Physical Habitat Assessment: Hinkson Creek

Goals and outcomes of the project

Physical Habitat Assessment – This work has been identified by several members of the Science Team as an essential first step towards improved management of Hinkson Creek and its eventual removal from the CWA 303(d) list. Currently, a number of biological and chemical parameters are measured on a regular basis. However, physical attributes that influence or provide habitat for macro invertebrates and fish have not been thoroughly investigated. These parameters could include sediment embededness, pool riffle sequencing, channel width to depth ratio, stream bank stability and vegetation, riparian corridor width and human disturbances. Science Team members will identify parameters, sampling locations and budget needs. This assessment shouldstart as early as Spring 2013 with an examination of existing spatial data. This will be followed by a field-based assessment to provide coverage of the stream system and more detailed data to support both analyses and future actions within the watershed.

Classification Assessment Parameters

- GIS Scale Parameters - from existing GIS sources, images although some may require digitization:
    - Valley width
    - Channel width
    - Proximity to valley wall
    - Channel slope (maybe)
    - Valley slope (probably)
    - Sinuosity (at various scales)
    - Riparian vegetation cover and class
    - Road crossings
    - Outfalls
    - Other infrastructure
    - Effective impervious area
        - EIA (Jacobson 2011) has been referenced as directly connected to stream channels (via pipes, drainage systems) and strongly related to macroinvertebrate richness and diversity (Stepenuck et al. 2002, Wang and Kanehl 2003).

- GIS Scale Parameters -- need new field data (probably):
    - Presence of bedrock in banks
    - Presence of bedrock in bed
    - Bank stabilization structures
    - Infrastructure not adequately mapped in GIS resources (including pipes, outfalls, discharge control structures
    - Disturbance features, including erosional gullies, slumps, bank failures, debris piles.

- If the investment is made to collect the field data listed above, then it may be cost effective for the field crew to also collect response variables:
    - Qualitative/categorical dominant substrate

- Sandbar/gravelbar extent
- Fine sediment distribution and thickness
- Depositional anomalies (debris fans, bank failures)
- Qualitative/categorical bank condition or stability
- Large woody debris (LWD): Important for habitat fish and macroinvertebrates and plays important roles in structuring channel geomorphology (Wallerstein and Thorne 2004, Cordova et al 2007). The quality, supply, and storage of LWD is influenced by riparian vegetation and channel form (Cordova et al. 2007). The orientation of LWD within the channel and the type of debris dam created can influence the effect that the debris has on erosion and sedimentation processes and can vary depending on the size of the stream (Wallerstein and Thorne 2004). Wallerstein and Thorne (2004) describe 4 types of debris jams: underflow jams in which water is directed under the debris, scouring the bed, dam jams in which water is flows over the debris creating a sediment trap on the upstream side, deflector jams, in which water is deflected to the side of the channel and can create bank scouring, and flow parallel/bar head jams, in which sediment is trapped at the head of sand bars. The frequency of each type of jam was found to vary with channel width (Wallerstein and Thorne 2004). Kaufmann (2006, p. 128) describes a procedure for tallying LWD pieces within a stream channel based on a matrix of size classes for length and diameter. Separate tallies are made for wood in the wetted portion of the channel, and wood that is above the bankfull level of the channel. In addition to the procedure described, field notes should be made describing the orientation of the debris (i.e. parallel or perpendicular to flow) and the occurrence of the type of debris jam (as described above). This addition would take the form of another column on the tally sheet and would require little additional time.
- *Thalweg Depth Profile:* Habitat diversity within a stream is important for maintaining aquatic species diversity. The variability of pool and riffle occurences is influenced by flow regime and sediment dynamics (Madej 1999). A thalweg depth profile can be used to measure to variability of depth within the stream channel (Madej 1999, Kaufmann 2006). Kaufman (2006, p.116) described a method for measuring the depth of the thalweg along a longitudinal transect of a stream reach. His method is coupled with a series of cross-sectional measurements of streambed profile and substrate particle size, but the thalweg depth procedure can be adapted independent of other variables. In this method, 101 measurements are taken along the length of a transect with the distance between each measurement equaling 1% of the entire reach length (Kaufman 2008). At each station, the depth from the surface of the water to the streambed at the deepest part of the channel is recorded.
- *Incised bank height:* Stream incision can result from land-use induced alterations to watershed hydrology (Booth and Jackson 1997, Shields et al 2010). Incision can result in a disconnection of the stream from the surrounding floodplains and can lower the adjacent ground water table (Schilling et al 2004). Lowering of the water table can in turn result in water stress on riparian vegetation during dry periods (Schilling et al 2004, Hall et al 2011). A procedure is outlined in Kaufman (2006) for measuring the incised height of a stream channel. The incised height is the elevation above the stream at which the stream bank flattens out into a floodplain. This measured by recording the vertical distance from the surface of the water to the top of the lowest bank (Kaufmann 2006). That distance is then added to the thalweg depth at

that location to obtain the total channel depth. Kaufmann's procedure stipulates taking measurements at 11 points along the length of the stream reach, spaced apart by 10% of the reach length. This would be complimentary to the GIS work above but higher precision.

