growth? (Y/N):	N
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	N
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	R
Specific Land Use:	

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4				
Water Temperature (Farenheit):		75			
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	7.86			
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0			
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0			
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	0.1			
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0			
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; >3.0 mg/L=4	0.1			
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	6.5			
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)				
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)				

FIELD SKETCH

Bellevue Manor PID

1016
PHILADELPHIA PK.



NPDES
Inventory Map
1:1,500



	INLET		SWALE VERTEX
	MANHOLE		Ditch
	CULVERT		Pipe
	SWALE END		Hydraulic Connection
	JUNCTION BOX		Bay Saver
	RISER		Biofiltration
	DUMMY NODE		Biofiltration & Bioretention
	Dry Pond		Bioretention
	Filter Strip		Storm Filter
	Infiltration Basin / Trench		Sediment Forebay
	Sand Filter		Wet Pond / Wetland

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 95458
2566 Red Lion Road

Illicit Discharge Incident Tracking Sheet

Date: 6/18/2010 **Logged by:** Matt Ortynsky **Contact #:** 302-731-9176 **Incident ID:**

Caller contact information:	Resident/DeIDOT	Subdivision: None
		County: New Castle
		ADC Map No./Grid: 18-D2

Incident Location

Primary Location Description

<input checked="" type="checkbox"/> Storm drain	<input type="checkbox"/> Outfall	<input type="checkbox"/> Other
<input type="checkbox"/> In Stream	<input type="checkbox"/> Along bank	
<input type="checkbox"/> Stormwater Pond	<input type="checkbox"/> Upland	

Outfall / inlet ID# : 95458

Closest street address: 2566 Red Lion Road

Watershed name: C & D Canal East Impacted Stream name:

Nearby landmark:

Narrative description of location

The storm drain is located in front of 2534 Red Lion Road.

Description of problem

Visual

- | | |
|--|---|
| <input type="checkbox"/> Oil / Oil sheen | <input type="checkbox"/> Soap |
| <input type="checkbox"/> Paint | <input checked="" type="checkbox"/> Flotables (toilet paper, etc.) |
| <input type="checkbox"/> Algae | <input type="checkbox"/> Dead fish |
| <input type="checkbox"/> Cloudy | <input checked="" type="checkbox"/> Flow -----> Precipitation in last 48-hours? Yes / No |
| <input type="checkbox"/> Anti-freeze | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Yard waste | |

Odor

- | | | |
|--|---|----------------------------------|
| <input checked="" type="checkbox"/> Sewage | <input type="checkbox"/> Sulfide ("rotten egg") | <input type="checkbox"/> Gas/oil |
| <input type="checkbox"/> None | <input type="checkbox"/> Other (describe) _____ | |

Narrative description/comments of problem

6/18/10 - KCI field crews observed active dry weather flow and took a sample to be tested. The sample tested above recordable limits for Detergents and only had moderate Ammonia levels. KCI field crews made plans to re-visit the location with the camera on a stick for further investigation. 6/23/10 - KCI
 field crews found no illicit connections however a 3" PVC pipe was noticed in the wall of the catch basin at the time of inspection which could be the source of the illicit flow. Prior inspection information from URS was checked and an illicit connection was noted during their inspection that showed obvious flow with soap suds. KCI is not certain which property the pipe connects to, but it is believed to be coming from the residence at 2572 Red Lion Road.

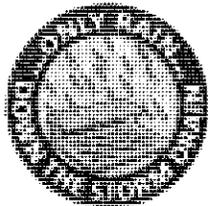
Plan of Action (check all that apply)

- | | | |
|--|---|---|
| <input checked="" type="checkbox"/> Sample | <input checked="" type="checkbox"/> Contact DNREC | <input checked="" type="checkbox"/> Contact NPDES Manager |
| <input checked="" type="checkbox"/> Photos | <input type="checkbox"/> Door hangers | <input type="checkbox"/> GPS Coordinates |

Other (describe) KCI notified Tom Wyatt of the KCI Newark office who has a contract with the New Castle County for eye testing sanitary flow. Tom will talk to the county about dye testing at this location.

Follow-up Action

Referred to DNREC by DeIDOT. DNREC capped illegal hook up after finding dye in pipe. Warrants pending for homeowners arrest.



DELDOT AGREEMENT 1495
POTENTIAL ILLICIT DISCHARGE FIELD DATA SHEET



Structure/Outfall ID Number: 95458

Address/Location Description: 2566 Red Lion Rd

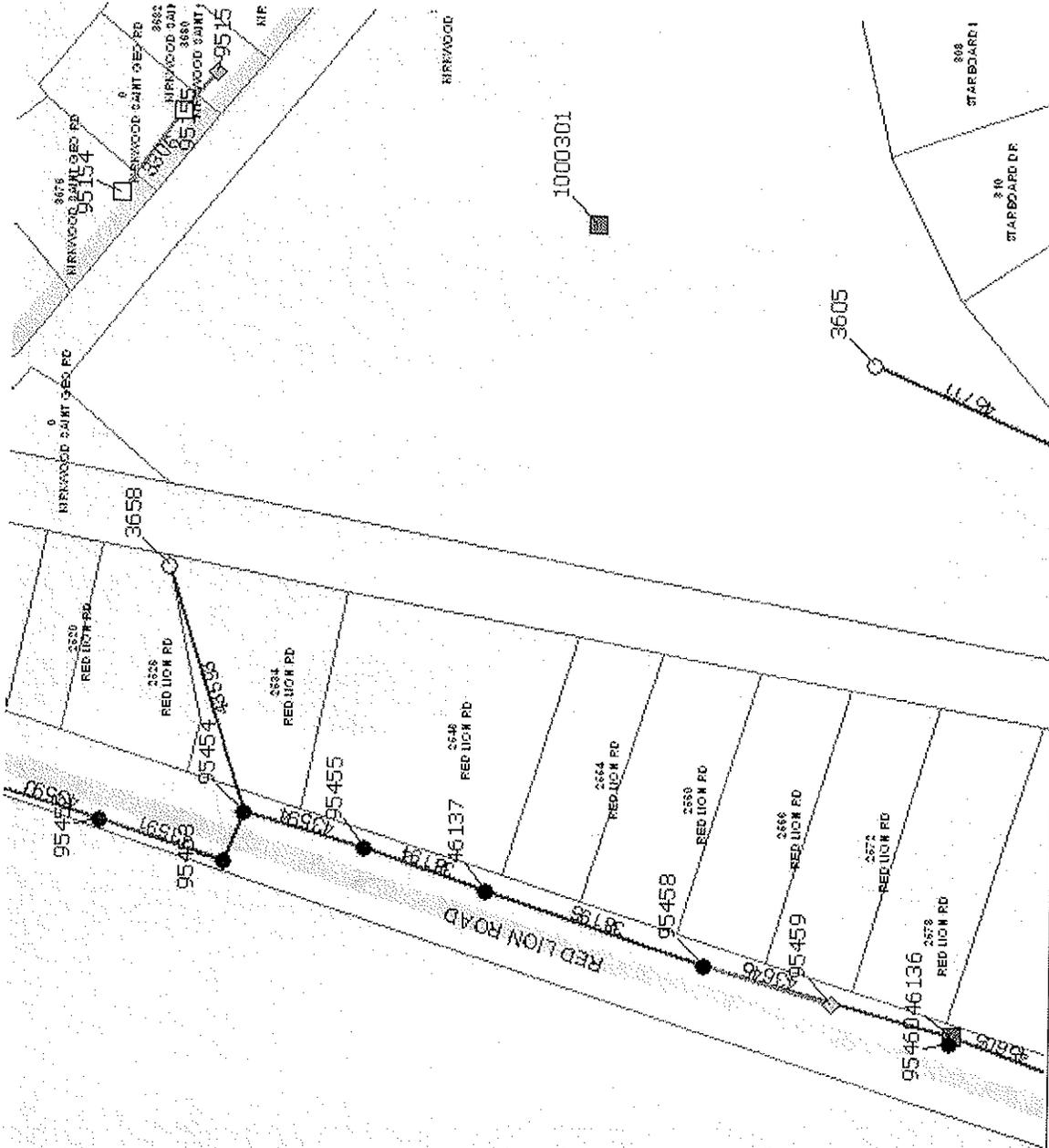
Outfall Data	
Digital picture? (Y/N):	Yes
Camera Number:	ES1
Picture Number:	
Personnel:	RL, RT
Date (MM/DD/YY):	6/18/10
Time:	8:00 am
Date of Last Rain >0.10" (MM/DD/YY):	
Follow Up Screen Date (MM/DD/YY):	
Follow Up Field Screen Time:	
Outfall Dimensions (in):	
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	
Outfall Type (CMP, RCP, PVC, Other):	
Flow Observed? (Y/N):	
Follow Up Flow Observed? (Y/N):	
Flow Source	
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	N
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	N
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	Sewage
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	N
Algae Growth? (Y/N):	N
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	N
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	R
Specific Land Use:	

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4	—	—		
Water Temperature (Fahrenheit):		72.6			
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	6.98			
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0			
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4				
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	71.3	4		
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0			
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; ≥3.0 mg/L=4	1.0	1		
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	24.71	1		
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	C	0		
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	S Toilet Paper	4		

FIELD SKETCH

Upon arrival on site the catch basin had significant flow. The flow quickly stopped making it impossible to trace origin. Sample was collected along with site.

Red Lion Road PID



NPDES
Inventory Map
1:1,500

3605

3600

STARBOARD I

STARBOARD D.F.

1000301

BIRKWOOD

3676 HIRWOOD CHANT OBEY RD 95154

3682 HIRWOOD CHANT OBEY RD 95155

3680 HIRWOOD CHANT OBEY RD 95156

3678 HIRWOOD CHANT OBEY RD 95157

3674 HIRWOOD CHANT OBEY RD 95158

3672 HIRWOOD CHANT OBEY RD 95159

3670 HIRWOOD CHANT OBEY RD 95160

3668 HIRWOOD CHANT OBEY RD 95161

3666 HIRWOOD CHANT OBEY RD 95162

3664 HIRWOOD CHANT OBEY RD 95163

3662 HIRWOOD CHANT OBEY RD 95164

3660 HIRWOOD CHANT OBEY RD 95165

3658 HIRWOOD CHANT OBEY RD 95166

3656 HIRWOOD CHANT OBEY RD 95167

3654 HIRWOOD CHANT OBEY RD 95168

3652 HIRWOOD CHANT OBEY RD 95169

3650 HIRWOOD CHANT OBEY RD 95170

3648 HIRWOOD CHANT OBEY RD 95171

3646 HIRWOOD CHANT OBEY RD 95172

3644 HIRWOOD CHANT OBEY RD 95173

3642 HIRWOOD CHANT OBEY RD 95174

3640 HIRWOOD CHANT OBEY RD 95175

3638 HIRWOOD CHANT OBEY RD 95176

3636 HIRWOOD CHANT OBEY RD 95177

3634 HIRWOOD CHANT OBEY RD 95178

3632 HIRWOOD CHANT OBEY RD 95179

3630 HIRWOOD CHANT OBEY RD 95180

3628 HIRWOOD CHANT OBEY RD 95181

3626 HIRWOOD CHANT OBEY RD 95182

3624 HIRWOOD CHANT OBEY RD 95183

3622 HIRWOOD CHANT OBEY RD 95184

3620 HIRWOOD CHANT OBEY RD 95185

3618 HIRWOOD CHANT OBEY RD 95186

3616 HIRWOOD CHANT OBEY RD 95187

3614 HIRWOOD CHANT OBEY RD 95188

3612 HIRWOOD CHANT OBEY RD 95189

3610 HIRWOOD CHANT OBEY RD 95190

3608 HIRWOOD CHANT OBEY RD 95191

3606 HIRWOOD CHANT OBEY RD 95192

3604 HIRWOOD CHANT OBEY RD 95193

3602 HIRWOOD CHANT OBEY RD 95194

3600 HIRWOOD CHANT OBEY RD 95195

●	INLET	◇	SWALE VERT	■	Bay Saver	▨	Filter Strip	▨	Wet Pond / Wetland
○	MANHOLE	—	Ditch	▨	Biofiltration	▨	Infiltration Basin / Trench	▨	Wet Pond
○	CULVERT	—	Pipe	▨	Biofiltration & Bioretention	▨	Sand Filter	▨	Wetland
○	SWALE END	—	Hydraulic Connection	▨	Bioretention	▨	Sediment Forebay	▨	
○	JUNCTION BOX	—		▨	Dry Pond	▨	Storm Filter	▨	
○	RISER	—		▨		▨		▨	
○	DUMMY NODE	—		▨		▨		▨	



MEMORANDUM

TO: Randy Cole
Marianne Walch, PhD
DelDOT Stormwater Quality Program

FROM: Ryan Coleman

DATE: June 23, 2010

SUBJECT: Agreement 1495 / KCI Project 0203019G
Red Lion Road PID
Structure ID # 95458

The purpose of this Memorandum is to summarize the investigation of a potential illicit discharge (PID) along Red Lion Road, at catch basin #95458 in New Castle County.

KCI Technologies was contacted by Randy Cole with a complaint he received about a possible illegal sewage connection to the storm drain system along Red Lion Road. KCI field personnel visited the site on Friday June 18, 2010 to investigate the complaint. Upon arrival on site the crew was met by the resident who made the complaint. He pointed out active flow in the catch basin in front of his property at 2534 Red Lion Road and stated that he has seen fecal matter floating in the catch basin. It was noticed that the flow quickly diminished pointing out that it was not a continuous flow source.

The field crew noticed an odor that could have possibly been sewage related and saw what appeared to be toilet paper in the catch basin. The KCI crew inspected the outfall (#3658) and the catch basins leading to that outfall. A sample of the flow was collected from catch basin #95454 to be tested and plans were made to re-visit the site with the camera-on-a-stick to check the pipes for illicit connections. The sample tested above recordable limits for Detergents and only had moderate Ammonia levels that did not test above limits.

KCI field personnel re-visited the PID on Wednesday June 23, 2010 to inspect the pipes for illicit connections. No illicit connections were found in the pipes during the inspection. A 3 inch PVC pipe was noticed in the wall of catch basin #95458 (**Figure 1**) which could be the source of the illicit flow. Prior inspection information from URS was checked on the DelDOT NPDES Viewer and this illicit connection was noted during their inspection. The pictures from the inspection showed obvious flow with soap suds (**Figure 2**). KCI is not certain which property the pipe connects to, but it is believed to be coming from the residence at 2572 Red Lion Road.

KCI believes that this is an illegal connection because of the evidence found. It is unclear whether sewage is being discharged because of low Ammonia levels but there is a possibility because of the smell and what appeared to be toilet paper in the catch basin. KCI notified Tom Wyatt of KCI Newark office who has contract with the New Castle County for dye testing sanitary flow. Tom will talk to the county about dye testing at this location.



Figure 1. Illicit Connection

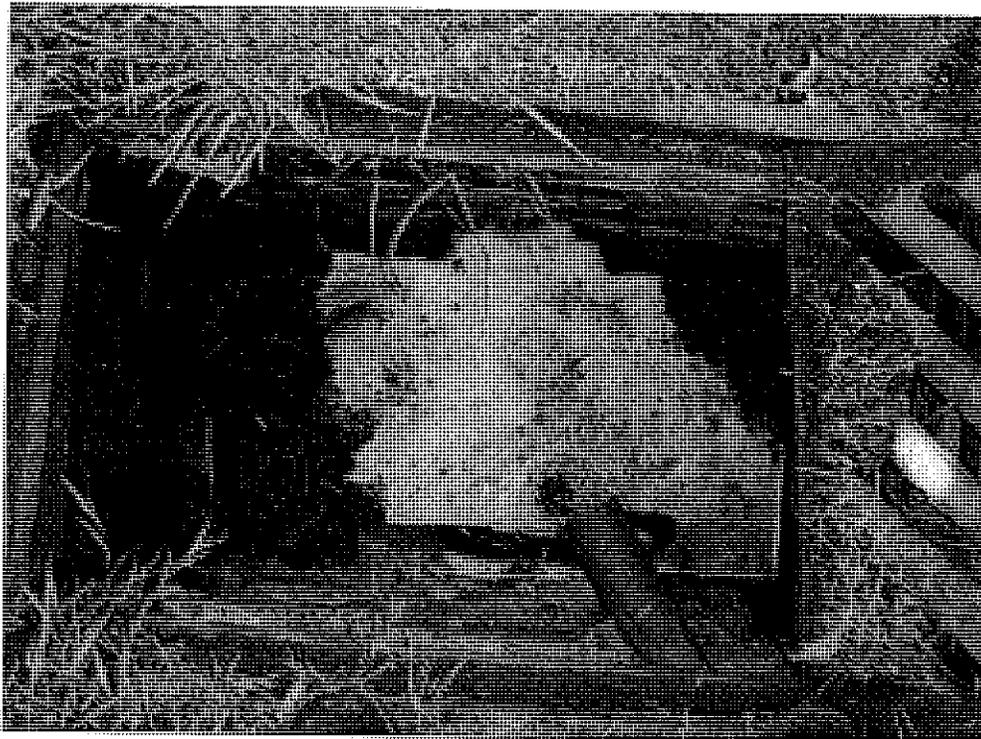


Figure 2. Illicit Flow

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structures 77010, 77011
Casho Mill Road/Julie Lane

Illicit Discharge Incident Tracking Sheet

Date: 8/3/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: City of Newark/DeIDOT
Subdivision: None
County: New Castle
ADC Map No./Grid: 10-C9

Incident Location

Primary Location Description

- | | | |
|---|-------------------------------------|--------------------------------|
| <input checked="" type="checkbox"/> Storm drain | <input type="checkbox"/> Outfall | <input type="checkbox"/> Other |
| <input type="checkbox"/> In Stream | <input type="checkbox"/> Along bank | |
| <input type="checkbox"/> Stormwater Pond | <input type="checkbox"/> Upland | |

Outfall / inlet ID#: 77010 & 77011

Closest street address: 1118 & 1100 Blair Court

Watershed name: Christina River Impacted Stream name:

Nearby landmark:

Narrative description of location

The two catch basins are located at the intersection of Julie Lane and Casho Mill Road.

Description of problem

Visual

- | | |
|--|--|
| <input type="checkbox"/> Oil / Oil sheen | <input type="checkbox"/> Soap |
| <input type="checkbox"/> Paint | <input type="checkbox"/> Flotables (toilet paper, etc.) |
| <input type="checkbox"/> Algae | <input type="checkbox"/> Dead fish |
| <input type="checkbox"/> Cloudy | <input type="checkbox"/> Flow -----> Precipitation in |
| <input type="checkbox"/> Anti-freeze | last 48-hours? Yes / No |
| <input type="checkbox"/> Yard waste | <input checked="" type="checkbox"/> Other <u>Hot Mix</u> |

Odor

- | | | |
|--|---|----------------------------------|
| <input type="checkbox"/> Sewage | <input type="checkbox"/> Sulfide ("rotten egg") | <input type="checkbox"/> Gas/oil |
| <input checked="" type="checkbox"/> None | <input type="checkbox"/> Other (describe) _____ | |

Narrative description/comments of problem

The City of Newark notified DeIDOT of a potential storm sewer blockage due to the placement of leftover hot mix into two catch basins along Casho Mill Road in Newark. KCI field crews observed that catch basin 77010 was filled with hot mix to the point that the catch basin outflow pipe was completely blocked. KCI field crews inspected catch basin 77011 but did not observe any hot mix or pipe blockage in this catch basin.

Plan of Action (check all that apply)

- | | | |
|--|--|--|
| <input type="checkbox"/> Sample | <input type="checkbox"/> Contact DNREC | <input type="checkbox"/> Contact NPDES Manager |
| <input checked="" type="checkbox"/> Photos | <input type="checkbox"/> Door hangers | <input type="checkbox"/> GPS Coordinates |
| <input type="checkbox"/> Other (describe) | | |

Follow-up Action

KCI field crews removed enough hot mix to allow positive flow. No further action required.



MEMORANDUM

TO: Marianne Walch, PhD
DeIDOT NPDES
Stormwater Quality Program

FROM: Bruce Thompson, KCI
Chris Bolton, KCI

DATE: August 5, 2010

SUBJECT: DeIDOT Agr. 1495 / KCI Project No. 0203019H
Casho Mill Road Catch Basins 77010 & 77011
Hot Mix Blockage Inspection
New Castle County

The purpose of this Memo is to summarize the field observations and corrective action that occurred during the inspection of catch basins 77010 and 77011 along Casho Mill Road in New Castle County on August 3, 2010.

The City of Newark notified DeIDOT of a potential storm sewer blockage due to the placement of leftover hot mix into two catch basins along Casho Mill Road in Newark. The two catch basins, numbers 77010 and 77011, are located at the intersection of Julie Lane and Casho Mill Road.

On August 3, 2010, a KCI field crew inspected the two catch basins. Upon inspection, it was observed that catch basin 77010 was filled with hot mix to the point that the catch basin outflow pipe was completely blocked. **See Figure 1.** Catch basin 77011 was also inspected, but KCI did not observe any hot mix or pipe blockage in this catch basin.

KCI removed enough hot mix material from catch basin 77010 to allow positive flow in the storm sewer system, which should alleviate any potential future storm event flooding. However, KCI was not able to remove all the material due to the hot mix compacting and hardening. **See Figure 2.**

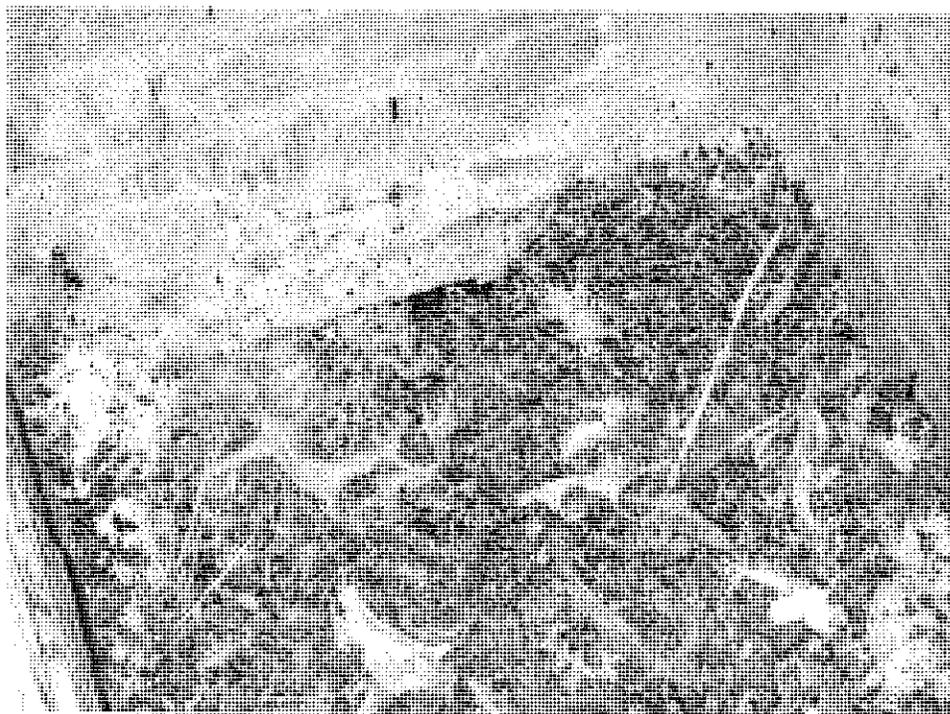


Figure 1 – Hot Mix Pipe Blockage CB 77010 (08/03/10)



Figure 2 – Removed Hot Mix Pipe Blockage (08/03/10)

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 13
404 Wesley Circle
Lambeth Riding

Illicit Discharge Incident Tracking Sheet

Date: 8/31/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: 1354 Field Crew
Subdivision: Lambeth Riding
County: New Castle
ADC Map No./Grid: 6-A6

Incident Location

Primary Location Description

- Storm drain Outfall Other
 In Stream Along bank
 Stormwater Pond Upland

Outfall / inlet ID# : 13

Closest street address: 404 Wesley Circle

Watershed name: White Clay Creek Impacted Stream name:

Nearby landmark:

Narrative description of location

Structure 13 is an outfall that is located behind 404 Wesley Circle.

Description of problem

Visual

- Oil / Oil sheen Soap
 Paint Flotables (toilet paper, etc.)
 Algae Dead fish
 Cloudy Flow -----> Precipitation in
 Anti-freeze last 48-hours? Yes / No
 Yard waste Other _____

Odor

- Sewage Sulfide ("rotten egg") Gas/oil
 None Other (describe) _____

Narrative description/comments of problem

Dry weather flow was observed. KCI field crews investigated this issue and found the flow was due to an underground stream outfalling into a creek bed. KCI does not consider this to be a PID and no sample was tested.

Plan of Action (check all that apply)

- Sample Contact DNREC Contact NPDES Manager
 Photos Door hangers GPS Coordinates
 Other (describe)

Follow-up Action

No further action required.



**DELDOT AGREEMENT 1495
POTENTIAL ILLICIT DISCHARGE FIELD DATA SHEET**



Structure/Outfall ID Number: 13

Address/Location Description: Behind 404 Wedg. Cir.

Outfall Data	
Digital picture? (Y/N):	
Camera Number:	4
Picture Number:	
Personnel:	
Date (MM/DD/YY):	08/31/10
Time:	10:00
Date of Last Rain >0.10" (MM/DD/YY):	
Follow Up Screen Date (MM/DD/YY):	
Follow Up Field Screen Time:	
Outfall Dimensions (in):	24"
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	R
Outfall Type (CMP, RCP, PVC, Other):	RCP
Flow Observed? (Y/N):	Y
Follow Up Flow Observed? (Y/N):	Y
Flow Source	groundwater
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	N
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	N
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	N
Algae Growth? (Y/N):	Y
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	N
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	R
Specific Land Use:	Neighborhood

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4	~			
Water Temperature (Fahrenheit):		~			
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	~			
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	~			
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	~			
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	~			
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	~			
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; ≥3.0 mg/L=4	~			
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	~			
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	C			
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	N			

FIELD SKETCH

See Attached Map



MEMORANDUM

TO: KCI Files

FROM: Chris Bolton

DATE: September 1, 2010

SUBJECT: Agreement 1495 / KCI Project 0203019H
Lambeth Riding PID - 504 Lambeth Place - Structure 5143
Lambeth Riding PID - 404 Wesley Circle - Structure 13

The purpose of this Memo is to summarize the investigation of two Potential Illicit Discharges (PIDs) initially discovered by a KCI Agreement 1354 field crew in the Lambeth Riding community in New Castle County on August 31, 2010.

While performing Agreement 1354 Re-inspections, the KCI field crew came across two PIDs at Structure #13 (**Photos 1-2**) and Structure #5143 (**Photos 3-4**). Structure #13 is an outfall located behind a residence at 404 Wesley Circle and Structure #5143 is a catch basin located in front of residence 504 Lambeth Place. The PIDs were reported to the Agreement 1495 KCI field crew responsible for investigating PIDs.

Upon inspection of the Outfall Structure #13, it was determined that the flow was due to an underground stream outfalling into a creek bed, and was therefore not tested for an illicit discharge. KCI does not consider this to be a PID.

The KCI field crew also inspected Catch Basin Structure #5143 and found a small 4 inch PVC pipe protruding into the side wall of the concrete pipe connecting into the catch basin (**Photo 4**). Water was observed flowing from the small PVC pipe and collecting in the catch basin. Field crews could not immediately determine the source of flow. A water sample was obtained and tested. Results indicated that all parameters were within allowable limits.

KCI will periodically re-test this PID in an effort to determine its source prior to concluding that no further action is needed.



Photo 1
Outfall #13

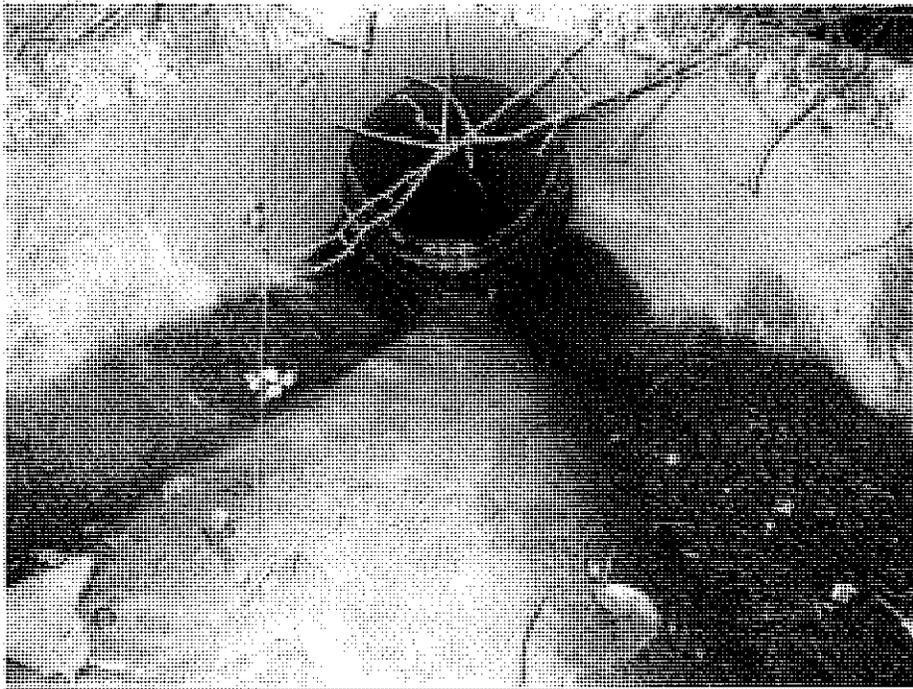


Photo 2
Outfall #13

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure 5143
504 Lambeth Place
Lambeth Riding

Illicit Discharge Incident Tracking Sheet

Date: 8/31/2010 **Logged by:** Matt Ortynsky **Contact #:** 302-731-9176 **Incident ID:**

Caller contact information: 1354 Field Crew	Subdivision: Lambeth Riding
	County: New Castle
	ADC Map No./Grid: 6-A6

Incident Location

Primary Location Description

<input checked="" type="checkbox"/> Storm drain	<input type="checkbox"/> Outfall	<input type="checkbox"/> Other
<input type="checkbox"/> In Stream	<input type="checkbox"/> Along bank	
<input type="checkbox"/> Stormwater Pond	<input type="checkbox"/> Upland	

Outfall / inlet ID#: 5143

Closest street address: 504 Lambeth Place

Watershed name: White Clay Creek Impacted Stream name:

Nearby landmark:

Narrative description of location

Structure 5143 is a catch basin that is located in front of 504 Lambeth Place.

Description of problem

Visual

- | | |
|--|---|
| <input type="checkbox"/> Oil / Oil sheen | <input type="checkbox"/> Soap |
| <input type="checkbox"/> Paint | <input type="checkbox"/> Flotables (toilet paper, etc.) |
| <input type="checkbox"/> Algae | <input type="checkbox"/> Dead fish |
| <input type="checkbox"/> Cloudy | <input checked="" type="checkbox"/> Flow -----> Precipitation in last 48-hours? Yes / No |
| <input type="checkbox"/> Anti-freeze | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Yard waste | |

Odor

- | | | |
|--|---|----------------------------------|
| <input type="checkbox"/> Sewage | <input type="checkbox"/> Sulfide ("rotten egg") | <input type="checkbox"/> Gas/oil |
| <input checked="" type="checkbox"/> None | <input type="checkbox"/> Other (describe) _____ | |

Narrative description/comments of problem

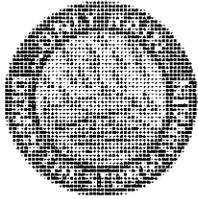
Dry weather flow was observed.

