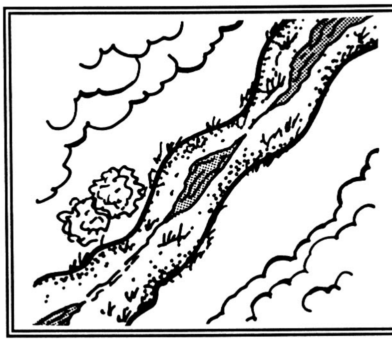
Environmental Indicator Profile Sheet



Indicator Profile No. 9

Impacted Dry Weather Flows

Category: **Physical and Hydrological**

Tools Used to Measure Indicator:

- Monitoring stream low flow data over time as land use changes.
- Comparing urban stream low flows with nearby rural stream low flows.

Description:

Dry weather flows are measured over a period of time to assess the effects of urbanization on stream base flow. An alternative approach is to analyze streamflow data for various urban streams and compare this data with streamflow data from nearby rural areas (within the same physiographic ecoregion). This alternative approach may require further partitioning for valid comparisons (e.g., within the same physiographic/geologic regime).

In more humid climates, the indicator is reduced dry weather flows (as urbanization increases) as a result of decreased groundwater recharge. In more arid climates, the indicator is increased dry weather flows (as urbanization increases) as a result of increased irrigation/domestic water use.

Dry weather water chemistry, as a result of illicit connections or other discharges, may degrade with increasing urbanization (reviewed as part of pollutant constituent monitoring, Indicator Profile No. 1).

Utility of Indicator to Assess Stormwater Impacts:

- Can assess the low flow quantity effects of increased urbanization.
- Can help assess the causes of reduced low flows in streams by evaluating effects associated with sanitary sewer and storm drainage pipe installation and by evaluating effects of increased impervious surfaces (humid climates).
- Can be used to help watershed managers to institute practices which encourage groundwater recharge and minimize impervious areas.
- Can help assess the causes of increased low flows in streams by evaluating domestic water usage and behavior patterns (arid climates).
- Degraded water chemistry, during low flow conditions can help identify pollutant causes and sources.
- Extremely useful when done in conjunction with stream widening/downcutting studies.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	○
Streams	●
Estuaries	○
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	○
* Municipal Programs	◖

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	◖
* Baseline Control	◖
* Reliable	◖
* Accuracy	○
* Low cost	◖
* Repeatable	◖
* All Watershed Scale	●
* Familiar to Practitioners	◖
* Easy to use & Low training	●

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3B

Advantages of Method:

- Provides a direct indicator of low flow quantity as related to watershed urbanization.
- Relatively easy to monitor flows and report results.
- Reduced stream low flow is easily understood by the general public who can apply pressure on decision makers to make appropriate land use decisions (humid climates).
- Most useful in assessing the impact of development on headwater streams.

Disadvantages of Method:

- May take several years to obtain statistically valid results showing trends in flow data with increasing urbanization.
- May not adequately address varying geologic or climatic conditions where other influences (such as irrigation, well drawdown, public water supply use, sea water intrusion, long term drought, etc.) can affect results, unless method is partitioned to account for this variability.
- Areas with excessively poor natural infiltration rates may show inconclusive trends with changing land use.
- The handful of studies conducted have not shown consistent trends.
- Trends are hard to detect in larger streams or where long term hydrology records are not available.
- In arid climates, where low flow tends to increase with increasing urbanization, resultant condition may be perceived by some as more beneficial than natural conditions.

Case Study: Ferguson, B.K.; P.W. Suckling, 1990
Changing Rainfall-Runoff Relationships in the Urbanizing Peachtree Creek Watershed, Atlanta, Georgia
Water Resources Bulletin, American Water Resources Association, Vol. 26, No. 2

Peachtree Creek is a gaged watershed located in a rapidly urbanizing area. The relationships of runoff to rainfall were studied for total annual flow, low flows and peak flows. Flows were compared between a later, more urbanized condition and an earlier, less urbanized condition. An increase in total runoff in wet years was observed as urbanization increased, but a decrease occurred during dry years. A decrease in low flow was also observed during dry years.

Increasing peak flows and declining low flows can be adequately explained by urban hydrologic theory. A decline in total runoff in dry years can be explained only by taking into account evapotranspiration. The concept of advectively assisted urban evapotranspiration is presented. Urban hydrologic theory must take into account vegetation and evapotranspiration, as well as impervious surfaces and their direct runoff, to explain the magnitude of total annual flows and low flows.

Method References:

- Low flow monitoring over time: Spinnello, A.F.; D.L. Simmons, 1992. *Base Flow of 10 South-Shore Streams, Long Island, New York, 1976-85, and the Effects of Urbanization on Base Flow and Flow Duration.* USGS Water-Resources Investigations Report 90-4205

- Comparing urban and rural low flow: Evett, J.B., 1994. *Effects of Urbanization and Land-Use Changes on Low Stream Flow.* Dept. of Civil Engineering, College of Engineering Univ. of North Carolina, UNC-WRRI-94-284