Guidelines for Eastern Hellbender Structural Habitat Augmentation

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The guidelines provided below are to be used when creating or augmenting Hellbender habitat using CPS 395. These guidelines provide a framework for what is considered adequate structural habitat to provide nesting locations and refugia for Eastern Hellbenders of all life stages. For all habitat augmentations in the guidelines below consult with the Private Lands Biologist for Hellbender Working Lands for Wildlife in your region.

1. *Site Requirements*
    a. Falls within the predicted suitable range for Hellbenders or where proximity to hellbender populations outside of the model-predicted range warrants structural habitat augmentation (consult with the Private Lands Biologist for Hellbender Working Lands for Wildlife).
    b. Current habitat must be within the range suitable for practices to be effective. Stream substrate within the reach must be sufficient for augmentation of nesting habitat and refugia to be effective. Nesting rocks must be placed on sand and/or gravel substrate.
        i. If the stream substrate does not meet these requirements before or immediately following restoration activities then reassess the site after one year to determine need and viability of augmenting hellbender habitat.
2. *Habitat Elements*
    a. The guidelines below are to be used in conjunction with CPS 395 practices laid out in Scenario 4 of NRCS guidelines, “Rock and Wood Structures”. Eastern Hellbenders require biodiverse ecosystems for prey availability, therefore, habitat for a diverse ecosystem is warranted.
    b. Site requirements for habitat elements will vary from site to site. Consult with Working Lands for Wildlife Private Lands Biologist to determine habitat elements necessary.
    c. Measurements below are guidelines and should be followed when possible, but in-stream habitat availability may alter exact measurements.

Habitat Feature	Potential Benefit
Nest Rock Augmentation	Nesting Habitat
Adult Cover Rock Augmentation	Adult refugia and habitat
Juvenile Cover Rock Augmentation	Juvenile refugia and habitat
Gravel and Cobble Establishment	Juvenile and Larval Habitat
Wood Structures (toewood, root wads, cover logs, LUNKRs)	Prey habitat and promotion of aquatic diversity

Feature	Spacing and Placement	Design Requirements
Nesting Locations	Approximately 1 cluster of 2 or more nest rocks every 3000-3500 ft^2 or every 100 linear ft, whichever is lower. Place clusters in runs or glides. 3 rocks/cluster is ideal if material is available. Nest rocks do not need to touch and should not overlap. Each individual rock should have the ability to form a viable cavity. See diagram in Figure 1. Facet location in higher gradient streams may necessitate different spacing.	Rocks must be > 3' diameter, at least 4" thick, and flat on the bottom (side resting on stream bed); substrate at nest rock location = sand, gravel, and/or bedrock (with preference toward sand and/or gravel > 1" diameter). See Figure 2 for design requirements for each nest rock in a cluster. Rocks should be at least 2x the size of the average of the 10 largest naturally occurring rocks to ensure stability of nesting locations.
Adult Cover Rocks	Approximately 2 cover rocks upstream and downstream of nesting rock clusters. Place so that cover rocks are spaced somewhat evenly between nest rocks (where habitat allows). See diagram in Figure 1.	Rocks must be 20-35.9" diameter, at least 3" thick, and flat on the bottom (side resting on stream bed); substrate at cover rock location = sand, gravel, and/or bedrock (with preference toward sand and/or gravel).
Juvenile Cover Rocks *	Refer to reference stream reach for representation of this cover rock type.	Rocks between 10-19.9" in diameter. This is basically a "large cobble" substrate.
Cobble Establishment *	Refer to reference stream reach for representation of this substrate.	Substrate between 2.6-9.9"
Gravel Establishment *	Refer to reference stream reach for representation of this substrate.	Substrate between 0.5-2.5"

* Augmentation of this substrate size class may not be necessary as the substrate may be abundant (or available upstream), but buried in silt and sand within the project reach. These habitat variables should be assessed 1 year after the stream has had sufficient time to normalize and coarsen after restoration activities. If there is not a sufficient gravel/cobble source upstream, establishment of these habitat types may not be possible. For all habitat augmentations consult with the Private Lands Biologist for Hellbender Working Lands for Wildlife.

