2012\_ScienceNeedsPortfolio\_(2)\_Aquatics\_Restructured.docx

**Thematic Area: Aquatic**

**MISSION:** tomaintain native habitats and endemic aquatic species in their current locations or support these as they migrate with land use and climate changes in the future.

*[science objective]* quantitatively describe current and future hydrologic and structural habitat conditions, and aquatic population trends (in order)

*[management objective]* to set conservation goals for both.

A. Heading: Regional Level

**1. PROGRAM: Landscape-level Disturbances & System-level Response**

[*Examines major disturbances* (*includes climate change) as well as the impacts associated with these, regardless of ecological organization (e.g., community, species, population)*]

**PROGRAM DESCRIPTION:** *This Program looks at Ecological Flows and Ecological Function in [response to] large-scale, transformation/alteration of the system + change of state (generally beyond the Focal Management Level) [and large-scale or regional planning tools].*

***a. Climate Change*** focus on development and compile climate change models [and observational data] for the LCC that can: (1) help managers predict likely impacts to the region's water resources, aquatic species, and human systems that rely upon those resources; (2) facilitate the development of more robust regional mitigation and management plans; and (3) help managers provide meaningful input to future revisions of state and Federal water regulations.

**b.** Expanding Energy and Related Infrastructure and Roads

**c.** Urbanization and Population Growth

**d.** Effects of Air Pollution

(Grouping) – *Foundational/Stock-taking Assessment/Classification System*

* **Project Description: [N]** [Conduct a] comparative analysis of [existing] landscape planning tools.
* **Project Description: [S]** [Conduct] stream habitat and riparian corridor assessments at fine scale [e.g. catchment level] to allow modeling that can be expanded to the landscape scale. Have adequate data at the catchment scale [and] link models to GIS to make the data more visual and available to partners. (stream classification)
* **Project Description: [S]** [Develop a] science-based methodology [to assign] priority habitats [as determined by] threats or values associated with watersheds at multiple scales. (Provides a science- based argument to address threats.)

(Grouping) – *Climate Change Science and abiotic or mechanical aspects*

* **Project Description: [S]** Develop a regional comprehensive description of seasonal and diurnal thermal and flow characteristics of surface waters including effects of climate change.
* **Project Description: [S]** Develop models / analytical tech to bridge the gap between downscaled GCMS and watershed based projections of climate change effects on aquatic species and habitats.
* **Project Description: [S]** Project the impact of land-use and climate change on the delivery of key aquatic ecosystem services.
* **Project Description: [N] [**Project the] Loss of cold/cool water habitats in response to thermal regime shift.

(Grouping) – *Climate Change Impacts on Ecological Function and Response to Changes*

* **Project Description:** Develop a web-based tool for riparian restoration based on variables indicative of climate change resiliency

[**AppLCC** **FY11/12 Funded Project:** (Nislow/USFS) “Web-Based Tool for Riparian Restoration Prioritization to Promote Climate Change Resilience (RPCCR) in Eastern US Streams”]

* **Project Description: [N] -** Identify impact of riparian and floodplain vegetation on aquatic community and the food chain in light of species composition and climate change on aquatic communities.
* **Project Description: [N]** Document the effects of extreme events on [key] habitat (specifically changes in structure & composition).
* **Project Description: [S]** Identify temp and flow tolerance limits of species and appropriate management technologies to improve the management of controlled systems to reduce impacts on downstream communities.
  + **(related) Project Description: [N]** Assess aquatic species vulnerability to changes in stream flow and temperature, water quality.
  + **(related) Project Description: [N]** Responses of populations to altered thermal /hydrologic regimes.
  + **(related) Project Description: [N]** identify impact of riparian and floodplain vegetation on aquatic community and the food chain in light of species composition and climate change on aquatic communities.
* **Project Description: [N]** Model where natural refugia [are likely to] occur in light of changing climate or altered environments and where is there potential for reserves and captive holding of ESUs.
  + **(related) Project Description: [S]** Develop a method to utilize mussels and their habitat as an indicator to identify multi species refugia, restoration sites for priority species, monitoring, and watershed restoration.
  + **(related) Project Description: [N]** identify suitable refugia for T&E species
* **Project Description:** Document the effects of extreme [weather] events on [key] habitat (specifically changes in structure & composition).
* **Project Description: [S]** Develop methods to rank resistance and resiliency to climate change using generic traits.

