Calculating System Development Charges for Stormwater Facilities

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INTRODUCTION

Stormwater runoff usually occurs during and immediately after rainfall, but can sometimes involve groundwater flow and snow melt. The primary purpose of stormwater systems and associated stormwater management policies is to control runoff in ways that minimize hazards to life and property, and minimize inconvenience to the general public. Urban development increases the frequency and severity of flooding by removing vegetation, filling natural water storage areas, covering floodplains and watersheds with pavement, and reducing the size of the natural channel available for flood flows. These disturbances increase flood velocities and flood heights. As watersheds are developed, buildings built in the floodplains face increased risk as flood levels rise. Development adjacent to natural floodplains may become subject to flooding as floodplain areas increase.

A primary consideration of stormwater analysis is amount and change in impervious surfaces. An impervious surface is any material that prevents absorption of stormwater into the ground. Retention and detention basins and dry wells allowing stormwater to percolate directly into the ground are not usually considered impervious surfaces. Graveled areas usually are. One method by which impervious surfaces can be defined is in terms of a percolation rate in minutes per inch.

Unlike wastewater and water systems, however, stormwater systems can be affected by development patterns occurring outside the jurisdiction of local government. For this reason, stormwater facility planning is best done on a drainage-basin level involving all relevant governmental units. This is not always possible, however.

Stormwater facility planning must consider hydrologic factors specific to the drainage basin and the development patterns of that basin, such as discharge rates, runoff volume, flow velocities, discharge characteristics at various stages of a rainfall or other runoff event, the condition of downstream flow conditions, and water quality. Stormwater facility planning also includes identification of system alternatives considering: land use patterns; storage, channeling and treatment options; risks to life, property, and convenience; and costs of installation, operation and maintenance, and replacement.

Stormwater facility planning is based on the magnitude of peak storm events. The magnitude of a storm is described by its likelihood of occurrence. For example, a "25-year storm" is likely to occur, on the average, once every 25 years. Another way of referring to a 25year storm would be to say it is a storm that has a 4% chance of occurring in any single given year.

Stormwater system development charges (SDCS) are used to help finance the particular stormwater system resulting from the planning process. SDCs for stormwater facilities are conceptually similar to those of wastewater and water SDC, but have many practical differences. Similar developments in different locations can have different levels of runoff quantity and quality, depending on soils, slopes, amount of impervious surface, setting with respect to other land uses, and other factors. In addition, stormwater systems can be affected by development patterns occurring outside the jurisdiction of local government. For this reason, stormwater facility planning is best done on a drainage-basin level involving all relevant governmental units, although this is not always possible.

One of the basic questions involved in calculating stormwater SDC is the unit of development impact on which to measure the impact of any particular development. The primary purpose of this chapter is to review some of the more general ways in which common units of impact measure may be developed and applied to stormwater SDCS. The chapter also presents two general approaches to the calculation of such fees. The first approach reviewed is where a stormwater collection system is installed to serve a region composed of one major drainage basin. The second approach is the calculation of fees in lieu of construction of stormwater storage facilities to accommodate specific developments. Both fees can be combined. The calculation of stormwater SDCs follows the same steps as for wastewater and water SDCs.

REGIONAL FACILITIES APPROACH

The first approach is where a stormwater collection system is installed to serve a region composed of one major drainage basin. This approach will apply SDCs to one common unit of impact, the equivalent drainage unit or EDU.

Service Area

Stormwater becomes runoff and flows downhill in depressions and ravines. Water collects from the network of small ravines to form a stream or creek. Land area that is drained by the stream or river and its tributaries is called a "drainage basin" or "watershed". A divide or ridge line separates drainage basins. The City of Columbia is situated in a single drainage basin that drains into the Cherokee River, winch empties into the Gulf of Mexico. Thus, one service area is considered.

Level of Service and Projections of Demand

The most important factor in determining the impact of a development on stormwater facility needs is the addition of impervious cover. To calculate the existing and growth-related costs per acre of impervious cover, it is necessary to estimate the amount of existing and future impervious cover for each of the two proposed service areas.

