

# Runoff

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Green Design and the City

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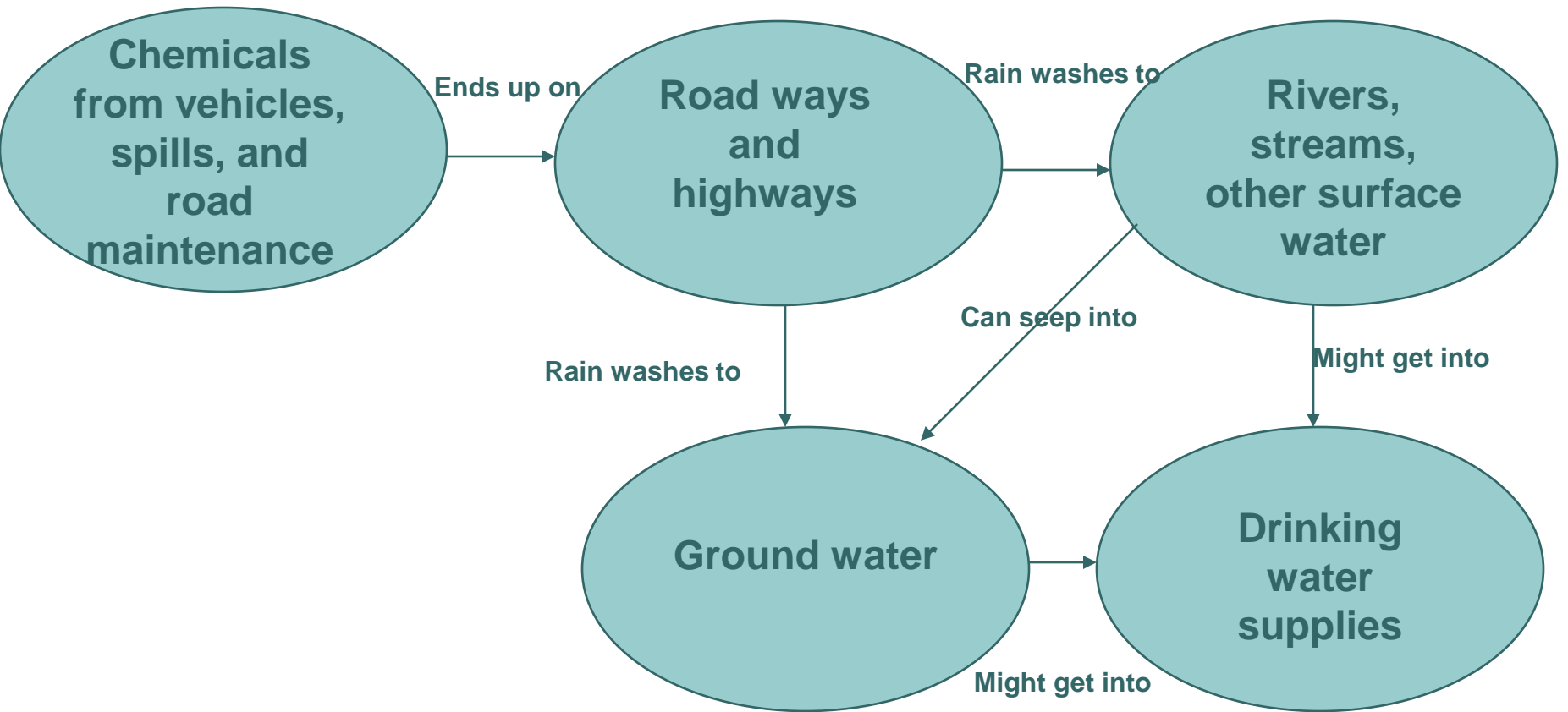
- Where does runoff come from?
- What is in runoff?
- What problems does it cause?
  - Streams
  - Ground water
- How can these problems be prevented?



# Where does runoff come from?

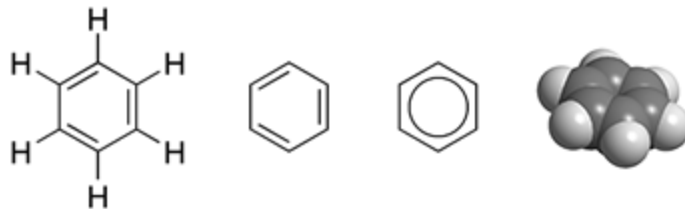
- Traffic
  - Particles from vehicles
  - Particles from fuel combustion
- Spills
  - Leaky cars
- Salting the roads
  - 350,000 tons of salt used on roads per year in Twin Cities metro area alone

● ● ● | **Flow**



# What is in runoff and why?

- Nitro-, chloro-, and phosphoroorganic pesticides
- Volatile halogenoorganic compounds
  - From burning of fossil fuels
- Petroleum hydrocarbons
  - Benzene from fuels due to its use as an octane booster



