# Environmental Indicator Profile Sheet

**Indicator Profile No. 24**

## Growth and Development

Category: **Programmatic**

**Tools Used to Measure Indicator:**

- GIS Systems, land use mapping
- Other physical, biological or chemical monitoring techniques.

**Description:**

As development in a watershed grows, imperviousness increases and the aquatic system is generally subjected to greater stress. This stress may include higher NPS pollutant loadings and increased stormwater runoff flows. Erosion within the stream system increases as the stream downcuts and widens to adjust to the new flow regime.

The relative health of a given system as measured through ecological impacts to the aquatic community (i.e., water quality, physical habitat, and biological diversity and health) can be correlated with the impervious percentage of the watershed. Zoning patterns in a watershed can be used to estimate existing and potential watershed imperviousness based on land use-imperviousness relationships.

The potential for continuing urbanization (and thus increased watershed imperviousness) can be tracked through review of building permits, environmental impact statements, and changes in population. Increases in the numbers of building permits issued and environmental impact statements completed and increased population are indicative of continuing urbanization.

**Utility of Indicator to Assess Stormwater Impacts:**

- Can be used to evaluate existing and potential impacts to aquatic systems. Imperviousness can predict aquatic health degradation thresholds.
- Can be used to evaluate the effectiveness of BMPs in extending development thresholds (e.g., increasing impervious area limits without increasing aquatic health degradation).
- Can be used as a planning tool in making zoning and master planning decisions.

**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 3.3E

**Advantages of Method:**

- Easily measured using land use mapping or GIS technology.
- Easily understood by policy decision makers and politicians.
- Inexpensive to measure and report (however, development of a detailed GIS can be very expensive).
- Can provide a uniform method for measurement and assessment.
- Provides a comprehensive measure of the cumulative impact of land development on subwatersheds.
- Many of the indicator parameters are already tracked by local jurisdictions.

**Disadvantages of Method:**

- Measurement and use of growth indicators is not yet standardized.
- Assessment of stream quality has not been statistically correlated with impervious area.
- Does not precisely measure imperviousness, but rather estimates relative increases in imperviousness.
- Zoning changes, environmental impact statements, and building permits represent probable (not definite) changes in imperviousness.
- Does not take into account that development can increase without increasing aquatic health degradation.

**Case Study:** Booth, D.B.; L.E. Reinelt, 1994
**Consequences of Urbanization on Aquatic Systems - Measured Effects, Degradation Thresholds, and Corrective Strategies**
*Pawlukiewicz, J.; et. al., (eds.). 1994. Watershed '93: A National Conference on Watershed Management, USEPA 840-R-94-002*

Several watersheds in King County, Washington were evaluated to assess the effect of urbanization on stream and wetland system health. Watershed imperviousness was used as the unit of measure of urbanization. Stream structure (bankfull width, depth and fluctuations in water level) and biological function (species and population counts and rapid field assessments of habitat quality) were evaluated. Results indicated that aquatic system function (as measured by fish populations) was indirectly proportional to watershed impervious area. While there was no distinct threshold where population densities dropped, there was a measurable effect at reasonably low levels of imperviousness (10 - 15%). Habitat degradation was measured in terms of "degraded, good or excellent". There was marked degradation at imperviousness between 8 and 10%. Change in physical structure with increasing imperviousness was also measured. For example, stable channels, with little or no erosion, and unstable channels, where long continuous reaches of bare and eroding banks occur, were evaluated as impervious area increases. At impervious area percentages above 10%, stream channel instability is dominant.

**Method References:**


- Watershed Mapping: Sogona, F.J.; C.G. Phillips, 1994. Application of Watershed Index of Pollution Potential to Aerial Inventory of Land Uses and Nonpoint Pollution Sources., In: Pawlukiewicz, J., et. al., (eds.), *Watershed '93: A National Conference on Watershed Management*. USEPA 840-R-94-002
- Biological Monitoring: Mangun, W.R. 1989. A Comparison of Five Northern Virginia Watersheds in Contrasting Land Use Patterns., In: *J. Environmental Systems,* Vol. 18(2) 133-151
- General: Schueler, T.R., 1994. The Importance of Imperviousness., *In: Watershed Protection Techniques*, Vol. 1, No. 3 pp.100-111