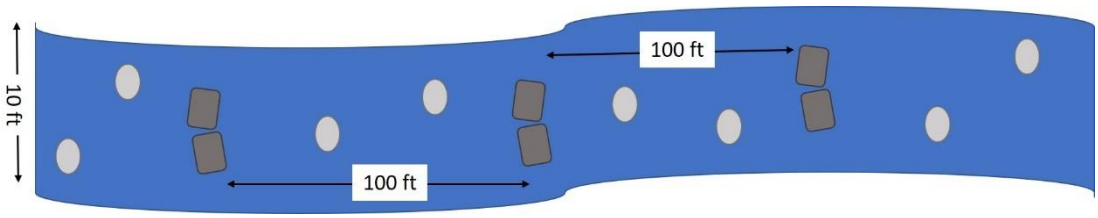
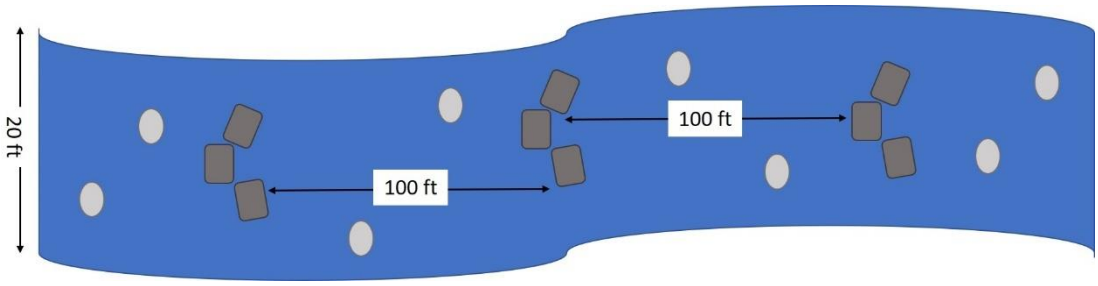
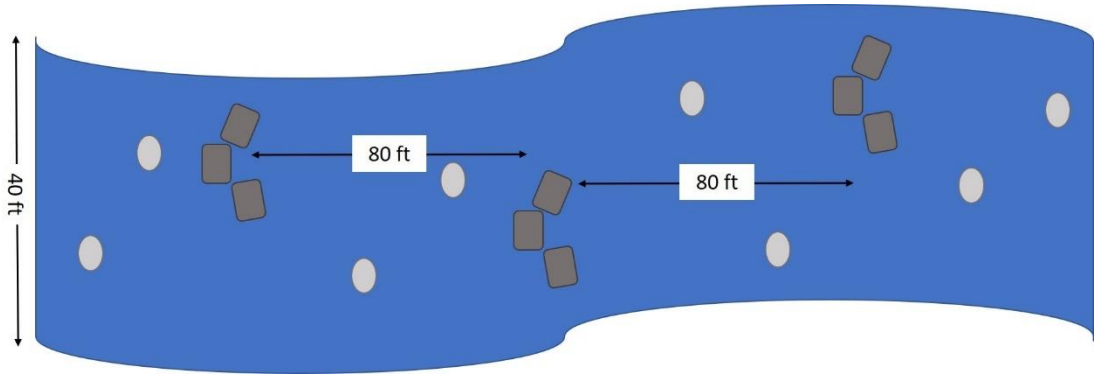
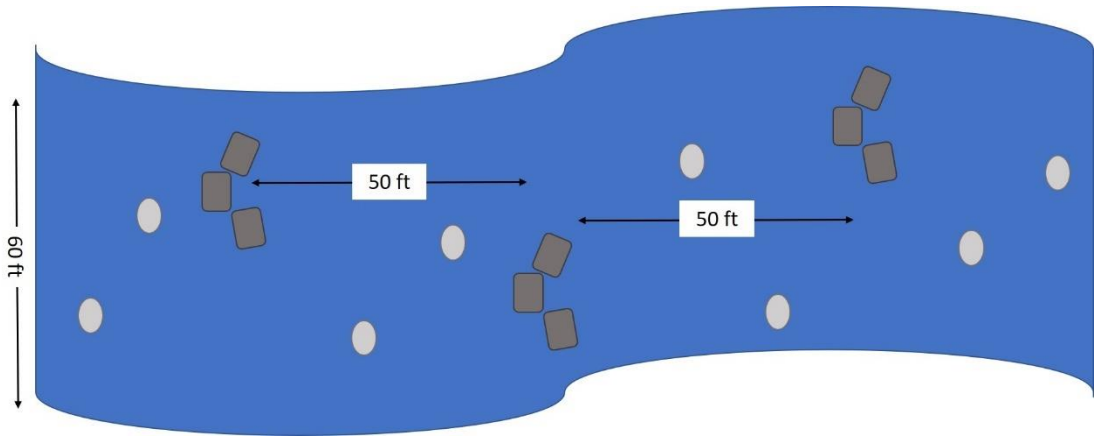
Wetted Width (ft) at Baseflow	Nest Rock Cluster Spacing (linear ft)	
10	100	
20	100	
40	80	
60	50	