The drainage basin studies that the City has completed were designed to accommodate the city's stormwater needs to the year 2010, based on its niid-1980s planning documents. Existing (1993) and future (2010) acres of impervious cover are estimated based on the City's existing land use inventory, population and employment estimates and projections by census tract, and typical impervious cover ratios for four general land use types. The first step in the analysis is to derive average population and employment densities for the four land use types and apply those to future population and employment estimates. This has been done based on the City's current land use inventory and 1990 population and employment data. Columbia has a residential density of about 8 persons per acre, and employment densities ranging from about 8 employees per acre for industrial land to about 69 employees per acre for office/commercial development, as shown in Table 1.

The next step is to estimate existing and future developed acres by each of the four land use categories for both service areas. This has been accomplished using the population and employment densities calculated in Table 1, and population and employment estimates and projections. Population and employment for each service area is based on their approximate correlation with census tract boundaries. The results are presented in Table 1.

Table 1 Average Population and Employment Densities: 1990

Land Use Category	Population, Employment 1990	Developed Acres 1990	Population, employment per acre	Population, employment 2010	Developed Acres 2010
Residential	319,583	39,406	8.11	355,219	43,800
Retail	40,961	1,411	29.03	49,992	1,722
Office/Commercial	211,561	3,071	68.89	295,505	4,290
Industrial	58,178	7,001	8.31	74,039	8,910
Total		50,889			58,722

The final step is to estimate the amount of existing and future impervious surface in each service area. This is done multiplying the estimates of developed acres by land use category derived in the above table by impervious cover ratios, as shown in Table 2. The impervious cover ratios are based on reasonable assumptions and data from other communities.

Inventory of Existing Systems and Planned Expansions

Columbia has been installing a regional stormwater collection system for nearly 3 decades and plans to install additional facilities over the next decade. The current value of the existing stormwater system and the planned expansions apportioned for new development is determined in the same manner as determined for water and wastewater systems in Chapter 6. For brevity, Table 3 summarizes what amounts to more than 300 stormwater items by subbasin, and Table 4 summarizes nearly an equal number of additions to the system planned to be installed over the next decade. The total cost attribution method is used.

Table 5 summarizes values and costs presented in Tables 3 and 4 attributed to new development. The analysis is similar to the steps presented in Chapter 7. It shows that new development can be attributed with $0.32 per square foot of impervious surface. Beware, however, that for brevity of exposition, Table 5 does not consider the effects of revenue credits on the net fee to be assessed; the table only reports the cost per impervious square foot.

Information displayed in Table 5 must be converted into common units of assessment for SDC purposes. The most common unit of measure is the *equivalent drainage unit* (EDU), or its alternates: equivalent service unit (ESU) and equivalent residential units (ERU).

Table 2 Land Use by Service Area, 1993-2010

Service area/ land	Developed acres		Impervious	Impervious acres	
use	1993	2010	cover ratio	1993	2010
Residential	39,406	43,800	0.21	8,275	9,198
Retail	1,411	1,722	0.67	945	1,154
Office/commercial	3,071	4,290	0.67	2,058	2,874
Industrial	7,001	8,910	0.50	3,501	4,455
Cherokee Basin	50,889	58,722		14,779	17,681

Another common unit is acre of development, an example of which is presented below. Table 6 calculates the stormwater SDC per EDU.

Table 7 calculates how the costs per EDU are applied to generate the cost per residential unit for single- and multiple-family residential developments, and per 1000 sq. ft. of gross leasable area for office (including government office), commercial (including institutional), and industrial developments.

Inasmuch as local governments may wish to differentiate SDCs by more refined categories than those presented m the tables above, Table 8 uses information from Table 6 to determine stormwater SDCs by zoning district classification.

