

## **Appendix A. Compensation Planning Framework (CPF)**

As documented in the Final Mitigation Rule (33 CFR §332), this Instrument includes a Compensation Planning Framework (CPF) that will be used to select, secure, and implement aquatic resource restoration, establishment, and preservation. This Appendix constitutes the CPF and shall serve as the guide for mitigation actions in each service area. The CPF will be referenced in future project mitigation plans and includes the following elements:

- I. The geographic service area, including a watershed-based rationale for the delineation of each service area.
- II. A description of aquatic resource threats within each service area and how the ILF Program will help offset impacts resulting from these threats.
- III. An analysis of historic aquatic resource loss in the service areas.
- IV. An analysis of current aquatic resource conditions, supported by appropriate level of field documentation, for each service area.
- V. A statement of aquatic resource goals and objectives for each service area, including a description of the general amounts, types and locations of aquatic resources the program will seek to provide;
- VI. A prioritization strategy for selecting and implementing compensatory mitigation activities.
- VII. An explanation of preservation objectives satisfy preservation criteria specified in 33 CFR §332.
- VIII. A description of any stakeholder involvement in plan development and implementation.
- IX. A description of the long term protection and management strategies for activities conducted by the Sponsor.
- X. A strategy for periodic review and reporting on the progress of the ILF Program in achieving goals listed in I - IX.

## I. The Geographic Service Areas

As announced on August 23, 2019 and documented in the Corps' "Predefined Service Areas for Third Party Mitigation Sites within Kentucky" (I.D. No. LRL-2018-01040; USACE 2019), 10 resource-based service areas have been identified for Kentucky. These 10 service areas were delineated using the following factors:

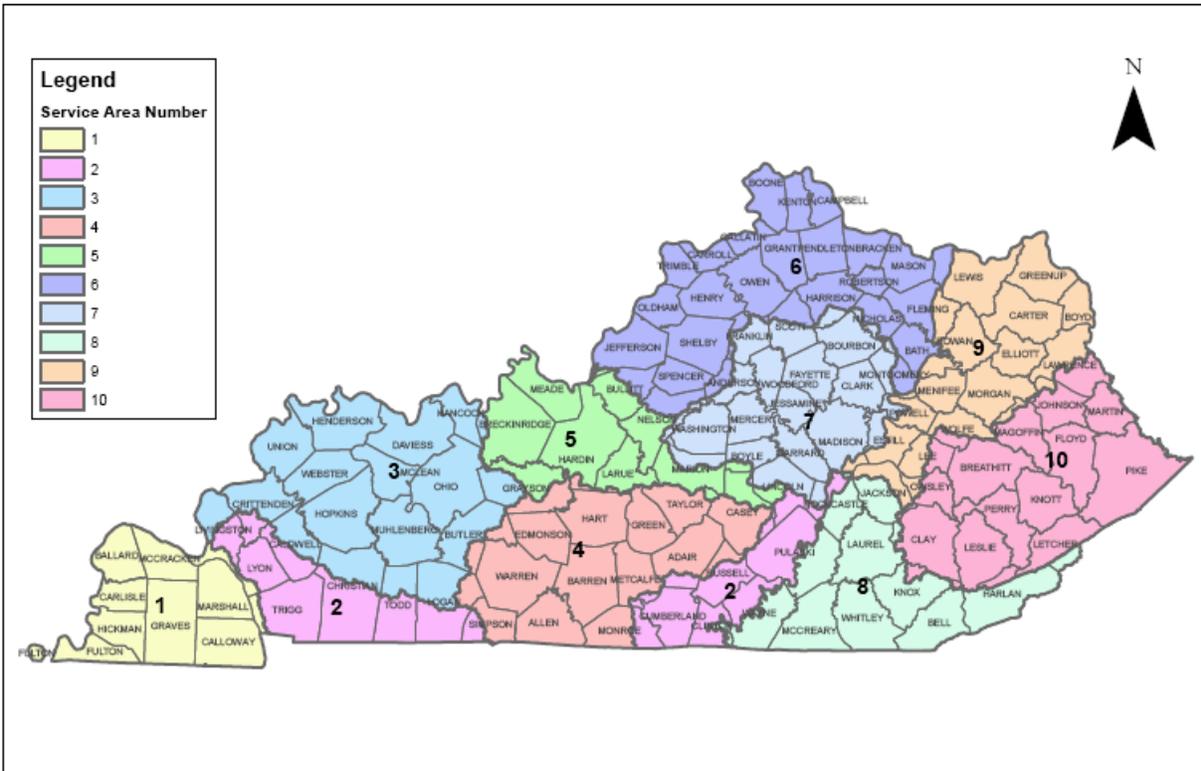
- geology (karst features and geologic age),
- physiographic regions, ecoregions and bioregions,
- hydrologic units (HUCs),
- Corps district boundaries,
- stream assessment and crediting protocols,
- aquatic "Species of Greatest Conservation Need (SGCN)"/aquatic Endangered Species Act (ESA) taxa,
- hydrology,
- topography,
- soil characteristics,
- detailed, ecologically based land uses and physiographic classes,
- habitat connectivity,
- wetland type and distribution,
- stream quality and distribution,
- natural resource extraction,
- economic viability,
- environmental justice/resource export,
- watershed health and vulnerability
- predicted land use impacts, and
- applicable, locally-developed standards and criteria.

According to USACE 2019, a wide array of federal and state databases were used to define 10 service areas in Kentucky, including geologic, physiographic, topographic, eco-regional, bioregional, hydrologic, soils, land use, aquatic habitat, type and distribution of aquatic SGCN/ESA taxa, watershed health and watershed vulnerability data. Economic viability and environmental justice data were also analyzed. Locally developed standards and criteria were reviewed. Stream assessment protocols were used in the service area delineation but the other locally developed standards and criteria were not applicable in this determination. Therefore, all four factors listed at 33 CFR §332.8(d)(6)(ii)(A) were considered in the development of the Kentucky service areas.

The initial boundaries were refined using 12-digit hydrologic units (HUCs) as the basic unit of analysis. The boundaries were also refined to minimize the division of urban areas. All other data validated the 12-digit HUC/urban adjusted boundaries. The final, resource-based,

predefined service areas are appropriately sized to ensure that the aquatic resources provided will effectively compensate for adverse environmental impacts across the entire service area.

This approach for defining service areas within Kentucky is consistent with 33 CFR §332 and meets the criteria set forth for the CPF; therefore, these 10 service areas will be utilized in this CPF. The 10 service areas are depicted in Figure A.1.



**Figure A.1. Kentucky Resourced-Based, Pre-Defined Service Areas for Third Party Mitigation**

## **II. Aquatic Resource Threats/Approach to Offsetting Potential Impacts**

According to the KDOW 2016 Integrated Report to Congress (KDOW 2016), 58% of Kentucky’s streams and rivers were deemed “impaired” and 42% met the designated use for aquatic life. The leading source of impairment to Kentucky’s streams is sedimentation/siltation (KDOW 2008). Other threats to Kentucky’s streams include excessive nutrients, elevated conductivity, habitat degradation and biological impacts. The underlying causes of impairment include stream channelization/relocation, stream bank modifications, loss of riparian habitat, dredging, aquatic habitat modifications, land-use alteration (e.g. vegetation removal/site grading for development or agriculture), timbering, and resource extraction (KDOW 2016).

Most of the wetland area in Kentucky has been drained or converted to other land uses. Approximately 6.1% (1.56 million acres) of Kentucky's total land area is estimated to have been wetlands (KSWCC 1982). Approximately 324,000 acres of wetlands remain in the Commonwealth. This represents a decline of approximately 80%. Current threats to wetland habitat include urban expansion and rural development, including agriculture (KDOW 2016).

### **III. Historic Aquatic Resource Losses**

The leading source of impairment to Kentucky's waterways is sedimentation/siltation (KDOW 2008). This impairment generally results from physical habitat conditions and alterations, such as channelization, loss of riparian habitat, streambank modifications/destabilization, site clearance for development, dredging, mineral extraction and habitat modification.

Most of the wetland area in Kentucky has been drained or converted to other land uses. Approximately 6.1% (1.56 million acres) of Kentucky's total land area is estimated to have been wetlands (KSWCC, 1982). Approximately 324,000 acres of wetlands remain in the Commonwealth. This represents a decline of approximately 80%. The Green River basin, included in Service Area 3, has approximately 88,000 acres of wetlands; the largest concentration of remaining wetland area in the Commonwealth (Kentucky Environmental Commission 1995; KDOW, 2008). Recent data on the gains and losses of Kentucky's wetlands is poorly documented. However, Dahl 1990 reported wetland occurrence in the 1980's to be approximately one to five percent of Kentucky's total land area. Dahl 2006 reported a net gain in wetland area (220,000 acres) nationally between 1998-2004. However, ponds were included as wetlands and there was no qualification as to wetland type. This report attributed 61 % of wetland loss between 1998-2004 to urban expansion and rural development.

Parola, et al. 2007 provided a synthesis of historic aquatic resource losses within Kentucky. In this synthesis, wetlands and streams losses were associated with significant clearing of forests, construction of mill dams, channel alterations, and draining of wetlands. Clearing of land and burning was used as a means to assist in developing land for agriculture.

By the 1930's, over 585,000 acres statewide had been included in regional drainage projects resulting in more than 1,200 miles of ditches and conversion of wetlands to agriculture. Many stream channels were moved from the center of the valley to valley walls at hillsides. The resulting disconnecting of stream channels from groundwater sources impacted riparian and stream areas. These impacts resulted in excessive sedimentation into valleys filling stream channels. Channel incision through post settlement alluvium and channel

straightening exacerbated channel incision. Some larger streams in the Bluegrass have experienced several cycles of floodplain alteration and channel modification.

Many of the regional drainage projects were federal (U.S. Department of Agriculture, "USDA") or state sponsored programs. These projects established local watershed districts that established fees/taxes, easements, funding for engineering design, construction, and maintenance of projects, and governance over a local watershed. Many of these projects had eminent domain powers and implemented easements that are still in effect.

Numerous other federal projects significantly altered Kentucky rivers, streams, and wetlands. Examples include numerous U.S. Army Corps of Engineers reservoirs, flood control and drainage projects, and USDA sponsored projects such as small flood control reservoirs or drainage of wetlands. Lock and dam construction significantly changed rivers or sections of rivers across Kentucky: Ohio River, Kentucky River, Green River, Barren River, Licking River, Tennessee River, Cumberland River, and Big Sandy River. Numerous other dams on small streams exist across Kentucky but not all are documented.

Surface and underground coal mining, logging, and both gas and oil production are common and have degraded surface waters. Acidic drainage and sedimentation from coal mines have decreased the biological productivity of many streams and in some reaches all but the most tolerant aquatic biota have been eliminated. However, gradual improvement in the control of acidic mine drainage is occurring.

In summary, statewide historic stream functional losses are attributed to fill for settlement/development, conversion of streams and wetlands to agriculture, mineral extraction, channelization, impoundment, drainage projects, and various land developments resulting in removal of native riparian vegetation.

#### **IV. Analysis of current aquatic resource conditions**

Kentucky has a rich aquatic fauna and with over 90,000 miles of streams provides one of the most expansive complex stream systems in the nation. Along with groundwater, which includes extensive underground stream systems, these waters support a wide variety of aquatic organisms.

Kentucky lies within the Ohio, Lower Mississippi and Tennessee watersheds. Within the state, these three watersheds are divided into 17 major watersheds, and are based on hydrology and the distributional patterns of freshwater fishes and mussels (Berry 2010).

Kentucky exhibits a diverse landscape, including varied terrain of mountains in the eastern/southeastern part of the state, rolling hills, karst landscape in the central portions, and a flat coastal plain in the west. This diverse landscape allows for a greater diversity of

aquatic life. Kentucky's diverse aquatic fauna is of global and national significance (Berry 2010). The state ranks third in the nation for native fish diversity, second only to Tennessee and Alabama. It ranks fourth in the nation for native freshwater mussel diversity and fifth for native crayfish diversity. Kentucky is home to 102 taxa believed to be endemic to the state.

Although Kentucky is rich in aquatic biodiversity, it remains in a constant state of decline. Threats to aquatic resources across the state belong to broad categories including urbanization, agriculture, and natural resource extraction. Dam installation, introduction of invasive species, pollutants, and many other factors also contribute to aquatic resource loss (Berry 2020).

## **V. Aquatic Resource Goals and Objectives**

In general, the program-wide aquatic resource goals and objectives include providing self-sustaining stream and wetland mitigation promoting aquatic resource quantity, function, and sustainability. Each approved project mitigation plan will identify site-specific goals and objectives with consideration of sections in the CPF.

The goals for each service area will be to restore, enhance, or preserve physical stream habitat including riparian zones and jurisdictional wetland habitat in amounts equal or greater to the number of advance credits sold. The goal is to compensate for the resource types lost through permit actions and when possible to use Reserve funds to implement additional mitigation either in excess of or in advance of resource loss. The objectives to reach these goals include 1) Conducting measurable physical restoration, establishment or preservation of wetlands or streams directly or indirectly by construction and conservation methods, 2) securing, to the extent required, sufficient property either in the form of easements, purchases, or working on public lands, 3) securing where possible adjacent uplands that contribute to watershed protection, and 4) building off existing mitigation sites or public lands.

## **VI. Prioritization Strategy**

The primary factor affecting project prioritization is the opportunity to restore and enhance degraded streams and wetlands with a focus on the potential to provide resilient, sustainable, ecologically appropriate compensation within the service area. Mitigation projects have the ability to improve the quantity and quality of aquatic resources and this approach sets this as priority.