Plan of Action (check all that apply)

- | | | |
|--|--|--|
| <input checked="" type="checkbox"/> Sample | <input type="checkbox"/> Contact DNREC | <input type="checkbox"/> Contact NPDES Manager |
| <input checked="" type="checkbox"/> Photos | <input type="checkbox"/> Door hangers | <input type="checkbox"/> GPS Coordinates |
| <input type="checkbox"/> Other (describe) | | |

Follow-up Action

Samples tested within acceptable parameter levels. KCI will re-visit the site in an effort to determine the source prior to concluding no further action is needed.



**DELDOT AGREEMENT 1495
POTENTIAL ILLICIT DISCHARGE FIELD DATA SHEET**



Structure/Outfall ID Number: 5113

Address/Location Description: 504 Lamberth Pl

Outfall Data	
Digital picture? (Y/N):	Y
Camera Number:	
Picture Number:	
Personnel:	CB/R
Date (MM/DD/YY):	8/31/10
Time:	11:15
Date of Last Rain >0.10" (MM/DD/YY):	
Follow Up Screen Date (MM/DD/YY):	
Follow Up Field Screen Time:	
Outfall Dimensions (in):	Catch basin
Outfall Shape: Round (R), Oval (O), Box (B), V-Ditch (VD), Trap Ditch (TD), Other Ditch (OD)	
Outfall Type (CMP, RCP, PVC, Other):	
Flow Observed? (Y/N):	Standing water
Follow Up Flow Observed? (Y/N):	
Flow Source	possible sump pump
Structural Condition: Normal (N), Concrete Spauling (SP), Peeling Paint (PP), Concrete Cracking (CC), Outfall Damaged (OD), Submerged (S), Metal Corrosion (MC), Other (O-explain)	N
Erosion (Outfall Area): None (N), Moderate (M), Severe (S)	N
Odor: None (N)=0, Rancid-Sour (RS)=4, Gas (G)=4, Sewage (S)=4, Oil (O)=4, Sulfur (S)=4, Other (Other-explain)	N
Deposits / Stains: None (N)=0, Sediment (S)=2, Oil (OY)=3, Other (O-explain)	N
Algae Growth? (Y/N):	N
Vegetative Condition (Outfall Area): Normal (N), Inhibited Growth (IG), Excessive Growth (EG), Other (O-explain)	N/A
Land Use: Industrial (I), Commercial (C), Residential (R), Other (O-explain)	R
Specific Land Use:	Neighborhood

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4	0	0		
Water Temperature (Fahrenheit):		68.7°			
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	6.42			
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0	0		
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0	0		
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	0.4	1		
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0	0		
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; ≥3.0 mg/L=4	0	0		
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	16	0		
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	C			
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	N			

FIELD SKETCH

See attached Map

		Result 1	Val.	Result 2	Val. 2
Flow Rate (cfs):	<0.022 cfs=0; ≥0.022 cfs=4	0	0		
Water Temperature (Fahrenheit):		68.7°			
pH:	<4.5=4; >8.5=4; change ≥ 2 units=1	6.42			
Phenol (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0	0		
Chlorine (mg/L):	<0.3 mg/L=0; ≥0.3 mg/L=4	0	0		
Detergents (mg/L):	<0.2=0; 0.2 - 0.4=1; ≥0.5 mg/L=4	0.4	1		
Copper (mg/L):	<0.01 mg/L=0; ≥0.01 mg/L=4	0	0		
Ammonia (mg/L):	<0.05-0.1 mg/L=0; 0.1-1.0 mg/L=1; 1.0-2.99 mg/L=2; ≥3.0 mg/L=4	0	0		
Turbidity:	0-10 ntu=0; 11-40=1; 41-150=3; >150=4	16	0		
Color:	Clear (C)=0, Gray (G)=1, Red (R)=1, Yellow (Y)=1, Brown (B)=1, Green (GR)=1, Other (O-explain)	C			
Floatables:	None (N)=0, Oil Sheen (OS)=4, Sewage (S)=4, Trash (T)=2, Other (O-explain)	N			

FIELD SKETCH

See attached Map



MEMORANDUM

TO: KCI Files

FROM: Chris Bolton

DATE: September 1, 2010

SUBJECT: Agreement 1495 / KCI Project 0203019H
Lambeth Riding PID - 504 Lambeth Place - Structure 5143
Lambeth Riding PID - 404 Wesley Circle - Structure 13

The purpose of this Memo is to summarize the investigation of two Potential Illicit Discharges (PIDs) initially discovered by a KCI Agreement 1354 field crew in the Lambeth Riding community in New Castle County on August 31, 2010.

While performing Agreement 1354 Re-inspections, the KCI field crew came across two PIDs at Structure #13 (**Photos 1-2**) and Structure #5143 (**Photos 3-4**). Structure #13 is an outfall located behind a residence at 404 Wesley Circle and Structure #5143 is a catch basin located in front of residence 504 Lambeth Place. The PIDs were reported to the Agreement 1495 KCI field crew responsible for investigating PIDs.

Upon inspection of the Outfall Structure #13, it was determined that the flow was due to an underground stream outfalling into a creek bed, and was therefore not tested for an illicit discharge. KCI does not consider this to be a PID.

The KCI field crew also inspected Catch Basin Structure #5143 and found a small 4 inch PVC pipe protruding into the side wall of the concrete pipe connecting into the catch basin (**Photo 4**). Water was observed flowing from the small PVC pipe and collecting in the catch basin. Field crews could not immediately determine the source of flow. A water sample was obtained and tested. Results indicated that all parameters were within allowable limits.

KCI will periodically re-test this PID in an effort to determine its source prior to concluding that no further action is needed.



Photo 3
Catch Basin #5143



Photo 4
Catch Basin #5143

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structures 11712 – 11721
 - Lamplighter Way
 - Mendenhall Village

Illicit Discharge Incident Tracking Sheet

Date: 11/1/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: 1354 Field Crew
Subdivision: Mendenhall Village
County: New Castle
ADC Map No./Grid: 6-D7, 6E7

Incident Location

Primary Location Description

- | | | |
|---|-------------------------------------|--------------------------------|
| <input checked="" type="checkbox"/> Storm drain | <input type="checkbox"/> Outfall | <input type="checkbox"/> Other |
| <input type="checkbox"/> In Stream | <input type="checkbox"/> Along bank | |
| <input type="checkbox"/> Stormwater Pond | <input type="checkbox"/> Upland | |

Outfall / inlet ID# : 11712 - 11721

Closest street address: Lamplighter Way

Watershed name: White Clay Creek

Impacted Stream name:

Nearby landmark:

Narrative description of location

Various catch basins along Lamplighter Way.

Description of problem

Visual

- | | |
|--|---|
| <input type="checkbox"/> Oil / Oil sheen | <input type="checkbox"/> Soap |
| <input type="checkbox"/> Paint | <input type="checkbox"/> Flotables (toilet paper, etc.) |
| <input type="checkbox"/> Algae | <input type="checkbox"/> Dead fish |
| <input type="checkbox"/> Cloudy | <input type="checkbox"/> Flow -----> Precipitation in |
| <input type="checkbox"/> Anti-freeze | last 48-hours? Yes / No |
| <input type="checkbox"/> Yard waste | <input type="checkbox"/> Other _____ |

Odor

- | | | |
|---------------------------------|---|----------------------------------|
| <input type="checkbox"/> Sewage | <input type="checkbox"/> Sulfide ("rotten egg") | <input type="checkbox"/> Gas/oil |
| <input type="checkbox"/> None | <input type="checkbox"/> Other (describe) _____ | |

Narrative description/comments of problem

DeIDOT informed KCI that a resident of Mendenhall Village was possibly dumping grass clippings into a catch basin on Lamplighter Way.

Plan of Action (check all that apply)

- | | | |
|--|--|--|
| <input type="checkbox"/> Sample | <input type="checkbox"/> Contact DNREC | <input type="checkbox"/> Contact NPDES Manager |
| <input checked="" type="checkbox"/> Photos | <input type="checkbox"/> Door hangers | <input type="checkbox"/> GPS Coordinates |
| <input type="checkbox"/> Other (describe) | | |

Follow-up Action

No evidence of grass clippings were found in any catch basins along Lamplighter Way. KCI will periodically check the catch basins for any signs of grass clippings.



MEMORANDUM

TO: KCI Files

FROM: Chris Bolton

DATE: November 11, 2010

SUBJECT: Agreement 1495 / KCI Project 0203019H
Lamplighter Way PID – Mendenhall Village, NCCo
316 Pigeon Point Rd – Wilmington, NCCo

The purpose of this Memo is to summarize the investigation of two Potential Illicit Discharges (PIDs) that KCI was informed of by DelDOT on November 1, 2010.

On November 1, 2010 Randy Cole, DelDOT, informed KCI Technologies of two potential illicit discharges in New Castle County, one in Mendenhall Village on Lamplighter Way and another at 316 Pigeon Point Rd, both located in New Castle County.

DelDOT informed KCI that a resident of Mendenhall Village was possibly dumping grass clippings into a catch basin on Lamplighter Way. Upon further investigation by KCI field personnel of all the catch basins on Lamplighter way, no evidence was found of grass clippings in any catch basin. KCI will periodically check the catch basins for any signs of grass clippings.

The other PID DelDOT informed KCI about is a storm drainage inlet pipe located at 316 Pigeon Point Rd in a heavy industrialized section of Wilmington. Joe Ellis, DelDOT, noticed a greenish substance in and around the area of a new storm drainage inlet pipe. .

OUTFALL SCREENING

2010 ANNUAL REPORT

APPENDIX A

POTENTIAL ILLICIT DISCHARGE INVESTIGATIONS

CORRESPONDENCE, FIELD INFORMATION AND DOCUMENTATION:

- Structure: Newly Constructed / Not Inventoried
316 Pigeon Point Road

Illicit Discharge Incident Tracking Sheet

Date: 11/1/2010 Logged by: Matt Ortynsky Contact #: 302-731-9176 Incident ID:

Caller contact information: 1354 Field Crew
Subdivision: None
County: New Castle
ADC Map No./Grid: 13-H2

Incident Location

Primary Location Description
 Storm drain Outfall Other Inlet Pipe
 In Stream Along bank
 Stormwater Pond Upland

Outfall / inlet ID# : Needs GPS Coordinates

Closest street address: 316 Pigeon Point Road

Watershed name: Christina River Impacted Stream name:

Nearby landmark:

Narrative description of location

Inlet pipe in front of 316 Pigeon Point Road.

Description of problem

Visual

- | | |
|--|--|
| <input type="checkbox"/> Oil / Oil sheen | <input type="checkbox"/> Soap |
| <input type="checkbox"/> Paint | <input type="checkbox"/> Flotables (toilet paper, etc.) |
| <input type="checkbox"/> Algae | <input type="checkbox"/> Dead fish |
| <input type="checkbox"/> Cloudy | <input type="checkbox"/> Flow -----> Precipitation in
last 48-hours? Yes / No |
| <input type="checkbox"/> Anti-freeze | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Yard waste | |

Odor

- | | | |
|---------------------------------|---|----------------------------------|
| <input type="checkbox"/> Sewage | <input type="checkbox"/> Sulfide ("rotten egg") | <input type="checkbox"/> Gas/oil |
| <input type="checkbox"/> None | <input type="checkbox"/> Other (describe) _____ | |

Narrative description/comments of problem

DeIDOT informed KCI about a storm drainage inlet pipe located at 316 Pigeon Point Road in a heavily industrialized section of Wilmington. Joe Ellis of DeIDOT noticed a greenish substance in and around the area of a new storm drainage inlet pipe.

Plan of Action (check all that apply)

- | | | |
|--|--|---|
| <input type="checkbox"/> Sample | <input type="checkbox"/> Contact DNREC | <input type="checkbox"/> Contact NPDES Manager |
| <input checked="" type="checkbox"/> Photos | <input type="checkbox"/> Door hangers | <input checked="" type="checkbox"/> GPS Coordinates |
| <input type="checkbox"/> Other (describe) | | |

Follow-up Action

KCI field crews found what appeared to be a dry white crystalized substance but no evidence of a greenish substance that was described. KCI will re-visit the site to check for signs of future signs of illicit discharge.



MEMORANDUM

TO: KCI Files

FROM: Chris Bolton

DATE: November 11, 2010

SUBJECT: Agreement 1495 / KCI Project 0203019H
Lamplighter Way PID – Mendenhall Village, NCCo
316 Pigeon Point Rd – Wilmington, NCCo

The purpose of this Memo is to summarize the investigation of two Potential Illicit Discharges (PIDs) that KCI was informed of by DelDOT on November 1, 2010.

On November 1, 2010 Randy Cole, DelDOT, informed KCI Technologies of two potential illicit discharges in New Castle County, one in Mendenhall Village on Lamplighter Way and another at 316 Pigeon Point Rd, both located in New Castle County.

DelDOT informed KCI that a resident of Mendenhall Village was possibly dumping grass clippings into a catch basin on Lamplighter Way. Upon further investigation by KCI field personnel of all the catch basins on Lamplighter way, no evidence was found of grass clippings in any catch basin. KCI will periodically check the catch basins for any signs of grass clippings.

The other PID DelDOT informed KCI about is a storm drainage inlet pipe located at 316 Pigeon Point Rd in a heavy industrialized section of Wilmington. Joe Ellis, DelDOT, noticed a greenish substance in and around the area of a new storm drainage inlet pipe. .

Appendix D. Tetra Tech report on Phase II environmental site assessment of the I-95 rest area property, Newark, Delaware.

**PHASE II ENVIRONMENTAL
SITE ASSESSMENT
of the
I-95 REST AREA PROPERTY**

NEWARK, DELAWARE

DECEMBER 2010

Prepared for:

State of Delaware
Department of Transportation
Dover, Delaware

Prepared by:

Tetra Tech NUS, Inc.
240 Continental Drive, Suite 200
Newark, DE 19713



112C03193

REPRESENTATIONS

This report was compiled based partially on information supplied to Tetra Tech from outside sources and other information that is in the public domain. The conclusions and recommendations herein are based solely on the information Tetra Tech obtained in compiling the report. Documentation for the statements made in the report is on file at Tetra Tech's Christiana, Delaware office. Tetra Tech makes no warranty as to the accuracy of statements made by others that may be contained in the report, nor are any other warranties or guarantees, expressed or implied, included or intended by the report except that it has been prepared in accordance with the current generally accepted practices and standards consistent with the level of care and skill exercised under similar circumstances by other professional consultants or firms performing the same or similar services. Because the facts forming the basis for the report are subject to professional interpretation, differing conclusions could be reached. Tetra Tech does not assume responsibility for the discovery and elimination of hazards that could possibly cause accidents, injuries or damage. Compliance with submitted recommendations or suggestions does not assure elimination of hazards or the fulfillment of clients' obligations under local, state or federal laws or any modifications or changes to such laws.

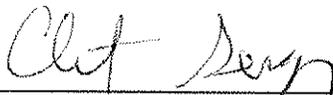
None of the work performed hereunder shall constitute or be represented as a legal opinion of any kind or nature, but shall be a representation of findings of fact from records examined.

Report Prepared by:



Vadim Petrov
Environmental Scientist

Report Reviewed by:



Christophe Geiger, Project Manager
Project Manager

INTRODUCTION

This report describes the procedures used and analytical results of a Phase II Environmental Investigation performed by Tetra Tech NUS, Inc. (Tetra Tech) at DelDOT's I-95 Rest Area site located in Newark, New Castle County, Delaware. The general site location and site plan are shown on Figure 1 and Figure 2, respectively.

During a recent inspection of the storm water drainage system at the site, DelDOT personnel observed a strong petroleum odor at one of the catch basins located on the southern portion of the site. The catch basin was located immediately adjacent to an area where residual soils from the recent I-95 Rest Area Renovation project were disposed. The goal of the Phase II Environmental Investigation was to identify if the residual soil was contaminated and storm water runoff from the soil was the source of the petroleum vapors within the storm water drainage system.

SAMPLING PROCEDURE

Tetra Tech subcontracted Green Services, Inc. to provide a Geoprobe direct-push drill rig for collecting subsurface soil samples from borings located on the subject property. A total of 27 soil borings were drilled at the site on December 2, 2010 (Figure 3). In addition, two storm water samples were collected on December 1, 2010, from two catch basins located on the southernmost portion of the rest area. The storm water samples were collected after a significant rain event that occurred on November 30, 2010.

Soil borings were advanced to a maximum depth of 10 feet based on field observations of stained soils, the presence of petroleum odor and/or free product. A Tetra Tech environmental scientist supervised the work. A photoionization detector (PID) calibrated to a 100 parts per million isobutylene standard was used to screen the split-spoon soil samples that were collected at each boring.

Soil samples were collected at each boring using a decontaminated stainless steel Macro Core Sampler. The Macro Core Sampler uses a cutting shoe, a drive head, and a Teflon inner sample sleeve to collect 4-foot samples. The sampler was driven into the subsurface using the percussion of the Geoprobe direct-push rig. The initial core sample was collected in the sleeve and sampler; it was then extracted from the borehole and the sleeve removed.

Composite subsurface soil samples were collected at six boring locations (SB-03, SB-07, SB-12, SB-17, SB-22, and SB-27 for laboratory analysis (Figure 3). The samples were to be collected

within intervals where elevated organic vapor concentrations were measured with the PID. However, no organic vapor measurements were detected above background at any of the boring locations, so the samples were collected from random locations throughout the study area. The soil samples and storm water samples were submitted to Mid-Atlantic Laboratories (New Castle, Delaware) and were analyzed for gasoline-range organics (GRO), diesel-range organics (DRO), and total petroleum hydrocarbons (TPH).

OBSERVATIONS

The area of investigation was concentrated within the footprint of the stockpiled soil location on the southernmost portion of the rest area. A 20-foot by 20-foot grid was marked out on top of the stockpile, and 26 borings were advanced to approximately 8 feet below ground surface (bgs). Two boreholes (SB-13 and SB-14) were advanced to 5 feet bgs. In addition, one boring (SB-27) was advanced to 8 feet bgs adjacent to the storm water catch basin located on southbound side of the rest area. The typical soil profile encountered in the borings within the study area consisted mostly of sandy loam/fill material. No stained soils or soils with a distinct petroleum odor were observed in any of the soil borings locations. The photoionization detector did not detect any organic vapors above background levels.

Additionally, Tetra Tech screened the ambient air for organic vapors in the vicinity of the storm water catch basin on the southbound side of the rest area. The instrument readings did not detect any organic vapors above background levels. Also, no sheen was observed on the storm water within the catch basins on the day they were sampled.

ANALYTICAL RESULTS

Copies of the laboratory chain-of-custody and the analytical reports are included in Appendix A. The soil analytical results were compared to the Delaware Risk-Based Corrective Action Program (DERBCAP) Tier 0 Action Levels. The Tier 0 Action Levels are Risk-Based Screening Levels determined by distance from source to a Point of Exposure (POE) or Point of Compliance (POC) for each chemical of concern (COC).

Soil Analytical Results

The soil analytical data collected at the site are summarized in Table 1. Diesel range organics (DRO) and gasoline range organics (GRO) were not detected above laboratory quantitation limits in any of the soil samples taken during this investigation. Total petroleum hydrocarbons (TPH) were

detected in four of the six samples with the highest concentration of 92.7 mg/Kg detected at boring location SB-03. The range of TPH concentrations varied from 64.9 mg/Kg to 92.7 mg/Kg. There is no DERBCAP Tier 0 Action Level established for TPHs; however, the TPH analysis is a total concentration measurement of all petroleum compounds from C-4 to C-44, including DRO and GRO. Therefore, the TPH concentrations detected were below DERCAP Tier 0 Action Levels.

Storm Water Analytical Results

The storm water analytical data collected at the site are summarized in Table 2. Two storm water samples (SW-CB01 and SW-CB02) collected from two catch basins located on either side of the rest area did not have any compounds detected at levels above their respective laboratory quantitation limits.

CONCLUSIONS

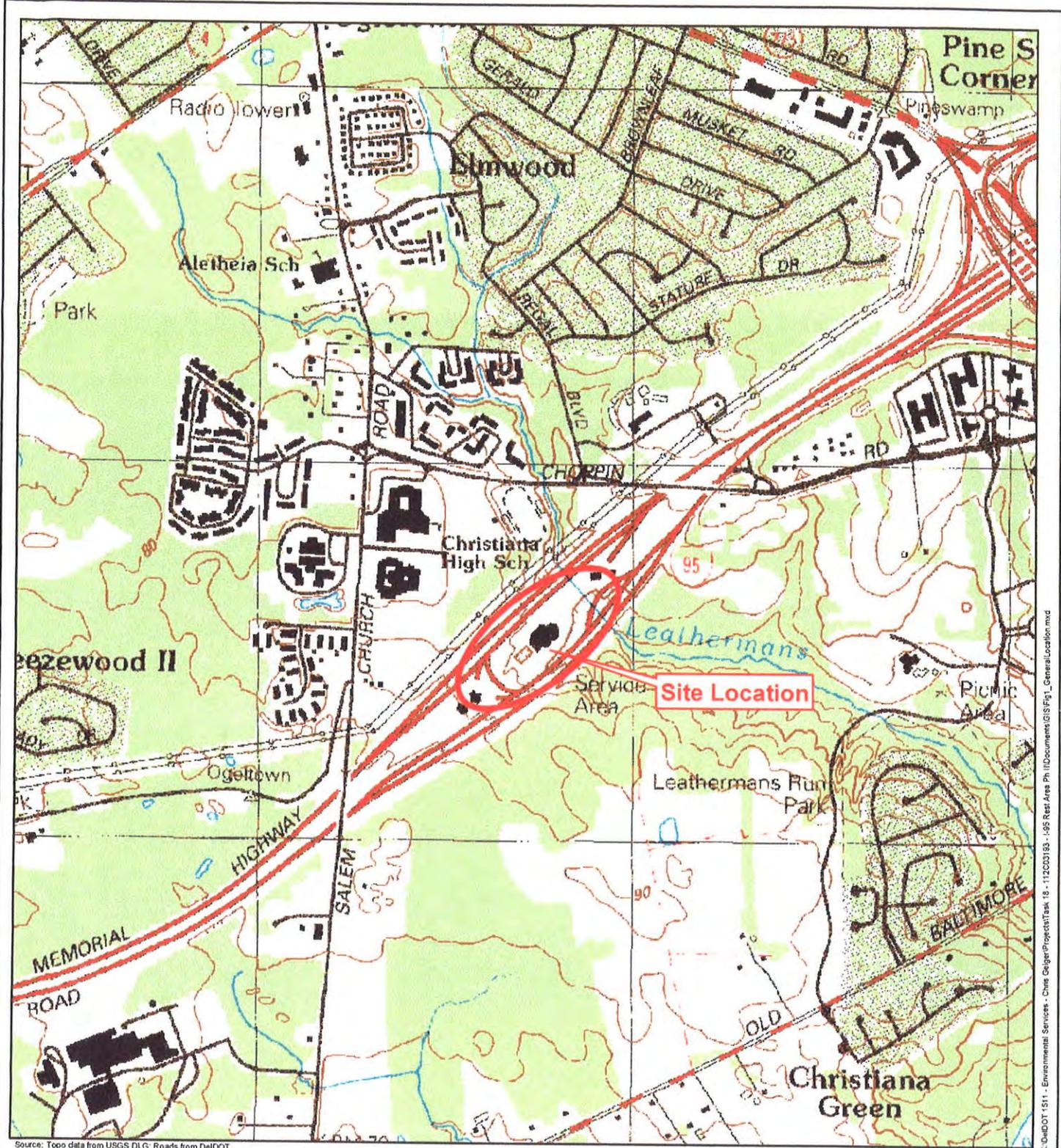
No compounds were detected in the storm water at levels exceeding their respective laboratory quantitation limits.

No DRO and GRO compounds were detected in subsurface soil at levels exceeding their respective laboratory quantitation limits. Analytical results for Total Petroleum Hydrocarbons obtained during this Phase II Environmental Investigation exhibited low levels of residual contamination. No stained soils or elevated organic vapor concentrations were noted during field activities.

Typically, 100 mg/Kg screening value is used as benchmark criteria during the Underground Storage Tank removal in the state of Delaware. The detected levels of residual petroleum contamination in soil were all below that action level. The highest detected concentration of 92.7 mg/Kg was observed in the soil sample from boring location SB-03.

In conclusion, the goal of the Phase II Environmental Investigation was to identify if the residual soil disposed of at the southern end of the site was the source of the petroleum vapors within the storm catch basin. Based on the results of investigation, it is unlikely that the source of organic petroleum vapors in the catch basin originates from the soil stockpiled on the southern end of the rest area.

FIGURES and TABLES

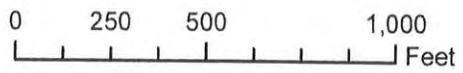


Source: Topo data from USGS DLG; Roads from DelDOT.

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Figure 1
 Site Location Map
 DelDOT I-95 Rest Area
 Newark, New Castle Co., DE



1 inch = 500 feet



Tetra Tech
 Phone: (302) 738-7551
 Toll Free: (800) 462-0910
www.tetrattech-de.com
www.tetrattech.com

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Source: Aerial from DelDOT; Roads from DelDOT.

K:\DelDOT 1511 - Environmental Services - Chris Geiger Projects\Track 18 - 112C03185 - I-95 Rest Area Ph II\Documents\GIS\Fig2_Site_Sketch.mxd

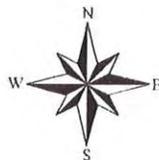


Figure 2
 Site Map
 DelDOT I-95 Rest Area
 Newark, New Castle Co., DE

0 150 300 600
 Feet

1 inch = 300 feet

Legend

- Extent of Investigation
- Delaware Roads



Tetra Tech
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 Toll Free: (800) 462-0910
www.tetrattech-de.com
www.tetrattech.com

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Source: Aerial from DelDOT; Roads from DelDOT.

K:\DelDOT\1511 - Environmental Services - Chris Geiger\Project\Task 18 - 112003193 - I-95 Rest Area_Ph II\Documents\GIS\Fig_3_Sampling Locations.mxd

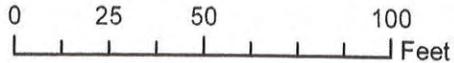
Legend

- Stormwater Sampling Location
- Soil Boring Location
- Soil Sampling Location
- Delaware Roads



Tetra Tech
 Phone: (302) 738-7551
 Toll Free: (800) 462-0910
www.tetrattech-de.com
www.tetrattech.com

Figure 3
 Boring/Sampling Location Map
 DelDOT I-95 Rest Area
 Newark, New Castle Co., DE



1 inch = 50 feet

This map is provided by Tetra Tech solely for display and reference purposes and is subject to change without notice. No claims, either real or assumed, as to the absolute accuracy or precision of any data contained herein, are made by Tetra Tech, nor will Tetra Tech be held responsible for any use of this document for purposes other than which it was intended.

Table 1
Soil Analytical Results

I-95 Rest Area Site
December 2010

Analyte	Units	DNREC Tier 0 Action Levels	SB-03	SB-07	SB-12	SB-17	SB-22	SB-27
Diesel Range Organics	mg/Kg	1000	ND	ND	ND	ND	ND	ND
Gasoline Range Organics	mg/Kg	100	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbons	mg/Kg	NA	92.7	69.9	ND	90.1	64.9	ND
Total Moisture	%	-	8.54	9.76	9.13	9.27	10.6	13.8

No - Action Level established

Table 2
Surface Water Analytical Results

I-95 Rest Area Site
December 2010

Analyte	Units	DNREC Tier 0 Action Levels < 50 feet	SW-CB01	SW-CB02
Diesel Range Organics	ug/L	-	ND	ND
Gasoline Range Organics	ug/L	-	ND	ND
Total Petroleum Hydrocarbons	ug/L	-	ND	ND

APPENDIX A

Laboratory Chain-of-Custody & Analytical Reports



Mid-Atlantic

Environmental Laboratories, Inc.

30 Lukens Drive, Suite A

New Castle, DE 19720

Phone: 302-654-1340 / TOLL FREE: 877-654-1340

www.maelinc.com

mael@maelinc.com

Analytical Report

Project Name: DelDot I-95 Rest Area

MAEL Job Number: 34514

Client: Tetra Tech, Inc
240 Continental Drive
Suite 200
Newark, DE 19713

Contact Name: Christopher Geiger

Date Received: 12/03/2010

Date Reported: 12/9/2010

Analytical test results for methods listed on the laboratory's scope of accreditation meet all requirements of NELAC unless otherwise noted. All sample holding times and preservation requirements were met unless otherwise noted. Test results relate only to the sample tested. This report shall not be reproduced, except in full, without prior written authorization of Mid-Atlantic Environmental Laboratories, Inc.

