Abstract

Using 2012 rainfall data from Hartsfield/Jackson International Airport, soil data from the National Resource Conservation Service web-based soil survey, and 2013 land cover data from Google Map imagery and i-Tree Canopy, we were able to estimate stormwater runoff on the approximately 21 acre tract of land on and around the parcel at 3330 Briarlake Road using the hydrology model i-Tree Hydro. Comparing the current land cover condition of the tract (96.5% tree canopy cover, 2.5% herbaceous cover, 1% impervious cover, and predominantly undisturbed, sandy loam soil) with a proposed post-development land cover condition (25% tree canopy cover, 50% herbaceous cover, 25% impervious cover, and predominantly compacted, clayey sub-soil base), it is estimated that total stormwater runoff volume will increase by over 300% from 12,322 cubic meters of water (3.26 million gallons) to 37,277 cubic meters (9.84 million gallons) annually. Because of reduced tree cover, base flow for the tract is estimated to increase by 28%, which is desirable. However, undesirable pervious and impervious runoff is also estimated to increase by 305% and 643%, respectively, thus increasing stormwater runoff pollution loading to receiving waters.

The i-Tree Hydro model estimates stormwater runoff pollutants such as total suspended solids (TSS), total phosphorus, soluble phosphorus, total Kjeldahl nitrogen, and nitrite/nitrate, among others, using national Estimated Mean Concentration (EMC) values. By reducing tree canopy cover by 70%, increasing impervious surface cover 25 fold, and removing the porous, sandy loam top soil of the site (leaving dense, clayey sub-soil), it is estimated that stormwater runoff pollution loading will increase by 476%.

Because i-Tree Hydro is a first-order stormwater runoff estimation model, it may be advantageous to seek the council of a professional hydrologist and to use a more detailed hydrology model if greater precision regarding stormwater runoff volume and pollution loading is desired.

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Data inputs for i-Tree Hydro

Delineated parcel boundary estimated using Google Map imagery through i-Tree Canopy (http://www.itreetools.org/canopy/index.php)

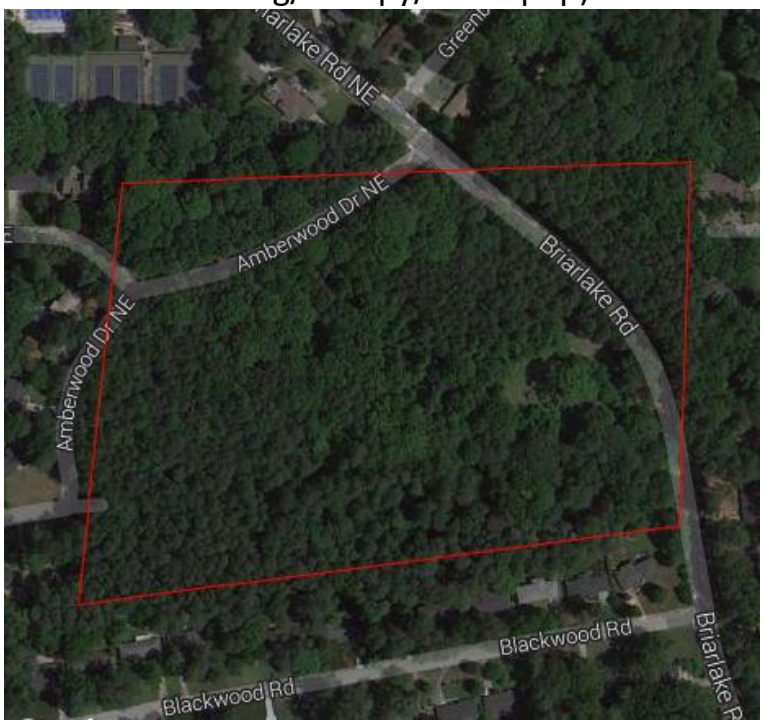

Figure 1 Parcel at 3330 Briarlake Rd, Decatur, GA and surrounding area. Area of interest within the red boundary is approximately 21 acres (0.09 km^2)

