6.0 Species Assessments, Impact Analysis, and Mitigation

This chapter summarizes the background, process, and results of the species assessments, including the calculation of incidental take, the impacts of that take, and the mitigation identified to compensate for the impacts of take.

It should be understood, for purposes of this chapter and for the entire MSHCP, that NiSource is committed in everything it undertakes to meet human needs while preserving the environment, now and for future generations. NiSource is on a sustainable journey which strives to resolve conflicts between competing goals in pursuing economic prosperity, environmental quality, and social equity in all NiSource does as a company. Therefore, in reviewing each enhancement to a NiSource energy facility, the "triple bottom line" concept receives due consideration and balance as decisions are made to maintain and grow its energy systems. The NiSource vision is one that establishes a legacy for sustained economic growth, social responsibility, and environmental stewardship reflective of a premier energy company.

Section 6.1 discusses the species assessment process: the purpose, approach, and content of the species-specific analysis, the information utilized in the species assessments, and the maps that are associated with the species. This section also addresses species for which the analyses determined that incidental take coverage would not be needed. Finally, this section provides a summary of the incidental take requested.

The heart of the chapter, Section 6.2, includes a discussion for each of the species for which NiSource is requesting incidental take, and for which NiSource and the Service have determined that take would be avoided through implementation of specific conservation measures. The Section begins with a description of the mitigation program, focusing on the requirements for permanent land conservation. This is followed by species-specific sub-sections, which include species introductions, a summary of the activity/threats/stressor analysis, measures to avoid and/or minimize impacts, anticipated types and amounts of incidental take, and mitigation measures.

Section 6.3 addresses critical habitat (i.e., specific geographic area or areas designated by the Service that are considered essential to a listed species' conservation).

A discussion of where species' conservation efforts overlap is included in Section 6.4. Species overlap will provide opportunities for landscape-level conservation efforts, but for some species, will also require the resolution of potentially conflicting species conservation needs (specifically conflicting AMMs suggested in overlapping species' range areas). Where possible, NiSource will attempt to coordinate and aggregate individual conservation activities on a broader geographic scale to maximize the benefits to the MSHCP species.

6.1 Species Assessment Methodology

6.1.1 Take Species Analysis

The purpose of the individual take species analysis is to document the conservation needs of each take species relative to their occurrence and distribution in and around the covered lands and to consider the impacts of the covered activities. Topics incorporated into the analysis include: background; life history (breeding, feeding and sheltering needs); planning units; effects on critical habitat; modeling; threats analysis; and biological goals and objectives.

The section on planning units was developed to address the linear nature of the MSHCP and analyzed if population segments existing within the planning area warranted separate analysis. Analysis assumptions are included throughout the discussion, with the majority of them specified in the sections regarding modeling and levels of take. Modeling was conducted for many, but not all, species analyses. Statistical habitat models were used to identify acreage of suitable habitat and, in some cases, estimate the number of individuals potentially occupying this suitable habitat within the covered lands.

6.1.2 Information Used to Perform Species Analyses

Information used for species analyses was collected from a variety of sources including natural heritage programs, the Service, state agencies, academic institutions, non-governmental organizations, and available information such as environmental documents, survey reports, and other published and unpublished documents.

The following natural heritage programs were consulted: Delaware Natural Heritage & Endangered Species Program, Indiana Department of Natural Resources, Kentucky State Nature Preserves Commission, Louisiana Natural Heritage Program, Mississippi Natural Heritage Program, New Jersey Landscape Project, New York Natural Heritage Program, Ohio Division of Natural Areas and Preserves, Pennsylvania Natural Heritage Program, Tennessee Division of Natural Areas, Virginia Department of Conservation and Recreation Natural Heritage Program, Virginia Department of Game and Inland Fisheries, and West Virginia Natural Heritage Program.

Numerous species experts were also consulted from a collection of Service offices, state agencies, academic institutions, and non-governmental organizations. The information gathered from these experts is cited in the Conservation Framework.

6.1.3 Species Maps

Species maps are included in **Appendix G**. These maps illustrate where covered activities within the covered lands may affect a particular species, and consequently, where NiSource will employ best management practices, and in some cases, additional species-specific avoidance and minimization measures.

In most cases, concerns regarding the display of location-specific, sensitive information about species preclude identification of documented occurrences. Therefore, most maps include a realistic representation of species habitats or range within the covered lands. In practice, best available data and, at times, pre-activity survey work will inform where NiSource will employ AMMs on the ground.

6.1.4 Species for Which the Covered Activities Will Have No Effect or No Adverse Impact

There are a number of species (32) that were analyzed during the development of the MSHCP for which No Effect (23) or No Adverse Impacts (nine) are anticipated. Species for which No Effect determinations were made include: Blackside dace, Braun's rock cress, Cumberland bean pearlymussel, Cumberland snubnose darter, Delmarva fox squirrel, Dromedary pearlymussel, Gulf sturgeon, Karner blue butterfly, Louisiana pearlshell, Maryland darter, Mead's milkweed, Mitchell's satyr butterfly, Pale lilliput pearlymussel, Pitcher's thistle, Puritan tiger beetle, Purple cat's paw pearlymussel, Scioto madtom, Shenandoah salamander, Slackwater darter, Tan riffleshell, West Indian manatee, White cat's paw pearlymussel, and White wartyback pearlymussel. Species for which no adverse impact determinations were made due to species-specific avoidance measures being implemented include: Birdwing pearlymussel, Cheat Mountain salamander, Cracking pearlymussel, Cumberland monkeyface pearly, Gray bat, Interior least tern, Oyster mussel, Louisiana black bear, and Virginia big-eared bat. Conservation Frameworks for these nine species are provided in **Appendix F**.

If the Service concurs with these determinations, NiSource will not request incidental take coverage for these species. The analysis and "No Effect" or "No Adverse Impact" determinations for these species were based on a number of sources, including but not limited to, initial determinations by the Service (Armstrong et al. 2007), species range and known occurrences relative to the location of the covered lands footprint, the types and anticipated impacts of covered activities, and through the development of mandatory species-specific avoidance measures.

6.1.5 Summary of Incidental Take Requested for Take Species

NiSource is requesting incidental take for 10 species (**Table 6.1.5-1**). Detailed take calculations for each of the take species is provided in Section 6.2.X.5 "Calculation of Incidental Take" for that species. As noted in the species-specific analysis, accurately predicting the number of individuals that may be taken isn't always possible. Where it is not, the MSHCP explains so and provides a rationale for the surrogate value (e.g. acres of habitat) chosen to monitor take.

Due to the nature of this MSHCP, in terms of scope of covered lands and permit duration, NiSource has not been able to predict with certainty where or when a given covered activity would occur. Thus, the species analyses rely on multiple assumptions to estimate the reasonable worst-case scenario for each species considered. Given the uncertainty of certain assumptions, it is possible that the modeling may underestimate the amount of take. To address this, Chapter 7 of the MSHCP provides adaptive management to assess the validity of assumptions, and implement specified contingencies

On the other hand, the reasonable worst case scenarios may err on the side of overestimating impacts of the covered activities on the take species. In practice, as the MSHCP is implemented, NiSource anticipates that by utilizing the "non-mandatory" avoidance and minimization measures the actual take numbers will be much less than the amount estimated. However, obtaining the take authorization and having a process to avoid, minimize, and mitigate the impact of take that does occur will provide NiSource with the flexibility it needs to be efficient in its operations, while providing a benefit to the take species through the MSHCP's landscape-level conservation approach.

Table 6.1.5-1 Summary of Incidental Take over the 50-Year Permit Duration

Species	Summary of Take Requested
Indiana bat	Incidental take is requested for no more than 69,900 acres of summer and/or spring staging/fall swarming habitat that could support up to 2,584 Indiana bat individuals.
Bog turtle	Incidental take is requested for impacts to turtles and habitat at 25 sites
Madison Cave Isopod	Incidental take is requested for two populations as represented by 2,764.5 surface acres and associated subsurface area of effect of Madison Cave Isopod habitat
Clubshell Mussel	Incidental take is requested for up to 166 acres of Clubshell habitat
Northern Riffleshell Mussel	Incidental take is requested for up to 165.3 acres of Northern Riffleshell habitat
Fanshell Mussel	Incidental take is requested for up to 283.2 acres of Fanshell habitat
James Spinymussel	Incidental take is requested for up to 12.8 acres of James Spinymussel habitat
Sheepnose Mussel	Incidental take is requested for up to 250.4 acres of Sheepnose habitat
Nashville crayfish	Incidental take is requested for up to 4.0 acres of Nashville crayfish habitat
American burying beetle	Incidental take is requested for 4 American burying beetle individuals

6.2 Species Assessments, Avoidance and Minimization Measures, Take Calculations, Impact Analysis, and Compensatory Mitigation

This section describes the species for which the MSHCP is designed, as it is anticipated that these species may be impacted by NiSource's covered activities within the covered lands. The discussion for each species includes a brief species introduction, potential impacts or threats to the species relative to the covered activities, biological goals and objectives, proposed avoidance and minimization measures, anticipated levels of take, and required mitigation.

Each species varies in the compensatory mitigation required. Mitigation packages are designed to compensate for the reasonable worst case scenario, should that amount of take be realized. Mitigation may include restoration or enhancement. It is important to note that FERC and the Army Corps of Engineers require certain restoration or enhancement of sites directly impacted by NiSource activities. As such, site restoration is included as part of NiSource's project description for various

NiSource covered activities and at times is incorporated into avoidance and minimization measures (AMMs) for individual species. In addition, for certain projects, the MSHCP contemplates mitigation activities, which may include additional enhancement on-site or the restoration, enhancement, or protection of habitat off-site, among other measures.

Certain mitigation obligations will be the same for all species. The term "protect" has a specific meaning in the MSHCP. For mitigation, habitat or land protection means the acquisition of a real property interest in perpetuity, with appropriate restrictions to conserve the species and its habitat. NiSource will choose the means of land protection, either fee acquisition with restrictions and subsequent donation to a third party conservation steward, or a conservation easement.[1]

Because the covered lands occur in portions of 14 states, and each species has different needs, it was not possible to develop a template deed or conservation easement. State laws vary with respect to the structure, purpose, content and enforceability of easements and real property conveyances. Additionally, land protection necessarily involves multiple parties. A template deed or conservation easement, though desirable for predictability, might make it difficult to negotiate acceptable terms with land owners or easement holders. These entities often prefer to use their own templates or forms.

Instead, in coordination with the Service, we have developed mandatory provisions to be included in any real property conveyance subject to the MSHCP. Appendix P of the MSHCP contains these mandatory provisions, and where appropriate, other provisions tailored to specific species, as described below. The following is a layperson's summary of **Appendix P**, which begins with mandatory provisions:

> Standard Recitals that identify the parties, applicable provisions of state law, description of property, intent to bind parties, etc.
>
> Additional Recitals describing: the relationship between the conveyance to the MSHCP, and ITP, and referencing the dates each is executed; the authority and role of the Service; the MSHCP species that is subject of the conveyance and date it is listed.
>
> The stated purpose of the easement or deed transfer, mainly the conservation of the MSHCP species and its habitat. Secondary purposes to allow the restoration or maintenance of a habitat type or other species may be permitted so long as they do not interfere with or diminish the values established for the MSHCP species.
>
> Processes for enforcement including damages, restoration, or other remedies at law.

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[1] Unless used in connection with a fee acquisition or conservation easement, deed restrictions and restricted covenants are disfavored as a land protection tool. In many states, deed restrictions or restrictive covenants are of limited duration, can be readily invalidated, and do not afford third-party beneficiary rights. Only under the most extenuating circumstances would they be considered, and then only with Service approval after consultation with the Office of the Solicitor.

Third party beneficiary rights for the Service to access the property and to enforce the terms of the conveyance.

A requirement that the conveyance be recorded in the land records of the county, parish or other jurisdiction in which the land is located.

That restrictions or easement terms are binding in perpetuity, regardless of species listing status.

A number of other provisions required by the Service, such as those dealing with: assignment, transfer, extinguishment, modification of the conveyance; interpretation and severability; and government permits and eminent domain.

All real property conveyances must include prohibitions on following uses:

Industrial Use
Residential Use
Commercial Use
Agricultural Use
Vegetative Clearing
Subdivision
Utilities (except for existing encumbrances)[2]
Littering or Dumping
Burning of Waste or Open Fires
Disposal of Hazardous Waste
Grading, Mineral Use, Excavation, Dredging
Placement of Spoils
Development Rights Extinguished

Additionally, all real property conveyances must include prohibitions on the following uses, which may be tailored to maintain or restore the values of the conservation area, or a species' needs:

Signage
Construction
Fencing
Hunting/Trapping/Collection
Pesticide, Herbicide
Pets
Mechanized vehicles/equipment

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[2] NiSource and proponents submitting mitigation proposals to the Mitigation Panel for consideration must identify existing encumbrances on properties to be acquired. Doing so will allow NiSource and the Service to determine whether existing rights-of-way or other encumbrances (e.g., mineral estates) interfere with the intended conservation values and purposes of the proposal. Assuming they do not interfere, it will be the responsibility of the third parties exercising their rights under these pre-existing interests to independently ensure compliance applicable local, state and federal laws and permits, including the ESA. Such uses, however, would not be covered activities under this MSHCP, and NiSource would therefore not responsible for the actions of third-parties. This critical evaluation of underlying encumbrances is discussed in Chapter 5 of the MSHCP, and will be further memorialized in the ITP and IA.

The grantor of the real property interest may also want to retain Reserved Uses, so long as they do not interfere with the purpose for which the conservation interest is acquired. The following reserved uses may be acceptable if properly conditioned:

Passive Recreational Use
Education al Use
Selective Vegetative Management
Restoration and Maintenance of Conservation Values

Finally, NiSource reserves the right to satisfy any land protection mitigation debt by purchasing credits in an ESA conservation bank. At this time, there are no established and operable ESA conservation banks within or adjacent to the covered lands. But to qualify in the future: 1) the conservation bank must comply with the Service's Guidance on the Establishment, Use and Operation of Conservation Banks (May 2, 2003), subsequent amendments to that document, and any subsequent Guidance on the same topic; 2) the Service must have officially approved the conservation bank; 3) the mitigation required must fall within the service area defined in the conservation bank establishment agreement; and 4) the location, duration and protections afforded by the bank lands are consistent with the mitigation requirements identified for each species in Section 6.2

6.2.1 Indiana Bat

The Indiana bat was originally listed as an endangered species by the Service in 1967. Thirteen winter hibernacula (11 caves and two mines) in six states were designated as critical habitat for the Indiana bat in 1976 (Service 1976). The Service published a recovery plan (Service 1983) outlining recovery actions, which is currently under revision (Service 2007a). The Draft Revised Recovery Plan provides the most current analyses of the best science available for the Indiana bat and thus has been relied upon heavily in developing the MSHCP. The Service proposed four Recovery Units for the species: Ozark-Central, Midwest, Appalachian Mountains, and Northeast in the Draft Revised Recovery Plan (Service 2007a).

DISTRIBUTION & RANGE-WIDE STATUS

The range of the Indiana bat extends west to the western Ozark region in eastern Oklahoma and Iowa, north and east to Michigan, New York, New England, and northern New Jersey, and south to northern Alabama and Arkansas, with accidental/non-regular occurrences outside this range. The species has disappeared from, or greatly declined, in most of its former range in the northeastern United States.

The majority of known maternity sites have been located in forested tracts in agriculturally dominated landscapes such as Missouri, Iowa, Indiana, Illinois, and western Kentucky, as well as the Northeast, with multiple recent spring emergence telemetry studies. Numerous maternity sites also exist to the south in heavily forested regions in central and eastern Kentucky to at least eastern Tennessee and western North Carolina; however, fewer colonies have been documented in these heavily forested areas likely due to the landscape present. In summer, these bats are apparently absent south of Tennessee. Based on limited band return data, Midwestern populations seemingly migrate south to Alabama, Tennessee, Kentucky, Indiana, Missouri, and

West Virginia for winter. Northeast populations also apparently hibernate in the Northeast. In winter, they are apparently absent from Mississippi and northern Indiana where suitable caves and mines are unknown.

Winter range

Historically, the Indiana bat had a winter range restricted to areas of cavernous limestone in the karst regions of the east-central United States (Service 2007a). As of September 2009, the Service had winter records of extant winter populations (i.e., positive winter occurrence since 1995) of the Indiana bat at approximately 310 different hibernacula located in 19 states. Hibernacula are divided into priority groups that have been redefined in the Service's Draft Recovery Plan (Service 2007a). Priority groups are defined as follows: Priority 1 (P1) hibernacula typically have a current and/or historically observed winter population of greater than or equal to 10,000 Indiana bats; Priority 2 (P2) have a current or observed historic population of 1,000 or greater, but fewer than 10,000; Priority 3 (P3) have current or observed historic populations of 50 to 1,000 bats; and Priority 4 (P4) have current or observed historic populations of fewer than 50 bats. Based on 2009 winter surveys, there were a total of 24 P1 hibernacula in seven states: Illinois (one); Indiana (seven); Kentucky (five); Missouri (six); New York (three); Tennessee (one); and West Virginia (one). A total of 55 P2 hibernacula are known from the aforementioned states, as well as Arkansas, Ohio, Pennsylvania, and Virginia. A total of 151 P3 hibernacula have been reported in 16 states, and 229 P4 hibernacula have been reported in 22 states (Armstrong et al. 2009). Some records from the periphery of the range likely represent occasional wanderers or accidentals rather than viable winter populations (Service 1983).

While hibernating bats were dispersed across 19 states in the winter of 2009, over 85% of the estimated range-wide population hibernated in just four states, including: Indiana (48.6%); Kentucky (15.4%); Illinois (13.8%); and New York (8.4%). The 10 most populous hibernacula in 2009 collectively held 71.9% of the range-wide total with Ray's Cave in southern Indiana leading the list with 48,657 bats (12.4% of total) (Armstrong et al. 2009).

Missouri, Indiana, and Kentucky have historically had the highest estimated numbers of hibernating bats; all had estimates of greater than 10,000 bats in 1965. Over the period 1965 to 2005, estimated numbers of hibernating bats in Missouri and Kentucky clearly declined. Among the group of states in which aggregate hibernaculum surveys have never reached 100,000 bats, hibernaculum surveys in Arkansas, Tennessee, and Virginia consistently declined from 1965 to 2000. Hibernacula surveys in Illinois, New York, Ohio, and West Virginia were greater in 2000 than in 1965, but trends are not entirely consistent through the period. Thus, the southern tier of states in the species' range shows declines in counts at hibernacula, whereas some states in the upper Midwest show increasing counts (Service 2007a).

Summer Range

The first Indiana bat maternity colony was not discovered until 1971 (in east-central Indiana). As of October 2006, there were records of 269 maternity colonies in 16 states that were considered to be locally extant. Of the 269 colonies, 54% (146) had been found (mostly during mist-netting surveys) within the past 10 years. Because maternity colonies are widely dispersed during the summer and difficult to locate, all the combined summer survey efforts have found only a fraction of the maternity colonies presumed to exist based on the range-wide population estimates derived from winter hibernacula surveys. For example, based on the preliminary 2009 range-wide population estimate of 391,163 bats, and assuming a 50:50 sex ratio, and an average maternity colony size of 20 to 100 adult females (Kurta 2004), the 269 known maternity colonies may only represent 7 to 11% of the 2,455 to 3,912 maternity colonies assumed to exist. Regardless of reasonable disagreements regarding the average colony size, the geographic locations of the majority of Indiana bat maternity colonies remain unknown (Service 2007a).

Most capture records of reproductively active females and juvenile Indiana bats (i.e., evidence of a nearby maternity colony) have occurred in glaciated portions of the upper Midwest including southern Iowa, northern Missouri, much of Illinois, most of Indiana, southern Michigan, western Ohio, and in Kentucky; however, a growing number of maternity records have been documented in New York, New Jersey, and Vermont in recent years as a result of spring emergence studies and mist-netting efforts (Service 2007a). The number of recorded maternity colonies by state include: Arkansas (one), Illinois (28), Indiana (83), Iowa (27), Kentucky (32), Maryland (two), Michigan (11), Missouri (20), New Jersey (seven), New York (31), Ohio (11), Pennsylvania (two), Tennessee (three), Vermont (seven), Virginia (one), and West Virginia (three) (Service 2007a).

LIFE HISTORY & BIOLOGICAL BACKGROUND

The Indiana bat is a temperate, insectivorous, migratory bat that hibernates in mines and caves in the winter and summers in wooded areas (Service 1999). The key stages in the annual cycle of Indiana bats are: hibernation, spring staging, pregnancy, lactation, volancy/weaning, migration and swarming. While varying with weather and latitude, generally bats begin winter torpor in mid-September through late-October and begin emerging in April. Females depart shortly after emerging and are pregnant when they reach their summer area. Birth of young occurs between mid-June and early July and then nursing continues until weaning, which is shortly after young become volant in mid- to late-July. Migration back to the hibernaculum may begin in August and continue through September. Males depart later from the hibernaculum and begin migrating back earlier than females (Service 2007a).

Hibernation

Generally, Indiana bats hibernate from October to April (September to May in northern areas) depending on local weather conditions (Service 1999). Hibernation facilitates survival during winter when prey are unavailable; however the bats must store sufficient fat to support metabolic processes until spring. Substantial risks are posed by events during the winter that interrupt hibernation and increase metabolic rates (Service 2007a). Hibernating individuals characteristically form large, compact clusters of as many as 5,000 individuals (averaging 500 to 1,000 bats per cluster). These individuals may be difficult to discern in clusters that range from 300 to 500 individuals per square foot (Service 2007a). Clusters form in the same area in a cave each year, with more than one cluster possible in a particular cave (NatureServe

2007a). It is generally accepted that Indiana bats, especially females, are philopatric, i.e., they return annually to the same hibernaculum. However, exceptions have been noted (Service 2007a).

During hibernation, Indiana bats arouse naturally, as do all hibernating animals. Generally, a rhythm of approximately one arousal every 12 to 15 days for hibernating bats is considered typical, but considerable variation has been observed. During the later stage of hibernation (i.e., spring), bats arouse more often and may move towards the entrance of the cave (Service 2007a).

Spring Staging and Migration

After hibernation ends in late March or early April, most Indiana bats migrate to summer roosts. Female Indiana bats emerge from hibernation prior to males. Reproductively active females store sperm from autumn copulations through winter. Ovulation takes place after the bats emerge from hibernation in spring. The period after hibernation and just before spring migration is typically referred to as "staging," a time when bats forage and a limited amount of mating occurs (Service 2007a).

Most bats leave their hibernaculum by late April. Migration may be stressful for the Indiana bat, particularly in the spring when their fat reserves and food supplies are low and females are pregnant. As a result, adult mortality may be highest in late March and April (Service 2007a). Once en route to their summer destination, females move quickly across the landscape. Radio-telemetry studies in New York documented females flying between 10 and 30 miles (mi) in one night after release from their hibernaculum, arriving at their maternity sites within one night. Indiana bats can migrate hundreds of miles from their hibernacula. Observed migration distances range from just 34.1 mi to 356.5 mi (Service 2007a). Migrants are primarily females, while males are more likely to stay near the hibernaculum (NatureServe 2007a).

Summer Roosting and Foraging

Maternity colonies and roosts

Upon emergence from the hibernacula in the spring, females seek suitable habitat for maternity colonies. Coloniality is a requisite behavior for reproductive success. Females may arrive in their summer habitats as early as April 15 in Illinois, and usually start grouping into larger maternity colonies by mid-May. During this early period, a number of roosts (e.g., small colonies) may be used temporarily, until a roost with larger numbers of bats is established (Service 1999). Although most documented maternity colonies contained 100 or fewer adult females, as many as 384 bats have been reported emerging from one maternity roost tree in Indiana (Service 2007a).

Indiana bat maternity roosts can be described as primary or alternate based upon the proportion of bats in a colony consistently occupying the roost site. Maternity colonies typically use 10 to 20 trees each year, but only one to three of these are primary roosts used by the majority of bats for some or all of the summer. Alternate roosts are used by individuals, or a small number of bats, and may be used intermittently throughout the summer or used on only one or a few days. All roost trees eventually become unusable – by losing bark, falling over, or through competition with other animals – which can often occur suddenly and without warning. The use of alternate roosts may be a way of discovering new primary roosts in the event that the primary roost becomes unavailable (Service 2007a).

On average, Indiana bats switch roosts every two to three days, although the reproductive condition of the female, roost type, and time of year affect switching. Lactating females may change roosts less often than pregnant or post-lactating females. Bats roosting under exfoliating bark may change more often than bats roosting in crevices. Roost switching occurs less often in the spring, most likely due to colder night temperatures, which may induce extended torpor (Service 2007a).

Male roosts/night roosts

Some adult males use mature forests around and near their hibernacula for roosting and foraging from spring through fall. However, some male bats have been found to leave the hibernaculum area completely. Male Indiana bats have been found to use the same habitat in subsequent years (Service 2007a).

Indiana bats may night roost for a variety of reasons, including (but not limited to) resting, aiding in digestion, protection from inclement weather, and conservation of energy. Night roosting may occur at the bat's day roost in conjunction with nocturnal tending of its young or during inclement weather, or, more often, at sites not generally used as day roosts (Service 2007a).

Reproduction

Young are born in June to July with females giving birth to a single offspring. The young require about 37 days before weaning and are able to fly between mid-July and early August. Mortality between birth and weaning was about 8% (NatureServe 2007a). Indiana bats spend the latter part of the summer accumulating fat reserves for the fall migration and hibernation. Young female bats can mate in their first autumn and have offspring the following year, whereas males may not mature until the second year (Service 1999). The lifespan for Indiana bats is generally between five and 10 years (Service 2007a), with a maximum life span of about 15 years (NatureServe 2007a).

Fall Swarming and Mating

Upon arrival at hibernating caves in August to September, Indiana bats "swarm," a behavior in which large numbers of bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in caves during the day. Swarming continues for several weeks and mating occurs during the latter part of the period (Service 1999). During fall swarming, fat supplies for Indiana bats are replenished as they forage in the vicinity of the hibernaculum, accomplishing pre-hibernation weight gain (Service 2007a). After mating, females enter directly into hibernation. A majority of bats of both sexes hibernate by the end of November (by mid-October in northern areas), but hibernacula populations may increase throughout the fall and even into early January (Service 1999).

HABITAT CONSIDERATIONS

The nearest hibernaculum designated as critical habitat to the NiSource covered lands is Bat Cave (Carter County, KY), which is located approximately 3.5 miles from the covered lands footprint. In the Federal Register notice designating this cave as critical habitat, a description of swarming and staging habitat was not included; likewise, no primary constituent elements were described. The description solely entails the confines of the Bat Cave hibernaculum.

Based on the Bat Cave description, its location outside of the covered lands footprint as described herein, and the fact that no other critical habitat exists within 10 miles of the NiSource covered lands, NiSource and the Service anticipate that the project would neither modify nor have any impact on Indiana bat critical habitat.

Winter Habitat

During winter, Indiana bats are restricted to suitable underground roost sites that attain appropriate temperatures and relative humidity to hibernate. The majority of these sites are caves located in karst areas of the east-central United States; however, Indiana bats also hibernate in other cave-like locations, including abandoned mines in several states, a railroad tunnel in Pennsylvania, and even a hydroelectric dam in Michigan (Service 2007a).

In southern parts of the bat's range, hibernacula trap large volumes of cold air and the bats hibernate where resulting rock temperatures drop; in northern parts of the range, however, the bats avoid the coldest sites. In both cases, the bats choose roosts with a low risk of freezing. Ideal sites are 50°F or below when bats arrive in October and November. Early studies identified a preferred mid-winter temperature range of 39°F to 46°F, but a recent examination of long-term data suggests that a slightly lower and narrower range of 37°F to 43°F may be ideal for the species. Only a small percentage of available caves provide for this specialized requirement. Stable low temperatures allow the bats to maintain a low rate of metabolism and conserve fat reserves through the winter, until spring (Service 1999). Relative humidity at roost sites during hibernation usually is above 74%, but below saturation, although relative humidity as low as 54% has been observed. Humidity may be an important factor in successful hibernation (Service 1999).

Specific cave configurations determine temperature and humidity microclimates and suitability for Indiana bats. Indiana bats select roosts within hibernacula that best meet their needs for cool temperatures; in many hibernacula, these roosting sites are near an entrance, but may be deeper in the cave or mine if that is where cold air flows and is trapped. Indiana bats often hibernate in the same hibernacula with other species of bats and are occasionally observed clustered with or adjacent to other species, including gray bats (*Myotis grisescens*), Virginia big-eared bats (*Plecotus townsendii virginianus*), little brown bats (*Myotis lucifugus*), and northern long-eared bats (*Myotis septentrionalis*) (Service 1999).

Summer Habitat

Roosting habitat

Upon emergence from the hibernacula in the spring, females seek suitable habitat for maternity colonies. These colonies are typically located under the sloughing bark of live, dead, and partially dead trees in upland and lowland forest. Colony trees are usually large-diameter, standing dead trees with direct exposure to sunlight (Service 2007a).