ANALYTICAL REPORT

Project Name: DelDot I-95 Rest Area

Date Sampled: 12/3/2010 8:55 PM

Lab Project #: 34514

Sampled By: VP

Lab Sample #: 34514-1

Sample Matrix: Soil

Client Sample ID: SB-03

Sample Type: Composite

Analyte	CASRN	Result	Q	Units	Method	PQL	Analyst	Date / Time Analysis
Diesel Range Organics - Non-aqueous								
Diesel Range Organics	-----	ND		mg/kg	8015B	50.0	S S	12/6/2010 3:59 PM
Gasoline Range Organics - Non-aqueous								
Gasoline Range Organics	-----	ND		mg/kg	8015B	0.10	S S	12/7/2010 12:08 PM
Percent Moisture/Percent Solid								
Total Moisture		8.54		%	2540B	0.10	GH A	
Total Petroleum Hydrocarbons (C-44) - Non-aqueous								
Total Petroleum Hydrocarbons (C-44)		92.7		mg/kg	8015B	50.0	S S	12/7/2010 7:10 PM



Charles Morrow
Quality Assurance Director

ANALYTICAL REPORT

Project Name: DelDot I-95 Rest Area

Date Sampled: 12/2/2010 9:25 AM

Lab Project #: 34514

Sampled By: VP

Lab Sample #: 34514-2

Sample Matrix: Soil

Client Sample ID: SB-07

Sample Type: Composite

Analyte	CASRN	Result	Q	Units	Method	PQL	Analyst	Date / Time Analysis
Diesel Range Organics - Non-aqueous								
Diesel Range Organics	-----	ND		mg/kg	8015B	50.0	S S	12/6/2010 4:26 PM
Gasoline Range Organics - Non-aqueous								
Gasoline Range Organics	-----	ND		mg/kg	8015B	0.10	S S	12/7/2010 1:37 PM
Percent Moisture/Percent Solid								
Total Moisture		9.76		%	2540B	0.10	GH A	
Total Petroleum Hydrocarbons (C-44) - Non-aqueous								
Total Petroleum Hydrocarbons (C-44)		69.9		mg/kg	8015B	50.0	S S	12/7/2010 7:36 PM

Charles Morrow

Charles Morrow
Quality Assurance Director

ANALYTICAL REPORT

Project Name: DelDot I-95 Rest Area

Date Sampled: 12/2/2010 10:20 AM

Lab Project #: 34514

Sampled By: VP

Lab Sample #: 34514-3

Sample Matrix: Soil

Client Sample ID: SB-12

Sample Type: Composite

Analyte	CASRN	Result	Q	Units	Method	PQL	Analyst	Date / Time Analysis
Diesel Range Organics - Non-aqueous								
Diesel Range Organics	-----	ND		mg/kg	8015B	50.0	S S	12/6/2010 4:52 PM
Gasoline Range Organics - Non-aqueous								
Gasoline Range Organics	-----	ND		mg/kg	8015B	0.10	S S	12/7/2010 2:17 PM
Percent Moisture/Percent Solid								
Total Moisture		9.13		%	2540B	0.10	GH A	
Total Petroleum Hydrocarbons (C-44) - Non-aqueous								
Total Petroleum Hydrocarbons (C-44)		ND		mg/kg	8015B	50.0	S S	12/7/2010 8:02 PM

Charles Morrow

Charles Morrow
Quality Assurance Director

ANALYTICAL REPORT

Project Name: DelDot I-95 Rest Area

Date Sampled: 12/2/2010 11:50 AM

Lab Project #: 34514

Sampled By: VP

Lab Sample #: 34514-4

Sample Matrix: Soil

Client Sample ID: SB-17

Sample Type: Composite

Analyte	CASRN	Result	Q	Units	Method	PQL	Analyst	Date / Time Analysis
Diesel Range Organics - Non-aqueous								
Diesel Range Organics	-----	ND		mg/kg	8015B	50.0	S S	12/6/2010 5:18 PM
Gasoline Range Organics - Non-aqueous								
Gasoline Range Organics	-----	ND		mg/kg	8015B	0.10	S S	12/7/2010 2:48 PM
Percent Moisture/Percent Solid								
Total Moisture		9.27		%	2540B	0.10	GH A	
Total Petroleum Hydrocarbons (C-44) - Non-aqueous								
Total Petroleum Hydrocarbons (C-44)		90.1		mg/kg	8015B	50.0	S S	12/7/2010 8:28 PM

Charles Morrow

Charles Morrow
Quality Assurance Director

ANALYTICAL REPORT

Project Name: DelDot I-95 Rest Area

Date Sampled: 12/2/2010 12:30 PM

Lab Project #: 34514

Sampled By: VP

Lab Sample #: 34514-5

Sample Matrix: Soil

Client Sample ID: SB-22

Sample Type: Composite

Analyte	CASRN	Result	Q	Units	Method	PQL	Analyst	Date / Time Analysis
Diesel Range Organics - Non-aqueous								
Diesel Range Organics	-----	ND		mg/kg	8015B	50.0	S S	12/6/2010 5:44 PM
Gasoline Range Organics - Non-aqueous								
Gasoline Range Organics	-----	ND		mg/kg	8015B	0.10	S S	12/7/2010 3:17 PM
Percent Moisture/Percent Solid								
Total Moisture		10.6		%	2540B	0.10	GH A	
Total Petroleum Hydrocarbons (C-44) - Non-aqueous								
Total Petroleum Hydrocarbons (C-44)		64.9		mg/kg	8015B	50.0	S S	12/7/2010 8:55 PM

Charles Morrow

Charles Morrow
Quality Assurance Director

ANALYTICAL REPORT

Project Name: DelDot I-95 Rest Area

Date Sampled: 12/2/2010 1:20 PM

Sampled By: VP

Lab Project #: 34514

Sample Matrix: Soil

Lab Sample #: 34514-6

Sample Type: Composite

Client Sample ID: SB-27

Analyte	CASRN	Result	Q	Units	Method	PQL	Analyst	Date / Time Analysis
Diesel Range Organics - Non-aqueous								
Diesel Range Organics	-----	ND		mg/kg	8015B	50.0	S S	12/6/2010 6:10 PM
Gasoline Range Organics - Non-aqueous								
Gasoline Range Organics	-----	ND		mg/kg	8015B	0.10	S S	12/7/2010 3:47 PM
Percent Moisture/Percent Solid								
Total Moisture		13.8		%	2540B	0.10	GH A	
Total Petroleum Hydrocarbons (C-44) - Non-aqueous								
Total Petroleum Hydrocarbons (C-44)		ND		mg/kg	8015B	50.0	S S	12/7/2010 9:21 PM

Charles Morrow

Charles Morrow
Quality Assurance Director

ANALYTICAL REPORT

Project Name: DelDot I-95 Rest Area

Date Sampled: 12/1/2010 1:00 PM

Lab Project #: 34514

Sampled By: VP

Lab Sample #: 34514-7

Sample Matrix: Stormwater

Client Sample ID: SW-CB01

Sample Type: Grab

Analyte	CASRN	Result	Q	Units	Method	PQL	Analyst	Date / Time Analysis
Diesel Range Organics - Aqueous								
Diesel Range Organics	-----	ND		ug/L	8015B	500	S S	12/6/2010 7:54 PM
Gasoline Range Organics - Aqueous								
Gasoline Range Organics	-----	ND		ug/L	8015B	100	S S	12/8/2010 12:59 AM
Total Petroleum Hydrocarbons (C-44) - aqueous								
Total Petroleum Hydrocarbons (C-44)		ND		ug/L	8015B	500	S S	12/7/2010 11:04 PM



Charles Morrow
Quality Assurance Director

ANALYTICAL REPORT

Project Name: DelDot I-95 Rest Area

Date Sampled: 12/1/2010 1:15 PM

Lab Project #: 34514

Sampled By: VP

Lab Sample #: 34514-8

Sample Matrix: Stormwater

Client Sample ID: SW-CB02

Sample Type: Grab

Analyte	CASRN	Result	Q	Units	Method	PQL	Analyst	Date / Time Analysis
Diesel Range Organics - Aqueous								
Diesel Range Organics	-----	ND		ug/L	8015B	500	S S	12/6/2010 8:20 PM
Gasoline Range Organics - Aqueous								
Gasoline Range Organics	-----	ND		ug/L	8015B	100	S S	12/8/2010 3:05 PM
Total Petroleum Hydrocarbons (C-44) - aqueous								
Total Petroleum Hydrocarbons (C-44)		ND		ug/L	8015B	500	S S	12/7/2010 11:30 PM



Charles Morrow
Quality Assurance Director

ANALYTICAL REPORT

Methodology

All analyses are adapted from one or more of the following reference methods:

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants" Code of Federal Regulations, Vol. 40, Part 136
- "Test Methods for Evaluating Solid Waste", SW846 Third Edition, September 1986, USEPA.
- Code of Federal Regulations Vol. 40, Part 261, "Appendix II Method 1311 Toxicity Characteristic Leaching Procedure."
- Standard Methods for the Examination of Water and Wastewater", 21st edition
- "Methods for the Chemical Analysis of Water and Wastes", EPA600/4-79-020, March 1983, U.S. EPA, EMSL
- "Annual Book of Standards, Section 11-Water", American Society for Testing and Materials (ASTM)
- "Methods for the Determination of Organic Compounds in Drinking Water", EPA 600/4-88/039, December 1988

Qualifiers

B	Detected in method blank	E	Detected above calibration limits, result estimated
H	Parameter run out of hold time	J	Detected below PQL, result estimated
P	Incorrect Preservative	R	See report notes
U	Compound not detected above method practical quantitation limit.		

Abbreviations

ppm	Parts Per Million (mg/kg or mg/L)	PQL	Practical Quantitation Level
ppb	Parts Per Billion (ug/kg or ug/L)	attached	Subcontract Lab Report Attached
g	gram (1000 g = 1Kg)	>	Greater than the PQL
kg	kilogram (1 kg - 1000 g)	<	Less than the PQL
mg	milligram (1000 mg = 1 g)	ND	Not Detected
mg/kg	milligram per kilogram (ppm)	NA	Not Applicable
ug/kg	microgram per kilogram (ppb)	NS	Not Spiked
ug	microgram (1000 ug = 1 mg)	NP	No PCB pattern detected
L	liter (1 L - 1000 mL)	NR	Not Requested
ml	milliliter (1000 ml = 1 L)	NI	Not Ignitable
ul	microliter (1000 ul = 1 ml)	NFL	No Free Liquid
mg/L	milligram per liter (ppm)	NTU	Nephelometric Turbidity Units
ug/L	microgram per liter (ppb)	S.U.	Standard Unit
ng/kg	nanogram per kilogram	RPD	Relative Percent Difference
BTU/lb	British Thermal Units per pound	RSD	Relative Standard Deviation
CFU/mL	Colony Forming Units per milliliter	MS/MSD	Matrix Spike/Matrix Spike Duplicate
MPN/100 ml	Most Probable Number per 100 mL	LCS	Laboratory Control Sample
mS/cm	milli Siemens per centimeter	BS	Blank Spike (Method Spike)
uS/cm	micro Siemens per centimeter	o F	degrees Fahrenheit
ug/sq cm	microgram per square centimeter	o C	degrees Celsius
ug/sq ft	microgram per square feet	umhos	Conductivity Units
ug/wipe	microgram per wipe	ohms	Resistivity Units

Note: All non-aqueous samples, with the exception of oils, wipes, and paint chips are dry weight corrected

Appendix E. Appoquinimink River Association summary report for 2010.

Appoquinimink River Association 2010 Report

Livable Lawns Campaign – Improper fertilization of lawns and open spaces is a huge problem in the entire state but especially in the Appoquinimink watershed with many new developments throughout. As a first phase of education on the topic, the Appoquinimink River Association, Department of Natural Resources and Environmental Control, Department of Transportation NPDES Program, Delaware Nursery and Landscape Association, Delaware Grounds Management Association, University of Delaware, USDA-Natural Resource



Conservation Service, Nutrient Management Commission and New Castle Conservation District began meeting to understand how commercial fertilizer companies must work in the state. They have developed and received comment on a system to recognize those applicators that are being environmentally friendly.

Pet Waste Education – Alongside the Departments of Natural Resources and Environmental Control and Transportation, the Appoquinimink River Association began an intensive pet waste education campaign throughout southern New Castle County and Dover. Over 7,200 portable pet waste collection bag holders were distributed to animal shelters (4,730), veterinary offices (900), training facilities (300), at outreach events (425), and by mail to dog owners (900).



Community Wildlife Habitats – Together the Delaware Nature Society, Department of Natural Resources and Environmental Control, Town of Townsend, and Appoquinimink River Association finished the three year



process to make Townsend the first Community Wildlife Habitat in the state of Delaware. As a part of this project, backyard habitats were established, two schoolyard habitats were created with the help of students at Townsend Elementary School, rain barrel workshops were held, and educational articles were written for the Town's newsletter.

Watershed Newsletter – There was a continuation by the Appoquinimink River Association of developing and sending residents of the watershed and surrounding areas of southern New Castle County newsletters in the spring and fall. Topics that were covered in 2010 included fertilizer education, native animals, soil tests, mulching,

healthy watersheds, water quality monitoring, and the value of clean water.

Technical Monitoring – The Association continued to support water quality monitoring efforts run by the Delaware Nature Society in which resident volunteers do monthly water monitoring at several sites throughout the Appoquinimink watershed.

Education and Outreach Events – The Appoquinimink River Association participated in education and outreach events like their 5K Race for Our Rivers with support from the Department of Transportation to hand out educational materials to the public like storm drain themed bags, stormwater education pamphlets, phosphate-free cleaners, soil test kits and pet waste materials.

Appendix F. KCI Technologies sand filter study 2010 annual report.



DELDOT AGREEMENT 1495
WATER QUALITY MONITORING
DELAWARE SAND FILTER STUDY
2010 ANNUAL REPORT
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**DELDOT AGREEMENT 1495
WATER QUALITY MONITORING
DELAWARE SAND FILTER STUDY
2010 ANNUAL REPORT**



As part of the Delaware Department of Transportation's National Pollutant Discharge Elimination System General Permit Program Regulations Governing Stormwater Discharge, KCI Technologies Inc. was contracted to evaluate the functionality of the stormwater management (SWM) device known as the Delaware Sand Filter (DSF). This was the fifth year of the study. A history of the DSF Study is described below.

A. PROJECT HISTORY

The *2006 DSF Study Annual Report* summarized the process of identifying DSFs (listed below) to be included in the study. These DSFs were determined to be representative of a variety of typical land use settings (roadways, transit facilities and park-and-ride lots) and different sand chamber designs. A fourth DSF, located at the Chapman Maintenance Yard, was added to the study in Summer 2008, when it was constructed as part of a BMP treatment train for a truck wash area. It was suspended from study in 2009 (Refer to the *2009 DSF Study Annual Report* for additional information). The fifth DSF, located at Kennett Pike, was added to the study in 2010.

- **Chapman Maintenance Yard DSF (Stormceptor/DSF Treatment Train)**
 - Treats Truck Wash Wastewater at DelDOT Maintenance Yard
 - Eliminated from Study in 2009

- **Lancaster Pike DSF (BMP 72)**
 - Treats Roadway Runoff
 - Uses Stone/Sand/Geotextile Sand Chamber Design

- **Route 273 / Route 7 Park-and-Ride Lot DSF (BMP 46)**
 - Treats Park and Ride Parking Lot Runoff
 - Uses Stone/Sand/Geotextile Sand Chamber Design

- **Wilmington Delaware Transit Corporation (DTC) Bus Facility DSF**
 - Treats Commercial Vehicle Parking Lot Runoff
 - Uses Sand/Geotextile/Stone Sand Chamber Design

- **Kennett Pike DSF (BMPs 364-430)**
 - Treats Roadway Runoff
 - Uses Stone/Sand/Geotextile Sand Chamber Design

The *2007 DSF Study Annual Report* summarized the following:

- Initial DSF Full Maintenance/Cleaning
- Dry and Wet Weather Field Observation Methodology
- Dry and Wet Weather Field Observations
- Lancaster Pike DSF Sand Analysis Results
- Initial DSF Maintenance Recommendations.

The *2008 DSF Study Annual Report* summarized the following:

- Dry and Wet Weather Field Observations
- Wilmington DTC DSF Sand Analyses
- DSF Study Methodologies Review
- Initial Maintenance Recommendations.

The *2009 DSF Study Annual Report* summarized the following:

- Dry and Wet Weather Field Observations
- Lancaster Pike DSF and Wilmington DTC DSF Sand Analyses
- Wilmington DTC DSF Automated Wet Weather Monitoring
- Statewide Delaware Sand Filter Maintenance Recommendations
- Lancaster Pike DSF Detailed Maintenance Schedule.

In Year 5 (2010), KCI conducted the following:

- Dry and Wet Weather Field Observations
- Commenced Kennett Pike DSF DWO
- Commenced WWO Water Quality Field Testing of DSF Inflow and Outflow
- Continued Automated WWM at Wilmington DTC DSF
- Installed Automated WWM at Lancaster Pike DSF
- Submitted a Preliminary Alternate Sand Chamber Media Design for the Wilmington DTC DSF in October 2010.



B. METHODOLOGY

The methodology for conducting DSF Dry Weather Observations (DWO), Wet Weather Observations (WVO), WVO Water Quality Field Testing and Automated Wet Weather Monitoring (WWM) is described below.

Dry Weather Observation (DWO) Methodology:

- General investigation of drainage area, focused on understanding flow patterns and pollutant sources.
- Sedimentation Chamber: Presence/depth of water, sediment depth; presence of oil/grease
- Sand Chamber: Presence/depth of water, depth of gravel, sand, discoloration, and debris; evidence of clogging, presence of oil/grease
- Date previous rainfall
- Photographs

Wet Weather Observation (WVO) Methodology:

- General investigation of drainage area
- Sedimentation Chamber: Presence/depth of water, presence of oil/grease
- Sand Chamber: Presence/depth of water; evidence of clogging, presence of oil/grease
- Date previous rainfall
- Photographs

WVO Water Quality Field Testing Methodology:

- DSF inflow and outflow tested for turbidity, pH, chloride, carbon dioxide, alkalinity, ammonia, hardness, dissolved oxygen and nitrite with HACH Fish Farming Test Kit.

Detailed DWO and WVO methodology information is provided in the *Delaware Sand Filter Dry and Wet Weather Observation Protocol* (April 30, 2010).

Wet Weather Monitoring Methodology - Lancaster Pike DSF and Wilmington DTC DSF:

Sampling techniques were performed in accordance with the Environmental Protection Agency (EPA) *Stormwater Sampling Guidance Document*, EPA 833-B-92-001 (July 1992). WWM sampling protocol included 72 hours of antecedently dry conditions and minimum predicted rainfall depth of 0.10 inches. The automated sampler is programmed to collect a first flush sample and nine composite samples every 20 minutes after first flush. First flush is collected by pre-determined programmed parameters. The samples are collected and delivered to Atlantic Coast Laboratory for analysis. Detailed WWM sampling methodology information, including the Sampling Protocol, Laboratory Costs, Standard Operating Procedures and Site Safety & Health Plan is provided in the *Wilmington Delaware Transit Corporation Delaware Sand Filter Automated Wet Weather Monitoring Sampling Protocol* (September 2009) and the *Lancaster Pike (BMP 72) Delaware Sand Filter Automated Wet Weather Monitoring Sampling Protocol* (September 2010).

C. DRY AND WET WEATHER OBSERVATIONS, WATER QUALITY FIELD TESTING, WET WEATHER MONITORING AND DSF RECOMMENDATIONS

Table 1 summarizes the DSF Study field activities for 2010.

**TABLE 1
 2010 DSF FIELD ACTIVITIES SUMMARY**

Date	Delaware Sand Filter			
	Lancaster Pike (BMP 72)	Route 273/7 Park-and-Ride (BMP 46)	Wilmington DTC	Kennett Pike (BMPs 364-430)
Dry Weather Observation				
01-13-10	✓	✓	✓	--
02-04-10	✓	✓	✓	--
03-16-10	✓	✓	✓	✓
04-23-10	✓	✓	✓	--
06-16-10	✓	✓	✓	✓
08-05-10	✓	✓	✓	✓
11-09-10	✓	✓	✓	✓
12-28-10	✓	✓	✓	--
Wet Weather Observation / Water Quality Field Testing				
01-25-10	✓	✓	✓	N/A
02-23-10	✓ ✓	✓ ✓	✓ ✓	N/A
03-26-10	✓	✓	✓	N/A
04-26-10	✓ ✓	✓ ✓	✓ ✓	N/A
05-18-10	✓ ✓	✓ ✓	✓ ✓	N/A
07-13-10	✓	✓	✓	N/A
09-27-10	✓ ✓	✓ ✓	✓ ✓	N/A
Wet Weather Monitoring				
01-25-10	--	NA	✓	N/A
02-23-10	--	NA	✓	N/A
11-10-10	✓	NA	--	N/A
12-01-10	✓	NA	✓	N/A

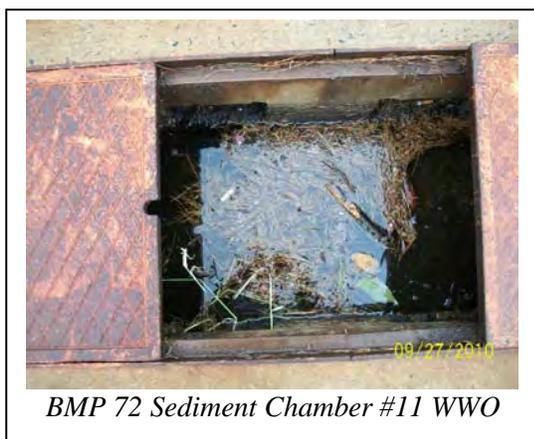
The results of the DWO, WWO, WWO Water Quality Field Testing, and Automated WWM, as well as future recommended actions, are provided within the discussion for each DSF below. The data collected during the field observations and sampling is provided in summary tables located in **Appendices A- D**.

- **Appendix A** - Lancaster Pike DSF Data
- **Appendix B** - Route 273/7 Park & Ride Lot DSF Data
- **Appendix C** - Wilmington DTC DSF Data
- **Appendix D** - Kennett Pike DSF Data

For DWO, **Appendices A-D** contain the actual data for each DWO, as well as the mean and standard deviation for quantifiable items such as water depth and sediment depth in the sediment chamber; and gravel depth, sand depth, discoloration depth, debris depth and debris coverage in the sand chamber.

For WWO, **Appendices A-D** contains the actual data for each WWO, as well as the mean and standard deviation for the water depth data in both the sediment and sand chambers. The WWO Water Quality Field Testing data for each testing date is proved in **Appendices A-D**, as well as the mean and standard deviation for each water quality parameter.

For WWM, the mean and standard deviation tables and WWM box and whisker plots are included in **Appendices A-D**. The statistical summary tables include the mean and standard deviation for each parameter measured in the field or analyzed by Atlantic Coast Laboratory. The laboratory data for each parameter for each WWM Event is located in the project's technical files. The WWM box and whisker plots, in descriptive statistics, are a convenient way to graphically depict groups of numerical data through their five-number summaries (the smallest observation, lower quartile (Q1), median (Q2), upper quartile (Q3), and largest observation). These plots are useful to display differences between populations without making any assumptions of the underlying statistical distribution. The spacings between the different parts of the box help to indicate the degree of dispersion (spread) and skewness in the data, and to identify outliers.



1. Lancaster Pike DSF (BMP 72)

Located in Wilmington, Delaware, this DSF consists of a series of separate DSFs treating roadway runoff along Lancaster Pike, only one of which, BMP 72, is studied in detail. Lancaster Pike has multiple vertical curves (with BMPs 72, 73, 52 and 54 located at the highest elevations and receiving the first runoff), and is predominantly surrounded by residential land use. Of these four DSFs, BMP 72 receives the highest volume of runoff. See the aerial below for the location and setting of the Lancaster Pike DSFs.



Lancaster Pike DSF – BMP 72

BMP 72 is comprised of a series of 11 sediment/sand chambers (pre-cast cells) that are not linked with over-flow openings. The sand chamber design consists of two inches of #57 stone placed on top of 18 inches of sand, with a single perforated effluent pipe wrapped with geotextile fabric. Based on field observations, it appears that this series of DSFs was last maintained in Spring 2007, in preparation for this DSF Study.

In 2008, one sediment and one sand chamber at BMP 72 were observed; and in 2009 and 2010, six of the 11 sediment and sand chambers were evaluated (1, 3, 5, 7, 9, and 11).



Observations

The DSFs on Lancaster Pike are located on a stretch of roadway, such that BMP 72 is at the top of slope and is the first to receive runoff. Based on 2010 DWO and WWO (**Appendix A**), previous years' observations, and KCI annual BMP inspections, BMP 72 has shown signs of maintenance needs, compared to those located further down the slope.

Since the DSF study began, KCI has observed a build-up of leaf litter and organic debris in the sediment and sand chambers of BMP 72. This is due to the large amount of deciduous vegetation in the surrounding residential area, which deposits leaf litter and organic debris into the roadway and ultimately accumulates in the DSF.

Water Quality Field Testing

During WWO, water quality field testing at the DSF inflow and outflow was conducted. In 2010, five samples were tested at the outflow, and four at the inflow (no flow for one date). The data for each of the testing dates, as well as the mean and standard deviation for each parameter are provided in **Appendix A**. **Table 2** provides a summary of the parameters with water quality field testing mean outflow levels that are less than the inflow levels (✓), and those parameters that were not detected (ND) at both inflow and outflow. A table cell without a symbol indicates that the mean outflow level is greater than the inflow level.

**TABLE 2
 LANCASTER PIKE DSF WATER QUALITY FIELD TESTING**

PARAMETER	MEAN OUTFALL < INFLOW
Turbidity	✓
pH	✓
Chloride	
Carbon Dioxide	
Alkalinity	
Ammonia	✓
Hardness	✓
Dissolved Oxygen	✓
Nitrite	ND

Wet Weather Monitoring

By the end of 2010, the automated equipment had been installed in BMP 72, and all that remained is the installation of pole for the antenna and solar panel. A manual test sample was collected in October to confirm the setup was working (i.e., flow insert, accurate readings, etc). In November, DelDOT provided the cell phone to use for communication to the equipment. ISCO completed the cell phone/modem communication test and shipped the remaining equipment in mid-December. The entire automated set-up will be completed when conditions

allow the installation of the pole for the antenna and solar panel; currently the ground is frozen and snow covered.

Two manual WWM events were conducted in November and December 2010. The WWM data for each site is provided in **Table 3**. The mean and standard deviation for each parameter are provided in **Appendix A**. **Table 4** provides a summary of the parameters with mean outflow levels that are less than the inflow levels (✓), parameters with equal or very similar mean inflow and outflow levels (=), and those parameters not detected (ND) at both inflow and outflow. A table cell without any symbol indicates that the mean outflow level is greater than the inflow level.

TABLE 3
LANCASTER PIKE DSF WET WEATHER MONITORING LABORATORY DATA

PARAMETER	LANCASTER PIKE DSF IN				LANCASTER PIKE DSF OUT			
	11/04/10		12/01/10		11/04/10		12/01/10	
	FF	COMP	FF	COMP	FF	COMP	FF	COMP
Total Suspended Solids (mg/L)	43	24	65	13	4	<4	<4	<4
Total Dissolved Solids (mg/L)	<10	<10	10	56	38	444	101	82
Chemical Oxygen Demand (mg/L)	30	<10	<10	<10	<10	<10	<10	<10
Biological Oxygen Demand (mg/L)	<4	<2	<3	<3	<4	<2	<3	4
Chloride (mg/L)	2.32	1.95	3.84	2.21	6.60	5.40	16.40	10.70
Oil & Grease (mg/L)	<5	<5	<5	<5	<5	<5	<5	<5
pH (units)	6.83	6.85	7.32	7.31	6.96	7.10	7.16	7.23
Total Kjeldahl Nitrogen (mg/L)	0.53	0.43	0.61	0.53	0.70	0.33	0.25	0.39
Ammonia (mg/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total Phosphorus (mg/L)	0.14	0.11	0.10	0.08	0.07	0.08	0.07	0.07
Dissolved Phosphorus (mg/L)	0.09	0.07	0.08	0.05	0.06	0.07	0.07	0.07
Ortho-Phosphate (mg/L)	0.10	0.12	0.09	0.09	0.07	0.06	0.07	0.08
Total Cadmium (mg/L)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Copper (mg/L)	<0.005	<0.005	0.009	0.006	<0.005	<0.005	0.006	<0.005
Total Lead (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Zinc (mg/L)	0.084	0.043	0.036	0.030	0.016	0.018	0.013	0.006

TABLE 4
LANCASTER PIKE DSF WET WEATHER MONITORING LABORATORY DATA
MEAN OUTFALL < INFLOW

PARAMETER	MEAN OUTFALL < INFLOW	
	First Flush	Composite
Total Suspended Solids	✓	✓
Total Dissolved Solids		
Chemical Oxygen Demand	✓	ND
Biological Oxygen Demand	ND	
Chloride		
Oil & Grease	ND	ND
pH	=	=
Total Kjeldahl Nitrogen	✓	✓
Ammonia	ND	ND
Total Phosphorus	✓	✓
Dissolved Phosphorus	✓	=
Ortho-Phosphate	✓	✓
Total Cadmium	ND	ND
Total Copper	✓	✓
Total Lead	ND	ND
Total Zinc	✓	✓

Recommendations

The DSFs on Lancaster Pike are located on a stretch of roadway such that BMP 72 is located at the top of slope and is the first series of filters to receive runoff. As a result, this filter becomes in need of maintenance quicker than those located down slope. KCI recommends that DelDOT remove all sediment/organic debris accumulated in the receiving weirs and sediment chambers of every series of DSFs along Lancaster Pike. In addition, DelDOT should rehab the sand chamber for all 11 chambers of BMP 72. Moving forward, KCI recommends frequent maintenance of BMP 72 (all or a portion of), which would reduce maintenance requirements for DSFs down slope, with the anticipated goal of maintaining these filters approximately every 10-15 years.

The following are specific actions recommended for the Lancaster Pike DSF.

Action 1 – To Be Performed by DelDOT:

As presented in the 2009 DSF Study Annual Report, KCI recommends removing all sediment/organic debris accumulated in the receiving weirs and sediment chambers of every series of DSFs along Lancaster Pike and rehabilitating the sand chamber for all 11 chambers of BMP 72 (Table 5).

**TABLE 5
 LANCASTER PIKE DSF MAINTENANCE RECOMMENDATIONS**

Lancaster Pike DSF BMP #	Weirs Leading into BMP	Sediment Chamber	Sand Chamber	Number of Chambers
52	Clean out	Clean out	Ok	6
54	Clean out	Clean out	Ok	6
55	Clean out	Clean out	Ok	6
56	Clean out	Clean out	Ok	7
57	Clean out	Clean out	Ok	7
58	Clean out	Clean out	Ok	2
59	Clean out	Clean out	Ok	2
60	Clean out	Clean out	Ok	3
61	Clean out	Clean out	Ok	2
62	Clean out	Clean out	Ok	6
63	Clean out	Clean out	Ok	5
64	Clean out	Clean out	Ok	5
65	Clean out	Clean out	Ok	10
66	Clean out	Clean out	Ok	19
67	Clean out	Clean out	Ok	6
68	Clean out	Clean out	Ok	5
69	Clean out	Clean out	Ok	10
70	Clean out	Clean out	Ok	4
71	Clean out	Clean out	Ok	6
72	Clean out	Clean out	Clean out	11
73	Clean out	Clean out	Ok	6

Action 2 – To Be Performed by KCI:

During the 2011 DSF Study at Lancaster Pike, KCI will focus on 11 BMP 72 chambers and observe the effect of organic material and debris to the sediment chamber and in-flow weirs. KCI will also observe BMP 73, which is at the top of slope on the opposite side of Lancaster Pike, to assess whether a maintenance strategy similar to BMP 72 would be appropriate.

Action 3 – To Be Performed by KCI:

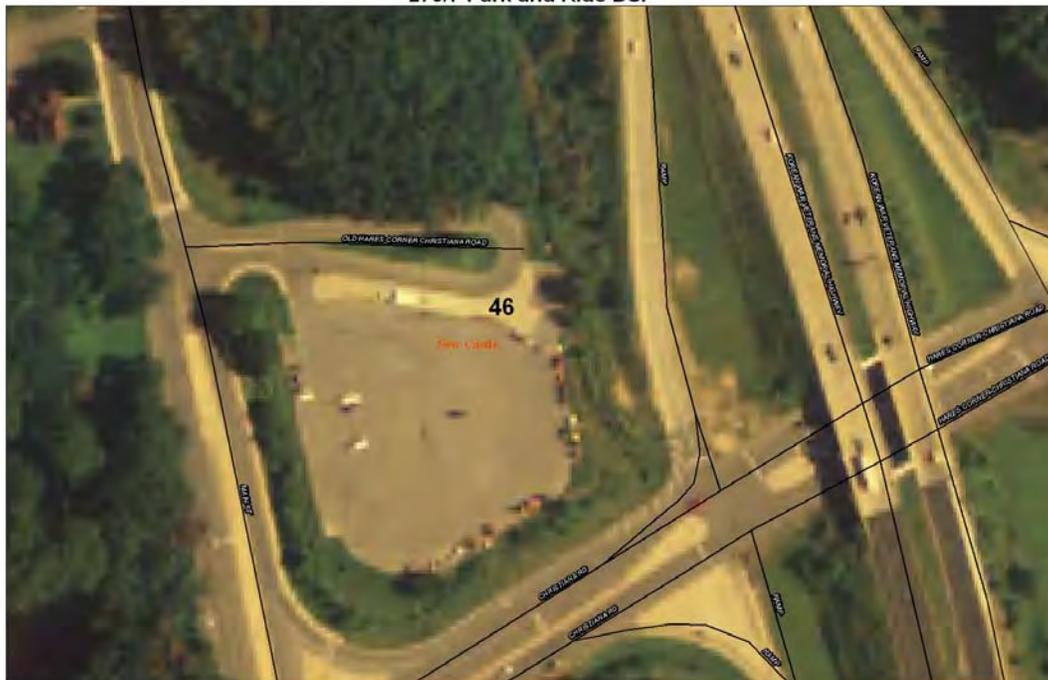
KCI will finalize installation of the automated WWM station at BMP 72 and begin automated WWM. This will aid in determination of the frequency of maintenance of BMP 72. As stated previously, KCI believes more frequent maintenance at BMP 72 will increase the performance of all the DSFs along Lancaster Pike. The water quality analyses will also be useful to verify that minimal maintenance is needed to keep these residential filters functioning in terms of water quality treatment, as opposed to the Wilmington DTC DSF, which represents the worst case scenario in terms of contaminant load and maintenance needs.