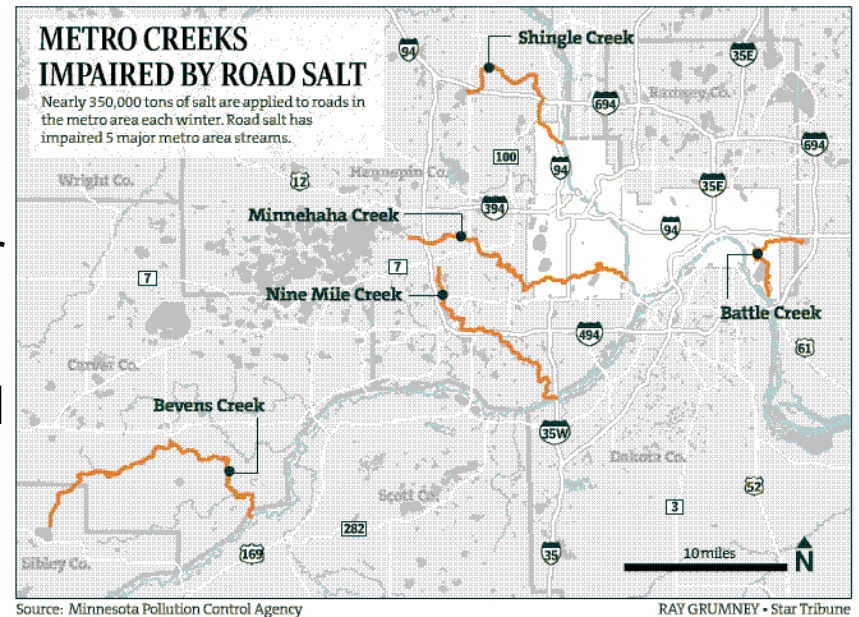


# What is in runoff and why?

- Cations ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$ ,  $\text{Ca}_2^+$ ) and anions ( $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{NO}_2^-$ ,  $\text{NO}_3^-$ ,  $\text{PO}_4^{3-}$ ,  $\text{SO}_4^{2-}$ )
  - $\text{Na}^+$ ,  $\text{Cl}^-$ , and  $\text{Ca}_2^+$  from salting roads in winter
  - $\text{NO}_3^-$  and  $\text{SO}_4^{2-}$  from burning of fossil fuels
- Fine particles of Cu, Zn, Cd, Cr, and Pb
  - From heavy road use activities, tires, fuels, etc.

# What problems does it cause in surface water?

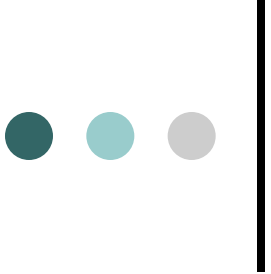
- Study done near the Twin Cities, 39 lakes were found to have increased steadily in salinity
  - Salt solution in lakes is heavier than water and sinks to the bottom, changes water chemistry, and kills aquatic insects and changes plant growth
  - Streams also found to be impaired due to salt



# Surface water, cont'

- Contamination with heavy metals
  - Fish
  - Safety of being in the water
- Increases sedimentation and turbidity of streams
- Runoff from hot asphalt increases temps
- Change in water chemistry results in crease of macro-invertebrates
  - Decrease in the processing of leaf litter





# What problems does it cause in groundwater?

- Chemicals can exceed drinking water standard
  - Heavy metals
  - Pesticides
  - Organic compounds

# Groundwater, cont'

- Road salting has several effects
  - Drinking standards
  - Decreases permeability
  - Increases alkalinity





# Breaking the flow

- Decreasing pollutants
  - Not de-icing the roads isn't an option, but de-icers with less/no Cl- might help
    - These might have too much phosphorus
  - To decrease other pollutants, we'd need to decrease the number of cars



# Breaking the flow

- “First Flush”

- 80% of road dust (?) moved in first 20% of storm event

- Filtering

- Peat filters

- Found to significantly lower concentration of most pollutants BUT depends on the initial concentration and needs longer-term research

- Fleece filters and GfeH absorbers

- 2-3 step process investigated in urban Switzerland
- Removed 70-97% of heavy metals



# Works cited

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- [http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6V78-4F8TKB7-1&\\_user=10&\\_rdoc=1&\\_fmt=&\\_orig=search&\\_sort=d&\\_docanchor=&\\_view=c&\\_searchStrId=1088230028&\\_rerunOrigin=scholar.google&\\_acct=C000050221&\\_version=1&\\_urlVersion=0&\\_userid=10&md5=0a53149c34e8113a47c3d59e79dad107](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V78-4F8TKB7-1&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&_docanchor=&_view=c&_searchStrId=1088230028&_rerunOrigin=scholar.google&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=0a53149c34e8113a47c3d59e79dad107) (What's in runoff and why?)
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