Individual Indiana bats have been found roosting in a large number of different types of trees and situations, but it is possible to summarize the essential characteristics of a typical primary roost. A typical primary roost is located under the exfoliating bark of dead ash, elm, hickory, maple, oak, or poplar, although any tree that retains large, thick slabs of peeling bark for a significant period of time after death probably is suitable. Average diameter of maternity roost trees is 18 inches and average diameter of roosts used by adult males is 13 inches. Height of the tree (snag) is greater than 10 feet, but height of the roosting tree is not as important as height relative to surrounding trees and the position of the snag relative to other trees, because relative height and position affect the amount of solar exposure. Primary roosts usually receive direct sunlight for more than half the day. Access to the roost site is typically unimpeded by vines or small branches. The tree is typically within canopy gaps in a forest, in a fenceline, or along a wooded edge. Primary roosts are usually not found in the middle of extensive open fields but often are within 50 feet of a forest edge. Primary roosts are usually in trees that are in early- to mid-stages of decay (Service 2007a).

Landscape preference

At one time, the Indiana bat was considered a riparian specialist, but further study demonstrated that this categorization is not valid. Maternity roosts of some colonies have been found primarily in riparian zones, bottomland and floodplain habitats, upland communities, or in a mix of riparian and upland habitat. Most Indiana bat maternity colonies have been found in areas with fragmented forests, even in predominantly agricultural states such as Indiana. However, maternity colonies of Indiana bats have also been found in large forested blocks. It is possible areas from which many maternity colonies are known simply occupy the historical summer range of the species. Today the bats are using the best of whatever wooded areas are still available. In summary, most maternity colonies of Indiana bats that are known exist in fragmented landscapes with low to moderate forest cover. It is unclear whether the distribution of known colonies reflects a preference for fragmented forests; further study is needed to determine whether survival or productivity varies, positively or negatively, with the amount and type of forest available and the degree of fragmentation that is present (Service 2007a).

Commuting corridors

The Indiana bat consistently follows tree-lined paths rather than crossing large open areas. As a result, suitable forest patches may not be available to Indiana bats unless the patches are connected by a wooded corridor. Indiana bats have been observed crossing interstate highways and open fields. Biologists do not know how large an open area must be before Indiana bats hesitate or refuse to cross (Service 2007a).

Foraging habitat

Observations of Indiana bat indicate that they typically forage in closed to semi-open forested habitats and forest edges. Radio tracking studies of adult males, adult females, and juveniles consistently indicate that foraging occurs preferentially in wooded areas, although type of forest (i.e., floodplain, riparian, lowland and/or upland) varies with individual studies. Indiana bats hunt primarily around, not within, the canopy of trees, but they occasionally descend to the subcanopy and shrub layers. In riparian areas, Indiana bats primarily forage around and near riparian and floodplain trees, as well as solitary trees and forest edges on the floodplain (Service 2007a). However, Indiana bats have been captured, observed, and radio tracked foraging in open habitats. In Indiana, individuals foraged most in habitats with large foliage surfaces, including woodland edges and crowns of individual trees. Many woodland bat species forage mostly along edges, an intermediate amount in openings, and least within forest interiors (Service 2007a).

Fall Swarming and Spring Staging Habitat near Hibernacula

Indiana bats use roosts in the spring and fall similar to those selected during the summer (i.e., bats typically roost under exfoliating bark) with occasional use of vertical crevices in trees. Species of trees also are similar to summer sites, although various pines (*Pinus* spp.) commonly are occupied in spring and fall. During this time, Indiana bats tend to roost more often as individuals than in summer. Roost switching occurs every two to three days and Indiana bats show fidelity to individual trees and roosting areas, within and among years. Various trees used by the same individual tend to be clustered in the environment. Roost trees most often are in sunny openings in the forest created by human or natural disturbance (Service 2007a)

During the fall, when Indiana bats swarm and mate at their hibernacula, male bats roost in trees nearby during the day and fly to the cave during the night. In Kentucky, Indiana bats were found roosting primarily in dead trees on upper slopes and ridgetops within 1.5 miles of their hibernaculum (Service 2007a). During September in West Virginia, male Indiana bats roosted within 3.5 miles of their caves, in trees near ridgetops, and often switched roost trees from day to day. One Indiana bat in Michigan roosted 1.4 miles away from the hibernaculum during fall swarming, and another chose trees at a distance of 2.1 miles (Service 2007a). Upon emergence from hibernation in the spring, some males remain within the vicinity of their hibernacula, where they roost and forage in mature forest; movements of 2.5 to 10 miles have been reported in Kentucky, Missouri, and Virginia, respectively (Service 1999).

RANGE-WIDE THREATS

Reasons for the decline of the Indiana bat include cave modification and human disturbance to winter hibernacula. Most of the population hibernates in relatively few caves, which makes the species exceptionally vulnerable to disturbance by humans and to local habitat changes. Recent surveys have found numerous maternity colonies, but recent declines (despite improved cave protection) suggest ongoing loss/degradation of summer habitat, including sites suitable for maternity colonies. The 2007 Plan (Service 2007a) identified and expounded upon additional threats including:

- quarrying and mining operations (summer and winter habitat);
- loss/degradation of summer/migration/swarming habitat;
- loss of forest habitat connectivity;

- some silvicultural practices and firewood collection;
- disease and parasites;
- predation;
- competition with other bat species;
- environmental contaminants (not just pesticides);
- climate change; and
- collisions with man-made objects (e.g., wind turbines, communication towers, airstrikes with airplanes, and roadkill).

With few exceptions, all of the identified threats are still affecting the species to varying degrees. The most significant rangewide threats to the Indiana bat have traditionally been habitat loss/degradation, forest fragmentation, winter disturbance, and environmental contaminants. In addition to these threats, climate change and White-Nose Syndrome (WNS) are increasingly being identified as significant threats to the future recovery of the Indiana bat and its congeners. The following discussion has been incorporated here from the Service's Indiana bat 5-year review (Armstrong et al. 2009).

Prior to the current WNS epizootic, significant disease outbreaks affecting populations of Indiana bats, or other North American bat species, were not known. Since the preparation of the 2007 Plan, WNS has emerged as an unprecedented threat to hibernating bat species in North America. The consensus of bat experts at a May 2009 WNS meeting in Austin, Texas, was that "White-Nose Syndrome is a devastating disease of hibernating bats that has caused the most precipitous decline of North American wildlife in recorded history." (http://www.batcon.org/, accessed 8-18-09). The following list highlights some of the emerging information surrounding WNS:

- WNS was first detected in a single, commercial cave (i.e., Howe Caverns) near Albany, New York, in February 2006, and has since rapidly spread over the subsequent four winters causing mass mortality of hibernating bats (Blehert et al. 2009).
- To date, over 100 WNS affected sites are known or suspected in twelve states including Connecticut, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, Pennsylvania, Tennessee, Vermont, Virginia and West Virginia (updated information on WNS is being maintained on the Service's Region 5 WNS webpage at http://www.fws.gov/northeast/white_nose.html). As of April 2010, there is at least one affected site within all four Recovery Units (i.e., Northeast, Appalachian Mountains, Midwest, and Ozark-Central) of the Indiana bat's range (Service 2007a). Since its initial discovery in New York in 2006, WNS has spread approximately 900 miles.
- WNS was named for a white, powdery fungus observed on the muzzles, ears and/or wings of most infected bats as they hibernated.
- This previously unknown fungus was recently named *Geomyces destructans* and is considered the causal agent of the cutaneous infection associated with WNS

(Gargas et al. 2009). The origin of this cold-loving fungus (does not grow at or above 75.2ºF) remains unknown (Gargas et al. 2009), but its uniquely curved conidia (i.e., asexual spores) are morphologically similar to those of a *Geomyces* sp. observed growing on noses of some hibernating bat species in several European countries since the 1980s and preliminary DNA analyses indicate that the European fungus may be the same species (Blehert 2009).

- While the pattern of emergence and spread of WNS is suggestive of an emergent infectious disease and *G. destructans* is clearly playing a significant role, the fungus itself has not yet been conclusively shown to be the single causative pathogen. Other potential underlying causes have not yet been completely explored or excluded. The possibility remains that WNS may be caused by synergistic effects of multiple causal influences (e.g., contaminants, altered patterns of fat deposition or utilization, and a potential pathogen).
- Behavioral changes are also characteristic of WNS affliction. Service and state biologists in the WNS-affected areas have observed a general shift of animals from traditional winter roosts to colder areas, or to roosts unusually close to hibernacula entrances. There has also been a general lack of responsiveness by affected bats to human activity during hibernation. Animals have been regularly observed flying across the mid-winter landscape, and, on occasions, carcasses of little brown bats by the hundreds to thousands have been found outside affected hibernacula with more found inside.
- In New York, WNS has killed up to 95% or more of bats in affected hibernation caves and mines and no clear evidence of resistance have been observed among survivors (Hicks 2009).
- WNS has infected six bat species including Indiana bat (*Myotis sodalis),* little brown bat (*M. lucifugus*), northern long-eared bat (*M. septentrionalis*), small-footed bat (*M. leibii*), tri-colored bat (formerly Eastern pipestrelle) (*Perimyotis subflavus*), and big brown bat (*Eptesicus fuscus*) (Blehert et al. 2009).
- Hibernating bats with WNS apparently rouse much more frequently (torpor bouts of only one to three days) than normal (Reeder 2009). Frequent arousal of bats leads to depletion of stored fat reserves before the end of winter. Therefore, starvation prior to the spring emergence of insects may be the ultimate cause of death of WNS-affected bats.
- Preliminary work has indicated that the transmission of WNS is primarily bat-to-bat, but human-assisted transmission from WNS-affected hibernacula to unaffected hibernacula remains a possibility. Thus, in March 2009, the Service issued a cave advisory recommending that people refrain from entering caves and mines in WNS-affected and adjacent states.
- Researchers have/are screening numerous chemicals for their ability to kill *G. destructans* (and/or a closely related surrogate species) in a laboratory setting. Preliminary field tests of some potentially promising chemicals (i.e., they were effective in the lab) are being planned (Barton 2009). The potential for causing

adverse affects by introducing various natural and/or synthetic fungicidal agents into cave ecosystems is a significant concern in need of further investigation.

- A primary concern for managers is the ability to scientifically predict when and where the fungus will next occur, which at present is highly uncertain. With 15% of the 2007 rangewide population, Indiana bats in Region 5 of the Service (i.e., the Northeast Region) currently are at highest risk for contracting WNS and suffering additional population declines. WNS was also discovered in a few Tennessee hibernacula in Region 4 (Southeast Region) and one Missouri hibernaculum in Region 3 (Midwest Region) during the winter of 2009-2010. Given its current rate of spread, WNS is expected to continue to spread to additional Indiana bat hibernacula in Regions 3 (Midwest Region) and 4 (Southeast Region) within the next couple of winters. In 2007, Indiana bat hibernacula in the Midwest and Southeast contained 67.4% and 17.6% of the rangewide population, respectively (Armstrong et al. 2009).
- If current trends of mortality at affected sites continue to spread to additional sites, WNS threatens to drastically reduce the abundance of most species of hibernating bats, including the Indiana bat, in major regions of North America in a remarkably short period of time.
- The Service and other state and federal managers/biologists, and other researchers and conservation partners, have taken many additional actions in response to WNS. A bulleted list summarizing many of these actions can be viewed at the Service's WNS website at http://www.fws.gov/northeast/white_nose.html.

In short, WNS has quickly and significantly raised the degree of threat against the Indiana bat.

6.2.1.1 Activities and Impact Analysis

The following NiSource O&M and new construction activities could adversely impact the Indiana bat: tree clearing associated with a wide variety of activities, tree side-trimming, access roads maintenance and construction, well plugging, presence of the pipeline corridor, construction and maintenance of waste pits, and herbicide application (**Appendix M, Table 6.2.1.1-1**). These activities could result in a variety of stressors to the Indiana bat including tree removal, crushing bats, flushing bats, entrapment, noise, and chemical contaminants, which may kill, wound, harm, harass if they are present during the work.

Impacts and potential resulting take of Indiana bats from NiSource covered activities may occur in the states and counties identified below. NiSource and the Service anticipate that the covered activities will have **no effect** on the Indiana bat on lands found outside of these counties.

- Indiana - DeKalb, Elkhart, Lake, LaPorte, Marshall, Noble, Porter, and St. Joseph counties;
- Kentucky - Adair, Allen, Barren, Bath, Bourbon, Boyd, Bracken, Campbell, Carter, Casey, Clark, Clay, Estill, Fayette, Floyd, Garrard, Greenup, Jackson,

Johnson, Knott, Lawrence, Lee, Letcher, Lewis, Lincoln, Madison, Martin, Mason, Menifee, Metcalfe, Monroe, Montgomery, Morgan, Nicholas, Owsley, Pendleton, Perry, Pike, Powell, Robertson, and Rowan counties;

- Maryland - Allegany, Garret, and Washington counties;
- New Jersey - Hunterdon, Morris, and Warren counties;
- New York - Orange and Rockland counties;
- Ohio - Adams, Allen, Ashland, Ashtabula, Athens, Belmont, Brown, Butler, Carroll, Champaign, Clark, Clermont, Clinton, Columbiana, Coshocton, Crawford, Cuyahoga, Defiance, Delaware, Erie, Fairfield, Fayette, Franklin, Gallia, Geauga, Greene, Guernsey, Hancock, Hardin, Harrison, Henry, Hocking, Holmes, Huron, Jackson, Jefferson, Knox, Lawrence, Licking, Logan, Lorain, Lucas, Madison, Mahoning, Marion, Medina, Meigs, Monroe, Montgomery, Morgan, Morrow, Muskingum, Noble, Ottawa, Paulding, Perry, Pickaway, Putnam, Richland, Ross, Sandusky, Scioto, Seneca, Stark, Trumbull, Tuscarawas, Union, Vinton, Warren, Washington, Wayne, Wood, and Wyandot counties;
- Pennsylvania - Adams, Allegheny, Armstrong, Beaver, Bedford, Blair, Bucks, Butler, Cambria, Cameron, Centre, Chester, Clarion, Clearfield, Clinton, Cumberland, Delaware, Elk, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Jefferson, Lancaster, Lawrence, Lehigh, McKean, Monroe, Montgomery, Northampton, Pike, Somerset, Washington, Westmoreland and York counties;
- Tennessee - Davidson, Hardin, Lewis, Macon, Maury, McNairy, Sumner, Trousdale, Wayne, Williamson, and Wilson counties;
- Virginia - Albemarle, Alleghany, Augusta, Botetourt, Clarke, Frederick, Giles, Greene, Lexington, Madison, Page, Rockbridge, Rockingham, Shenandoah, Warren, and Waynesboro counties as well as the independent cities of Lexington and Waynesboro; and
- West Virginia – Barbour, Boone, Braxton, Brooke, Cabell, Calhoun, Clay, Doddridge, Fayette, Gilmer, Grant, Greenbrier, Hampshire, Hancock, Hardy, Harrison, Jackson, Kanawha, Lewis, Lincoln, Logan, Marion, Marshall, Mason, McDowell, Mercer, Mineral, Mingo, Monongalia, Monroe, Morgan, Nicholas, Ohio, Pendleton, Pocahontas, Preston, Putnam, Raleigh, Randolph, Roane, Summers, Taylor, Tucker, Tyler, Upshur, Wayne, Webster, Wetzel, Wirt, Wood, and Wyoming counties.

The most direct threat involves the clearing of vegetation (e.g., trees suitable for roosting) associated with covered activities while bats are present. This may cause take (e.g., kill, wound, harm, harass) of Indiana bats by crushing bats when the roost tree is felled. Additional take may result from the entrapment of bats in waste pits (kill), noise associated with construction equipment (harassment), chemical contamination of bats drinking from waste pits (harm leading to the likelihood of death or injury), and predation from bats being flushed from roost trees (harm leading to the likelihood of death or injury). Indirect effects potentially resulting in take of Indiana bats would result from the loss or degradation of roosting, foraging, and travel corridor habitats along the ROW (harassment).

MODELING

Three models were developed to aid in identifying impact areas and assist in determining take for the project. An overall core summer range estimation methodology, a swarming and staging habitat methodology, and a maternity habitat identification methodology were all used in order to calculate take later in this chapter.

Core Summer Range Impacts

The overall core summer range estimation methodology for the species was modeled after Gardner and Cook (2002), which calculated core summer range using a range-wide predictive model (i.e., within the maximum migration distance of any Priority 1 hibernacula or 322.4 mi) (Armstrong et al. 2008). Gardner and Cook's (2002) model information was updated with recently identified hibernacula. Core range that fell within Canada was excluded, as a newly discovered hibernaculum in New York is at the northern extent of the species range.

Swarming and Staging Impacts

Impacts to Indiana bat swarming and staging habitat were based on identified hibernacula in or near the covered lands. Hibernacula were split into categories based on the priority level of the hibernacula. Priority 1 and 2 hibernacula were put in one group (P1&2), and priority 3 and 4 hibernacula were put in a second group (P3&4).

The process started with 227 known hibernacula. Hibernacula more than 10 miles away from any areas of the covered lands were removed from the analysis because Indiana bats using those hibernacula beyond 10 miles of the covered lands would not be impacted by covered activities. Hibernacula with only historic information and low potential importance (e.g., hibernacula with little to no documented use by Indiana bats over the last 20 years and that are not identified as important to future recovery efforts) for recovery were also removed from the analysis. This left 86 potentially impacted hibernacula in or near the covered lands. A more detailed breakdown, indicating the covered lands type:

In Storage Field (SF) & ROW Covered Lands:	2 (both P4)
In SF & near ROW Covered Lands:	2 (one P3, one P4)
In SF but not near ROW Covered Lands:	0
In ROW Covered Lands & near SF:	0
In ROW Covered Lands but not near SF:	1 (P4)
Near SF & near ROW Covered Lands:	5 (all P4)
Near SF Covered Lands only:	2 (one P3, one P4)
Near ROW Covered Lands only:	74 (3 P1, 7 P2, 19 P3, & 45 P4)
In or within 10 miles of Covered Lands total:	86

The acres of intersection between the covered lands and the swarming and staging area around hibernacula were calculated. Swarming and staging areas were defined as areas within 10 miles of a hibernaculum. The amount of staging/swarming habitat was determined utilizing the methodology described in the maternity habitat identification discussion below because habitats used in staging/swarming are similar to summer. Areas that were near hibernacula in both priority groups (i.e., overlapping habitat of staging/swarming zones for two or more hibernacula) were only counted in the higher priority group (P1&2). Acreages are rounded to the nearest 100 acres.

Areas of SF & ROW Covered Lands in P1&2 swarming area:	0 acres
Areas of ROW Covered Lands only in P1&2 swarming area:	52,000 acres
Areas of SF Covered Lands only in P1&2 swarming area:	0 acres
Areas of SF & ROW Covered Lands in P3&4 swarming area:	93,400 acres
Areas of ROW Covered Lands only in P3&4 swarming area:	188,300 acres
Areas of SF Covered Lands only in P3&4 swarming area:	523,400 acres

Maternity Colony Impacts

The maternity habitat identification methodology was developed utilizing known maternity roost occurrence information acquired from natural heritage programs and the Service. Records older than 1960, and those with a low level of certainty, were excluded. These records were used to identify suitable NLCD and vegetation classifications that could be negatively impacted by NiSource's covered activities. These classifications were in turn utilized to determine, in part, the impact area for the MSHCP. The NLCD classifications identified include:

- (21) Developed open space
- (22) Developed, low intensity
- (23) Developed, medium intensity
- (41) Deciduous forest
- (42) Evergreen forest
- (43) Mixed forest
- (90) Woody wetlands

Potential impacts to Indiana bat maternity colonies were estimated by making a few assumptions, and using these to model the number of maternity colonies within the covered lands. The number of maternity colonies within the covered lands was initially calculated to identify a reasonable worst case scenario for impacts. This reasonable worst case was then adjusted to reflect what is known about Indiana bat population numbers. Assumptions included:

- 2001 NLCD data can accurately predict Indiana bat suitable habitat;
- Indiana bat home ranges do not overlap;
- Indiana bat home ranges are consistent in size and shape (2.5 mile radius circles);
- Indiana bat density is equally distributed across its entire range; and
- Geographic distribution of Indiana bat is consistent between the entire Indiana bat range and the covered lands areas (when applying adjustment ratio).

The Indiana bat range-wide data (approximately 304,557,000 acres) were provided by the Service's Bloomington, Indiana Field Office, and modified to remove any areas above 900 feet in elevation in New York State. The total number of potential Indiana bat maternity colonies was estimated by simulating colony points across the entire Indiana bat range using a five-mile triangular grid. Colonies inside the range were considered viable if their home range contained at least 10% suitable habitat (1,256 acres in any combination of NLCD categories 21, 22, 23, 41, 42, 43, or 90). This method produced an estimate of 19,823 viable maternity colony home ranges across the entire Indiana bat range. This number is not a realistic estimate of the number of Indiana bat colonies. Based on the preliminary 2009 range-wide population estimate of 391,163 bats, and assuming a 50:50 sex ratio, and an average maternity colony size of 60 adult females, it is estimated that a total of 3,260 maternity colonies exist range-wide, thus suggesting the estimate above was high by about a factor of six. The estimate was used to create an occupation adjustment for the analysis that estimated maternity colonies impacted within the covered lands.

The maternity colony impact estimates needed to be adjusted because the analysis of maternity colonies in the covered lands took into account the complex geographic extent of the covered lands. The substantially linear shape of the covered lands produces more intersections with colonies than would occur with a compact shape with the same acreage. Because the actual locations of maternity colonies throughout the covered lands are not known, the covered lands analysis assumed that maternity colonies were regularly spaced and occurred anywhere there was enough suitable habitat. Indiana bats do not occupy all suitable habitat within the covered lands, so this method overestimates the number of impacted colonies. To account for this overestimate, an analysis was performed across the entire Indiana bat range (as described above). This produced a ratio of occupied to viable Indiana bat maternity colonies in the entire Indiana bat range. The ratio identifies the amount of adjustment to be applied to the model results to account for a lower than 100% occupation rate of viable modeled colonies.

The covered lands intersect approximately 8,651,000 acres of the Indiana bat range (about 2.8% of the overall Indiana bat range). The analysis of colonies within the covered lands used the subset of potential colonies in the entire home range that fell within 2.5 miles of the covered lands. Viable colonies were counted and then split into categories depending on which types of covered lands (ROW or Storage Field [SF] counties) they were in or near. The analysis produced an estimate of 1,881 viable colonies in or near the covered lands. (Note: These data include 22 colonies that do not fall within the boundaries of the "May Affect" counties. "May Affect" counties are those counties within the covered lands where implementation of covered activities have been identified as potentially causing take of Indiana bats. They were left in because the range data was used for this analysis, and this maintained consistency.)

- 253 are within 2.5 miles of both pipeline buffer (the one-mile-wide corridor) and storage field county lands.
- 62 are in both the pipeline buffer and an SF county.
- 12 are in the pipeline buffer and within 2.5 miles of a SF county.

- 125 are within 2.5 miles of a pipeline buffer and in a SF county.
- 54 are within 2.5 miles of a pipeline buffer and within 2.5 miles of a SF county.
- 1,455 are within 2.5 miles of pipeline buffer lands only.
- 291 are in the pipeline buffer lands.
- 1,164 are within 2.5 miles of pipeline buffer lands.
- 173 are within 2.5 miles of storage field county lands only.
- 118 are in SF counties.
- 55 are within 2.5 miles of SF counties.

The above estimates are used in the take calculation in Section 6.2.1.4.

The analysis provided above is our preferred method but we also considered another way to estimate the number of maternity colonies near the covered lands. The discussion that follows provides a summary of an additional analysis using a grid with a different origin. As would be expected, this analysis showed only slight variations in the resulting numbers of colonies. This second analysis also used the areas of the "May Affect" counties as boundaries, rather than the Indiana bat range data. This produced some additional differences in colonies included and excluded, but these changes largely cancelled each other out. These differences were small (less than 20 colonies) relative to the size of the analysis dataset (almost 1,900 colonies).

An adaptive management program is necessary for a species with significant uncertainties and high levels of risk. *See* Sections 7.4.1 and 7.6.4.3 for the proposed adaptive management program for the Indiana bat.

6.2.1.2. Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicants should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; *see also* the Service's HCP Handbook at 3-20 ("HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery tools"; "contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the Indiana bat. With these general goals in mind, the main conservation objective is to avoid or minimize impacts to summer and winter habitat for the Indiana bat and avoid or minimize impact to individual bats, primarily through conducting activities outside the summer active season and minimizing ROW impacts. Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that can not be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 - Permanently protect, restore, enhance and/or manage priority Indiana bat hibernacula (Service reclassification and delisting criteria for the Indiana bat), including establishing and maintaining buffer lands surrounding each priority hibernaculum.

Rationale: Conservation and management of important hibernacula across the Indiana bat's range is essential to the species' continued existence, recovery, and long-term conservation. Greater than 80% of the Indiana bat population hibernates in Priority 1 hibernacula, while greater than 14% of the Indiana bat population hibernates in the Priority 2 hibernacula. The draft Indiana Bat Recovery Plan (Service 2007a) calls for permanent protection of a minimum of 80% of Priority 1 hibernacula in each Recovery Unit, with a minimum of one Priority 1 hibernaculum protected in each unit (reclassification criteria) and permanent protection of a minimum of 50% of Priority 2 hibernacula in each Recovery Unit (delisting criteria). To be considered protected, the hibernacula can be publicly or privately owned, but there must be a long-term voluntary landowner agreement, such as a stewardship plan, conservation easement, habitat management plan, or memorandum of agreement that protects the hibernacula in perpetuity. Protection of hibernacula includes assuring minimal disturbance to the bats during the season of hibernation.

Protection of hibernacula also includes conserving a buffer zone around each hibernaculum and restoration of hibernacula if necessary. Hibernacula are highly vulnerable to changes made on the land's surface, especially areas that drain to them. Boundaries of forested buffer zones ideally should be custom designed to conform to the unique topography and natural features surrounding each hibernaculum rather than drawn as a generic circle. One strategy would be to ensure landowners adjacent to priority hibernacula understand various options for restoring and maintaining their land as buffer lands for Indiana bat hibernacula.

Goal 2 - Permanently protect, restore, and/or manage optimal Indiana bat summer habitat to maximize survival and fecundity. This includes, but is not limited to, maternity sites, foraging habitat, water sources, and travel corridors (a Service high-priority recovery action for the Indiana bat).

Rationale: Protecting summer habitat, with known maternity colonies, will help ensure habitat availability for the Indiana bat and address the potential threat posed by habitat loss and degradation. Indiana bat maternity areas generally consist of one or more primary maternity roost trees that are used repeatedly by large numbers of bats, *and varying numbers of alternate roosts, which may be used less frequently and by smaller numbers of bats. Primary maternity roosts are large trees with loose, exfoliating bark and a high degree of solar exposure. Indiana bats eat terrestrial and aquatic insects while foraging in forested stream corridors, upland and bottomland forests, and over impounded bodies of water at night (Whitaker 1972, Lee 1993, Murray and Kurta 2002). Indiana bats tend to avoid vast open spaces, so wooded corridors linking roosting sites with foraging areas are important in areas where forests are fragmented (Murray and Kurta 2004). Habitat connectivity (corridors) among roost sites, foraging areas, and drinking water sources influence the quality of a roosting site. Optimal juxtaposition among these resource elements is likely determined by the distance between sites, the quality and quantity of the prey base, and the intervening cover.*

Goal 3 - Permanently protect, restore, and/or manage Indiana bat fall swarming/spring staging habitat to maximize survival and fecundity. This includes, but is not limited to, roost sites, foraging habitat, water sources, and travel corridors (a Service high-priority recovery action for the Indiana bat).

Rationale: Protecting fall swarming/spring staging habitat around known hibernacula will help ensure habitat availability for the Indiana bat and address the potential threat posed by habitat loss and degradation. Indiana bat fall swarming/spring staging areas generally consist of varying numbers of roost trees used by varying numbers of bats, which are dependent upon the population using the hibernaculum (i.e., priority number). Indiana bats eat terrestrial and aquatic insects while foraging in forested stream corridors, upland and bottomland forests, and over impounded bodies of water at night (Whitaker 1972, Lee 1993, Murray and Kurta 2002). Indiana bats tend to avoid vast open spaces, so wooded corridors linking roosting sites with foraging areas are important in areas where forests are fragmented (Murray and Kurta 2004). Habitat connectivity (corridors) among roost sites, foraging areas, and drinking water sources influence the quality of a roosting site. Optimal juxtaposition among these resource elements is likely determined by the distance between sites, the quality and quantity of the prey base, and the intervening cover.

Based on the background information above and the available information on the species, its status, and conservation,[3] NiSource developed a list of general minimization and mitigation sub-goals for Indiana bats within the covered lands and range-wide. If achieved, these sub-goals would support the conservation strategy discussed above. The sub-goals are listed below in order of preference:

- Protect and manage known P1 and P2 hibernacula.
- Protect and manage (including restoration) existing forested habitat:
    a. Swarming habitat within 10 miles of a known hibernaculum; and/or

[3] NiSource relied heavily on the draft revised Indiana Bat Recovery Plan, state heritage information, and the knowledge of experienced Indiana bat biologists to derive this list, but a number of other sources of information were also used.

   b. Summer habitat within 2.5 miles of a documented maternity roost tree or within 5.0 miles of a maternity capture (mist-net) record.

- If and when suitable control options are available for WNS, NiSource would fund implementation of these measures at infected hibernacula.
- Restore winter habitat conditions in degraded caves that exhibit the potential for successful restoration such as, but not limited to, those caves identified as having High Potential (HP) in the draft revised Indiana bat Recovery Plan.

