MEMORANDUM

DATE: November 8, 2012

TO: James Donovan | Town of Canton

FROM: Indrani Ghosh | Kleinfelder

CC: Lisa Grega | Town of Canton

Kirsten Ryan, File | Kleinfelder

SUBJECT: Estimate of Directly Connected Impervious Area in Canton – NPDES MS4 Phase II

KLEINFELDER NO.: 2011429.01-A

This memo briefly describes the methodology used by Kleinfelder to estimate the Town of Canton's baseline impervious area (IA) and directly connected impervious area (DCIA). The results of this analysis are summarized and compared with the IA and DCIA results that are published in the spreadsheet "IC Stats.xls" on EPA Region 1 NPDES Stormwater website for Canton. The reason for this analysis is to recommend if Canton should use the EPA methodology, or adopt a customized methodology in future years for reporting obligations.

The 2010 NPDES Small MS4 Draft North Coastal Permit section 2.4.6.9 requires that baselines estimates of IA and DCIA be made for Year 1 of the permit, and annual estimates of IA and DCIA acres added or removed in each sub-basin need to be accounted for in Year 2 of the permit. According to EPA's definition in the MS4 permit, "IA includes conventional pavements, sidewalks, driveways, roadways, parking lots, and rooftops. DCIA is portion of IA with a direct hydraulic connection to the permittee's MS4 or a waterbody via continuous paved surfaces, gutters, pipes and other impervious features." It does not include isolated impervious areas or those that otherwise drain to a pervious area.

EPA's Methodology for DCIA
EPA's methodology to estimate baseline DCIA is essentially based on 5 steps that are listed in the document "EPA's Methodology to Calculate Baseline Estimate of Impervious Area (IA) and Directly Connected Impervious Area (DCIA) for Massachusetts Communities, which can be found at http://www.epa.gov/region1/npdes/stormwater/ma/IA-DCIA-Calculation-Methodology.pdf. These steps comprise of (1) Aggregation of MassGIS LandUse 2005 datalayer into EPA's ten commonly used land use categories; (2) Identification of drainage sub-basins based on Massachusetts Nested Subbasins

dataleyer; (3) Calculation of impervious area in each subbasin for each EPA land use on the landuse categories*****

Kleinfelder's Methodology for DCIA
Kleinfelder used a similar methodology as the EPA to estimate the baseline IA and DCIA for Canton. However, as an estimate of DCIA for the whole Town, Kleinfelder first used the methodology to quantify DCIA by each land use category and compared this to the EPA results.

The landuse data for Canton was obtained from the MassGIS Land Use 2005 datalayer, which was last revised in 2009. This land use classification consists of 40 land use codes. The MassGIS land use classes for the whole Town were aggregated into EPA's ten commonly used land use categories according to EPA Code and Code Definition.

Next, the 1-meter Impervious Surface raster layer (last updated June 2011) for Canton was obtained from MassGIS, converted to a polygon feature class and the percent of impervious area (IA) for each EPA land use code was determined. Using these IA estimates, the directly connected impervious area (DCIA) associated for each land use type was determined based on the Sutherland equations. These results were then compared with EPA's DCIA results, after the latter were aggregated by each land use code from each sub-basin. The analyses of results between the two methods are discussed below.

Discussion of Results

Table 1 below presents the comparison of the DCIA estimates between EPA's methodology and the modified approach. It is observed from the results below that there is a 20%, 14%, 4% and 3% difference in area between the two methods, respectively for medium-density residential, agriculture, forest and low-density residential land use code. The overall difference in area between the two methods is approximately 4%. However, there seems to be discrepancies in percent DCIA estimates between the two methods, as well. For example, our approach based on land use analysis (using the most updated MassGIS land use layer) showed 132 ac for agriculture type, of which we estimated only 0.5% as DCIA. According to EPA's results, agriculture land use acreage for Canton was 116 ac, of which they estimate 7.7% to be DCIA. This DCIA estimate of higher than 7% for agriculture land use seems to be on the higher side than expected. Similarly, our approach based showed 4,228 ac for forest type, of which we estimated only 0.1% as DCIA. According to EPA's results, forest land use acreage for Canton was 4,054 ac, of which they estimate approximately 1% to be DCIA. Again this DCIA estimate for forest land use code is higher than expected. These discrepancies should be further investigated and verified.

Table 1: Results for area and DCIA estimates for EPA land use codes between EPA methodology and modified approach

	Total Area_KLF	Total Area_EPA	% diff	DCIA_KLF	DCIA_EPA	% diff	% DCIA_KLF	%DCIA_EPA
Commercial	176.90	176.93	-0.01	120.78	121.31	-0.44	68.27	68.56
Industrial	974.71	944.56	3.19	586.94	574.87	2.10	60.22	60.86
Low Density Residential	1041.61	1041.65	0.00	103.96	104.69	-0.69	9.98	10.05
Medium Density Residential	1679.73	1393.19	20.57	264.66	224.95	17.65	15.76	16.15
High Density Residential	175.59	175.64	-0.03	74.24	74.45	-0.28	42.28	42.39
Urban Public/Institutional	437.52	437.55	-0.01	127.78	130.39	-2.00	29.21	29.80
Agriculture	132.44	116.02	14.15	0.77	8.97	-91.41	0.58	7.73
Forest	4228.22	4054.06	4.30	4.02	39.50	-89.82	0.10	0.97
Open Land	738.01	738.12	-0.01	28.68	30.84	-7.01	3.89	4.18
Water	2901.48	2901.94	-0.02	0.00	0.00	-	0.00	0.00
Total	12486.23	11979.65	4.23				10.51	10.96

