

Appendix A. KCI Technologies Storm Drain Inventory and Inspection Project
Summary Report.



DeIDOT Agr 1354
Statewide
MS4 / BMP Inventory / Inspection

2008 ANNUAL REPORT

Prepared For
*Delaware Department of Transportation
Stormwater Quality Program*



Prepared By
KCI Technologies, Inc.

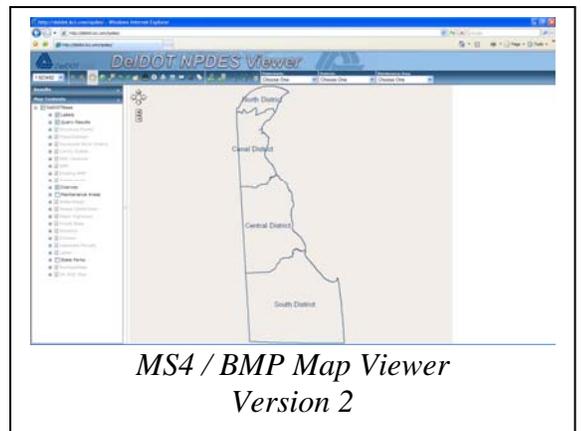
February 2009



BMP Inventory / Inspection



MS4 Inventory / Inspection



*MS4 / BMP Map Viewer
Version 2*



DELDOT AGREEMENT 1354
STATEWIDE MS4 / BMP INVENTORY & INSPECTION
2008 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, 2008 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 2008, KCI conducted eight monthly status meetings, 13 internal staff meetings, seven internal database staff meetings, and two miscellaneous meetings. KCI submitted to DelDOT a *2007 Agreement 1354 Annual Report* and a *2007 Annual BMP Inventory & Inspection Report*, as well as several Memorandums related to the Agreement.

1. Project Status Meetings

Eight project status meeting 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, which included 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.

In many cases, technical staff from DelDOT, KCI, and other agencies or contractors was invited to attend project status meetings, depending on the primary subject matter. For example, when a project status meeting was planned to discuss DelDOT's NPDES Database or Map Viewer, DelDOT and KCI invited representatives of their Information Technology (IT) and Technology Services (TS) departments to the meeting. For the October 30, 2008 project status meeting, DelDOT's invasive spraying contractor, JCM, was invited to the meeting so that KCI/CEI, DelDOT and JCM could field visit several BMPs to discuss limits of spraying around BMPs and to establish communication between KCI/CEI and JCM regarding KCI/CEI's approach to inspecting BMPs. This meeting also resulted in JCM providing KCI/CEI with spraying locations and dates, so that during the following year's BMP inspections, KCI/CEI inspection staff will know which BMPs were sprayed, and be able to assess the spraying's effectiveness. Other main topics discussed included maintenance work orders, developing a future BMP inspection schedule, and work priorities.

2. Internal Staff Meetings

KCI conducted 13 internal staff meetings (at least once a month) to discuss scheduling and to identify data collection issues (**Table 1**). Three field crews (two from KCI and one from CEI) conducted MS4 and BMP inventory and inspections. In some instances, field crews adopted techniques that shortened the time needed to inventory and inspect storm drain structures. The purpose of these internal meetings was to provide an opportunity for the field crews to share their experiences with other field crews and to develop the most efficient and consistent inspection methodology.

3. Miscellaneous Meetings

Two meetings were held to discuss specific issues related to the project (**Table 1**). The purpose of the first meeting on January 31, 2008 was to meet with DelDOT to discuss their requirements for a NPDES Web-based Map Viewer. The topic of the second meeting on March 3, 2008 was BMP Maintenance Work Orders, and included KCI/CEI, DelDOT, and DelDOT's North and Canal Maintenance Districts.

Table 1 summarizes all project-related coordination meetings in 2008.

**TABLE 1
 AGREEMENT 1354
 COORDINATION MEETINGS**

PROJECT STATUS	INTERNAL		MISCELLANEOUS	
	Field Staff	Database Staff		
01-09-08	01-03-08	07-10-08	DelDOT View App	01-31-08
02-21-08	01-23-08	07-14-08	DelDOT BMP MWO	03-04-08
04-23-08	03-04-08	08-01-08		
06-11-08	03-19-08	08-18-08		
08-07-08	03-20-08	09-17-08		
09-04-08	04-15-08	10-13-08		
10-30-08	05-06-08	11-19-08		
12-11-08	07-01-08			
	07-31-08			
	08-28-08			
	10-13-08			
	11-18-08			
	12-19-08			

4. Deliverables

Table 2 lists the deliverables transmitted in 2008.

