Best Practices to Reduce Nutrients in Stormwater

• Stormwater runoff typically picks up pollutants such as sediment, oil, fertilizer, pet, and yard waste **(grass clippings, leaf litter**) which then might flow directly into the local water bodies, or it may enter the storm drain until it is released ***untreated*** into a local waterway.

❖ ***Nutrients from fertilizers***

- Urban runoff is the third greatest cause of lake deterioration in the US, accounting for approximately **28 %** of the lakes that don't meet water quality standards.
- **27 %** of the streams and river have excessive N and **40%** have excessive P.
- Several studies identify urban watersheds as substantial contributors to nitrogen and phosphorus loading **second only to agriculture**
- Household lawn fertilizer dominates N inputs to urban watersheds representing **37 to 59%** of the total N inputs. Lawn fertilizer exceeds the **combined** fertilizer N contribution from golf, courses, cemeteries, parks, and other nonresidential vegetated areas.
- It is estimated that nationwide **77 %** of households apply herbicides, **64%** of households fertilize their lawn and **79%** irrigate their lawn. In the US, **67 million** pounds of fertilizer is applied by homeowners annually, of that **40-60% of N** contained in the fertilizer ends up in streams.
- The average N inputs to fertilized lawns in the US **is 96 kg per ha per year**.
- The percentage of nutrients in urban stormwater due to fertilizers averages **44 %** of the total nitrate in urban stormwater.
- Lawns and streets are contributing about **80% of** the total annual P loading.
- **At least 11 states have existing ban of phosphorus fertilizer use or sale: Illinois, Maine, Maryland, Michigan, Minnesota, New Jersey, New York, Vermont, Virginia, Washington, and Wisconsin.** I general these states **prohibit P application unless it is for establishing new turf, in cases where soil test shows phosphorus deficiency or repairing turf.**
- "**Phosphorus levels are adequate** in most established **Colorado soils**. Deficiency is more likely to occur in **new gardens** where the organic matter content is low" (Whiting, 2014). Phosphorus deficiencies are **rarely observed in established turfgrass** unless the phosphorus level in the soil is extremely low or unfavorable soil pH exists.

Best Practices: Spring fertilizer application can lead to the development of shallow root systems and excessive top growth which cannot sustain lawns during harsh weather conditions. It is recommended that fertilizers are applied in early fall to promote healthy root systems and improve the lawn's environmental stress-tolerance.

Slow- release fertilizers release their nutrients gradually reducing the chance of over-application, also they are not water soluble which reduces the possibility of them being washed away in stormwater runoff

❖ ***Nutrients from grass clippings and Leaf litter***

- The N output from household leaf litter removal represents **12-36%** of the total N outputs in the urban watershed and for P that percentage range was **11-22%** of the total P outputs.
- Recent USGS study concluded that without removal, leaf litter and organic debris in the fall contribute to **56 %** of the annual total P load in urban stormwater compared to only **16 %** when streets were cleared.

- Leaf litter decomposition in urban impervious surfaces is over **twice as fast** as in forested land. Removal of plant debris should be done as soon as possible because stormwater can easily and rapidly extract nutrients from the leaf litter.
- Household grass clippings contribute as much as **7-21%** of total N and **15-30%** of total P outputs.
- Grass clippings store **25 to 60% of applied nitrogen** in established turfgrass.
- The concentration of P in grass clippings is **2-15 kg per ha per year**.
- About **14 lb. of fresh grass clippings** can contain as much as **0.1 lb.** of P which is enough to produce **30 to 50 lb. of algae** if it ends up in lakes or ponds.
- One pond of P can produce **300-500** pounds of algae.

Best Practices: Leaving grass clippings on the lawn is beneficial because the clippings act as a constant source of slow-release fertilizer as well as supplying additional moisture to the lawn. It is important to keep grass clippings out of the street gutter by either composting or properly disposing of them. Leaves and grass clippings can be composted and used as a source of nutrient-rich soil for gardens and flower beds.

❖ ***Residential Irrigation***

- The cumulative daily water consumption in the US amounts **to 26 billion gallons** of those 7.8 billion gallons or **30 % is devoted to outdoor uses** and as much as **50% of that is estimated to be wasted** due to inefficient watering practices. **50%** of the single-family water use in **Denver** metro area is residential outdoor water use.

Best Practices: First step to reducing unnecessary runoff is to eliminate wasteful practices, such as over-irrigating plants and turf, by adjusting irrigation controllers seasonally and repairing leaky irrigation systems. Selecting plant species that are native to the region can decrease the amount of turf needed, the required water for irrigation as well as the amount of fertilizer.

Nutrient Facts

Table 11
Comparison of Median Nutrient Concentrations For Various Land Uses in the Watershed

Land Use	Total P	Soluble P	Total N
	(mg/l)		
Urban [1]	0.30	0.16	2.0
Cropland [2]	0.25-0.50	0.10 -0.20	2.0 to 8.0
Forest [3]	0.05	0.01	0.6

[1] from Pitt et al 2004
[2] from various sources, range reflects differences in crop type, management, slope and manure/fertilization regime
[3] from Cappiella et al 2006

Table 7 National Median Nutrient Concentrations for Various Urban Land Uses (N= 3500)		
Urban Land Use	Total P (mg/l)	Total N (mg/l)
Residential	**0.30**	2.0
Commercial	0.22	2.2
Industrial	0.26	2.1
Freeway	0.25	2.3
Overall	0.27	2.1
Source: Pitt et al 2004		

Table 4-2. Sources of Contaminants in Urban Storm Water Runoff

Contaminant	Contaminant Sources
Sediment and Floatables	Streets, lawns, driveways, roads, construction activities, atmospheric deposition, drainage channel erosion
Pesticides and Herbicides	Residential lawns and gardens, roadsides, utility right-of-ways, commercial and industrial landscaped areas, soil wash-off
Organic Materials	Residential lawns and gardens, commercial landscaping, animal wastes
Metals	Automobiles, bridges, atmospheric deposition, industrial areas, soil erosion, corroding metal surfaces, combustion processes
Oil and Grease/ Hydrocarbons	Roads, driveways, parking lots, vehicle maintenance areas, gas stations, illicit dumping to storm drains
Bacteria and Viruses	Lawns, roads, leaky sanitary sewer lines, sanitary sewer cross-connections, animal waste, septic systems
Nitrogen and Phosphorus	Lawn fertilizers, atmospheric deposition, automobile exhaust, soil erosion, animal waste, detergents

Table 6 Nitrogen and Phosphorus EMCs for different urban land covers		
Urban Land Cover	Total N (mg/l)	Total P (mg/l)
Lawns	**9.70**	**1.9**
Highway	2.95	0.6
Streets (Variable)	1.40	0.5
Parking Lots	1.94	0.16
Rooftops	**1.50**	**0.12**
Stormwater Runoff EMC	**2.0**	**0.3**
Source; CWP, 2003 EMC = Event Mean Concentration		