2. Route 273/7 Park-and-Ride Lot DSF (BMP 46)

This DSF consists of a long, single set of sedimentation and sand chambers. The sand chamber design consists of two inches of #57 stone placed on top of 18 inches of sand, with a single perforated effluent pipe wrapped with geotextile fabric. The drainage area consists of a large relatively flat paved parking area used as a park-and-ride bus stop at the intersection of Route 273 and Route 7 in Bear, Delaware. Cars and trucks are routinely parked in the area. There is also a public recycling center within the park-and-ride lot. The Route 273/7 Park-and-Ride Lot was last maintained in Spring 2007, in preparation for this DSF Study. See the aerial for the location and setting of this DSF.



273/7 Park and Ride DSF



Observations

As indicated in 2010 DWO and WWO (**Appendix B**) and during the 2008-2009 observations, there is a black coating on the gravel in the sand chamber. There were no other potential maintenance issues identified by field crews during the DWO and WWO (**Appendix B**).

Water Quality Field Testing

During WWO, water quality field testing at the DSF inflow and outflow was conducted. In 2010, five samples were tested at the outflow, and four at the inflow (no flow for one date). The mean and standard deviation for each parameter are provided in **Appendix B. Table 6** provides a summary of the parameters with mean outflow levels that are less than the inflow levels (✓), parameters with equal or very similar mean inflow and outflow levels (=), and those parameters not detected (ND) at both inflow and outflow. A table cell without any symbol indicates that the mean outflow level is greater than the inflow level.

**TABLE 6
 ROUTE 273-7 PARK-AND-RIDE DSF WATER QUALITY FIELD TESTING**

PARAMETER	MEAN OUTFALL < INFLOW
Turbidity	✓
pH	=
Chloride	
Carbon Dioxide	=
Alkalinity	✓
Ammonia	✓
Hardness	✓
Dissolved Oxygen	=
Nitrite	ND

Recommendations

No maintenance is recommended for this BMP; the BMP is performing as designed.

Action 1 – To Be Performed by KCI:

KCI will continue to observe this DSF in 2011. The goal is to determine the point at which the performance of this DSF is compromised, and then present a formal maintenance schedule to DelDOT. This DSF has been functioning properly for three years without maintenance.

3. Wilmington DTC Bus Facility DSF

This site consists of a series of chambers tied together with overflow openings. The surrounding area is commercial land use, which is entirely paved and sloped at the Wilmington Delaware Transit Corporation (DTC) facility on Monroe Street. The DTC parking facility is used for parking mass transit buses, and has daily bus traffic. The sand chamber design consists of 12 inches of sand over six inches of #57 stone, with geotextile between the sand and stone. The perforated outflow pipe lies in the stone layer. See the aerial for the location and setting of this DSF.



Observations

In 2009 and 2010, DWO and WWO indicated a black residue containing oily waste accumulating on the top layer of the sand. This black residue clogs the top of the sand, which impedes the flow of water through the sand media (**Appendix C**). Based on field observations, it appears that this DSF was maintained in May, October and December 2010.

Water Quality Field Testing

During WWO, water quality field testing at the DSF inflow and outflow was conducted. In 2010, five samples were tested at the outflow, and four at the inflow (no flow for 1 date). The mean and standard deviation for each parameter are provided in **Appendix C**. **Table 7** provides a summary of the parameters with water quality field testing mean outflow levels that are less than the inflow levels (✓), and those parameters that were not detected (ND) at both inflow and outflow. A table cell without a symbol indicates that the mean outflow level is greater than the inflow level.

**TABLE 7
 WILMINGTON DTC DSF WATER QUALITY FIELD TESTING**

PARAMETER	MEAN OUTFALL < INFLOW
Turbidity	✓
pH	=
Chloride	
Carbon Dioxide	
Alkalinity	
Ammonia	=
Hardness	
Dissolved Oxygen	✓
Nitrite	ND

Automated Wet Weather Monitoring

An automated sampler was installed in the manhole that receives stormwater from the Wilmington DTC DSF on August 13, 2009. Three WWM events were conducted at the DSF outflow in 2010. Samples were also collected at the DSF inflow for the December 1, 2010 event. The WWM data for each site is provided in **Table 8**. The mean and standard deviation for each parameter are provided in **Appendix C**.

Recommendations

After review of the 2009 Wilmington DTC DSF Sand Analyses laboratory results, it appears that removing only the top layer of sand would not be an appropriate method of maintenance. This is because a number of the pollutants have infiltrated to the bottom layer of sand.

KCI's observations of the Lancaster Pike and Route 273/7 DSFs in 2007-2010 indicated that the placement of a stone layer on top of the sand may reduce clogging of the sand; therefore KCI is recommending an alternative sand chamber design with stone on top. A long-term study of both designs at the same DSF is recommended.

Action 1 – To Be Performed by KCI:

Fix antenna cable to allow automated WWM. KCI needs to be notified of, and present during, the next clean-out of the sand filter at the DTC facility to install a new antenna cable, which will enable automated WWM to resume.

Action 2 – To Be Performed by DelDOT:

KCI would like to obtain copies of the sand filter data collected by Eldredge, the DSF maintenance contractor, to supplement the data currently being collected by KCI.

Action 3 – To Be Performed by DelDOT:

KCI is recommending that DelDOT implement an alternate sand filter design. This alternate design can be implemented at any time most convenient to DelDOT in 2011, and will allow KCI to compare the performance of the sand filter using two unique designs. KCI recommends altering the sand chamber design every other year at this DSF, allowing a comparison of a new design (stone/sand/geotextile/stone) with the current design (sand/geotextile/stone).

**TABLE 8
WILMINGTON DTC DSF WET WEATHER MONITORING LABORATORY DATA**

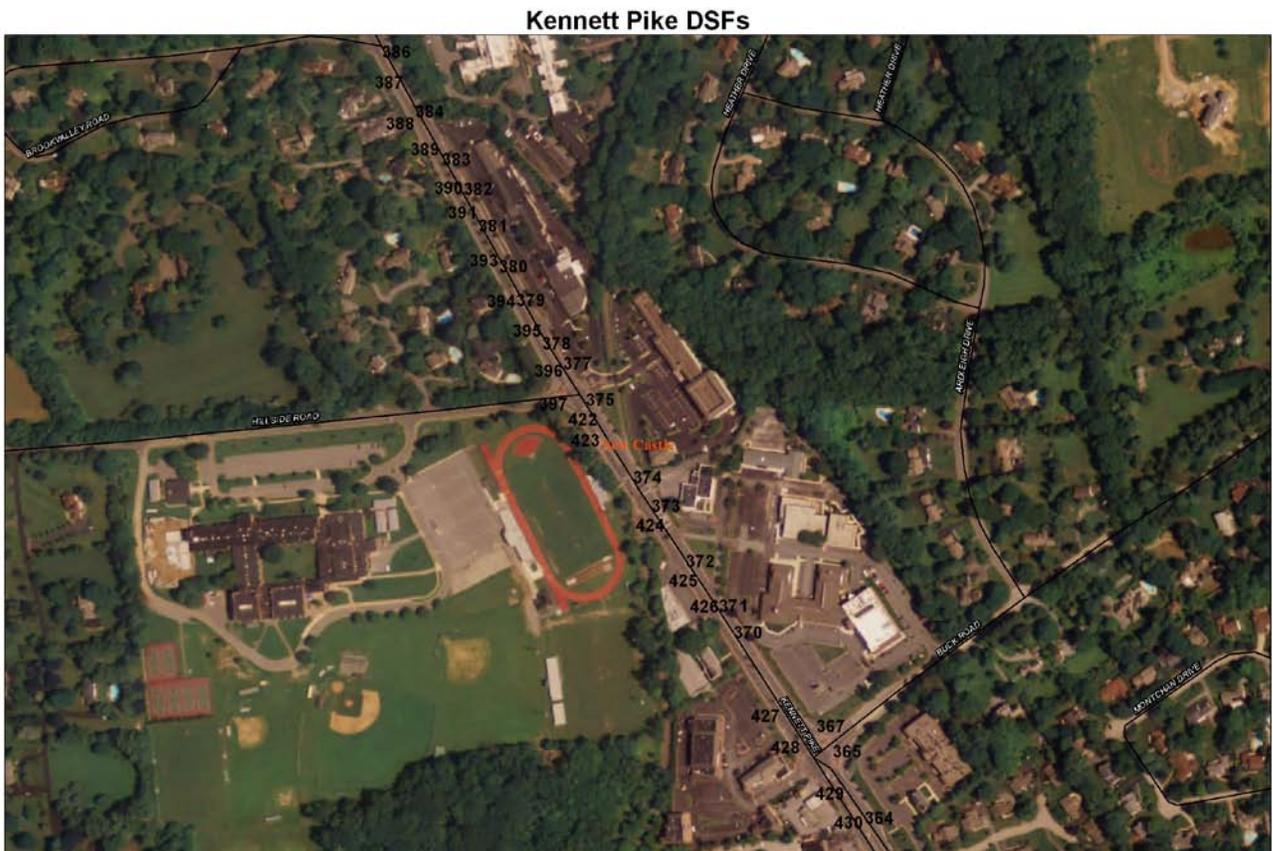
PARAMETER	WILM DSF IN				WILM DSF OUT			
	12/01/10		01/25/10		02/23/10		12/01/10	
	FF	COMP	FF	COMP	FF	COMP	FF	COMP
Total Suspended Solids (mg/L)	79	15	87	60	117	64	7	9
Total Dissolved Solids (mg/L)	44	38	960	564	834	499	67	58
Chemical Oxygen Demand (mg/L)	43	<10	53	16	101	68	<10	<10
Biological Oxygen Demand (mg/L)	<3	<3	15	8	9	15	13	7
Chloride (mg/L)	<1	1.22	--	--	524	366	3	2.48
Oil & Grease (mg/L)	<5	<5	<5	<5	10.60	<5	<5	<5
pH (units)	7.70	7.52	8.08	8.35	8.50	8.18	7.95	7.97
Total Kjeldahl Nitrogen (mg/L)	0.47	<0.2	0.58	0.50	0.75	0.55	0.31	<0.2
Ammonia (mg/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total Phosphorus (mg/L)	0.09	<0.05	0.08	0.06	0.15	0.09	<0.05	<0.05
Dissolved Phosphorus (mg/L)	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05
Ortho-Phosphate (mg/L)	0.10	0.08	<0.05	<0.05	0.06	<0.05	0.14	0.10
Total Cadmium (mg/L)	<0.004	<0.004	<0.002	<0.002	<0.002	<0.002	<0.004	<0.004
Total Copper (mg/L)	0.020	<0.005	0.013	0.009	0.018	0.017	<0.005	<0.005
Total Lead (mg/L)	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Zinc (mg/L)	0.256	0.055	0.075	0.065	0.105	0.080	0.007	0.005

4. Kennett Pike DSF (BMPs 364-430)

When KCI submitted the formal recommendations for maintenance at the Lancaster Avenue DSFs in 2009, it was understood that these recommendations were not appropriate for the adjacent Kennett Pike DSFs located in Centerville, Delaware. This is due to the unique setting in which the Lancaster Pike DSFs treat runoff along the roadway. Lancaster Pike has a distinct vertical alignment, which places several DSFs at the top of the DSF series. This is different from the Kennett Pike DSFs, which tend to individually treat runoff along this roadway having an undulating vertical alignment. Because the primary goal of the entire DSF Study is to recommend a maintenance plan for all DeIDOT sand filters, it was decided to include the Kennett Pike DSF to the DSF Study. See the aerial for the location and setting of the Kennett Pike DSFs.



Kennett Pike DSF 367



Observations

In 2010, four DWO were performed at the 44 Kennett Pike DSFs. **Appendix D** contains the DWO field data collected for each filter for each of the four monthly DWO, as well as a statistical summary of the mean and standard deviation for the quantifiable parameters (i.e., water depth, sediment depth, debris depth, % coverage). WWO, Water Quality Field Testing and WWM are not performed at the Kennett Pike DSFs.

The 2010 DWO indicated no significant increase in debris depth in the sand chamber for the majority of sand filters. A heavy thick black residue was observed accumulating on the stone in the sand chambers; however it does not seem to be affecting the functionality of the sand filters. There were no other potential maintenance issues identified by field crews during the DWO.

Recommendations

As presented in the *2009 DSF Study Annual Report*, KCI recommends the DSFs be maintained as indicated in **Table 9**. For 2011, KCI recommends that DelDOT remove all sediment/organic debris accumulated in the receiving weirs and sediment chambers of every series of DSFs along Kennett Pike. In addition, DelDOT should rehabilitate the sand chamber for all chambers of BMP 371 and BMP 373.

**TABLE 9
 KENNETT PIKE DSF MAINTENANCE RECOMMENDATIONS**

Kennett Pike BMP #	Weirs Leading into BMP	Sediment Chamber	Sand Chamber	Number of Chambers
364	Clean out	Clean out	Ok	1
365	Clean out	Clean out	Ok	1
366	Clean out	Clean out	Ok	1
367	Clean out	Clean out	Ok	2
368	Clean out	Clean out	Ok	1
369	Clean out	Clean out	Ok	2
370	Clean out	Clean out	Ok	1
371	Clean out	Clean out	Clean out	1
372	Clean out	Clean out	Ok	1
373	Clean out	Clean out	Clean out	2
374	Clean out	Clean out	Ok	2
375	Clean out	Clean out	Ok	3
376	Clean out	Clean out	Ok	1
377	Clean out	Clean out	Ok	1
378	Clean out	Clean out	Ok	2
379	Clean out	Clean out	Ok	1
380	Clean out	Clean out	Ok	2

Kennett Pike BMP #	Weirs Leading into BMP	Sediment Chamber	Sand Chamber	Number of Chambers
381	Clean out	Clean out	Ok	1
382	Clean out	Clean out	Ok	1
383	Clean out	Clean out	Ok	2
384	Clean out	Clean out	Ok	2
385	Clean out	Clean out	Ok	1
386	Clean out	Clean out	Ok	2
387	Clean out	Clean out	Ok	1
388	Clean out	Clean out	Ok	1
389	Clean out	Clean out	Ok	1
390	Clean out	Clean out	Ok	1
391	Clean out	Clean out	Ok	1
392	Clean out	Clean out	Ok	1
393	Clean out	Clean out	Ok	1
394	Clean out	Clean out	Ok	1
395	Clean out	Clean out	Ok	1
396	Clean out	Clean out	Ok	1
397	Clean out	Clean out	Ok	1
421	Clean out	Clean out	Ok	1
422	Clean out	Clean out	Ok	1
423	Clean out	Clean out	Ok	1
424	Clean out	Clean out	Ok	4
425	Clean out	Clean out	Ok	1
426	Clean out	Clean out	Ok	1
427	Clean out	Clean out	Ok	1
428	Clean out	Clean out	Ok	1
429	Clean out	Clean out	Ok	3
430	Clean out	Clean out	Ok	2

D. NEXT STEPS

The following describes KCI's planned DSF Study activities for 2011. Highlights of the 2011 activities include evaluating an alternate sand chamber design at the Wilmington DTC DSF and beginning automated WWM at the Lancaster Pike DSF (BMP 72).

Chapman Maintenance Yard DSF

Due to frequent clogging during truck wash operations, this DSF was removed (sand chamber replaced with rip-rap) and was eliminated from the DSF Study in 2010. There will be no evaluations of this DSF in 2011, unless the DSF is re-built as part of the Stormceptor Truck Wash BMP; however, there are no plans to do this at this time.

Lancaster Pike DSF (BMPs 52, 54-73)

KCI recommends that DelDOT begin the maintenance of this DSF in 2011, as described previously. KCI will focus its 2011 activities on determining the extent of maintenance of the uppermost DSF (BMP 72), by continuing the DWO and WWO, and WWM at BMP 72.

Route 273/7 Park & Ride (BMP 46)

KCI has not observed any major performance issues concerning this DSF during the life of the DSF study. KCI will continue to monitor this BMP as in previous years.

Wilmington DTC DSF

KCI will coordinate with the Wilmington DTC maintenance staff to fix the broken antenna cable during the next scheduled maintenance. In addition, KCI recommends that DelDOT install the alternate sand chamber design during a future maintenance in 2011, to allow a long term study of the effects of the different designs.

Kennett Pike DSF (BMPs 364-430)

KCI recommends that DelDOT begin the maintenance of this DSF in 2011, as described previously. KCI will focus its 2011 activities on determining trends at this series of BMPs in order to develop a maintenance schedule.

DELAWARE SAND FILTER STUDY

2010 ANNUAL REPORT

APPENDIX A

LANCASTER PIKE BMP 72 DSF

- **DRY WEATHER OBSERVATION SUMMARY TABLE**
- **WET WEATHER OBSERVATION SUMMARY TABLE**
- **WATER QUALITY FIELD TESTING SUMMARY TABLE**
- **WWM MEAN & STANDARD DEVIATION TABLE**
- **WWM BOX & WHISKER PLOTS**

**LANCASTER PIKE DELAWARE SAND FILTER
WET WEATHER FIELD OBSERVATIONS
2010 WET SUMMARY**

Date Inspected	01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	2010 MEAN (M) & STANDARD DEVIATION (SD)																																														
Precipitation Past 24 Hours (in)	1.68	0.56	0.32	0.67	0.51	0.53	0.08																																															
INFLOW TURBIDITY (NTU)																																																						
IN (Curb)	54.50	86.94	No Flow	46.18	22.48	No Flow	33.06	See Next Page																																														
OUT (Pipe in Catch Basin)	8.68	23.25	No Flow	5.42	76.53	9.35	5.05																																															
PETROLEUM ODOR																																																						
Yes (Y) / No (N)	N	N	N	N	N	Y	Y	N/A																																														
SEDIMENTATION CHAMBER																																																						
Chambers Inspected	#1	#3	#5	#7	#9	#11	#1	#3	#5	#7	#9	#11	#1	#3	#5	#7	#9	#11	#1	#3	#5	#7	#9	#11	#1	#3	#5	#7	#9	#11	#1	#3	#5	#7	#9	#11	#1	#3	#5	#7	#9	#11												
Water Present (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	M	SD										
Water Depth (ft)	2.0	2.2	2.1	2.2	1.8	2.1	2.2	2.1	2.1	2.2	1.5	2.1	0.5	1.3	1.5	1.8	1.7	1.4	0.7	1.5	1.3	1.5	1.1	1.3	1.9	1.7	1.8	1.8	1.4	0.3	1.8	1.7	1.8	1.7	1.8	0.3	2.0	1.5	1.9	2.2	1.6	0.8	1.56	0.701	1.70	0.330	1.78	0.298	1.90	0.282	1.56	0.240	1.18	0.768
Oil or Grease Present (Y/N)	N	N	N	N	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A											
SAND CHAMBER																																																						
Water Present (Y/N)	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N/A											
Depth Water on Sand (ft)	0.5	0.6	0.3	0.7	0.3	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.8	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.31	0.314	0.20	0.346	0.04	0.113	0.10	0.265	0.04	0.113	0.11	0.184
Clogging Evidence (Y/N)	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N/A											
Oil or Grease Present (Y/N)	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A											

Number of Samples = 7

FIELD NOTES:

02/23/10: Road cinders and pine needles at DSF.

LANCASTER PIKE DELAWARE SAND FILTER

WET WEATHER FIELD OBSERVATIONS

2010 WATER QUALITY SUMMARY

PARAMETER	UNITS	DSF IN								
		01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	IN Mean	IN SD
Time		*	9:20	**	10:00	10:00	**	12:50	--	--
Air Temp	F	*	38.0	**	52.0	49.0	**	71.0	52.50	13.723
Water Temp	F	*	45.6	**	57.5	55.0	**	71.6	57.43	10.749
Turbidity	NTU	*	86.94	**	46.18	22.48	**	33.06	47.17	28.233
pH	units	*	7.25	**	7.19	7.52	**	7.66	7.41	0.222
Chloride	mg/L	*	210.0	**	60.0	60.0	**	60.0	97.50	75.000
Carbon Dioxide	mg/L	*	10.0	**	10.0	10.0	**	10.0	10.00	0.000
Alkalinity	mg/L	*	17.1	**	51.3	51.3	**	85.5	51.30	27.924
Ammonia	mg/L	*	1.0	**	0.4	0.6	**	2.9	1.23	1.144
Hardness	mg/L	*	68.4	**	51.3	51.3	**	68.4	59.85	9.873
Dissolved Oxygen	mg/L	*	10.0	**	8.0	10.0	**	7.0	8.75	1.500
Nitrite	mg/L	*	0	**	0	0	**	0	0	0

N = 4

* No Water Quality Testing
 ** No Flow

DSF OUT									
01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	OUT Mean	OUT SD	
*	9:40 am	**	10:15	10:00	2:30	1:10	--	--	
*	38.0	**	52.0	49.0	83.0	71.0	58.60	18.091	
*	46.1	**	58.7	55.8	82.9	71.6	63.02	14.369	
*	23.25	**	5.42	76.53	9.35	5.05	23.92	30.327	
*	7.11	**	7.18	7.42	7.61	7.21	7.31	0.205	
*	240.0	**	90.0	60.0	90.0	90.0	114.00	71.624	
*	10.0	**	10.0	15.0	10.0	10.0	11.00	2.236	
*	68.4	**	51.3	34.2	85.5	85.5	64.98	22.296	
*	0.5	**	0.2	0.0	0.6	0.8	0.42	0.319	
*	51.3	**	34.2	51.3	34.2	85.5	51.30	20.943	
*	10.0	**	8.0	7.0	8.0	7.0	8.00	1.225	
*	0	**	0	0	0	0	0	0	

N = 5

Mean-SD without 07/13/10 OUT Data, because there was no IN Data (no flow)

DSF OUT									
01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	OUT Mean	OUT SD	
*	9:40 am	**	10:15	10:00		1:10	--	--	
*	38.0	**	52.0	49.0		71.0	52.50	13.723	
*	46.1	**	58.7	55.8		71.6	58.05	10.518	
*	23.25	**	5.42	76.53		5.05	27.56	33.732	
*	7.11	**	7.18	7.42		7.21	7.23	0.133	
*	240.0	**	90.0	60.0		90.0	120.00	81.240	
*	10.0	**	10.0	15.0		10.0	11.25	2.500	
*	68.4	**	51.3	34.2		85.5	59.85	22.076	
*	0.5	**	0.2	0.0		0.8	0.38	0.350	
*	51.3	**	34.2	51.3		85.5	55.58	21.517	
*	10.0	**	8.0	7.0		7.0	8.00	1.414	
*	0	**	0	0		0	0	0	

N = 4

LANCASTER PIKE DELAWARE SAND FILTER (BMP 72)

WET WEATHER MONITORING

2010 LABORATORY MEAN & STANDARD DEVIATION

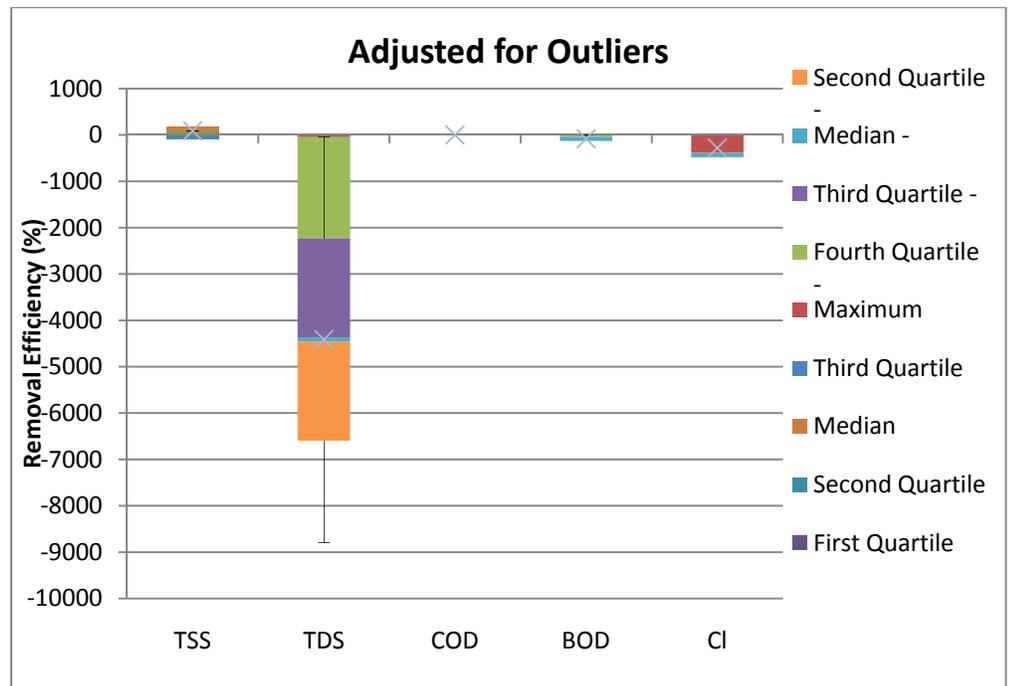
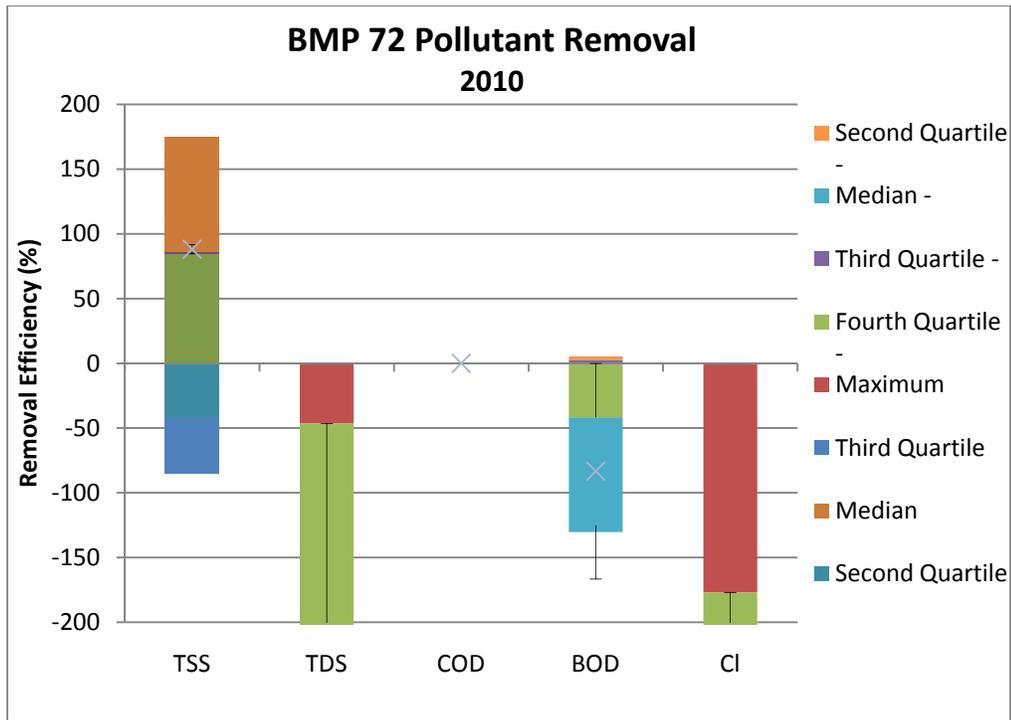
PARAMETERS	BMP 72 IN				BMP 72 OUT			
	First Flush		Composite		First Flush		Composite	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Suspended Solids	54	15.6	18.5	7.78	3	1.4	ND	ND
Total Dissolved Solids	8	3.5	30.5	36.06	70	44.5	263.0	256.0
Chemical Oxygen Demand	18	17.7	ND	ND	ND	ND	ND	ND
Biological Oxygen Demand	ND	ND	ND	ND	ND	ND	2.5	2.1
Chloride	3.08	1.075	2.08	0.184	11.50	6.930	8.1	3.7
Oil & Grease	ND	ND	ND	ND	ND	ND	ND	ND
pH	7.08	0.35	7.08	0.33	7.06	0.14	7.17	0.09
Total Kjeldahl Nitrogen	0.57	0.057	0.48	0.071	0.48	0.318	0.36	0.042
Ammonia	ND	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus	0.12	0.028	0.10	0.021	0.07	0.000	0.08	0.007
Dissolved Phosphorus	0.09	0.007	0.06	0.014	0.07	0.007	0.07	0.000
Ortho-Phosphate	0.10	0.007	0.11	0.021	0.07	0.000	0.07	0.014
Total Cadmium	ND	ND	ND	ND	ND	ND	ND	ND
Total Copper	0.006	0.0046	0.004	0.0025	0.004	0.0025	ND	ND
Total Lead	ND	ND	ND	ND	ND	ND	ND	ND
Total Zinc	0.060	0.0339	0.037	0.0092	0.015	0.0021	0.012	0.0085

Number of Samples (n) = 2

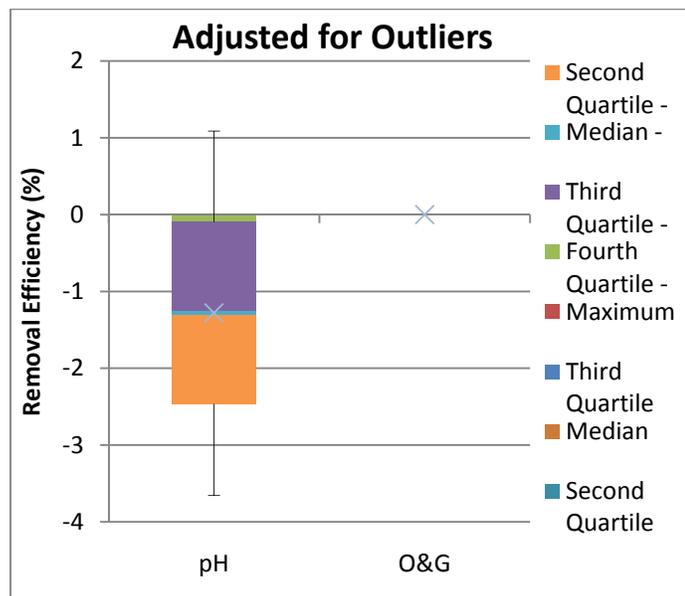
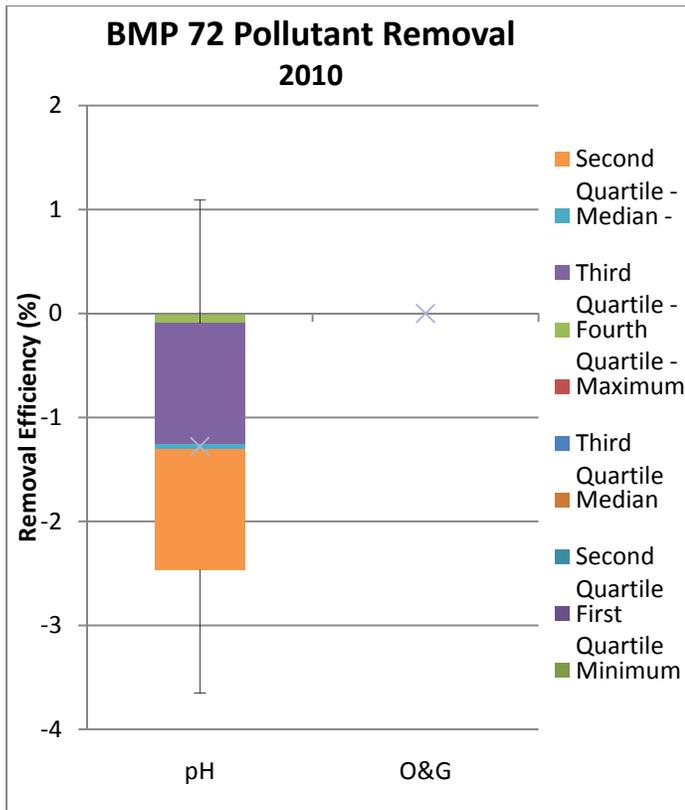
SD = Standard Deviation

ND = Non Detects - Those levels that were less than the laboratory equipment detection limit.