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Land cover class estimates using i-Tree Canopy

Table 1 Land cover classes observed, description of the cover class type, cover class abbreviation, percent land cover and standard error for each identified cover class on the designated area of interest

Cover Class	Description of Cover Class	Abbreviation	% Cover	SE
Canopy / Decid. / Pervious	Deciduous tree canopy over permeable surface cover	CDP	47.5	3.5
Canopy / Decid. / Impervious	Deciduous tree canopy over impervious surface cover	CDI	1.5	0.9
Canopy / Evrgrn / Pervious	Evergreen tree canopy over permeable surface cover	CEP	46.0	3.5
Canopy / Evrgrn / Impervious	Evergreen canopy cover over impervious surface cover	CEI	1.5	0.9
Herbaceous	Herbaceous ground cover	H	2.0	1.0
Impervious / Connected	Impervious surface cover that drains directly to receiving waters via storm drains	IC	1.5	0.9

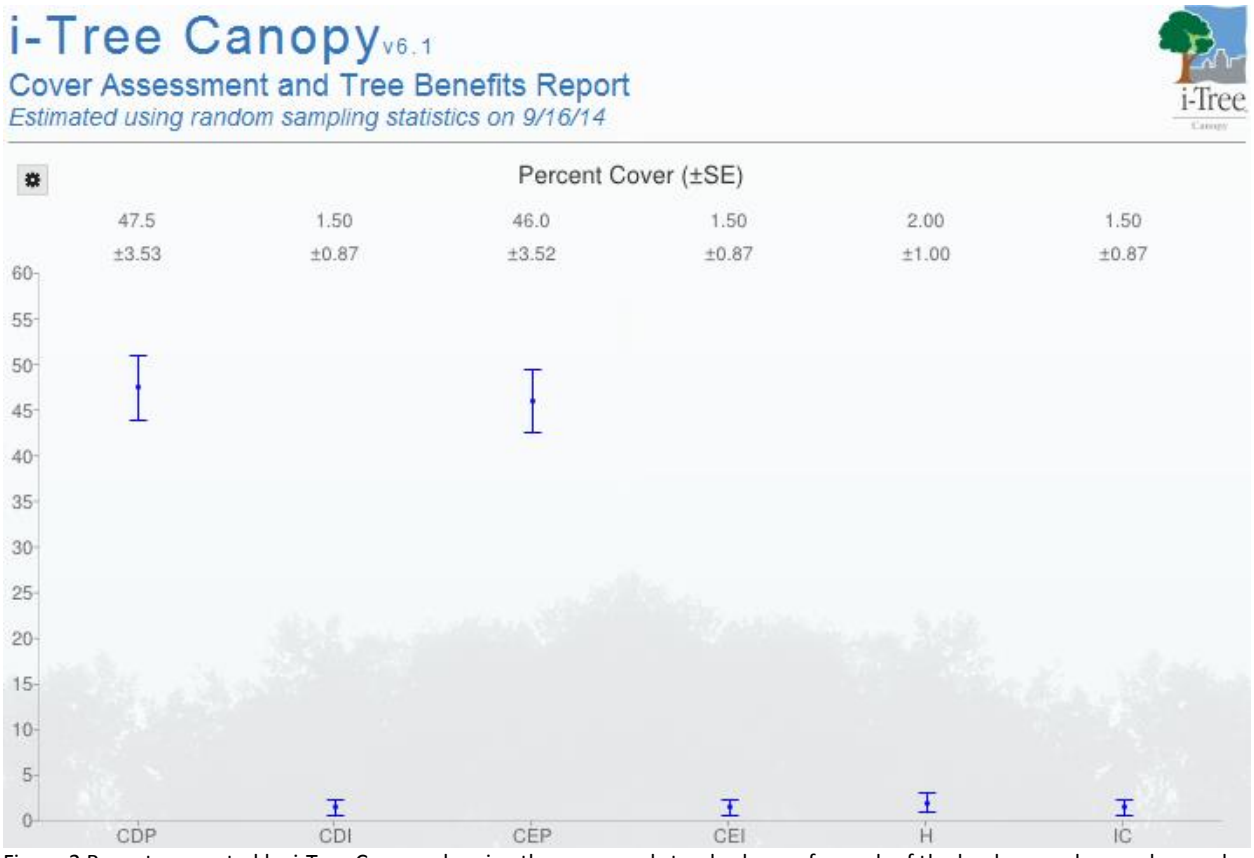

Figure 2 Report generated by i-Tree Canopy showing the mean and standard error for each of the land cover classes observed.

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Soil parameters using Natural Resources Conservation Service (NRCS) web-based soil survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

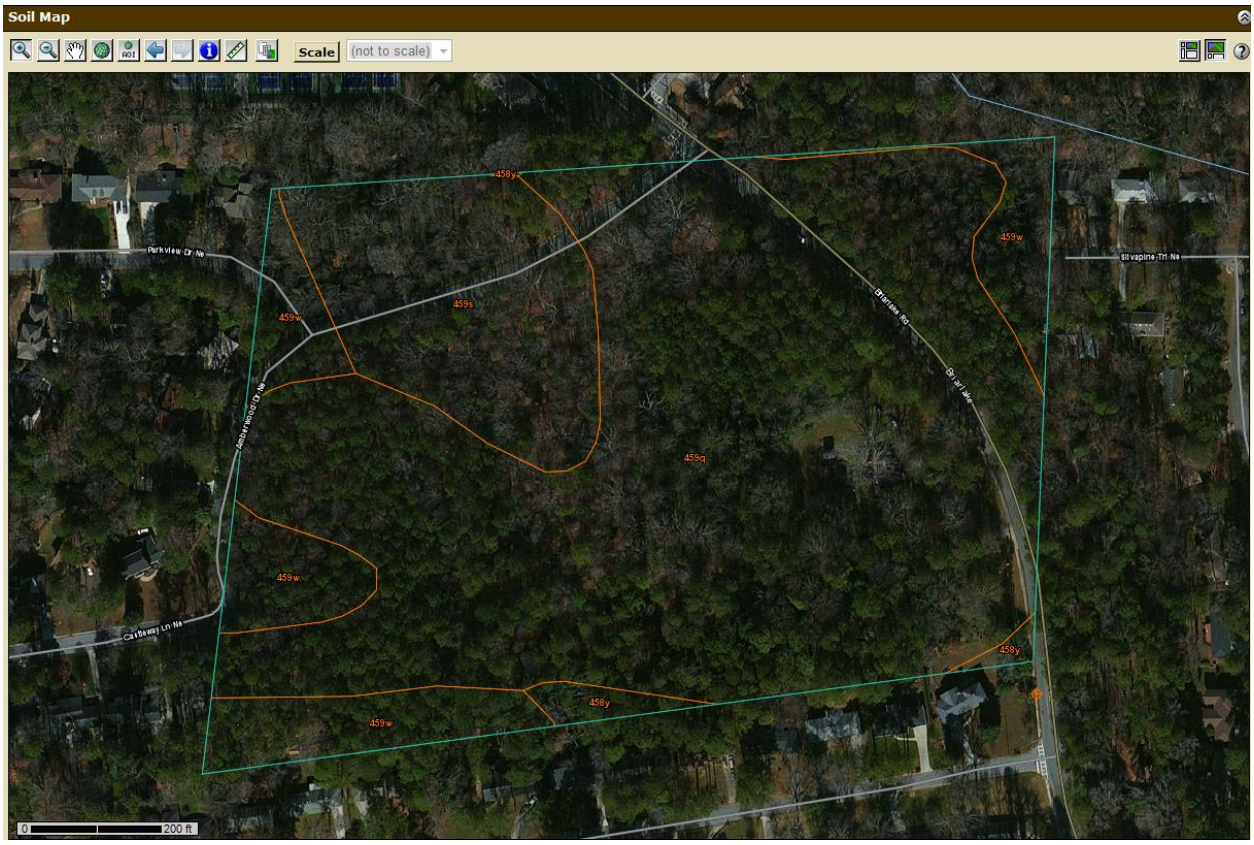

Figure 3 The web-based soil survey tool shows the approximate soil type within the area of interest

