Poudre Runs Through It Study / Action Group

"*Health* – shorthand for good condition (e.g., healthy economy, healthy communities) – is grounded in science yet speaks to citizens."[1]

A healthy working Poudre River:

- Has biological, chemical, and physical integrity. For example:
  - Has good water quality (temperatures, nutrients, sediments, and other pollutants are not excessive).
  - Supports and sustains communities of animals and plants (aquatic and riparian) that are characteristic of the region. These communities would likely include non-native species such as brown trout or crack willow.
  - A diversity of habitats is present and connected, both up and down the river and from the river to the floodplain.

- Is an ecosystem that is persistent, resilient, and self-maintaining.
  - Persistent means that the river's structure, composition, and function are maintained over time.
  - Resilient means that it can withstand and recover from stresses.
  - Self-maintenance requires that processes are in place to sustain water quality, habitats, and species. For rivers, streamflow is a "master variable" that maintains rivers with less dependence on management such as dredging, streambank reinforcement, and planting trees.

- Speaks to people by providing a desirable balance of economic, recreation, education, and aesthetic benefits; for example, it remains fishable and swimmable while supporting consumptive uses.

- Depends on the health and ongoing stewardship of its upstream watershed including headwaters and tributaries

[1] Karr JR. 1999. Defining and measuring river health. *Freshwater Biology* **41**:221-234.

For management, river health needs to be expressed in terms of measureable quantities and related to intended water use. Multiple indicators of health must be used because no single factor is a sufficient indicator. Important indicators include:

- Indicators of economic benefits (agricultural, municipal, industrial) that depend on withdrawals of clean water, and the quantity and timing of these withdrawals.
- Indicators of recreational benefits (including economic) that depend on clean water and the river corridor.
- Biological indicators for the river, for example:
    - Native fish and trout population size, biomass, and reproduction.
    - Aquatic insect diversity and abundance.
    - Numbers, extent, and reproduction of streamside vegetation.
- Indicators of watershed health, for example:
    - Vegetation cover.
    - Proportion of impermeable surfaces.
    - Forest health (relates to runoff and water quality).
- Area, frequency and duration of riparian forest flooding.
- Water quality (including suitability for drinking water treatment, irrigation, industrial use, and recreation, as well as temperature, nitrogen and phosphorus levels).
- Quality and diversity of aquatic habitats (for example, the variety and pattern of depth, velocity, and substrate combinations).
- Number of structures that impede fish passage, change sediment dynamics, etc.
- Extent of berms, levees, and armoring that impede connections between the channel and the riparian zone.
- How often and amount of time that environmental streamflow targets are met, including:
    - Large floods (>5000 cfs?) every 20-30 years.
    - Periodic flushing flows that clean the river bed surface of fine sediment and algae.
        - Average dimensionless shear stress of 0.017-0.021 referenced to the median bed material size – this corresponds to ~1500-2100 cfs in Fort Collins depending on the channel shape and bed material at a particular location.
        - Occurring at least 2 out of 3 (or 3 out of 4) years for 3-5 days.
    - Periodic flows that rejuvenate the river bed and maintain channel form and flood conveyance.

- Average dimensionless shear stress of 0.030-0.035 referenced to the median bed material size – this corresponds to ~2500-3000 cfs in Fort Collins depending on the channel shape and bed material at a particular location.
- Occurring 1 out of 3 (or 2 out of 3) years for 1-5 days.

- Monthly or seasonal targets outside of peak flows, by type of year. One (ambitious) perspective[2]:

	25th%ile (dry year)	50th%ile (avg year)	75th%ile (wet year)
Jan	36	48	67
Feb	50	57	66
Mar	43	64	80
Apr	87	131	221
May	420	675	825
Jun	641	1125	1465
Jul	272	428	685
Aug	121	166	288
Sep	67	94	125
Oct	73	87	113
Nov	55	71	86
Dec	42	56	71

- Flows changes less than X% or Y cfs per day due to structure operations (X and Y to-be-determined).

[2] Bartholow JM. 2010. Constructing an Interdisciplinary Flow Regime Recommendation. *Journal of the American Water Resources Association (JAWRA)* 1-15. DOI: 10.1111/j.1752-1688.2010.00461.x.