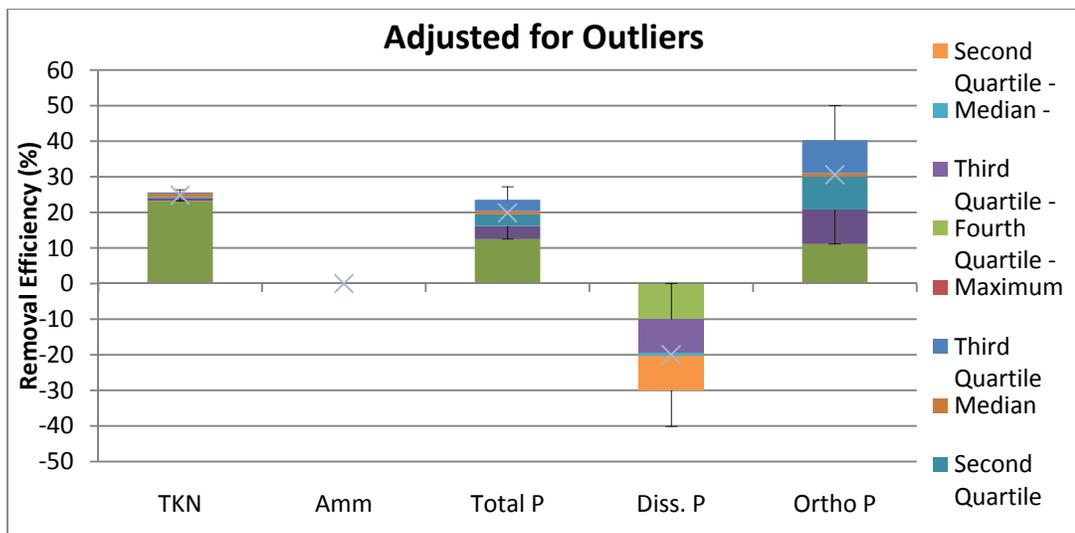
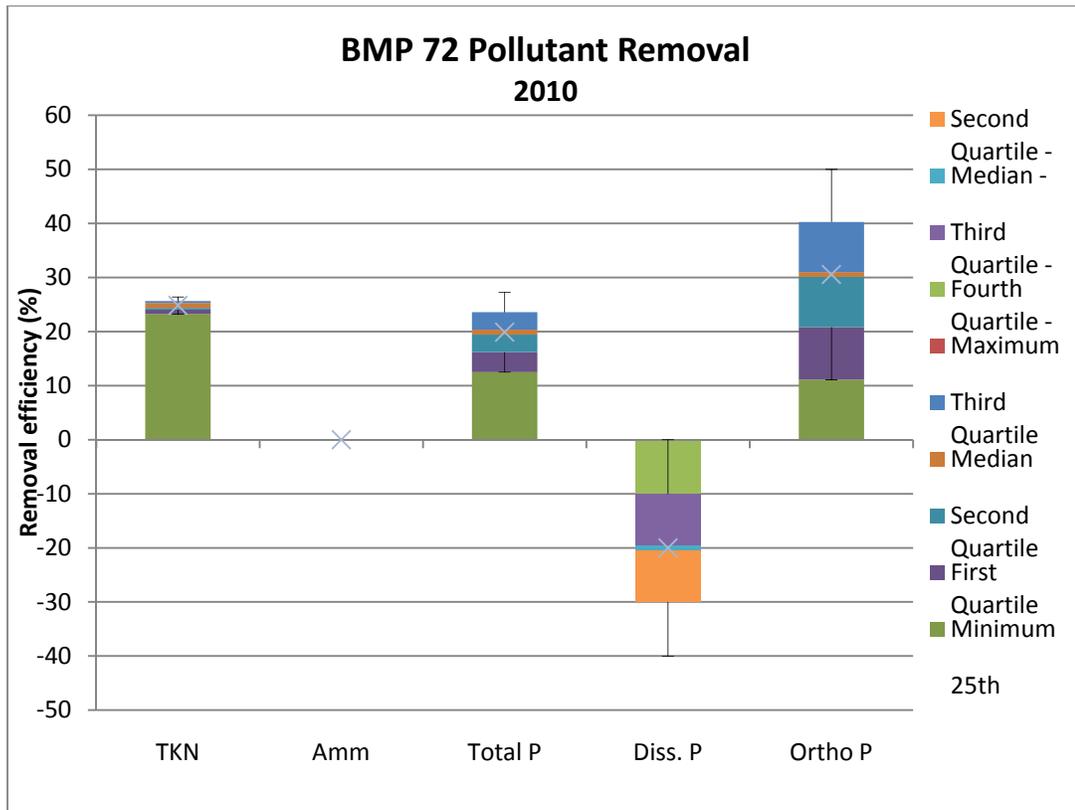
For the purpose of calculating means, Non Detects were assumed to be one half of the limit of detection.



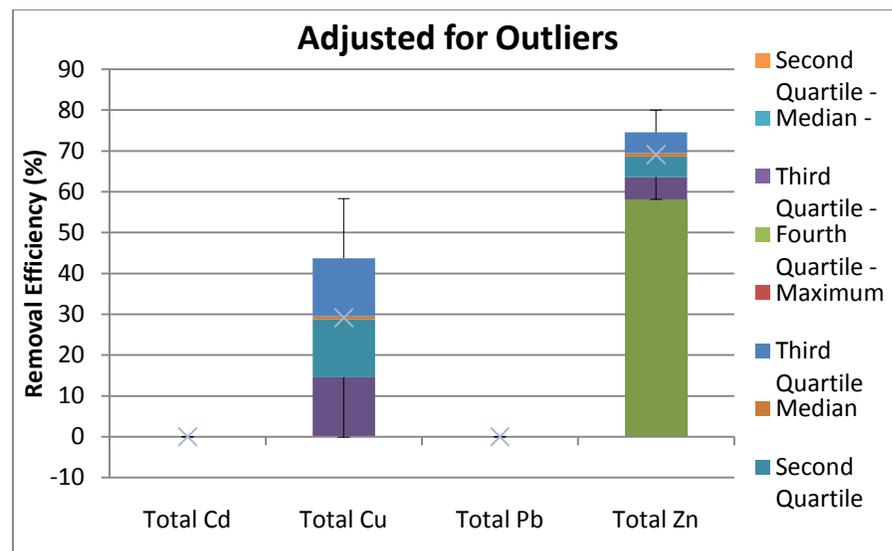
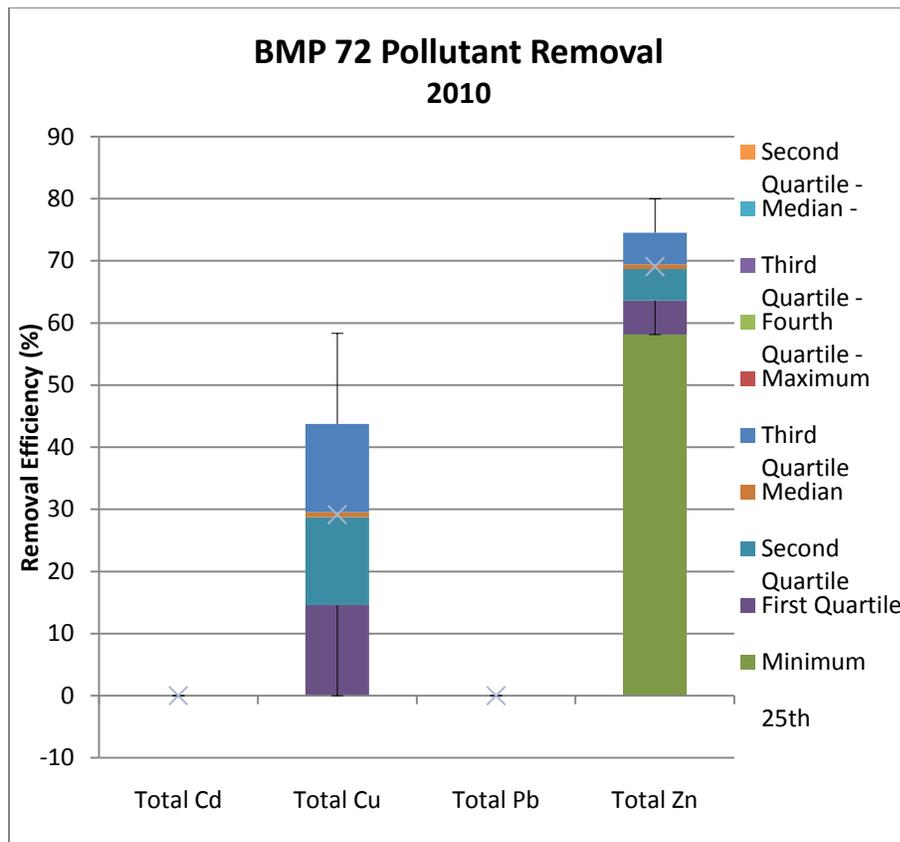
Removal Efficiency Statistical Data					
	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Chemical Oxygen Demand (COD)	Biological Oxygen Demand (BOD)	Chloride (Cl)
Count	2	2	2	2	2
Min	84.62	-8780	ND	-166.67	-384.16
25th	86.3825	-6596.61	ND	-125.003	-332.35
Median	88.145	-4413.22	ND	-83.335	-280.54
75th	89.9075	-2229.82	ND	-41.6675	-228.73
Max	91.67	-46.43	ND	0	-176.92
Mean	88.145	-4413.22	ND	-83.335	-280.54
SD	4.985103	6175.567	ND	117.8535	146.5408



Removal Efficiency Statistical Data		
	pH	Oil & Grease (O&G)
Count	2	2
Min	-3.65	ND
25th	-2.465	ND
Median	-1.28	ND
75th	-0.095	ND
Max	1.09	ND
Mean	-1.28	ND
SD	3.351686	ND



Removal Efficiency Statistical Data					
	Total Kjeldahl (TKN)	Ammonia	Total Phosphorus	Dissolved Phosphorus	Ortho Phosphate
Count	2	2	2	2	2
Min	23.26	ND	12.5	-40	11.11
25th	24.05	ND	16.1925	-30	20.8325
Median	24.84	ND	19.885	-20	30.555
75th	25.63	ND	23.5775	-10	40.2775
Max	26.42	ND	27.27	0	50
Mean	24.84	ND	19.885	-20	30.555
SD	2.234457	ND	10.44397	28.28427	27.49938



Removal Efficiency Statistical Data				
	Total Cadmium (Cd)	Total Copper (Cu)	Total Lead (Pb)	Total Zinc (Zn)
Count	2	2	2	2
Min	ND	0	ND	58.14
25th	ND	14.5825	ND	63.605
Median	ND	29.165	ND	69.07
75th	ND	43.7475	ND	74.535
Max	ND	58.33	ND	80
Mean	ND	29.165	ND	69.07
SD	ND	41.24554	ND	15.45735

DELAWARE SAND FILTER STUDY

2010 ANNUAL REPORT

APPENDIX B

ROUTE 273 / 7 PARK-AND-RIDE LOT DSF

- **DRY WEATHER OBSERVATION SUMMARY TABLE**
- **WET WEATHER OBSERVATION SUMMARY TABLE**
- **WATER QUALITY FIELD TESTING SUMMARY TABLE**

ROUTE 273/7 PARK & RIDE DELAWARE SAND FILTER

DRY WEATHER FIELD OBSERVATIONS

2010 DRY SUMMARY

Date Inspected	01/13/10	02/04/10	03/16/10	04/23/10	06/16/10	08/05/10	11/09/10	12/28/10	2010	
Previous Precipitation	01/01/10	01/25/10	03/15/10	04/21/10	06/13/10	08/04/10	11/04/10	12/12/10	Mean (M)	Standard Deviation (SD)
SEDIMENTATION CHAMBER										
Water Present (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	N/A	
Water Depth (ft)	1.7	1.7	1.4	1.6	1.6	1.7	1.8	1.3	1.60	0.169
Sediment Depth (ft)	0.1	0.2	0.4	0.1	0.2	0.2	0.1	0.5	0.2	0.151
Oil or Grease Present (Y/N)	Y	Y	Y	N	Y	Y	Y	Y	N/A	
SAND CHAMBER										
Water Present (Y/N)	N	N	N	N		N	N	N	N/A	
Gravel Depth (ft)	0.5	0.5	0.5	0.5	0.5	0.6	0.3	0.5	0.5	0.083
Sand Depth (ft)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.026
Discoloration Depth (ft)	0.1	0.1	0.1	0.1	0.3	0.4	0.1	0.3	0.2	0.113
Clogging Evidence (Y/N)	N	N	N	N	N	N	N	N	N/A	
Debris Depth (ft)	0.1	0.1	0.0	0.2	0.2	0.3	0.1	0.1	0.1	0.088
Debris Coverage (%)	100	100	100	100	100	100	100	10	88.8	31.820
Oil or Grease Present	Y	Y	Y	N	Y	Y	Y	Y	N/A	

N = 8

FIELD NOTES:

01/13/10: Sediment chamber frozen - broke ice to get measurements.

ROUTE 273/7 PARK & RIDE DELAWARE SAND FILTER

WET WEATHER FIELD OBSERVATIONS

2010 WET SUMMARY

Date Inspected	01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	2010	
Precipitation Past 24 Hours (in)	1.68	0.55	0.42	0.78	0.57	0.69	0.50	Mean (M)	Standard Deviation (SD)
TURBIDITY (NTU)									
IN (Curb)	8.11	16.21	No Flow	12.96	151.80	No Flow	17.32	See Next Page	
OUT (Manhole)	21.15	30.13	No Flow	5.59	49.72	3.09	2.30		
PETROLEUM ODOR									
Yes (Y) / No (N)	N	N	N	N	Y	Y	Y	N/A	
SEDIMENTATION CHAMBER									
Water Present (Y/N)	Y	Y	Y	Y	Y	Y	Y	N/A	
Water Depth (ft)	1.7	1.9	1.8	1.5	1.7	1.8	1.8	1.74	0.119
Oil or Grease Present (Y/N)	N	Y	Y	Y	Y	Y	Y	N/A	
SAND CHAMBER									
Water Present (Y/N)	N	N	N	N	N	N	N	N/A	
Water Depth (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Clogging Evidence (Y/N)	N	N	N	N	N	N	N	N/A	
Oil or Grease Present (Y/N)	N	Y	Y	Y	Y	Y	Y	N/A	

N = 7

ROUTE 273-7 PARK & RIDE DELAWARE SAND FILTER

WET WEATHER FIELD OBSERVATIONS

2010 WATER QUALITY SUMMARY

PARAMETER	UNITS	DSF IN								
		01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	IN Mean	IN SD
Time		*	11:00	**	11:15	11:45	**	2:00	--	--
Air Temp	F	*	39.0	**	52.0	49.0	**	71.0	52.75	13.376
Water Temp	F	*	47.3	**	59.8	54.6	**	72.6	58.58	10.663
Turbidity	NTU	*	16.21	**	12.96	151.80	**	17.32	49.57	68.177
pH	units	*	7.31	**	7.31	7.50	**	8.11	7.56	0.379
Chloride	mg/L	*	120.0	**	60.0	30.0	**	60.0	67.50	37.749
Carbon Dioxide	mg/L	*	5.0	**	10.0	5.0	**	5.0	6.25	2.500
Alkalinity	mg/L	*	17.1	**	68.4	17.1	**	51.3	38.48	25.650
Ammonia	mg/L	*	0.4	**	0.5	0.0	**	0.1	0.25	0.238
Hardness	mg/L	*	34.2	**	51.3	51.3	**	68.4	51.30	13.962
Dissolved Oxygen	mg/L	*	11.0	**	8.0	9.0	**	7.0	8.75	1.708
Nitrite	mg/L	*	0	**	0	0	**	0	0	0

* No Water Quality Testing
 ** No Flow

N = 4

DSF OUT								
01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	OUT Mean	OUT SD
*	11:00	**	11:30	11:30	2:45	2:15	--	--
*	39.0	**	52.0	49.0	83.0	71.0	58.80	17.810
*	48.0	**	59.4	56.5	79.0	72.10	63.00	12.440
*	30.13	**	5.59	49.72	3.09	2.30	18.17	21.071
*	7.21	**	7.23	7.50	7.99	7.62	7.51	0.321
*	180.0	**	60.0	30.0	120.0	30.0	84.00	65.038
*	5.0	**	10.0	5.0	5.0	5.0	6.00	2.236
*	17.1	**	51.3	17.1	85.5	51.3	44.46	28.614
*	0.4	**	0.4	0.0	0.0	0.0	0.16	0.219
*	51.3	**	51.3	51.3	68.4	34.2	51.30	12.092
*	11.0	**	7.0	9.0	7.0	8.0	8.40	1.673
*	0	**	0	0	0	0	0	0

N = 5

Mean-SD without 07/13/10 OUT Data, because there was no IN Data (no flow)

DSF OUT								
01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	OUT Mean	OUT SD
*	11:00	**	11:30	11:30		2:15	--	--
*	39.0	**	52.0	49.0		71.0	52.75	13.376
*	48.0	**	59.4	56.5		72.10	59.00	9.984
*	30.13	**	5.59	49.72		2.30	21.94	22.300
*	7.21	**	7.23	7.50		7.62	7.39	0.202
*	180.0	**	60.0	30.0		30.0	75.00	71.414
*	5.0	**	10.0	5.0		5.0	6.25	2.500
*	17.1	**	51.3	17.1		51.3	34.20	19.745
*	0.4	**	0.4	0.0		0.0	0.20	0.231
*	51.3	**	51.3	51.3		34.2	47.03	8.550
*	11.0	**	7.0	9.0		8.0	8.75	1.708
*	0	**	0	0		0	0	0

N = 4

DELAWARE SAND FILTER STUDY

2010 ANNUAL REPORT

APPENDIX C

WILMINGTON DTC DSF

- **DRY WEATHER OBSERVATION SUMMARY TABLE**
- **WET WEATHER OBSERVATION SUMMARY TABLE**
- **WATER QUALITY FIELD TESTING SUMMARY TABLE**
- **WWM MEAN & STANDARD DEVIATION TABLE**
- **WWM BOX & WHISKER PLOTS**
- **WWM FLOWLINK GRAPHS**

WILMINGTON DTC DELAWARE SAND FILTER

DRY WEATHER FIELD OBSERVATIONS

2010 DRY SUMMARY

Date Inspected	01/13/10			02/04/10			03/16/10			04/23/10			06/16/10			08/05/10			11/09/10			12/28/2010			2010 MEAN (M) & STANDARD DEVIATION (SD)													
Previous Precipitation	01/01/10			01/25/10			03/15/10			04/21/10			06/13/10			08/04/10			11/04/10			12/12/2010																
SEDIMENTATION CHAMBER																																						
Chambers Inspected	#1	#4	#5	#1	#4	#5	#2	#4	#6	#1	#3	#5	#2	#4	#6	#1	#3	#5	#2	#4	#6	#1	#3	#5	#1	#2	#3	#4	#5	#6								
Water Present (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD		
Water Depth (ft)	1.4	2.2	1.9	1.5	2.1	1.8	1.6	2.2	1.7	1.5	2.1	1.9	1.5	2.1	1.8	1.5	2.4	1.9	1.5	2.0	1.7	1.5	2.3	1.9	1.48	0.045	4.60	0.058	6.80	0.153	2.12	0.084	1.88	0.045	1.72	0.029		
Sediment Depth (ft)	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0	0	0.1	0.04	0.055	0.10	0.058	0.0	0	0.06	0.055	0.04	0.055	0.07	0.058		
Oil or Grease Present (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A													
SAND CHAMBER																																						
Water Present (Y/N)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N/A													
Gravel Depth (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.5	1.5	0.8	1.5	1.6	0.56	0.134	2.00	0.289	2.50	0.577	0.70	0.447	0.72	0.492	0.83	0.577		
Sand Depth (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.3	0.3	0.1	0.65	0.75	0.25	0.53	0.067	1.30	0.115	1.75	0.144	0.45	0.112	0.45	0.112	0.37	0.231		
Discoloration Depth (ft)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.10	0	0.40	0.058	0.30	0	0.12	0.045	0.10	0	0.13	0.058		
Clogging Evidence (Y/N)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N/A													
Debris Depth (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.00	0	0.0	0	0.0	0		
Debris Coverage (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0.00	0	0.0	0	0.0	0	0.0	0
Oil or Grease Present (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A													

FIELD NOTES:

01/13/10: Sediment chamber frozen - broke ice to get measurements.

02/04/10: Black antenna cable cut in half coming out of grate from sediment chamber #5.

06/16/10: DSF cleaned in May.

N = 5 N = 3 N = 3 N = 5 N = 5 N = 3

WILMINGTON DTC DELAWARE SAND FILTER

WET WEATHER FIELD OBSERVATIONS

2010 WET SUMMARY

Date Inspected	01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	2010 MEAN (M) & STANDARD DEVIATION (SD)																									
Precipitation Past 24 Hours (in)	--	--	0.28	0.64	0.37	1.62	0.08																										
INFLOW TURBIDITY (NTU)																																	
IN (Curb)	--	18.88	No Flow	39.49	108.4	No Flow	24.61	See Next Page																									
OUT (Manhole on Sidewalk)	--	23.89	No Flow	15.74	10.81	No Flow	6.17																										
PETROLEUM ODOR																																	
Yes (Y) / No (N)	--	--	N	N	Y	Y	Y	N/A																									
SEDIMENTATION CHAMBER																																	
Chambers Inspected	--	--	--	--	--	--	#1	#3	#5	#2	#4	#6	#1	#3	#5	#2	#3	#5	#1	#4	#6	#1	#2	#3	#4	#5	#6						
Water Present (Y/N)	--	--	--	--	--	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Water Depth (ft)	--	--	--	--	--	--	1.6	2.3	1.9	1.6	2.3	1.9	1.6	2.6	2.0	1.5	2.3	1.8	1.6	2.1	1.9	1.60	0.000	1.57	0.042	2.37	0.161	2.20	0.141	1.88	0.126	1.90	0.000
Oil or Grease Present (Y/N)	--	--	--	--	--	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A											
SAND CHAMBER																																	
Water Present (Y/N)	--	--	--	--	--	--	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N/A											
Depth Water on Sand (ft)	--	--	--	--	--	--	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.058	0.05	0.071	0.15	0.180	0.05	0.071	0.03	0.058	0.05	0.071
Clogging Evidence (Y/N)	--	--	--	--	--	--	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N/A											
Oil or Grease Present (Y/N)	--	--	--	--	--	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A											

FIELD NOTES:

01/25/10: Buses parked on DSF - no inspection

02/23/10: Snow cover and buses parked over DSF - no inspection; noticeable oil sheen flowing into DSF.

03/26/10: Oil sheen in sedimentation chamber; black coating on sand in sand chamber.

N = 3 N = 2 N = 3 N = 2 N = 3 N = 2

WILMINGTON DTC DELAWARE SAND FILTER

WET WEATHER FIELD OBSERVATIONS

2010 WATER QUALITY SUMMARY

PARAMETER	UNITS	DSF IN								
		01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	IN Mean	IN SD
Time		*	8:20	**	8:30	9:10	**	12:40	--	--
Air Temp	F	*	37.0	**	51.0	49.0	**	71.0	52.00	14.095
Water Temp	F	*	40.1	**	57.0	53.5	**	71.6	55.55	12.944
Turbidity	NTU	*	18.88	**	39.49	108.40	**	24.61	47.85	41.294
pH	units	*	7.60	**	7.23	7.43	**	7.80	7.52	0.243
Chloride	mg/L	*	210.0	**	30.0	30.0	**	30.0	75.00	90.000
Carbon Dioxide	mg/L	*	5.0	**	10.0	5.0	**	5.0	6.25	2.500
Alkalinity	mg/L	*	17.1	**	34.2	34.2	**	34.2	29.93	8.550
Ammonia	mg/L	*	0.2	**	0.5	0.0	**	0.6	0.33	0.275
Hardness	mg/L	*	68.4	**	34.2	34.2	**	34.2	42.75	17.100
Dissolved Oxygen	mg/L	*	9.0	**	9.0	10.0	**	8.0	9.00	0.816
Nitrite	mg/L	*	0	**	0	0	**	0	0	0

DSF OUT								
01/25/10	02/23/10	03/26/10	04/26/10	05/18/10	07/13/10	09/27/10	OUT Mean	OUT SD
*	8:20	**	8:45	8:50	**	12:55	--	--
*	37.0	**	51.0	49.0	**	71.0	52.00	14.095
*	42.1	**	56.9	57.8	**	71.70	57.13	12.093
*	23.89	**	15.74	10.81	**	6.17	14.15	7.577
*	7.50	**	7.18	7.57	**	7.65	7.48	0.206
*	150.0	**	90.0	30.0	**	60.0	82.50	51.235
*	5.0	**	10.0	5.0	**	10.0	7.50	2.887
*	51.3	**	34.2	51.3	**	68.4	51.30	13.962
*	0.3	**	0.2	0.0	**	0.8	0.33	0.340
*	51.3	**	34.2	51.3	**	85.5	55.58	21.517
*	10.0	**	9.0	9.0	**	5.0	8.25	2.217
*	0	**	0	0	**	0	0	0

* No Water Quality Testing
 ** No Flow

N = 4

N = 4

02/23/10: Snow on DSF; oil sheen visible flowing into DSF

WILMINGTON DTC DELAWARE SAND FILTER

WET WEATHER MONITORING

DSF OUT 2009 - 2010 LABORATORY MEAN & STANDARD DEVIATION

PARAMETERS	WILM DTC OUT			
	First Flush		Composite	
	Mean	SD	Mean	SD
Total Suspended Solids	79.3	49.70	36.0	30.1
Total Dissolved Solids	488.8	474.30	301.8	266.9
Chemical Oxygen Demand	62.5	43.60	32.8	28.2
Biological Oxygen Demand	26.0	27.40	16.8	14.0
Chloride	263.7	368.10	184.2	257.0
Oil & Grease	4.53	4.05	3.6	2.3
pH	8.19	0.240	8.05	0.280
Total Kjeldahl Nitrogen	0.53	0.190	0.38	0.200
Ammonia	0.10	0.000	0.10	0.000
Total Phosphorus	0.07	0.060	0.05	0.030
Dissolved Phosphorus	0.03	0.020	0.03	0.000
Ortho-Phosphate	0.06	0.050	0.04	0.040
Total Cadmium	0.000	0.0000	0.000	0.0000
Total Copper	0.010	0.0100	0.010	0.0100
Total Lead	0.010	0.0000	0.010	0.0000
Total Zinc	0.060	0.0400	0.040	0.0300

N = 4

SD = Standard Deviation

ND = Non Detects - Those levels that were less than the laboratory equipment detection limit.

For the purpose of calculating means, Non Detects were assumed to be one half of the limit of detection.