**TABLE 2
 AGREEMENT 1354
 DELIVERABLES**

DATE	DELIVERABLE
02-12-08	2007 Annual Report
02-21-08	2007 Annual BMP Report
04-23-08	NPDES Map Viewer, Version 1
09-4-08	Future BMP Inspection Schedule Options
11-19-08	NCCo BMPs – Prioritized Contractor Repair Work Memo
12-11-08	NPDES Map Viewer, Version 2

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.

1. Field Application Development – Version 2

In early 2008, KCI developed a revised field application that fit the new Database design. This field application allowed for initial inventory and inspection of structures and conveyances, for multiple re-inspections of structures and conveyances, and for multiple inspections of DelDOT’s BMPs.

2. NPDES Map Viewer

As part of their NPDES Program, DelDOT wanted to upgrade their existing map viewing applications to leverage newer web technologies based on ESRI’s ArcGIS Server platform, as well as provide access to the re-designed and more robust geodatabase model that KCI developed in 2007.

The original NPDES Map Viewer application was developed using Xmarc technology, which promotes data format neutrality; however the technology has aged, data format neutrality does not provide compatibility to working with data in common GIS desktop mapping software packages, and further application development requires knowledge of Xmarc's proprietary language, FIRE. The data model originally developed with the Xmarc solution no longer suits DelDOT's needs for the following reasons:

- The data model was based upon a non-modified SDSFIE datastructure, resulting in many unused, unpopulated, or mis-used fields;
- Inconsistent data in fields causing trouble with executing queries with consistent results;
- Inability to capture multiple inspections for a feature including inspection photos;
- Inability to capture one to many relationships between features and attributes such as pipe seal;
- Incompatibility and performance issues with Oracle Spatial's data format for other integration or work in ESRI's desktop and mobile mapping solutions.

The data model has since been re-designed in ESRI's geodatabase format to incorporate these changes as well as augment for additional information being collected in the field using automated mobile applications. Therefore, DelDOT requested that KCI develop a Map Viewer application that accesses the new data model as well as being developed in ESRI's ArcGIS Server technology.

a. Map Viewer Development – Version 1

At the April 23, 2008 Project Status Meeting, KCI presented the NPDES Map Viewer Version 1 for DelDOT review and comment. KCI had primarily worked on the map viewer functionality, with planned future work on the performance, once all functionality was completed. After review of Version 1, DelDOT requested the following revisions be incorporated into Version 2 of the NPDES Map Viewer:

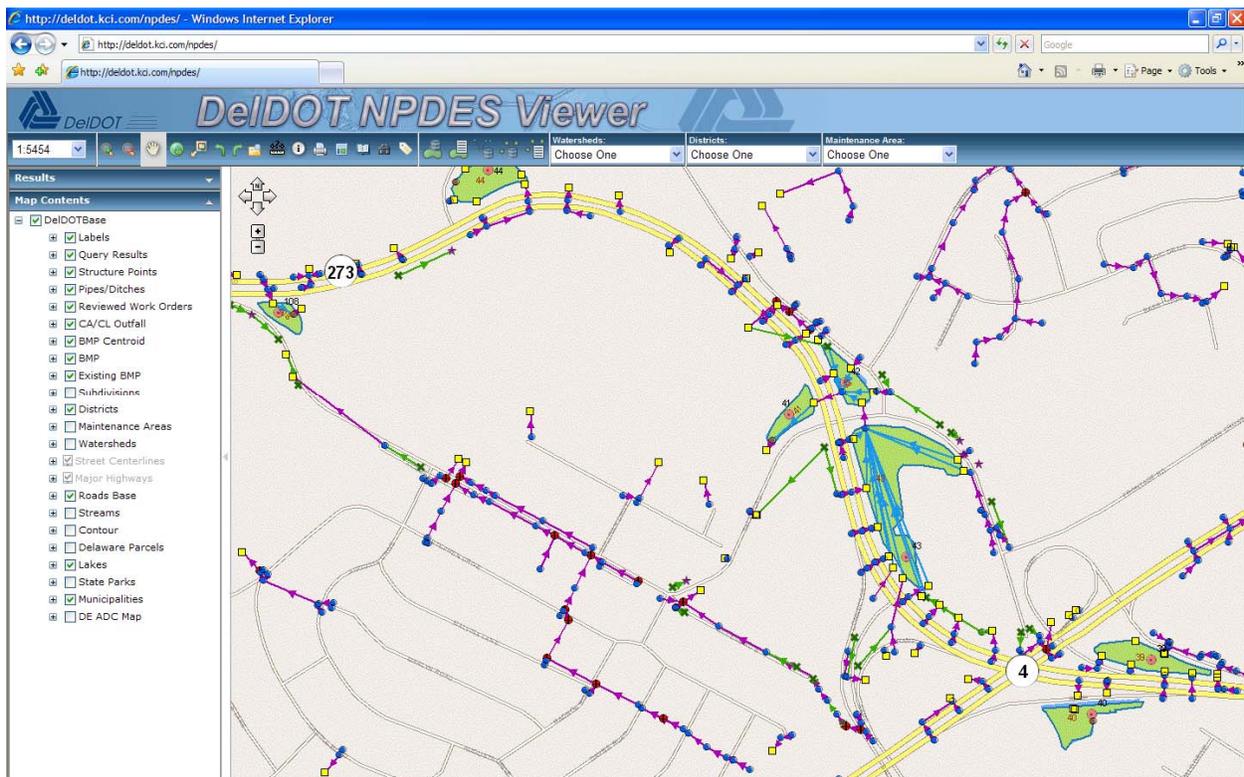
- Obtain Parcel Attribute Data from DelDOT
- Label pipes in NPDES Viewer
- Label structures in NPDES Viewer
- Add label for ADC Grids in NPDES Viewer
- Add major roads to viewer overview map
- Add login for NPDES Viewer
- Show pipe/ditch lengths in reports
- Investigate filtering out values w/o data
- Add mark up tools (NOTE: This is currently slated for Version 3 of the Viewer)
- Reset menu options on zoom clear
- Select by Maintenance District Number
- Add ADC GRID to Zoom to menu bar
- Access Tree View and Report directly from tooltips