- *Rootmat Survey:* Submerged woody rootmats are an important habitat for aquatic macroinvertebrates (Rabeni et al 1997). However, currently no established methods exist to quantify availability and quality of submerged woody root habitat in streams. A method is proposed here to estimate volume and structure of root habitat and to describe the composition of riparian vegetation which may be important to rootmat availability.
  1. Measure volume of submerged rootmats. This would be done by measuring each contiguous area of rootmat in three dimensions (parallel to bank, perpendicular to bank, and vertical).
  2. Visually estimate percent by volume of fine roots (< 2mm diameter). Data could be recorded in terms of size ranges (i.e. 0-10%, 11-20%, etc.).
  3. Record species of parent tree or shrub. In cases where the exact parent tree cannot be determined, the dominant or most abundant species within a certain radius could be recorded, and noted accordingly.
  4. Measure (or estimate) the diameter (DBH) or the parent tree. This could be either an exact measurement using a diameter tape, or using predetermined size classes (<10cm, 11-30cm, 31-60cm, etc.). Estimation would require less time in the field.
  5. Measure distance of base of tree to stream edge. This could be recorded as one simple linear distance, or as separate distances for height above bank and horizontal distance from bank.

References:

Booth, D. B., and C. J. Jackson. 1997. Urbanization of aquatic systems: degradation thresholds, stormwater detention and the limits of mitigations. Water Resources Bulletin 33:1077–1090.

Cordova, J.M., E.J. Rosi-Marchall, A.M. Yamamuro, G.A. Lamberti. 2007. Quantity, controls, and functions of large woody debris in Midwestern USA streams. River Research and Applications. 23: 21-33.

Elliott, C.M., Huhmann, B.L., and Jacobson, R.B., 2009, Geomorphic classification of the Lower Platte River, Nebraska: U.S. Geological Survey, 29 p. http://pubs.usgs.gov/sir/2009/5198/.

Elliott, C.M., and Jacobson, R.B., 2006, Geomorphic classification and assessment of channel dynamics in the Missouri National Recreational River, South Dakota and Nebraska, 66 p. http://pubs.er.usgs.gov/usgspubs/sir/sir20065313.

EPA. 2006. Surface Waters. Western Pilot Study: Field Operations Manual for Wadeable Streams. Environmental Monitoring and Assessment Program, EPA 620/R-06/003.

Hall, J. M. Pollock. S. Hoh. 2011. Methods for successful establishment of cottonwood and willow along and incised stream in semiarid eastern Oregon, USA. Ecological Restoration. 29(3): 261-269.

Jacobson, C. R., 2011. Identification and quantification of the hydrological impacts of imperviousness in urban catchments: A review. Journal of Environmental Management 92: 1438-1448.

Kaufmann, P.R. 2006. Section 7: Physical Habitat Charcterization. Western Pilot Study: Field Operations Manual for Wadeable Streams. U.S. Environmental Protection Agency. Washington D.C. EPA 620/R-06/003.

Madej, M.A. 1999. Temporal and spatial variability in thalweg profiles of a gravel-bed river. Earth Surface Processes and Landforms. 24: 1153-1169.

Panfil, M.S., and Jacobson, R.B., 2001, Relations Among Geology, Physiography, Land Use, and Stream Habitat Conditions in the Buffalo and Current River Systems, Missouri and Arkansas: U.S. Geological Survey Biological Science Report BSR-2001-0005, 110 p. http://www.cerc.usgs.gov/pubs/center/pdfdocs/BSR2001-0005.pdf.

Schilling, K.E., Y.K. Zhang. P. Drobney. 2004. Water table fluctuations near an incised stream, Walnut Creek, Iowa. Journal of Hydrology. 286: 236-248.

Shields Jr., F.D., R.E. Lizotte Jr., S.K. Knight, C.M. Cooper, D. Wilcox. The stream channel incision and water quality. Ecological Engineering. 36: 78-90.

Stepenuck, K. F., Crunkilton, R. L. and Wang, L. 2002. Impacts of Urban Land Use on Macroinvertebrate Communities in Southeastern Wisconsin Streams. Journal of the American Water Resources Association, 38: 1041–1051.

Rabeni C. F., R. J. Sarver, N. Wang, G. S. Wallace, M. Weiland, and J. T. Peterson. 1997. Development of regionally based biological criteria for streams of Missouri. A report to the Missouri Department of Natural Resources. Missouri Cooperative Fish and Wildlife Research Unit, University of Missouri, Columbia, Missouri.

Wang L. and P. Kanehl. 2003. Influences of watershed urbanization and instream habitat on macroinvertebrates in cold water streams. Journal of the American Water Resources Association, 39: 1181–1196.

Wallerstein, N.P., C.R. Thorne. 2004. Influence of large woody debris on morphological evolution of incised, sand-bed channels. Geomorphology. 57:53-73.