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Table 2 Based on the NRCS web-based soil survey, the area of interest is approximately 86% sandy loam with a rooting depth of about six inches. A thick, dense clay sub-soil layer is typically found under the sandy loam top soil layer. In i-tree Hydro the sandy loam soil parameter was chosen and the depth of root zone was adjusted to 0.15 m (6 inches).

DeKalb County, Georgia

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
458y	Cecil-Urban land complex, 2 to 10 percent slopes	0.3	1.4%
459q	Pacolet sandy loam, 2 to 10 percent slopes	16.7	70.9%
459s	Pacolet sandy loam, 15 to 30 percent slopes	3.5	14.7%
459w	Pacolet-Urban land complex, 10 to 25 percent slopes	3.1	13.0%
Totals for Area of Interest		**23.6**	**100.0%**

Digital Elevation Model (DEM) used by i-Tree Hydro to estimate elevation change and simulate stormwater runoff flow.

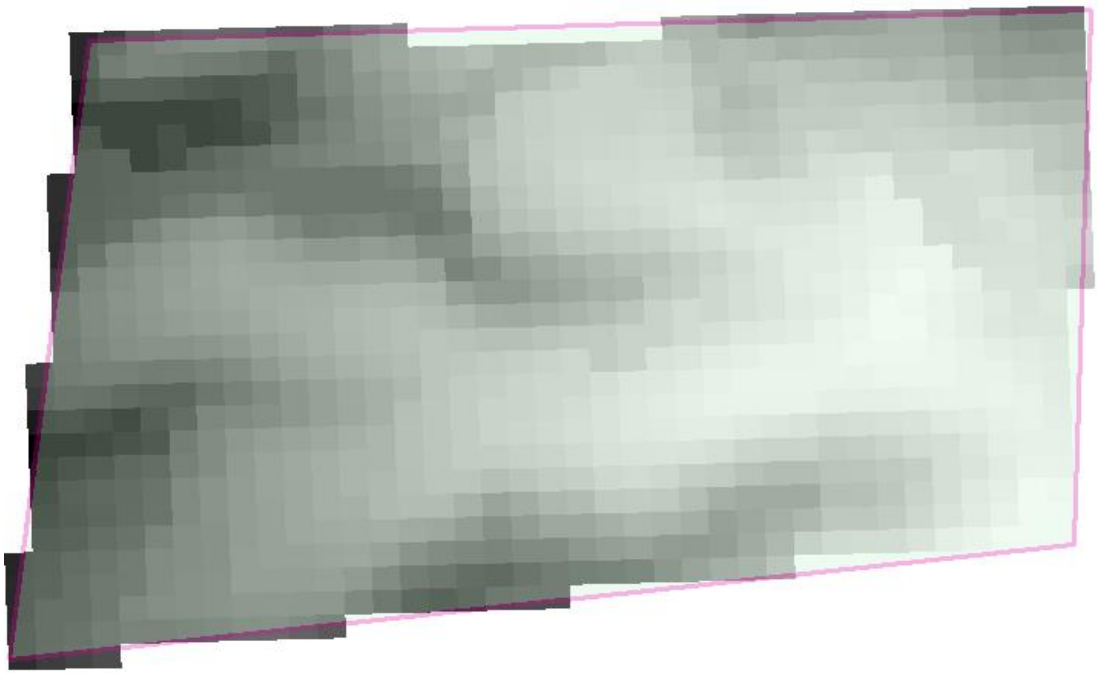

Figure 4 10 m DEM obtained from the United State Geological Survey website (http://viewer.nationalmap.gov/viewer/) and clipped to boundary of the area of interest using ESRI ArcGIS 10.1 software. Lighter pixels indicate higher elevation.