b. Map Viewer Development – Version 2

KCI presented Map Viewer Version 2 to DeIDOT at the December 11, 2008 Project Status Meeting. DeIDOT suggested the following revisions be incorporated to make the viewer more user-friendly:

- Hide nonessential fields in query results
- Explore returning empty values for attributes that return NULL results
- Remove “sample set” in the query builder
- Add BMP plans to treeview
- Pull report directly from a mouse click on the pipe, BMP, or structure
- Change ADC locator to Address locator; DeIDOT to provide merged parcel dataset to use as a base
- Make sure upper and lower case are addressed in the query builder

It anticipated that these enhancements to Version 2 of the Map Viewer will be complete by the end of February 2009.



C. BEST MANAGEMENT PRACTICE (BMP) INVENTORY AND INSPECTION

In early 2008, KCI submitted a *2007 Annual BMP Inventory & Inspection Report*. This report summarized the inspections for each BMP and provided recommended actions for BMPs in three categories:

- BMPs requiring **MAINTENANCE** by DelDOT’s maintenance staff (maintenance work orders)
- BMPs with **INVASIVE SPECIES** to be eradicated by DelDOT’s invasive spraying contractor
- BMPs that needed **RETROFIT** evaluations by DelDOT’s NPDES Program.

KCI developed a rating scale for each BMP (**Table 3**).

**TABLE 3
AGREEMENT 1354
OVERALL BMP RATING CATEGORIES**

Rating	Recommended Action
A	No Action Needed No Maintenance Work Orders, Invasive Species, or Retrofits. BMP is new or has been recently maintained, sprayed, or retrofitted to new condition.
B	Action Recommended Maintenance Work Orders are rated No. 2 or below; less than 100 square feet of invasive vegetation species; no Canada Thistle present; and no retrofit recommendations. BMP is working properly - some maintenance is recommended, but not required, prior to the next inspection.
C	Action Needed One or more Maintenance Work Orders are rated No. 3 or above; invasive species are 100 square feet or more; Canada Thistle is present; and no retrofit recommendations. BMP needs some maintenance to work properly, and should be maintained prior to the next inspection.
D	Minor Retrofit Maintenance Work Orders may or may not be present; invasive species may or may not be present; and retrofit is recommended. A minor retrofit is recommended, with guidance from the DelDOT NPDES group.
E	Major Retrofit BMP has failed. Maintenance Work Orders, spraying for invasive species, or a simple retrofit would not successfully recondition the BMP. BMP is in total disrepair (reconstruct); not working as designed (new design needed); or does not exist. Total reconstruction is recommended, with guidance from the DelDOT NPDES group.

1. 2008 BMP Inventory and Inspection

In 2007, BMP inspections were documented manually using hard-copy field sheets. The development of Field Application Version 2 (see Database Management section) enabled field staff to input 2008 BMP inspection information directly into the database by using Panasonic Toughbook computers. The focus of the 2008 inspections was to update GPS locations of each BMP (using points or shapes depending on BMP type), create conveyances for all BMPs, and check BMP condition as related to last year's inspection. In June 2008, DelDOT performed maintenance actions on several BMPs according to KCI's 2007 inspections. These actions were incorporated into the 2008 inspection database.