Figure 1: Habitat structure placement in various channel sizes (baseflow). Note that nest rocks should be close to each other in clusters, but not overlapping.

 = Nest Rock Cluster  = Adult Cover Rock

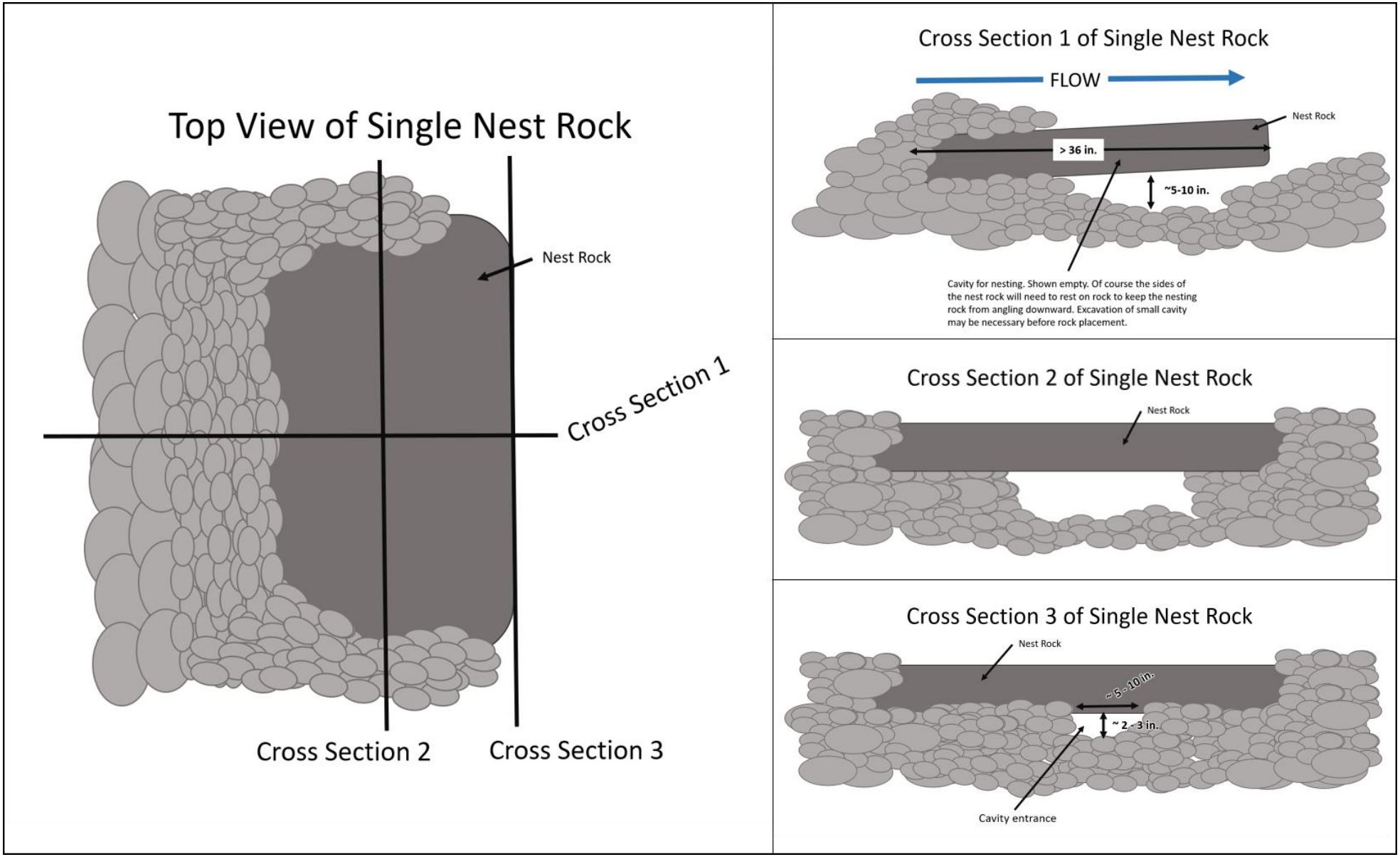


Figure 2: Diagram of a single nest rock. Each nest rock in a cluster should follow these guidelines. Sand substrate should be present in the gravel and cobble and the gravel and cobble composition in these diagrams just represents general “substrate”. The structure should be “toed in” to the substrate on the upstream side. The substrate should not just be “piled” on to the rock. The substrate surrounding the nest rock needs not only to provide stability but also to cover all gaps except for the cavity entrance. We want to mimic a natural seal around all sides, leaving just a hellbender-sized cavity entrance. The percent gravel, cobble, and sand in the substrate surrounding the structure should be the most appropriate substrate to the site to ensure stability of the nest rock. Within the cavity, Hellbenders prefer gravel or sand (not silt) substrate.

References

1) Burgmeier, N.G., T.M. Sutton, & R.N. Williams. (2011) Spatial Ecology of the Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*) in Indiana. *Herpetologica* 67: 135-145.