6.2.1.3 Measures to Avoid and Minimize Impacts

Explanation of Terms

Throughout this document, certain terms are used repeatedly to describe Indiana bat habitat. For the purpose of this document the following definitions are provided:

1. "Known habitat" refers to suitable summer habitat or suitable spring staging/fall swarming habitat that is located within 10 miles of a documented hibernaculum, five miles of a documented maternity capture record or a positive identification of Indiana bat from properly deployed acoustic devices (unless NiSource conducts further site specific studies), or 2.5 miles of a documented maternity roost tree. It also refers to suitable winter habitat (i.e., hibernacula) that has been documented to have housed Indiana bats within the last 20 years or is identified by the Service as important to future recovery efforts.
2. "Maternity habitat" refers to suitable summer habitat used by juveniles and reproductive (pregnant, lactating, or post-lactating) females. Maternity foraging and roosting habitat typically occurs within five miles of a documented maternity capture record or a positive identification of Indiana bat from properly deployed acoustic devices (unless NiSource conducts further site specific studies), or 2.5 miles of a suitable roost tree that has been documented as a maternity roost tree.
3. "Occupied" refers to known and suitable habitat that is expected or presumed to be in use by Indiana bats at the time of impact. For summer habitat, this applies from May 15 through August 14; for staging/swarming habitat, this period is from April 1 to May 15 and August 15 to November 14, respectively.
4. "Suitable habitat" occurs where summer and/or winter habitat is appropriate for use by Indiana bats exists.
   a. Suitable winter habitat (hibernacula) is restricted to underground caves and cave-like structures (e.g. abandoned mines, railroad tunnels). These hibernacula typically have a wide range of vertical structures; cool, stable temperatures, generally between 39.2°F and 46.4°F; and humidity levels above 74% but below saturation.
   b. Suitable summer habitat for Indiana bats consists of the variety of forested/wooded habitats where they roost, forage, and travel. This includes forested patches as well as linear features such as fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees

are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 0.25 mile from the next nearest suitable roost tree, woodlot, or wooded fencerow.

c. Suitable spring staging/fall swarming habitat for Indiana bats consists of the variety of forested/wooded habitats where they roost, forage, and travel. This includes forested patches as well as linear features such at fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 0.25 mile from the next nearest suitable roost tree, woodlot, or wooded fencerow.

5. "Suitable roost tree" refers to a tree (live, dying, dead, or snag) with a diameter at breast height (DBH) of five inches or greater that exhibits any of the following characteristics: exfoliating bark, crevices, or cracks.
6. "Unoccupied" refers to suitable habitat not expected to be in use by Indiana bats **at the time of impact**. For summer habitat, this is the period from August 15 through May 14; for swarming habitat, this period is from November 15 to March 31.

These measures apply to all known occupied locations (i.e., where individuals have been documented to occur) and/or suitable habitats where occurrence may be presumed in Indiana, Kentucky, Maryland, New Jersey, New York, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia counties (*See* Section 6.2.1.1 and **Appendix G, Figures 6.2.1.3-1 and -2**). These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Application of measures in *italic* font text will be considered on a case-by-case basis depending on the project needs as more fully described in Chapter 5 of this MSHCP.

NiSource can use the survey processes outlined below (or assume presence) in order to determine the presence of habitat or habitat use. These will inform NiSource about the level of anticipated effects that covered activities may have on the Indiana bat. Once a determination is made whether the species and/or its habitat are present within the proposed covered activity's action area and the type and extent of effects are identified, the relevant AMMs will be implemented.

Habitat Assessments/Surveys to Evaluate the Presence of the Species and/or Suitable Habitat

1. Habitat Assessment to Determine Presence of Suitable Summer Habitat

Habitat assessments will be used to complete a project-specific, on-the-ground analysis to determine if proposed activities will adversely affect Indiana bats and/or their habitat. NiSource is responsible for developing and providing sufficient information as to whether suitable summer Indiana bat habitat exists within a proposed project area. In order to accomplish this, NiSource must have knowledge of the project area sufficient to adequately and accurately describe the potential suitable Indiana bat summer habitat conditions that may or may not exist on-site. This knowledge can be derived from any number of sources including, but not limited to, on-site visits, review of aerial photography and other maps, previous mining records (if applicable), forest inventories, previous species survey reports, and the work of NiSource's consultants or other designees. At a minimum, however, NiSource must determine if suitable Indiana bat habitat is present, define the general quality of that habitat (i.e., trees ≥ 5" dbh present), and quantify the extent of each habitat class identified. The results of such assessments will be recorded and documented in NiSource's annual compliance report. Results will be valid for one year and can be completed anytime of year. **Appendix L** provides specific guidance for completing these habitat assessments.

i. Examine identified impact areas for the following characteristics:

   a. Suitable summer habitat (*see* definition of this habitat as well as suitable roost trees in the "Explanation of Terms" section above).

   Suitable primary roosting summer habitat is habitat meeting the suitable summer habitat definition but includes suitable roost tree(s) ≥ 9" dbh.

   b. Suitable spring staging and fall swarming habitat is habitat meeting the summer habitat definition that is located within a 10-mile radius of P1, 2, 3, and 4 hibernacula.

2. Assessments to Determine Presence of Suitable Winter Habitat (hibernacula)

NiSource will develop sufficient information as to whether potentially suitable winter Indiana bat habitat exists within a proposed project area. This knowledge will be derived from, but not limited to, the following sources: on-site visits, review of aerial photography and other maps, previous mining records (if applicable), forest inventories, previous species survey reports, and the work of NiSource's consultants or other designees. Indiana bats have been documented using caves (and their associated sinkholes, fissures, and other karst features), quarries, and abandoned mine portals (and their associated underground workings) as winter hibernation habitat.

NiSource personnel or its consultants will determine whether potentially suitable winter habitat exists within the project area by conducting "Winter Habitat Assessments" as described below. The results of these assessments will be recorded and documented in NiSource's annual compliance report. Results will be valid for two years and can be completed any time of year. The Winter Habitat Assessment Protocols are:

i. Examine identified impact areas for the following characteristics:

   a. The ground openings at least one foot in diameter or larger.

   b. Underground passages should continue beyond the dark zone and not have an obvious end within 40 feet of entrance (Note: This may not be verifiable by surveyor due to safety concerns).

   c. Entrances that are flooded or prone to flooding (i.e., debris on ceiling), collapsed, or otherwise inaccessible to bats will be excluded.

   d. Ground openings that have occurred recently (i.e., within the past 12 months) due to creation or subsidence will be excluded. However, a written description and photographs of the opening must be included in the pre-survey report.

Surveys to Confirm Use of Suitable Winter Habitat

*ii. If suitable winter habitat is discovered as a result of the habitat assessments above (AMM#2i), do not alter, modify, or otherwise disturb entrances or internal passages of caves, mines, or other entrances to underground voids (potential hibernacula) within the MSHCP covered lands until a "Determination of Suitable Winter Habitat for Indiana Bats" is completed. The survey protocols to make this determination are provided in **Appendix L** and will be followed to determine if the suitable habitat is in fact, occupied. Some surveys will require modification (or clarification) of these guidelines; therefore, coordination with the Service Field Office responsible for the state in which the site-specific project occurs is necessary prior to initiating suitable winter habitat surveys. Results of completed surveys will be submitted to the responsible Service Field Office(s) prior to clearing of identified habitat. The Service will accept the results of these surveys for the purposes of determining whether and to what degree take is anticipated.*

If surveys (conducted using approved methodology) fail to detect Indiana bats, AMMs in winter habitat are not mandatory. However, NiSource may voluntarily elect to employ any of the AMMs to maintain the viability of the suitable winter habitat.

Alternatively, NiSource may assume presence of Indiana bats in this suitable winter habitat and apply mandatory AMMs.

Surveys to Determine Presence in Suitable Summer Habitat

3. NiSource may conduct summer surveys to determine presence or probable absence of Indiana bats within suitable summer habitat for site-specific projects not located within known habitat as defined above. The current "Indiana Bat Mist Netting Guidelines" provided in Appendix 5 of the 2007 Indiana Bat Draft Revised Recovery Plan or future versions of superseding Service-approved guidelines will be applied. Some surveys will require modification (or clarification) of these guidelines; therefore, coordination with the Service Field Office responsible for the state in which the site-specific project occurs is necessary prior to initiating summer presence/absence surveys. Results of completed summer surveys will be submitted to the responsible Service Field Office(s) prior to clearing of identified suitable summer habitat. The Service will accept the results of these surveys for the purposes of determining whether and to what degree take is expected. Survey results are valid for two years unless new information changes the Service's view on whether certain geographic areas provide suitable summer habitat for Indiana bats.

If no Indiana bats are captured and no other recent information suggests the presence of Indiana bats, no further AMMs or mitigation are necessary. If Indiana bats are captured, the relevant AMMs and mitigation would apply.

Alternatively, NiSource may elect to assume presence of Indiana bats in suitable summer habitat and apply the AMMs and mitigation measures.

Measures to Avoid and Minimize Impacts to Indiana Bats in Known or Presumed Occupied Caves /Winter Habitat

4. When burning brush piles within 0.25 mile of known or presumed occupied hibernacula from August 15 to May 15, the brush piles can be no more than 25 feet by 25 feet, must be spaced at least 100 feet apart, and located at least 100 feet from known hibernacula entrances and associated sinkholes, fissures, or other karst features.

5. No woody vegetation or spoil (e.g., soil, rock, etc.) disposal within 100 feet of known or presumed occupied hibernacula entrances and associated sinkholes, fissures, or other karst features (*see* related adaptive management discussion in Chapter 7).

6. Protect potential recharge areas of cave streams and other karst features that are hydrologically connected to known or presumed occupied hibernacula by employing the relevant NGTS ECS standards such as Section III, Stream and Wetland Crossings, and Section IV, Spill Prevention, Containment and Control.

7. Blasting within 0.5 mile of known or presumed occupied hibernacula will be conducted in a manner that will not compromise the structural integrity or alter the karst hydrology of the hibernacula (e.g., maximum charge of two inches per second ground acceleration avoids impact to nearby structures) (*see* related adaptive management discussion in Chapter 7).

8. Drilling within 0.5 mile of known or presumed occupied hibernacula will be conducted in a manner that will not compromise the structural integrity or alter the karst hydrology of the hibernacula (e.g., outer drilling tube filled with concrete to ensure no modification to any karst encountered) (*see* related adaptive management discussion in Chapter 7).

9. If authorized by the landowner, block (e.g., gate) access roads and ROWs leading to known or presumed occupied hibernacula from unauthorized access.

10. Equipment servicing and maintenance areas will be sited at least 300 feet away from streambeds, sinkholes, fissures, or areas draining into sinkholes, fissures, or other karst features.

11. Operators, employees, and contractors (working in areas of known or presumed Indiana Bat Habitat as described in this section) will be educated on the biology of the Indiana bat, activities that may affect bat behavior, and ways to avoid and minimize these effects (AMMs in MSHCP).

12. Restrict use of herbicides for vegetation management within 10 miles of known or presumed occupied hibernacula to those specifically approved for use in karst (e.g., sinkholes) and water (e.g., streams, ponds, lakes, wetlands).

Measures to Avoid and Minimize Impacts to Indiana Bats in Spring Staging/Fall Swarming Habitat

13. No clearing of suitable spring staging and fall swarming habitat within a 10-mile radius of any Priority 1 and 2 presumed occupied hibernacula from April 1 to May 31 and August 15 to November 14.

14. *No clearing of suitable spring staging and fall swarming habitat within a 10-mile radius of any Priority 3 and 4 hibernacula from April 1 to May 31 and August 15 to November 14.*

15. Operators, employees, and contractors (working in areas of known or presumed Indiana Bat Habitat as described in this section) will be educated on the biology of the Indiana bat, activities that may affect bat behavior, and ways to avoid and minimize these effects (AMMs in MSHCP).

16. No woody vegetation or spoil (e.g., soil, rock, etc.) disposal within 100 feet of known or presumed occupied hibernacula entrances and associated sinkholes, fissures, or other karst features (*see* related adaptive management discussion in Chapter 7).

17. Protect potential recharge areas of cave streams and other karst features that are hydrologically connected to known or presumed occupied hibernacula by following relevant NGTS ECS standards such as Section III, Stream and Wetland Crossings, and Section IV, Spill Prevention, Containment and Control.

18. Blasting within 0.5 mile of known or presumed occupied hibernacula will be conducted in a manner that will not compromise the structural integrity or alter the karst hydrology of the hibernacula (e.g., maximum charge of two inches per second ground acceleration avoids impact to nearby structures) (*see* related adaptive management discussion in Chapter 7).

19. Drilling within 0.5 mile of known or presumed occupied hibernacula will be conducted in a manner that will not compromise the structural integrity or alter the karst hydrology of the hibernacula (e.g., outer drilling tube filled with concrete to ensure no modification to any karst encountered) (*see* related adaptive management discussion in Chapter 7).

20. *Activities (e.g., drilling) involving continuing (i.e., longer than 24 hours) noise disturbances greater than 75 decibels measured on the A scale (e.g., loud machinery) within a one-mile radius of known or presumed occupied hibernacula should be avoided during the spring staging (April 1 to May 31) and fall swarming (August 15 to November 14) seasons.*

21. Equipment servicing and maintenance areas will be sited at least 300 feet away from streambeds, sinkholes, fissures, or areas draining into sinkholes, fissures, or other karst features.

22. *Within 10 miles of Priority 1, 2, 3, and 4 hibernacula and only in areas identified as suitable summer habitat, retain snags, dead/dying trees, and trees with exfoliating (loose) bark ≥ 5-inch diameter at breast height (dbh) in areas ≤ one mile from water.*

23. Contaminants, including but not limited to oils, solvents, and smoke from brush piles, should be strictly controlled as provided for in the EMCS and ECS, Section II.C.2, and Section IV so the quality, quantity, and timing of prey resources are not affected.

24. From April 1 to May 31, and August 15 to November 14, use tanks to store waste fluids to ensure no loss of bats by entrapment in waste pits within 10 miles of Priority 1 & 2 hibernacula or presumed occupied hibernacula.

25. *From April 1 to May 31, and August 15 to November 14, use tanks to store waste fluids to ensure no loss of bats by entrapment in waste pits within 10 miles of Priority 3 & 4 hibernacula.*

26. Implement strict adherence to sediment and erosion control measures, ensure restoration of pre-existing topographic contours after any ground disturbance, and restore native vegetation (where possible) as specified in the ECS upon completion of work within and known or presumed occupied spring staging and fall swarming habitat.

Measures to Avoid and Minimize Impacts to Indiana Bats in Summer Habitat

27. No clearing of known maternity colony summer habitat within the covered lands of the MSHCP or trees greater than nine inches dbh within any existing ROW and/or appurtenant facility of the covered lands of the MSHCP from April 1 to October 15 to avoid direct affects to females (pregnant, lactating, and post-lactating) and juveniles (non-volant and volant) (*see* related adaptive management discussion in Chapter 7).

28. *Retain snags, dead/dying trees, and trees with exfoliating (loose) bark ≥ 5 inches dbh in areas identified as known maternity colony summer habitat and ≤ one mile from water.*

29. No clearing of suitable summer habitat within the covered lands of the MSHCP from June 1 to August 1 to protect non-volant Indiana bat pups or “side-trimming” of suitable summer habitat from April 15 to September 1 to avoid direct affects to females (pregnant, lactating, and post-lactating) and juveniles (non-volant and volant).

30. *No clearing of suitable summer habitat within the covered lands of the MSHCP from April 1 to May 31 to avoid direct affects to pregnant females and minimize direct affects on Indiana bats in summer habitat.*

31. *No clearing of suitable summer habitat located more than 10 miles from a Priority 1, 2, 3 and 4 hibernacula within the covered lands of the MSHCP from August 2 to October 15 to avoid direct effects to post-lactating females and volant juveniles and minimize direct effects to Indiana bats in summer habitat.*

32. Operators, employees, and contractors (working in areas of known or presumed Indiana Bat Habitat as described in this section) will be educated on the biology of the Indiana bat, activities that may affect bat behavior, and ways to avoid and minimize these effects.

33. *No aerial application of herbicide on ROWs from April 15 to August 15 to protect maternity colonies in summer habitat.*

34. *Retain snags, dead/dying trees, and trees with exfoliating (loose) bark ≥ 5 inches dbh in areas identified as suitable summer habitat and ≤ one mile from water.*

35. Contaminants, including but not limited to oils, solvents, and smoke from brush piles, should be strictly controlled as provided for in the EMCS and ECS, Section II.C.2, and Section IV so the quality, quantity, and timing of prey resources are not affected.

36. Implement and strict adherence to sediment and erosion control measures, ensure restoration of pre-existing topographic contours after any ground disturbance, and

restore native vegetation (where possible) as specified in the ECS upon completion of work within suitable summer habitat and known or presumed occupied spring staging and fall swarming habitat.

37. Equipment servicing and maintenance areas will be sited at least 300 feet away from streambeds, sinkholes, fissures, or areas draining into sinkholes, fissures, or other karst features.

38. Between April 1st and November 14th, use tanks to store waste fluids to ensure no loss of bats by entrapment in waste pits in known maternity colony summer habitat within the covered lands of the MSHCP.

39. *Between April 1st and November 14th, use tanks to store waste fluids to ensure no loss of bats by entrapment in waste pits in suitable summer habitat within the covered lands of the MSHCP.*

40. *Avoid conducting construction activities after sunset in known or suitable summer habitat to avoid harassment of foraging Indiana bats.*

A detailed EM&CP will be prepared for any project within Indiana bat habitat. The plan will incorporate the relevant requirements of NiSource's current ECS and include site-specific details particular to the project area and potential impact. The plan will be strongly oriented towards avoiding and minimizing disturbance to known hibernacula, spring staging and fall swarming habitat, as well as known summer maternity colony and suitable summer habitats as well as impacts within known foraging habitat. The plan will also incorporate the applicable AMMs prescribed in the MSHCP. The plan will be approved in writing by NiSource NRP personnel, prior to project implementation, and will include a tailgate training session for all onsite project personnel to highlight the environmental sensitivity of the habitat and any Indiana bat AMMs which must be implemented.

6.2.1.4 Calculation of Incidental Take

The calculation of incidental take was derived utilizing the following assumptions and operating facts:

Covered Lands:

(1) There are approximately 5,700,000 acres of suitable summer habitat within the covered lands; estimated using the methodology outlined in the modeling section (3,272,400 linear and 2,427,600 storage fields);

(2) There are 310,573 acres of known summer habitat within the covered lands; estimated using the methodology outlined in the modeling section (60,131 linear and 250,442 storage fields);

Covered Activities:

(3) O&M activities within the existing ROW and storage fields would impact 0.07% or approximately 3,900 acres of the total suitable habitat acreage present within covered lands;

(4) New pipeline construction would impact 1.9% or 63,000 acres of the total acreage of assumed suitable habitat present within the one-mile-wide corridor covered lands;

(5) New construction within storage fields would impact 0.12% or 3,000 acres of assumed suitable habitat present within storage field county covered lands;

(6) Clearing of forested habitat on existing pipeline facilities during O&M could occur at anytime within the 50-year permit term (thereafter, the facilities area, including ROWs, would be maintained in a non-forested state for required safety patrols);

(7) After clearing occurs for new construction projects, the pipeline would be maintained in a vegetative state unsuitable for roosting by Indiana bats but potentially used as a travel corridor or for foraging;

Avoidance & Minimization Measures:

(8) For the purpose of calculating a reasonable worst-case take of Indiana bats, it is assumed that non-mandatory AMMs listed in the previous section will not be implemented;

(9) No lactating females and immobile bats (i.e., pups) will be impacted due to implementation of AMMs;

(10) No direct or indirect impacts to known or presumed Indiana bat hibernacula will occur from covered activities due to implementation of AMMs;

(11) No direct or indirect take would occur to wintering bats (in the hibernacula) with the implementation of the AMMs for this species;

(12) All direct impacts from covered activities to known spring staging/fall swarming roosts within 10 miles of P1 and P2 hibernacula are avoided due to implementation of AMMs;

(13) All direct impacts to known summer roosts from covered activities are avoided due to implementation of AMMs;

(14) No direct take would occur to summering bats in known maternity colonies with the implementation of the AMMs for this species;

(15) NiSource will maintain and update known Indiana bat maternity colony and hibernacula location information annually to use in implementing the MSHCP;

(16) NiSource will assume presence of Indiana bats within identified suitable winter habitat a maximum of ten times – i.e., five linear (ROW) and five storage field county covered lands – throughout the life of the permit. These "presumed" hibernacula are considered as P2 hibernacula for the purposes of calculating take to the associated presumed spring staging/fall swarming habitat.

Species Biology:

(17) Indiana bats are evenly distributed in suitable habitat;

(18) An even 50:50 sex ratio exists in the population (Thomson 1982);

(19) The range of maternity colony sizes observed for the Indiana bat is 20-100 adult females (Kurta 2004). NiSource and the Service have assumed 60 adult females and their 60 pups occur per maternity colony within the covered lands. This assumption is based on the fact that the covered lands do not overlap areas of the species summer range documented to have the highest densities of adult females in colonies but the covered lands do overlap a significant portion of the species' summer range; therefore, using the average of the overall variability observed was appropriate;

(20) Home range of a maternity colony is the area within a 2.5-mile radius (i.e., 12,560 acres) around documented roosts or within a 5-mile radius (i.e., 50,265 acres) around capture location of a reproductive female or juvenile Indiana bat or a positive identification of Indiana bat from properly deployed acoustic devices (unless NiSource conducts further site specific studies);

(21) The absolute minimum amount of suitable summer habitat required for a maternity colony to exist at a given point on the landscape (i.e., 10%) was based on data provided in the draft revised Indiana bat recovery plan (Service 2007a);

(22) 5% of disturbed adult bats would not escape from felled roost trees during implementation of covered activities between April 1 and November 14 (Belwood 2002);

(23) Effects on adult male Indiana bats in summer habitat (beyond the protection afforded to them from suitable summer maternity colony, spring staging/fall swarming, and winter habitat AMMs) is considered insignificant due to the dispersed nature of males and the minimal type and amount of impact anticipated;

(24) Fall swarming and spring staging habitat occurs within a 10-mile radius (i.e., 201,062 acres) of a hibernaculum;

(25) Due to extensive survey data collected in New York (Niver 2009), covered lands in the State of New York that are greater than 900 feet in elevation will not be considered as meeting the definition of suitable Indiana bat summer habitat. For all other states, sufficient evidence does not exist to suggest that elevation plays a key role for determining suitable maternity colony habitat. Therefore, sites at any elevation will be considered as suitable habitat in all other states;

(26) Lands covered by the MSHCP within the states of Louisiana and Mississippi will not be considered as meeting the definition of suitable summer habitat (as defined below) for Indiana bats. Similarly, land covered by the MSHCP within the states of Indiana, Mississippi, and Louisiana will not be considered to have winter habitat for Indiana bats. These assumptions are based on the survey data available to the Service within these areas;

(27) The NLCD classifications outlined in the swarming, staging, and maternity habitat identification methodology are representative of suitable summer habitat for this species (refer to the modeling section); and

(28) The 2009 population estimates for Indiana bat were used for estimating maternity habitat and hibernacula populations;

The calculation of incidental take was separated into the different types of covered lands and activities [i.e., Linear (ROW) vs. Storage Fields and O&M vs. New Construction] as these activities may impact Indiana bats differently in these covered lands. A two-step process was used to calculate incidental take within each covered lands group. First, modeling results were used to calculate the number of Indiana bats (i.e., maternity colonies or individuals) estimated to be present within the covered lands group. These estimates were then incorporated into a calculation of take that considered the assumptions provided above, information provided in **Appendix A** (Annual Acreage Disturbance Estimates and the amount of suitable Indiana bat habitat available within the covered lands group) to quantify the reasonable worst-case take over the 50-year permit term.

MATERNITY COLONIES:

A. The following numbers are derived from the modeling discussed earlier in this chapter and are used below to quantify take within the linear (ROW) Covered Lands (in non-storage field counties):

- 60,131 acres of linear (ROW) covered lands (except in storage field counties) contain known maternity colony habitat with a total of 14 known maternity colonies; and
- 3,212,269 additional acres of linear (ROW) covered lands in total modeled suitable Indiana bat summer habitat with a total of 240 estimated colonies.

It is difficult to approximate the number of colonies present within the linear (ROW) covered lands because (a) Indiana bats, even when thought to be present, are difficult to capture using currently accepted survey techniques (Robbins, unpublished data, 2001; Murray et al. 1999); (b) survey efforts have not been consistent throughout the species' range; and (c) the geographic locations of the majority of Indiana bat maternity colonies (i.e., 89-93% of the estimated 2,455 to 3,912 maternity colonies throughout the range) remain unknown (Service, unpublished data, 2009e). Based on the preliminary 2009 range-wide population estimate of 391,163 bats, and assuming a 50:50 sex ratio, and an average maternity colony size of 60 adult females within the covered lands, it is estimated that a total of 3,260 maternity colonies exist range-wide, which falls within the range calculated in the recovery plan of 2,455 to 3,912 colonies.

As stated above, there are 14 known colonies with home ranges that cross the linear (ROW) covered lands. Using a modeling exercise (*see* the Modeling Section, above), the estimated maximum number of additional maternity colonies that may occur along the NiSource linear (ROW) covered lands could be 1,455 colonies. The maximum number of colonies was calculated by developing a grid of maternity colony home ranges (i.e., 2.5-mile radius circles) throughout and adjacent to the linear (ROW) covered lands. Next, each colony home range was evaluated using the suitable Indiana bat habitat model to determine the number of colonies that had a minimum of 1,256 acres (i.e., 10% of the potential home range; assumption 14) of modeled suitable habitat present. A maximum of 12,560 acres of habitat exists within a 2.5 mile home range.

Should 1,455 maternity colonies exist along the linear (ROW) covered lands, they would represent 45% of the range-wide estimate of 3,260 maternity colonies. Given that the covered lands intersect 2.8% of the total Indiana bat range, NiSource could estimate that a minimum of approximately 93 maternity colonies exist within the covered lands of the NiSource MSHCP. Therefore, the estimated 1,455 colonies appeared highly unlikely as a broader distribution of colonies throughout the species range is expected.

A habitat modeling exercise was also conducted to establish a reasonable number of maternity colonies along the linear (ROW) covered lands. NiSource and the Service calculated the total number of theoretical Indiana bat maternity colonies if they were common and regularly dispersed (using a 5-mile triangular grid) across the species range. Colonies were considered viable if their potential 2.5-mile home range contained at least 10% suitable habitat (1,256 acres). The Indiana bat range-wide data were modified to remove any areas above 900 feet in elevation in New York State. This method produced an estimate of 19,823 viable colony sites across the entire range. This number is not a realistic estimate of the number of Indiana bat colonies range-wide, but rather was created to identify an occupation adjustment to apply to the similar analysis that was conducted to estimate colonies impacted in the NiSource MSHCP. NiSource then compared the total number of viable colony sites modeled rangewide (19,823) with the estimate of colonies rangewide (3,260; *see* the discussion above) to calculate a 16.45% adjustment factor (3,260 ÷ 19,823 = 0.1645).

The adjustment factor was then applied to the number of modeled maternity colonies along the linear (ROW) covered lands to estimate that there would be 240 colonies along the linear (ROW) covered lands (1,455 x 0.1645 = 239.28). This number includes both colonies that would be centered within the linear ROW of the covered lands, and colonies that would be centered outside of the covered lands but close enough that their home ranges could be impacted by activities within the covered lands.

This is a reasonable estimate of the number of colonies that are likely to occur within the NiSource linear (ROW) covered lands and 254 total colonies (240 modeled plus 14 known) will be used for the rest of the calculations. A conservative approach has been used to estimate take throughout this analysis. For the purposes of the remaining calculation below, NiSource and the Service assume that each of the 14 known colonies would be impacted in some manner. It is important to note, however, that not all impacts within the covered lands will rise to the level of take. For instance, although some activities may temporarily disturb Indiana bats, we do not anticipate that all such activities will cause such a significant disruption or annoyance as to cause injury or death. On the other hand, take of individual bats within a maternity colony are more likely to be as a result of harm or harassment than through direct mortality or injury. This is in part due to the nature of vegetation removal and the already-cleared condition of the existing ROW in which O&M activities will occur. And even then, not all bats within a maternity colony will necessarily be affected or taken in the same manner. These distinctions are more thoroughly discussed in Section 6.2.1.5.

1. O&M

Given the assumptions above, information provided in **Appendix A** (Annual Acreage Disturbance Estimates and the amount of suitable Indiana bat habitat available within the covered lands), O&M activities that have been identified to potentially cause take of Indiana bats will only occur on up to 3,900 acres (*see* Assumption 3 above) of the overall 3,272,400 acres of linear (ROW) covered lands that are also suitable Indiana bat summer habitat over the 50-year permit term. Therefore, NiSource and the Service estimate a total of two colonies (one known and one additional) would be impacted and individuals within the colonies taken (i.e., harm, harass, kill, injure) by O&M activities within the existing ROW covered lands (3,900 acres of O&M impact ÷ 3,272,400 acres of linear (ROW) covered lands in suitable Indiana bat summer habitat = 0.119%; 0.00119 x 240 colonies = 0.29 maternity colonies [rounded up to one]; 0.00119 x 14 known colonies = 0.02 known maternity colonies in which Indiana bats may be harmed or harassed [rounded up to one]). However, there are 14 known colonies with home ranges that cross the linear (ROW) covered lands and a conservative approach has been used to estimate take throughout this analysis. Therefore, NiSource and the Service assume that each of these 14 colonies, as opposed to the two colonies modeled above, would be affected and up to 1,680 individuals [i.e., 14 maternity colonies x 120 (60 adult females + 60 pups = 120) = 1,680 individuals] within the colonies could be impacted or taken through harassment, or harm by O&M within the existing ROW covered lands.