Table 3 Current Value of Existing Improvements by Subbasin

Improvement types	North Creek	South Creek	West Creek	Total
RCP pipe	$19,083,775	$172,500	$2,297,500	$21,553,775
Catch basins	$1,315,200	$6,600	$316,800	$1,638,600
Manholes	$1,800	$14,400	$230,400	$246,600
Yard inlets	$33,000	$13,500	$19,500	$66,000
Headwalls	$513,000	$44,800	$378,650	$936,450
Gabion slope protection	$1,503,072	$495,620	$377,978	$2,376,670
Rip Rap outlet protection	$28,200	$0	$0	$28,200
Concrete channel lining	$0	$0	$647,459	$647,459
Retaining wall	$0	$36,000	$1,740,250	$1,776,250
Curb and gutter	$725,813	$27,313	$303,375	$1,056,501
Raise existing curb/gutter	$0	$0	$0	$0
Private driveway bridges	$0	$0	$0	$0
Priv. driveway adjustments	$61,380	$1,980	$92,400	$155,760
Easements	$4,289,125	$470,770	$1,943,340	$6,703,235
Clearing and grubbing	$1,372,520	$172,849	$707,290	$2,252,659
Unclassified excavation	$0	$19,384	$185,196	$204,580
Repair structures	$156,000	$0	$0	$156,000
Engineering/admin.	$2,209,091	$147,572	$924,013	$3,980,676
Total current value	$31,991,976	$1,623,288	$10,164,151	$43,779,415
Growth-related share	8.75%	11.60%	0.00%	
Growth-related current value	$2,799,298	$188,301	$0	$2,987,599
Systemwide current value	$29,192,678	$1,434,987	$10,164,151	$40,791,816

Table 4 Planned Expansions by Subbasin

Improvement types	North Creek	South Creek	West Creek	Total
RCP pipe	$456,250	$8,080,150	$16,128,135	$24,664,535
Catch basins	$77,600	$1,065,975	$648,870	$1,792,445
Manholes	$30,600	$333,200		$363,800
Yard inlets	$9,000		$26,962	$35,962
Headwalls	$56,500	$274,295	$345,067	$675,862
Gabion slope protection	$16,400	$2,313,492	$144,635	$2,474,527
Rip Rap outlet protection	$0	$0	$5,580	$5,580
Concrete channel lining	$80,377	$22,595	$0	$102,972
Retaining wall	$1,360,750	$93,995	$0	$1,454,745
Curb and gutter	$36,750	$94,750	$185,670	$317,170
Raise existing curb/gutter	$0	$0	$6,713	$6,713
Private driveway bridges	$269,842	$0	$3,808,761	$4,078,603
Priv. driveway adjustments	$1,320	$27,720	$19,544	$48,584
Easements	$932,225	$1,617,175	$3,968,558	$6,517,958
Clearing and grubbing	$331,458	$166,968	$1,269,338	$1,767,764
Unclassified excavation	$45,470	$198,090	$55,370	$298,930
Repair structures	$0	$0	$146,755	$146,755
Engineering/admin.	$370,454	$1,431,041	$2,675,996	$4,477,491
Total Costs	$4,074,996	$15,719,446	$29,435,954	$49,230,396
Growth-related percent	0.00%	46.75%	68.40%	
Growth-related expansion costs	$0	$7,348,841	$20,134,193	$27,483,034
Systemwide expansion costs	$4,074,996	$8,370,605	$9,301,761	$21,747,362

Table 7 Equivalent Drainage Units per Unit of Development

Land Use	Unit of impact	EDUs per unit	SDC per unit
Single family	Res. Unit	1.00	$992
Multiple family	Res. Unit	0.79	$784
Office/government	1000 sq. ft.	1.25	$1240
Commercial/institutional	1000 sq. ft.	1.30	$1290
Industrial	1000 sq. ft.	1.23	$1220

Table 8 Calculation of SDCs by Zoning District

Zoning district	Unit of impact	EDUs per unit	SDCs @ $1054/EDU
R-1	Res. Unit	1.00	$992
R-2	Res. Unit	1.00	$992
R-4	Res. Unit	1.00	$992
R-6	Res. Unit	1.00	$992
R-8	Res. Unit	1.00	$992
R-10	Res. Unit	0.79	$784
R-20	Res. Unit	0.79	$784
R-30	Res. Unit	0.79	$784
OI-1	1000 sq. ft.	1.25	$1240
OI-2	1000 sq. ft.	1.25	$1240
OI-3	1000 sq. ft.	1.25	$1240
C-1	1000 sq. ft.	1.30	$1290
C-2	1000 sq. ft.	1.30	$1290
C-3	1000 sq. ft.	1.30	$1290
I-1	1000 sq. ft.	1.23	$1220
I-2	1000 sq. ft.	1.23	$1220