To enhance the ecologically appropriateness and sustainability of compensatory mitigation projects, site selection will generally include consideration of the degree and type of

impairment (for non-preservation mitigation), landscape position, resource type, the types and location of compensatory mitigation projects, the habitat requirements of important species, habitat loss, and other factors. To achieve the desired aquatic functions and services over time in a changing landscape, project selection may also include one or more additional considerations, including but not limited to:

- Likelihood of success
- Ability to address multiple functions and services, such as improvement of fish & wildlife habitat, support for rare or threatened/endangered aquatic species, water quality improvement, and recreation or education values
- Improve previously impacted or lower quality reaches and watersheds where ecological lift can be maximized
- Timeliness of mitigation actions
- Adjacent to or within other protected lands
- Adds to or compliments protected natural lands
- Supports regional conservation initiatives
- Compliments other conservation efforts or leverages other funding for watershed improvements
- Located in high quality waters (i.e. Outstanding State Resource Waters (OSRW's))
- Addresses threats to state or federally listed rare, threatened, or endangered aquatic or wetland species
- Offers long-term protection and project sustainability
- Preserves streams or wetlands and associated habitat that have exceptional quality

In addition to meeting the criteria listed above, other considerations such as overall watershed health and protection and reach scale characteristics may also be considered for mitigation.

Site selection will be based on conditions that favor the success of mitigation projects. In general, mitigation sites with conditions which tend to hinder success that cannot be adequately addressed will not be selected. Unless approved by USACE, projects shall not be undertaken that fall outside the purview of compensatory mitigation for losses to Waters of the United States as defined in the 2008 Mitigation Rule and subsequent rulings.

## **VII. Preservation Objectives**

Preservation will be used when it meets requirements set forth in 33 CFR §332. In general, the objective of preservation proposals will include be long-term protection of high quality and/or exceptional waters and waters that may contribute significantly to conservation needs in a service area and/or that benefit existing mitigation projects.

**VIII. Stakeholder Involvement**

KDFWR will work with private landowners, trust agencies, state and federal agencies, non-government conservation organizations, local governments, universities, and public land agencies to meet the objectives of the Instrument. Individual projects will be implemented on private and public lands. Where appropriate, projects will be coordinated with other private or public interests to leverage benefits to aquatic resources.

**IX. Long term protection and management**

All compensatory mitigation sites will have long term protection mechanisms. These may include: conservation easements, acceptable management plans on public lands, deed restrictions, or other methods employed by the Sponsor as approved by the Corps. Long-term protection may be achieved by third party entities as approved by the Corps.

**X. Periodic Review and Reporting**

Project Compliance Reports will be submitted for active projects as specified in each Project Mitigation Plan. All projects will be inspected annually for compliance with long-term protection requirements to address long term protection goals.

Periodic evaluation and reporting strategy has been addressed in the main body of the Instrument. Annual Program Reports will be submitted to the Corps with accounting and mitigation information related to the Instrument and compensatory mitigation projects.

**XI. Service Area 1**

**a. Geographic Location**

Service Area 1 is located in the far western portion of Kentucky and encompasses three physiographic provinces: the Tennessee River Plain, Eastern Gulf Coastal Plain, and the Mississippi Alluvial Plain. This area borders Tennessee, Missouri, and Illinois, and contains all or portions of the following counties:

- Ballard
- Calloway
- Carlisle
- Fulton
- Graves
- Hickman
- Livingston
- Lyon
- Marshall
- McCracken
- Trigg

The following 8-digit HUC's occur in Service Area 1: 06040005 (Kentucky Lake. Kentucky, Tennessee), 06040006 (Lower Tennessee. Kentucky, Tennessee), 05140206 (Lower Ohio. Illinois, Kentucky), 08010100 (Lower Mississippi-Memphis. AR, KY, MS, MO, TN), 08010201 (Bayou De Chien-Mayfield. Kentucky, Tennessee) 08010202 (Obion. Kentucky, Tennessee)

Service Area 1 has a drainage area of approximately 2,700 square miles within the Kentucky boundaries. Stream statistics for this area include 7,306 miles of total stream length of which 72 are currently listed as 303(d) totaling 443.8 miles (KDOW 2008).

Service Area 1 includes the Mississippi Valley Loess Plains Level III Ecoregion. This area is defined as irregular plains, gently rolling hills, and, near the Mississippi River, bluffs. It is characteristically covered by thick loess and alluvium and is underlain by unconsolidated coastal plain sediments that are susceptible to rapid erosion. The area is lithologically distinct from the consolidated bedrock of the Interior Plateau ecoregion and the Interior River Valleys and Hills. It is generally a flat area having less relief than other ecoregions in the state (Woods et al. 2002).

**b. Threats and Offsetting Approaches**

According to Woods et al., grasslands and forested wetlands were once widespread in Service Area 1 within the Western Pennyroyal Karst Plain Ecoregion. Most of the original vegetation has now been replaced by cropland. Extensive corn, soybean, wheat, hay, tobacco, livestock, and poultry farming occurs. Agricultural runoff has degraded surface water quality. High turbidity and siltation are common in the streams and rivers of Service Area 1 and many channelized streams occur.

Forested wetlands were once extensive but have been replaced by extensive cropland and pastureland. Streams typically have low gradients and gravelly to sandy bottoms. Stream alkalinity and hardness levels are lower than in other portions of the state.

The primary threat to Service Area 1 of agricultural activities results in excessive siltation and pathogens. (KDOW 2008). Sedimentation and channel alteration are common causes of stream impairment and habitat loss, therefore affecting aquatic fauna in this area. In-lieu fee mitigation projects will improve channel morphology and reduce the negative effects of sedimentation that often result from streambank erosion and channel alteration. Native riparian vegetation replacement will aid in improving multiple stream and wetland functions.

**c. Historic Aquatic Resource Loss**

Historic land use and stream alterations provided in the synthesis by Parola, et al. 2007 generally apply to Service Area 1 as well. In addition to this review, Parola et al. 2005 provided a review of stream condition and historic impacts for the Mississippi

Embayment Physiographic Region that is within Service Area 1. Conversion of woodlands and barrens into agricultural lands was extensive in this region. Meandering lowland streams were converted to straight channels to drain land for agricultural purposes. Stream channel incision, over-widening, and bank erosion continue to present problems related to sediment, and channel widening. This review estimated that cumulative effects of stream channelization have been significant leaving only a 25-mile section of Obion Creek unaltered.

Since 1998, Kentucky has monitored surface waters using a five-year rotating watershed management approach in which each of the five major Basin Management Units (BMU's) receives intensive monitoring in sequential years over the five-year cycle (KDOW 2008). The KDOW refers to the Jackson Purchase area (included in Service Area 1) as the Four Rivers Area, which includes the Lower Tennessee, Lower Cumberland, Ohio, and Mississippi drainages, while the KY Wetland and Stream Mitigation Program's Service Area 1 excludes the Lower Cumberland River basin.

A total of 656 miles of rivers and streams in KDFWR's Service Area 1 Jackson Purchase area (which does not include the Lower Cumberland basin) were reported as not fully supporting aquatic life use in the most recent Integrated Report (KDOW 2008). Of the 276 miles assessed in the Mississippi River basin, 218 miles either did not support or partially supported the use. In the Tennessee River basin, 295 miles were assessed, with 151 miles impaired for the use. Another 287 impaired stream miles (of 490 miles assessed) were found in minor tributaries to the Ohio River in this area.

Special use waters in the Jackson Purchase Basin Management Unit (included in Service Area 1) are designated in parts of 18 streams in 6 counties in the Tennessee River basin and in 8 streams and 3 counties in the Mississippi River basin (401 KAR 10:026 and 10:030). Reaches of the main stem Ohio River and Mississippi River are also designated as Outstanding State Resource Waters because of the presence of federally threatened mussel species, but these mainstem reaches are not included in the totals above.

KDFWR's CWCS (Comprehensive Wildlife Conservation Strategy; KDFWR 2005) and/or other sources of information indicate that all six of the 8-digit HUC's in Service Area 1 include some or all of the priority conservation areas based on presence of species of aquatic fauna with the greatest conservation need in the state. These include: Terrapin Creek State Nature Preserve, Obion Creek Wildlife Management Area and State Nature Preserve which includes Murphy's Pond and Emerson-Letourneau Woods wetlands, Reelfoot National Wildlife Refuge, Three Ponds State Nature Preserve, Ballard Wildlife Management Area, and others. Special interest will be focusing specifically on the 8-digit HUC's 08010201 (Bayou de Chien-Mayfield), and 08010202 (Obion) which are given higher priority. Two such areas included are the Terrapin Creek drainage in Graves and Calloway Counties and the Bayou de Chien drainage in Graves, Hickman, and Fulton Counties.

**d. Status of Aquatic Resource Conditions**

Service Area 1 is mostly a flat, broad alluvial plain with river terraces, swales, and levees providing the main elements of relief. Soils are typically finer-textured and more poorly drained than the upland soils of bordering ecoregions. However, better-drained loamy, silty, and sandy soils also occur. Winters are mild and summers are hot. Bottomland forests dominated by water-tolerant oaks and swamp forests of tupelo and bald cypress were once common. Grasslands occurred on well-drained sandy sites. Much of the natural vegetation has been cleared and drained for cultivation. Streams are extremely low in gradient and have sandy to muddy substrates. Fish assemblages, with the exception of a few rare and sporadically occurring species, are similar to those in the lowland streams in other parts of the state (Woods et al. 2002).

Potential natural vegetation is oak–hickory forest and is unlike the southern floodplain forest of the Mississippi Alluvial Plain. Streams typically have low gradients and gravelly to sandy bottoms. Stream alkalinity and hardness levels are lower than in the central portion of the state (i.e. Bluegrass). Fish assemblages, with the exception of several locally endemic species, are similar to those central-western portions of the state (Woods et al. 2002).

Several areas of Service Area 1 have been set aside and given special protection because of their natural qualities and scenic beauty. While these lands are managed for their long-term protection, many are open to the public. A major benefit to these areas is providing habitat or refugia for rare species and high quality ecological systems.

**e. Aquatic Resource Goals and Objectives**

The objective of compensatory mitigation site selection in Service Area 1 is to improve the quality and quantity of aquatic resources through strategic selection of sites, compensation for permanent losses, and preservation of unique aquatic resources in exceptional circumstances.

Mitigation projects will be identified by existing outreach efforts, coordination with other agencies including USFWS, KDOW, USDA, Corps, U.S. Forest Service, and KDFWR regional staff.

Mitigation projects will be identified in part by coordinating with the Division of Water and their priority watershed efforts that rank impaired streams by severity and public and agency interest and funding. KDFWR staff will communicate with watershed coordinators, and at times participate in the watershed meetings, to receive recommendations and offer input on realistic expectations from the in-lieu program. One positive aspect of a mitigation project in a priority water would be that if the

mitigation addresses the source of the impairment, the stream could be removed from the 303(d) list without resources being expended on developing a TMDL.

Another potential source of projects that will be investigated in each Service Area is public lands, including KDFWR Wildlife Management Areas and U.S. Army Corps of Engineers holdings around major reservoirs. Enhancing and rehabilitating impaired streams on public land is highly desirable because these areas generally have protected watershed and are accessible to and viewed by the public.

In addition to statewide priorities, mitigation projects in Service Area 1 will be prioritized as follows:

- i. Public lands and high quality waters
  1. WOUS that have been physically impacted that are within public lands, including state lands, KDFWR Wildlife Management Areas, U.S. Forest Service lands, or other lands. These areas offer watershed protection increasing the likelihood of success and long term protection.
  2. WOUS that are connected or associated with high quality waters.
- ii. Preservation of high quality WOUS
  1. Preservation of high quality streams and wetlands will be a priority in this service due to the paucity of such waters and threats in the region. Extensive cumulative impacts have left very few unaltered stream channels and wetlands (Parola et al. 2005).
  2. Special consideration will be given to high quality streams that are already in public ownership or adjacent to other mitigation projects.
  3. Existing high quality streams that will be considered for preservation opportunities include those in the following geographic areas:
    - Special Use Waters identified by the KYEPC-DOW in water quality standards regulations 401 KAR 10:026 and 10:030 and additional streams recently identified that indicate exceptional water quality and aquatic fauna
    - HUC's that harbor or contribute to CWCS conservation areas and species (KDFWR 2005)
    - HUC's that harbor or contribute to federally listed threatened or endangered aquatic or wetland species.
- iii. Comprehensive Wildlife Conservation Strategy (CWCS)
  1. Service Area 1 harbors several imperiled aquatic or wetland species, both state and federally listed. Priority will be given to projects that are within or influenced by targeted HUCs identified in the CWCS. Working in areas that

improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for federal listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.

iv. Imperiled, unique species and Special Use Waters

1. Priority will be given to projects that can improve habitat for endemic or imperiled aquatic or wetland species (state or federally listed threatened, endangered) or streams recognized for special use and high species diversity.

v. Cost-effective mitigation

1. Mitigation work will be focused on projects that:
  - provide a largest ecological lift for the least cost
  - compliment other habitat related projects in the river basin

**XII. Service Area 2**

**a. Geographic Location**

Service Area 2 encompasses the portion of the Cumberland River outside of the Eastern Coal fields. The area is located in southern Kentucky, but includes geographically separate tracts, referred to as eastern and western portions. The total area is approximately 5,177 square miles in the western portion and 2,039 square miles in the eastern portion. The following 8-digit HUC's are included in Service Area 2: Lower Cumberland, Red, Obey, Upper Cumberland-Lake Cumberland, Rockcastle, and South Fork Cumberland. It includes portions of the Level IV Ecoregions: Western Highland Rim, Crawford-Mammoth Cave Uplands, Western Pennyroyal Karst Plain, Outer Nashville Basin, Eastern Highland Rim, Knobs-Norman Upland; Level III Ecoregions: Interior Plateau, and primarily Eastern and Western Pennyroyal Physiographic regions. It includes the Pennyroyal Bioregion.