2) Da Silva Neto, J.G., Sutton, W. B., & Freake, M. J. (2019). Life-Stage Differences in Microhabitat Use by Hellbenders (*Cryptobranchus alleganiensis*). *Herpetologica*. *75*(1), 21–29.

3) Hecht, K. A., Freake, M.A.N., & Colclough, P. (2019). Hellbender Salamanders (*Cryptobranchus alleganiensis*) Exhibit an Ontogenetic Shift in Microhabitat Use in a Blue Ridge Physiographic Region Stream. *Copeia*. 107(1), 152-159.

4) Humphries, W. J., & Pauley, T. K. (2005). Life History of the Hellbender, *Cryptobranchus alleganiensis*, in a West Virginia Stream. *The American Midland Naturalist*, *154*(1), 135–142.

5) Jachowski, C. M. B. (2016). Effects of Land Use on Hellbenders (*Cryptobranchus alleganiensis*) at Multiple Levels and Efficacy of Artificial Shelters as a Monitoring Tool. Doctoral Dissertation. Virginia Tech.

6) Nickerson, M.A. & C.E. Mays. 1973. A Study of the Ozark Hellbender *Cryptobranchus alleganiensis bishopi*. *Ecology* 54: 1164-1165.

7) Pugh, M. W., & Hutchins, M. (2016). Land-use and Local Physical and Chemical Habitat Parameters Predict Site Occupancy by Hellbender Salamanders. *Hydrobiologia*, (May).

8) Rosgen, D.L. (2001). The Cross-Vane, W-Weir and J-Hook Vane Structures:Their Description, Design and Application for Stream Stabilization and River Restoration. *Wetlands Engineering & River Restoration*. 1-22.