2. New Construction

Given the assumptions above, information provided in **Appendix A** (Annual Acreage Disturbance Estimates and the amount of suitable Indiana bat habitat available within the covered lands), NiSource has determined that new construction (capital expansion projects) activities that have been identified to potentially cause take of Indiana bats will only occur on up to 63,000 acres (*see* Assumption 4 above) of linear (ROW) within the covered lands over the 50-year permit term. Therefore, NiSource and the Service estimate a total of six colonies (one known and five additional) would be impacted and some individuals within the colonies taken (i.e., harm or harass, killed, injured) by new construction within linear (ROW) covered lands (63,000 acres of new construction impact ÷ 3,272,400 acres of linear (ROW) covered lands in suitable Indiana bat summer habitat = 1.9%; 0.019 x 240 colonies = 4.62 maternity colonies [rounded up to five]; 0.019 x 14 known colonies = 0.27 known maternity colonies with individuals experiencing some form of take [rounded up to one]). However, there are 14 known colonies with home ranges that cross the linear (ROW) covered lands and a conservative approach has been used to estimate take throughout this analysis. Therefore, NiSource and the Service assume that each of these 14 colonies, as opposed to the six colonies modeled above, would be affected and up to 1,680 individuals [i.e., 14 maternity colonies x 120 (60 adult females + 60 pups = 120) = 1,680 individuals] within the colonies could experience in order of likelihood harassment, harm or lethal take by new construction within the linear (ROW) covered lands. Note that these are the same colonies as described in the O&M calculation above and thus will not be additive to the overall amount of take requested by NiSource.

B. The following numbers are derived from the modeling discussed earlier in this chapter and are used below to quantify take within the SF Counties:

- 250,442 acres of storage field counties intersect with known maternity colony habitat with a total of four known colonies; and
- 2,177,158 additional acres of storage field covered lands in total modeled suitable Indiana bat habitat with a total of 71 estimated colonies.

A total of 4,187,926 acres exist within the 12 storage field counties and are considered covered lands. Using a modeling exercise (*see* the Modeling Section, above), NiSource estimated the maximum number of additional maternity colonies that may occur within the NiSource storage field covered lands to equal 426 colonies [number includes 173 colonies within 2.5 miles of a storage field county (not near a pipeline buffer) and 253 colonies within 2.5 miles of both a pipeline buffer and a SF county]. The maximum number of colonies was calculated by developing a grid of maternity colony home ranges (i.e., 2.5-mile radius circles) throughout and adjacent to the storage field covered lands. Next, each colony home range was evaluated using the suitable Indiana bat habitat model to determine the number of colonies that had a minimum of 1,256 acres (i.e., 10% of the 12,560 acres within a 2.5 mile maternity colony home range) of modeled suitable habitat present within their potential home range.

The rationale provided above for the ROW (non-storage field counties) generally applies to storage field counties as well. NiSource and the Service would not expect that 13% (426 storage field colonies ÷ 3,260 rangewide colonies = 0.13) of the estimated range-wide 3,260 maternity colonies exist within the storage field covered lands counties. In order to establish a reasonable number of maternity colonies assumed to exist within the storage field covered lands, NiSource and the Service calculated the total number of theoretical Indiana bat maternity colonies if they were common and regularly dispersed (using a five-mile triangular grid) across the species range. Colonies were considered viable if their home range contained at least 10% suitable habitat (1,256 acres). The Indiana bat range-wide data were modified to remove any areas above 900 feet in elevation in New York State. This method produced an estimate of 19,823 viable colonies across the entire range. This number is not a realistic estimate of the number of Indiana bat colonies range-wide, but rather was created to identify an occupation adjustment (i.e., 16.45%) to apply to the similar analysis that was conducted to estimate colonies impacted in the NiSource MSHCP (3,260 ÷ 19,823 = 0.1645).

The percentage of viable modeled colonies occupied was applied to the number of modeled maternity colonies along the storage field covered lands to estimate that there would be 71 additional colonies along the storage field covered lands (426 x 0.1645 = 70.08). This number includes both colonies that would be centered within the storage field covered lands, and colonies that would be centered outside of the covered lands but close enough that their home ranges could be impacted by activities within the covered lands. Thus a total of 75 (four known and 71 modeled) colonies will be used for the following calculations. Since a conservative approach has been used to estimate take throughout this analysis, NiSource and the Service assume that each of the four known colonies would be affected and individuals within the colonies could be impacted, including harassment, harm or lethal take, by new construction within the storage field covered lands even though the modeling was designed to estimate all colonies impacted by activities within the covered lands.

1. O&M

While O&M activities specific to storage field operations may cause take of Indiana bats (i.e., construction and operation of waste pits associated with well reconditioning and abandonment), the majority of O&M activities anticipated to cause take are those that occur within the linear ROW, some of which cross storage field counties. Those impacts and resulting take were analyzed above. Because portions of the ROW are coextensive with the storage field counties, they are not double counted in this section. The take from the construction and operation of waste pits associated with reconditioning and abandonment has been accounted for in the storage field new construction covered lands analysis.

2. New Construction

Given the assumptions above, information provided in **Appendix A** (Annual Acreage Disturbance Estimates, and the amount of suitable Indiana bat habitat available within the covered lands), new construction (capital expansion projects) activities that have been identified to potentially cause take of Indiana bats will only occur on up to 3,000 acres (*see* Assumption 5 above) of storage field counties within the covered lands over the 50-year permit term. For the purpose of this analysis, NiSource and the Service have assumed that all new construction will occur within suitable Indiana bat habitat.

Estimating the take for maternity colonies is not straightforward involving new construction in storage field covered lands. While the entire 3,000-acre expected area of construction could fit within a single maternity colony home range (a home range encompasses 12,560 acres), storage fields are constructed in a network, not in a single large patch. New storage field networks are made up of small patches distributed across the landscape. These networks have very small landscape footprints in acreage, but have a large extent because of the way the patches are distributed. The locations of new storage fields can not be described in more specificity than to the county (for business and homeland security reasons), so they can not be geographically modeled.

A model of a storage field network indicates a maximum worst-case scenario of 540 acres of disturbance within a single 2.5-mile radius home range (**Figure 6.2.1.4-1**). If storage fields were constructed as densely as possible, they would intersect at least six modeled colony home ranges (3,000 acres ÷ 540 acres per colony = 5.56 maternity colonies [rounded up to six]). If storage field expansion activities are more dispersed, as many as four known and 71 modeled maternity colonies could be impacted by storage field expansion on a significantly reduced scale. In other words, as the acreage of disturbance within a single 2.5-mile radius home range decreases, impacts to the maternity colonies, though greater in number, grow more diffuse. The impact of this take is discussed in the Take Analysis (*see* Section 6.2.1.5 below).

This wide range of potential take (from four to 75 maternity colonies) and construction amounts per colony (from 0.11-4.3%) cannot be resolved without describing in more detail the locations of storage field projects. However, the reasonable worst-case scenario would be the intensely developed network impacting 540 acres/colony. Therefore, take is calculated for new construction in storage field counties as 3,000 acres which represents impacts to six maternity colonies or up to 720 individuals [i.e., six maternity colonies x 120 (60 adult females + 60 pups = 120) = 720 individuals] within the colonies that could be affected, by tree removal resulting in harassment, harm or possible lethal take by new construction within the storage field covered lands.

<u>SPRING STAGING/FALL SWARMING BATS</u>:

A. The following numbers are derived from the modeling discussed earlier in this chapter and are used below to quantify take within the linear (ROW) covered lands (in non-storage field counties):

- 240,300 acres of linear (ROW) covered lands through known spring staging/fall swarming habitat for 75 known hibernacula.
    - 52,000 acres of linear (ROW) covered lands through spring staging/fall swarming habitat for 10 Priority 1 & 2 hibernacula; and
    - 188,300 acres of linear (ROW) covered lands through spring staging/fall swarming habitat for 65 Priority 3 & 4 hibernacula.
- 16,000 acres of linear (ROW) covered lands through presumed spring staging/fall swarming habitat for 5 presumed Priority 2 hibernacula.

Similar to maternity colonies, NiSource and the Service are capable of reaching a supportable conclusion on an estimate of the number of Indiana bats taken (i.e., killed, harmed, harassed) by covered activities within the linear (ROW) covered lands. The Service and states have surveyed populations of Indiana bats occupying these hibernacula for decades in many cases and have defined the importance of each hibernaculum by defining them into one of four priority groupings. Priority groups (P) are defined as follows: P1 hibernacula typically have a current and/or historically observed winter population of greater than or equal to 10,000 Indiana bats; P2 have a current or observed historic population of 1,000 or greater but fewer than 10,000; P3 have current or observed historic populations of 50 to 1,000 bats; and P4 have current or observed historic populations of fewer than 50 bats. The following discussion outlines the two step process used to calculate the reasonable worst-case scenario for take of Indiana bats in spring staging/fall swarming habitat.

First, a reasonable worst-case scenario take of Indiana bats was estimated, using the priority groupings and making the assumption that the maximum number of Indiana bats allowed for each priority grouping occupies the hibernaculum with the only deviation being for P1 hibernacula (i.e., P2 = 10,000 Indiana bats; P3 = 1,000 bats, P4 = 50 bats). Because P1 hibernacula are defined as having greater than 10,000 bats occupying them, the sum of the three P1 hibernacula spring staging/fall swarming populations intersected by the covered lands was calculated to determine the worst-case scenario take of Indiana bats at P1 hibernacula. The total sum 2009 population estimate for these three P1 hibernacula is 38,081 bats.

Once this reasonable worst-case scenario take was calculated, NiSource was then able to refine this estimate by incorporating the average percentage of the hibernacula's spring staging/fall swarming zone intersected by linear (ROW) and Storage Field covered lands to calculate the reasonable worst-case take for impacts to spring staging/fall swarming habitat.

1. O&M

Based on the results of modeling of spring staging/fall swarming impacts, the O&M of ROW covered lands may cause take of Indiana bats within spring staging/fall swarming habitat of 75 hibernacula (three P1, seven P2, 19 P3, and 46 P4 hibernacula) over the 50-year permit. Following the process outlined above, the maximum worst-case scenario of take from O&M of ROW covered lands would total 129,381 Indiana bats across 75 known hibernacula.

Given the assumptions above, information provided in **Appendix A** (Annual Acreage Disturbance Estimates, and the amount of suitable Indiana bat habitat available within the covered lands), NiSource has estimated that O&M activities that have been identified to potentially cause take of Indiana bats will occur on up to 3,900 acres (*see* Assumption 3 above) of suitable Indiana bat habitat over the 50-year permit term. For the purpose of this analysis, NiSource and the Service have assumed that O&M of existing ROW covered lands will occur once within the 240,300 acres (from above) of suitable Indiana bat spring staging/fall swarming habitat. Once this habitat has been cleared, the pipeline ROW would be maintained in a vegetative state unsuitable for roosting by Indiana bats (*see* assumption 7 above). An additional step was added to account for the fact that only 3,900 of the 240,300 acres of suitable spring staging/fall swarming habitat would be impacted by construction within the existing ROW covered lands, reducing the estimate to 2,200 Indiana bats (3,900 acres ÷ 240,300 acres = 0.017; 0.017 x 129,381 bats = 2,200 bats).

Once this reasonable worst-case scenario take was calculated, NiSource was then able to refine this estimate by incorporating the average percentage of the hibernacula's spring staging/fall swarming zone intersected by linear (ROW) and Storage Field covered lands to calculate the reasonable worst-case take for impacts to spring staging/fall swarming habitat.

1. O&M

Based on the results of modeling of spring staging/fall swarming impacts, the O&M of ROW covered lands may cause take of Indiana bats within spring staging/fall swarming habitat of 75 hibernacula (three P1, seven P2, 19 P3, and 46 P4 hibernacula) over the 50-year permit. Following the process outlined above, the maximum worst-case scenario of take from O&M of ROW covered lands would total 129,381 Indiana bats across 75 known hibernacula.

Given the assumptions above, information provided in **Appendix A** (Annual Acreage Disturbance Estimates, and the amount of suitable Indiana bat habitat available within the covered lands), NiSource has estimated that O&M activities that have been

identified to potentially cause take of Indiana bats will occur on up to 3,900 acres (*see* Assumption 3 above) of suitable Indiana bat habitat over the 50-year permit term. For the purpose of this analysis, NiSource and the Service have assumed that O&M of existing ROW covered lands will occur once within the 240,300 acres (from above) of suitable Indiana bat spring staging/fall swarming habitat. Once this habitat has been cleared, the pipeline ROW would be maintained in a vegetative state unsuitable for roosting by Indiana bats (*see* assumption 7 above). An additional step was added to account for the fact that only 3,900 of the 240,300 acres of suitable spring staging/fall swarming habitat would be impacted by construction within the existing ROW covered lands, reducing the estimate to 2,200 Indiana bats (3,900 acres ÷ 240,300 acres = 0.017; 0.017 x 129,381 bats = 2,200 bats).

However, this is not a supportable conclusion of take because only 0.17% (the average percentage of known hibernaculum range covered by existing ROW, i.e. 331 acres per hibernaculum) of the spring staging/fall swarming habitat available to Indiana bats at each hibernacula could be impacted by O&M activities. NiSource and the Service used the assumption that Indiana bats in spring staging/fall swarming habitat surrounding the hibernacula are evenly distributed throughout that habitat and used the average percentage of this habitat intersected by the covered lands to estimate the reasonable worst-case take of Indiana bats from O&M activities in spring staging/fall swarming habitat intersecting existing ROW covered lands to be a total of four individuals over the 50-year permit term (2,200 bats x 0.0017 = 3.74 bats [rounded up to four]).

2. New Construction

Based on the results of modeling of spring staging/fall swarming impacts, new construction within linear (ROW) covered lands could cause take of Indiana bats within spring staging/fall swarming habitat of 75 known hibernacula (three P1, seven P2, 19 P3, and 46 P4) over the 50-year permit term. Impacts could also occur to currently unknown hibernacula. NiSource additionally estimates five sites with potential to be hibernacula could be impacted by new construction activities (*see* AMM #2 in Section 6.2.1.3 and Assumption 16 above). NiSource and the Service assumed all such sites will be presumed to be P2 hibernacula because it is highly unlikely that a P1 hibernacula would remain unknown given the range-wide population monitoring program in place. Following the process outlined above, the maximum worst-case scenario of take from new construction in linear (ROW) covered lands would total 179,381 Indiana bats (129,381 across 75 known hibernacula + 50,000 at five currently unknown presumed P2 hibernacula).

Given the assumptions above, information provided in **Appendix A** (Annual Acreage Disturbance Estimates, and the amount of suitable Indiana bat habitat available within the covered lands), NiSource has estimated that new construction (capital expansion projects) activities that have been identified to potentially cause take of Indiana bats will occur on up to 63,000 acres (*see* Assumption 4 above) of linear ROW within the covered lands over the 50-year permit term. For the purpose of this analysis, NiSource and the Service have assumed that all new construction will occur within suitable spring staging/fall swarming Indiana bat habitat. An additional step was added to account for the fact that only 63,000 of the 256,300 acres of suitable spring

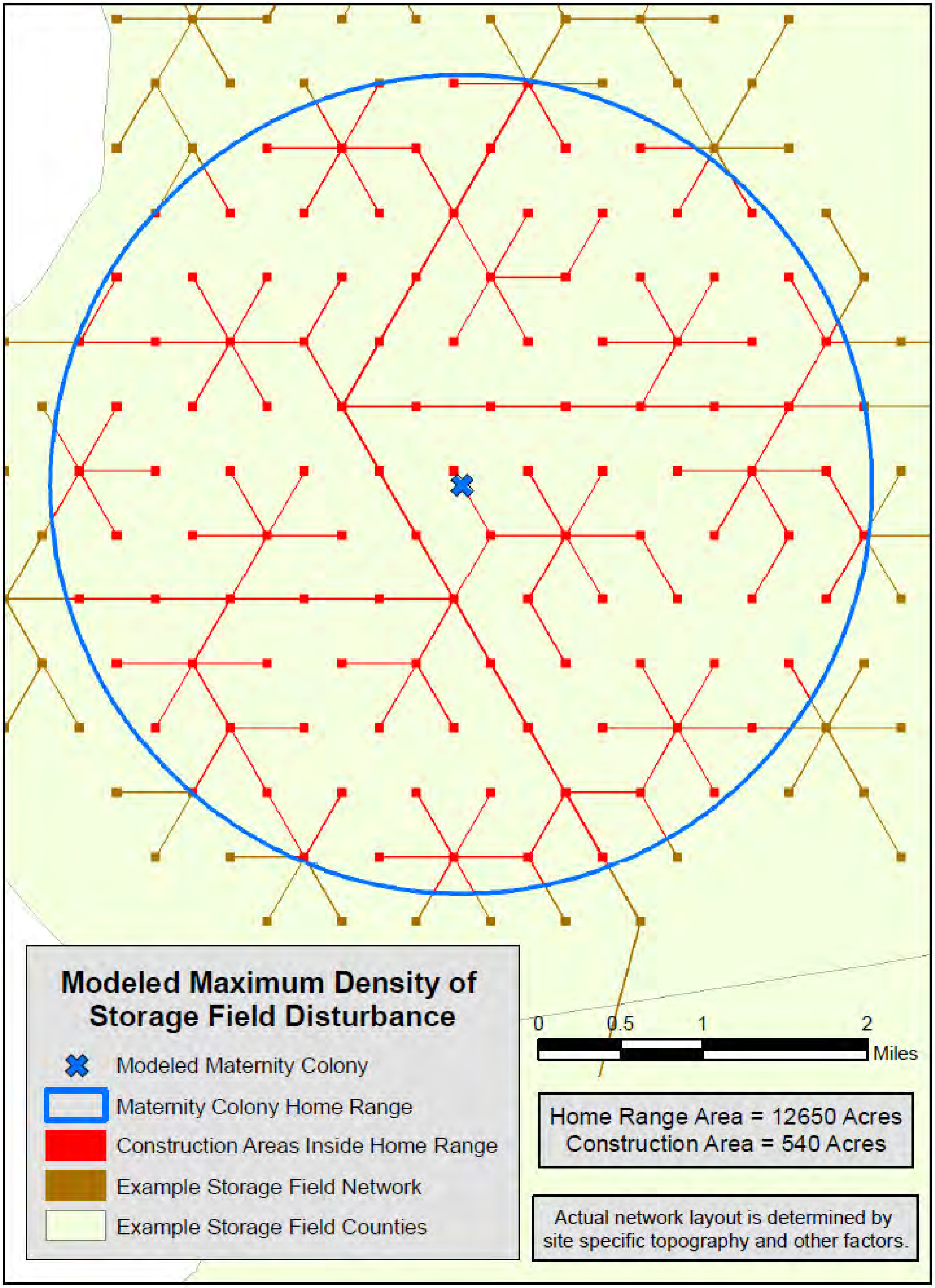

Figure 6.2.1.4-1 Modeled Maximum Density of Storage Field Disturbance

staging/fall swarming habitat would be impacted by new construction within the linear (ROW) covered lands, reducing the estimate to 44,846 Indiana bats (63,000 acres ÷ 256,300 acres = 0.25; 0.25 x 179,381 bats = 44,846 bats).

However, this is not a supportable conclusion of take because only 0.22% (the average percentage of known hibernaculum range covered by existing ROW, plus a 33% increase for the larger width of a new construction ROW, i.e. 441 acres per hibernaculum) of the spring staging/fall swarming habitat available to Indiana bats at each hibernacula is likely to be impacted by new construction activities. NiSource and the Service used the assumption that Indiana bats in spring staging/fall swarming habitat surrounding the hibernacula are evenly distributed throughout that habitat. NiSource and the Service estimate the reasonable worst-case take of Indiana bats from new construction activities in spring staging/fall swarming habitat intersecting linear (ROW) covered lands to be a total of 99 individuals over the 50-year permit term (44,846 bats x 0.0022 = 98.66 bats [rounded up to 99]).

B. The following numbers are derived from the modeling discussed earlier in this chapter and are used below to quantify take within the Storage Field Counties:

- 616,800 acres of storage field counties covered lands through known spring staging/fall swarming habitat for 11 known hibernacula.
  - All 616,800 acres of storage field counties covered lands through spring staging/ fall swarming habitat for 11 Priority 3 & 4 hibernacula.
- 280,400 acres of storage field counties covered lands through presumed spring staging/fall swarming habitat for five presumed Priority 2 hibernacula.

1. O&M

While O&M activities specific to storage field operations may cause take of Indiana bats (i.e., construction and operation of waste pits associated with well reconditioning and abandonment), the majority of O&M activities anticipated to cause take are those that occur within the linear ROW, some of which cross storage field counties. Those impacts and resulting take were analyzed above. Because portions of the ROW are coextensive with the storage field counties, they are not double counted in this section. The take from the construction and operation of waste pits associated with reconditioning and abandonment has been accounted for in the storage field new construction covered lands analysis.

2. New Construction

Based on the results of modeling of spring staging/fall swarming impacts, new construction within storage field covered lands could cause take of Indiana bats at two P3 and nine P4 hibernacula over the 50-year permit term. Impacts could also occur to currently unknown hibernacula. NiSource additionally estimates five sites with potential to be hibernacula could be impacted by new construction activities (*see* AMM #2 in Section 6.2.1.3 and Assumption 16 above). NiSource and the Service assumed all such sites will be presumed to be P2 hibernacula because it is highly unlikely that a P1 hibernacula would remain unknown given the range-wide population monitoring program in place. Following the process outlined above, the maximum worst-case scenario of take from new construction activities within storage field covered lands would total 52,450 Indiana bats (2,450 across 11 known hibernacula + 50,000 at five currently unknown presumed P2 hibernacula).

Given the assumptions above, and information provided in **Appendix A** (Annual Acreage Disturbance Estimates), NiSource has determined that new construction (capital expansion projects) activities that have been identified to potentially cause take of Indiana bats will only occur on up to 3,000 acres (*see* Assumption 5 above) of storage field counties within the covered lands over the 50-year permit term. For the purpose of this analysis, NiSource and the Service have assumed that all storage field new construction will occur within suitable spring staging/fall swarming Indiana bat habitat. An additional step was added to account for the fact that only 3,000 of the 897,200 acres of suitable spring staging/fall swarming habitat would be impacted by new construction within the storage field covered lands, reducing the estimate to 179 Indiana bats (3,000 acres ÷ 897,200 acres = 0.0034; 0.0034 x 52,450 bats = 179 bats).

However, this is not a supportable conclusion of take because only 45% (the average percentage of known hibernaculum range covered by existing ROW, i.e. 90,315 acres per hibernaculum) of the spring staging/fall swarming habitat available to Indiana bats at each hibernacula is likely to be impacted by new construction activities. NiSource and the Service used the assumption that Indiana bats in spring staging/fall swarming habitat surrounding the hibernacula are evenly distributed throughout that habitat. NiSource and the Service estimate the reasonable worst-case take of Indiana bats from new construction activities in spring staging/fall swarming habitat intersecting storage field covered lands to be a total of 81 individuals over the 50-year permit term (179 bats x 0.45 = 80.55 bats [rounded up to 81]).

SUMMARY:

Through modeling, NiSource covered activities could result in impacts to known and potentially suitable summer habitat that could support up to 2,400 individuals within 20 maternity colonies. Similarly, NiSource covered activities could also impact spring staging/fall swarming habitat that could support up to 184 individuals. However, NiSource and the Service were unable to estimate with precision the actual number of individuals that will be taken as a result of NiSource covered activities.   For this reason, NiSource and the Service used habitat as a surrogate to the number of individuals potentially taken. The maximum acreage of potentially suitable Indiana bat habitat that could be impacted over the life of the permit is 69,900 acres, and the estimates of take, through modeling, have been calculated as a subset of that total acreage.

6.2.1.5 Impact of Take Analysis

Take is requested for a low, but immeasurable percentage of the 2,584 total Indiana bat individuals estimated to be present within no more than 69,900 acres of summer and/or spring staging/fall swarming habitat impacts over the life of the permit.

As a reference for the impact of the take discussion to follow, a summary of the type of take anticipated within each habitat/specific life stage is provided in **Table 6.2.1.5-1**.

The take calculation above describes the reasonable worst-case estimate of take in individuals and also the maximum acreage of known and suitable Indiana bat habitat impacted by NiSource (estimated), in instances where impacts rise to the level of mortality, harm, or harassment. The take analysis builds on the take calculation by further explaining the anticipated impact this reasonable worst-case take is anticipated to have on Indiana bats at the individual and population (i.e., maternity colony and spring staging/fall swarming group) level.

__Individual Level__

Because Indiana bat records occur broadly across the covered lands, nearly any action within suitable habitat has the potential to take individuals. Generally speaking, individual Indiana bats must have adequate roosting, foraging, and commuting resources within their maternity colony home range and spring staging/fall swarming zone in order to successfully meet their life history requirements. Based on the effects analysis completed for the MSHCP, covered activities identified to cause take only included the clearing of roost trees in known and suitable summer habitat and spring staging/fall swarming habitat, as well as the construction of waste pits in storage field counties.

The scale of clearing associated with these covered activities range from 61 to 3,000 acres depending upon the type of covered lands and activities. A maximum worst-case scenario of 61 acres (12,560 acres x 0.48%[4] = 60.61 acres) of total habitat within a maternity colony may be impacted from O&M or new construction within the linear (ROW) covered lands. Likewise, a maximum worst-case scenario of 242 acres (201,062 acres x 0.12%[5] = 242.42 acres) of total habitat within a spring staging/fall swarming population may be impacted from O&M or new construction within the linear (ROW) covered lands.

For storage field impacts within a summer maternity colony, an intensely developed network (**Figure 6.2.1.4-1**) of impacts to 540 acres (12,560 acres x 4.3%[6] =

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[4] The maximum acreage of an estimated home range for each maternity colony that may be taken by new construction of a linear (ROW) is 60.61 acres [length of the ROW through center of maternity colony home range is assumed to be 5.0 miles (2.5 mile radius x 2); width of ROW is assumed to be 100 feet; 5 x 5,280 feet = 26,400 feet; 26,400 feet x 100 feet = 2,640,000 square feet; 2,640,000 sq. ft. ÷ 43,560 sq. ft. per acre = 60.61 acres]. This maximum acreage of take represents only 0.48% (60.61 acres ÷ 12,560 acres = 0.004825 x 100 = 0.48%) of a maternity colony's home range.

[5] The maximum acreage of an estimated swarming zone for each spring staging/fall swarming site that may be taken by new construction of a linear (ROW) is 242 acres [length of the ROW through center of spring staging/fall swarming zone is assumed to be 20 miles (10 mile radius x 2); width of ROW is assumed to be 100 feet; 20 x 5,280 feet = 105,600 feet; 105,600 feet x 100 feet = 10,560,000 square feet; 10,560,000 sq. ft. ÷ 43,560 sq. ft. per acre = 242.42 acres]. This maximum acreage of take represents only 0.48% (242.42 acres ÷ 201,062 acres = 0.001206 x 100 = 0.12%) of a maternity colony's home range.

[6] 540 acres (from modeling exercise) of maximum worst case impact ÷ 12,560 acres of area within a maternity colony home range = 0.0430 or 4.3%.

540 acres) of maternity colony habitat may occur from O&M or new construction. Although this estimate is used as the maximum worst-case scenario for the purpose of population level analysis of impact to the species, it is not expected that this level of impact (i.e., 540 acres) will occur within any given maternity colony home range. This estimate is based on the assumption that the impact to the entire network of well sites and transmission lines would occur within suitable summer habitat. Forested habitat (i.e., suitable summer habitat), at a landscape scale, is generally clustered within

Table 6.2.1.5-1 Table of Indiana Bat Habitat/Specific Life Stage Types and Type of Take Expected within the Covered Lands

HABITAT/SPECIFIC LIFE STAGE TYPE	TYPE OF TAKE[7]
Known Summer Maternity Habitat	Indirect
Suitable Summer Habitat	Direct[8] & Indirect
Immobile Indiana Bats (i.e., pups)	None
Known Spring Staging/Fall Swarming Habitat of P1/P2 Hibernacula	Indirect
Known Spring Staging/Fall Swarming Habitat of P3/P4 Hibernacula	Direct & Indirect
Presumed Spring Staging/Fall Swarming Habitat (always assumed as of P1/P2 hibernacula)	Indirect
Known Winter Hibernacula Habitat	None
Presumed Winter Hibernacula Habitat (always assumed as P1/P2 hibernacula)	None

a patchwork of non-forested lands (e.g., residential properties, agricultural lands, pasture lands, commercial development, etc.). Thus, the likelihood that suitable summer habitat would be impacted is reduced because of the dispersed nature of this impact. Furthermore, the less suitable summer habitat present within a given maternity colony home range, the less likely it will be that the 540 acres of maximum impact would occur to that suitable summer habitat. In other words, a maternity colony home range largely dominated by forest (i.e., suitable summer habitat) might have 540 acres of impact to its summer habitat but the significance of that habitat would be reduced due to the large percentage of summer habitat remaining within the home range.

For storage field impacts within a spring staging/fall swarming population, an intensely developed network (**Figure 6.2.1.4-1**) of impacts to 8,644 acres (201,062

[7] Direct take refers to take that occurs while Indiana bats are present at the time of impact to habitat (i.e., occupied). Indirect take refers to take that occurs while Indiana bats are absent at the time of impact to habitat (i.e., unoccupied).