WILMINGTON DTC DELAWARE SAND FILTER

WET WEATHER MONITORING

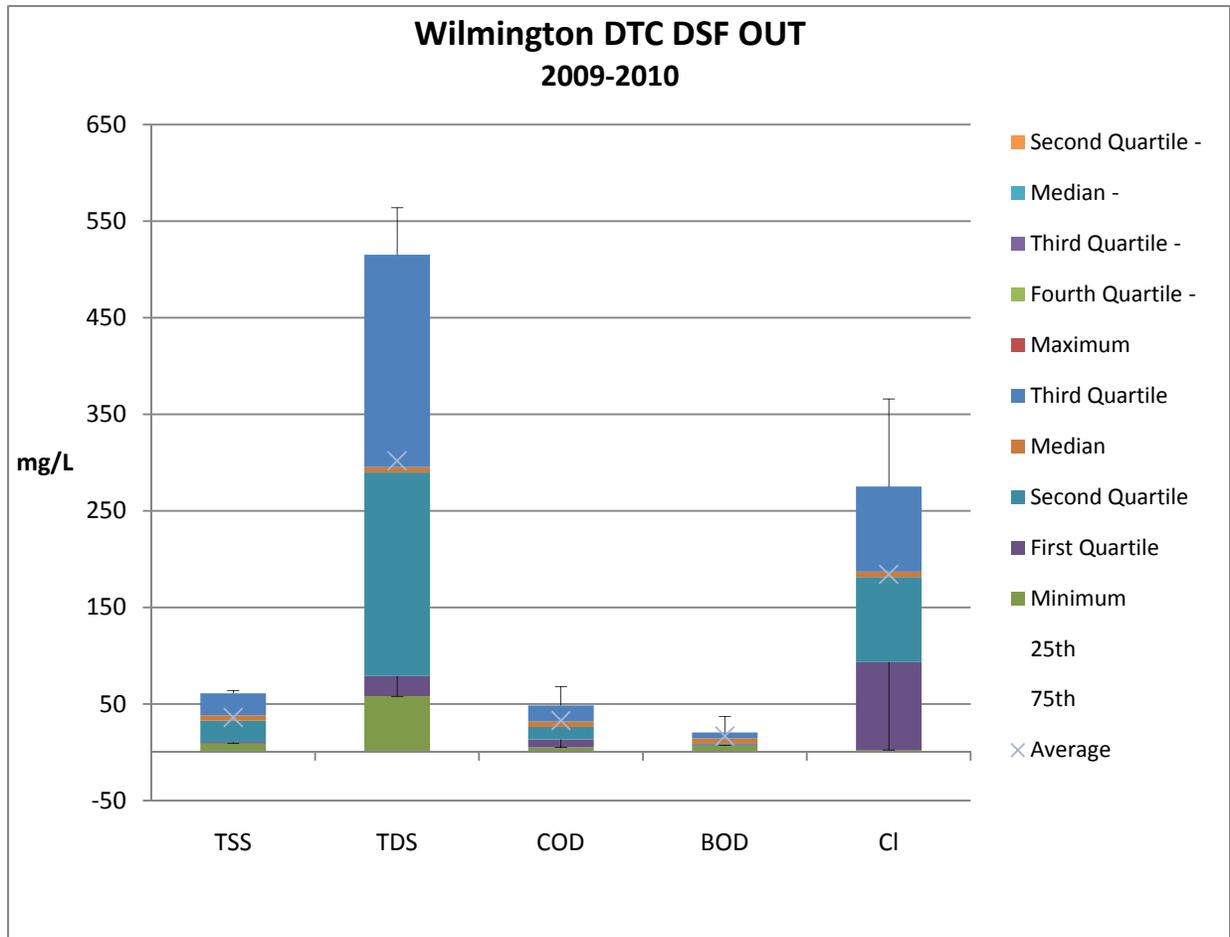
DECEMBER 1, 2010 LABORATORY DATA

PARAMETERS	WILM DTC IN		WILM DTC OUT	
	First Flush	Composite	First Flush	Composite
	Data	Data	Data	Data
Total Suspended Solids	79	15	7	9
Total Dissolved Solids	44	38	67	58
Chemical Oxygen Demand	43	ND	ND	ND
Biological Oxygen Demand	ND	ND	13.0	7.0
Chloride	ND	1.22	3.38	2.48
Oil & Grease	ND	ND	ND	ND
pH	7.70	7.52	7.95	7.97
Total Kjeldahl Nitrogen	0.47	ND	0.31	ND
Ammonia	ND	ND	ND	ND
Total Phosphorus	0.09	ND	ND	ND
Dissolved Phosphorus	ND	ND	ND	ND
Ortho-Phosphate	0.10	0.08	0.14	0.10
Total Cadmium	ND	ND	ND	ND
Total Copper	0.020	ND	ND	ND
Total Lead	0.011	ND	ND	ND
Total Zinc	0.256	0.055	0.007	0.005

N = 1

N = 1

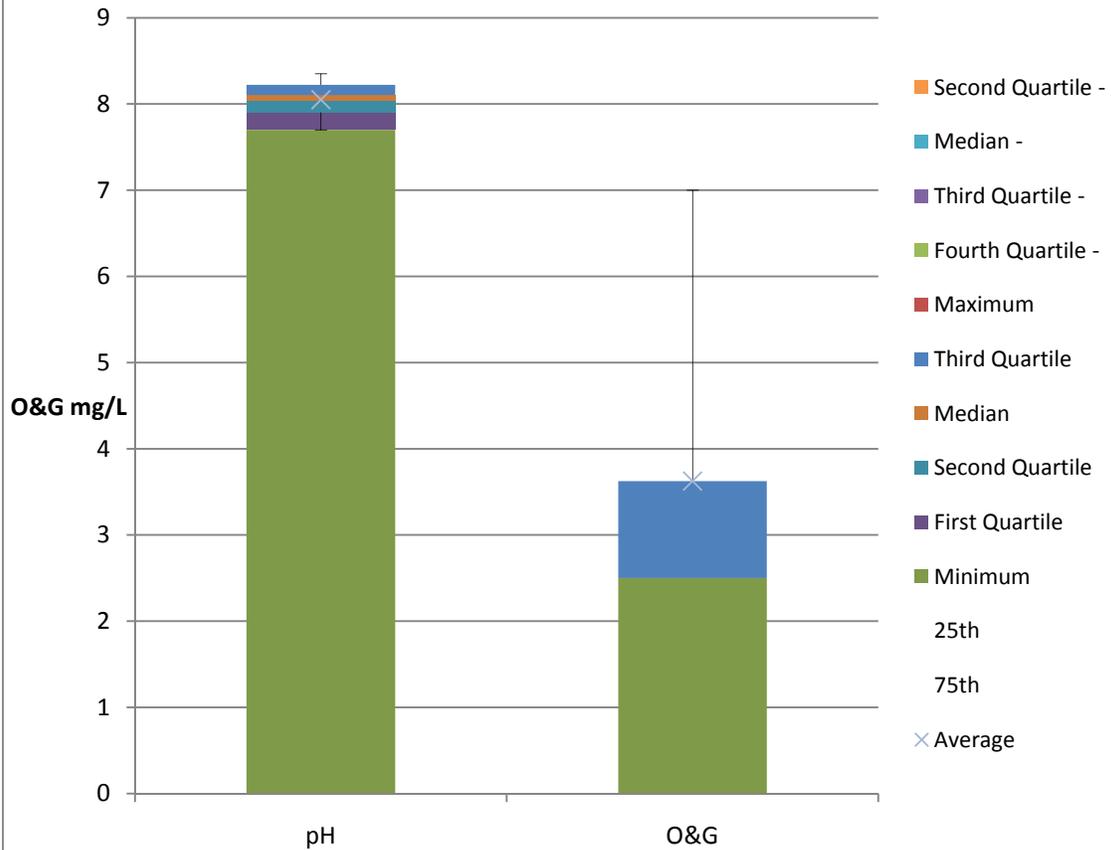
ND = Non Detects - Those levels that were less than the laboratory equipment detection limit.



Statistical Data (2009-2010)					
	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Chemical Oxygen Demand (COD)	Biological Oxygen Demand (BOD)	Chloride (Cl)
Count	4	4	4	4	2
Min	9	58	5	7	2.48
25th	10.5	79	13.25	7.75	93.36
Median	35.5	292.5	29	11.5	184.24
75th	61	515.25	48.5	20.5	275.12
Max	64	564	68	37	366
Mean	36	301.75	32.75	16.75	184.24
SD	30.07768	266.8612	28.15878	13.96126	257.0475

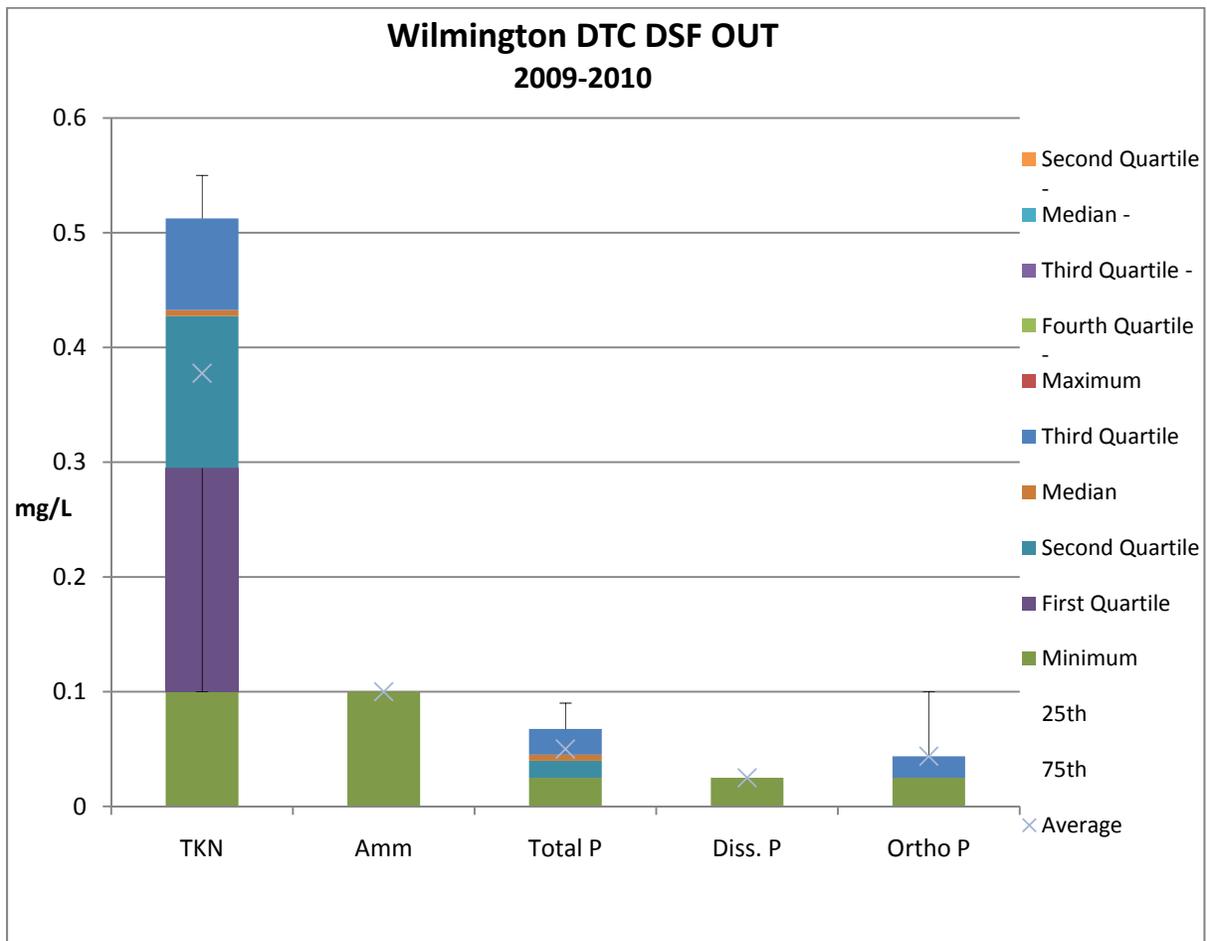
Laboratory Data (2009-2010)					
Date	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Chemical Oxygen Demand (COD)	Biological Oxygen Demand (BOD)	Chloride (Cl)
12/09/09	11	86	42	37	--
01/25/10	60	564	16	8	--
02/23/10	64	499	68	15	366
12/01/10	9	58	ND	7	2.48

Wilmington DTC DSF OUT 2009-2010



Statistical Data (2009-2010)		
	pH	Oil & Grease (O&G)
Count	4	4
Min	7.7	2.5
25th	7.9025	2.5
Median	8.075	2.5
75th	8.2225	3.625
Max	8.35	7
Mean	8.05	3.625
SD	0.280357	2.25

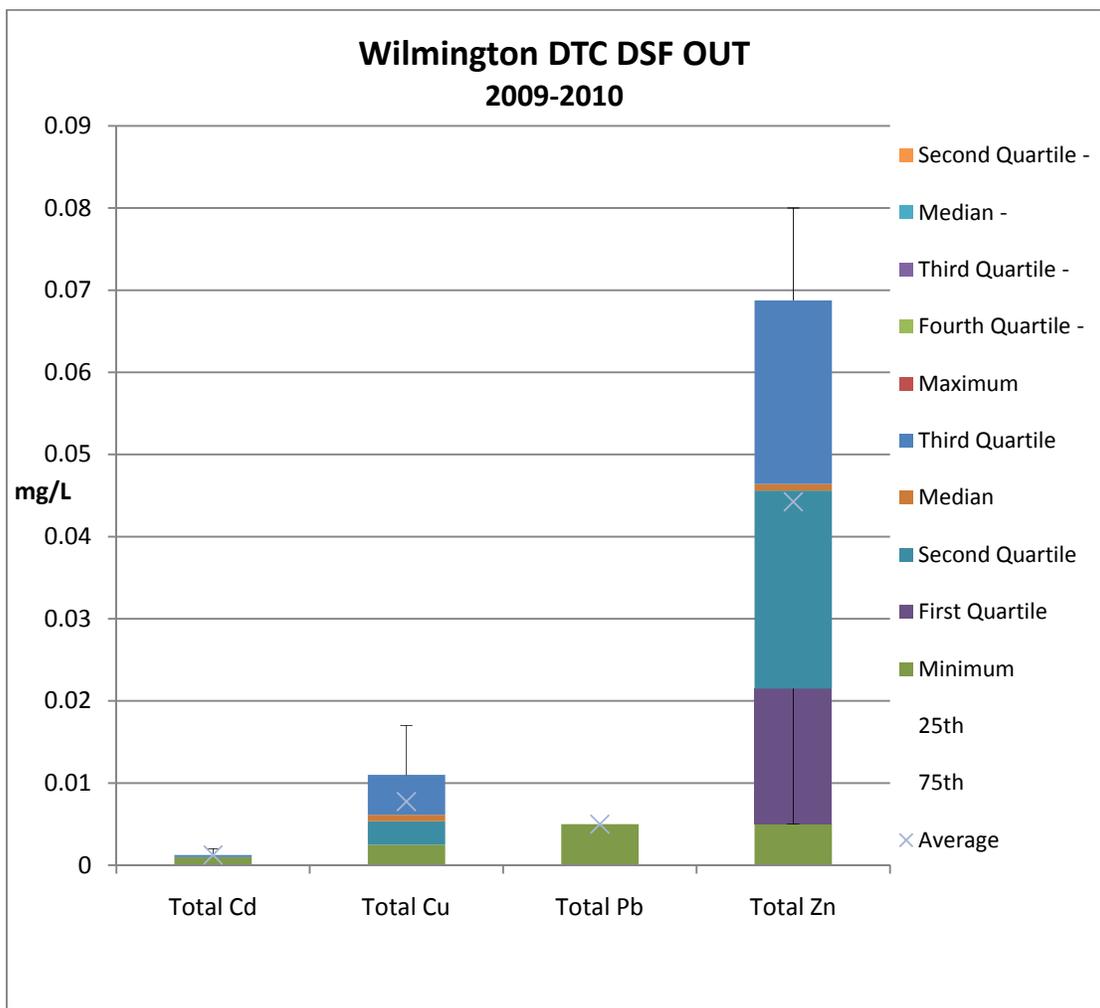
Laboratory Data (2009-2010)		
Date	pH	Oil & Grease (O&G)
12/09/09	7.7	7
01/25/10	8.35	ND
02/23/10	8.18	ND
12/01/10	7.97	ND



**ALL AMMONIA & DISSOLVED PHOSPHORUS COMPOSITE LEVELS
WERE BELOW THE LABORATORY EQUIPMENT DETECTION LIMITS**

Statistical Data (2009-2010)						
	Total Kjeldahl (TKN)	Ammonia	Total Phosphorus	Dissolved Phosphorus	Ortho Phosphate	
Count	4	4	4	4	4	
Min	0.1	ND	0.025	ND	0.025	
25th	0.295	ND	0.025	ND	0.025	
Median	0.43	ND	0.0425	ND	0.025	
75th	0.5125	ND	0.0675	ND	0.04375	
Max	0.55	ND	0.09	ND	0.1	
Mean	0.3775	ND	0.05	ND	0.04375	
SD	0.201722	ND	0.031358	ND	0.0375	

Laboratory Data (2009-2010)						
Date	Total Kjeldahl (TKN)	Ammonia	Total Phosphorus	Dissolved Phosphorus	Ortho Phosphate	
12/09/09	0.36	ND	ND	ND	ND	
01/25/10	0.50	ND	0.06	ND	ND	
02/23/10	0.55	ND	0.09	ND	ND	
12/01/10	ND	ND	ND	ND	0.10	

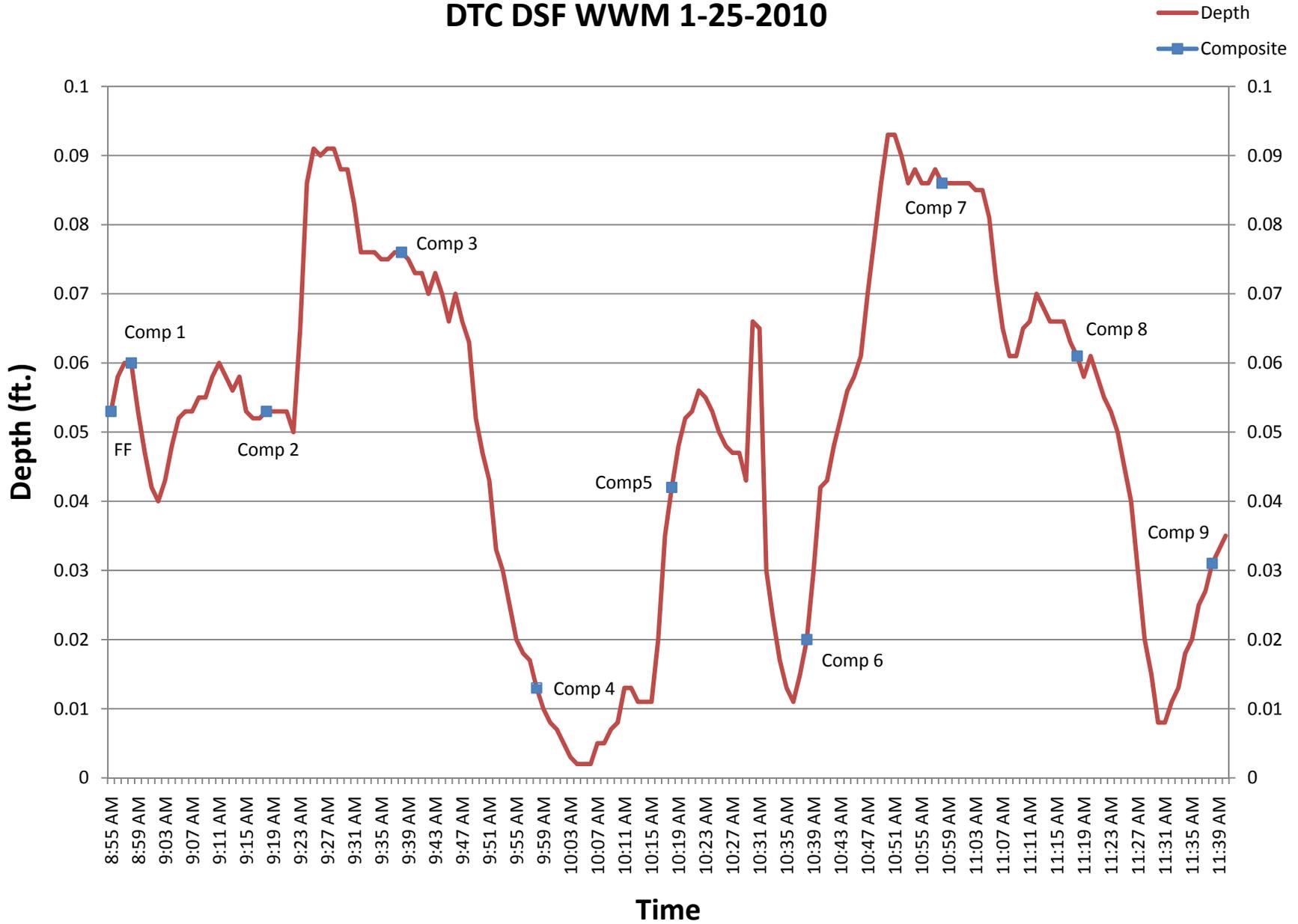


**ALL TOTAL CADMIUM & TOTAL LEAD COMPOSITE LEVELS
WERE BELOW THE LABORATORY EQUIPMENT DETECTION LIMITS**

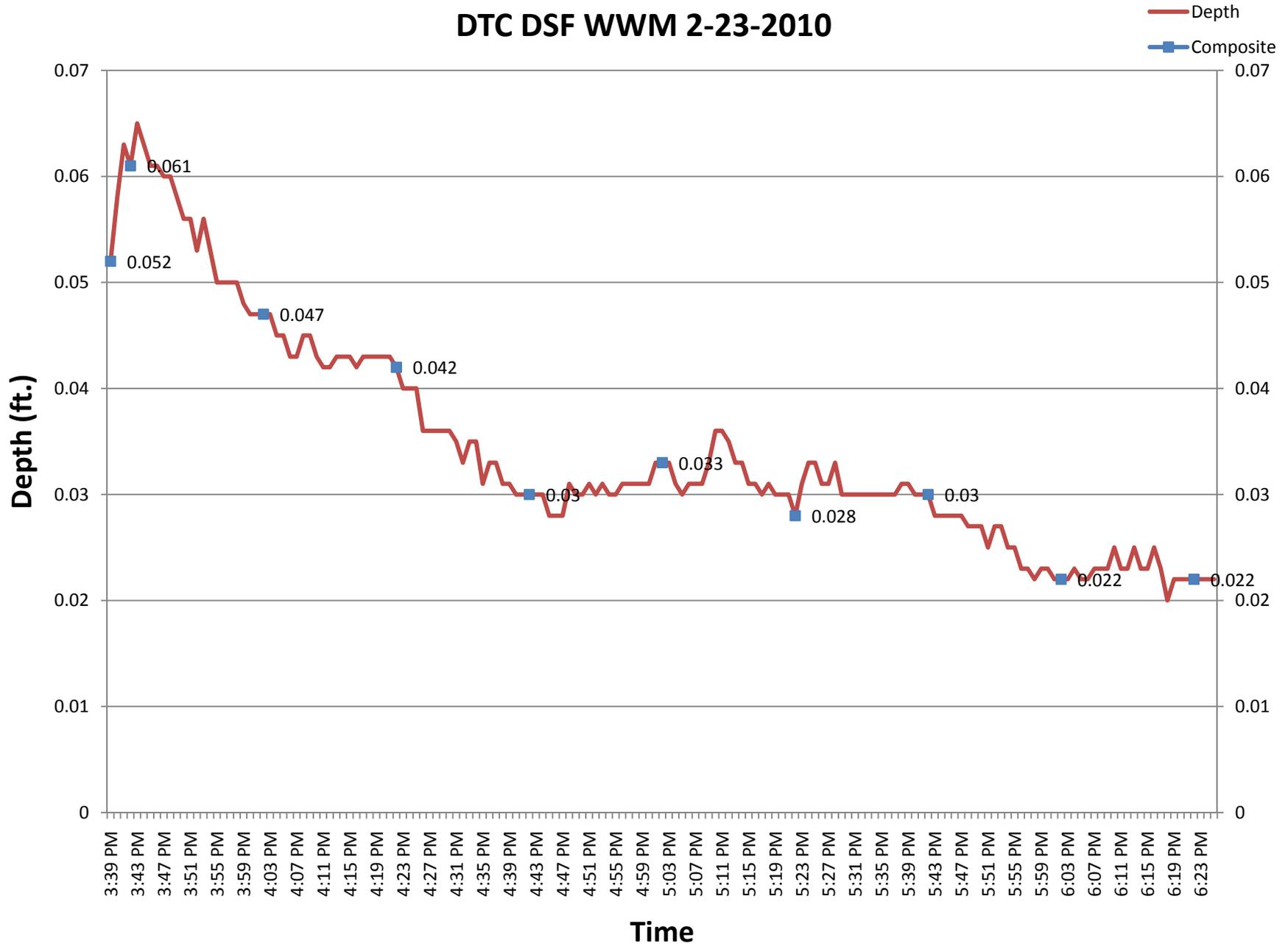
Statistical Data (2009-2010)				
	Total Cadmium	Total Copper	Total Lead	Total Zinc
Count	4	4	4	4
Min	ND	0.0025	ND	0.005
25th	ND	0.0025	ND	0.0215
Median	ND	0.00575	ND	0.046
75th	ND	0.011	ND	0.06875
Max	ND	0.017	ND	0.08
Mean	ND	0.00775	ND	0.04425
SD	ND	0.006886	ND	0.034384

Laboratory Data (2009-2010)				
Date	Total Cadmium	Total Copper	Total Lead	Total Zinc
12/09/09	ND	ND	ND	0.027
01/25/10	ND	0.009	ND	0.065
02/23/10	ND	0.017	ND	0.080
12/01/10	ND	ND	ND	0.005

DTC DSF WWM 1-25-2010



DTC DSF WWM 2-23-2010



DELAWARE SAND FILTER STUDY

2010 ANNUAL REPORT

APPENDIX D

KENNETT PIKE DSF

- **DRY WEATHER OBSERVATION STATISTICAL SUMMARY TABLE**
- **DRY WEATHER OBSERVATION MONTHLY SUMMARY TABLE**

**KENNETT PIKE DELAWARE SAND FILTER
 DRY WEATHER OBSERVATION
 2010 DRY MEAN & STANDARD DEVIATION**

BMP No.	Sed. Chamber Water Depth (ft)		Sed. Chamber Sediment Depth (ft)		Sand Chamber Debris Depth (ft)		Sand Chamber Debris Coverage (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
364	1.10	0.100	0.70	0.100	0.10	0	57.5	25.300
365	1.30	0.300	0.40	0.100	0.10	0	57.5	15.000
366	0.70	0.300	0.80	0.300	0.10	0	35.0	30.800
367	1.30	0.100	0.30	0.100	0.10	0	62.5	30.700
368	1.50	0.200	0.30	0.100	0.10	0	80.0	36.700
369	1.50	0.200	0.20	0.000	0.10	0.100	23.8	2.500
370	1.30	0.200	0.60	0.200	0.10	0.100	16.3	7.500
371	1.60	0.200	0.20	0.100	0.10	0	46.3	14.900
372	1.40	0.200	0.50	0.100	0.10	0	91.3	11.800
373	1.20	0.400	0.70	0.400	0.10	0.100	100.0	0
374	1.30	0.100	0.30	0.100	0.10	0	38.8	16.500
375	1.20	0.300	0.70	0.300	0.30	0	92.5	11.900
376	1.60	0.200	0.10	0.100	0.10	0.100	11.3	6.300
377	1.50	0.200	0.30	0.100	0.10	0	77.5	22.200
378	1.50	0.200	0.30	0.100	0.10	0	67.5	17.100
379	1.60	0.100	0.40	0.100	0.10	0	86.3	7.500
380	1.50	0.100	0.50	0.100	0.10	0	90.0	10.800
381	1.40	0.100	0.50	0.100	0.10	0	76.3	4.800
382	1.00	0.200	0.50	0.200	0.10	0	73.8	18.900
383	1.50	0.300	0.50	0.300	0.10	0	100.0	0
384	1.40	0.200	0.40	0.200	0.10	0	80.0	21.600
385	1.30	0.200	0.70	0.200	0.10	0	86.3	11.100
386	0.80	0.300	1.10	0.200	0.10	0.100	50.0	57.700
387	0.30	0.400	1.20	0.500	0.10	0.100	90.0	20.000
388	0.90	0.300	0.70	0.300	0.10	0	71.3	32.200
389	1.50	0.200	0.60	0.200	0.10	0.100	100.0	0
390	1.30	0.300	0.70	0.300	0.20	0.100	100.0	0
391	1.70	0.200	0.20	0.100	0.10	0.100	6.3	4.800
392	1.40	0.200	0.20	0.500	0.20	0.100	22.5	20.200
393	1.70	0.100	0.30	0.100	0.10	0	75.0	18.700
394	1.30	0.300	0.50	0.100	0.10	0	47.5	24.700
395	1.20	0.100	0.80	0.100	0.10	0	78.8	14.400
396	0.90	0.400	0.90	0.300	0.20	0.100	85.0	23.800
397	0.70	0.500	1.20	0.500	0.10	0	75.0	10.800
421	1.40	0.200	0.50	0.200	0.10	0.100	87.5	9.600
422	1.40	0.000	0.30	0.100	0.10	0	42.5	9.600
423	1.40	0.200	0.40	0.100	0.10	0	66.3	13.800
424	1.50	0.300	0.50	0.300	0.10	0	72.5	48.600
425	1.60	0.200	0.40	0.200	0.10	0	92.5	9.600
426	1.60	0.100	0.30	0.100	0.10	0	85.0	17.300
427	1.40	0.100	0.20	0.100	0.10	0	85.0	10.000
428	1.50	0.200	0.20	0.100	0.10	0	80.0	13.500
429	1.70	0.200	0.20	0.100	0.10	0	100.0	0
430	1.30	0.200	0.40	0.200	0.20	0.100	100.0	0

Number of Samples = 4

Kennett Pike DSF Dry Weather Observation
March 2010

BMP #	Sed. Chamber Water Present	Sed. Chamber Water Depth (ft)	Sed. Chamber Sediment Depth (ft)	Sed. Chamber Oil or Grease	Sand Chamber Water Present	Sand Chamber Clogging Evidence	Sand Chamber Debris Depth (ft)	Sand Chamber Debris Coverage (%)	Sand Chamber Oil or Grease
364	Y	1.25	0.50	Y	N	N	0.10	75	Y
365	Y	1.65	0.35	Y	N	N	0.10	50	Y
366	Y	1.00	0.55	Y	N	N	0.10	10	Y
367	Y	1.45	0.20	Y	N	N	0.10	90	Y
368	Y	1.75	0.25	Y	N	N	0.10	100	Y
369	Y	1.80	0.15	Y	N	N	0.10	25	Y
370	Y	1.50	0.50	Y	N	N	0.10	10	Y
371	Y	1.75	0.15	Y	N	N	0.10	50	Y
372	Y	1.55	0.40	Y	N	N	0.15	100	Y
373	Y	1.40	0.60	Y	N	N	0.20	100	Y
374	Y	1.35	0.25	N	N	N	0.10	15	Y
375	Y	1.40	0.60	Y	N	N	0.25	100	Y
376	Y	1.80	0.20	Y	N	N	0.10	10	Y
377	Y	1.70	0.25	Y	N	N	0.10	100	Y
378	Y	1.80	0.20	Y	N	N	0.10	60	Y
379	Y	1.70	0.25	Y	N	N	0.10	90	Y
380	Y	1.65	0.35	Y	N	N	0.10	90	Y
381	Y	1.50	0.50	Y	N	N	0.10	80	Y
382	Y	1.20	0.35	Y	N	N	0.10	60	Y
383	Y	1.60	0.40	Y	N	N	0.10	100	Y
384	Y	1.50	0.35	Y	N	N	0.10	90	Y
385	Y	1.50	0.50	Y	N	N	0.10	90	Y
386	Y	0.90	1.10	Y	Y	Y	*	--	Y
387	Y	0.50	0.90	Y	N	N	0.10	100	Y
388	Y	0.80	0.75	Y	N	N	0.10	80	Y
389	Y	1.60	0.40	Y	N	N	0.10	100	Y
390	Y	1.50	0.50	Y	N	N	0.20	100	Y
391	Y	1.90	0.10	Y	N	N	0.10	10	Y
392	Y	1.60	0.30	Y	N	N	0.10	5	Y
393	Y	1.80	0.20	Y	N	N	0.10	80	Y
394	Y	1.50	0.45	Y	N	N	0.10	15	Y
395	Y	1.30	0.71	Y	N	N	0.10	70	Y
396	Y	1.40	0.60	Y	N	N	0.10	50	Y
397	Y	0.80	1.10	Y	N	N	0.10	65	Y
421	Y	1.30	0.35	Y	N	N	0.10	80	Y
422	Y	1.40	0.20	Y	N	N	0.10	30	Y
423	Y	1.30	0.40	Y	N	N	0.10	80	Y
424	Y	1.70	0.20	Y	N	N	0.00	0	Y
425	Y	1.70	0.20	Y	N	N	0.10	80	Y
426	Y	1.60	0.25	Y	N	N	0.10	70	Y
427	Y	1.40	0.20	Y	N	N	0.10	80	Y
428	Y	1.60	0.15	Y	N	N	0.10	75	Y
429	Y	1.90	0.20	Y	N	N	0.10	100	Y
430	Y	1.50	0.20	Y	N	N	0.20	100	Y

* = Water in Sand Chamber

* = 0.50'