Service Area 2 includes portions or entirety of the following counties:

- |              |              |              |
|--------------|--------------|--------------|
| • Adair      | • Cumberland | • Monroe     |
| • Caldwell   | • Lincoln    | • Pulaski    |
| • Casey      | • Livingston | • Rockcastle |
| • Christian  | • Logan      | • Russel     |
| • Clinton    | • Lyon       | • Simpson    |
| • Crittenden | • Metcalfe   | • Todd       |

- Trigg

- Wayne

The western portion of Service Area 2 includes the Western Highland Rim Level IV Ecoregion. It is a hilly region and is bisected by the Tennessee and Cumberland River valleys. It is much more wooded and rugged than the nearby agricultural plains of bordering Ecoregions. It is underlain by Mississippian limestone and shales and, in the west, by Cretaceous-Paleocene shale, siltstone, and sandstone. Ridges and hills are often capped by cherty gravels and veneered by thin loess. Karst valleys underlain by limestone also occur. Upland soils tend to be cherty, droughty, low in fertility, and are mostly covered by mixed oak forests. Some agriculture occurs on flatter interfluvial areas and in valleys. Recreation is an important land use in the Land-Between-the-Lakes area (Woods et al. 2002).

The Eastern Highland Rim dominates the eastern portion of this service area. Key characteristics include a diverse ecoregion with undulating plains, hills, and karst. Near the Cumberland River, steep bluffs, springs, cascades, and wide bottomlands occur. The degree of dissection is variable. Overall, nearly level terrain is more extensive than in the Western Highland Rim, and stream density is greater than in the lower, less rugged Western Pennyroral Karst Plain. The area is mostly underlain by Mississippian limestone, chert, shale, siltstone, and sandstone; it is lithologically distinct from the Pennsylvanian carboniferous sedimentary rocks of other portions of the state.

Potential natural vegetation is mapped as oak–hickory forest but, in ravines near the Cumberland Plateau (68a), forests are mixed mesophytic in character. Today, white oak dominates upland forests and bottomland trees grow along streams. Streams are nutrient-rich and moderate in gradient. Riffle substrates are composed of cobble, gravel, or bedrock. Fish, macroinvertebrate, and mussel biodiversity is greater than in the Bluegrass (Ecoregions 71d, 71k, and 71l). (Woods et al. 2002).

#### **b. Threats and Offsetting Approaches**

Major threats to Service Area 2 include agriculture and urbanization. According to Woods et al., the Western Pennyroral Karst Plain (included in Service Area 2) is underlain by Middle Mississippian limestones and is extensively farmed; it is both physiographically and lithologically distinct from surrounding ecoregions. Sinkholes, ponds, springs, sinking streams, and dry valleys occur. Underground drainage is well developed, stream density is low, and soils are quick to dry. Most upland streams have limited discharge or are intermittent or ephemeral; they become laden with suspended sediment after heavy rains. Deeper, more intense dissection occurs near incised master streams which are fed by cool, nitrate-rich groundwater (Woods et al. 2002).

Recent information has shown a significant increase in the number of 303(d) listed streams in recent years; however, this may be due to the increase in monitoring efforts rather than increases in impacts. The 2008 Integrated Report (KDOW 2008) shows 22 miles and 865 acres of delisted waters in the Cumberland River basin. Sedimentation and channel alteration are common causes of stream impairment and habitat loss in the Cumberland River basin. These impairments cause habitat loss and impact aquatic fauna. Mitigation projects will improve channel morphology reduce the negative effects of sedimentation that often result from streambank erosion and channel alteration.

**c. Historic Aquatic Resource Loss**

The leading causes of impairment are siltation and pathogens. Sources in the Cumberland River Basin include mining, logging, hydromodification, agriculture, and other impacts such as urban runoff/ stormwater management, permitted wastewater, discharges, illegal straight-pipe discharges of domestic sewage, and off-highway vehicles.

**d. Status of Aquatic Resource Conditions**

Streams are cool and clear. They have moderate gradients and gravel and sand substrates. Stream alkalinity and hardness vary from east to west but are usually greater than in bordering ecoregions. Sinkholes, ponds, springs, sinking streams, and dry valleys occur. Underground drainage is well developed, stream density is low, and soils are quick to dry. Most upland streams have limited discharge or are intermittent or ephemeral; they become laden with suspended sediment after heavy rains. Deeper, more intense dissection occurs near incised master streams which are fed by cool, nitrate-rich groundwater. Fish assemblages vary among river systems (Woods et al. 2002).

Potential natural vegetation is mapped as a mosaic of bluestem prairie and oak–hickory forest. Barrens (i.e. bluestem prairies) were once more widespread than elsewhere in Kentucky. Today, extensive tobacco, livestock, corn, soybean, and small grain farming occurs (Woods et al. 2002).

The eastern tract of Service Area 2 includes a diverse ecoregion with undulating plains, hills, and karst. Near the Cumberland River, steep bluffs, springs, cascades, and wide bottomlands occur. The degree of dissection is variable. Overall, nearly level terrain is more extensive than in bordering ecoregions and stream density is greater than lower, less rugged ecoregions. The area is mostly underlain by Mississippian limestone, chert, shale, siltstone, and sandstone; it is lithologically distinct from the Pennsylvanian carboniferous sedimentary rocks of other ecoregions. Potential natural vegetation is mapped as oak–hickory forest but, in ravines near the Cumberland Plateau, forests are mixed mesophytic in character. Today, white oak dominates upland forests and

bottomland trees grow along streams. Streams are nutrient-rich and moderate in gradient. Riffle substrates are composed of cobble, gravel, or bedrock. Fish, macroinvertebrate, and mussel biodiversity is greater than in the Bluegrass.

The aquatic fauna of the Cumberland River system is extremely important and unique on a global scale. In North America, the mussel fauna is composed of 297 taxa (Turgeon et al. 1988). The southeastern United States has 91% of the North American mussel fauna (Neves et al. 1997). The Cumberland region has 37% of this fauna and is the primary center for North American freshwater mussel biodiversity (Ortman 1918, 1925). It is one of only six regional faunas on the continent (van der Schalie and van der Schalie 1950).

The Cumberland River Area includes 30,958 streams totaling 14,039 miles. Of these, 199 streams (194.3 miles) are currently listed on the 303(d) list (2004 KDOW GIS data). The Upper and Lower Cumberland River watersheds encompass drainage areas of 5,180 and 2,039 square miles within Kentucky, respectively. Many parts of the Upper Cumberland River Basin have been set aside and given special protection because of their natural qualities and scenic beauty. While these lands are managed for their long-term protection, many are open to the public. In addition to providing a refugia for rare species and unique ecological systems, these areas provide outstanding scenery and recreational opportunities (KDOW 2006).

**e. Aquatic Resource Goals and Objectives**

The objective of compensatory mitigation site selection in Service Area 2 is to improve the quality and quantity of aquatic resources through strategic selection of sites, compensation for permanent losses, and preservation of unique aquatic resources in exceptional circumstances.

The CWCS indicated that the 8-digit HUCs 05130101 (Upper Cumberland), 05130102 (Rockcastle River), 05130103 (Buck Creek), 05130104 (South Fork of Cumberland) were priority conservation areas based on presence and ranking of aquatic SGCN.

Mitigation projects will be identified in part by coordinating with the Division of Water and their priority watershed efforts that rank impaired streams by severity and public and agency interest and funding. KDFWR staff will communicate with watershed coordinators, and at times participate in the watershed meetings, to receive recommendations and offer input on realistic expectations from the in-lieu program. One positive aspect of a mitigation project in a priority water would be that if the mitigation addresses the source of the impairment, the stream could be removed from the 303(d) list without resources being expended on developing a TMDL.

Another potential source of projects that will be investigated in each Service Area is public lands, including KDFWR Wildlife Management Areas and U.S. Army Corps of Engineers holdings around major reservoirs. Enhancing and rehabilitating impaired streams on public land is highly desirable because these areas generally have protected watershed and are accessible to and viewed by the public,

In addition to statewide mitigation priorities, mitigation projects in Service Area 2 will be prioritized as follows:

i. Comprehensive Wildlife Conservation Strategy

1. The Cumberland River and its tributaries harbor several imperiled aquatic or wetland species, both state and federally listed. Priority will be given to projects that are within or influenced by targeted HUCs identified in KDFWR's CWCS (KDFWR 2005) with preference given to the HUCs based on ranking. Working in areas that improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for federally listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high-quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.

ii. Imperiled, unique species and Special Use Waters

1. Priority will be given to projects that can improve habitat for endemic or imperiled aquatic or wetland species (state or threatened, endangered) or streams recognized for special use and high species diversity.

iii. Public lands

1. Mitigation projects will be targeted within or adjacent to public lands, including state lands, KDFWR Wildlife Management Areas, U.S. Forest Service lands, and other areas. These areas offer watershed protection increasing the likelihood of success and long term protection.

iv. Cost-effective mitigation

1. Mitigation work will be focused on projects that:
  - provide the largest ecological lift for the least cost
  - compliment other habitat related projects in the river basin

v. Preservation of high quality WOUS

1. Special consideration will be given to high quality streams that are adjacent to other mitigation projects.
2. Existing high quality streams that will be considered for preservation opportunities include those in the following geographic areas:
  - Special Use Waters identified by the KYEPC-DOW in water quality standards regulations 401 KAR 10:026 and 10:030 and additional streams recently identified that indicate exceptional water quality and aquatic fauna
  - HUC's that harbor or contribute to CWCS conservation areas and species (KDFWR 2005)
  - HUC's that harbor or contribute to federally listed threatened or endangered aquatic or wetland species

**XIII. Service Area 3**

**a. Geographic Location**

As with the other service areas in the USACE 2019 document, a resource-based rationale for the service area delineation was utilized including the elements listed in USACE 2019 and section I of this document, with further refinement. Specifically, to Service Area 3, the following is unique:

This service area is located in the western portion of the state and encompasses an area of approximately 5,495 square miles. Service Area 3 includes portions of Green River-Southern Wabash Lowlands, Caseyville Hills, Wabash-Ohio Bottomlands, and Crawford-Mammoth Cave Uplands Level IV Ecoregions; Interior Plateau and Interior River Valleys and Hills Level III Ecoregions; Western Kentucky Coal Field and Western Pennyroyal physiographic regions; Pennyroyal and Mississippi Valley Interior River bioregions within the following eight 8-digit HUCs: Lower Ohio-Little Pigeon, Rough, Middle Green, Pond, Tradewater, Lower Green, Highland-Pigeon, and Lower Ohio-Bay.

Service Area 3 includes portions or entirety of the following counties:

- |                |              |              |
|----------------|--------------|--------------|
| • Breckinridge | • Grayson    | • McLean     |
| • Butler       | • Hancock    | • Muhlenberg |
| • Caldwell     | • Henderson  | • Ohio       |
| • Christian    | • Hopkins    | • Todd       |
| • Crittenden   | • Livingston | • Union      |
| • Davies       | • Logan      | • Webster    |

Service Area 3 is principally characterized by the Western Coalfield Physiographic Region, and the Mississippi Valley Interior River Bioregion. It is the only service area

principally characterized by this bioregion. The service areas is dominated by the Green River-Southern Wabash Lowlands (72c) Level IV Ecoregion (USACE 2019).

According to USACE 2019, four of the seven LRL service areas (Service Area 3, 6, 9 and 10) are dominated by a single percent slope quantile. Service Area 3 is the only LRL service area dominated by gentle slopes (e.g., 0-5.6% average slope)

Service Areas 3, 6, 7, 9 and 10 are generally characterized by a single extreme soil texture. Service Area 3 is dominated by silt and is the only LRL service area dominated by this soil texture (USACE 2019).

**b. Threats and Offsetting Approaches**

Major threats to Service Area 3 include agriculture and coal mining (Woods et al. 2002; USACE 2019). According to USACE 2019, Service Area 3 includes five ecologically based land use types, with cultivated cropland (27.55%) being the dominant type. This land use type consists of large parcels (average parcel size is 41.4 acres). When combined with pasture/hay, approximately 41% of this service area's land use is related to agricultural activities, which occur on relatively large tracts of land (e.g., average agricultural parcel size is 27.5 acres). Service Area 3 is approximately 41% forested, however forested parcels are much smaller in size (average parcel size is 4.6 acres) when compared to agriculturally related parcels. Approximately 5% of this service area is open water. Therefore, Service Area 3 consists of two dominant ecologically based land use types: forest and agriculture. Generally, the agriculture-related land uses are within the center of the service area and the forested land-uses are in an arc-like perimeter surrounding the agricultural area. However, the forested land uses (which tend to be smaller parcels) are also scattered among the center agricultural area (USACE 2019).

Impacts throughout the region have resulted in channelized streams that lack riparian forests and have very warm water, high turbidity, and limited concentrations of dissolved oxygen. Wetland vegetation and hydrology are greatly altered due to cropland conversion resulting in vegetation removal and drain tile installation (Woods et al. 2002).

Today, some woodlands remain but livestock, hay, alfalfa, corn, soybean, and wheat farming is extensive as well as logging, oil production and coal mining are among dominant land uses. Land use is affected by seasonally high water tables and localized flooding. Low gradient streams with silt or sand bottoms occur and are inhabited by Ohio River-type fish fauna. Channelization and drainage ditches are common (Woods et al. 2002).

The program would strive to offset the above listed impacts by implementing projects that improve lost functions. Efforts could include (not limited to), purchase of properties or providing site protection, locating existing wetlands and implementing preservation. Purchasing land with site protection. Create natural channels with riparian zones. Team with project partners to locate remaining high-quality areas.

**c. Historic Aquatic Resource Loss**

Impacts to the western portion of the state (Service Areas 1-3) include extensive wetland drainage and bottomland forest clearance. Drainage canals and field tile drains are common. Most of the original vegetation has been replaced by cropland. Agricultural runoff has degraded surface water quality. High turbidity and siltation are common in the streams and rivers and many channelized streams occur. Bottomland deciduous forests and swamp forests were once extensive on poorly-drained, nearly level, lowland sites but most have been replaced by cropland and pastureland. Hilly uplands remain mostly forested. Extensive surface and underground coal mines occur and have significantly degraded downstream habitat and water quality.