[8] Direct take will only occur from ROW and storage field new construction activities. Direct take of Indiana bats from O&M activities in the existing ROW has been avoided in suitable summer habitat (*see* AMMs #27 and #29 above).

acres x 4.3% = 8,644 acres) of total habitat were calculated as the maximum worst-case impacts from O&M or new construction. However, this is not a reasonable maximum estimate for spring staging/fall swarming habitat given that NiSource could impact no more than 3,000 acres (*see* Assumption 5 in Take Calculation, Section 6.2.1.4) over the 50-year permit term. Reducing this amount to 3,000 acres is still a conservative overestimate because it is highly unlikely that all 3,000 acres of impact planned through the permit term would occur within a single spring staging/fall swarming zone. The more likely scenario is that there will be much smaller scale impacts across several staging/swarming zones. Despite this, it is assumed that 3,000 acres or 1.5% (3,000 ÷ 201,062 = 0.0149) of suitable spring staging/fall swarming habitat would be removed as the maximum worst-case scenario for the purpose of population-level analysis of impact to the species. Given the type of impact from covered activities in combination with this small scale, the effects analysis determined that impacts to foraging and commuting habitat is insignificant to individual Indiana bats.

As a result, individual Indiana bats may experience impacts that range from minor nuisance (e.g., short-term nearby noise) to death (e.g., clearing of an occupied roost tree while bats are present and entrapment of bats in waste pits). As illustrated in **Table 6.2.1.5-1**, NiSource has avoided the majority of direct take (i.e., occupied habitat impacts) to individual Indiana bats in known habitat and has avoided direct take of lactating females and immobile pups throughout the covered lands resulting in a significant reduction in the likelihood of mortality occurring. While the potential for mortality does exist within known spring staging/fall swarming habitat of P3 and P4 hibernacula, suitable summer habitat from tree clearing activities, and the operation of waste pits associated with well construction, reconditioning, and abandonment, the frequency in which it is expected to occur is low due to the small scale of the impact. Despite this, a low, but immeasurable amount of mortality is expected to occur to individuals over the 50-year permit term.

Clearing of suitable summer and/or spring staging/fall swarming habitat will displace all bats within the action area. This includes Indiana bats, as well as all other species of bats that are present within the action area. These displaced bats are expected to move into the remaining suitable habitat present immediately adjacent to the action area. Interspecific and intraspecific competition between displaced bats and bats within adjacent undisturbed areas may significantly increase as the displaced bats attempt to locate new roosting and foraging areas. The feeding habits of Indiana bats are similar to those of other species known to exist within the covered lands like the little brown bat (*M. lucifugus*), the Northern long-eared bat (*M. septentrionalis*), and to a lesser extent the Eastern pipistrelle (*P. subflavus*) (Whitaker 2004). Therefore, competition between those species may be pronounced as all species move quickly into adjacent roosting habitat. Although very little literature is available to assess the impact of this effect, interspecific competition has been identified as an area of significant concern by researchers monitoring maternity colonies subject to habitat alterations in Indiana (Whitaker 2010). It is possible that displaced individual bats will experience lower survival rates (i.e., harm) when competing against other bats that have already established territories and are familiar with the area; however, we are not able to measure the amount of harm that is expected to occur due to the lack of knowledge assessing the impact of this effect. The displaced bats may need to increase energy expenditures since they may be required to increase commuting distances to traditional foraging areas, and/or expend additional energy seeking new foraging and roost sites. This increased energy expenditure is anticipated to "harm" and "harass" individuals by affecting fitness, nutrition, and reproductive success.

Indirect take (i.e., unoccupied habitat impacts) could also result because Indiana bats show fidelity to individual trees and roosting areas, within and among years. Thus, removing known and/or presumed occupied roosting habitat while the bats are absent from their habitat still causes harassment when bats return to an altered summer and/or spring staging/fall swarming habitat. Individual bats returning to summer habitat will be forced to locate new roosts in the spring at a time when they are stressed from hibernation, migration, and the increased energy costs of reproduction. The impact is lessened because roost trees are ephemeral habitats (bats inherently must be prepared to deal with sudden loss of roosts), roost switching occurs every two to three days, and trees used by individual bats tend to be clustered in the environment making it less likely, given the small percentage of a bats home range (i.e., 0.48%) or staging/swarming zone (i.e., 0.27% or 4.3%) impacted, that large numbers of roosts would be removed. Indirect take from the operation of waste pits associated with well construction, reconditioning, and abandonment is possible if an individual bat drinking from the pit was not entrapped. Although we are not able to measure the amount of harm that is expected to occur due to the lack of knowledge, assessing the impact of this effect (e.g., bats are small and not usually observed or recovered when impacted by similar activities), NiSource and the Service anticipate harm may occur to those bats from the ingestion of waste fluids while cleaning themselves after their escape by affecting fitness and reproductive success. It is important to note that these pits are temporary features on the landscape used by NiSource during the construction, reconditioning, and abandonment of drilling well sites. Thus, long-term effects to individuals are not anticipated to occur.

Population-Level Impacts

As described above, individual Indiana bats may experience decreased reproductive success and slightly increased mortality as a result of NiSource's activities. Of importance here though, is how these potential adverse effects to individual bats affect the overall health and viability of a maternity colony and/or spring staging/fall swarming populations present within the covered lands. The covered lands of the NiSource MSHCP lie near the center of the Indiana bat's range and contains numerous caves and forestlands known to contain and provide summer maternity and spring staging/fall swarming habitat for the species. The analysis that follows describes impact of the incidental take requested on Indiana bats at the maternity colony and spring staging/fall swarming population levels.

Maternity Colony Populations within the Covered Lands

Approximately 18 known maternity colonies are scattered throughout the covered lands with notable clusters of maternity colonies occurring in Kentucky, New York, Ohio, and Pennsylvania. Through modeling efforts, NiSource and the Service have estimated that a total of 254 maternity colonies exist within the covered lands. Furthermore, there are estimated to be a total of 120 individuals (60 adult females and

60 pups) present within each of these maternity colonies. Of these 254 colonies, NiSource and the Service anticipate take in the form of mortality, harm, and harassment may occur at a low, but immeasurable level to 2,400 individuals within 20 colonies.

Spring Staging/Fall Swarming Populations around known and Presumed hibernacula within the Covered Lands

Approximately 86 Priority 1 - 4 hibernacula identified in the draft, revised Indiana bat recovery plan lie within ten miles of the covered lands. Of these hibernacula, at least five are located within the covered lands themselves (four in NiSource identified storage field counties and one in the ROW covered lands corridor. Additionally, ten are identified as Priority 1 or 2 hibernacula, while the remaining 76 are Priority 3 or 4 hibernacula. Many of these caves occur within areas of existing conservation ownerships, both private and public. Of particular note are the Daniel Boone (Kentucky), Wayne (Ohio), and Monongahela (West Virginia) National Forests managed by the U.S. Forest Service, Carter Cave State Resort Park and Kingdom Come State Park managed by the Kentucky Department of Parks. NiSource's covered activities may result in impacts to spring staging/fall swarming habitat located within 10 miles of an unspecified number of the 86 known hibernacula. NiSource and the Service anticipate these impacts may result in the incidental taking of a low, but immeasurable percentage of 184 individual Indiana bats present within the populations of these 86 spring staging/fall swarming sites in the form of mortality, harm, and harassment.

As stated previously, a reasonable worst-case scenario approach has been used to calculate the amount of take and analyzing the impact of that take in both suitable summer and spring staging/fall swarming habitats. In using this approach, NiSource and the Service have operated under the assumption that all 69,900 acres of impact would occur in each of these habitat types independently. This approach results in a significant overestimation of the actual take incurred during implementation. However, without more information regarding the location of specific projects for the next 50 years, this conservative approach is reasonable to ensure that the mitigation program fully compensates for the impact of the take. Thus, the overall take is represented by no more than 69,900 acres of suitable summer and/or spring staging/fall swarming habitat impacts over the life of the permit.

Because the scale of impacts to a summer maternity colony or spring staging/fall swarming population is small compared to other actions on the landscape with significantly larger impact footprints, adverse affects at the population level from reduced colony cohesion, increased stress, or increased energy demands from searching for new roost areas are not expected. Similarly, decreased thermoregulatory efficiency is not expected or that these impacts will lead to reduced reproductive success at the population level. As summarized above, NiSource and the Service expect that minor, short term effects at the population level are possible because of the removal of roost trees, and the operation of waste pits.

As explained in the individual level analysis, the risk of tree cutting and the operation of waste pits associated with well construction, reconditioning, and abandonment to bats varies depending upon the timing of the clearing activities within the occupied habitat. The use of these habitats by bats varies by season. For the purposes of completing the effects analysis, it is assumed Indiana bats could be in spring staging habitat from April 1st to May 31st, suitable summer habitat from April 1st to August 15th and fall swarming habitat from August 15th to November 14th. There is some overlap in these time periods due to the variability in when Indiana bats leave and arrive in their summer maternity and spring staging and fall swarming habitats as a result of significant climate differences from the northern and southern portions of this wide-ranging species.

NiSource has avoided any risk to Indiana bat spring staging/fall swarming populations of P1 and P2 hibernacula by agreeing not to remove suitable habitat and not operating waste pits associated with well construction, reconditioning, and abandonment during these time periods (*see* AMMs #13 and #24). Within spring staging habitat of P3 and P4 hibernacula, cutting trees and the operation of waste pits associated with well construction, reconditioning, and abandonment while bats are emerging from hibernation and staging before migrating to summer habitats may increase the risk of affecting pregnant females. The death of a pregnant female would result in the take of two Indiana bats (the adult female as well as her fetus); affecting both the size and reproductive potential of the maternity colony to which she will migrate.

Within fall swarming habitat of P3 and P4 hibernacula, cutting trees and the operation of waste pits associated with well construction, reconditioning, and abandonment while bats are swarming near hibernacula will increase the risk of affecting Indiana bats within these populations. When a female fails to return to her hibernaculum, the size of the hibernating population is reduced. This is magnified by the loss of her unrealized reproductive potential (i.e., lost progeny that will never be part of or contribute to that hibernating population, or any other hibernating population). There are several advantages to being a member of a large hibernating population. Clawson et al. (1980) suggests that the "substantial metabolic advantages" of large clusters, and the bats' clustering behaviors, may buffer populations within individual hibernacula from extinction. Additionally large populations benefit from the social and energetic (thermoregulatory) advantages of hibernating in dense clusters; congregating for spring staging; and having many individuals available during fall swarming to ensure reproductive success.

While NiSource has avoided population level risks to Indiana bats at the largest spring staging/fall swarming populations of P1 and P2 hibernacula, a reduction in the numbers of bats present to swarm, mate, and cluster within a source hibernacula (especially at a P3 or P4 hibernaculum) may place the remaining bats at a physiological disadvantage. These remaining bats may be more susceptible to changes in temperature, rapid arousal, and extreme stress during hibernation, thus causing a reduction in survival or reproduction (Clawson et al. 1980).

Within summer maternity habitat, the risk may be slightly less in April and early May, when the bats are migrating between their hibernacula and summer habitat. However, Indiana bats have been documented to arrive in maternity areas as early as early April (Armstrong 2010). Regardless, by mid-May they are usually established in their summer habitat. Cutting trees and operating waste pits associated with well construction, reconditioning, and abandonment in late April and May will increase the risk of affecting pregnant females. Injury to a pregnant female may result in injury to, or death through spontaneous abortion of her fetus, also resulting in a reduction of the colony's reproductive potential through loss of intra-season recruitment of her pup into the colony. Data regarding the year-to-year recruitment of female Indiana bats into a maternity colony is lacking at the current time. NiSource has avoided any risk to lactating females and immobile pups during the nursing period of June 1 to August 1 by agreeing to not remove suitable summer habitat or operating waste pits associated with well construction, reconditioning, and abandonment during this time (*see* AMMs #29 and #38). Cutting trees and the operation of waste pits associated with well construction, reconditioning, and abandonment in early to mid-August may increase the risk of affecting post-lactating females and newly volant juvenile bats, affecting both the size and reproductive potential of the colony in future years.

In summary, NiSource has agreed to avoid these population-level affects within known summer maternity habitat, known and presumed spring staging/fall swarming habitat of P1 and P2 hibernacula, and suitable summer habitat during the time when lactating females and immobile pups are present. It is unknown whether there are a minimum number of bats that are needed for a colony or staging/swarming population to be viable. However, the severity of these impacts would be minor at best given that a large percentage (i.e., 99.52% in suitable summer habitat to 95.70% in spring staging/fall swarming habitat) of the area encompassed by the population will be unaffected outside the impact area. Therefore, NiSource and the Service do not expect the adverse effects to individual bats will affect the overall health and viability of a maternity colony or spring staging/fall swarming populations present within the covered lands.

White-Nose Syndrome

WNS, the cause of which has yet to be verified, has spread rapidly throughout the Northeast – from just four wintering sites in New York in 2007 to more than 100 sites in twelve states [Connecticut, Massachusetts, New York, New Jersey, Pennsylvania, Vermont, West Virginia, New Hampshire, Virginia, Tennessee, Maryland, and Missouri (likely)] by April 2010. This reflects a jump in the radius of WNS affected hibernacula from approximately 124 miles in 2008, to approximately 403 miles in 2009, to approximately 800 miles in 2010 (assuming confirmation of WNS in Missouri). All known Indiana bat hibernacula in New York, Vermont, and New Jersey, except for a newly-discovered site (P3 or P4) in Orange County, NY (Bull Mine), have been documented with WNS (Service, unpublished data, 2009e). However in 2009, most Indiana bat hibernacula in other parts of the species' range were surveyed in accordance with the biennial winter survey schedule and no signs of WNS were observed beyond those aforementioned states (King 2009).

There is some evidence that impacts to Indiana bats may be inconsistent between hibernacula. Biologists conducted photographic surveys of all Indiana bat hibernacula in the State of New York in March 2008, to compare with the 2006-2007 counts. While still in draft form at present, there are some notable discrepancies in the population trends evident between different affected sites. For example, Indiana bat numbers and roosting locations appeared normal at both Barton Hill and Williams Hotel (Hicks

2008), however, at Glen Park Cave, the "K-cluster" of Indiana bats appeared to be where expected at the end of March 2008, but preliminary analyses indicate that there were approximately 600-800 fewer individuals that season compared to the total estimate (1,932 Indiana bats) from 2006-2007. This difference represents a drop in abundance of 30-40%. A more drastic decline (100%) was observed at Haile's Cave, where Indiana bats had been documented during every survey since 1981. In 2004-2005, 685 Indiana bats were observed at the site, but no Indiana bats (living or dead) were found at Haile's Cave during surveys in 2007, 2008, or 2009 (Hicks and Newman 2007; Hicks 2008). Haile's Cave has been classified as an ecological trap hibernaculum in the Indiana Bat Draft Recovery Plan (Service 2007a) due to the history of occasional flooding and freezing events at this site. However, the total and persistent loss of all Indiana bats at this site is unprecedented. Lastly, late winter counts in Williams Preserve and Williams Lake are down by 92-99% when compared to 2006-2007 mid-winter surveys. In 2006-2007, there were approximately 13,014 and 1,003 Indiana bats in the Williams Preserve and Williams Lake, respectively. In April 2008, counts were closer to 124 and 80 Indiana bats (Hicks et al. 2008). Because the surveys were conducted late in the season, and no carcasses were found at these sites, it was hoped the missing Indiana bats had moved to new hibernacula or had emerged prior to the survey. Count data collected during the 2009 survey at this site, conducted in February, did not support this alternate hypothesis, however, and Indiana bat abundance was slightly lower than recorded in April 2008 (Hicks 2009).

WNS has now been documented in twelve states, and the degree of impact to bats varies greatly by site and species. Based on observations of continued mass-mortality at several sites, the loss of Indiana bats is anticipated to continue in all regions currently affected. In addition, WNS will likely continue to radiate out to new sites, however the potential for climate, or some other environmental factor, to influence the spread of WNS, or the severity of its impact on affected bats, is unknown.

In summary, population-level impacts from NiSource activities could affect both animals and habitat. Existing data (King 2009) reveals that the populations of Indiana bats within WNS-affected states are declining due to a significant loss of bats from WNS. Despite this recent downward turn, overall population numbers are significantly higher than they were as recently as 2003. As stated above, Indiana bat populations are affected by WNS throughout the northeastern part of its range and has recently began to affect populations of hibernating bats (but not Indiana bats) in the Midwest and Ozark-Central Recovery Units, which overlap with multiple states in NiSource covered lands, therefore impacts associated with WNS are part of the baseline when considering the effects of NiSource activities. While a number of WNS-infected maternity colonies and spring staging/fall swarming populations could be impacted by NiSource covered activities (i.e., part of the baseline), NiSource and the Service do not expect that the adverse effects to individual bats will affect the overall health and viability of a maternity colony or spring staging/fall swarming populations present within the covered lands (*see* individual and population-level take analysis above). However, as WNS continues to spread south and westward closer to the core of the species' largest hibernating colonies in Indiana and Kentucky, even minimal impacts to Indiana bats in suitable summer and/or spring staging/fall swarming habitat may become important. Because it is not known how WNS will progress in the future (i.e., significant uncertainty), contingencies are explicitly identified in Chapter 10 (Assurances, Changed Circumstances, Disease, Section 10.3.6) that ensures population status, take from covered activities, and progression of WNS are evaluated annually.

Genetic-Level Implications

Recent population genetics research supports the premise of population discreteness. With the exception of one hibernaculum in the Northeast Recovery Unit (Jamesville Quarry Cave), populations in the proposed Northeast and Appalachian Mountain Recovery Units have very different frequencies of haplotypes than populations in the Midwest Recovery Unit (Vonhof 2006). Additionally, populations in the Northeast Recovery Unit have significantly less genetic diversity than those in the Appalachian Mountain, Midwest, and Ozark-Central Recovery Units and are likely of more recent origin.

The principle genetic consequences of activities that impact individuals or the habitat of a species include reduction in effective population size and the related: (1) loss of genetic variance through genetic drift and its importance for adaptation; and (2) fitness and its reduction through inbreeding depression (Schonewald-Cox et al. 1983).

Taxonomic studies and genetic analysis have identified that populational ranges of the Indiana bat have acted as isolating mechanisms, producing noticeable variation in the northeastern population. However, it has been concluded that while the establishment of populational ranges restricts gene flow within the species, this apparently has not been in effect long enough to allow race differentiation to occur (Service 2007a). Based on this existing information, there is no reason to assume genetic differences exist among populations of Indiana bat within the NiSource MSHCP covered lands. Due to this, NiSource and the Service conclude that the proposed impacts from its covered activities do not pose a significant genetic risk to Indiana bat.

6.2.1.6 Compensatory Mitigation

Implementation of NiSource's covered activities are anticipated to result in impacts to known and suitable summer habitat resulting in the incidental taking of an immeasurable percentage of 2,400 individuals within 20 Indiana bat maternity colonies. Similarly, NiSource's covered activities are anticipated to result in impacts to known and presumed spring staging/fall swarming habitat resulting in the incidental taking of an immeasurable percentage of 184 individual Indiana bats. Thus, take is requested for a low, but immeasurable percentage of the 2,584 total Indiana bat individuals estimated to be present within no more than 69,900 acres of summer and/or spring staging/fall swarming habitat impacts over the life of the permit. Given the avoidance and minimization measures developed for the MSHCP, take of Indiana bats in winter hibernacula or take of the winter habitat is not anticipated. NiSource and the Service also do not anticipate take to occur to immobile Indiana bats (i.e., pups) within the covered lands (i.e., within known and suitable summer habitat). No direct take is anticipated to occur in known summer maternity habitat and known spring staging/fall swarming habitat of Priority 1 and 2 hibernacula.

Mitigation Package

The following mitigation measures are required to compensate for the take of Indiana bat. Where the term "protection" appears below, please refer to Section 6.2 for a further definition and the requirements for securing conservation of mitigation lands and other real property interests.

1. **Linear impacts to summer habitat (up to 66,900 acres)**
   - Impacts anticipated to habitat and bats within 14 maternity colonies
   - Reasonable estimate of impact to a colony = 61 acres
   - 61 acres/colony × 14 colonies = 854 acres impacted over life of the permit

Mitigation Type

Protection (fee title or easement) of maternity colony habitat as mitigation for linear impacts to 14 maternity colonies using the ratios below.

Mitigation Ratios[9]

- o Unoccupied (out-of-season) fall swarming P3/P4- NO RATIO NEEDED - *see* Mitigation package item #1 above
- o Unoccupied (out-of-season) fall swarming P1/P2- NO RATIO NEEDED - *see* Mitigation package item #1 above
- o Occupied (in-season) fall swarming P3/P4- NO RATIO NEEDED - *see* Mitigation package item #1 above
- o Unoccupied (out-of-season) suitable summer (assumed or documented colony) (1.5:1)
- o Occupied (in-season) suitable summer (assumed only) (2:1)

2. **Storage field impacts to summer habitat** (up to 3,000 acres)
   - Impacts anticipated to bats and habitat within 6 maternity colonies
   - Reasonable estimate of impact to a colony = 540 acres
   - 540 acres/colony × 6 maternity colonies = 3,240 acres impacted over the life of the permit, however, NiSource has limited their actual clearing to 3,000 acres total.

Mitigation Type

Protection (fee title or easement) of maternity colony habitat as mitigation for storage field impacts to 6 maternity colonies using the ratios below.

Mitigation Ratios

- o Unoccupied (out-of-season) fall swarming zone- NO RATIO NEEDED – *see* Mitigation package item #1 above

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[9] In order to mitigate at the appropriate level, ratios will be applied by NiSource to ensure the mitigation is commensurate with the take expected during implementation. The selection of the ratio during implementation of the MSHCP is determined by establishing whether the take will occur while the habitat impacted would be occupied by Indiana bats (i.e., direct take) or while habitat would be unoccupied by Indiana bats (i.e., indirect take).

- Occupied (in-season) fall swarming P3/P4 – NO RATIO NEEDED – *see* Mitigation package item #1 above
- Unoccupied (out-of-season) suitable summer (assumed or documented) (2.5:1)
- Occupied (in-season) suitable summer (assumed only) (3:1)

3. **Impacts to spring staging/fall swarming habitat (up to 69,900 acres)**
   - Linear and/or storage field impacts anticipated to habitat and bats near 91 documented or assumed hibernacula.

Protection includes the development and implementation of a Hibernaculum Protection Plan to address threats (e.g., gating).

Mitigation Type

Protection of P1 and/or P2 Hibernacula and associated habitat to compensate for all impacts to spring staging and fall swarming habitat.

Mitigation Amount

If all work is done out-of-season (Unoccupied) - protect one P1 or P2 hibernaculum

If any activities also include in-season clearing (Occupied) - protect one additional P1 or P2 hibernaculum.

Total Maximum Mitigation

Spring Staging/Fall Swarming = 2 hibernacula projects = **252 Acres**

Gating estimate = $5,000 (estimated)

Summer habitat (suitable) = **1,708 Acres**

Storage Field Impacts = **9,000 Acres**

Sum = 10,960 Acres over 50 years = 219 acres/year

Total Minimum Mitigation (estimated without use of non-mandatory AMMs)

Spring Staging/Fall Swarming = 1 hibernaculum project = **126 Acres**

Gating estimate **= $2,500**

Summer habitat (suitable) = **1,281 Acres**

Storage Field = **7,500 Acres**

Sum = 8,907 Acres over 50 years = 178 acres/year

Summer Habitat Mitigation Sideboards:

a. Mitigation projects will occur at sites that are known to be used by Indiana bats (i.e., documented roost trees present) or assumed to have a very high likelihood of being used based on proximity to known roosting, foraging, and swarming sites (e.g., within 2.5 miles of known colonies or within 10 miles of hibernacula)

b. Mitigation projects will occur within the same recovery unit as the impacts occurred as first priority.

c. Habitat mitigation projects will be no smaller than 50 acres in size. Mitigation funds will continue to accrue until this minimum project size can be accomplished unless projects are contiguous to other lands protected and managed for the Indiana bat.

d. Projects will be conducted where summer habitat is fragmented.

e. Options include:

   i. Protection of roosting or foraging habitat;

   ii. Reforestation of corridors between known roosting and foraging areas; and

   iii. Reforestation of woodlots (blocks of habitat).

f. The covered activities' impact(s) to summer habitat should be divided into the actions or impact types described below and then quantified to yield the acreage of impact for each action. For impacts where suitable habitat is sparse,[10] each suitable roost tree should be counted, and the number of suitable roost trees should be multiplied by 0.09 acres/tree to determine the acreage of suitable habitat loss (i.e., the single tree method). For impacts involving the loss or alteration of blocks of forested habitat, the acreage of the impact is determined by identifying the perimeter and area of the impact with Global Positioning System or Geographic Information System technology (i.e., the habitat block method).

g. The actual mitigation costs to NiSource will vary with inflation, the price of land, and various mitigation transaction and project costs. To account for these fluctuations, NiSource will calculate its mitigation funding obligations on an annual basis using current land values specific to the region where the mitigation will occur, and representative of the habitat needed for mitigation.

Hibernaculum and Spring Staging/Fall Swarming Habitat Mitigation Sideboards:

a. NiSource will prepare a hibernaculum protection plan that will determine the actual protection measures necessary to protect the hibernacula.

b. Protection will include both the hibernaculum itself (i.e., gate) and the surrounding habitat.

c. For the purposes of calculating mitigation, it is estimated that a minimum of 0.25 mile around each hibernaculum must be protected which equals approximately **126 acres** per hibernaculum (assumes protection around one opening as the central point) plus gating.

d. Implementation of this type of mitigation will be delayed until the Service can identify which hibernacula are appropriate for protection. This delay is due to impact WNS is having on bats in infected hibernacula and uncertainty with the range and speed in which this malady may spread in the future. The Service will evaluate

[10] Sparse habitat is defined as areas containing widely spaced (i.e., greater than one crown width (35-foot radius) between the trees) or less than 20 trees ≥ five inches dbh. An example of sparse habitat is a single tree fence row that is not connecting forested blocks.

the current status of WNS annually and determine when this portion of the package may be implemented.

e. The focus of this mitigation will be on those hibernacula that are not already in public ownership or have no perpetual protective easements in place.

Mitigation Options that May Be Considered in the Future

While the mitigation package presented above fully compensates for the impact of the take, NiSource and the Service recognize that other mitigation options may in the future provide value to Indiana bats; however, the options presented below have yet to be evaluated to determine if they would fully compensate for the impact of the take. Thus, future analysis would be necessary with the following options. The mitigation options provided below for the Indiana bat are not in any priority order.

These measures are not deemed acceptable mitigation at this time for various reasons including the availability of complete science to implement them. At the time of consideration, the Service and NiSource would determine whether a major amendment would be required before they could be implemented. The amount of mitigation required for these options would be determined as part of the amendment authorizing their use.

Future WNS Mitigation Option:

If and when suitable control options are available for WNS, NiSource could fund implementation of these measures. WNS research will not be funded with NiSource mitigation funds. Only those control options consistent with the National WNS Implementation Plan and agreed to by the Service would be considered for implementation as part of a mitigation project. The treatment of bats and/or their hibernacula as well as the captive propagation of Indiana bats are a few of the options that might be funded with NiSource mitigation funds. However, only those options that clearly compensate for the impact of the take requested in the MSHCP would be considered.

Future Hibernaculum Restoration Option:

If and when the Service is able to identify which hibernacula are appropriate for mitigation given the current uncertainty related to the range and speed in which WNS may spread in the future, NiSource could fund the restoration of a hibernaculum rather than the protection of a hibernaculum (*see* #1 of mitigation package). This option would entail the restoration of winter habitat conditions in degraded caves and or mines that exhibit the potential for successful restoration such as, but not limited to, those caves identified as having High Potential (HP) in the draft revised Indiana Bat Recovery Plan (e.g., Mammoth Cave in KY and Rocky Hollow Cave in VA).

a. The goal of this mitigation should be to restore winter habitat conditions for Indiana bat hibernaculum as defined in the Habitat Considerations, Winter Habitat discussion above.

b. A wide range of methods exist for implementing hibernacula restoration projects including but not limited to the following:

    1. construction of air dams (internal and external);

2. sinkhole restoration;
3. demolition and removal of man-made structures restricting airflow and/or bat movements;
4. restoration of historic entrances; and
5. closure of man-made entrances.

6.2.2 Bog Turtle

The bog turtle was first described and named as Muhlenberg's tortoise (*Testudo muhlenbergii*) by Johann David Schoepff in 1801 based on specimens received in 1778 from Heinreich Muhlenberg of Lancaster County, Pennsylvania. In 1835, the species was transferred to the genus *Clemmys*, but it is now believed to be in the genus *Glytemys*. This genus name change has been recognized and supported by the Society for the Study of Amphibians and Reptiles since 2003 (Crother et al. 2003).

Impacts and potential resulting take of bog turtle is likely to occur in the following counties: New Castle County, Delaware; Baltimore, Cecil, and Harford counties, Maryland; Gloucester, Hunterdon, Morris, Salem, and Warren counties, New Jersey; Orange and Rockland counties, New York; and Adams, Bucks, Chester, Cumberland, Delaware, Lancaster, Lehigh, Monroe, Montgomery, Northampton, and York counties, Pennsylvania.

The bog turtle is one of the smallest turtles in North America (Service 2001). This species is identified by a combination of characters: (1) a light brown to ebony, lightly sculptured carapace; and (2) a bright yellow, orange, or red blotch on each side of the head.