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Results

i-Tree Hydro Executive Summary
Project Location: Decatur, GA
Project Time Period: 01/01/2012 – 01/31/2012
Watershed Area: 0.09 km^2
Total Rainfall (for 2012): 838.7 mm
Predicted Total Runoff from current location: 12,321.8 m^3

Table 3 Land cover percentages for the parcel are estimated for the current condition using 2012 Google Map imagery. Soil type and rooting depth for the current condition are taken from NRCS soil survey data. Soil type and rooting depth for the proposed, post-development condition are based on NRCS soil survey data for the parcel after existing top soil is removed during development.

Land Cover	Current condition	Proposed post-development condition
Tree cover	96.5%	25.0%
Herbaceous cover	2.5%	50.0%
Impervious cover	1.0%	25.0%
Soil type	Sandy loam	Clayey sub-soil
Rooting depth	6”	2”

Table 4 Estimated annual stormwater runoff volume for current and proposed post-development conditions segregated by flow type. The percentage of annual runoff increase between conditions is also calculated.

Site condition	Total flow (m^3)	Base flow (m^3)	Pervious flow (m^3)	Impervious flow (m^3)
Current	12,322	5,063	4,700	2,559
Post-development	37,277	6,488	14,327	16,462
Percent Increase	303%	28%	305%	643%

Using 2012 rainfall data from Hartsfield/Jackson International Airport, soil data from the National Resource Conservation Service (NRCS) web-based soil survey, and 2013 land cover data from Google Map imagery and i-Tree Canopy, we were able to estimate stormwater runoff on the approximately 21 acre tract of land on and around the parcel at 3330 Briarlake Road using the hydrology model i-Tree Hydro. Comparing the current land cover condition of the tract (96.5% tree canopy cover, 2.5% herbaceous cover, 1% impervious cover, and predominantly

undisturbed, sandy loam soil) with a proposed, post-development land cover condition (25% tree canopy cover, 50% herbaceous cover, 25% impervious cover, and predominantly compacted, clayey sub-soil base), it is estimated that total stormwater runoff volume will increase by over 300% from 12,322 cubic meters of water (3.26 million gallons) to 37,277 cubic meters (9.84 million gallons) annually.