**d. Status of Aquatic Resource Conditions**

Service Area 3 has approximately 88,000 acres of wetlands; the largest concentration of remaining wetland area in the Commonwealth (The Kentucky Environmental Commission 1995; KDOW 2008), despite significant wetland losses in this region. Approximately, 80% of Kentucky's wetland acreage has been lost. The Green River basin has approximately 88,000 acres of wetlands remaining; the largest concentration of remaining wetland area in the Commonwealth (The Kentucky Environmental Commission 1995; KDOW 2008). U.S. Fish & Wildlife Service identified a proposed refuge on 23,000 acres of the lower Green River area known as Scuffletown Bottoms located between Henderson, KY and Evansville, IN. This area has been cleared and farmed for a number of years. To the west of Henderson, KY KDFWR owns a significant amount of public land, the Sloughs WMA, which is managed for wetlands. To the east of Henderson and adjacent to the proposed USFWS refuge in Scuffletown Bottoms, the Kentucky Division of Forestry owns a large tract of lands restored to bottomland hardwood wetlands. This area was targeted for waterfowl conservation as early as 1958 by the USFWS. It has been identified again by the North American Waterfowl Management Plan in 1989 as a high conservation priority for bottomland hardwood wetland restoration.

Broad, low gradient valleys occur and are filled with alluvium, loess, and lacustrine deposits. Drainage conditions and terrain strongly affect land use. Wetlands are common on lowlands and bottomlands. Bottomland deciduous forests and swamp forests were once extensive on poorly-drained, nearly level, lowland sites but most have

been replaced by cropland and pastureland. Hilly uplands remain mostly forested. Extensive surface and underground coal mines occur and have significantly degraded downstream habitat and water quality. Silt and sand dominate lowland channels while upland streams are rockier. Streams typically have lower nutrient, alkalinity, and hardness levels than bordering ecoregions. Fish assemblages are lowland in character and are rather similar to those found in the Mississippi Valley Loess Plains Ecoregion, although several species are unique to a particular river basin.

Acid coal mine runoff has decreased biological productivity in streams; many tributaries have low numbers of fish and fish species while others are entirely devoid of fish. Macroinvertebrate and fish communities are similar to those in low gradient streams near the Ohio River, but are less diverse than in the upland streams. Upland perennial streams are cooler and have higher gradients, rockier substrates, better water quality, more diverse habitats, and more productive fish and macroinvertebrate communities.

**e. Aquatic Resource Goals and Objectives**

In general, streams will not be considered for mitigation projects where problems such as acid mine drainage, high conductivity, chronic water quality problems, and projected or on-going land uses would threaten success of the project.

Mitigation projects will be identified in part by coordinating with the Division of Water and their priority watershed efforts that rank impaired streams by severity, public and agency interest, and funding. KDFWR staff will communicate with watershed coordinators, and at times participate in the watershed meetings, to receive recommendations and offer input on realistic expectations from the in-lieu program. One positive aspect of a mitigation project in a priority water would be that if the mitigation addresses the source of the impairment, the stream could be removed from the 303(d) list without resources being expended on developing a TMDL.

Another potential source of projects that will be investigated in each Service Area is public lands, including KDFWR Wildlife Management Areas and U.S. Army Corps of Engineers holdings around major reservoirs. Enhancing and rehabilitating impaired streams on public land is highly desirable because these areas generally have protected watershed and are accessible to and viewed by the public.

In addition to statewide priorities, mitigation projects in Service Area 3 will be prioritized as follows

- i. Comprehensive Wildlife Conservation Strategy
  - 1. Service Area 3 harbors several imperiled aquatic or wetland species, both state and federally listed. Priority will be given to projects that benefit imperiled species or targeted HUCs identified in KDFWR's CWCS

(KDFWR 2005). Working in areas that improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for federally listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high-quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.

ii. Imperiled, unique species and Special Use Waters.

1. Priority will be given to projects that can improve habitat for endemic or imperiled aquatic or wetland species (state or federally listed threatened, endangered) or streams recognized for special use and high species diversity.
2. Public lands and conservation targets
  - Mitigation projects that are within existing public lands will be targeted.
  - Mitigation projects that help achieve conservation goals or leverage other conservation projects will be targeted.

iii. Cost-effective mitigation

1. Mitigation work will be focused on projects that:
  - provide a largest ecological lift for the least cost
  - compliment other habitat related projects in the river basin

iv. Preservation of high quality WOUS

1. Special consideration will be given to high quality streams that are adjacent to other mitigation projects.
2. Existing high quality streams that will be considered for preservation opportunities include those in the following geographic areas:
  - Special Use Waters identified by the KYEPC-DOW in water quality standards regulations 401 KAR 10:026 and 10:030 and additional streams recently identified that indicate exceptional water quality and aquatic fauna
  - HUC's that harbor or contribute to CWCS conservation areas and species (KDFWR 2005)
  - HUC's that harbor or contribute to federally listed threatened or endangered aquatic or wetland species.
  - WOUS identified on a case-by-case basis that have exceptional water quality, fauna, or other unique aquatic features.

#### **XIV. Service Area 4**

##### **a. Geographic Location**

As with the other service areas in the USACE 2019 document, a resource-based rationale for the service area delineation was utilized including the elements listed in USACE 2019 and Section I of this document, with further refinement. Specifically, to Service Area 4, the following is unique:

This service area is located in the south-central portion of the state and encompasses an area of approximately 4,424 square miles. Service Area 4 includes portions of Caseyville Hills, Crawford-Mammoth Cave Uplands, Western Pennyroyal Karst Plain, Eastern Highland Rim, and Mitchell Plains Level IV Ecoregions, Interior Plateau and Interior River Valleys and Hills Level III Ecoregions; Eastern Pennyroyal, Western Pennyroyal, Western Kentucky Coalfield and Knobs physiographic regions, and Pennyroyal, Pennyroyal/Upper Green, and Mississippi Valley-Interior River bioregions within the Upper Green and Barren 8-digit HUCs (USACE 2019).

Service Area 4 includes portions or entirety of the following counties:

- Adair
- Allen
- Barren
- Butler
- Casey
- Edmonson
- Grayson
- Green
- Hardin
- Hart
- Larue
- Logan
- Metcalfe
- Monroe
- Russell
- Simpson
- Taylor
- Warren

Service Area 4 is dominated by the Eastern and Western Pennyroyal Physiographic Regions, the Pennyroyal and the Pennyroyal/Upper Green Bioregions and the Eastern Highland Rim (71g) Level IV Ecoregion (USACE 2019).

Service Areas 4 and 5 are uniquely characterized by two soil extremes: sand and clay. The distribution of soils with high sand, clay or silt content within a service area can affect the distribution of mitigation sites within that service area. The distribution of extreme soils within Service Areas 3, 4, 5, and 7 is generally uniform or homogeneous; therefore, will not impede the implementation of appropriate compensation within these service areas.

This service area is dominated by rolling uplands. Rolling uplands are defined as all moderately moist physiographic sites that are not described as dry tops, dry slopes, deep sands, other xeric, or flatwoods (USACE 2019).

**b. Threats and Offsetting Approaches**

Current threats to Service Area 4 primarily includes agriculture and urban development. According to USACE 2019, Service Area 4 is characterized by two major ecologically based land uses: agriculture (35.72% pasture/hay and 8.12% cultivated cropland) comprising a total of 43.84% and forested comprising 43.25% (21.70% South-Central Interior Mesophytic Forest and 21.55% Southern Interior Low Plateau Dry-Mesic Oak Forest) of the land acreage. As with Service Area 3, the agricultural land uses represent larger parcels (average parcel size is 25.4 acres) than the forested (average parcel size is 4.6 acres). The distribution of the forested parcels coincides with the distribution of the Aquatic SGCN/ESA taxa areas; therefore, the forested parcels represent mitigation opportunities within Service Area 4 (USACE 2019).

The leading causes of impairment in the Green River basin are pathogens, siltation, and physical substrate habitat alteration. The leading sources of impairment are loss of riparian habitat and agriculture activities (KDOW 2008).

Threats include forest loss, erosion, water demands, and increasingly volatile cycles of flood and drought caused by a changing climate. (<https://www.nature.org/en-us/about-us/where-we-work/united-states/kentucky/stories-in-kentucky/profile-of-the-green-river/>).

Future threats to Service Area 4 include channel and riparian zone alteration from agriculture as they account for 67% of pollutant causes. The majority of in-lieu fees from this area have been generated from stream impacts from road construction and urbanization impacts.

Areas in Service Area 4 are known for having high biological diversity in comparison with other regions in the state (Berry 2010; Cicerello & Hannan 1991). These areas will be considered for preservation projects with permanent protection. Others areas that have been impacted by agriculture or urban development will be selected for restoration activities with permanent protection.

According to the KDOW 2014 report, sedimentation/siltation is still the most common cause (pollutant) of impairment for aquatic life in Kentucky by monitored and assessed miles in this watershed.

**c. Historic Aquatic Resource Loss**

In the central portion of the state, (Service Areas 4-7). Water quality has been degraded by municipal effluent, agricultural discharge, and bank erosion following riparian forest

removal. In some locations, concentrations of suspended sediment and nutrients can be high.

**d. Status of Aquatic Resource Conditions**

Stream morphology is highly variable and both high gradient streams with boulder or cobble substrates and low gradient streams with sand or gravel bottoms occur. Stream nutrient and alkalinity levels are usually higher than in Ecoregions 68, 69, and 70. Within Ecoregion 71, elements of the fish assemblages in the Green and Cumberland river basins are distinct from those in the Kentucky, Salt, and Licking basins.

Streams are nutrient-rich and moderate in gradient. Riffle substrates are composed of cobble, gravel, or bedrock. Fish, macroinvertebrate, and mussel biodiversity is greater than in the Bluegrass (Ecoregions 71d, 71k, and 71l).

The fish fauna of the Green River (located in Service Area 4) is among the more diverse in the state and nation. Approximately two thirds of the Kentucky fauna are known from the Green River drainage, second only to the Cumberland River in fish diversity (Cicerello & Hannan 1991).

**e. Aquatic Resource Goals and Objectives**

Projects will be identified in part by coordinating with the Division of Water and using their priority watershed efforts that rank impaired streams by severity and public and agency interest and funding. KDFWR staff will communicate with watershed coordinators, and at times participate in the watershed meetings, to receive recommendations and offer input on realistic expectations from the in-lieu program. One positive aspect of a mitigation project in a priority water would be that if the mitigation addresses the source of the impairment, the stream could be removed from the 303(d) list without resources being expended on developing a TMDL.

Another potential source of projects that will be investigated in each Service Area is public lands, including KDFWR Wildlife Management Areas and U.S. Army Corps of Engineers holdings around major reservoirs. Enhancing and rehabilitating impaired streams on public land is highly desirable because these areas generally have protected watershed and are accessible to and viewed by the public.

In addition to the statewide priorities, mitigation projects in Service Area 5 will be prioritized as follows:

- i. Comprehensive Wildlife Conservation Strategy

1. Priority will be given to projects that contribute to aquatic species and target HUCs identified in KDFWR's CWCS (KDFWR 2005). Working in areas that improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for federally listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.
- ii. Imperiled, unique species and Special Use Waters
  1. Priority will be given to projects that can improve habitat for endemic or imperiled aquatic or wetland species (state or federally listed threatened, endangered) or streams recognized for special use and high species diversity.
- iii. Cost-effective mitigation
  1. Mitigation work will be focused on projects with the largest ecological lift for the least cost
- iv. Preservation of high quality WOUS
  1. Preservation of high quality streams and wetlands will be a priority in these Service Areas due to the paucity of such waters and development threats from Louisville and anticipated threats in the basin.
  2. Special consideration will be given to high quality streams that are already in public ownership or adjacent to other mitigation projects.
  3. Existing high-quality streams that will be considered for preservation opportunities.
- v. Impaired waters
  1. Proximity to streams or waters identified as impaired by KDOW where the mitigation project can address the causes of impairment.

**XV. Service Area 5**

**a. Geographic Location**

As with the other service areas in the USACE 2019 document, a resource-based rationale was utilized for the service area delineation including the elements listed in USACE 2019 and Section I of this document, with further refinement. Specifically, to Service Area 5, the following is unique:

This service area is in the north-central portion of the state and is approximately 2,851 square miles. Service Area 5 includes portions of the Knobs-Norman Upland, Mitchell Plain, Crawford-Mammoth Cave Uplands and Outer Bluegrass Level IV Ecoregions; Interior Plateau Level III Ecoregion; Knobs, Western Pennyroyal, Eastern Pennyroyal, Outer Bluegrass, and Western Coal Field physiographic regions; and Pennyroyal and Bluegrass bioregion within the following seven 8-digit HUCs: Salt, Rolling Fork, Upper Green, Rough, Lower Ohio-Little Pigeon, and Blue-Sinking.

Service Area 5 includes portions or entirety of the following counties:

- Boyle
- Breckinridge
- Bullitt
- Casey
- Grayson
- Hardin
- Larue
- Lincoln
- Marion
- Meade
- Nelson
- Taylor

Service Area 5 is generally comprised of the Western Pennyroyal and Knobs Physiographic Regions and is exclusively characterized by the Pennyroyal Bioregion. No other LRL service area is principally characterized by the Pennyroyal Bioregion.

The service area is characterized by three level IV ecoregions: Crawford-Mammoth Cave Uplands (71a), Mitchell Plains (71b), and Knobs-Norman Upland (71c). No other service area is co-dominated by three level IV ecoregions.

