STORMWATER WORK GROUP

ASSESSMENT QUESTIONS TO PRIORITIZE

General clarification: the focus of the Stormwater Work Group is on areas of developed and developing lands, and our initial work will not address commercial agriculture or forestry.

STATUS AND TRENDS – IMPACTS OF STORMWATER ON BENEFICIAL USES

What are the *effects* of flows and pollutants in stormwater on receiving waters and beneficial uses?

- What are the effects/potential impacts of pollutants/stressors from stormwater on the habitat and quality of our marine, lake, stream, ground, and other receiving waters? On biota? On human health?
    - What are the best indicators that stormwater has impacted water or sediment quality, habitat or biota?
    - Which pollutants/stressors most influence biota or human health? Where or under what conditions?
        - What are the concentrations of *nutrients and pathogens* in waters that receive stormwater and where do nutrients and pathogens have the greatest impact on human health and biota?
        - What are the concentrations of *toxic chemicals* in waters and sediments that receive stormwater and where do toxic chemicals have the greatest impact on human health and biota?
            - What is the relative severity of the impact of specific toxic chemicals, or categories of toxic chemicals, in stormwater?
            - What are the chronic and acute effects of toxic chemicals in stormwater? What are the processes/mechanisms by which toxic chemicals harm biota?
        - What are the effects of increased *flow* rates and volumes from stormwater? How do these changes impact the habitat and biota?
- Where does stormwater significantly impact receiving waters, resources, species, or beneficial uses in the Puget Sound basin?
    - Where does stormwater *currently* have a known, defined impact on water quality, habitat, or biota, and where may stormwater soon *become* a problem?
        - What are the potential impacts of climate change on stormwater?
        - Where do increased *flow* rates and volumes from stormwater have the greatest impact?
            - What differences in magnitude and timing of peak and low flow in a particular basin (WRIA) are due to stormwater?
    - What size, location, or other variable makes a particular stormwater discharge more or less likely to cause harm?
    - How does stormwater from one part of the Puget Sound basin affect other parts?
        - What is the relationship between stormwater discharges and habitat and water quality conditions in the nearshore environment?
        - What is the relationship between stormwater discharges and water quality conditions in deepwater Puget Sound?

STATUS AND TRENDS – STORMWATER CHARACTERIZATION AND POLLUTANT LOADINGS

What are the *relative contributions* of stormwater to harm compared with other pathways in the Puget Sound basin? How do these relative contributions vary geographically and how are they changing over time? Where did the pollutants in each part of the Puget Sound basin come from?
[Note: Although these questions are beyond the scope of the Stormwater Work Group, we propose to contribute to the overall answers by answering the highest priority questions about stormwater.]

- What are the concentrations of toxics, nutrients and pathogens entering Puget Sound and the food chain from stormwater?
    - What are pollutant concentrations and loads from stormwater? What factors affect fate and transport of stormwater pollutants? How do concentrations and loads vary based on geography, geology, climate, land use, season, and other conditions? Where are the greatest loads? Where do we need to be focusing our efforts?
        - What proportions of the pollutants (nutrients, pathogens, toxic chemicals) in stormwater reach surface waters via: air deposition, specific land uses (commercial, residential, industrial, transportation), groundwater, spills, permitted point sources?
        - What is the variability in stormwater pollutant loads by land use or geographic area? What other variables influence the spatial and temporal distribution of pollutant loads?
        - How does land use influence pollutant concentrations and loadings? What pollutants are coming from each land use type and what are the primary and secondary sources of those pollutants? What land uses or land use combinations are of greatest interest?
        - What factors within a land use control pollutant concentrations and loadings?
            - How do differences in stormwater infrastructure (*i.e.*, pipes versus ditches) affect pollutant loads and flows from similar land uses?
        - How do air transport and deposition affect stormwater pollutant loads?
        - What proportion of pollutant loads from stormwater reach Puget Sound? Where significant differences exist (*i.e.*, pollutant loads do not "add up" likely due to losses between upper reaches and mouths of rivers/streams) what are the explanations for the differences?
        - What is the seasonal and annual variation in toxics concentrations and loadings throughout the Puget Sound basin?

EFFICACY OF STORMWATER MANAGEMENT

Are our stormwater management actions preventing and reducing future harm in Puget Sound?

- How effective are the current suite of BMPs in preventing and reducing future harm?
    - What techniques are most effective at the site or local scale, and under what conditions?

- Among the most widely used practices and promising new practices that are available, what specific individual BMPs are most effective in reducing pollutant loads at new development sites?
  - ◊ How effective are structural treatment BMPs in reducing pollutant loads?
  - ◊ How effective are source control practices in reducing pollutant loads?
  - ◊ How effective are infiltration practices in reducing pollutant loads?
- To what extent are Low Impact Development (LID) and other flow reduction approaches effective in preventing and reducing future harm?
  - What is the ability of watershed-scale application of low impact development in an area of new development to effectively maintain the hydrologic regime in a stream?
  - Is there a significant difference in stream flows in basins where LID is encouraged and practiced?
  - How do LID practices affect critical areas and wetlands?
- What specific techniques or combinations of techniques are most effective at the collective or regional scale and under what conditions?
  - What is the effectiveness of watershed-scale combinations of stormwater management actions (techniques) at reducing harm?
    - ◊ Under what conditions are findings likely to be transferable to other watersheds?
  - How effective are cumulative BMPs, or targeted suites of BMPs, in reducing pollutant loads at a watershed scale? At the Puget Sound basin scale?
  - What changes in land use practices are most effective in reducing pollutant loads?
  - What are the most effective land use planning tools to protect existing high-functioning habitat from harm caused by stormwater?

- Are there unintended effects of BMPs?
  - Are there places where stormwater management practices are causing harm?
  - To what extent are BMPs for flow control reducing particulate pollution and exacerbating temperature problems?
  - Can stormwater be infiltrated into the ground without creating a soil or shallow groundwater pollution problem?

<u>How can we most effectively target and prioritize retrofit projects throughout the Puget Sound basin to reverse past harm?</u>

- To what extent can retrofits reverse past harm? To what extent can the beneficial uses of water bodies be restored in sub-basins that already have some degree of development? At what degree of development, or under what other specific conditions, is a particular retrofit strategy most likely to be successful?

- Among the most widely used practices and promising new practices that are available, what specific retrofits or restoration practices are most effective in reducing pollutant loads and recovering damaged habitat?
  - What are the benefits of restoring hydrologic equilibrium to an urban stream that is not returned to its historic condition?
  - To what extent can retrofits reduce loading of toxic chemicals to surface waters and sediments in an urban watershed?
  - To what extent can retrofits reduce loading of nutrients and pathogens to surface waters in a suburban or rural watershed?

- How effective are source control practices in reducing pollutant loads from existing development?
  - How effective are site-specific or targeted land use practices?
  - How effective are public education and outreach in achieving behavior changes that result in reduced pollutant loads?
  - How much will new practices, products, or product substitutions used on the landscape reduce pollutant loads? Are they better or worse than existing practices/products for pollutants of concern?

- To reduce pollutant loads, is it most effective to target new development, retrofit existing development, or a combination of both?