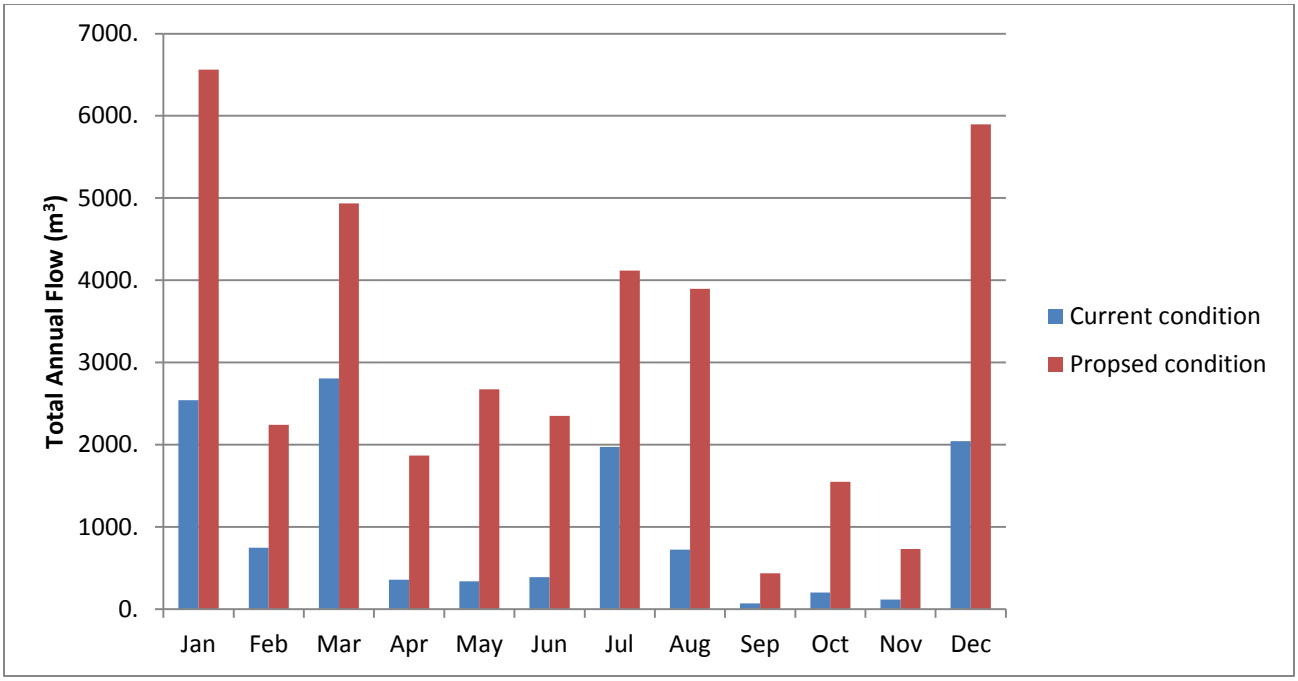

Figure 5 Comparison of the total monthly stormwater runoff volume in cubic meters between the current site condition and the proposed, post-development site condition.

Because of reduced tree cover for the proposed, post-development condition, base flow for the tract is estimated to increase by 28%, which is desirable. However, undesirable pervious and impervious runoff is also estimated to increase by 305% and 643%, respectively, thus increasing stormwater runoff pollution loading to receiving waters.

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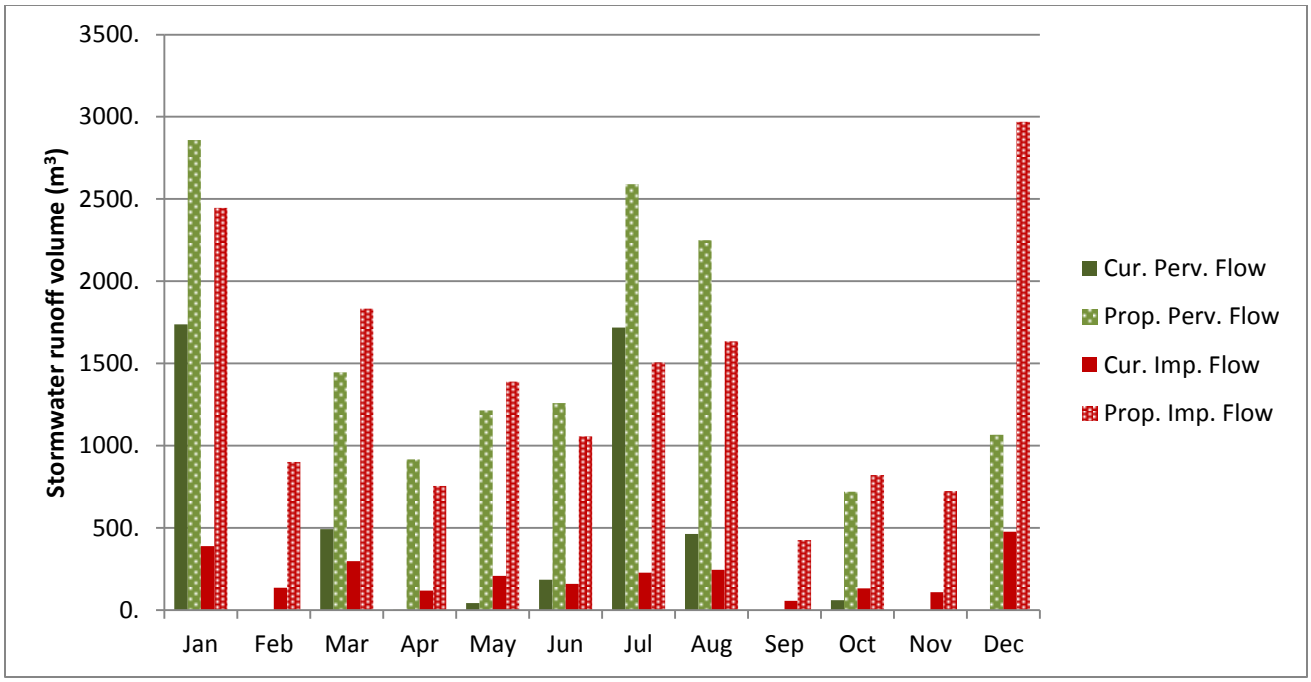