Service Areas 4 and 5 are characterized by two soil extremes: sand and clay. No other service areas are co-dominated by sand and clay; therefore, Service Areas 4 and 5 are dissimilar from all other LRL service areas.

Each service area is dominated by a single physiographic class. Service Areas 3–7 and Service Area 9 are dominated by rolling uplands. Rolling uplands are defined as all moderately moist physiographic sites that are not described as dry tops, dry slopes, deep sands, other xeric, or flatwoods.

**b. Threats and Offsetting Approaches**

The land use of Service Area 5 is dominated by forest (48.25%), with almost equal amounts of forest types (Southern Interior Low Plateau Dry-Mesic Oak Forest and South-Central Interior Mesophytic). Agricultural land use (Pasture/Hay and Cultivated Cropland) comprises approximately 32% of Service Area 5. Parcel size for forested land use (average size 5.85 acres) is smaller than agricultural (22.55 acres) parcel size, with the distribution of agricultural land use concentrated in a central, north-south band; however, forested parcels are also present in this area. Impacts to waters within Service Area 5 are anticipated to occur throughout the service area but are likely to be

concentrated in the central portion and associated with urban development and agriculture. Although karst features and hydric soils are also concentrated in this area, sufficient distribution of these features and associated aquatic habitat exists across the entire service area to ensure implementation of appropriate compensation within Service Area 5. Site selection criteria and review of mitigation site proposals will also facilitate effective compensation for adverse environmental impacts across the entire service area.

Water quality has been degraded by municipal effluent, agricultural discharge, and bank erosion following riparian forest removal. However, nutrient concentrations are not typically as high as in Ecoregion 71e. (Woods et al. 2002). Mixed oak forestland still exists in the area with some agriculture and rural development, primarily pastureland. The threats, however are not evenly distributed across this service area and would likely be located in central portions of the area, therefore mitigation restoration efforts should be commensurate.

**c. Historic Aquatic Resource Loss**

In the central portion of the state, (Service Areas 4-7). Water quality has been degraded by municipal effluent, agricultural discharge, and bank erosion following riparian forest removal. In some locations, concentrations of suspended sediment and nutrients can be high.

Over the past 150 years, portions of Service Area 5 have been negatively impacted by agricultural activities, damming, riparian impacts, wetland draining, stream straightening, gravel dredging, logging, poorly operating municipal and package treatment facilities of domestic wastewaters, and chemical and nutrient pollution from urban sources.

The 2006 Integrated Report to Congress on Water Quality (KDOW 2006) lists the most current water quality conditions within the Salt River Basin Management Unit. Out of 1071 river miles assessed for aquatic life use support, 406 miles (38%) are listed as impaired. The leading causes of impairment in the Salt River basin are pathogens, siltation, and nutrients. The leading sources of impairment are municipal point source discharges and urban runoff (KDOW, 2006).

**d. Status of Aquatic Resource Conditions**

The extensive plains of Service Area 5 include dissected uplands, knobs, a few deeply incised master streams, and large areas of karst. Local relief and drainage density are less than in higher, cooler, and wetter ecoregions to the east. Physiographic patterns strongly reflect geology. The area is underlain by Mississippian-age through Ordovician-age limestone, calcareous shale, sandstone, siltstone, and shale. It is lithologically unlike

the unconsolidated coastal plain sediments of bordering ecoregions. Alfisols are common on limestone plains and support a potential natural vegetation of oak–hickory forest and bluestem prairie; both soils and potential natural vegetation contrast with the Ultisols, Inceptisols, and mixed mesophytic forests of ecoregions to the east. Stream morphology is highly variable and both high gradient streams with boulder or cobble substrates and low gradient streams with sand or gravel bottoms occur. Stream nutrient and alkalinity levels are usually higher than in eastern ecoregions. Within the area, elements of the fish assemblages in the Green and Cumberland river basins are distinct from those in the Kentucky, Salt, and Licking basins (Woods et al. 2002).

**e. Aquatic Resource Goals and Objectives**

Projects will be identified in part by coordinating with the Division of Water and using their priority watershed efforts that rank impaired streams by severity and public and agency interest and funding. KDFWR staff will communicate with watershed coordinators, and at times participate in the watershed meetings, to receive recommendations and offer input on realistic expectations from the in-lieu program. One positive aspect of a mitigation project in a priority water would be that if the mitigation addresses the source of the impairment, the stream could be removed from the 303(d) list without resources being expended on developing a TMDL.

Another potential source of projects that will be investigated in each Service Area is public lands, including KDFWR Wildlife Management Areas and U.S. Army Corps of Engineers holdings around major reservoirs. Enhancing and rehabilitating impaired streams on public land is highly desirable because these areas generally have protected watershed and are accessible to and viewed by the public.

In addition to the statewide priorities, mitigation projects in Service Area 5 will be prioritized as follows:

- i. Comprehensive Wildlife Conservation Strategy
  1. Priority will be given to projects that contribute to aquatic species and target HUCs identified in KDFWR’s CWCS (KDFWR 2005). Working in areas that improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for federally listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.
- ii. Imperiled, unique species and Special Use Waters

1. Priority will be given to projects that can improve habitat for endemic or imperiled aquatic or wetland species (state or federally listed threatened, endangered) or streams recognized for special use and high species diversity.
- iii. Cost-effective mitigation
    1. Mitigation work will be focused on projects with the largest ecological lift for the least cost
  - iv. Preservation of high quality WOUS
    1. Preservation of high quality streams and wetlands will be a priority in these Service Areas due to the paucity of such waters and development threats from Louisville and anticipated threats in the basin.
    2. Special consideration will be given to high quality streams that are already in public ownership or adjacent to other mitigation projects.
    3. Existing high-quality streams that will be considered for preservation opportunities.
  - v. Impaired waters
    1. Proximity to streams or waters identified as impaired by KDOW where the mitigation project can address the causes of impairment.

## **XVI. Service Area 6**

### **a. Geographic Location**

As with the other service areas in the USACE 2019 document, a resource-based rationale was utilized for the service area delineation including the elements listed in USACE 2019 and Section I of this document, with further refinement. Specifically, to Service Area 6, the following is unique:

This service area is in the northern portion of the state and encompasses an area of approximately 5,402 square miles. It includes portions of the Outer Bluegrass, Knobs-Norman Upland, and Hills of the Bluegrass Level IV Ecoregions; Interior Plateau Level III Ecoregion; Outer Bluegrass, Inner Bluegrass, and the Knobs physiographic region; and Bluegrass bioregion within the following seven 8-digit HUCs: Silver-Little Kentucky, Salt, South Fork Licking, Middle Ohio -Laughery, Ohio Brush - Whiteoak, Lower Kentucky, and Licking (USACE 2019).

Service Area 6 includes portions or entirety of the following counties:

- Anderson
- Bath
- Boone
- Bracken
- Bullitt
- Campbell
- Carroll
- Fleming
- Franklin
- Gallatin
- Grant
- Harrison
- Henry
- Jefferson
- Kenton
- Lewis
- Mason
- Montgomery
- Nelson
- Nicholas
- Oldham
- Owen
- Pendleton
- Robertson
- Scott
- Shelby
- Spencer
- Trimble

The boundary between Service Areas 6 and 7 was determined principally by physiographic region, and secondarily by karst geology. Service Area 6 is mostly characterized by the Outer Bluegrass Physiographic Region and Service Area 7 principally by the Inner Bluegrass Physiographic Region. The Bluegrass Bioregion is only found within Service Areas 6 and 7; therefore, this bioregion distinguishes these two service areas from all other LRL service areas. Service Area 6 is exclusively characterized by two level IV ecoregions: the Outer Bluegrass (71d), and Hills of the Bluegrass (71k) (USACE 2019).

Four of the seven LRL service areas (Service Area 3, 6, 9 and 10) are dominated by a single percent slope quantile. Service Area 6 is the only service area dominated by moderate (5.6-11.17%) slopes (USACE 2019).

Service Areas 3, 6, 7, 9 and 10 are generally characterized by a single extreme soil texture. Service Areas 6 and 7 are principally characterized by soils with high clay content. These are the only service areas dominated by clay; therefore, high clay content separated these two service areas from all others. The pattern of distribution of high clay content soils is a factor in delineating Service Area 6 and 7.

Each service area was dominated by a single physiographic class. Service Areas 3–7 and Service Area 9 were dominated by rolling uplands. Rolling uplands are defined as all moderately moist physiographic sites that are not described as dry tops, dry slopes, deep sands, other xeric, or flatwoods.

**b. Threats and Offsetting Approaches**

Primary threats to Service Area 6 include urban development and agriculture.

Four service areas (Service Areas 4, 5, 6 and 7) contained small regions of high average percent slope (11.17% or greater, also see Parola et al. 2007). Impacts in these four

service areas include agriculture, oil and gas extraction, and residential and commercial developments. Many of these activities typically do not require mitigation (e.g. oil and gas, agriculture) or the impacts do not occur on steep slopes due to construction constraints. It is also unlikely that mitigation will occur in these steeply sloped HUCs within Service Areas 4, 5, 6 and 7 due to mitigation site selection criteria and case-specific evaluation of mitigation site proposals.

The economic viability of Service Areas 4, 5, 6, and 7 was considered in the context of population growth patterns. As of 2017, Kentucky's population was 4,454,189 (U.S. Census Bureau, "Population Estimates: Kentucky, July 2017"). Kentucky is mostly rural, with the majority of the population concentrated near cities along the Ohio River and its major tributaries. Most Kentucky counties are losing population, except in counties surrounding the major metropolitan areas, which are gaining population (USACE 2019).

Service Areas 6 and 7 contain most of the urban/suburban development. This region, referred to as "The Golden Triangle" (Tenkotte and Claypool, 698), contains the three major metropolitan areas: Louisville, Lexington and the northern Kentucky region. This is the region with the highest relative population increases. The counties exhibiting the highest relative population increase in Kentucky are found in Service Area 6. Service Area 7 has slightly lower relative rate of population increase; however, both areas have high historic permit demand and are anticipated to retain that high demand in the future. Thus, these two service areas are economically viable.

**c. Historic Aquatic Resource Loss**

According to Paorla et al. 2007, by the 1850's more than 80% of the Bluegrass Bioregion (Service Areas 6 and 7) was in farms, 59% of which was classified as improved (under cultivation).

In the central portion of the state, (Service Areas 4-7). Water quality has been degraded by municipal effluent, agricultural discharge, and bank erosion following riparian forest removal. In some locations, concentrations of suspended sediment and nutrients can be high.

**d. Status of Aquatic Resource Conditions**

The rolling to hilly Outer Bluegrass contains sinkholes, springs, entrenched rivers, and intermittent and perennial streams. Local relief is variable but is usually less than in the geomorphically distinct Knobs–Norman Upland (71c). Discontinuous glacial outwash and leached, pre-Wisconsinan till deposits occur in the north from Louisville to Covington. Glacial deposits do not occur elsewhere in Kentucky. Ecoregion 71d is mostly underlain by Upper Ordovician limestone and shale. Natural soil fertility is higher than in the

shale-dominated Hills of the Bluegrass (71k). Today, pastureland and cropland are widespread and dissected areas are wooded. At the time of settlement, open savanna woodlands were found on most uplands. On less fertile, more acidic soils derived from Silurian dolomite, white oak stands occurred and had barren openings. Cane grew along streams and was especially common in the east. Distinct vegetation grew in areas underlain by glacial drift (see summary table). Upland streams have moderate to high gradients and cobble, boulder, or bedrock substrates. Mean stream density is greater than in Ecoregion 71l but less than in Ecoregion 71k. Mean summer stream temperatures are much warmer than in Ecoregions 71b, 71c, and 71e. Concentrations of suspended sediment and nutrients can be high (Woods et al. 2002).

The mostly forested Hills of the Bluegrass ecoregion is underlain by Upper Ordovician calcareous shale, siltstone, and limestone. It is lithologically unlike the Knobs–Norman Upland (71c), Outer Bluegrass (71d), and Inner Bluegrass (71l). Upland soils are fairly high in phosphorus, potassium, and lime but are not as naturally fertile as Ecoregions 71d and 71l; they support young, mixed forests rich in white oak, hickory, and cedar. The Hills of the Bluegrass (71k) has steeper terrain, droughtier soils, lower soil fertility, higher drainage density, and is more erosionprone than Ecoregions 71d and 71l. As a result, less than ten percent of Ecoregion 71k is suited to row crop agriculture and the rest is wooded, pastureland, or hayland. Stream nutrient levels are generally lower than in Ecoregions 71d and 71l. Upland streams are often intermittent and have cobble, boulder, or bedrock substrates. Gradients are steeper than in Ecoregion 71l. Fish and macroinvertebrate assemblages are similar to Ecoregions 71d and 71l but have elements that are distinct from Ecoregion 71c (Woods et al. 2002).

**e. Aquatic Resource Goals and Objectives**

Projects to mitigate for these types of impacts will be identified in part by coordinating with the KDOW and their priority watershed efforts that rank impaired streams by severity, public and agency interest, and funding. KDFWR staff will communicate with watershed coordinators, and at times participate in the watershed meetings, to receive recommendations and offer input on realistic expectations from the Mitigation Program. One positive aspect of a mitigation project in a priority water would be that if the mitigation addresses the source of the impairment, the stream could be removed from the 303(d) list without resources being expended on developing a TMDL.

Another potential source of projects that will be investigated in each Service Area is public lands, including KDFWR Wildlife Management Areas and U.S. Army Corps of Engineers holdings around major reservoirs. Because these areas are accessible to and viewed by the public, enhancing and rehabilitating impaired streams on public land is highly desirable.

In addition to the statewide priorities, mitigation projects in Service Area 6 will be prioritized as follows:

- i. Comprehensive Wildlife Conservation Strategy
  1. Priority will be given to projects that contribute to aquatic species and target HUCs identified in KDFWR's CWCS (KDFWR 2005). Working in areas that improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for federally listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.
  