Kennett Pike DSF Dry Weather Observation

June 2010

BMP #	Sed. Chamber Water Present	Sed. Chamber Water Depth (ft)	Sed. Chamber Sediment Depth (ft)	Sed. Chamber Oil or Grease	Sand Chamber Water Present	Sand Chamber Clogging Evidence	Sand Chamber Debris Depth (ft)	Sand Chamber Debris Coverage (%)	Sand Chamber Oil or Grease
364	Y	0.92	0.83	N	N	N	0.10	25	N
365	Y	1.08	0.50	N	N	N	0.10	50	N
366	Y	0.50	1.00	Y	N	N	0.10	25	N
367	Y	1.17	0.33	Y	N	N	0.10	85	N
368	Y	1.25	0.42	N	N	N	0.10	95	N
369	Y	1.33	0.17	Y	N	N	0.10	25	N
370	Y	1.33	0.42	Y	N	N	0.10	10	Y
371	Y	1.42	0.42	Y	N	N	0.10	60	Y
372	Y	1.17	0.58	Y	N	N	0.15	100	N
373	Y	1.33	0.58	N	N	N	0.20	100	N
374	Y	1.33	0.25	Y	N	N	0.10	40	Y
375	Y	1.08	0.58	Y	N	N	0.25	95	N
376	Y	1.67	0.08	N	N	N	0.10	5	N
377	Y	1.17	0.33	Y	N	N	0.10	90	N
378	Y	1.58	0.25	Y	N	N	0.10	70	Y
379	Y	1.50	0.42	Y	N	N	0.10	90	N
380	Y	1.50	0.50	N	N	N	0.10	95	N
381	Y	1.33	0.42	N	N	N	0.10	80	N
382	Y	1.17	0.42	Y	N	N	0.10	60	Y
383	Y	1.75	0.25	N	N	N	0.10	100	N
384	Y	1.50	0.25	N	N	N	0.10	80	N
385	Y	1.17	0.67	Y	N	N	0.10	80	Y
386	Y	1.00	1.00	Y	Y	Y	*	--	Y
387	Y	0.00	1.65	Y	N	N	0.10	100	N
388	Y	1.20	0.40	Y	N	N	0.10	80	N
389	Y	1.70	0.30	Y	N	N	0.10	100	N
390	Y	1.30	0.60	N	N	N	0.25	100	N
391	Y	1.60	0.20	N	N	N	0.10	5	N
392	Y	1.40	0.30	Y	N	N	0.10	10	Y
393	Y	1.70	0.20	N	N	N	0.10	95	N
394	Y	1.00	0.60	Y	N	N	0.10	50	Y
395	Y	1.10	0.80	N	N	N	0.10	75	N
396	Y	1.00	0.70	Y	N	N	0.10	90	Y
397	Y	0.60	1.20	N	N	N	0.10	70	N
421	Y	1.60	0.40	Y	N	N	0.10	80	N
422	Y	1.40	0.20	N	N	N	0.10	40	N
423	Y	1.50	0.40	Y	N	N	0.10	75	N
424	Y	1.70	0.50	N	N	N	0.10	90	N
425	Y	1.70	0.30	Y	N	N	0.10	90	Y
426	Y	1.70	0.20	N	N	N	0.10	70	N
427	Y	1.50	0.10	Y	N	N	0.10	80	Y
428	Y	1.60	0.20	Y	N	N	0.10	70	Y
429	Y	1.60	0.30	Y	N	N	0.10	100	Y
430	Y	1.30	0.30	Y	N	N	0.20	100	Y

* = Water in Sand Chamber

* = 0.54'

**Kennett Pike DSF Dry Weather Observation
August 2010**

BMP #	Sed. Chamber Water Present	Sed. Chamber Water Depth (ft)	Sed. Chamber Sediment Depth (ft)	Sed. Chamber Oil or Grease	Sand Chamber Water Present	Sand Chamber Clogging Evidence	Sand Chamber Debris Depth (ft)	Sand Chamber Debris Coverage (%)	Sand Chamber Oil or Grease
364	Y	1.10	0.70	Y	N	N	0.10	50	N
365	Y	1.20	0.40	Y	N	N	0.10	50	N
366	Y	0.90	0.60	Y	N	N	0.10	25	Y
367	Y	1.40	0.20	Y	N	N	0.10	25	N
368	Y	1.40	0.20	Y	N	N	0.10	25	N
369	Y	1.40	0.20	Y	N	N	0.10	25	N
370	Y	1.10	0.80	Y	N	N	0.10	25	N
371	Y	1.70	0.20	Y	N	N	0.10	25	N
372	Y	1.50	0.40	Y	N	N	0.10	75	N
373	Y	1.50	0.50	Y	N	N	0.10	100	N
374	Y	1.40	0.20	Y	N	N	0.10	50	N
375	Y	1.50	0.50	Y	N	N	0.30	75	N
376	Y	1.60	0.10	Y	N	N	0.10	10	N
377	Y	1.60	0.30	Y	N	N	0.10	50	N
378	Y	1.20	0.40	Y	N	N	0.10	50	N
379	Y	1.60	0.30	Y	N	N	0.10	75	N
380	Y	1.50	0.50	Y	N	N	0.10	75	N
381	Y	1.40	0.40	Y	N	N	0.10	75	N
382	Y	1.10	0.40	Y	N	N	0.10	75	N
383	Y	1.70	0.30	Y	N	N	0.10	100	N
384	Y	1.50	0.30	Y	N	N	0.10	50	N
385	Y	1.40	0.50	Y	N	N	0.10	75	N
386	Y	1.00	0.90	Y	Y*	N	0.20	100	Y
387	Y	0.80	0.70	Y	N	N	0.20	100	N
388	Y	1.00	0.60	Y	N	N	0.10	25	N
389	Y	1.30	0.70	Y	N	N	0.20	100	N
390	Y	1.50	0.50	Y	N	N	0.30	100	N
391	Y	1.40	0.20	Y	N	N	0.00	0	N
392	Y	1.40	0.50	Y	N	N	0.10	25	N
393	Y	1.60	0.30	Y	N	N	0.10	75	N
394	Y	1.00	0.60	Y	N	N	0.10	75	N
395	Y	1.30	0.70	Y	N	N	0.10	100	N
396	Y	0.70	0.90	Y	N	N	0.20	100	N
397	Y	0.10	1.90	Y	N	N	0.10	75	N
421	Y	1.50	0.50	Y	N	N	0.20	100	N
422	Y	1.40	0.20	Y	N	N	0.10	50	N
423	Y	1.20	0.30	Y	N	N	0.10	50	N
424	Y	1.60	0.30	Y	N	N	0.10	100	N
425	Y	1.50	0.40	Y	N	N	0.10	100	N
426	Y	1.50	0.30	Y	N	N	0.10	100	N
427	Y	1.20	0.30	Y	N	N	0.10	100	N
428	Y	1.30	0.30	Y	N	N	0.10	75	N
429	Y	Construction							
430	Y	1.20	0.40	Y	N	N	0.20	100	N

* = Water in Sand Chamber

* = 0.7'

**Kennett Pike DSF Dry Weather Observation
November 2010**

BMP #	Sed. Chamber Water Present	Sed. Chamber Water Depth (ft)	Sed. Chamber Sediment Depth (ft)	Sed. Chamber Oil or Grease	Sand Chamber Water Present	Sand Chamber Clogging Evidence	Sand Chamber Debris Depth (ft)	Sand Chamber Debris Coverage (%)	Sand Chamber Oil or Grease
364	Y	1.00	0.75	Y	N	N	0.05	80	Y
365	Y	1.20	0.50	Y	N	N	0.05	80	Y
366	Y	0.50	1.05	Y	N	N	0.05	80	Y
367	Y	1.20	0.30	Y	N	N	0.05	50	Y
368	Y	1.50	0.35	Y	N	N	0.05	100	Y
369	Y	1.40	0.15	Y	N	N	0.00	20	Y
370	Y	1.30	0.60	Y	N	N	0.00	20	Y
371	Y	1.70	0.20	Y	N	N	0.05	50	Y
372	Y	1.40	0.50	Y	N	N	0.05	90	Y
373	Y	0.70	1.30	Y	N	N	0.05	100	Y
374	Y	1.10	0.50	Y	N	N	0.05	50	Y
375	Y	0.90	1.10	Y	N	N	0.20	100	Y
376	Y	1.40	0.10	Y	N	N	0.00	20	Y
377	Y	1.50	0.50	Y	N	N	0.05	70	Y
378	Y	1.50	0.40	Y	N	N	0.05	90	Y
379	Y	1.50	0.50	Y	N	N	0.05	90	Y
380	Y	1.50	0.50	Y	N	N	0.05	100	Y
381	Y	1.50	0.50	Y	N	N	0.10	70	Y
382	Y	0.70	0.80	Y	N	N	0.05	100	Y
383	Y	1.00	1.00	Y	N	N	0.10	100	Y
384	Y	1.20	0.60	Y	N	N	0.05	100	Y
385	Y	1.00	1.00	Y	N	N	0.10	100	Y
386	Y	0.40	1.40	Y	N	N	0.10	100	Y
387	Y	0.00	1.50	Y	N	N	0.05	60	Y
388	Y	0.60	1.00	Y	N	N	0.05	100	Y
389	Y	1.20	0.80	Y	N	N	0.10	100	Y
390	Y	0.80	1.20	Y	N	N	0.10	100	Y
391	Y	1.70	0.30	Y	N	N	0.00	10	Y
392	Y	1.20	0.70	Y	N	N	0.05	50	Y
393	Y	1.60	0.40	Y	N	N	0.05	50	Y
394	Y	1.60	0.40	Y	N	N	0.05	50	Y
395	Y	1.20	0.80	Y	N	N	0.05	70	Y
396	Y	0.60	1.20	Y	N	N	0.20	100	Y
397	Y	1.30	0.60	Y	N	N	0.10	90	Y
421	Y	1.30	0.70	Y	N	N	0.10	90	Y
422	Y	1.40	0.40	Y	N	N	0.05	50	Y
423	Y	1.50	0.50	Y	N	N	0.05	60	Y
424	Y	1.10	0.80	Y	N	N	0.05	100	Y
425	Y	1.40	0.60	Y	N	N	0.05	100	Y
426	Y	1.40	0.40	Y	N	N	0.10	100	Y
427	Y	1.30	0.30	Y	N	N	0.05	80	Y
428	Y	1.40	0.20	Y	N	N	0.05	100	Y
429	Y	1.70	0.20	Y	N	N	0.05	100	Y
430	Y	1.00	0.60	Y	N	N	0.10	100	Y

* = Water in Sand Chamber

* = 0.7'

Appendix G. KCI Technologies 2010 report on monitoring of green technology BMPs.



**DELDOT AGREEMENT 1495
WATER QUALITY MONITORING**

**GREEN TECHNOLOGY
2010 ANNUAL REPORT**

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APPENDIX A

Table 1 – Bioswale 104 WWM Laboratory Data

Table 2 – Bioswale 104 WWM Mean and Standard Deviation

Table 3 – Bioswale 104 WWM Total Effectiveness

APPENDIX B

Bioswale 104: Pollutant Removal Efficiency Box & Whisker Plots



**DELDOT AGREEMENT 1495
WATER QUALITY MONITORING
GREEN TECHNOLOGY
2010 ANNUAL REPORT**



As part of the Delaware Department of Transportation's National Pollutant Discharge Elimination System General Permit Program Regulations Governing Stormwater Discharge, KCI Technologies, Inc. was contracted to perform the following Green Technologies Best Management Practices (BMPs) Performance studies:

- Bioswale 104 Study – BMP 104
- Route 299 Grass Side Slope Study / Green Technology Modeling

A. BIOSWALE 104 STUDY

The purpose of the Bioswale 104 Study is to determine the efficiency of a bioswale in the removal of pollutants and in the reduction of flow rates for stormwater runoff. The study includes wet weather monitoring (WWM).

After review of the DelDOT Master BMP Inventory and KCI field inspection data, it was determined that water quality monitoring would be conducted at BMP 104, a bioswale along Valley Road and Lancaster Pike in New Castle County (see Location Map). This bioswale provides treatment for stormwater runoff from Lancaster Pike.



The BMP 104 WWM Sampling Protocol, Laboratory Costs, Standard Operating Procedures and Site Safety & Health Plan are located in the KCI Project Files.

1. WWM Methodology

Sampling techniques were performed in accordance with the Environmental Protection Agency (EPA) *Storm Water Sampling Guidance Document*, EPA 833-B-92-001 (July 1992). WWM sampling protocol included 72 hours of antecedently dry conditions and minimum predicted rainfall depth of 0.10 inches. A two-person crew prepared the equipment for sampling and inspected the sample site prior to the storm event. Site inspection included outfall structure inspection and debris removal from the sampling area. The first storm sample (first flush and first composite) was collected within 30 minutes from the first noticeable flow, or increase in

flow at the site. This first flush grab sample was collected early in the storm event for the same parameters as the composite, ensuring that constituents were properly collected, prepared, delivered, and analyzed per 40 CFR Part 136. As grab samples were collected, air and water temperature, pH and turbidity levels were recorded.

Grab samples used for the composite were collected every twenty (20) minutes for the first three (3) hours of the storm, or until runoff had receded to base flow conditions, whichever came first. The samples were transferred into the appropriate laboratory containers and placed into a cooler with ice for the duration of the sample period. One duplicate sample was collected from one site at the time of sampling to act as a laboratory control, the results of which are located in the KCI Project Technical Files. Standard chain-of-custody procedures were followed, and copies of the forms are located in the KCI Project Technical Files.

Depth of flow and cubic feet per second were recorded from the ISCO sampler each time a sample was collected. Measurements were recorded on the field sample collection form. Rainfall amount was collected with an on-site rain gage; data was also obtained from the Delaware Environmental Observing System Network (ODD-DEOS Precipitation) at Hockessin, DE.

Routine maintenance of the equipment included cleaning the area velocity sensors, examination and cleaning of the pump tubes and strainers, clearing access, and recalibration of automated sampling equipment. Additional details regarding sampling protocol can be found in the *Bioswale Wet Weather Monitoring Sampling Protocol* (September 2009).

2. WWM Event History

WWM Event Memorandums, Field Data Sheets, and Laboratory Data for each sampling event are located in the KCI Project Technical Files. Five WWM Events were conducted on the following dates:

- January 25, 2010
- March 12, 2010
- June 9, 2010
- October 14, 2010
- November 4, 2010



*BMP 104 WWM Event
November 2010*

3. WWM Laboratory Results

The WWM Event-specific laboratory data for all parameters at each sample site is located in **Appendix A-Table 1**. The 2010 WWM Data was organized into the following:

- Mean and Standard Deviation Summary Table
- Effectiveness Table
- Box-Whisker Plots

a. Summary Tables

The mean and standard deviation for each water quality parameter at BMP 104 IN and BMP 104 OUT is summarized in **Appendix A-Table 2**. A summary of the Total Effectiveness, comparing BMP 104 IN versus BMP OUT for each water quality parameter is located in **Appendix A-Table 3**.

b. Box and Whisker Plots

The laboratory data collected in 2010 was also organized into Box and Whisker Plots (**Appendix B**). In descriptive statistics, a Box and Whisker Plot is a convenient way to graphically depict groups of numerical data through their five-number summaries (the smallest observation, lower quartile (Q1), median (Q2), upper quartile (Q3), and largest observation). These plots are useful to display differences between populations without making any assumptions of the underlying statistical distribution. The spacings between the different parts of the box help to indicate the degree of dispersion (spread) and skewness in the data, and to identify outliers.



BIOSWALE 104 STUDY LOCATION MAP



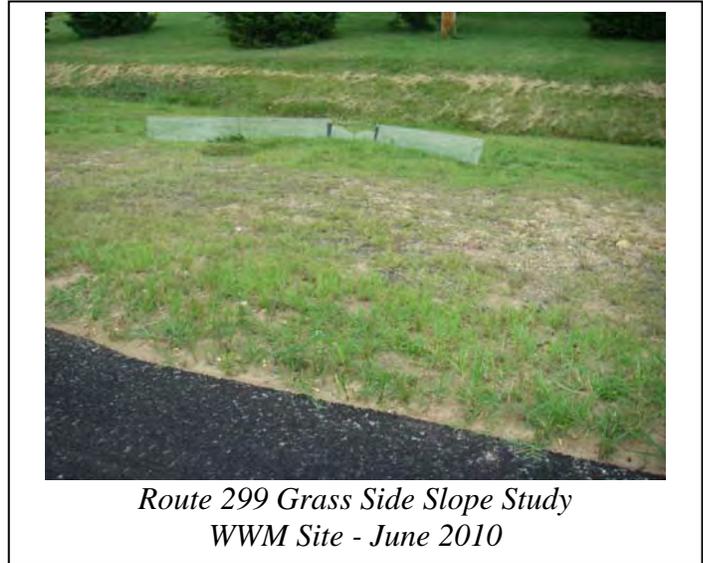
B. ROUTE 299 GRASS SIDE SLOPE STUDY

The purpose of the Route 299 Grass Side Slope Study is to determine the efficiency of a grass side slope in the removal of pollutants and in the reduction of flow rates for stormwater runoff. The study includes wet weather monitoring (WWM) and Modeling.

1. Wet Weather Monitoring

The slope along Route 299 in front of the Odessa Maintenance Yard was chosen for the study because it has a steep slope conducive for collecting flow. The sample site captures all three lanes of Route 299 runoff (see Location Map).

There were three WWM False Starts in 2010 (March, June and July). The March False Start was due to insufficient precipitation. The June and July False Starts were due to equipment installation issues. The plexiglass weirs have proved difficult to install in the hard-packed earth in the sample site area. KCI is developing alternative sampling options for 2011.



2. Modeling Study

The Modeling Study will focus on the following:

- Parameters: Metals (Cu, Pb, Cd, Zn), Nutrients (TN, TP, TKN, Ortho-P), and Total Suspended Solids.
- Annual Loading (lbs/yr discharge) for Total Maximum Daily Loads.
- Seasonal Model Runs because seasonal environmental conditions (i.e., frozen ground, minimal winter vegetation), have the potential to impact infiltration and pollutant removal of the grass swales.

The delineation of grass side slope treatment areas receiving roadway runoff along I-95 has been completed. The delineation of similar areas on SR 1 is in progress. The Modeling Study is on hold until WWM data can be obtained from successful WWM Events at the Route 299 side slope, as the data will be used to calibrate the model.

C. NEXT STEPS

KCI will continue to conduct WWM at BMP 104; the goal is to obtain at least 10 WWM Events. KCI will develop a revised sampling plan for the Route 299 Grass Side Slope Monitoring Study.

ROUTE 299 GRASS SIDE SLOPE STUDY LOCATION MAP



GREEN TECHNOLOGY

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APPENDIX A

BIOSWALE 104 STUDY

- **Table 1** – Bioswale 104 WWM Laboratory Data
- **Table 2** – Bioswale 104 WWM Mean and Standard Deviation
- **Table 3** – Bioswale 104 WWM Total Effectiveness

**TABLE 1
BIOSWALE 104 IN & OUT WWM LABORATORY RESULTS
BIOSWALE 104 IN**

PARAMETER	Units	01/25/10		03/12/10		06/09/10		10/14/10		11/04/10	
		FF	COMP								
TOTAL SUSPENDED SOLIDS	mg/L	145	64	638	240	248	47	17	14	26	17
TOTAL DISSOLVED SOLIDS	mg/L	151	141	507	333	94	79	78	88	28	20
CHEMICAL OXYGEN DEMAND	mg/L	71	27	485	225	245	72	36	16	69	56
BIOLOGICAL OXYGEN DEMAND	mg/L	9	5	20	9	14	19	5	<4	19	7
CHLORIDE	mg/L					22.30	22.30	7.25	5.94	6.57	5.37
OIL & GREASE	mg/L	10.10	<5	<5	<5	<5	<5	<5	<5	<5	<5
pH	units	7.31	7.31	7.26	7.27	7.50	7.40	7.14	7.05	7.01	6.98
TOTAL KJELDAHL NITROGEN	mg/L as N	1.96	1.22	6.53	3.31	2.98	2.21	1.18	1.14	1.06	0.80
AMMONIA	mg/L as N	0.24	<0.2	0.46	0.27	0.59	0.35	<0.2	<0.2	<0.2	<0.2
TOTAL PHOSPHORUS	mg/L as P	0.43	0.22	1.26	0.62	0.78	0.44	0.26	0.22	0.33	0.23
DISSOLVED PHOSPHORUS	mg/L as P	0.14	0.14	0.10	0.10	0.35	0.35	0.19	0.15	0.21	0.16
ORTHO-PHOSPHATE	mg/L	0.13	0.11	0.11	0.13	0.27	0.25	0.19	0.16	0.26	0.20
TOTAL CADMIUM	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.004	<0.004	<0.004
TOTAL COPPER	mg/L	0.051	0.024	0.137	0.067	0.061	0.019	0.010	0.008	<0.005	<0.005
TOTAL LEAD	mg/L	0.011	<0.01	0.051	0.027	0.011	<0.01	<0.01	<0.01	<0.01	<0.01
TOTAL ZINC	mg/L	0.176	0.094	0.674	0.312	0.244	0.068	0.023	0.015	0.038	0.037

BIOSWALE 104 OUT

PARAMETER	Units	01/25/10		03/12/10		06/09/10		10/14/10		11/04/10	
		FF	COMP								
TOTAL SUSPENDED SOLIDS	mg/L	226	114	259	113	199	31	31	16	11	15
TOTAL DISSOLVED SOLIDS	mg/L	196	138	604	377	116	110	61	48	65	56
CHEMICAL OXYGEN DEMAND	mg/L	110	44	264	129	134	59	40	27	69	54
BIOLOGICAL OXYGEN DEMAND	mg/L	10	5	13	7	20	11	7	<4	13	5
CHLORIDE	mg/L					27.20	28.10	5.66	4.85	9.43	6.15
OIL & GREASE	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
pH	units	7.40	7.39	7.26	7.37	7.19	7.19	6.90	6.88	7.18	7.16
TOTAL KJELDAHL NITROGEN	mg/L as N	2.31	1.19	4.54	2.30	5.49	<0.2	1.53	1.10	1.43	0.89
AMMONIA	mg/L as N	0.25	<0.2	0.39	0.21	0.66	0.39	0.36	0.25	<0.2	<0.2
TOTAL PHOSPHORUS	mg/L as P	0.52	0.30	0.71	0.37	0.90	0.41	0.28	0.22	0.43	0.30
DISSOLVED PHOSPHORUS	mg/L as P	0.12	0.11	0.08	0.13	0.25	0.24	0.18	0.15	0.28	0.22
ORTHO-PHOSPHATE	mg/L	0.10	0.12	0.09	0.09	0.28	0.23	0.19	0.15	0.20	0.32
TOTAL CADMIUM	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.004	<0.004	<0.004
TOTAL COPPER	mg/L	0.039	0.023	0.072	0.041	0.054	0.013	0.014	0.011	<0.005	<0.005
TOTAL LEAD	mg/L	<0.01	<0.01	0.028	0.011	0.011	<0.01	<0.01	<0.01	<0.01	<0.01
TOTAL ZINC	mg/L	0.172	0.100	0.333	0.162	0.261	0.043	0.048	0.034	0.022	0.022

**BIOSWALE 104 STUDY
WET WEATHER MONITORING
Mean & Standard Deviation**

TABLE 2

PARAMETERS	BIO IN				BIO OUT			
	First Flush		Composite		First Flush		Composite	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Suspended Solids	215	254.9	76	93.8	145	115.6	58	51.2
Total Dissolved Solids	172	192.6	132	120.2	208	227.8	146	134.6
Chemical Oxygen Demand	181	188.5	79	84.5	123	86.6	63	39.1
Biological Oxygen Demand	13	6.4	8	6.5	13	4.8	6	3.3
Chloride	12	8.9	11	9.6	14	11.5	13	13.1
Oil & Grease	4.02	3.399	ND	ND	ND	ND	ND	ND
pH	7.24	0.18	7.20	0.18	7.19	0.18	7.20	0.21
Total Kjeldahl Nitrogen	2.74	2.252	1.74	1.025	3.06	1.848	1.12	0.789
Ammonia	0.30	0.220	0.18	0.118	0.35	0.206	0.21	0.121
Total Phosphorus	0.61	0.414	0.35	0.180	0.57	0.242	0.32	0.073
Dissolved Phosphorus	0.20	0.095	0.18	0.098	0.18	0.084	0.17	0.057
Ortho-Phosphate	0.19	0.073	0.17	0.056	0.17	0.079	0.18	0.093
Total Cadmium	ND	ND	ND	ND	ND	ND	ND	ND
Total Copper	0.052	0.0540	0.024	0.0250	0.036	0.0280	0.018	0.0150
Total Lead	0.017	0.0190	0.009	0.0100	0.011	0.0100	0.006	0.0030
Total Zinc	0.231	0.2650	0.105	0.1190	0.167	0.1340	0.072	0.0580
	n = 5				n = 5			

n = number of samples collected

SD = Standard Deviation

ND = Not Detected: Parameter levels were less than laboratory equipment detection limit for all WWM Events

Mean calculation: For those parameters with levels less than and greater than the detection limit, the ND data were assumed to be one half of the limit of detection

**BIOSWALE 104 STUDY
WET WEATHER MONITORING
BMP 104 IN / BMP 104 OUT COMPARISON**

**TABLE 3
TOTAL EFFECTIVENESS**

PARAMETER	Sample Date	01/25/10		03/12/10		06/09/10		10/14/10		11/04/10		TOTAL EFFECTIVENESS	
	Units	FF	Comp	FF	Comp								
TOTAL SUSPENDED SOLIDS	mg/L	55.86%	78.13%	-59.40%	-52.92%	-19.76%	-34.04%	82.35%	14.29%	-57.69%	-11.76%	0.27%	-1.26%
TOTAL DISSOLVED SOLIDS	mg/L	29.80%	-2.13%	19.13%	13.21%	23.40%	39.24%	-21.79%	-45.45%	132.14%	180.00%	36.54%	36.97%
CHEMICAL OXYGEN DEMAND	mg/L	54.93%	62.96%	-45.57%	-42.67%	-45.31%	-18.06%	11.11%	68.75%	0.00%	-3.57%	-4.97%	13.48%
BIOLOGICAL OXYGEN DEMAND	mg/L	11.11%	0.00%	-35.00%	-22.22%	42.86%	-42.11%	40.00%	0.00%	-31.58%	-28.57%	5.48%	-18.58%
CHLORIDE *	mg/L					21.97%	26.01%	-21.93%	-18.35%	43.53%	14.53%	14.52%	7.39%
OIL & GREASE	mg/L	-75.25%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-15.05%	0.00%
pH	units	1.23%	1.09%	0.00%	1.38%	-4.13%	-2.84%	-3.36%	-2.41%	2.43%	2.58%	-0.77%	-0.04%
TOTAL KJELDAHL NITROGEN	mg/L as N	17.86%	-2.46%	-30.47%	-30.51%	84.23%	-95.48%	29.66%	-3.51%	34.91%	11.25%	27.24%	-24.14%
AMMONIA	mg/L as N	4.17%	0.00%	-15.22%	-22.22%	11.86%	11.43%	260.00%	150.00%	0.00%	0.00%	52.16%	27.84%
TOTAL PHOSPHORUS	mg/L as P	20.93%	36.36%	-43.65%	-40.32%	15.38%	-6.82%	7.69%	FALSE	30.30%	30.43%	6.13%	4.91%
DISSOLVED PHOSPHORUS	mg/L as P	-14.29%	-21.43%	-20.00%	30.00%	-28.57%	-31.43%	-5.26%	0.00%	33.33%	37.50%	-6.96%	2.93%
ORTHO-PHOSPHATE	mg/L	-23.08%	9.09%	-18.18%	-30.77%	3.70%	-8.00%	0.00%	-6.25%	-23.08%	60.00%	-12.13%	4.81%
TOTAL CADMIUM	mg/L	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TOTAL COPPER	mg/L	-23.53%	-4.17%	-47.45%	-38.81%	-11.48%	-31.58%	40.00%	37.50%	0.00%	0.00%	-8.49%	-7.41%
TOTAL LEAD	mg/L	-54.55%	0.00%	-45.10%	-59.26%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-19.93%	-11.85%
TOTAL ZINC	mg/L	-2.27%	6.38%	-50.59%	-48.08%	6.97%	-36.76%	108.70%	126.67%	-42.11%	-40.54%	4.14%	1.53%

- Reduction in OUT vs IN (< -5%)
- Between -5% and 5%
- Increase in OUT vs IN (> 5%)

* Chloride not sampled in January or March.