2. Future BMP Inspection Schedule

DelDOT asked KCI to investigate a revised BMP inspection schedule; one that would enable BMP inspections on a Bi-Yearly Cycle (i.e., every other year), instead of an Annual Cycle. This would provide DelDOT maintenance staff, invasive spray contractor and stormwater engineers appropriate time to complete routine maintenance, invasive plant spraying, and retrofit design prior to the next scheduled inspection. KCI submitted options for future BMP scheduling to DelDOT at the September 4, 2008 Project Status Meeting. DelDOT and KCI decided that it was best to conduct inspections at all BMPs in 2009. However, KCI will continue to refine an inspection schedule, to be implemented in 2010, that would recommend every other year inspections based on such factors as BMP types, previous inspections, and previous BMP ratings.



3. 2008 BMP Annual Report

In early 2009, KCI will submit a *2008 Annual BMP Inventory & Inspection Report* that details the 2008 BMP inspections, including maintenance issues, invasive species list, and retrofit recommendations. The 2008 BMP report will be submitted under separate cover from this report.

D. NEW CASTLE COUNTY RE-INSPECTION

KCI began re-inspection of DelDOT’s MS4 in New Castle County subdivisions in February 2008, based on KCI’s Agreement 1354 Subdivision Re-inspection Schedule (**Table 4**), which was submitted at the January 9, 2008 Project Status Meeting. 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. Any subdivisions accepted over 20 years prior to the beginning of this Agreement (and any future Agreement), would be re-inspected on an every 5-year cycle. Any subdivisions accepted within 20 years of this Agreement (and any future Agreement), would be re-inspected on a 10-year cycle. The subdivisions planned for re-inspection in 2008 included those subdivisions accepted from 1935-1950. KCI completed re-inspections of these subdivisions in December 2008, which included 107 subdivisions and 4,966 structures (**Table 5**).

**TABLE 4
AGREEMENT 1354
SUBDIVISION RE-INSPECTION SCHEDULE**

Year	Subdivisions	End Date*	Cycle	Re-inspect?	Date Completed
1	Database Re-design	12/20/2007	--	--	December 2007
2	1935-1950	12/20/2008	5	Yes	December 2008
3	1951-1965	12/20/2009	5	Yes	
4	1966-1980	12/20/2010	5	Yes	
5	1981-1995	12/20/2011	10	Yes	
5	1996-2005	12/20/2011	10	No	--

* Based on 12/20/06 Notice to Proceed

**TABLE 5
AGREEMENT 1354
2008 RE-INSPECTION TOTALS**

Month (2008)	Number of Subdivisions	Number of Structures
January	5	231
February	2	205
March	11	335
April	8	359
May	10	503
June	11	484
July	22	1,068
August	8	455
September	6	313
October	11	571
November	5	227
December	8	215
2008 TOTAL	107	4,966

E. NEW CASTLE COUNTY INITIAL INVENTORY AND INSPECTION

KCI continued initial inventory and inspection work in New Castle County in 2008. This included performing initial inventory and inspection work at subdivisions recently accepted by DelDOT, and at non-subdivision roadways not inventoried and inspected during previous NPDES Agreements. KCI performed initial inventory and inspection at 15 subdivisions and along 25.9 miles of non-subdivision roadways, for a total of 1,120 structures (**Table 6**).

**TABLE 6
 AGREEMENT 1354
 2008 INITIAL INVENTORY / INSPECTION TOTALS
 NEW CASTLE COUNTY**

Month (2008)	Number of Subdivisions	Number of Miles of Non-Subdivision Roadways	Number of Structures
January	0	0.0	120
February	0	0.0	0
March	0	0.0	0
April	0	0.0	0
May	0	0.0	0
June	0	0.0	0
July	0	0.0	0
August	2	0.0	50
September	8	0.0	193
October	3	6.4	306
November	0	19.5	81
December	2	0.0	370
2008 TOTAL	15	25.9	1,120

F. KENT / SUSSEX COUNTIES INITIAL INVENTORY AND INSPECTION

CEI continued initial inventory and inspection work in Kent and Sussex Counties in 2008. CEI inventoried and inspected 48 subdivisions and 53.8 miles of non-subdivision roadways, for a total of 6,325 structures in Kent and Sussex Counties (**Table 7**). In Kent County, the work was concentrated in the St. Jones Watershed, which is anticipated to be completed in early 2009. Work will then progress to the Murderkill River Watershed.

**TABLE 7
 AGREEMENT 1354
 2008 INITIAL INVENTORY / INSPECTION TOTALS
 KENT / SUSSEX COUNTIES**

Month (2008)	Number of Subdivisions	Number of Miles of Non-Subdivision Roadways	Number of Structures
January	3	0.0	546
February	7	0.0	277
March	11	0.0	379
April	12	0.0	451
May	2	4.2	393
June	4	6.8	513
July	0	13.5	864
August	0	11.0	668
September	7	11.1	415
October	1	5.2	862
November	1	0.0	592
December	0	2.0	365
2008 TOTAL	48	53.8	6,325