The bog turtle is only active during part of the year. Generally, it becomes active in late March to late April, depending upon latitude, elevation, and seasonal weather conditions (Service 2001). In the northern distinct population segment, the turtle is active from approximately April to mid-October. The species hibernates from October to April, often just below the upper surface of frozen mud or ice (Service 1997), and generally retreats into more densely vegetated areas to hibernate (Service 2001). Bog turtles have been found to over-winter with spotted turtles and to demonstrate strong fidelity to their hibernacula (Service 2001).

The bog turtle is active during daylight hours, generally from mid-morning to late afternoon, or early evening (NatureServe 2007a). In early spring, activity takes place mainly at midday and in the afternoon. The bog turtle's peak activity period occurs in late spring and summer during the morning (NatureServe 2007a). Klemens reported that daily activity in Massachusetts's populations varied considerably with the time of year, prevailing weather conditions, and the previous night's temperature (Service 2001). The bog turtle is more active on cloudy days than on bright sunny days (NatureServe 2007a). On cooler, windy days, turtles have been observed basking partially hidden under dry vegetation. During warm summer days, bog turtles have been observed basking half-buried in a self-made depression on a shallow, flooded mud flat, with only a small portion of their carapace breaking the water's surface (Service 2001).

Female bog turtles reach sexual maturity between five and eight years of age (Service 1997). Bog turtle courtship and mating occurs in spring, from March to May (Harding 2002). The breeding season may last from mid-May to early July, with most eggs laid in June. Unlike most other semi-aquatic turtles, the bog turtle does not leave its wetland habitat and travel to dry, upland areas to lay eggs. Instead, females select a slightly elevated site, generally on *Carex stricta* hummocks, for nesting within marshy habitat (Service 1997). Nesting areas typically have limited canopy closure, moist substrates, and provide ample sun exposure.

Females may also lay eggs in common nesting areas, or nurseries (Service 2001). One to six (usually three to five) eggs are laid annually, with no evidence to suggest multiple clutches are produced in a breeding season. Eggs hatch after an incubation period of six to nine weeks, and the young emerge in August or early September (Service 1997). In the species' northern range, hatchlings may not emerge from the nest until October (Service 2001; NatureServe 2007a). Infertile eggs are common, and not all females produce clutches annually.

The bog turtle is a semi-aquatic species, and usually occurs in small, discrete populations occupying suitable wetland habitat dispersed along a watershed (Service 1997, 2001). Potential bog turtle habitat is recognized by three criteria: suitable hydrology, suitable soils, and suitable vegetation. Bog turtles prefer wetland habitats that include shallow, spring-fed fens, sphagnum bogs, swamps, marshy meadows, and pastures that have soft, muddy bottoms; clear, cool, slow-flowing water, often forming a network of rivulets; and open canopies. Wetland habitat is a mosaic of micro-habitats that include dry pockets, saturated areas, and areas that are periodically flooded. The turtle depends upon this diversity of microhabitats for foraging, nesting, basking, hibernation, shelter, and other needs. Historically, the bog turtle probably moved from one open-canopy wetland patch to another, as succession closed wetland canopies in some areas and natural processes opened canopies in other areas (Service 2001). The bog turtle forages on land and in the water, and its varied diet consists of beetles, lepidopteran larvae, caddisfly larvae, snails, nematodes, millipedes, fleshy pondweed seeds, sedge seeds, and carrion (Service 1997; NatureServe 2007a).

The bog turtle has been reported from 12 eastern states, and is sparsely distributed over a discontinuous geographic range extending from New England, south to northern Georgia (Service 1997, 2001). A 250-mile gap within the range separates the species into northern and southern distinct population segments. The northern population extends from southern New York and western Massachusetts southward through western Connecticut, New Jersey, and eastern Pennsylvania, to northern Delaware and Maryland. Bog turtles in the northeast are found in the inter-montane valleys and rolling hills of the Piedmont. The southern population occurs in the Appalachian Mountains from southwestern Virginia southward through western North Carolina, eastern Tennessee, northwestern South Carolina, and northern Georgia (Service 1997).

There are 601 extant bog turtle occurrences[11] in the range of the northern distinct population segment, which when grouped make up 390 populations (Service unpublished data). Of the 390 populations range-wide, 251 consist of a single documented occurrence, 74 consist of two occurrences, 32 consist of three occurrences, and 33 consist of four or more occurrences (Service unpublished data). Viability of a bog turtle population has not been quantified to date.

To facilitate recovery, the Service divided the species into five recovery units in the Bog Turtle Recovery Plan (Service 2001). The covered lands cross three bog turtle recovery units (Hudson Housatonic, Delaware, and Susquehanna/Potomac). Threats and potential conservation measures are similar among the three recovery units.

6.2.2.1 Activities and Impact Analysis

The northern population of the bog turtle was listed as a threatened species in 1997, under the provisions of the ESA (62 Federal Register [FR] 59605, 59623). Concurrently, the southern allopatric population was listed as threatened due to similarity of appearance to the northern population (Service 2001).

The listing was based on a number of factors including, but not limited to: habitat destruction, degradation and fragmentation from agriculture and development, habitat succession due to invasive exotic and native plants, and illegal trade and collecting. The following details the anticipated impacts of NiSource's covered activities on the bog turtle within the covered lands (**Appendix M, Table 6.2.2.1-1**). Bog turtles may be impacted by both O&M on existing ROW and new construction activities. No impacts from storage well activities are anticipated, as storage wells do not occur in counties with known or potential bog turtle occurrences. The impact analysis is presented topically, arranged by the threats associated with NiSource activities. Take calculations based on specific categories of covered activities are presented in Section 6.2.2.4.

Habitat Loss, Degradation and Fragmentation

Wetland habitats supporting bog turtles may be impacted during O&M activities, as well as by new construction. The NiSource O&M activities involve ground disturbance (e.g., replacement or removal of pipe) in wetlands or in uplands that may impact nearby wetlands. Depending upon the topography and type of activity these activities may result in temporary or permanent impacts to bog turtles and/or their habitat. Primary impacts from ground-disturbing O&M and new construction activities are the initial vegetation removal, grading, and trenching of the site.

Vegetation removal is the removal of the larger trees and shrubs. Grading removes all of the remaining low-growing vegetation and micro-topography of the site, which will eliminate nesting, foraging, basking and hibernating habitat, at least until the site becomes adequately revegetated. Even if herbaceous vegetation becomes re-established, the area may be unusable for that nesting season, and the quality of nesting

[11] The term "occurrence" refers to bog turtles associated with a specific location or site, typically a specific discrete wetland. One or more occurrences may make up a populations or population analysis site (PAS). Occurrences are grouped to form a PAS based on specific criteria.

habitat may be impaired for several seasons, since pedestal vegetation takes several years to develop. Trenching has the potential to destroy/modify hibernacula, although the likelihood of hibernacula occurring directly over an existing pipeline is low. The remaining activities associated with pipeline construction, replacement, or removal are not anticipated to cause further habitat impact as they will all occur within the cleared/graded ROWs and/or access roads. Silt fences and monitors will be used to prevent bog turtles from re-entering the active work zone for all of the activities associated with replacement, construction, and/or removal.

Heavy equipment may cause damage to nesting, foraging, and hibernation habitat. Vehicles may degrade habitat by altering the micro-topography of nesting habitat (e.g., creating vehicle tracks, crushing hummocks, compacting soil). Vehicles may also transport seeds from invasive plant species, further altering vegetation at bog turtle sites.

The construction of a new ROW may result in increased human access to bog turtle sites and increase the potential for destruction from all-terrain vehicles (ATVs). However, there is no information suggesting there are problem areas within bog turtle habitat along the existing NiSource ROWs from ATVs. In addition, NiSource will attempt to avoid new ROWs through or near bog turtle sites.

Alterations to local hydrologic systems also are a significant threat to bog turtle populations. Bog turtle habitats are sustained by groundwater regimes that are sensitive to changes in subsurface water supplies. Patterns of subsurface water flow can be altered by infrastructure construction and other development projects. Drilling under wetlands (e.g., to install pipelines) has the potential to disrupt the flow of water and potentially fracture bedrock and affect flow paths of groundwater. This can significantly impact a small wetland system. Minor (normal) frac-outs are not likely to result in significant alterations in overall wetland hydrology, although they could temporarily or permanently alter water flow to, from and within hibernacula, rendering these hibernacula temporarily unsuitable.

Vegetation management of existing ROWs is anticipated to result in beneficial effects to bog turtles by maintaining vegetation in an early successional stage. NiSource’s management of low-growing vegetation along their ROWs may provide suitable habitat for bog turtles. In fact, in wetlands that do not receive any form of disturbance or management to prevent natural succession, the ROWs may provide the only suitable nesting habitat for bog turtles. However, NiSource’s activities could also negatively impact bog turtles by temporarily or permanently modifying nesting, foraging, or hibernating habitat.

Water withdrawal

Hydrostatic testing withdrawal and discharge may result in temporary increases or decreases in the water levels of wetlands. However, NiSource has developed avoidance and minimization measures to prevent this in known or assumed bog turtle sites. Therefore, no impacts are anticipated from hydrostatic testing activities.

Altered hydrology

Trenching within and immediately adjacent to wetlands may affect hydrology within all or part of the wetland. When trenches are excavated upslope of a wetland, particularly between the wetland and upslope springs seeps, water flow may be diverted from the wetland, at least temporarily. Hydrology may also be affected when trenches are excavated within the wetland, especially if seeps, rivulets or underground tunnel systems are intercepted. Trenches that intercept the groundwater table will fill with water, which has to be pumped from the trench and emptied onto the surface. If this water is discharged down-gradient of the wetland or into a nearby stream, it will result in a temporary reduction in wetland water levels, especially near the trench. The most significant adverse effects are expected when trenching, pumping and diversion alters water flow to, from or within hibernacula, particularly when turtles are in hibernation. Mortality would be expected to occur due to freezing or the inability of turtles to relocate to another hibernaculum mid-winter.

There is also the potential for temporary or permanent alteration of hydrology in adjacent wetlands due to nearby in-stream work. This type of work includes stabilization, culverts, crossings, and other stream restoration activities. Alterations in hydrology can flood sites, making them unsuitable for nesting or hibernation. It also can lead to increased sedimentation of the wetland, which impacts micro-topography and vegetation (Werner and Zedler 2002).

Modifications to hydrology can directly result in changes to wetland vegetation, which may result in unsuitable nesting habitat. Finally, altered hydrology can result in the drying of sites, decreasing “mucky” soils and available water used as cover from potential predators.

Loss of individuals

Vehicles pose a direct threat to bog turtles because they can kill and injure individuals. Roads near occupied bog turtle sites contribute significantly to mortality as is evidenced by the number of dead turtles found along roadsides (Service 1997). Roads that are adjacent to or within wetlands pose the greatest threat to bog turtles.

All activities that NiSource conducts using vehicles/heavy equipment along existing ROWs or access roads, or are associated with construction of new ROWs, pose a risk of crushing turtles and nests. Similarly, vehicles driven directly through bog turtle wetlands during the active season may crush (kill) or injure bog turtles or crush bog turtle nests. While far less likely, vehicles driven directly adjacent to bog turtle wetlands also have the potential for crushing or injuring bog turtles that may be traveling between sites.

Vehicles driven through mucky areas of bog turtle sites during winter may also crush (kill), injure/wound, or displace turtles from their hibernacula, placing them at an increased risk of death. Vehicles may also break through the snow/ice cover over mucky areas supporting hibernating bog turtles and kill or injure turtles.

Turtle surveys will be conducted and any bog turtles found within the work area will be captured (by hand or traps) and moved to suitable habitat out of the work area. These beneficial actions of collection and temporary holding are still considered take.

However, only qualified bog turtle surveyors with current permits will conduct these actions. Fences erected around any of the construction work areas must be properly maintained to keep bog turtles from entering those areas. If they are not maintained, turtles that are attempting to move within or disperse from wetlands due to project-associated harassment and/or in search of food, mates, or basking areas will likely be killed or injured by machinery if they enter construction work areas.

HDD or horizontal boring may alter fracture patterns in the bedrock and affect flow paths of groundwater. If this occurs beneath wetlands in the winter, it may result in temporary or permanent alteration to the hibernation site. Hibernating bog turtles may be displaced and unable to find alternative suitable hibernacula. This would result in turtles freezing to death. There has been at least one documented case in Pennsylvania of bog turtles being pushed out of their hibernacula during the winter due to frac-outs associated with HDD (Copeyon 2009).

Chemical contaminants

Bog turtles may be exposed to herbicides, fertilizers, and vehicle fluids during routine O&M activities that include vegetation maintenance. There is some available information indicating that glyphosate and LI-700® may adversely affect bog turtles. This includes a study (Sparling 2005) indicating that the direct exposure of eggs to these chemicals may cause adverse effects. However, the risk of incidental take due to herbicide or surfactant exposure from hand-application is very small because: (1) most treatment methods result in delivery of herbicide directly to the target plant, resulting in little risk of bog turtle or nest exposure; (2) exposure of adults will be minimal because they are not likely to occur in high densities in the areas to be treated (i.e., forested areas, thick shrubby vegetation, or thick monotypic stands of invasive herbaceous vegetation); and (3) when used according to label directions, glyphosate and LI-700® appear to have a low risk of toxicity effects.

In addition, exposure to vehicle fluids or directional drilling materials, such as bentonite clay, is also possible. Reduced native vegetation species richness and increased invasive species may result from fertilizers, pesticides, oil, grease, and possible other surface water contaminants.

Isolation

The bog turtle is threatened with local extirpation and range-wide reduction due to: (1) the small size of existing populations; (2) the isolation of existing populations; (3) the delay in reaching sexual maturity; (4) low juvenile recruitment rates; and (5) relatively low mobility and small home ranges. Isolation of populations prevents gene flow, which can result in low fecundity. Isolation and habitat fragmentation prevent recolonization of existing habitat or expansion and colonization into newly created habitats (Service 1997).

NiSource activities are unlikely to result in additional isolation of bog turtle sites. Maintained ROWs in wetlands should not act as barriers like roads, walls, impoundments, etc. Construction activities that occur within bog turtle wetlands could, however, result in the temporary isolation of bog turtles from nesting, foraging, basking, and/or hibernating habitat.

Illegal collection and trade

The presence of existing ROWs and construction of new ROWs may allow for increased human access to bog turtle wetlands. However, it is not anticipated that increased collection of bog turtles will result from the presence of ROWs. There will be no signage or other publicly available NiSource materials highlighting the presence of bog turtles in specific locations along the ROW.

An adaptive management program is necessary for a species with uncertainties in associated with their conservation program. *See* Section 7.6.4.2 for the proposed adaptive management program for the bog turtle.

6.2.2.2 Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend to permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicants should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; *see* also the Service's HCP Handbook at 3-20 ("HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery tools"; "contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the bog turtle. With these general goals in mind, the main bog turtle conservation objective for ROW vegetation maintenance and all other O&M activities is to avoid or minimize impacts to known or potential bog turtle wetlands for the bog turtle (e.g., minimize impacts to bog turtle nesting, basking, hibernating, foraging areas) and avoid or minimize impacts to bog turtles (e.g., crushing/killing/chemical application). The main conservation objective for all construction projects (i.e., off existing ROW) is to avoid or minimize impacting known or potential bog turtle sites (e.g., through project routing) and avoid or minimize impact to bog turtles (crushing/killing/ chemical application).

Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that can not be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 – Support protection and/or maintenance of the northern distinct population segment of bog turtle at priority locations within impacted bog turtle recovery units.

Rationale: According to the Bog Turtle Recovery Plan (Service 2001), one of the delisting criteria for the bog turtle is: long-term protection is secured for no fewer than 185 viable populations distributed among the five recovery units. The 185 populations should be protected from present and foreseeable anthropogenic and natural threats that may interfere with their survival (e.g., habitat loss and destruction, collection of turtles, elevated levels of predation). Most of the extant populations of bog turtles currently occur on private land. Permanent protection through management agreements, conservation easements, and other long-term instruments has been identified as a priority action within the Recovery Plan (Service 2001). Long-term protection requires that the habitat areas used by a population are protected against adverse effects to the site (e.g., wetland draining, ditching, filling or excavation; drawdown by water supply wells; pollution from point and non-point sources; succession to woody vegetation; invasive plant species) and the recharge areas and buffer zones to prevent adverse hydrological alterations due to stream diversions, mining, wells, roads, impervious surfaces, etc. Where needed, habitat protection may be augmented by habitat restoration, protection from predators, reintroduction of turtles at selected sites, and a heightened emphasis on law enforcement actions and outreach to curb illicit trade in this species.

Objective 1 – Protect, restore, enhance, and/or maintain known bog turtle populations and their habitat.

Rationale: Bog Turtle populations are highly dependent upon specialized wetland habitats such as fens and spring fed bogs. NiSource activities have the potential to degrade these wetlands, reducing their suitability for bog turtle survival.

Objective 2 – Conduct surveys to locate additional bog turtle sites.

Rationale: Bog Turtle populations are highly dependent upon specialized wetland habitats such as fens and spring fed bogs. NiSource activities have the potential to degrade these wetlands, reducing their suitability for bog turtle survival. Additional bog turtle sites likely occur along the ROWs and throughout the covered lands.

Objective 3 – Partner with stakeholders having related responsibility and/or expertise in bog turtle conservation and recovery, and intensify and concentrate resources in high priority bog turtle areas.

Objective 4 – Provide landowners with suitable habitat and within and adjacent to NiSource MSHCP covered lands information to understand options for protecting, restoring, and maintaining their land for the benefit of bog turtles.

Objective 5 - Provide landowners with suitable habitat and within and adjacent to NiSource covered lands information to understand the threat posed by illicit bog turtle collection and trade. As appropriate, work with landowners to control use of access roads and ROWs.

Rationale: NiSource access roads and ROW may facilitate illicit collection opportunities.

6.2.2.3 Measures to Avoid and Minimize Impacts

These measures apply to all known occupied and assumed occupied wetlands in the counties listed in Section 6.2.2 (**Appendix G, Figures 6.2.2.3-1 and -2**). These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Measures in *italic* font text will be applied on a case-by-case basis depending on the requirements of the activity. These requirements include consideration of customer and business needs, practicality, and effectiveness as more fully described in Chapter 5 of this MSHCP. Details on selecting the appropriate waterbody crossing method are provided in Section 5.2.1.1.

<u>Surveys to Evaluate Presence of the Species and/or Suitable Habitat</u>

1. Either assume wetlands are suitable for bog turtles OR use current Phase 1 survey protocols for all previously unsurveyed wetlands[12] that are in bog turtle counties. Please refer to Service Guidelines for Bog Turtle Surveys April 2006 (**Appendix L**) (or future updated Service Guidelines) for further description of bog turtle habitat and survey protocols. These surveys can be conducted by qualified bog turtle surveyors[13] (recognized by the Service and/or the appropriate State wildlife agency) or NiSource staff[14] that has been appropriately trained by the Service. Lists of recognized surveyors can be obtained from each Field Office on an annual basis. These habitat surveys will be accepted for the life of NiSource's ITP unless the Phase 1 survey was conducted during drought conditions or significant habitat change is noted and reviewed with the local Service Field Office (i.e., habitat restoration or natural factors [e.g., beaver] change local hydrology, or adjacent development renders currently suitable habitat as unsuitable in the future).

For any activity within a bog turtle county that involves disturbance in or within 300 feet of wetlands (not including lakes, ponds, or rivers)

<u>Step 1.</u> For wetlands that have not previously been surveyed by a qualified surveyor, either conduct Phase 1 survey or presume the wetland is potential habitat. Maintain Phase 1 survey reports (including Phase 1 field forms) and enter both positive and negative Phase 1 findings in a GIS database. The results should be submitted to the Service and the state Fish and Wildlife agencies annually (including both the Phase 1 reports and the GIS data). If wetlands have been previously surveyed and no potential habitat is present, no further surveys, AMMs or mitigation measures are needed. If

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[12] NiSource defines two types of wetlands (dry and wet), both of which will be included in surveys.

[13] NiSource acknowledges that the lists maintained by the Field Offices do not constitute endorsements, recommendations or guarantees regarding the quality or suitability of the work. Rather, the field offices have developed the lists based on the requisite experience needed to identify bog turtle habitat and locate bog turtles with the habitat.

[14] NiSource staff must meet the same qualification standards as those surveyors that are included on the Service "qualified bog turtle surveyor list".

wetlands have previously been surveyed and potential habitat is present, go to step 2. If wetlands have previously been surveyed and bog turtles are known to be present, go to step 3. If a Phase 1 survey is not conducted, each wetland is assumed to be potential habitat, go to step 2.

Potential habitat present?

- If no, document for future NiSource activities and annual compliance report and no further bog turtle AMMs are needed.
- If yes, conduct Phase 2 and, if recommended by local Service Field Office, trapping or assume bog turtle presence.

<u>Step 2a.</u> If conducting Phase 2 and trapping (if recommended) surveys:

Bog turtles found?

- If no, document for future NiSource activities and annual compliance report and no further bog turtle AMMs are needed.
- If yes, conduct further bog turtle AMMs – go to step 3.
- Submit both positive and negative Phase 2 survey reports to the Service Field Office in the state in which the surveys were conducted annually and Service MSHCP contact.

<u>Step 2b.</u> If assuming presence, employ further bog turtle AMMs – go to step 3 **(not AMM # 3).**

<u>Step 3.</u> Employ further bog turtle AMMs #2-26.

<u>Timing of Actions and Associated Generic AMMs Related to Earth Disturbance</u>

2. If a proposed activity is within 300 feet of a wetland that is known or assumed to be occupied by bog turtles - identify the full extent of the wetland area that will be subject to disturbance from any and all sources or activities (e.g., vehicles, staging areas, excavation, side-cast soil, timber mats, etc.). Within the anticipated wetland disturbance area, a qualified bog turtle surveyor will determine whether any "mucky"[15] areas are present, as described in the current *Bog Turtle Survey Guidelines*, and determine the extent and location of these mucky areas. They will also determine the vegetative cover type(s) present in mucky areas proposed for disturbance (see below), since this will affect project timing. An EM&CP will be developed whenever earth disturbance is proposed in wetlands that are known or assumed to be occupied by bog turtles.

   a. **Scenario 1: Mucky areas ARE present in the proposed disturbance area.** Conduct construction and earth disturbance outside the hibernation period

      i. When disturbance is proposed in areas of the wetland that are dominated by woody vegetation (trees or shrubs) or invasive herbaceous species that are not conducive to bog turtle nesting (*e.g.*, *Phragmites*, purple loosestrife, reed canary grass):

[15] "Mucky" refers to soft, saturated soils that can be probed (e.g., with a blunt tool handle) to a depth of at least three inches. In this case, it does NOT refer to a specific wetland soil type(s) or classification.

(1) conduct pre-construction turtle survey (*see* **Appendix L** for Pre-construction Survey Protocol which includes moving any turtles found out of the work area);
(2) install silt fencing to isolate work area (AMM #3); and
(3) conduct activities between **April 1 and September 30**

ii. When disturbance is proposed in areas of the wetland that are dominated by herbaceous species
(1) conduct pre-construction turtle survey;
(2) install silt fencing between **April 1 and June 15**; and
(3) conduct activities between **April 1 and September 30**.

b. **Scenario 2: Mucky areas are NOT present in the proposed disturbance area.**
i. install silt fencing between **October 1 and March 31** to isolate work area; and
ii. conduct work between **October 1 and March 31** (i.e., when turtles are hibernating or concentrated near their hibernacula)

or

iii. conduct pre-construction turtle survey;

iv. install silt fencing to isolate work area; and
v. conduct work activities between **April 1 and September 30**

c. **Scenario 3: No wetlands occur within the proposed disturbance area, but known or assumed bog turtle wetlands occur within 300 feet of it.**
i. install silt fencing between **October 1 and March 31** to isolate work area; and

ii. conduct work between **October 1 and March 31** (i.e., when turtles are hibernating or concentrated near their hibernacula)

OR

iii. conduct pre-construction turtle survey (*see* **Appendix L** for Pre-construction Survey Protocol which includes moving any turtles found out of the work area);

iv. install silt fencing to isolate work area per AMM #3; and

v. conduct work activities between **April 1 and September 30.**

3. Employ silt fences around construction/soil disturbance activities within known or assumed bog turtle wetlands. The silt fencing should completely isolate the work area from the remainder of the wetland to ensure bog turtles cannot enter the work area, and to ensure silt does not enter un-disturbed parts of the wetland. Ensure soil is level with grade and pressed against the inside and outside of the silt fence, so there is no potential for turtles to approach the fence and fall into a trench on either side of the fence. Inspect silt fences each morning prior to work to ensure there are no breaches in the fence. Repair any breaches immediately, and do not begin work until they are

repaired. If there is a breach in the silt fence during the bog turtle active season (April 1 to September 30), conduct another pre-construction bog turtle survey within the fenced work area prior to re-starting work activities. When work activities are finished and the site is stabilized, remove all silt fencing from the wetland and fill in any trenches or furrows to grade. [NOTE: Adaptive Management will be employed for this AMM.]

Vegetation Management on the Existing ROW

4. Do not drive through "mucky" areas to minimize risk of crushing turtles.

5. Do not step on hummocks and tussocks when conducting vegetation management in known or potential bog turtle habitat.

6. Do not pull woody vegetation out by the roots in "mucky" areas to avoid destruction of potential hibernacula.

7. Mowing: Conduct between **October 1 and April 15** to avoid impacts to nests and eggs and minimize impacts to hatchlings.

8. Herbicide application:

   a. Apply herbicides in accordance with NiSource policy and procedures, EPA guidelines and requirements, state requirements, and the manufacturer's label. Prior to herbicide use, consult with the timing requirements specified previously.

   b. Do not use aerial herbicide application methods within 300 feet of known/assumed bog turtle wetland.

   c. For non-aerial application of herbicides within known or presumed bog turtle wetlands, follow current Service herbicide guidelines for use in bog turtle sites. The following are from March 10, 2006, Appendable Biological Opinion on Bog Turtle Habitat Restoration Practices (Service 2006):

      i. Hack and squirt (frill or drill and fill) – cut trunk of tree and apply glyphosate using backpack sprayer, squirt bottle, syringe, or tree injector.
      ii. Inject pellets of glyphosate or imazapyr directly into trunks of woody vegetation (red maple, alder, poison sumac).
      iii. Cut stump/stem – cut tree or shrub and apply glyphosate to cut surface using spray bottle or wick applicator.
      iv. Wick application – apply glyphosate directly to leaves and/or stem via "glove application" or paint stick with a contained reservoir to hold the herbicide.
      v. Spot spray – spray glyphosate directly onto leaves or stem via backpack sprayer, squirt bottle, or modified low volume hydraulic applicator – no high pressure sprayers.
      vi. Herbicide will not be applied using an open container of herbicide for any application to reduce risk of spills.
      vii. When conducting foliar application of glyphosate, the surfactant LI-700 may be used in accordance with EPA-approved label instructions.
      viii. Filling and emptying of herbicide containers will occur in upland areas.
      ix. All applicators will have a spill kit available.

x. All hoses, tanks, and clamps will be inspected in uplands prior to use each treatment day.
xi. Apply herbicide when wind speed at treatment height is ≤ 5 miles per hour.

9. Do not drag vegetation through known or assumed bog turtle wetlands (hand-carry pieces and if too large, cut into smaller pieces) if soil conditions are saturated.

10. Do not burn brush piles along ROW within 300 feet of known/assumed bog turtle wetlands.

Construction Practices (Existing or New ROW)

11. *Avoid stepping on hummocks and tussocks in open, emergent areas of known or assumed bog turtle wetlands.*

12. *Avoid vehicle-use within known or assumed bog turtle wetlands. Conduct patrols, vegetative maintenance, etc., by foot whenever practical.*

13. *Avoid pulling woody vegetation out by the roots in "mucky" areas to avoid destruction of potential hibernacula.*

14. Do not drag vegetation through known or assumed bog turtle wetlands (carry pieces and if too large, cut into smaller pieces) if soil conditions are saturated.

15. Do not withdraw water from known or assumed bog turtle wetlands for hydrostatic testing.

16. Do not discharge hydrostatic testing water into known or assumed bog turtle wetlands.

17. Discharge hydrostatic testing water in the following manner (in order of priority and preference):

a. Discharge hydrostatic testing water down gradient of known or assumed bog turtle wetlands unless on-the-ground circumstances (e.g. man-made structures, terrain, other sensitive resources) prevent such discharge.

b. If those circumstances occur, discharge water into uplands >300 feet from known or assumed bog turtle wetlands unless on-the-ground circumstances (e.g. man-made structures, terrain, other sensitive resources) prevent such discharge.

c. If those circumstances occur, discharge water as far from wetland as practical and utilize additional sediment and water flow control devices (**Figures 6A&B, 7, 8,14A&B; ECS**) to minimize effects to the wetland area.

18. Re-vegetate wetlands in accordance with the ECS (e.g., use indigenous, non-invasive species).

19. Do not apply fertilizers within 300 feet of known or assumed bog turtle wetlands.

20. Ensure that upland work (including access roads) does not result in impacts (altered hydrology) to adjacent bog turtle sites. [NOTE: Adaptive Management will be employed for this AMM.]

21. Ensure that work in streams including crossings, restoration, and culvert repair/replacement methods do not result in impacts (altered hydrology) to adjacent bog

turtle sites by following the requirements specified in the ECS. [NOTE: Adaptive Management will be employed for this AMM.]

22. Do not abandon pipe (leaving on surface) in presumed or known bog turtle wetlands. Below-grade abandonment is acceptable.