(Grouping) – *Energy and Related Infrastructure and Roads*

* **Project Description:** Develop flow-ecology relationships to enable states to redirect or change their flow standards to better protect aquatic ecosystems.

**[AppLCC** **FY11/12 Funded Project:** (Fisher/Cornell University) “Development of a hydrologic foundation and flow-ecology relationships for monitoring riverine resources in the Marcellus Shale region”]

* + **(related/component) Project Description:** Review existing information. Compile and make information available.
* **Project Description:** [Determine the] effects of resource extraction – related to energy development and resource (energy) extraction.
  + **(related/component)** Sitings; physical landscape; effects of fragmentation, sedimentation.
  + **(related) [N]** [Create an]interactive GIS-based decision support tool for reducing environmental impacts of resource extraction sitings.
  + **(related)** Vulnerability of aquatic species and communities to Marcellus shale development in Appalachia.
  + **(related)** **[S]** Identify the effects on water quantity and quality of gas extraction and the impacts on aquatic communities.
* **Project Description:** **[S]** [Determine] if dissolved ion / ions and or [heavy] metals [discharged] downstream of surface and underground mining [sites] are toxic to benthic macro invertebrates.
* **Project Description: [S]** Identify the effects of chemicals constituents associated with coal processing and storage, fly ash, and discharges from settling ponds on survival, condition and reproduction of fish and aquatic invertebrates.

(Grouping) – *Urbanization, Population Growth and (Domestic or Industrial) Water Demands*

* **Project Description: [N]** [Predict the] influence of [major] land use changes [(e.g. climate change, urbanization, etc.)] on water quality/quantity.
  + **(related) Project Description: [N]** [Evaluate] the effects of future predicted water withdrawals and return flows on aquatic resources and populations.

(Grouping) – *Agricultural Expansion and (Ag-related) Water Demands*

(Grouping) – *Effects of Air Pollution*

* **Project Description: [N]** Effects of atmospheric deposition on aquatic ecosystems.
* **Project Description: [N]** [Improve understanding of the synergistic] effects of complex mixtures (air contaminants).

(Grouping) – *Cumulative Impacts*

B. Heading: Human Dimensions

**2. PROGRAM: Social Component**

**PROGRAM DESCRIPTION:** *Determine direct and intrinsic socioeconomic benefits of aquatic species and resources.*

(Grouping) – *Value/Ecosystem Services and Conflict*

* **Project Description: [N]**  [Anticipate potential conflicts between] various user groups and develop alternative solutions to resolve] conflict[ing needs (e.g. water supply versus ecological flow)] needs.
* **Project Description:** For the stressors which are currently politically impossible to correct (agriculture, forestry, urban growth, mining, etc.), [conduct sociological studies to serve as the foundation to] develop and communicate culturally viable solutions to address these stressors across the landscape.
* **Project Description:** **[N]** [Collect data and model ecosystem services (e.g. clean water) and social values (e.g. open space) to] quantify and establish thresholds for ecosystem functions.

(Grouping) – *Recreational, Commercial, Subsistence Use*

* **Project Description: [N]** Determine the economic and social value of various fisheries [of *…target species (ID?)*]
* **Project Description: [N]** What is the magnitude of current use and trends of recreational use?
* **Project Description: [N]** What is the magnitude of current use and trends of commercial use?
* **Project Description: [N]** What is the magnitude of current use and trends of subsistence use?