- ii. Imperiled, unique species and Special Use Waters
  1. Priority will be given to projects that can improve habitat for endemic or imperiled aquatic or wetland species (state or federally listed threatened, endangered) or streams recognized for special use and high species diversity.
  
- iii. Cost-effective mitigation
  1. Mitigation work will be focused on with a largest ecological lift for the least cost
  
- iv. Preservation of high quality WOUS
  1. Preservation of high quality streams and wetlands will be a priority in these Service Areas due to the paucity of such waters in the Upper Kentucky River Area and threats that exist in both the Upper & Lower Kentucky River Areas.
  2. Special consideration will be given to high quality streams that are already in public ownership or adjacent to other mitigation projects.
  3. Existing high quality streams that will be considered for preservation opportunities.
  
- v. Impaired waters
  1. Proximity to streams or waters identified as impaired by KDOW where the mitigation project can address the causes of impairment.

## XVII. Service Area 7

### a. Geographic Location

As with the other service areas in the USACE 2019 document, a resource-based rationale for the service area delineation was utilized, including the elements listed in USACE 2019 and Section I of this document, with further refinement. Specifically, to Service Area 7, the following is unique:

Service Area 7 is in the central portion of the state and encompasses approximately 3,720 square miles. It includes portions of Inner Bluegrass, Outer Bluegrass, Knobs-Norman Upland, and Hills of Bluegrass Level IV Ecoregions; Interior Plateau Level III Ecoregion; Knobs, Inner Bluegrass and Outer Bluegrass physiographic regions; Bluegrass bioregion within the following five 8- digit HUCs: Upper Kentucky, South Fork Licking, Lower Kentucky, Rolling Fork and Salt (USACE 2019).

Service Area 7 includes portions or entirety of the following counties:

- Anderson
- Bath
- Bourbon
- Boyle
- Casey
- Clark
- Estill
- Fayette
- Franklin
- Garrard
- Harrison
- Jessamine
- Lincoln
- Madison
- Marion
- Mercer
- Montgomery
- Nelson
- Nicholas
- Powell
- Rockcastle
- Scott
- Washington
- Woodford

The boundary between Service Areas 6 and 7 was determined principally by physiographic region, and secondarily by karst geology (USACE 2019). Service Area 6 is mostly characterized by the Outer Bluegrass Physiographic Region and Service Area 7 principally by the Inner Bluegrass Physiographic Region. Karst features, which are formed from eroded limestone, can result in inter-basin water transfer (affecting hydrology/water budgets), affect surface water chemistry (e.g., specific conductance, pH, etc.) and stream temperature. Karst features can affect the distribution of aquatic resources within areas where they are found. Therefore, Service Area 7 was expanded beyond the Inner Bluegrass Physiographic Region to encompass most of the karst area (USACE 2019).

The Bluegrass Bioregion is only found within Service Areas 6 and 7; therefore, this bioregion distinguishes these two service areas from all other LRL service areas.

Service Area 7 contains portions of three ecoregions: the Outer Bluegrass (71d), Hills of the Bluegrass (71k), and Inner Bluegrass (71l) ecoregion. Although this service area contains 71d and 71k, it is separated from Service Area 6 by the presence of 71l. Service

Area 7 is principally characterized by the Inner Bluegrass (711) ecoregion and no other service area contains 711.

Service Areas 4, 5, and 7 have co-dominant percent slope quantiles, differentiating these service areas from Service Areas 3, 6, 9 and 10. Average percent slope could not be used to delineate Service Areas 4, 5, and 7 from each other; therefore, other factors were used. Four service areas (Service Areas 4, 5, 6 and 7) contained small regions of high average percent slope (11.17% or greater, also see Parola et al. 2007).

Service Areas 3, 6, 7, 9 and 10 are generally characterized by a single extreme soil texture. Service Areas 6 and 7 are principally characterized by soils with high clay content. These are the only service areas dominated by clay; therefore, high clay content separated these two service areas from all others. However, the distribution of high clay content soils differed in Service Area 6 and 7. Therefore, the pattern of distribution of high clay content soils is a factor in delineating Service Area 6 and 7.

Each service area was dominated by a single physiographic class. Service Areas 3–7 and Service Area 9 were dominated by rolling uplands. Rolling uplands are defined as all moderately moist physiographic sites that are not described as dry tops, dry slopes, deep sands, other xeric, or flatwoods (USACE 2019).

**b. Threats and Offsetting Approaches**

Agricultural land development and urbanization are common threats to Service Area 7. Agricultural land use is present in the eastern and central regions of Kentucky (Service Areas 3, 4, 5, 6, and 7) while the eastern region of Kentucky (Service Areas 9 and 10) are dominated by forested land use (USACE 2019). Agriculture contributes sediment, nutrients, pesticides, and pathogens to surface water; algal blooms and low concentrations of dissolved oxygen occur especially where the riparian tree canopy has been removed. Wastewater discharge and runoff downstream of urban areas release trace metals into some streams. Package waste treatment plants for small residential subdivisions often discharge into dry valleys, produce effluent-dominated streams, and have a high failure rate. The Kentucky River has some of the highest nitrite plus nitrate and phosphate concentrations in Kentucky. It has been impounded by a series of locks and dams, causing the number of pool-inhabiting fish to increase at the expense of upland habitat species. (Woods et al. 2002)

Major urban centers are present in all service areas. Service Areas 6 and 7 contain the largest urban areas while Service Area 10 the smallest. Service Areas 6 and 7 are clearly different with respect to broad land use patterns.

The economic viability of Service Areas 4, 5, 6, and 7 was considered in the context of population growth patterns. As of 2017, Kentucky's population was 4,454,189 (U.S. Census Bureau, "Population Estimates: Kentucky, July 2017"). Kentucky is mostly rural, with the majority of the population concentrated near cities along the Ohio River and its major tributaries. Most Kentucky counties are losing population, except in counties surrounding the major metropolitan areas, which are gaining population. Service Areas 6 and 7 contain most of the urban/suburban development. This region, referred to as "The Golden Triangle" (Tenkotte and Claypool 2009), contains the three major metropolitan areas: Louisville, Lexington and the northern Kentucky region. This is the region with the highest relative population increases. The counties exhibiting the highest relative population increase in Kentucky are found in Service Area 6. Service Area 7 has slightly lower relative rate of population increase; however, both areas have high historic permit demand and are anticipated to retain that high demand in the future (USACE 2019).

**c. Historic Aquatic Resource Loss**

According to Parola et al. 2007, by the 1850's more than 80% of the Bluegrass Bioregion (Service Areas 6 and 7) was in farms, 59% of which was classified as improved (under cultivation). Such land use changes have resulted in channelized streams, increased sediment and nutrient loads and removal of native riparian vegetation.

Agriculture contributes sediment, nutrients, pesticides, and pathogens to surface water; algal blooms and low concentrations of dissolved oxygen occur especially where the riparian tree canopy has been removed. Wastewater discharge and runoff downstream of urban areas release trace metals into some streams. Package waste treatment plants for small residential subdivisions often discharge into dry valleys, produce effluent-dominated streams, and have a high failure rate. The Kentucky River has some of the highest nitrite plus nitrate and phosphate concentrations in Kentucky. It has been impounded by a series of locks and dams, causing the number of pool-inhabiting fish to increase at the expense of upland habitat species (Woods et al. 2002).

In the central portion of the state, (Service Areas 4-7). Water quality has been degraded by municipal effluent, agricultural discharge, and bank erosion following riparian forest removal. In some locations, concentrations of suspended sediment and nutrients can be high.

**d. Status of Aquatic Resource Conditions**

The nearly level to rolling Inner Bluegrass (included in Service Area 7) is a weakly dissected agricultural plain containing extensive karst, intermittent streams, and expanding urban-suburban areas that originally developed near major springs. Deep,

forested gorges also occur along the Kentucky and Dix rivers. This area is characteristically underlain by Middle Ordovician Lexington Limestone and is lithologically distinct from the rest of Ecoregion 71. Very fertile Alfisols and Mollisols have developed from the residuum of underlying phosphatic limestone; natural soil fertility is greater than in Ecoregion 71k. The original open woodlands, savannas, and swamp forests have been largely replaced by agriculture and urban-suburban-industrial areas. However, deciduous forests containing eastern redcedar still occur in ravines, along the Kentucky River, and near streams. Thoroughbred horse farms, cattle grazing, tobacco, alfalfa, and hay farming are common land uses. Some upland streams are very warm and have seasonally variable flows but others, fed by major springs, are colder and have plentiful perennial flow. In either case, they have moderate to low gradients, cobble or bedrock substrates, and fish assemblages that are similar to the Outer Bluegrass (71d) and the Hills of the Bluegrass (71k). Higher gradient streams draining into the Kentucky River gorge have macroinvertebrate and fish assemblages that are more typical of the Knobs–Norman Upland (71c) than the rest of Ecoregion 71I (Woods et al. 2002).

**e. Aquatic Resource Goals and Objectives**

Projects to mitigate for these types of impacts will be identified in part by coordinating with the KDOW and their priority watershed efforts that rank impaired streams by severity, public and agency interest, and funding. KDFWR staff will communicate with watershed coordinators, and at times participate in the watershed meetings, to receive recommendations and offer input on realistic expectations from the Mitigation Program. One positive aspect of a mitigation project in a priority water would be that if the mitigation addresses the source of the impairment, the stream could be removed from the 303(d) list without resources being expended on developing a TMDL.

Another potential source of projects that will be investigated in each Service Area is public lands, including KDFWR Wildlife Management Areas and U.S. Army Corps of Engineers holdings around major reservoirs. Because these areas are accessible to and viewed by the public, enhancing and rehabilitating impaired streams on public land is highly desirable.

In addition to the statewide priorities, mitigation projects in the Upper and Lower Kentucky River Areas will be prioritized as follows:

- i. Comprehensive Wildlife Conservation Strategy
  1. Priority will be given to projects that contribute to aquatic species and target HUCs identified in KDFWR's CWCS (KDFWR 2005). Working in areas that improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas

that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for federally listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.

- ii. Imperiled, unique species and Special Use Waters
  - 1. Priority will be given to projects that can improve habitat for endemic or imperiled aquatic or wetland species (state or federally listed threatened, endangered) or streams recognized for special use and high species diversity.
- iii. Cost-effective mitigation
  - 1. Mitigation work will be focused on with a largest ecological lift for the least cost
- iv. Preservation of high quality WOUS
  - 1. Preservation of high quality streams and wetlands will be a priority in this Service Area.
  - 2. Special consideration will be given to high quality streams that are already in public ownership or adjacent to other mitigation projects.
  - 3. Existing high quality streams that will be considered for preservation opportunities.
- v. Impaired waters
  - 1. Proximity to streams or waters identified as impaired by KDOW where the mitigation project can address the causes of impairment.

## **XVIII. Service Area 8**

### **a. Geographic Location**

Service Area 8 is in the southeast portion of the state and encompasses an area of approximately 3,517 square miles. The area includes portions of the Mountain Bioregion, Eastern Coalfield and Cumberland Escarpment Physiographic regions, Southwestern Appalachians and Central Appalachians Level III Ecoregions and Plateau Escarpment, Cumberland Plateau, Dissected Appalachian Plateau, and Cumberland Mountain Thrust Block Level IV Ecoregions.

It includes portions or entirety of the following counties:

- Bell
- Clay
- Clinton
- Harlan
- Jackson
- Knox
- Laurel
- Letcher
- Madison
- McCreary
- Pulaski
- Rockcastle
- Wayne
- Whitley

The Southwest and Central Appalachian Level III Ecoregions, thus composed of low mountains, hills, and intervening valleys, primarily characterize Service Area 8. A deeply incised escarpment divides Ecoregion 68 from the Interior Plateau (71) to the west. In Kentucky, Ecoregion 68 drains to the Cumberland River and contains fish and mollusk species that are not found in the Kentucky River tributaries of Ecoregions 69 or 70. Moderate to high gradient streams are common and have cobble- or boulder-dominated substrates. Low gradient streams also occur and have gravelly or sandy bottoms. Potential natural vegetation is mapped as mixed mesophytic forest; it contrasts with the oak–hickory forest of Ecoregion 71. Mixed mesophytic forests of varying composition grow on cool, moist north- and east-facing slopes and in coves. Mixed oak forests are common on drier sites including upper slopes and on south- and west-facing middle and lower slopes. Well-drained, acidic Ultisols are common on uplands and have less natural fertility than the base-rich soils of the Interior Plateau (71). Today, forests are widespread. Forest age and composition are variable and reflect logging, fire, and grazing histories. Pastureland and limited areas of cropland also occur. Overall, Ecoregion 68 is much less dominated by agriculture than Ecoregion 71 and nutrient concentrations in streams are correspondingly lower. Coal mining occurs and is responsible for the siltation and acidification of many stream segments.

The dissected, forested hills and mountains of Ecoregion 69 are typically underlain by flat-lying, Pennsylvanian sandstone, shale, siltstone, conglomerate, and coal. Ecoregion 69 is higher, cooler, steeper, more rugged, and more densely forested than the Western Allegheny Plateau (70) and the Interior Plateau (71). Its potential natural vegetation is mixed mesophytic forest and contrasts with the oak–hickory forest of Ecoregion 71. Like in Ecoregion 68, mixed mesophytic forests grow on cool, moist north- and east-facing slopes and in coves; mixed oak forests are common on drier sites including upper slopes and south- and west-facing middle and lower slopes. White oak forests are also common and red maple is widespread, especially in secondary forests and on sites formerly occupied by American chestnut. Rugged terrain, cool temperatures, and nutrient-poor soils sharply limit agricultural potential. Surface and underground bituminous coal mines are common. Surface mines have reshaped ridges and hollows and are responsible for the siltation and acidification of many streams. Upland soils are derived from residuum and colluvium and are mostly Ultisols and Inceptisols which contrast with the Alfisols that dominate most of

Ecoregion 71. Streams have moderate to high gradients and cobble or boulder substrates. They have low nutrient and ionic concentrations. Elements of the fish and mussel assemblages in the Kentucky River tributaries of Ecoregion 69 are distinct from those in the Cumberland River tributaries of Ecoregion 68.