Figure 6 Comparison of the monthly stormwater runoff volume in cubic meters for pervious (green bars) and impervious (red bars) flow for the current site condition (solid bars) and the proposed, post-development condition (hatched bars).

The i-Tree Hydro model estimated stormwater runoff pollutants such as total suspended solids (TSS), total phosphorus, soluble phosphorus, total Kjeldahl nitrogen, and nitrite/nitrate, among others, using national Estimated Mean Concentration (EMC) values. By reducing tree canopy cover by 70% and increasing impervious surface cover 25 fold on this parcel, it is estimated that stormwater runoff pollution loading to receiving waters will increase by approximately 425%.

Table 5 Estimated annual stormwater pollution runoff in kilograms for current and proposed, post-development conditions by pollutant type.

Pollutant Constituent	Current condition pollutant loading (kg)	Proposed, post-development pollutant loading (kg)
Total suspended solids (TSS)	569	2414
Biochemical oxygen demand (BOD)	102	434
Chemical oxygen demand (COD)	383	1626
Total phosphorus (TP)	2.3	9.7
Soluble phosphorus (SolP)	0.9	4.0
Total Kjeldahl nitrogren (TKN)	12.6	53.3
Nitrite/Nitrate (NO2_3)	4.8	20.3

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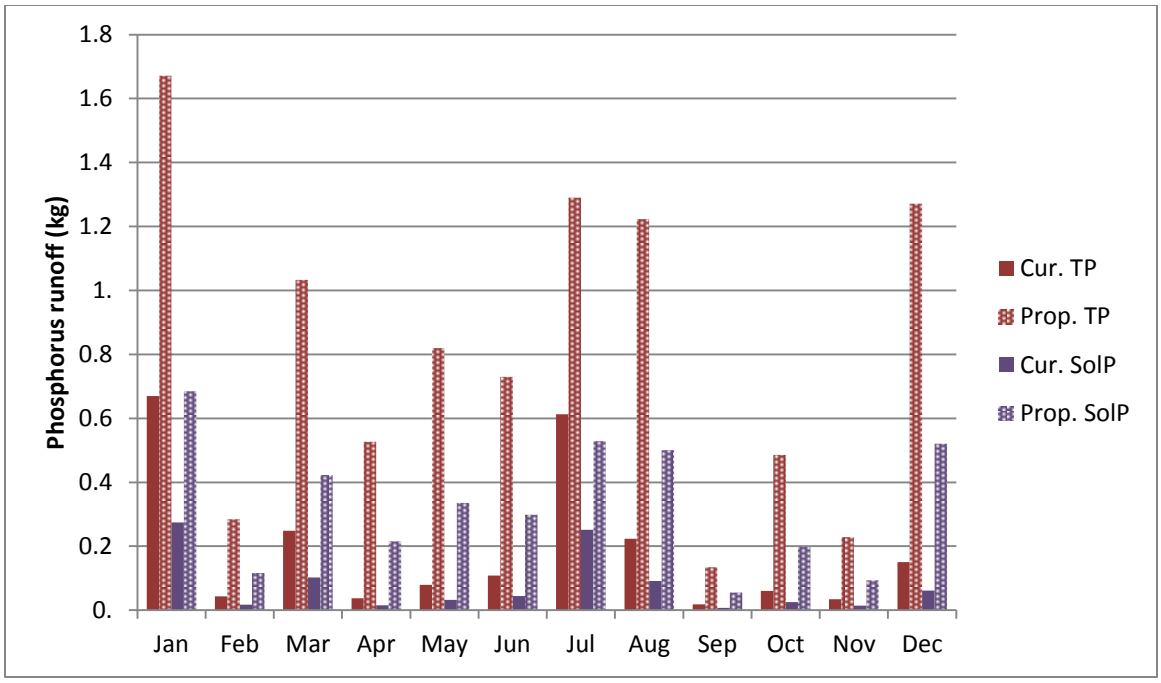