23. Refuel equipment and check for leaks each day as described in the ECS "Spill Prevention, Containment and Control".

24. Do not construct bell holes and trenches for remote/perpendicular cathodic protection in bog turtle habitat.

Routing Criteria (replacements, loops, new ROWs, access roads)

NiSource is strongly oriented towards using existing ROWs for facility replacement and/or expansion projects as these areas have been previously disturbed. However, to avoid and/or minimize impacts to bog turtles or their habitat, NiSource will consider the following AMMs during route selection. This consideration will include, for example, overall effect of using the existing ROW versus disturbance of new areas, landowner concurrence, and the ability to construct the new facility using trenchless methods. When routing new or replacement facilities away from the existing ROW, strong emphasis will be placed on avoidance of bog turtles or their actual or assumed habitat. Details on selecting the appropriate waterbody crossing method are provided in Section 5.2.1.1. If an HDD is planned, a frac out contingency plan will be prepared and included in the EM&CP (AMM #2).

Note that mitigation requirements generally increase with impacts associated with each successive option for construction routing.

25. Pipeline replacement projects (non FERC 7c) shall be done in the following manner (in order of priority/preference):

a. Abandon line in place and conduct HDD or horizontal bore to install pipe under wetland between **April 1 and October 1** to avoid any potential impact to hibernating turtles from frac-outs. HDDs can be conducted at other times if engineering studies determine that the potential for a frac-out within the wetland area is minimal (solid rock). Also, route to avoid potential hibernacula.

or

b. Use conventional construction practices, narrow or reconfigure the work area to avoid impacts to "mucky" areas of wetland, and follow timing and monitoring guidelines from above (AMM #2).

or

c. If the existing line is in "mucky" area and all above measures are not possible, follow timing and monitoring guidelines from AMM #2.

26. FERC 7c projects shall be done in the following manner (in order of priority/preference):

a. Route projects (loops, new ROWs and access roads) to avoid known or assumed bog turtle wetlands (the entire wetland).

or

b. conduct HDD or horizontal bore to install pipe under wetland between **April 1 and September 30** to avoid any potential impact to hibernating turtles from frac-outs. HDDs can be conducted at other times if engineering studies determine that the potential for a frac-out within the wetland area is minimal (solid rock). Also, route to avoid potential hibernacula.

or

c. use conventional construction practices, route projects to avoid impacts to ”mucky” areas of the wetland, and follow timing and monitoring guidelines from above (AMM #2).

6.2.2.4 Calculation of Incidental Take

NiSource is requesting incidental take coverage over a 50-year period for bog turtles occurring at 25 sites as further described in Section 6.2.2.5. As will be discussed, take is anticipated to occur through any or a combination of the following: killing, wounding harm, and harassment. Take is also predicted in association with certain minimization or mitigation measures, capture and temporary holding. While take will occur in a variety of ways, it will never occur at more than 25 bog turtle sites.

A reasonable worst case scenario is used to calculate take, although NiSource anticipates the actual take will be less.

Habitat/Sites within NiSource Covered Lands

A model was developed for the purpose of estimating the number of potential sites and acres of habitat within the covered lands and the existing right-of-way. National wetland inventory (NWI) was the main data source. Three models were developed.

Model A (inclusive) was based on Service and New York Natural Heritage Program knowledge and included the following NWI classes:

- System: Palustrine
- Class: UB- Unconsolidated Bottom, EM- Emergent, SS- Scrub-shrub, FO- Forested
- Water Regime: All except: ‘D’ – Seasonally Flooded/Well Drained; and ‘K’ – Artificially Flooded; J- Intermittently Flooded; W- Intermittently Flooded/Temporary; and Y- Saturated/Semi permanent/Seasonal. Removed all tidal.

Model B (narrow) used element occurrence data from New York, Tennessee, and Virginia; however, this was too narrow as it did not pick up bog turtle sites in New Jersey when tested with New Jersey landscape project data.

Model C was developed on Model A and modified based on professional opinions of New York and New Jersey state biologists and broken into two classes (inland and estuary).

- NiSource created Model C_inland for all counties in Maryland, New York, Pennsylvania, and northern New Jersey which kept all Model A NWI classes except those with a freshwater pond descriptor. In addition, in New York, only polygons less than 1000 feet were included as no current bog turtle occurrences in NY are greater than 1000 feet.

- NiSource created Model C_tidal_estuary and added estuary classes and classes with tidal modifiers (based on the New Jersey landscape project data overlayed with NWI data in "may affect" counties) to create Model C_inland for three counties (the two southern New Jersey counties and the one county in Delaware).

Many wetlands were mapped as multiple NWI classes; therefore, NiSource buffered the polygons by 300 feet and combined polygons that overlapped into one site. Given the limitations of NWI data, a 1.6 correction factor was applied to the numbers estimated reflecting that only 40% of bog turtle wetlands appear on the NWI maps[16].

It is important to note that there have been multiple Phase 1 and 2 surveys on NiSource ROWs. For example, additional within-ROW sites are not anticipated in New York as extensive surveys (<1000 feet in elevation) were completed in Orange and Rockland counties for the Millennium Pipeline project. Also, additional within-ROW sites are not anticipated in Delaware given the overall low frequency of sites in that state.

However, there are large sections that have not been surveyed to date. In addition, off-ROW areas within the covered lands have not been fully surveyed. The estimate of the number of sites was further refined using previous Phase 1 and/or 2 survey information available for portions of the NiSource ROW in New York and Pennsylvania. In Pennsylvania, 5-10% of sites identified as potential bog turtle habitat during Phase 1 surveys have bog turtles (Copeyon 2009). Based on the fact that Pennsylvania has the most occurrences and the best available information regarding the percentage of positive Phase 1 surveys that have bog turtles, NiSource used the Pennsylvania data to assume that 10% of sites surveyed for potential habitat (Phase 1 surveys) actually have bog turtle populations.

NiSource will conduct Phase 2 surveys or assume presence of bog turtles at sites with potential habitat and completely avoid new disturbance of bog turtle sites whenever practicable.

As summarized in **Table 6.2.2.4-1**, 13 known bog turtle sites occur within the existing ROWs. Based on the modeling conducted, it is estimated that there are an additional seven (total of 20) bog turtle sites within the existing ROWs. Within the one-mile corridor (including the existing ROW), there are 29 known bog turtle sites. Based on the modeling conducted, it is estimated that there are approximately 99 additional bog turtle sites (total of 128) within the covered lands.

Approximately 751 miles of existing pipe occur in counties where bog turtles are known or likely to occur. Of these, the Service determined that approximately 13.14 miles in New York are too high in elevation for bog turtles. In Maryland, 25.93 miles of pipeline in Baltimore County are unlikely to have bog turtles (Smith et al. 2008). This leaves a total of 711.8 miles of pipe and associated corridor that may have bog

[16] This is based on a sample of sites in Chester County, PA.

turtles present. It is assumed that this entire length of pipe may be replaced and potentially looped throughout the anticipated permit.

Looping

NiSource will attempt to route future loops to either stay within the ROW (when bog turtle habitat is adjacent or further away from the existing ROW) or route around bog turtle habitat (when the habitat is close to the existing ROW). Due to the location of the existing facilities and our past experience in routing looping projects, NiSource estimates that up to one half of the on-ROW bog turtle sites (10 sites) may occur

Table 6.2.2.4-1 Bog Turtle Site Location Summary

State	Known Bog Turtle Sites in ROW	Estimated Sites that may need Phase 1/Phase 2 Surveys in ROW[17]	Estimated Bog Turtle Sites in ROW	Known Bog Turtle Sites in CL	Estimated Sites that may need Phase 1/Phase 2 Surveys in CL	Estimated Bog Turtle Sites in CL
Delaware	--	2	0	?	3	0
Maryland	2	6	2	4	45	5
New Jersey	4	56	6	6	195	20
New York	0	0	0	1	216	22
Pennsylvania	7	119	12	18	810	81
Total	**13**	**183**	**20**	**29**	**1269**	**128**

within a future looping project (although not through mucky part of wetland). NiSource will avoid the mucky portions (where there is the greatest likelihood of turtle use) of the wetland for looping projects. In addition, NiSource has AMMs that have all observed turtles moved out of the work area prior to construction; however, it can be difficult to find bog turtles because they are small and often under vegetation or submerged in saturated soils or rivulets. Surveyors often only find bog turtles when they get on the ground and actively search with the hands under hummocks. Therefore, it is assumed that a small number of turtles (~one to five per site) may be missed and wounded or killed. In summary, it is anticipated that 10-50 bog turtles that are not moved out of the way may be wounded or killed from looping projects over the duration of the permit. In addition, NiSource and the Service anticipate all remaining bog turtles at the site to experience harassment/harm (primarily reduced reproductive success) due to the direct and indirect impacts to their habitat.

[17] This is the number of wetlands from the modeling exercise that may be potential habitat. This modeling exercise should have captured any actual element occurrences.

New Alignment

NiSource will attempt to avoid new bog turtle sites during new construction routing and given the small size of most bog turtle sites, NiSource should be able to avoid most sites. Any new construction through new bog turtle sites would not go through mucky areas of the wetland. Due to the location of the existing facilities and our past experience in routing new construction projects, NiSource estimates bog turtles at five new sites may be impacted from construction projects off-existing ROWs.

NiSource will be avoiding the mucky portions (where there is the greatest likelihood of turtle use) of the wetland for new alignment projects. In addition, NiSource has AMMs that have all observed turtles moved out of the work area prior to construction; however, as stated above it can be difficult to find bog turtles. Therefore, it is assumed that a small number of turtles (~one to five per site) may be missed and wounded or killed. In summary, it is anticipated that five to 25 bog turtles that are not moved out of the way may be wounded or killed from new alignment projects. In addition, it is anticipated all remaining bog turtles at the site (entire population) to experience harassment/harm (primarily reduced reproductive success) due to the direct and indirect impacts to their habitat.

Operations and Maintenance

Bog turtles at the estimated 20 sites within the existing ROWs and future estimated five new sites are likely to be impacted by O&M (e.g., vegetation management and pipeline replacement). Bog turtles may be concentrated in the ROWs where O&M occur.

Replacement

NiSource anticipates replacing pipe through all estimated 20 sites along the existing ROW. NiSource will attempt to avoid the mucky portions (where there is the greatest likelihood of turtles) of the wetland for replacement projects. NiSource anticipates that of the 20 estimated bog turtle sites along the existing ROW, five of those will involve conventional trenching methods and the remaining 15 will involve abandonment in place and rerouting or HDD.

NiSource will have all observed turtles moved out of the work area prior to construction; however, it can be difficult to find bog turtles. Therefore, it is assumed that a small number of turtles (~one to five per site) may be missed and wounded or killed during the duration of the permit. In summary, it is anticipated take associated replacement projects using conventional methods. It is anticipated five to 25 bog turtles may be wounded or killed and all remaining bog turtles at the site to experience harassment/harm (primarily reduced reproductive success) due to the direct and indirect impacts to their habitat.

General Vehicle Use

Given the current likely concentrated habitat within the existing ROWs, there is potential for turtles to be run over during the normal course of routine O&M activities (driving up and down the ROW for inspections, vegetation management, etc.). It is difficult to estimate how many turtles may be impacted because there is little information from most sites on turtle populations. In addition, there is no site-specific information on the extent of suitable bog turtle habitat crossed by existing ROWs or extending off-ROWs. Finally, it can be difficult to find bog turtles and subsurface turtles that are crushed and may never be discovered. However, the Service previously estimated that one to two turtles per site may be wounded or killed from being run over during similarly conducted activities. For the purposes of this analysis NiSource assumed that one to two turtles per site are similarly likely to be wounded or killed during the life of the permit for a total of 25-50 turtles.

Mowing

NiSource has developed an AMM to conduct mowing between October 1 and April 1 in known or potential bog turtle habitat. This significantly reduces the likelihood that turtles will be crushed by a mowing because turtles are primarily inactive and underground. In addition, NiSource does not mow over mucky areas and so impacts to hibernating bog turtles are not expected. However, there is potential for a turtle to be active and in the area where mowing is necessary. Therefore, it is anticipated that for every 10 sites (on existing ROW and new loops) mowed, one turtle may be wounded or killed during each vegetation cycle (every seven years; seven cycles during the permit period) for a total of approximately 18 bog turtles.

Herbicides

In the 2006 Bog Turtle BO (Service 2006), the Service acknowledged "there may be some risk of take due to the direct or indirect effects of the herbicide and/or surfactant, the risk is likely to be very small and any take resulting from such effects is currently unquantifiable." In addition, the Service recognized that there is also a risk of incidental take due to the human activity associated with herbicide application, and due to short- and long-term changes in the wetland. The Service further anticipated "that bog turtle nests will be damaged or destroyed, or bog turtles will be harassed or harmed in the following situations: (1) when a large crew carries out herbicide application throughout a significant portion of the wetland; (2) when unknown hibernating areas are treated; (3) when unknown nesting are treated; and (4) when large areas of the emergent part of the wetland are treated and fail to quickly re-vegetate." NiSource will not be carrying out herbicide application with large crews and NiSource is responsible for ensuring revegetation. However, there is a possibility that unknown nesting or hibernacula areas would be treated.

The Service further estimated that one turtle per site for similar vegetation management would be impacted. The Service anticipates a similar level of impact and estimates one turtle per site per round of vegetation management (every seven years; seven cycles over the requested permit period) is anticipated to be impacted (harassment/ harm) for a total of 175 turtles impacted.

Minor Spill Events

Minor spills may include events such as fuel spills from small containers, hydraulic hose leaks or breaks, or other leaks from equipment and could result in contaminant exposure to bog turtles. The likelihood that a minor spill event would occur in a bog turtle site seems low. However, given the number of times vehicles travel along ROWs, it is not discountable. It is anticipated that one bog turtle site will be impacted by a minor spill and that all bog turtles at the one site may be harassed and/or harmed.

6.2.2.5 Impact of Take Analysis

Anticipated Take of Individuals and Quantification of Impacted Sites

Individual Impact

Individuals may experience impacts that range from minor nuisance (e.g., short-term nearby noise) to death. The take calculation above describes the anticipated take of individuals and also the impacted habitat and sites where they occur, in instances where impacts rise to the level of killing, wounding, harm and harassment. NiSource identified the number of turtles anticipated to be killed or wounded from activities. However, it is far more difficult to assess the number of turtles harmed or harassed because the average number of bog turtles at a site may not reflect what is actually at a site impacted by NiSource. The reasonable worst case scenario predicts harm and harassment to occur to all bog turtles by significantly impacting essential behaviors leading to injury or death at a site. But mortality to every individual is not anticipated. Rather, in the majority of cases NiSource anticipates a short-term reduction in reproductive success. This would be anticipated during the year of NiSource activities when they may be harassed by noise and disturbance in a given site. However, there may be situations when reductions in reproductive success occur over several years. For example, for activities involving ground disturbance when the existing ROW provides the majority of currently available nesting habitat at a site, this reduction may occur for a couple of years as the site is restored.

Construction (Ground-Disturbance) Activities at 20 Sites

NiSource anticipates either looping or replacing pipeline in areas that may impact up to 15 of the 20 estimated bog turtle sites in the existing ROW and an additional five sites associated with new alignment.

<u>Looping (10 sites):</u> one to five turtles per site wounded or killed for a total of 10-50 bog turtles. All remaining bog turtles at the site to experience harassment/harm.

<u>Replacement (five sites):</u> one to five turtles per site wounded or killed for a total of five to 25 bog turtles and all remaining bog turtles at the site to experience harassment/harm

<u>New Alignment (five sites):</u> one to five turtles per site wounded or killed for a total of five to 25 bog turtles. All remaining bog turtles at the site to experience harassment/harm.

Non-ground-Disturbing O&M Activities at 25 Sites

NiSource anticipates that bog turtles at the estimated 20 sites within the existing ROWs and future estimated five new sites are likely to be impacted by O&M.

<u>General Vehicle Use (25 sites):</u> one or two turtles per site wounded or killed for a total of 25-50 turtles.

<u>Mowing (25 sites):</u> For every 10 sites (on existing ROW and new loops) mowed, one turtle wounded or killed during each vegetation cycle (every seven years; seven cycles during the permit period) for a total of approximately 18 bog turtles.

Herbicide (25 sites): one turtle per site per round of vegetation management (every seven years; seven cycles over the requested permit period) impacted (harassment/ harm) for a total of 175 turtles impacted.

Minor Spill Events (one site): one bog turtle site will be impacted by a minor spill and that all bog turtles at the one site may be harassed or harmed.

In summary, 25 total sites may be affected.

Population Impact

The following summary information is from the BO on Bog Turtle Habitat Restoration Practices (Service 2006). Multi-year, mark-recapture studies have only been conducted at a few sites range-wide. However, based on the finding of only old individuals at some sites and the degraded condition of existing habitat at many locations, many sites are thought to support small numbers of turtles – probably between 15 and 30. This places the population estimate for the species in its northern range at about 10,000 individuals.

Because many bog turtle sites are not being actively managed, we would expect to find similarly degraded sites within the covered lands and similar numbers of turtles.

NiSource and the Service are aware of bog turtle sites with a range of between one and 85 documented turtles. For example, in the Lake Plain/Prairie Peninsula Recovery Unit there are five extant sites with 1, 7, ~20, ~30, and ~85 individual turtles found to date (Rosenbaum 2009). However, the Lake Plain/Prairie Peninsula Recovery Unit is not representative of bog turtle habitat throughout the range. This Recovery Unit is at the northern extent of the range and includes much larger wetlands than the rest of the range. In addition, this Recovery Unit is not going to be impacted by NiSource activities.

Over the life of the permit, given the potential take associated with various actions, there is a maximum potential estimate of four to 13 turtles per site being wounded or killed. In addition, for new alignment, it is assumed that one to five turtles per site may be wounded or killed during initial construction.

All remaining turtles at a site impacted by NiSource are anticipated to be harassed or harmed periodically throughout the life of the permit. This is not anticipated to result in mortality of the remaining turtles, but a short-term reduction in reproductive success. In long-lived species, like bog turtles, adult survival is far more important than annual nest or hatchling survival. The temporary reduction of reproductive success is not anticipated to result in significant impacts to any given population. In addition, any short-term losses of reproduction are expected to be offset by the beneficial effects of habitat restoration and management in a condition appropriate for the turtle As stated in Section 6.2.2.1, NiSource's management of low-growing vegetation along their ROWs may provide suitable habitat for bog turtles; in some cases, the ROWs may provide the only suitable nesting habitat for bog turtles.

In summary, over the life of the permit, NiSource activities may wound or kill 4-13 turtles from estimated current populations of 15-30 turtles. Given NiSource AMMs and the timing between vegetation management cycles, any loops, and replacement projects, impacts to bog turtle sites can range from nearly negligible to extirpation (if the site has very small numbers to begin with). It is important to note that NiSource activities are anticipated throughout the covered lands over the entire life of the permit and that while NiSource is planning for replacement and looping of the entire line, this may not be realized. In other words, while all sites within the existing ROW will be impacted by vegetation management, all may not be impacted by construction-related impacts. In addition, all sites will not be impacted at the same time. Individual sites facing harm and harassment from NiSource activities are generally anticipated to rebound (albeit slowly) (particularly given the proposed mitigation below). In addition, individual sites are often linked (by streams or wetland complexes) to other sites. If an already small population was extirpated, that would not result in the loss of a larger bog turtle population unless the site was isolated.

Genetic Impacts/Implications

Rosenbaum et al. (2007) found low levels of mitochondrial DNA differences among 41 bog turtles sampled from 21 populations throughout most of the turtle's distribution. This suggests that any losses of turtles from individual sites are unlikely to result in significant changes to the species genetic diversity. In addition, the majority of the impacts are likely in the central part of the range (e.g., Pennsylvania) rather than on the edges of the range where adaptations (e.g., for short growing seasons and cold temperatures) may be important.

6.2.2.6 Compensatory Mitigation

As a minimization measure, NiSource will promptly restore the ROW of any bog turtle sites impacted as a result of its activities. Mitigation will compensate for impacts associated with two categories of activities (O&M and Construction). Impacts at an estimated 25 sites associated with O&M activities include small numbers of turtles wounded or killed from general vehicle use and mowing at each site. In addition, turtles may be harassed/harmed from herbicide use. Impacts at an estimated 20 sites associated with construction include 1-5 turtles wounded/killed per site and a temporary reduced reproduction of all remaining turtles at the sites.

Mitigation is required for impacts to 25 sites total. The mitigation required is restoration (beyond the existing ROW habitat) and protection of sites known and documented to contain bog turtles. Where the term "protection" appears below, please refer to Section 6.2 for a further definition and the requirements for securing conservation of mitigation lands and other real property interests.

A. Construction (Ground-Disturbance) Activities and Non-ground-Disturbing O&M at 20 Sites

For each site impacted by looping (estimate of 10), new construction (estimate of five) and/or conventional replacement methods (open trench) (estimate of five) (and all non-ground-disturbing O&M impacts), NiSource must either protect and restore a bog turtle site to optimal habitat[18] or protect an existing site with optimal bog turtle habitat.

Sites must include a minimum 300-foot upland buffer.

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[18] Optimal Habitat as minimally defined as a fens, wet meadows, and other shallow water wetlands with a mosaic of roughly 25% forested habitat and 75% open habitat

Priorities for additional characteristics: when available, TCF's green infrastructure effort is anticipated to enable the mitigation panel to focus on the following priorities assuming the above criteria are met:

- sites are within a complex of existing or ongoing restoration/protection efforts rather than isolated sites;
- sites protect the entire wetland;
- sites are larger in overall acreage and turtle population size; and,
- sites provide greater than 300 feet upland buffer. These priorities are expected to increase the likelihood of long-term success of all of the projects and turtle populations in that focus area.

B. Non-ground-Disturbing O&M Activities at Five Additional Sites

The mitigation for take associated with O&M activities at sites that also involve ground-disturbing activities is addressed above. Mitigation for take associated with O&M activities at sites that do not involve ground-disturbing activities is either: 1) habitat restoration/enhancement and long-term management agreement (life of the permit) of the wetland crossed by the NiSource ROW or 2) off-site protection and restoration (same mitigation as described above).

Habitat restoration/enhancement of core fen habitat within bog turtle wetlands that are crossed by the ROW will expand the amount of high quality emergent vegetation necessary for bog turtle nesting, basking, and escape cover which is expected to result in increased survival and reproductive success of the population. In addition, off-ROW habitat restoration and management of core fen habitat is anticipated to decrease the likely concentration of bog turtles within the ROW which will further reduce the risk of future impacts to individual turtles from NiSource activities. Periodic future management (generally mowing, herbicide, or grazing) is required to keep restored sites in an optimal state.

However, if the bog turtle site crossing the existing ROW is severely degraded and has additional significant threats (e.g., completely surrounded by development) or the landowner is not amenable to expanding habitat off-ROW, NiSource will protect and restore (similar to construction-related mitigation) a bog turtle site for each site impacted.

Mitigation is intended to address (compensate for) any recurring impacts at a given site. The Service is not requiring habitat protection in perpetuity because the activities are cyclical in nature and if they stop, impacts to the bog turtles will also stop. Long-term management agreement consistent with the remainder of the permit is sufficient.

O&M mitigation projects can occur within previously protected sites (e.g., state or NGO current lands) that are in need of restoration and management.

Mandatory Criteria Applicable to all Mitigation under Category A and B

For both mitigation categories A and B, above, each mitigation project shall include:

(1) development of a management, monitoring and if needed restoration, plan for Service review and approval including (a) the current status of the habitat and bog turtle population (whatever is known) at the site; (b) a general location map; (c) a detailed site map showing: property boundaries, any encumbrances (rights-of-way) on the property, wetland boundaries, general invasive species locations (label which species), bog turtle locations, bog turtle nesting area (if known), bog turtle hibernacula (if known), fencing boundaries (if applicable), map scale, and north arrow; (d) timeline of activities; (e) description of activities including measures designed to minimize impacts to turtles during restoration and management; (f) adaptive management strategy; (g) plan to monitor success of project; and (h) estimated costs (restoration, management, and monitoring);

Restoration activities could include use of biological controls for purple loosestrife, manual or mechanical removal of woody vegetation, herbicide application, and prescribed grazing. Restoration activities generally would be done in accordance with current Service guidelines (e.g., March 10, 2006, Appendable Biological Opinion on Bog Turtle Habitat Restoration Practices [Service 2006]). If alternative restoration techniques are chosen, coordination with the Service would be necessary to develop an appropriate restoration plan.

Restoration project sizes are anticipated to range between two to ten acres of core fen area in size. This figure is based on the Service's prior experience restoring bog turtle sites. Actual restoration acreage must be at least two acres in size and will be determined for a specific site and included in the restoration plan for Service review and approval.

(2) Long-term management and protection:

A. Construction (Ground-Disturbance) Activities and Non-ground-Disturbing O&M at 20 Sites:

The area to be protected must include either the existing or restored core fen. As stated above, priority shall be placed on projects that protect entire wetlands and greater than the minimum 300 foot upland buffer. However, there may be multiple landowners of a large wetland complex that render this impractical.

B. Non-ground-Disturbing O&M Activities at Five Additional Sites:

Where landowners are willing to undertake a long-term management agreement for the duration of permit; that is all that is needed. Where adjacent landowners are unwilling to do this, permanent protection measures described under Construction Activities must be used.

(3) Appropriate Timing - As more fully described in Chapters 5 and 8, mitigation for O&M projects shall be initiated within the first seven years of the MSHCP. Mitigation for construction projects shall be initiated within two years after the project is completed.

6.2.3 Madison Cave Isopod

The Madison Cave isopod (*Antrolana lira*), a rare, sightless, aquatic invertebrate, is a member of the family Cirolanidae, and is restricted to subterranean lakes and deep karst aquifers (phreatic waters). The Madison Cave isopod is known from 16 locations within the Shenandoah Valley from Leetown, West Virginia, south to Lexington, Virginia - a range of 136.4 miles long and 24.8 miles wide (Hutchins 2007). Four of these occur in Jefferson County, West Virginia (the county is not crossed by NiSource covered lands). Twelve of these occur in Virginia in counties that are crossed by NiSource covered lands (from south to north - one in Rockbridge County, three in Augusta County, four in Rockingham County, three in Warren County, and one in Clarke County). All locations are within the Shenandoah River drainage, except for the southernmost (Lime Kiln Cave) which is within the James River drainage. There are no known locations within the covered lands. The closest locations to the ROW range between 0.5-12 miles.

Madison Cave isopods occur deep below the ground. Known occurrences are based on sampling areas (e.g., wells or caves) that represent only a point for a given population. There is no information available on the actual geographic extent (vertical and horizontal) of population areas. However, it appears unlikely that any populations represented by known occurrences extend beneath the existing ROW. In addition, with the exception of Lime Kiln Cave, which occurs at the edge of the covered lands, it appears unlikely that any of the populations are within the covered lands. Therefore, NiSource and the Service do not anticipate any direct impacts to known occurrences. However, there are likely unknown occurrences that may extend beneath the covered lands. The primary impacts of interest are possible indirect effects to some of the known occurrences and direct or indirect impacts to unknown occurrences. Madison Cave isopods are not found in any of the storage field counties, so no storage field activities will impact Madison Cave isopod.

The Madison Cave isopod was first described by T. E. Bowman in 1964 and is the only member of the genus *Antrolana.* The species is non-migratory, although it is a strong swimmer and a benthic walker. It is thought to feed on small pieces of living or formerly living plants and animals that enter the groundwater from the surface (Service 1996b). Because this species lives in a habitat that is difficult at best to study, relatively little is known about its reproduction, home range, trends in population, and ecological relationships.

Madison Cave isopod are predominantly adapted to unlighted subsurface lakes and deep, water-filled fissures. It is assumed that the Madison Cave isopod does not occupy habitat above, or in very close proximity to, the earth's surface, including surface waters. Madison Cave isopods live in deep karst aquifers and underground lakes where water temperatures range from 51.8 to 57.2°F. Besides the observation that Madison Cave isopod is found in waters supersaturated with calcium carbonates, little is known about the chemical conditions of Madison Cave isopod habitat (Service 1996b).

Madison Cave isopods occupy subsurface bodies of water in karst geology. In the karst geology, subsurface waters (both water contained in the bedrock and water contained in open spaces) are dynamic and may move quickly through voids in the bedrock. For this reason, bedrock is not likely to be an effective sediment filter for subsurface waters. Because the presence or absence of voids, fractures, and solution cavities within bedrock is unpredictable in karst geology, there may be instances where surface waters directly connect to subsurface waters.

Common associated species may include the Madison Cave amphipod (*Stygobromus stegerorum*) and the subterranean amphipod (*S. gracilipes*) (Service 1996b). Individuals are encountered when groundwater wells intersect or when deep fissures in caves provide access to this habitat.

There are no global abundance estimations for Madison Cave isopod, but mark-recapture population-size estimates of the most abundant populations range roughly between 1972 (+/- 851) and 6,678 (+/- 3,782) individuals (Service 1996b). The large standard errors were associated with low recapture rates.

Impacts and potential resulting take of Madison Cave isopod may occur in the following counties: Augusta, Clarke, Page, Rockbridge, Rockingham, Shenandoah, and Warren counties, and the City of Waynesboro, Virginia.

6.2.3.1 Activities and Impact Analysis

The Madison Cave isopod was listed as a threatened species in 1982, under the provisions of the ESA (47 Fed. Reg. 43699-43701). Critical habitat has not been designated for the Madison Cave isopod.