**b. Threats and Offsetting Approaches**

Logging, coal mining, and livestock grazing are common and limited cropland occurs on broader ridge tops and in valleys. Cleared land, as a percentage of the total, is greater than in more rugged Ecoregions 68c and 69d but less than in Ecoregion 70f. Acidic drainage and sedimentation from coal mining have decreased the biological productivity of many streams. As a result of sedimentation, streams are generally more turbid than in Ecoregion 68c

Pastureland and limited areas of cropland also occur. Overall, Ecoregion 68 is much less dominated by agriculture than Ecoregion 71 and nutrient concentrations in streams are correspondingly lower.

Sedimentation from coal mines, coal washing, and logging as well as acidic mine drainage have decreased the biological integrity and productivity of surface waters. Small streams are common and have high gradients, waterfalls, many riffles, few pools, and cobble or boulder substrates. Nutrient and alkalinity levels are lower, thermal regimes are cooler, and fish populations are less diverse than in Ecoregion 69

**c. Historic Aquatic Resource Loss**

In the eastern portion of the state (proposed Service Areas 8, 9, 10) historic impacts include logging, fire and grazing with some areas of pastureland and cropland, however agriculture impacts are less common than other areas in the state. Coal mining occurred and is responsible for siltation and acidification of many stream segments.

**d. Status of Aquatic Resource Conditions**

Characteristic features of this service areas are composed of low mountains, hills, and intervening valleys. Streams in Service Area 8 primarily drain to the Cumberland River and contains fish and mollusk species that are not found in the Kentucky River tributaries of bordering Ecoregions 69 or 70. Moderate to high gradient streams are common and have cobble or boulder-dominated substrates. Low gradient streams also occur and have gravelly or sandy bottoms. Potential natural vegetation is mapped as mixed mesophytic forest. Mixed mesophytic forests of varying composition grow on cool, moist north- and east-facing slopes and in coves. Mixed oak forests are common on drier sites including upper slopes and on south- and west-facing middle and lower

slopes. Well-drained, acidic Ultisols are common on uplands and have less natural fertility than the base-rich soils of the Interior Plateau (71). Today, forests are widespread.

**e. Aquatic Resource Goals and Objectives**

The objective of compensatory mitigation site selection in the Cumberland River Basin is to improve the quality and quantity of aquatic resources through strategic selection of sites, compensation for permanent losses, and preservation of unique aquatic resources in exceptional circumstances.

The CWCS indicated that the 8-digit HUCs 05130101 (Upper Cumberland), 05130102 (Rockcastle River), 05130103 (Buck Creek), 05130104 (South Fork of Cumberland) were priority conservation areas based on presence and ranking of aquatic SGCN.

Mitigation projects will be identified in part by coordinating with the Division of Water and their priority watershed efforts that rank impaired streams by severity and public and agency interest and funding. KDFWR staff will communicate with watershed coordinators, and at times participate in the watershed meetings, to receive recommendations and offer input on realistic expectations from the in-lieu program. One positive aspect of a mitigation project in a priority water would be that if the mitigation addresses the source of the impairment, the stream could be removed from the 303(d) list without resources being expended on developing a TMDL.

Another potential source of projects that will be investigated in each Service Area is public lands, including KDFWR Wildlife Management Areas and U.S. Army Corps of Engineers holdings around major reservoirs. Enhancing and rehabilitating impaired streams on public land is highly desirable because these areas generally have protected watershed and are accessible to and viewed by the public,

In addition to statewide mitigation priorities, mitigation projects in the Upper and Lower Cumberland River Areas will be prioritized as follows:

**i. Comprehensive Wildlife Conservation Strategy**

1. The Cumberland River and its tributaries harbor several imperiled aquatic or wetland species, both state and federally listed. Priority will be given to projects that are within or influenced by targeted HUCs identified in KDFWR's CWCS (KDFWR 2005) with preference given to the HUCs based on ranking. Working in areas that improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for

federally listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.

- ii. Imperiled, unique species and Special Use Waters
  1. Priority will be given to projects that can improve habitat for endemic or imperiled aquatic or wetland species (state or threatened, endangered) or streams recognized for special use and high species diversity.
- iii. Public lands
  1. Mitigation projects will be targeted within or adjacent to public lands, including state lands, KDFWR Wildlife Management Areas, U.S. Forest Service lands, and other areas. These areas offer watershed protection increasing the likelihood of success and long term protection.
- iv. Cost-effective mitigation
  1. Mitigation work will be focused on projects that:
    - provide the largest ecological lift for the least cost
    - compliment other habitat related projects in the river basin
- v. Preservation of high quality WOUS
  1. Special consideration will be given to high quality streams that are adjacent to other mitigation projects.
  2. Existing high quality streams that will be considered for preservation opportunities include those in the following geographic areas:
  3. Special Use Waters identified by the KYEPC-DOW in water quality standards regulations 401 KAR 10:026 and 10:030 and additional streams recently identified that indicate exceptional water quality and aquatic fauna
  4. HUC's that harbor or contribute to CWCS conservation areas and species (KDFWR 2005)
  5. HUC's that harbor or contribute to federally listed threatened or endangered aquatic or wetland species

## **XIX. Service Area 9**

### **a. Geographic Location**

As with the other service areas in the USACE 2019 document, a resource-based rationale for the service area delineation was utilized including the elements listed in

USACE 2019 and Section I of this document, with further refinement. Specifically, to Service Area 9, the following is unique:

Service Area 9 is in the northeastern portion of the state and encompasses approximately 3,764 square miles.

The area includes portions of the Knobs-Lower Scioto Dissected Plateau, Dissected Appalachian Plateau, Carter Hills, Ohio/Kentucky Carboniferous Plateau, Northern Forested Plateau Escarpment, and Monongahela Transition Zone Level IV Ecoregions; Western Allegheny Plateau Level III Ecoregion; Eastern Kentucky Coalfield and Eastern Pennyroyal, and Knobs physiographic regions; and Mountain bioregion within the following nine, 8-digit HUCs: Little Scioto-Tygarts, Little Sandy, Big Sandy, Licking, Upper Kentucky, Lower Kentucky, North Fork Kentucky, Ohio Brush-White oak, Monongahela Transition Zone and Lower Levisa (USACE 2019).

Service Area 9 includes portions or entirety of the following counties:

- Boyd
- Carter
- Elliot
- Estill
- Greenup
- Jackson
- Johnson
- Lawrence
- Lee
- Lewis
- Madison
- Magoffin
- Menifee
- Morgan
- Owsley
- Powell
- Wolfe

The Eastern Kentucky Stream Assessment Protocol (EKSAP) is utilized for impact and mitigation assessment in Eastern Kentucky. The line separates Service Areas 8 and 9 from Service Areas 2, 6, and 7. The EKSAP is applicable in the following level IV ecoregions: 68a and c; 69d and e; 70b, d, f, g and h (USACE 2019).

Service Areas 9 and 10 are characterized by the Eastern Coalfield Physiographic Region and the Mountains Bioregion.

This bioregion is only found in these two service areas. Therefore, the Mountains Bioregion distinguishes Service Areas 9 and 10 from all other service areas; however, it does not separate Service Area 9 from 10. Thus, other data were used to define the boundaries between Service Areas 9 and 10 (USACE 2019).

Service Area 9 consists of a mosaic of five level IV ecoregions: Monongahela Transition Zone (70b), Knobs-Lower Scioto Dissected Plateau (70d), Ohio/Kentucky Carboniferous Plateau (70f), Northern Forested Plateau Escarpment (70g), and Carter Hills (70h). These five ecoregions are only found in Service Area 9.

The Service area boundaries were initially defined using a combination of level IV ecoregions and 12-digit HUCs. Generally, the service areas in eastern Kentucky (Service Areas 9 and 10) follow a level IV ecoregion line. The boundary between Service Area 6 and 9 and between 7 and 9 also adhere to the ecoregion line. Use of the level IV ecoregion in these areas is consistent with the EKSAP area. All other service area boundaries used a combination of level IV ecoregion line and 12-digit HUC, with the HUC-12 forming the service area boundary when the level IV ecoregion and HUC-12 boundary were adjacent.

Four of the seven LRL service areas (Service Area 3, 6, 9 and 10) are dominated by a single percent slope quantile. Service Areas 9 and 10 were principally characterized by steep sloped HUCs (11.17-29.19%) and were the only service areas dominated by steep slopes. Therefore, average percent slope, expressed by 12-digit HUC, differentiated Service Areas 9 and 10 from all other service areas but did not separate Service Area 9 from 10. However, other data used in the delineation analysis did support the separation of this region into two service areas.

Service Areas 3, 6, 7, 9 and 10 are generally characterized by a single extreme soil texture. Service Areas 9 and 10 are the only service areas dominated by sand.

Service Area 9 is dominated by rolling uplands (44.5%); however, it has a large percentage (29.5%) of moist slopes and coves. Moist slopes and coves contain relatively deep, fertile soils that often have a northern or eastern exposure and are partially shielded from wind and sun and includes moist mountaintops and saddles (US Forest Service, 2016).

**b. Threats and Offsetting Approaches**

Oil and gas extraction are common threats within Service Area 9. Service Area 9 is dominated by forested (69.76%) land use. The average parcel size for all forest types is 6.2 acres. Agriculture (hay/pasture) makes up 10.93% of Service Area 9's land use. These parcels are, on average, 4.7 acres. The dominance of a single ecologically based land use type supports the retention of Service Area 9 boundaries as this facilitates the implementation of appropriate compensation across the entire service area.

Therefore, Service Area 9 should be targeted for preservation activities to reduce this risk. Service Area 10, which has the highest vulnerability should be targeted for preservation and restoration activities.

Future threats to Service Area 9 include urban growth, road construction, channel alteration from agriculture, urbanization, road construction, logging and coal mining. The majority of in-lieu fees from the Licking River area have been generated from valley

fills for road construction. Future mining in the upper portion of the basin will continue to be a potential threat.

**c. Historic Aquatic Resource Loss**

In the eastern portion of the state (proposed Service Areas 8, 9, 10) historic impacts include logging, fire and grazing with some areas of pastureland and cropland, however agriculture impacts are less common than other areas in the state. Coal mining occurred and is responsible for siltation and acidification of many stream segments.

Primary land uses are logging, livestock farming, general farming, and, in contrast to the Interior Plateau (71), surface and underground coal mining. Nutrient and alkalinity levels are higher than in Ecoregions 68 and 69 but are lower than in carbonate-dominated, agriculturally intensive, and highly populated portions of Ecoregion 71. Bituminous coal mining has caused the sedimentation and acidification of many surface water bodies. Logging, oil well brines, agricultural practices, and sewage discharges have further degraded surface water quality in Ecoregion 70. Water quality in many stream reaches has been degraded by underground and surface coal mining, logging, agriculture, and oil production

Region varies in amount of cleared land, but most of region has underlying coal extraction impacts.

**d. Status of Aquatic Resource Conditions**

Characteristics of Service Area 9 include unglaciated, mostly forested, and underlain by horizontally bedded, often carboniferous, sedimentary rock. Its hills and ridges are more rugged than the limestone plains of Ecoregion 71 to the west or the glaciated, till-covered plains of Ecoregion 55 to the north. Maximum elevations and local relief are lower than in the Central Appalachians (69). Streams are typically cool and have moderate to high gradients. Riffles have cobble or boulder substrates. Some fish and mussel species in the Kentucky, Licking, and Little Sandy drainage basins are distinct from those found further south in the Cumberland River system of Ecoregion 68. Potential natural vegetation is mixed mesophytic forest; it contrasts with the oak–hickory forest of Ecoregion 71 and the less diverse beech forest of Ecoregion 55. Today, Ecoregion 70 remains mostly forested. Primary land uses are logging, livestock farming, general farming, and, in contrast to the Interior Plateau (71), surface and underground coal mining. Nutrient and alkalinity levels are higher than in Ecoregions 68 and 69 but are lower than in carbonate-dominated, agriculturally intensive, and highly populated portions of Ecoregion 71. Bituminous coal mining has caused the sedimentation and acidification of many surface water bodies. Logging, oil well brines, agricultural

practices, and sewage discharges have further degraded surface water quality in Ecoregion 70 (Woods et al. 2002).

**e. Aquatic Resource Goals and Objectives**

Special Use Waters in the Licking Basin Area (portions of Service Area 9 are designated in parts of 27 streams in 16 counties (401 KAR10:026 and 10:030)). Many of the Special Use Waters are located in the northern portion of the Daniel Boone National Forest in Rowan, Morgan, Bath, and Menifee counties. Some of the special use waters were noted as being in good condition in older fisheries reports (Carter 1951, Jones 1970): Blackwater Creek (Morgan County), Grassy Creek (Pendleton County), and Slate Creek (Montgomery and Bath Counties).

The Licking River harbors several imperiled aquatic or wetland species, both state and federally listed. Priority will be given to projects that are associated with targeted aquatic species and HUCs identified in the CWCS. Working in areas that improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for federally listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.

**i. Comprehensive Wildlife Conservation Strategy**

1. Priority will be given to projects that contribute to aquatic species and target HUCs identified in KDFWR's CWCS (KDFWR 2005). Working in areas that improve conditions for federally listed aquatic or wetland species will promote endangered species recovery. Working in areas that benefit SGCN will help preserve or restore aquatic faunal diversity helping to preclude the need for federally listing these species under the Endangered Species Act. These priority areas serve as indicators of remaining high quality areas within a watershed. Mitigation in these areas helps maintain aquatic ecosystem viability within a watershed.