C. Heading: System Level

**SYSTEM LEVEL DESCRIPTION:** *Compile data to help partners and stakeholders better understand the types of aquatic habitats that occur within the LCC, the distribution and condition of those habitats, issues threatening the quality of those habitats, the relative importance of those habitats for species conservation within each of the states, and techniques that can be used to restore those habitats after they have been degraded.(e.g., connectivity, water quality, habitat quality including riparian habitat, instream, and structural habitat, habitat quantity, hydrology including water quantity and timing, distribution.*

**3. PROGRAM: Ecological Functions of Managed/Human-Altered Systems**

**PROGRAM DESCRIPTION:** *[*D*escribe how altered systems function and how they can best be managed.]*

(Grouping) – *Foundational/Stock-taking Assessment/Classification System*

* **Project Description: [Assessment of]** common hydrologic models/hydrologic data (models like stream stats for non-gauged streams) *(common to both Program 3 &4)*

(Grouping) – *Barriers (flows and species movement)*

* **Project Description:** [Determine the]effects of dams/instream barriers
  + **(related) [S]** Develop a method to evaluate the effect of barriers (chemical, physical, and biological) and the interaction between those barriers.
  + **(related)** [N] Effects of fragmentation (connectivity) on aquatic species – viability, sustainability.
  + **(related) [N]** [Develop] barrier removal prioritization scheme with multiple criteria [include assessment of when is it desirable and undesirable to remove barriers.]
* **Project Description [S]** Understand the influence of hydrology and sediment transport around dams.

(Grouping) – *Mitigating Ag and Forestry Impacts*

(Grouping) – *Protection & Restoration Approaches*

* **Project Description: [S]** Evaluate the relative effectiveness of various riparian protection measures across different scales and land use practices to protect water quality and habitat.
  + **(related/component): [S]** ID factors and elements of unsuccessful and successful restoration techniques.
  + **(related/component):** Develop a protocol using these factors to identify areas for restoration.
* **Project Description:** Determine the effectiveness of various stream restoration techniques for their ability to restore both function and structure. Need to identify reference reaches to properly design and evaluate restoration projects.
* **Project Description: [N]** [Determine the] effects of stormwater management/impervious surfaces on aquatics.

**4. PROGRAM: Ecological Functions of Natural/Intact Systems**

**PROGRAM DESCRIPTION:** *[Develop understanding of natural systems interrelatedness and interdependency, focusing on ecological flows, fluvial geomorphology, and species/habitat responses]* at a systems level. “Accounting for natural differences in flow variability among rivers, and understanding the importance of this for the protection of freshwater biodiversity and maintenance of goods and services that rivers provide.” *Understanding how flow variability sustains river ecosystems.*]

(Grouping) – *Foundational/Stock-taking Assessment/Classification System*

* **Project Description:** [Produce an assessment of]common hydrologic models/hydrologic data (models like stream stats for ungaged streams) *(common to both Program 3 &4)* 
  + - * **Project Description:** establish a stream classification system

**[AppLCC FY11/12 Funded Project:** (Anderson et al., The Nature Conservancy & ORNL) “A Stream Classification System for the Appalachian Landscape Conservation Cooperative”]

* + - * **Project -** Develop a rapid assessment (management) program and ground-truthing for assessing riparian and floodplain vegetation.

(Grouping) – *Effects of Fire on Ecosystems*

* **Project Description: [N]** Effects of fire on aquatic ecosystems [e.g., nutrient cycling/loading, temperature regimes, plant communities, etc.]

(Grouping) – *Relationship/ Ecological flows and Nutrient dynamics*

* **Project Description: [N]** Identify the role of Fresh Water Mussels (aquatic organisms) in nutrient cycling, removal of suspended sediments, bioturbation, bottom stabilization and enrichment, and creating stable aquatic habitats.
  + **(related) Project Descriptions [N]** [Determine the]effects of aquatic organisms’ dispersal on nutrient dynamics [*COP needs to elaborate/explain purpose*].
* **Project Description: [N]** [Identify the]relationship between [specific suites of] benthic biodiversity and [paired conditions of] nutrient dynamics [Editor: Best guess; *COP needs to elaborate/explain*]
* **Project Description: [N]** Evaluate [the upstream and downstream effects] of natural channel design on ecosystems [e.g., project implementation on intact, stable riverine]. [Editor: Best guess; *COP needs to elaborate/explain*]