Debt Service Costs and Credits

Debt service costs and credits are handled in one of three ways. The most common way is for stormwater facilities to be financed by revenue bonds retired by water or wastewater rates. Since volume of water or wastewater is used to calculate rates for a given customer, the debt service costs and credit would be handled the same as for water and wastewater revenue bonds presented in Chapter 6. Sometimes, stormwater facilities are financed from general obligation bonds, Appendix 2 shows how debt service credits are calculated when retired through property taxes. At other times, stormwater facility revenue bonds may be retired by stormwater utility rates. However, those rates are often not calibrated to volume of stormwater generated, but rather in terms of general land use categories. In these situations, one would need to develop a per-cubic-foot revenue credit by general land use similar to the credit per gallon of water and wastewater consumption shown in Chapter 6. This approach would require estimating annual changes by general land use category, similar to the manner shown in Appendix 2 for the property tax credit.

FEE IN-LEEU OF CONSTRUCTION APPROACH

The second approach, fees in lieu of constructing on-site detention/ retention facilities, is more common and more simple, but potentially less defensible than the approach presented earlier. It is used where individual developments are required to construct stormwater storage facilities on-site as project improvements based on the locally adopted level of service. Sometimes, these individual storage facilities may hold water and then release it into nearby streams. In other situations, the water is held until it drains into the soils. In still other situations, water is held and then released into regional transmission lines that transmit it to centralized treatment facilities. The third solution is becoming more common in urbanized areas. The in-lieu approach does not necessarily assume that any of the three options are locally employed. Regardless of the option, each option requires construction of an on-site storage facility; or in the absence of such a facility, a fee in-lieu to be used by local government to construct such a facility elsewhere.

We shall assume that the service area and level of service are the same as in the approach presented above. A local hydrological study estimates the cost of constructing stormwater storage facilities to average $23,400 per acre-foot. This cost can be slightly higher per acre-foot for very small facilities and ran be lower per acre-foot for very large facilities. Nonetheless, the average cost may be used to determine reasonable fees in-lieu of a developer constructing such facilities. The cost per EDU can be derived from the rational method of estimating stormwater runoff,

Rather than using EDUs, however, consider the nature of fees if one used acres of land developed instead. For any class of land use, especially residential, there may be very different runoff coefficients. For example, single-family estate areas may average one home per acre, while a moderate-density, single-family area may have up to eight homes per acre. While the estate may have more impervious surface than the average home, the concentration of eight homes on 1 acre results in vastly greater impervious surface. It is thus reasonable to establish average coefficients of runoffs for each class of land use. This can be easily done using the local zoning districts as a guide, which was done by city of Columbia and shown in Table 9.

Under this method, Table 9 becomes the fee in-lieu schedule applied to development within each zoning district for situations where developers choose not to install stormwater storage facilities on-site. Consistent with *rational nexus* requirements, individual developers who demonstrate lower runoff coefficients would be assessed lower fees associated with reduced generation of acre-feet.

Table 9 In-lieu of Fees per Acre of Development by Zoning District

Zoning district	**Unit of impact**	**Cubic feet per unit of develop-ment**	**In-lieu fee per cf @ $23,400 per acre-ft.**	**In-lieu fee per unit of develop-ment**
R-1	Res. Unit	726	$0.54	$392
R-2	Res. Unit	608	$0.54	$328
R-4	Res. Unit	502	$0.54	$271
R-6	Res. Unit	502	$0.54	$271
R-8	Res. Unit	454	$0.54	$245
R-10	Res. Unit	396	$0.54	$214
R-20	Res. Unit	396	$0.54	$214
R-30	Res. Unit	396	$0.54	$214
OI-1	1000 sq. ft.	628	$0.54	$339
OI-2	1000 sq. ft.	628	$0.54	$339
OI-3	1000 sq. ft.	628	$0.54	$339
C-1	1000 sq. ft.	652	$0.54	$352
C-2	1000 sq. ft.	652	$0.54	$352
C-3	1000 sq. ft.	652	$0.54	$352
I-1	1000 sq. ft.	619	$0.54	$334
I-2	1000 sq. ft.	619	$0.54	$334