Figure 7 Comparison of the estimated monthly total (TP; pink) and soluble (SolP: purple) phosphorus runoff in kilograms for the current site condition (solid bars) and the proposed, post-development condition (hatched bars).

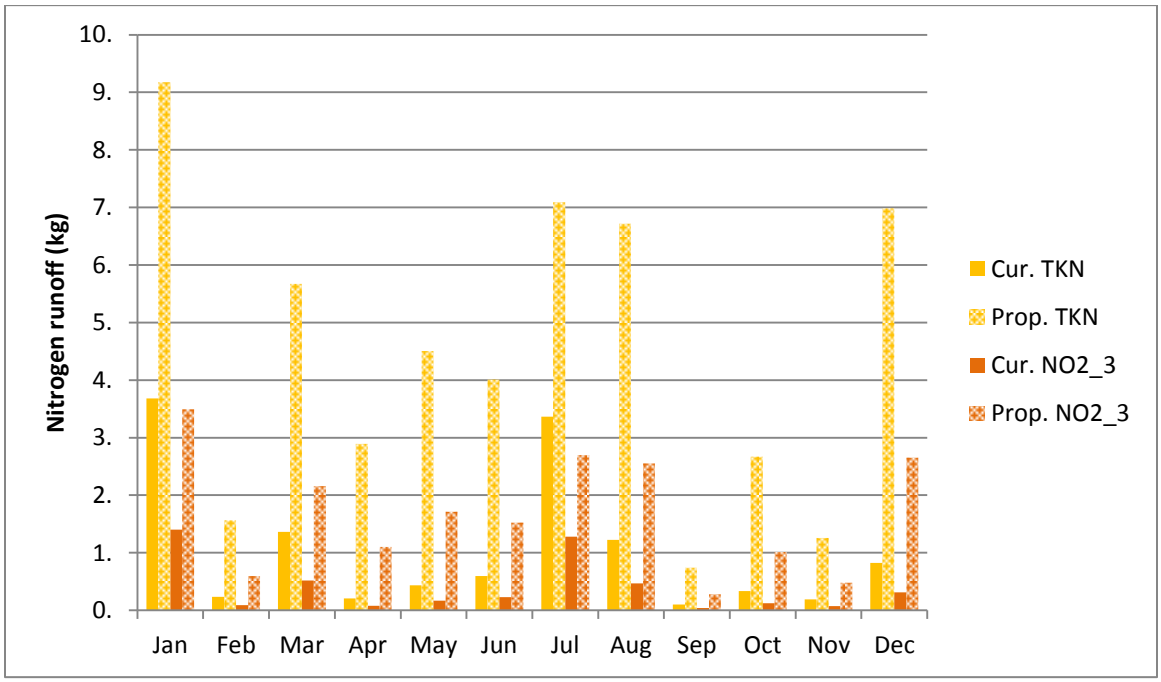

Figure 8 Comparison of the estimated monthly total Kjeldahl nitrogen (TKN; yellow) and nitrite/nitrate (NO2_3: orange) runoff in kilograms for the current site condition (solid bars) and the proposed, post-development condition (hatched bars).

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