GREEN TECHNOLOGY

2010 ANNUAL REPORT

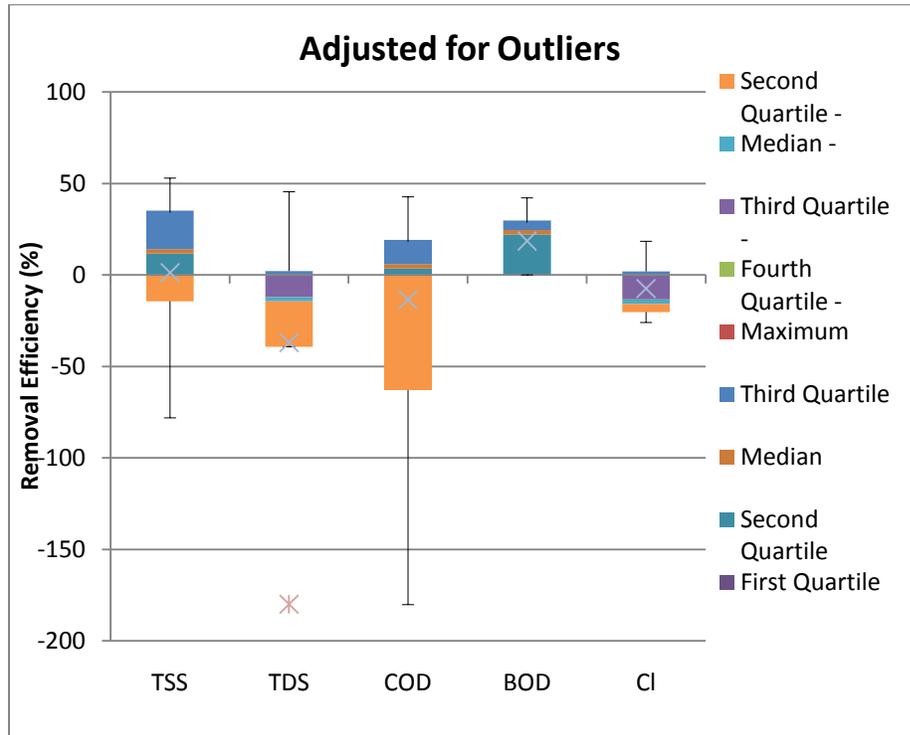
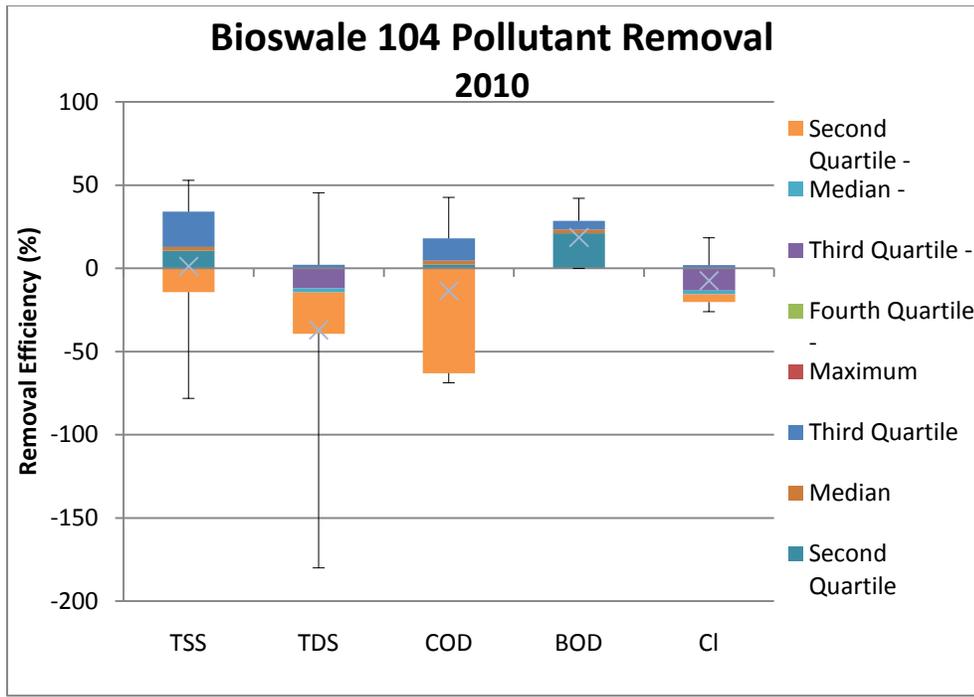
APPENDIX B

BIOSWALE 104 STUDY

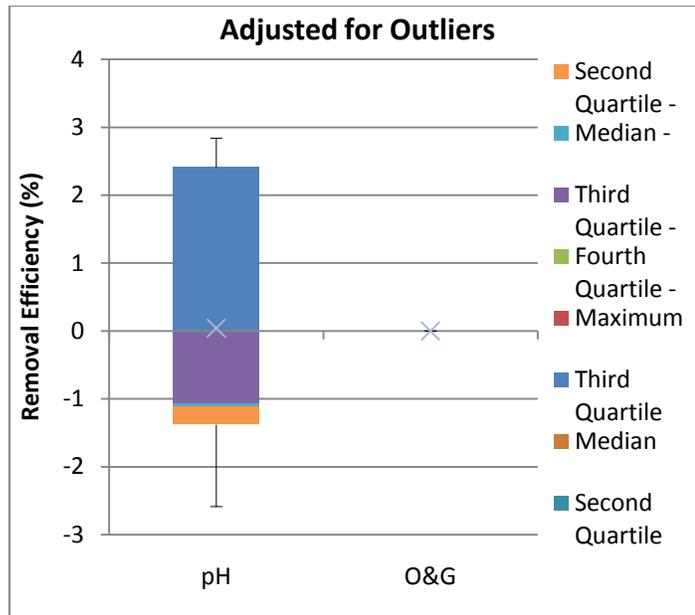
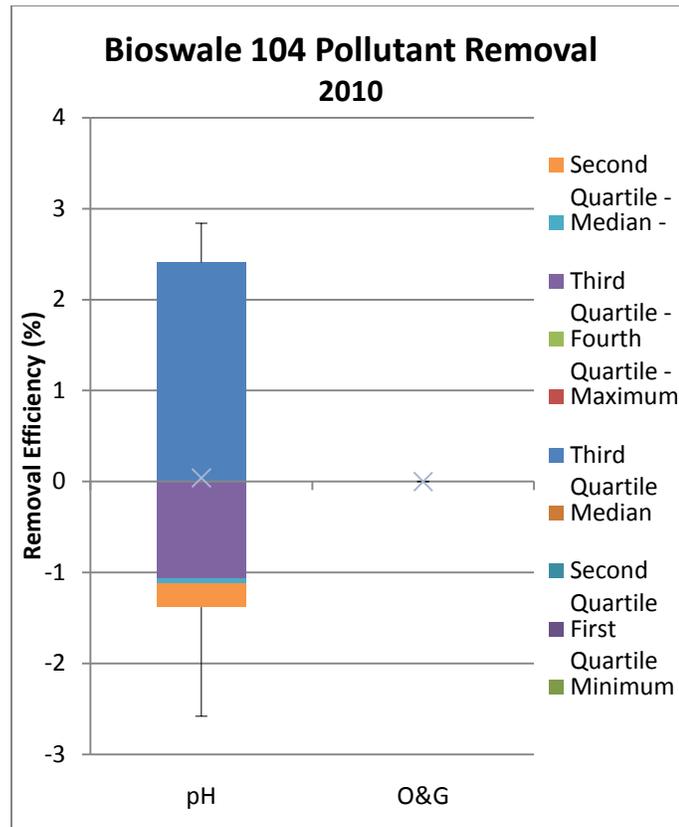
BOX & WHISKER PLOTS

POLLUTANT REMOVAL EFFICIENCY:

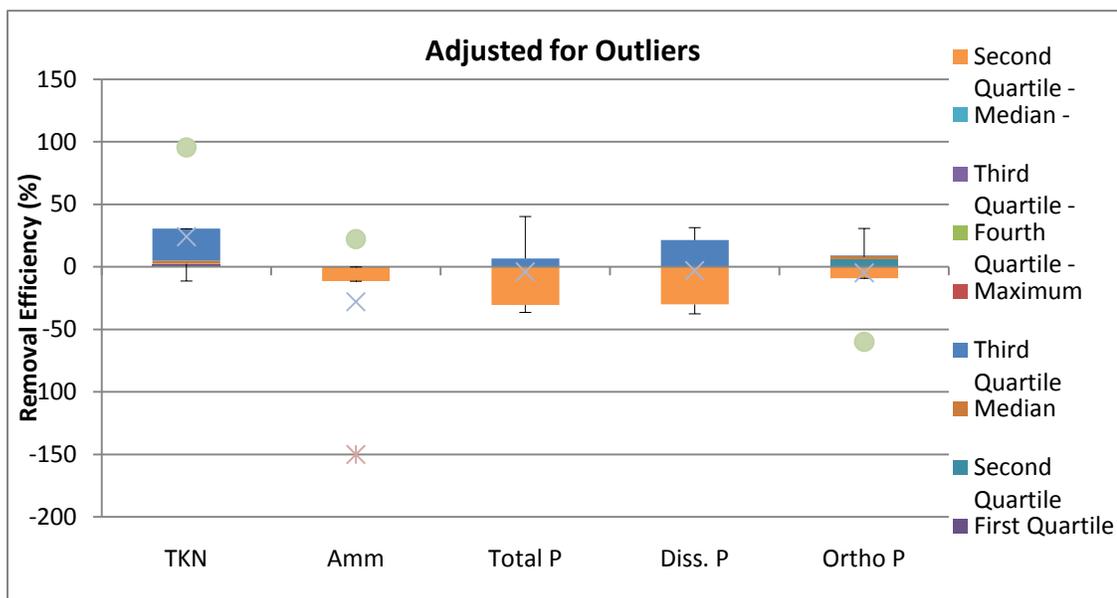
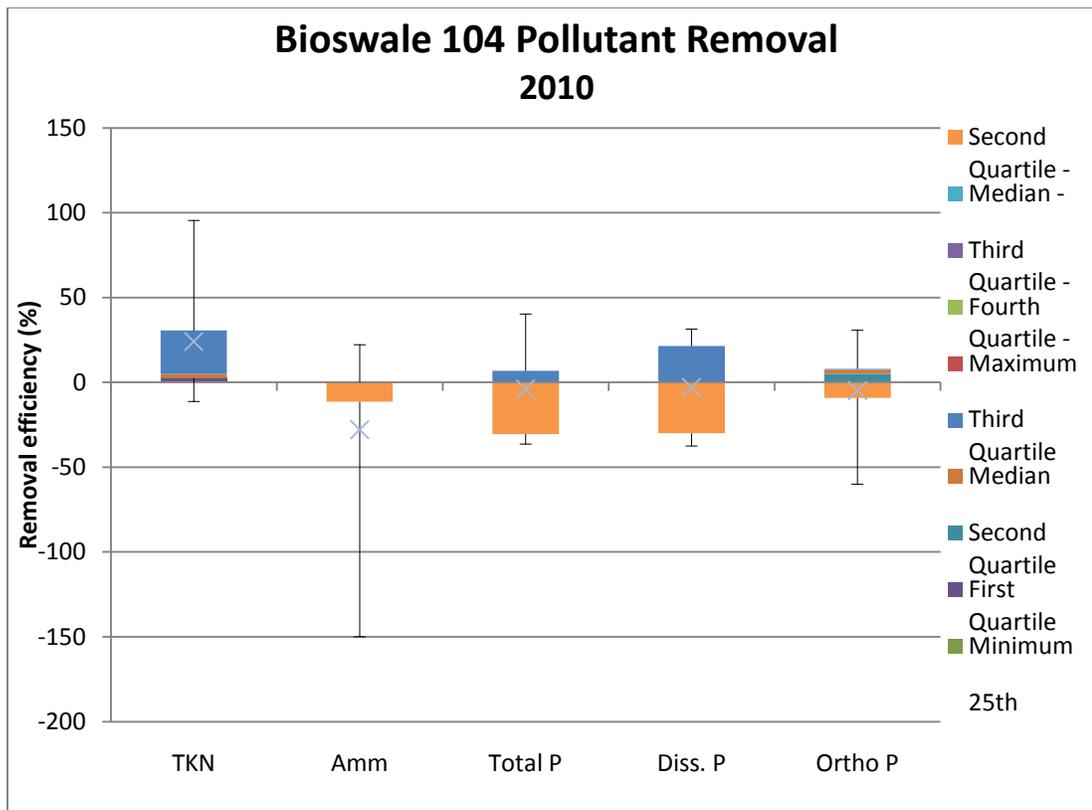
- Total Suspended Solids, Total Dissolved Solids, Chemical Oxygen Demand, Chloride
- Oil & Grease, pH
- Total Kjeldahl Nitrogen, Ammonia, Total Phosphorus, Dissolved Phosphorus, Ortho-Phosphate
- Total Cadmium, Total Copper, Total Lead, Total Zinc



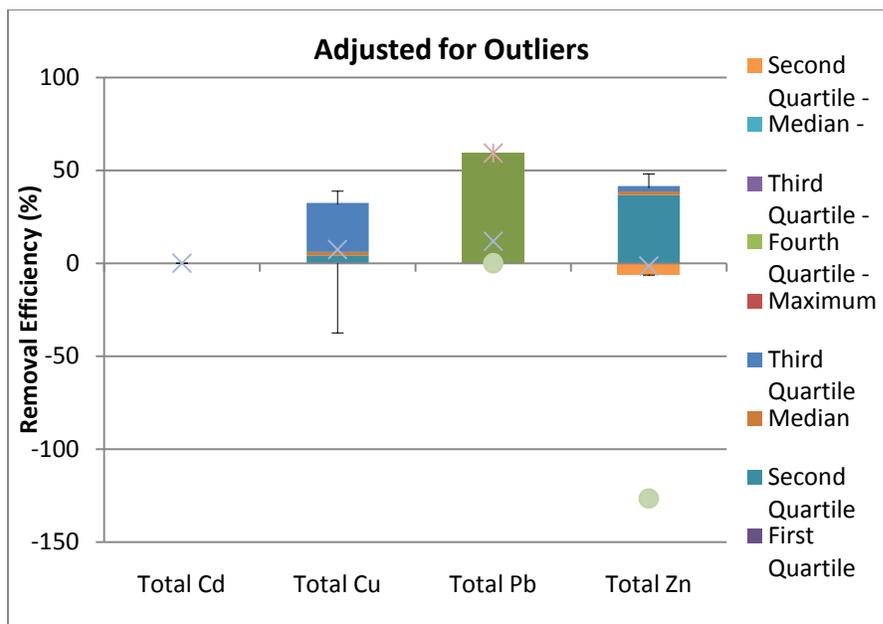
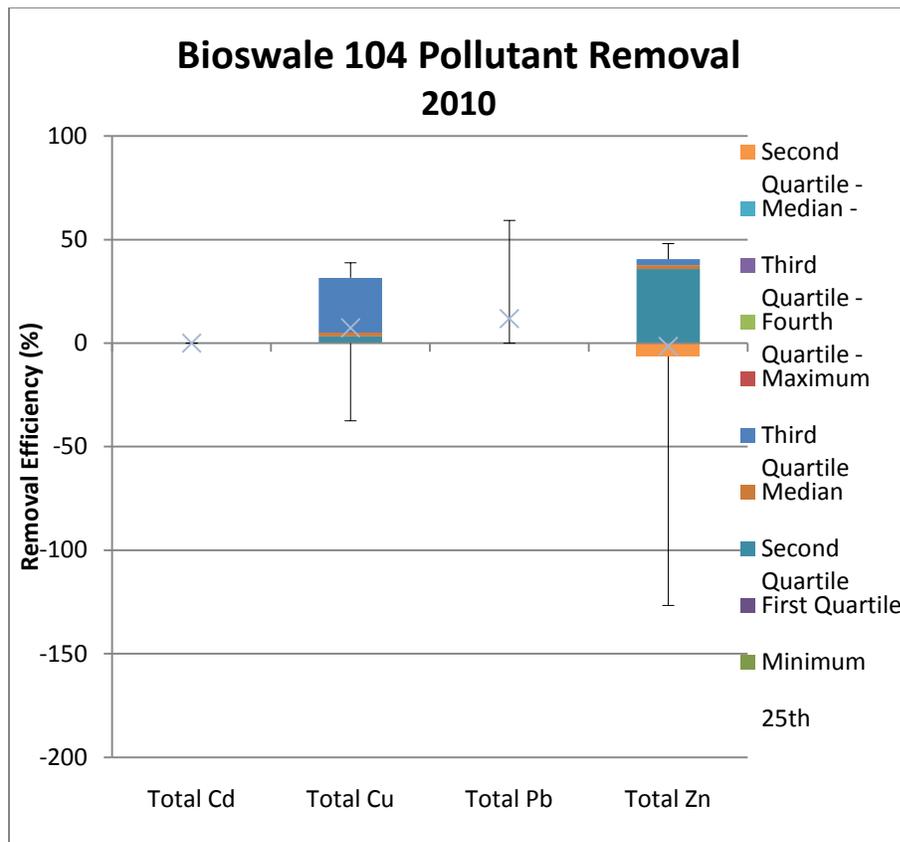
Removal Efficiency Statistical Data					
	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Chemical Oxygen Demand (COD)	Biological Oxygen Demand (BOD)	Chloride (Cl)
Count	5.00	5.00	5.00	5.00	3.00
Min	-78.13	-180.00	-68.75	0.00	-26.01
25th	-14.29	-39.24	-62.96	0.00	-20.27
Median	11.76	-13.21	3.57	22.22	-14.53
75th	34.04	2.13	18.06	28.57	1.93
Max	52.92	45.45	42.67	42.11	18.38
Mean	1.26	-36.97	-13.48	18.58	-7.39
SD	50.99	85.66	49.85	18.42	23.04



Removal Efficiency Statistical Data		
	pH	Oil & Grease (O&G)
Count	5.00	5.00
Min	-2.58	ND
25th	-1.38	ND
Median	-1.09	ND
75th	2.41	ND
Max	2.84	ND
Mean	0.04	ND
SD	2.43	ND



Removal Efficiency Statistical Data					
	Total Kjeldahl (TKN)	Ammonia	Total Phosphorus	Dissolved Phosphorus	Ortho Phosphate
Count	5.00	5.00	5.00	5.00	5.00
Min	-11.25	-150.00	-36.36	-37.50	-60.00
25th	2.46	-11.43	-30.43	-30.00	-9.09
Median	3.51	0.00	0.00	0.00	6.25
75th	30.51	0.00	6.82	21.43	8.00
Max	95.48	22.22	40.32	31.43	30.77
Mean	24.14	-27.84	-3.93	-2.93	-4.81
SD	42.66	69.37	31.00	30.46	33.97



Removal Efficiency Statistical Data				
	Total Cadmium (Cd)	Total Copper (Cu)	Total Lead (Pb)	Total Zinc (Zn)
Count	5.00	5.00	5.00	5.00
Min	ND	-37.50	0.00	-126.67
25th	ND	0.00	0.00	-6.38
Median	ND	4.17	0.00	36.76
75th	ND	31.58	0.00	40.54
Max	ND	38.81	59.26	48.08
Mean	ND	7.41	11.85	-1.53
SD	ND	30.22	26.50	73.11

Appendix H. KCI Technologies report on continuous stream monitoring.



**DELDOT AGREEMENT 1495
WATER QUALITY MONITORING
CONTINUOUS STREAM MONITORING
2010 ANNUAL REPORT
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Location Map

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**DELDOT AGREEMENT 1495
WATER QUALITY MONITORING
CONTINUOUS STREAM MONITORING
2010 ANNUAL REPORT**



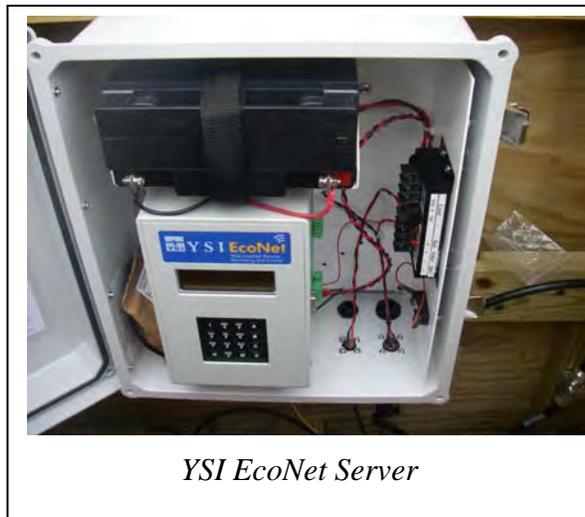
As part of the Delaware Department of Transportation's National Pollutant Discharge Elimination System General Permit Program Regulations Governing Stormwater Discharge, KCI Technologies, Inc. was contracted to administer continuous water quality monitoring of Leatherman's Run (during the reconstruction of the I-95 Service Plaza), and Christina River (during the Elkton Road reconstruction). The purpose of this monitoring is to evaluate the effect of construction activity on Leatherman's Run and Christina River.

KCI installed and maintains the monitoring equipment at both locations, in addition to continually evaluating the water quality data. The upstream and downstream solar powered YSI water quality data loggers are equipped to monitor the following parameters: dissolved oxygen, turbidity, pH, temperature, and conductivity.



Water Quality Data Logger

The water quality data loggers are each hard wired to a separate docking station by a long cable protected by a 1.25 inch electrical conduit buried in the ground. The docking stations are each equipped with a 20 watt solar panel, antenna and EcoNet Data Logger/Transmitter that transfers real-time data to an EcoNet Data Acquisition System, which can be viewed through the YSI EcoNet Website on the internet. EcoNet provides automated data reports, and real time alarming and alerting when parameters exceed user-defined thresholds. KCI monitors the data collected from the water quality loggers and prepares weekly memorandums summarizing data observations. DelDOT is notified of unusual parameter levels or other equipment issues.



YSI EcoNet Server



Water Quality Data Logger Inside PVC Housing Attached to Cinderblock

A. LEATHERMAN'S RUN: I-95 SERVICE PLAZA

The continuous monitoring equipment was installed on the southbound (upstream) and northbound (downstream) slopes on I-95 where Leatherman's Run crosses under the I-95 Service Plaza in New Castle County. The equipment installation was completed and logging data in June 2009. The purpose of the monitoring was to evaluate water quality during Service Plaza re-construction. After re-construction began at the Service Plaza in 2009, KCI identified significantly high turbidity readings at the downstream location. This was reported to DelDOT, resulting in DelDOT directing the contractor to alter their pumping operations.

2010 Weekly Memorandums Summary

The EcoNet data from the two YSI monitoring systems is evaluated on a weekly basis, and a weekly memorandum (see page 4) is prepared for the project's technical files. A graph depicting turbidity versus rainfall is also compiled each week (see page 5). DelDOT was notified of unusual parameter levels or other equipment issues as they occur. Highlights of the weekly memorandums/graphs are provided below.

January to March 2010: Downstream turbidity spikes were identified due to pumping operations at the Service Plaza construction site. These readings were sometimes as high but not as frequent as those recorded in 2009 prior to the contractor implementing better controls for pumping operations. Some downstream spikes were false readings, occurring as result of sondes needing to be cleaned. Field cleaning of the sondes could not be performed during cold weather due to possibility that the sonde probes could be damaged when exposed to cold air temperatures. An increase in conductivity was identified, most likely due to road salt used during two major snow storms. Elevated flow was observed at both sondes due to rain and melting snow.

April to June 2010: Sondes were cleaned and bench calibrated. Bench calibration is performed in the office, rather than in the field, approximately every three months (more often if readings seem to fluctuate). The upstream location was relocated in an attempt to decrease the amount of debris/sediment load that clogs sonde tube, however, the new placement did not correct the issue. Due to the limited installation options, KCI decided the most effective solution was to perform field cleaning when sonde becomes clogged. It was noted that the upstream site had issues with



large sediment and debris loading during rain events, which was probably due to the power company tree clearing activities directly upstream of the site. Construction activities and stream bank tree removal resulted in erosion and increased sediment loads to Leatherman's Run. Tree branches that had been cut and fell in the stream were left there and eventually washed downstream.

Several downstream spikes in turbidity were noted due to Service Plaza re-construction; the majority of these were less than 280 NTU. In June, the Service Plaza re-opened, with some construction still taking place and numerous bio-swales not yet stabilized. Also in June, a lack of precipitation caused low stream flows with increased water temperatures, causing biofouling on probes. KCI increased the cleaning frequency.

July to September 2010: In July, KCI noted elevated turbidity at both sites due to rain, which quickly stabilized after rain stopped. No other turbidity disturbances were observed related to Plaza. Beginning in August, a lack of precipitation caused water levels to subside significantly, resulting in the removal of the sondes in September to avoid damage

October to December 2010: KCI re-installed the sondes in early October after late September rains raised water levels sufficiently. KCI observed elevated turbidity readings due to rain events; levels returned to normal within 24 hours during this period. No other turbidity disturbances were observed related to Plaza.

LEATHERMAN'S RUN – I-95 SERVICE PLAZA CONTINUOUS STREAM MONITORING - LOCATION MAP



TYPICAL WEEKLY MEMORANDUM



**I-95 SERVICE PLAZA
LEATHERMAN'S RUN
YSI MONITORING**

TIMEFRAME: 10/11/10 – 10/17/10

RAINFALL				
DATE	10/12/10	10/14/10		
AMOUNT (in)	.02"	.72"		

EQUIPMENT MALFUNCTION OR DOWNTIME:

There were no equipment malfunctions or downtime during the report week.

ONE-WEEK YSI TURBIDITY DATA INTERPRETATION:

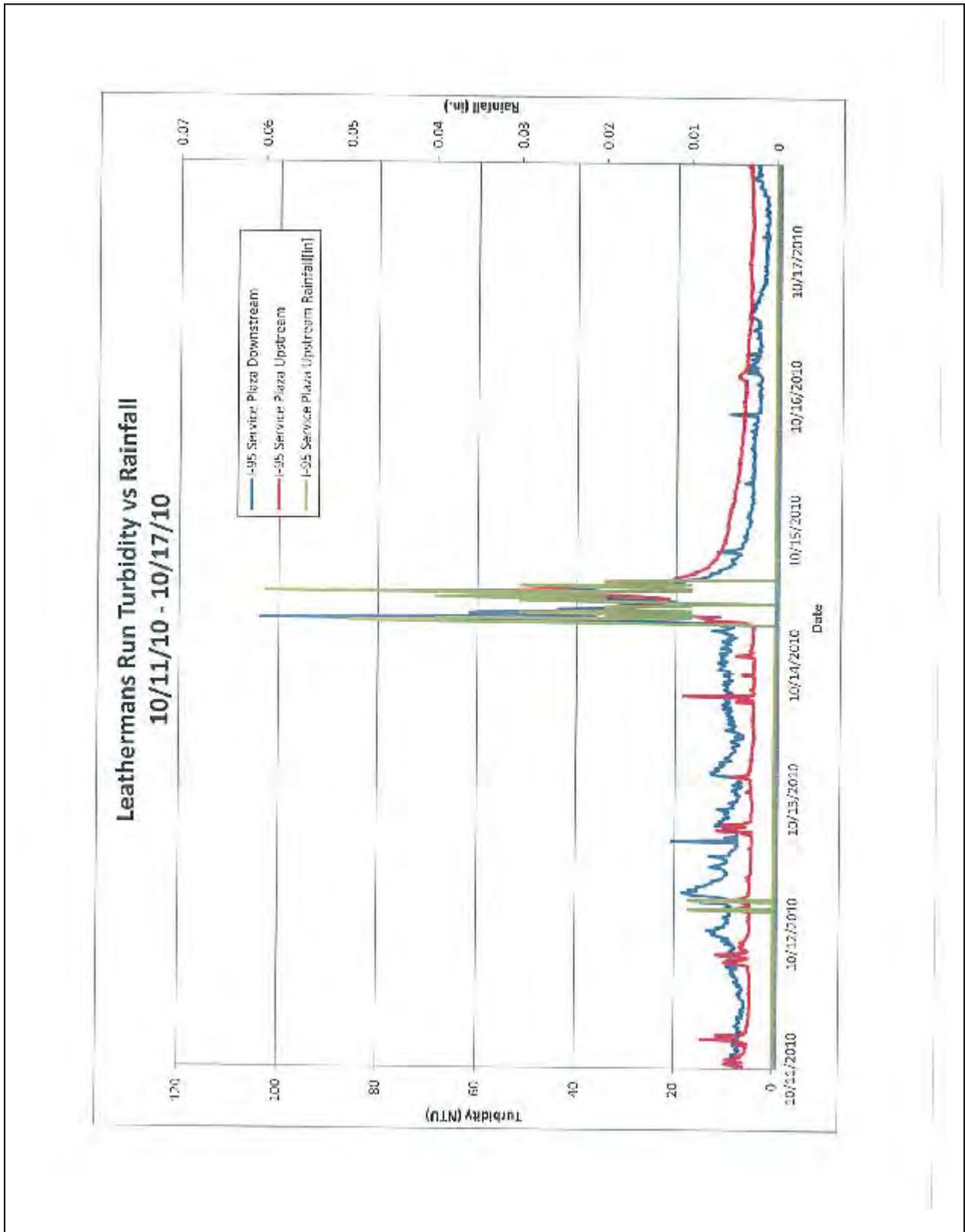
(See attached Graph)

The first minor elevated turbidity readings on October 12, 2010 were in relation to a small rain event with little precipitation. Turbidity readings returned to normal shortly after the precipitation ceased. The second elevated turbidity readings occurred on October 14, 2010 as a result of a major rain event. Turbidity readings returned to normal within 24 hrs. of precipitation ending. No other spikes or disturbances in turbidity were recorded.

ADDITIONAL OBSERVATIONS:

None.

TYPICAL WEEKLY GRAPH



B. CHRISTINA RIVER: ELKTON ROAD

Continuous stream monitoring equipment was installed on the westbound (upstream) and eastbound (downstream) sides of the Elkton Road overpass of the Christina River in New Castle County (See Location Map next page). Installation was completed in December 2010. The purpose of the monitoring is to evaluate water quality during the Elkton Road construction project. The project includes pavement reconstruction; additional turn lanes at the intersection of Elkton Road and Casho Mill and Apple Roads; reducing Elkton Road between Apple Road and Delaware Avenue from four to two lanes with a two-way center turn lane and a landscaped median just south of Amstel Avenue Intersection; new sidewalks and curb ramps; bike lanes; and utility improvements. The project's estimated completion date is September 2012.

Continuous water quality monitoring started towards the end of December. Weekly Memorandums will be compiled in 2011. As with Leatherman's Run, KCI will notify DelDOT of any unusual turbidity levels or other issues.



*Christina River: Elkton Road
Upstream Docking Station*



*Christina River
Upstream of Elkton Road*

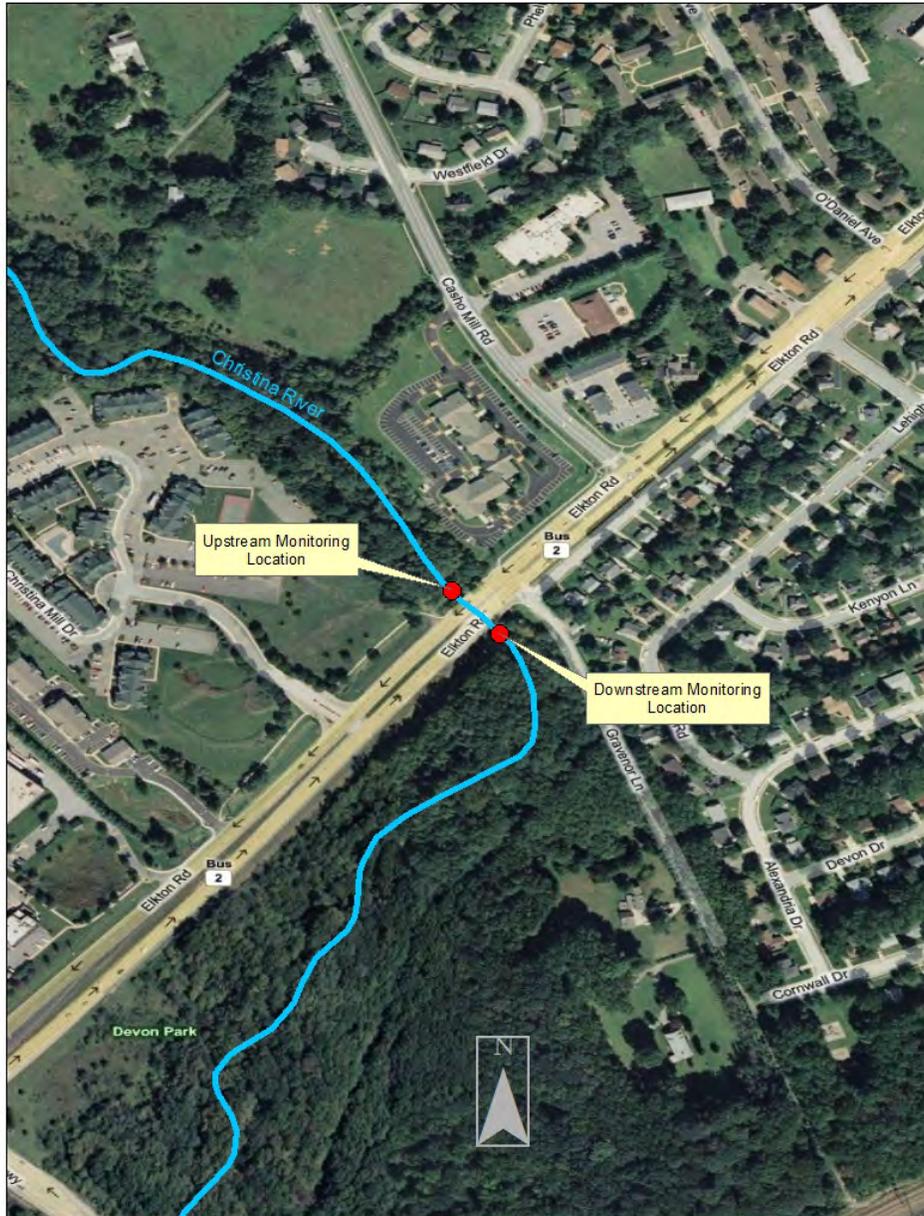


*Christina River: Elkton Road
Downstream Docking Station*



*Christina River
Downstream of Elkton Road*

**CHRISTINA RIVER – ELKTON ROAD
CONTINUOUS STREAM MONITORING
LOCATION MAP**



C. NEXT STEPS

KCI will continue to monitoring Leatherman's Run and Christina River, and respond to DelDOT needs for additional monitoring.