Comments on EPA's approach for DCIA estimates

1. EPA's DCIA methodology refers to the USGS sub-basin layer from the "MA Nested Subbasins" layer presented in "Local and Cumulative Impervious Cover of Massachusetts Stream Basins," U.S. Geological Survey Data Series 451, developed by Sara L. Brandt and Peter A. Steeves in cooperation with the U.S. Environmental Protection Agency, for use in the IA/DCIA analysis. However, the layer downloaded from the USGS link (from EPA's DCIA guidance document), http://water.usgs.gov/GIS/metadata/usgswrd/XML/ds451_subbasins.xml, both the data and resolution is different from the MassGIS Drainage Sub-basins layer (http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/subbas.html - "MassGIS has produced a statewide digital datalayer of the approximately 2300 sub-basins as defined and used by the USGS Water Resources Division and the Mass Water Resources Commission and as modified by Executive Office of Environmental Affairs (EOEA) agencies."). This discrepancy between the two data sources should be investigated since both data sources (Figures 1b and 1c) refer to USGS and at a similar scale, similar sub-basin delineation between the two sources should be expected.

2. The drainage sub-basin layer from the "MA Nested Subbasins" dataset is also different significantly from what is published in the EPA's Impervious Cover and Watershed Delineation by Subbasin Map for Canton published on the website at http://www.epa.gov/region1/npdes/stormwater/ma/ic/MA_Imperv2010_Canton.pdf. For example, the area that is denoted as sub-basin ID 21040 (in Figure 1a) is different in the electronic layer – in the latter the sub-basin ID 21040 is essentially the whole Town. Refer to the EPA published map (Figure 1a) and the electronic layer that was downloaded from the USGS website (Figure 1b). Also, since the electronic layer is "nested" the sub-basin layer features are not mutually exclusive, and there is overlap between one-sub-basin and the next.

   As a result of the above discrepancies, it may not be possible for us to reproduce the EPA analysis provided in the DCIA calculation for Canton in

the excel sheet at http://www.epa.gov/region1/npdes/stormwater/ma.html since it is not possible to replicate the same sub-basin layer that EPA has used in their analysis. Some edits are required on the USGS nested sub-basins layer and come up with the same resolution as used by EPA. This will require time and additional level of effort. Also, if the baseline DCIA estimate provided by EPA itself is not accurate, it may not be appropriate for the Town to be required to meet the permit requirements related to minimizing/reduction of DCIA.

Our recommendation is that the IA and DCIA baseline estimates be done using the MassGIS drainage sub-basin layer. This is easily available for all communities, are mutually exclusive, and has a resolution similar (not exactly same) as the EPA sub-basin layer published in the map. However, this would most likely require approval from EPA, if and when the permit becomes effective.
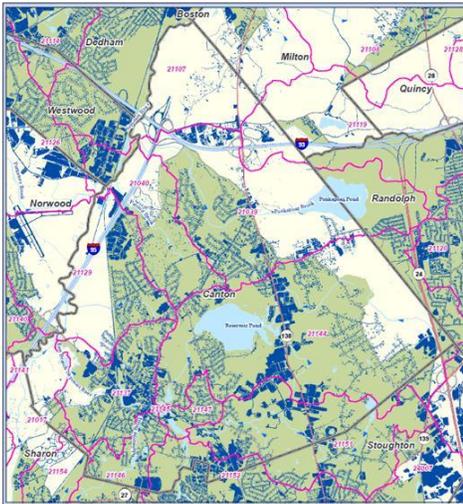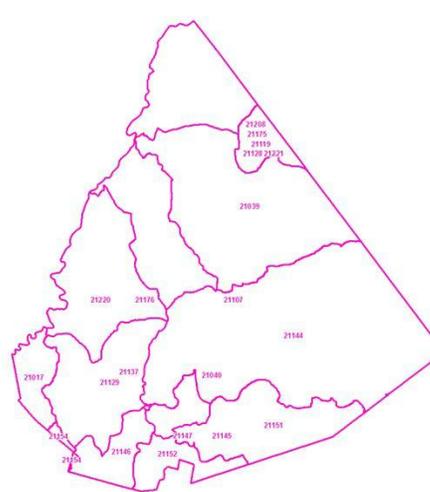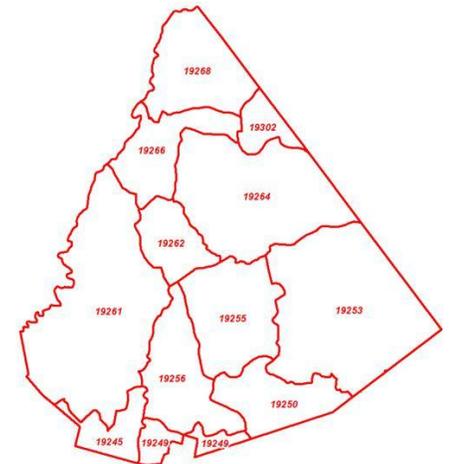

Figure 1a   Figure 1b   Figure 1c