**ii. Imperiled, unique species and Special Use Waters**

1. Priority will be given to projects that can improve habitat for endemic or imperiled aquatic or wetland species (state or federally listed threatened, endangered) or streams recognized for special use and high species diversity.

- iii. Cost-effective mitigation
  - 1. Mitigation work will be focused on with a largest ecological lift for the least cost
  
- iv. Preservation of high quality WOUS
  - 1. Preservation of high quality streams and wetlands will be a priority in this Service Area.
  - 2. Special consideration will be given to high quality streams that are already in public ownership or adjacent to other mitigation projects.
  - 3. Existing high quality streams that will be considered for preservation opportunities.
  
- v. Impaired waters
  - 1. Proximity to streams or waters identified as impaired by KDOW where the mitigation project can address the causes of impairment.

**XX. Service Area 10**

**a. Geographic Location**

As with the other service areas in the USACE 2019 document, a resource-based rationale for the service area delineation was utilized including the elements listed in USACE 2019 and Section I of this document, with further refinement. Specifically, to Service Area 10, the following is unique:

Service Area 10 is in the southeastern portion of the state and encompasses approximately 4,867 square miles.

The area includes portion of the Dissected Appalachian Plateau, Cumberland Plateau, and Ohio/Kentucky Carboniferous Level IV Ecoregion; Central Appalachians Level III

Ecoregions; Eastern Kentucky Coalfield physiographic region; and Mountain bioregion within the following nine, 8-digit HUCs: Big Sandy, Tug, Lower Levisa, Upper Levisa, Licking, North Fork, Middle Fork and South Fork Kentucky.

Service Area 10 includes portions or entirety of the following counties:

- Bell
- Breathitt
- Clay
- Floyd
- Harlan
- Jackson
- Johnson
- Knott
- Knox
- Lawrence
- Lee
- Leslie
- Letcher
- Magoffin
- Martin
- Morgan
- Owsley
- Perry
- Pike
- Wolfe

Service Areas 9 and 10 are characterized by the Eastern Coalfield Physiographic Region and the Mountains Bioregion. This bioregion is only found in these two service areas. Therefore, the Mountains Bioregion distinguishes Service Areas 9 and 10 from all other service areas; however, it does not separate Service Area 9 from 10. Thus, other data were used to define the boundaries between Service Areas 9 and 10. Unique to Service Area 10 is a single level IV ecoregion, the Dissected Appalachian Plateau (69d; USACE 2019).

Four of the seven LRL service areas (Service Area 3, 6, 9 and 10) are dominated by a single percent slope quantile. Service Areas 9 and 10 are principally characterized by steep sloped HUCs (11.17-29.19%) and were the only service areas dominated by steep slopes. Therefore, average percent slope, expressed by 12-digit HUC, differentiated Service Areas 9 and 10 from all other service areas but did not separate Service Area 9 from 10. However, other data used in the delineation analysis did support the separation of this region into two service areas (USACE 2019).

Service Areas 3, 6, 7, 9 and 10 are generally characterized by a single extreme soil texture. Service Areas 9 and 10 are the only service areas dominated by sand. However, high sand content could not be used to discern the boundary between Service Area 9 and 10 (USACE 2019).

Service area 10 is uniquely characterized by Physiographic Class, as it is the only service area dominated by moist slopes and coves (USACE 2019).

**b. Threats and Offsetting Approaches**

This area corresponds to the coal extraction region. Due to the general inability to implement site protection instruments within the coal extraction region, compensation will generally occur in the western portion of Service Area 10.

Service Area 10 is dominated (74%) by a single, ecologically-based, land use, the Allegheny-Cumberland Dry Oak Forest and Woodland – Hardwood. Two other land use types, Disturbed/Successional - Grass/Forb Regeneration (8%) and South-Central Interior Mesophytic Forest (6.8%), together contribute approximately 15% of the land use of Service Area 10. The average size of the Allegheny-Cumberland Dry Oak Forest and Woodland – Hardwood areas is 61 acres, indicating that these land use areas are relatively large tracts of land. Additionally, when all forest land use types are combined, approximately 81% of the total land use within this service area is forested. Because of the relationship between land use and aquatic resource type and distribution, the dominance of a single land use type within Service Area 10 facilitates effective compensation for adverse environmental impact across this service area. Therefore, Service Area 9 should be targeted for preservation activities to reduce this risk. Service Area 10, which has the highest vulnerability should be targeted for preservation and restoration activities.

**c. Historic Aquatic Resource Loss**

In the eastern portion of the state (proposed Service Areas 8, 9, 10) historic impacts include logging, fire and grazing with some areas of pastureland and cropland, however agriculture impacts are less common than other areas in the state. Coal mining occurred and is responsible for siltation and acidification of many stream segments.

Ecoregion 69d is underlain by flat-lying Pennsylvanian shale, siltstone, sandstone, and coal. Surface and underground coal mining, logging, and both gas and oil production are common and have degraded surface waters. Acidic drainage and sedimentation from coal mines have decreased the biological productivity of many streams and, in some reaches, all but the most tolerant aquatic biota have been eliminated. However, gradual improvement in the control of acidic mine drainage is occurring. Nutrient levels in streams are very low and are a reflection of the ecoregion's low population density, limited agriculture, and non-carbonate rocks

**d. Status of Aquatic Resource Conditions**

The Dissected Appalachian Plateau ecoregion (unique to Service Area 9) is composed of narrow ridges, deep coves, and narrow valleys and is mostly forested. Cool, high gradient streams with cobble and boulder substrates and extensive riffles are common.

Ecoregion 69d is more rugged, more extensively forested, and has higher stream gradients than the Cumberland Plateau (68a) and the Ohio/Kentucky Carboniferous Plateau (70f). Forest composition is controlled by aspect, slope position, degree of topographic shading, and past usage and, thus, is highly variable. Ecoregion 69d is underlain by flat-lying Pennsylvanian shale, siltstone, sandstone, and coal. Surface and underground coal mining, logging, and both gas and oil production are common and have degraded surface waters. Acidic drainage and sedimentation from coal mines have decreased the biological productivity of many streams and, in some reaches, all but the most tolerant aquatic biota have been eliminated. However, gradual improvement in the control of acidic mine drainage is occurring. Nutrient levels in streams are very low and are a reflection of the ecoregion's low population density, limited agriculture, and non-carbonate rocks (Woods et al. 2002).

**e. Aquatic Resource Goals and Objectives**

Sedimentation and channel alteration are common causes of stream impairment in the Big Sandy River Area. These impairments cause habitat loss and impact aquatic fauna. Mitigation projects will improve channel morphology and reduce sedimentation that often results from streambank erosion and channel alteration.

Projects to mitigate for these types of impacts will be identified in part by coordinating with the KDOW and their priority watershed efforts that rank impaired streams by severity, public and agency interest, and funding. KDFWR staff will communicate with watershed coordinators, and at times participate in the watershed meetings, to receive recommendations and offer input on realistic expectations from the Sponsor. One positive aspect of a mitigation project in a priority water would be that if the mitigation addresses the source of the impairment, the stream could be removed from the 303(d) list without resources being expended on developing a TMDL.

Another potential source of projects that will be investigated in each Service Area is public lands. Enhancing and rehabilitating impaired streams on public land is highly desirable because these areas are accessible to and viewed by the public and easier to effect permanent protection.

Other causes of impairment are related to sewage, acid mine drainage, metals, or water chemistry problems that would threaten the success of mitigation projects. 404 mitigation projects do not usually address these impairments. In general, streams will not be considered for mitigation projects where problems such as acid mine drainage, high conductivity, chronic water quality problems, and projected or on-going land uses would threaten a mitigation project.

In addition to the statewide priorities, two major goals in Service Area 10 are to build upon existing projects to maximize watershed benefits and preserve high quality

streams and waters. KDFWR will use these goals as justification to expand existing mitigation projects in general and specifically around the few remaining high quality areas.

Mitigation projects in the Big Sandy Area will be prioritized as follows:

- i. Proximity to existing projects
  1. New mitigation projects will be focused in areas that build upon and/or benefit existing mitigation projects. Selecting projects in close proximity to existing or completed projects and other protected areas will increase the aquatic functional benefits generated by increasing the percentage of the watershed that is supporting designated uses. This also increases the amount of aquatic resources protected from future physical impacts.
- ii. Preservation of high quality WOUS
  1. Preservation of high quality streams and wetlands will be a priority in this service due to the paucity of such waters and threats in the region. Special consideration will be given to high quality streams that are already in public ownership, adjacent to other mitigation projects, identified by KDOW as high quality waters, or harbor target species identified in KDFWR's CWCS (KDFWR 2005).
- iii. Watershed based targets
  1. Proximity to waters associated with watersheds targeted for aquatic conservation in KDFWR's CWCS (KDFWR 2005).
  2. Proximity to waters with federal threatened or endangered species, and special use waters (401 KAR 5:026 and 5:030).
- iv. Cost-effective mitigation
  1. Mitigation work will be focused on areas where with a large ecological lift for the least cost.
- v. Impaired waters
  1. Proximity to streams or waters identified as impaired by KDOW where the mitigation project can address the causes of impairment.

The paucity of streams that fully support aquatic life in the Service Area 10 heightens the need to restore and preserve areas adjacent to high quality areas to augment existing aquatic "refuges" or "reserves". This is a conservation strategy that reduces effects of fragmentation, builds upon known resources, and through time may link aquatic communities with contiguous habitat. Preservation was made a priority due to the low number of documented high quality streams in the Service Area. Individual preservation projects remain subject to the approval of the Corps. Areas prioritized for

preservation will include the Special Use Waters identified by the KDOW in water quality standards regulations 401 KAR 10:026 and 10:030, any additional streams recently identified that indicated exceptional water quality and aquatic fauna, and streams harboring aquatic species identified in KDFWR's CWCS (KDFWR 2005).

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**Appendix B. Example List of Approved Compensatory Mitigation Projects**

Table 1. List of Approved Compensatory Mitigation Projects							
Table of Corps Approved Mitigation Projects: KDFWR Mitigation Program - Louisville LRL-2010-325							
PROJECT	COUNTY	SERVICE AREA	Instrument Mod. No.	404 PERMIT ID.NO.	404 PERMIT APPROVAL DATE	401 WQC ID. NO.	401 WQC APPROVAL DATE
ILF-KDFWR Elm Fork/Kleber WMA Stream Restoration Project (MOA)	Owen	Lower Kentucky River Service Area	2	LRL-2012-00263	02/12/13	2012-050-1	10/22/12
ILF-KDFWR Indian Creek Stream Restoration Project (MOA)	Menifee	Upper Kentucky River Service Area	3	LRL-2012-00273	07/09/13	2013-009-1	03/07/13
ILF-KDFWR Roger's Gap Stream Restoration Project (MOA)	Scott	Lower Kentucky River Service Area	4	LRL-2012-00134	12/04/13	2013-026-1	06/26/13
ILF-KDFWR Eagle Creek Tributaries Restoration Project (MOA & ILF-I)	Union	Green River Service Area	5	LRL-2012-00716	01/16/15	2014-18-1M	06/04/14
ILF-KDFWR Myer's Station Stream Restoration (ILF-I)	Nicholas	Lower Licking River Service Area	6	LRL-2012-00637	04/20/16	2016-004-1	01/15/16
ILF-KDFWR Old Trace Creek Restoration (ILF-I)	Lewis	Big Sandy River Service Area	7	LRL-2013-00336	02/13/17	2016-029-1	04/26/16
KDFWR ILF Instrument Full Modification (to add 9 counties/change SA)	All	9 County Region	8	LRL-2010-325		NA	
ILF-KDFWR Goose Creek Restoration (ILF-I)	Casey	Green River Service Area	9	LRL-2012-00646	03/23/17	2016-090-7	09/21/16
ILF-KDFWR Minor's Creek Restoration (ILF-I)	Owen, Franklin	Lower Kentucky River Service Area	10	LRL-2013-00091	05/22/17	2016-097-1	10/31/16
ILF-KDFWR Ross Creek Stream & Wetland Restoration Phase I & II (MOA & ILF-I)	Lee, Estill	Upper Kentucky River Service Area	11	LRL-2013-00143	10/26/17	2016-111-7R	09/25/17
ILF-KDFWR Red Oak Creek Restoration Project, Drainage C (ILF-I)	Owen	Lower Kentucky River Service Area	12	LRL-2014-00500	04/17/18	2017-091-1	12/18/17
ILF-KDFWR Big Farm Indian Creek Restoration Project (ILF-I)	Bath	Lower Licking River Service Area	13	LRL-2014-00209	05/30/19	2019-001-7	10/05/18
Table of Corps Approved Mitigation Projects: KDFWR Mitigation Program - Nashville LRN-2011-00709							
PROJECT	COUNTY	SERVICE AREA	Instrument Mod. No.	404 PERMIT ID.NO.	404 PERMIT APPROVAL DATE	401 WQC ID. NO.	401 WQC APPROVAL DATE
Sinking Valley Preservation Project	Pulaski	Upper Cumberland	2	LRN-2012-00326	12/11/2013	n/a	n/a
Hatchery Creek Restoration Project	Russell	Lower Cumberland	3	LRN-2010-00444	7/25/2014	23-041-7M(3)	7/15/2014
Blue Spring Creek Stream Restoration Project	Trigg	Lower Cumberland	4	LRN-2013-00776	4/23/2019	2015-092-1R	1/3/2019
Table of Corps Approved Mitigation Projects: KDFWR Mitigation Program - Memphis MVM-2013-95							
PROJECT	COUNTY	SERVICE AREA	Instrument Mod. No.	404 PERMIT ID.NO.	404 PERMIT APPROVAL DATE	401 WQC ID. NO.	401 WQC APPROVAL DATE
Obion II	Hickman	Jackson Purchase	1	MVM-2010-074	4/29/2014	2010-027-1	3/23/2010