(Grouping) – *Ecosystem Integrity / Resiliency*

D. Heading: Community Level

**5. PROGRAM: Community level (description and function or basic community ecology)**

**PROGRAM DESCRIPTION:** *[NEEDED: none given]*

(Grouping) – *Basic Ecology/Ecological Relationships*

* **Project Description: [N]** [Document the] effect of judicious stocking of non-native species on native biota.
* **Project Descriptions: [N]** Identify interspecies relationships (pollinators, host fish, etc.).
* **Project Description: [S]** Assess levels and patterns of most fundamental form of biodiversity from the intra-specific to the community level.
* **Project Description: [N]** [Document the] impacts of density of aquatic vegetation on fish community composition.
* **Project Description: [N]** [Conduct an]evaluation of macro-habitat features [influence] on biodiversity distribution.
* **Project Description:** [Develop] mussel/fish habitat models that relate occupancy and abundance to habitat characteristics.
* **Project Description: [N]** [Describe the]temporal and spatial scale relationships to aquatic communities (headwater disturbances, land use/cover associated with aquatic communities – can be temporal component).
  + **(related) Project Description: [N]** [Assess the] effects of headwater stream disturbance on downstream fish/mussel communities.

E. Heading: Species/Population Level

**6. PROGRAM: Basic Biological Understanding (Species-level)**

**PROGRAM DESCRIPTION:** *[NEEDED: none given] [… refers to basic, broadening our understanding of the biology of organisms]*

(Grouping) *– Basic Biological Information*

* **Project Description: [N]** [Conduct] an inventory/status assessment of species
  + **(related) Project Description [N]** rigorous understanding of population dynamics/viability for fresh water mussels (other at risk species)
  + **(related) Project Description: [S]** Develop range-wide genetic assessment of keystone aquatic species.
  + **(related) Project Description: [N]** Identify key limiting factors and stressors for priority aquatic taxa
* **Project Description: [N]** [Describe] the dispersal abilities of aquatic animals.
* **Project Description: [S]** Develop a framework for appropriate standardized sampling design methodologies for the long term monitoring of priority aquatic species.
* **Project Description: [N]** [Describe] environmental flow requirements for species, populations for the region….relationship between flow and habitat and aquatic life (ecological flows).
* **Project Description: [N]** Monitor effectiveness of BMPs/water quality standards/criteria – is it effective for target species?
  + **(related) Project Description: [S]** Develop a rigorous predictive understanding of the net water quality outcomes from aquatic species restoration / augmentation.
* **Project Description: [N]** [Investigate approaches/]improvements to fish sterilization techniques (triploidy technology).
* **Project Description: [S]** Develop a framework for appropriate standardized sampling design methodologies for the long term monitoring of priority aquatic species.
* **Project Description: [N]** Map remaining suitable and free flowing riverine habitat for freshwater mussels.
* **Project Description:** **[N]** [Examine] relationships between sedimentation rates and biological response [e.g. survival rates, breeding success of aquatic organisms].
* **Project Description: [N]** Assess aquatic species vulnerability to changes in stream flow and temperature [[as it relates to]] water quality.
* **Project Description: [N]** Develop additional IBIs tailored to basins/regions/additional species [in order to establish baseline conditions and track changes over time, which might be linked to causes].
* **Project Description: [N]** Assess aquatic species vulnerability to changes in stream flow and temperature, water quality.
* **Project Description: [N]** improve, refine, test efficiency of captive propagation techniques.
* **Project Description: [N]** develop criteria for relocation/augmentation (genetics, disease, etc.)
* **Project Description:** aquatic species models that relate occupancy and abundance to habitat characteristics

(Grouping) – At-Risk Species/Populations & Endemics

* **Project Description: [N]** Establish a protocol to populate a genetics database for at-risk species.
* **Project Description: [N]** Determine theeffect of population densities on recruitment potential [for at-risk species / determine minimum effective population size].
* **Project Description: [N]** Develop habitat models for at risk species [Editor: Vague, *COP needs to elaborate/explain*]
  + **(related) Project Description: [N]** Need to [develop standard, long-term datasets for species] surveys [and apply models for] at-risk aquatic populations [to assess survival rates and population viability].

(Grouping) – *Contaminants/Pollutants Effects on Species/Populations*

* **Project Description: [N]** [Document]the [synergistic] **effects of complex mixtures** (water contaminants) [on aquatic organisms and their reproductive and survival rates].
  + **(related) Project Descriptions: [N]** [Conduct a] comparative assessment of relative sensitivity of biota to contaminants [suspected of impairing survival or reproductive capacity]**.**
  + **(related) Project Descriptions: [S]** [Collect] data on toxic effects on reproduction and growth of pharm, chemicals that are unregulated, ions, etc. on priority aquatic species.
* **Project Descriptions: [S]** Projecting effects of **wastewater effluent** on aquatic species and populations in light of continued human population growth projections.
  + **(related) Project Description: [S] [**Establish long-term studies to research] toxic effects of pharmaceuticals, ions, and other unregulated [[discharged]] chemicals on reproduction and growth of priority aquatic species.
* **Project Descriptions: [S]** Identify the effects of chemicals constituents **associated with coal** processing and storage, fly ash, and discharges from settling ponds on survival, condition and reproduction of fish and aquatic invertebrates.

(Grouping) – *Invasive organisms effect on species and populations*

* **Project Description: [N]** Effect of invasive species on ecological function (riparian zone and instream) (e.g. Japanese knotweed).
* **Project Description:** Identify distribution of invasive species across watersheds and identify how and to what extent they threaten aquatic species.
  + **(related/component)** Complete a threats analysis of invasive species on aquatic species.
  + **(related/component)** Gather data on how states regulate exchange between states or intra-state movement of species in relation to non-indigenous species or move between watersheds**.**
  + **(related) Project Description: [S]** ID risks associated with pathways for introduction and spread of invasive species as well as the techniques to manage the risks.
  + **(related) Project Description: [S]** Quantify the amount of critical habitat occupied by invasive species and identify which invasive species they are.
* **Project Description: [S]** Assess aquatic species diversity utilizing eDNA and contemporary monitoring tools (see URL for reference to “environmental DNA” <http://environmentalchange.nd.edu/programs/asian-carp/> ) basically to take water samples and filter out shed DNA to give an early warning of an invasive species moving into a previously undetected area.

(Grouping) – *Effects of Disease (on a species or taxonomic group)*

* **Project Description: [N]** [Describe the] effects of disease and parasites [Editor: Vague, *COP needs to elaborate/explain]*

F. Heading: “How (the LCC) Should Do Business”

* **[N]** Encourage BMPs for riparian zone management.
* **[S]** Support and add value to ongoing efforts to establish methods for assessing cumulative watersheds impacts.
* **[N]** develop recovery plans for those species already identified
* **[N]** develop conservation genetic management plans for aquatic species
* **[N]** develop technology and protocols for restoring common mussel communities for their ecosystem function
* Gather data on how states regulate exchange between states or intra-state movement of species in relation to non-indigenous species or move between watersheds.
* Develop a way to access privately collected monitoring data from the permitted community.

**[AppLCC’s new Web Portal]** Portal offers to host most data sets and these can be shared narrowly or widely, as controlled by the content source.]

* Develop a phone book or list of data, expert advice, etc. and make it available to all partners.

**[AppLCC’s new Web Portal]** Portal includes an Experts Database has been compiled from attendees at the November 2011 Projects Workshop and from members.]

* **[N]** develop efficient environmental inventory tools
* **[N]** develop conservation genetic management plans for aquatic species
* Need to develop NHD data at 1:24K
* **[N]** Effect of invasive species on ecological function (riparian zone and instream) (e.g. Japanese knotweed) --- [Note: coordinate with Aquatic Nuisance Panels.]

**Notes:** version posted: 2012-12-18