The listing was based on a number of factors including, but not limited to: the limited known range of the species, vandalism, siltation, and mercury contamination. Current threats include: thermal and chemical pollution from urban development and agricultural runoff (e.g., poultry farming), physical pollution, human disturbance (both cave vandalism and visitation). Barriers to forming recovery strategies include a lack of ecological and life history information for Madison Cave isopod and a lack of information regarding the physical limits of recharge zones that affect Madison Cave isopod habitat (Service 1996b).

The following details the anticipated impacts of NiSource's covered activities on the Madison Cave isopod within the covered lands (**Appendix M, Table 6.2.3.1–1**). Madison Cave isopod may be impacted by both O&M on existing ROW and new construction activities. The impact analysis is presented topically, arranged by the threats. Take calculations based on specific categories of covered activities are presented in Section 6.2.3.4.

It is important to recognize that all of these types of impacts are not going to happen all of the time. However, it is likely that some impacts may occur some of the time and if they occur in the vicinity of Madison Cave isopod, take is possible.

Contamination

The long-term viability of existing Madison Cave isopod populations is primarily threatened by groundwater contamination, including contamination in deep karst aquifers. However, this threat of groundwater contamination is difficult to fully assess because the recharge zones of the aquifers that support populations are largely unknown (Service 1996b). The recharge zone is the area through which water recharges the aquifers. It is important to understand the recharge zones to determine where contamination or sedimentation may be entering the system. Given that bedrock is not likely to be an effective sediment filter for subsurface waters and there may be instances where surface waters directly connect to subsurface waters, any contaminants released into surface waters may quickly reach water used by the Madison Cave isopod.

Within karst carbonate geologic formations of Virginia and West Virginia, which include the habitat occupied by Madison Cave isopods, McKoy and Kozar (2007) and Nelms, et al. (2003), characterize these aquifers as susceptible to contamination. The potential for an aquifer to be contaminated from near-surface sources is indicated by the presence of young waters. Age of the water is determined by the presence of a suite of environmental tracers, (chlorofluorocarbons (CFCs), sulfur hexafluoride (SF_6), tritium (^3H), and others) (Nelms, et al. 2003). Environmental tracers indicate the transfer of contaminants from the environment through the karst system into the aquifer. Because all of the water samples exceeded at least one of the threshold values, it is concluded that young water is present throughout most of the Valley and Ridge Carbonate regional aquifer system.

Ground-water movement along fractures, joints, and solution features can be rapid, especially under stressed conditions that can result from pumpage. The geometry of these features can allow young ground water to circulate to substantial depths in these regional aquifer systems (Nelms, et al. 2003). A study of the aquifer in Berkeley County, WV, which supports isopods and similar geologic characteristics to those in Virginia Madison Cave isopod habitat, documented high rates of water movements within the aquifer based on dye trace studies (Schultz, et al. 1995). Groundwater movement velocities ranged from 42 ft per day in less transmissive areas to 1,879 ft/day in the more conduit-dominated portions of the karst aquifer (Schultz, et al. 1995). A 2000 study of the same aquifer also documented contamination by coliform bacteria in 62 percent of the 50 wells sampled (Mathes 2000), indicating a high degree of direct groundwater connectivity.

Minor spills include fuel, fertilizer, or herbicide spills from small containers, hydraulic hose leaks or breaks, or other leaks from equipment and could result in contaminant exposure to Madison Cave isopods. Impacts to the Madison Cave isopod from a spill would depend on the location of the spill, quantity, concentration, and material spilled, water levels and flow at the time of the spill as well as the hydrological connections to any Madison Cave isopod habitat. Extrapolating from the environmental tracers and dye studies conducted at wells in the region, NiSource and the Service anticipate that chemicals released into surface or subsurface karst features during minor spill events may reach known and potential occurrences up to 1/2 mile of the spill with relatively little dilution. The hydrodynamics in karst aquifers and the folded and faulted nature of these karst systems may allow contaminants to pool behind obstructions when the water levels are low. This may mean that the contaminant may become concentrated further from the site of entry. It may also create a slug of contaminants once the water level is high enough to overflow the obstruction. Non-volatile contaminants, contaminants that do not readily bind with the subsurface sediment, contaminants with a lighter density than the phreatic waters, and contaminants that are more water soluble have the characteristics that could increase flow distance and movements (Vesper, et al. 2003).

When small volumes of contaminants reach the aquifer, dilution is expected to occur, reducing the concentrations of contaminants relatively quickly depending on the volume and movement/mixing of connected waters. Once a contaminant has entered the aquifer, it is likely that it will disperse throughout connected aquifers over extended time periods, though in low concentrations. The concentrations of contaminants that result from small spills are expected to be diluted to levels with low toxicity to invertebrates at distances over ½ mile from the source.

There have been no studies on the effects of any chemicals on lethal or sublethal responses from Madison Cave isopod. However, a review of indirect effects of contaminants in aquatic ecosystems (Fleeger, et al. 2003) summarized that direct (lethal or sublethal) effects on aquatic biota are possible and depends on the intensity and duration of exposure to a toxicant, as well as the species tolerance to the substance. In addition, indirect or secondary effects of contaminants may alter competitive interactions and/or alter populations of predators or prey of Madison Cave isopod. The review included papers regarding impacts on benthic freshwater isopods from insecticides, but otherwise did not specifically address any type of contaminants impacts on this group. The Madison Cave Isopod Recovery Plan (Service 1996b) suggests that Madison Cave isopods are highly vulnerable to disturbance and includes pollution as a threat. Research on Madison Cave isopod sensitivities will help address this issue but until any is completed, the analysis will err on the side of the species and expect that all exposed Madison Cave isopods will have either lethal or sublethal (e.g., reduced reproduction) responses. NiSource has developed measures to reduce the potential of exposure of Madison Cave isopods to contaminants. AMMs 9-13 address the application of fertilizers and herbicides and control of other potential contaminants. However, the risk cannot be reduced to the point where no minor spills are anticipated. Major spills (those greater than EPA reporting limits) are not addressed in the MSHCP but will be through emergency Section 7 consultation procedures with the FERC and the Service.

Habitat Loss, Degradation and Fragmentation

Subsurface lakes and aquifers supporting Madison Cave isopods may be impacted during O&M activities, as well as by new construction. The NiSource O&M activities involve ground disturbance (e.g., replacement or removal of pipe) in wetlands that may have hydrologic connections to Madison Cave isopod habitats. In addition, disturbances in uplands may result in filling or caving in of sink holes or other karst features or increased sedimentation that may end up in these karst features. Primary impacts from ground-disturbing O&M and new construction activities are the initial vegetation removal and grading. Trenching, blasting, and drilling may also result in impacts.

Vegetation removal is the clearing of the trees and shrubs and does not involve significant earth disturbance. Impacts to Madison Cave isopods from clearing are not expected. Grading removes all of the remaining low-growing vegetation and microtopography of the site. These activities may cave in sink holes. In addition, the topsoil and vegetation may be placed in adjacent surface karst features. Finally, surface soil disturbances may result in increased temporary erosion and sediments that may end up in karst features. This could result in smothering of individuals and degradation of habitat.

Trenching has the potential to cause subsidence in adjacent sinkholes or cut through karst features resulting in soil and vegetation falling into these features. This could range from minor sedimentation to complete filling of the features. Trenching is anticipated to result in impacts to individuals (smothering) and degradation of habitat. Crushing of individuals is not anticipated given that Madison Cave isopods primarily occur at depths far below NiSource activities (8-10 feet below the surface).

New access road construction has the same potential impacts as new ROW construction.

Karst features will be flagged, or otherwise clearly marked, to minimize potential impacts during O&M activities. NiSource will also attempt to avoid routing new ROWs and access roads through or near any karst features in the mapped potential Madison Cave isopod range. However, it is possible to miss karst features that have no surface openings in the footprint of disturbance.

Alterations to local hydrologic systems also are a significant threat to Madison Cave isopod populations. Madison Cave isopod habitats are sustained by groundwater regimes that are sensitive to changes in subsurface water supplies. Patterns of subsurface water flow can be altered by infrastructure construction and other development projects.

Water withdrawal

Hydrostatic testing withdrawal and discharge may result in temporary increases or decreases in the water levels of karst features. However, NiSource has developed avoidance and minimization measures to address this. Therefore, no impacts are anticipated from hydrostatic testing activities.

Loss of individuals

Human disturbance of individual animals is generally not a significant threat to the Madison Cave isopod given that underground lakes and deep karst aquifers are difficult to access. Cave access is further limited because caves containing known populations of the Madison Cave isopod are located on private lands and in some cases are protected by iron gates.

However, there are NiSource activities that may result in impacts to individuals. For example, blasting (potentially caving in habitat) may result in direct impacts (e.g., smothering) to Madison Cave isopod.

Summary

In summary, the primary threats to Madison Cave isopods from NiSource are: loss, degradation, and/or fragmentation of habitat due to collapsing or filling in subsurface features and/or altering subsurface water quality and/or quantity. The changes in habitat would render them temporarily to permanently unsuitable for future use by the Madison Cave isopod and may prevent movements among or between populations. Any Madison Cave isopods present in the zones of impact would likely be killed by smothering or poisoning.

While the anticipated impacts to exposed Madison Cave isopods could be severe, it is important to remember that no known sampling locations are within 0.5 mile of the covered lands. Therefore, the primary concern is that additional, currently unknown populations occur within or in close proximity to the covered lands or the extent of the known populations is much larger than anticipated.

An adaptive management program is necessary for a species with significant uncertainties and high levels of risk. *See* Section 7.6.4.6 for the proposed adaptive management program for the isopod.

6.2.3.2 Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicants should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; *see* also the Service's HCP Handbook at 3-20 ("HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery tools"; "contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the Madison Cave isopod. With these general goals in mind, the main Madison Cave isopod conservation objectives are to avoid or minimize impacts to known or presumed occupied habitat (e.g., destruction/alteration of caves, sinkholes, fissures, or other karst features) and avoid or minimize impact to Madison Cave isopods and their habitat (e.g., kill/injure/contaminate). The main conservation objective for all new construction projects (i.e., off existing ROW) is to avoid or minimize impacting known or potential Madison Cave isopod habitat (e.g., through project routing) and avoid or minimize impact to Madison Cave isopods (killing/chemical application). Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that can not be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 – Support protection and maintenance of Madison Cave isopod populations.

Rationale: The Madison Cave Isopod Recovery Plan (Service 1996b) calls for protecting, restoring, and maintaining Madison Cave isopod populations and their habitat at Front Royal Caverns, Linville Quarry Cave No. 3, and Madison Saltpetre

Cave/Steger's Fissure to such a degree that populations are shown to be stable over a ten-year monitoring period, based on a monitoring protocol that ensures standardized and comparable population trend data. Additional sites to those above may warrant permanent protection to meet this criterion. Protection of newly discovered populations, if any, will be incorporated into this criterion in so far as they contribute to maintenance of overall genetic diversity.

Objective 1 - Avoid or minimize impacts to known Madison Cave isopod populations and habitat (e.g., destruction/alteration of caves, sinkholes, fissures, or other karst features).

Objective 2 - Conduct surveys to locate potential habitat (connections with karst features) and/or new Madison Cave isopod occurrences.

6.2.3.3 Measures to Avoid and Minimize Impacts

These measures apply to the 76 miles of ROW and covered lands above karst features in Augusta, Clarke, Page, Rockbridge, Rockingham, Shenandoah, and Warren counties, and the City of Waynesboro, Virginia (**Appendix G, Figure 6.2.3.3-1**). These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Measures in *italic* font text will be applied on a case-by-case basis depending on the requirements of the activity. These requirements include consideration of customer and business needs, practicality, and effectiveness as more fully described in Chapter 5 of this MSHCP.

Surveys to Evaluate Karst Features (indicators of potential presence of Madison Cave isopod) (Appendix L)

1. Field inspections and remote sensing for surface karst features within the range of Madison Cave isopod were completed in 2009 (Denton, et. al. 2009). Findings suggest that no caves, or closed depressions, with open throats occur within the existing ROW. However, there are four locations with open throats that receive drainage from the existing ROW. In addition there are areas with vegetated closed depressions (sinkholes) that are internally drained and may be areas of potential future subsidence.

Within one calendar year prior to start of any earth disturbing activity, the area of the disturbance will be surveyed visually to document the presence of existing karst features, and to identify new karst features that may have developed after the completion of the 2009 GeoConcepts survey (Denton, et. al. 2009). This information will be included in the annual compliance report.

Surveys to Evaluate Presence of the Species in Subsurface Habitat

2. NiSource will assume Madison Cave isopod subsurface presence along the 76 miles of ROW and covered lands of mapped potential habitat (**Figure 6.2.3.3-1**).

At this time, surveys for individuals are not recommended due to the limited information about the species, inadequacy of existing survey protocols, and the physical inability to survey for individuals in many cases. The best available survey guidelines have been developed by B. Hutchins and W. Orndorff. (Hutchins B. and Orndorff W.

2009). At this time the Service has not developed standard survey protocols based on this publication.

Once survey protocols are available, NiSource will conduct surveys for Madison Cave isopods in cases where suitable survey locations (survey points that are connected to NiSource areas of disturbance) are available and landowner permission is granted. If no suitable survey locations are available, NiSource will assume presence and follow the AMMs below. It is anticipated that the survey protocols will specify the number of years they will be considered valid. If no Madison Cave isopods are found, then the findings of the survey will be documented for future NiSource activities and the annual compliance report, and no further Madison Cave isopod AMMs or mitigation are needed.

Measures to Avoid and Minimize Impacts to Madison Cave Isopod and its Habitat

3. Protect known and/or future mapped recharge areas of cave streams and other karst features by following relevant ECS standards, such as Section III, Stream and Wetland Crossings; and Section IV, Spill Prevention, Containment and Control.

4. Buffers of 300 feet around karst features[19] in all work areas (within and off-ROW including discharge areas) must be established and clearly marked in the field with signs and/or highly visible flagging until construction-related ground-disturbing activities are completed.

5. Earth-disturbing activities will be conducted in a manner that minimizes alteration of existing grade and hydrology of existing surficial karst features. Land disturbances including permanent filling, excavating, or otherwise altering existing karst features, or any of these activities within 300 feet of a feature, will be avoided, if possible, or minimized. In addition to the requirements in the ECS, the following will be implemented in these areas:

a. If new open-throated sinkholes form within the ROW or construction work area, work in that area will stop and the sinkhole will be isolated from the rest of the work area with sandbags or other suitable materials. The Service will be notified. The sinkhole will be inspected (size, location, connectivity to ground water, etc.) and appropriate action taken (e.g. facility relocated, sinkhole remediated, etc.) to ensure facility integrity and protection of the aquatic resource and Madison Cave isopod habitat. If the sinkhole must be filled, an inverted filter to bridge the karst feature above the water table rather than filling it below, will be used (**Appendix L, Figures 6.2.3.3-2,-3,-4, and -5**).

b. If a subsurface void should open or be intersected, or a new sinkhole forms within the ROW or construction work area, work in that area will stop and the void will be isolated from the rest of the work area with sandbags or other suitable materials. The Service will be notified. The void will be inspected by a qualified geologist and/or engineer and appropriate action taken including filter

[19] Specific geologic structures that characterize the karst landscape, including sinkholes, caves, sinking or losing streams, ponors, pinnacled bedrock and large springs.

fabric secured over the void and other such measures as necessary (e.g. facility relocated, sinkhole remediated, etc.) to ensure facility integrity and protection of the aquatic resource and Madison Cave isopod habitat, (standard operating procedures for sinkhole remediation can be found in **Appendix L**).

c. In linear excavations adjacent to karst features, spoils will be placed on the upgradient side of the excavation so that if any erosion takes place the stockpiled soil will flow back into the excavation and not downgradient towards the karst feature;

d. Surface water control measures, including, but not limited to: diversion (direct water flow into trench or off-ROW areas past area of concern), detention or collection and transportation, will be utilized to prevent construction-influenced surface water from freeflowing into open-throated surface karst features, and eventually into the subsurface.

e. Open-throated surface karst features will not be utilized for the disposal of water generated by covered activities. Water will be discharged through energy dissipating devices (ECS).

6. Blasting within the Madison Cave isopod potential habitat zone (**Figure 6.2.3.3-1**) will be conducted in a manner that will not compromise the structural integrity or alter the karst hydrology of known or presumed occupied habitat. If rock is required to be hammered or blasted out of the way of a new pipeline installation, then the following parameters shall be adhered to:

a. The excavation shall be carefully inspected for any voids, openings, or other indications of solution activity.

b. If the rock removal intercepts an open void, channel, or cave, the work in that area shall be stopped until a remedial assessment can be carried out by a qualified geologist or engineer with experience in karst terrain.

c. All use of explosives shall be limited to low-force charges that are designed to transfer the explosive force only to the rock which is designated for removal (e.g., maximum charge of two inches per second ground acceleration).

d. If the track drill used to prepare the hole(s) for the explosive charge(s) encounters a subsurface void larger than six inches within the first 10 feet of bedrock, or a group of voids totaling more than 6 inches within the first 10 feet of bedrock, then explosives should not be used or a subsurface exploration should be conducted to determine if the voids have connectivity with a deeper structure. The subsurface exploration can be carried out with track drill probes, coring drill, electrical resistivity, or other techniques capable of resolving open voids in the underlying bedrock. If a track drill or coring rig is used, then all open holes shall be grouted shut after the completion of the investigation.

[NOTE: Adaptive Management will be employed for this AMM.]

7. Do not utilize HDD within the Madison Cave isopod potential habitat zone (**Figure 6.2.3.3-1**).

8. *If authorized by the landowner, block (e.g., gate) access roads and ROWs leading to known or presumed occupied habitat from unauthorized access.*

9. Further avoid and minimize the impact of spills by the following additions to the Spill Prevention Control and Countermeasures (SPCC) Plan contained in the ECS:

a. Equipment refueling will not be performed within flagged or marked buffer areas of streambed, sinkhole, fissure, or areas draining into these or other karst feature except by hand-carried cans (five gallon maximum capacity) when necessary;

b. Equipment servicing and maintenance areas will be sited outside of flagged or marked buffer areas of streambeds, sinkholes, fissures, or areas draining into sinkholes, fissures, or other karst features;

c. Prevent runoff resulting from construction equipment washing operations to directly enter any karst feature by locating these operations outside of the buffer area;

d. Construction equipment vehicles, materials, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products will not be parked, stored, or serviced within 300 feet of any karst feature;

e. All equipment will be checked by a NiSource inspector daily for leaks prior to beginning to work in karst habitat, and equipment will be removed or repaired if necessary; and

f. If a reportable spill has impacted a karst feature:

    i. follow spill response plan; and

    ii. call the Service at 413-539-3194 to report the release, in addition to the National Response Center (800-424-8802) and the Virginia Department of Environmental Quality (800-469-8892).

10. Restrict use of herbicides for vegetation management within the known or presumed occupied habitat to those provided by the Service (appropriate for aquatic use and unknown to be toxic to crustaceans) (**Appendix L**). Other appropriate herbicides may be approved by the Service upon request by NiSource.

11. Herbicide application

a. Apply herbicides in accordance with NiSource policy and procedures, EPA guidelines and requirements, state requirements, and the manufacturer's label.

b. Do not use aerial herbicide application methods within 300 feet of marked or flagged buffers of karst features.

c. The following measures must be undertaken for non-aerial application of herbicides within 300 feet of marked or flagged buffers of karst features:

    i. Hack and squirt (frill or drill and fill) – cut trunk of tree and apply glyphosate using backpack sprayer, squirt bottle, syringe, or tree injector.

    ii. Inject pellets of glyphosate or imazapyr directly into trunks of woody vegetation (red maple, alder, poison sumac).

iii. Cut stump/stem – cut tree or shrub and apply glyphosate to cut surface using spray bottle or wick applicator.

iv. Wick application – apply glyphosate directly to leaves and/or stem via "glove application" or paint stick with a contained reservoir to hold the herbicide.

v. Spot spray – spray glyphosate directly onto leaves or stem via backpack sprayer, squirt bottle, or modified low volume hydraulic applicator – no high pressure sprayers.

vi. Herbicide will not be applied using an open container of herbicide for any application to reduce risk of spills.

vii. When conducting foliar application of glyphosate, the surfactant LI-700 (or less toxic future surfactants) shall be used in accordance with EPA-approved label instructions.

viii. Filling and emptying of herbicide containers will occur in areas that do not drain into sinkholes, fissures, streambeds, or other karst feature.

ix. All applicators will have a spill kit available.

x. All hoses, tanks, and clamps will be inspected in non-karst areas prior to use each treatment day.

xi. Apply herbicide when wind speed at treatment height is ≤ 5 miles per hour.

12. Do not apply fertilizers within marked or flagged buffer of streambeds, sinkholes, fissures, or areas draining into sinkholes, fissures, or other karst features.

13. Contaminants, including but not limited to oils, solvents, and others, shall be strictly controlled as provided for in the EMCS and ECS, Section II.C.2, as well as Section IV so the known occupied or presumed occupied habitat is not affected.

14. Operators, employees, and contractors will be educated on the biology of the species, activities that may affect behavior, and ways to avoid and minimize these effects.

15. Hydrostatic test water will not be obtained from karst features (only free-flowing streams) within the mapped Madison Cave isopod range. To prevent effects to the isopod, water from known or presumed occupied habitat will be withdrawn in a manner that will not visibly reduce the wetted perimeter of the steam channel.

16. Do not discharge hydrostatic testing water from new pipe directly into flagged or marked buffer areas of sinkholes, fissures, or other karst features or channels or surface features that flow towards those features. Discharge this hydrostatic testing water in the following manner (in order of priority and preference):

a. Discharge hydrostatic testing water down gradient of flagged or marked buffer areas of sinkholes, fissures, or other karst features unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.

b. If those circumstances occur, discharge water into uplands more than 300 feet from flagged or marked buffer areas of sinkholes, fissures, or other karst features unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.

c. If not practicable, discharge water as far from flagged or marked sinkholes, fissures, or other karst features as practical and utilize additional sediment and water flow control devices (**Figures 6A&B, 7, 8,14A&B**; ECS) to minimize effects.

17. Do not discharge hydrostatic testing water from existing pipe directly into flagged or marked buffer areas of sinkholes, fissures, or other karst features or channels or other surface features that flow towards those features. Discharge this hydrostatic testing water down gradient of flagged or marked buffer areas unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge. If such circumstances occur, collect water and dispose of it in an approved disposal facility.

Routing Criteria (new ROWs, access roads)

18. NiSource is strongly oriented towards using existing ROWs for facility replacement and/or expansion projects as these areas have been previously disturbed. When routing new or replacement facilities away from the existing ROW, strong emphasis will be placed on avoidance of surface karst features and their 300-foot buffers, in particular open throated sinkholes or other features that provide direct access to subsurface water. In situations where surface (or unknown subsurface) karst features cannot be avoided (e.g., due to other environmentally sensitive resources, man-made structures, landowner concerns, or terrain), the appropriate AMMs above will be applied to the construction, operation, and maintenance activities for the facility.

NiSource will coordinate with the Service if either surface or subsurface features are intersected (*see* above AMMs).

6.2.3.4 Calculation of Incidental Take

NiSource is using the disturbance of surface area that may be hydrologically connected to the subsurface as a surrogate for subsurface impacts to Madison Cave isopod. NiSource is requesting incidental take coverage over a 50-year period for impacts to two populations of Madison Cave isopod as represented by 2,764.5 surface acres of covered lands. As will be discussed, take is anticipated to occur through killing (smothering, desiccating, poisoning), harm, harassment, and in association with surveys for Madison Cave isopods, there may be temporary collection (any take associated with surveys would be covered under individual scientific collector's permits).

Given the discussion in Section 6.2.3.5, a reasonable worst case scenario is used to calculate take, although the actual take is anticipated to be less.

The Service anticipates incidental take of the Madison Cave isopod will be difficult to detect for the following reasons:

(1) The individuals are small and occupy underground habitats where they are difficult to find;

(2) Finding dead or injured specimens during or following project implementation is unlikely; and

(3) The lack of information about the existence or nature of hydrological connections; and

(4) The extent and density of the species within its habitat in the action area is unknown.

Because of the difficulty in determining a level of take based on the number of Madison Cave isopods that will be adversely affected, the Service has decided that it is appropriate to base the level of authorized incidental take on the number of known and likely occurrences (representing populations) within 0.5 (or one half) mile of the covered lands.

Since it will be difficult to assess impacts to these populations, take will be expressed in terms of the area of surface ground disturbance (easily measurable) and estimated associated subsurface impacts (based on distances sediments and contaminants are anticipated to disperse) within the mapped distribution of the species. It is important to understand that while Madison Cave isopods may occur anywhere throughout the mapped range that overlaps with the NiSource covered lands, NiSource and the Service currently estimate that one known population and one additional (currently unknown) population will be impacted by NiSource activities. However, should additional information on the number of occurrences (and estimated populations) become available, NiSource will revisit this species, through changed circumstances (Chapter 10.3.8).

Known Occurrences

As stated above, there are currently 16 documented occurrences of Madison Cave isopod. Four of these occur in Jefferson County, West Virginia (the county is not crossed by NiSource covered lands). Twelve of these occur in Virginia in counties that are crossed by NiSource covered lands (from south to north - one in Rockbridge County, three in Augusta County, four in Rockingham County, three in Warren County, and one in Clarke County). None of the occurrences is within the existing ROW or covered lands.

Occurrences represent a sampling point where Madison Cave isopods were captured. The geographic extent of populations is anticipated to be much larger than the individual sampling point.

The closest known occurrence to the covered lands is 0.5 mile from the edge of the covered lands and 1.0 mile from the existing ROW. The strongly folded and faulted nature of the sedimentary rocks in the Shenandoah Valley indicates limited physical connectivity of deep karst aquifers in different belts of carbonate rocks (Holsinger, et al. 1994). Holsinger, et al. (1994) further suggested that some of the most widely separate populations of Madison Cave isopods, such as those in Augusta and Warren county sites, are completely physically isolated. Genetic work conducted by Fong and Hutchins (2006) supports these ideas and indicate that Madison Cave isopod exist as at least three distinct genetic units (northern, southern, and western) with Warren County sites in the northern unit and Augusta County sites in the southern. However, the northern unit is approximately 31 miles wide and suggests periodic movements of individuals on this scale. While these periodic movements occur, it is not anticipated that sediments will move widely throughout the folded/faulted system. Sites within 0.5 mile of NiSource activities might be impacted by contaminants or sedimentation. Only one sampling point is within 0.5 mile of the covered lands (Lime Kiln).

Potential Additional Occurrences

Without site specific-information, the Service assumes presence of the Madison Cave isopod within phreatic waters of karst limestone in the lower Great Valley of Virginia and West Virginia (865,415 acres of medium and high probability areas in **Figure 6.2.3.3-1**). The covered lands cross approximately 76 miles of these mapped karst limestone features in Augusta, Clarke, Page, Rockbridge, Rockingham, Shenandoah, and Warren counties, and the City of Waynesboro, Virginia.

Field inspections and remote sensing for surface karst features within the range of Madison Cave isopod were completed in 2009 (Denton, et. al. 2009). Findings suggest that no caves, or closed depressions with open throats, were discovered within the existing ROW. However, there are four complexes of karst features with a series of open throats that receive drainage from the existing ROW. In addition there are areas with vegetated closed depressions (sinkholes) that are internally drained and may be areas of potential future subsidence.

In addition to field inspections of the existing ROW, remote sensing of the covered lands was conducted to inventory potential areas for future field investigations. Closed depressions, caves, abandoned wells, and perennial springs were located.

NiSource will conduct field inspections for any surface karst features prior to off-ROW construction projects.

Take Calculation

As discussed above, take is expressed in terms of two Madison Cave isopod populations anticipated to be impacted by covered activities conducted along 76 miles of pipeline above mapped Madison Cave isopod potential habitat.

- Two different sets of activities will occur within 76 miles of the one-mile-wide corridor:
  - Activities associated with replacement/repair of existing pipelines within the existing 50-foot ROW and an additional 25- to 50-foot temporary work area around ROWs (total of 100-foot surface disturbance width).
  - Activities associated with the construction and the subsequent replacement/repair of two possible new pipelines (e.g., loops) within two new 50-foot ROWs and two associated 25- to 50-foot temporary work areas around each of the new ROWs. (Total of an additional 200-foot surface disturbance width).
- The total maximum area for surface impacts = 300-foot wide disturbance area for 76 miles or 4.3182 mi^2 or 2,764.6 acres.

- Take is expressed in terms of the 2,764.6 acres of ground surface and vegetation disturbance above Madison Cave isopod potential habitat.
- Surface or subsurface activities may result in contaminants/sediments traveling through openings into phreatic waters up to 0.5 mile from the area of input totaling in 76 mi^2 or 48,640 acres of potentially affected subsurface area.
- The currently estimated distribution of the species encompasses 865,415 acres.
- For the purposes of this MSHCP, it is assumed that one unknown Madison Cave isopod population occurs within the area of effect.

Because little is known about extent of indirect effects resulting from the covered activities or the extent of Madison Cave isopod populations throughout the covered lands, impacts to karst features within all of the covered lands are considered equally likely to result in take to the one assumed unknown population. As part of an adaptive management strategy, NiSource will evaluate this assumption.

In conclusion, there is potential take to one known and one unknown population, but because there is no way to currently quantify how that take manifests itself or monitor the impacts to these populations, surface and subsurface habitat is being used as a surrogate.

6.2.3.5 Impact of Take Analysis

Anticipated Take of Individuals and Quantification of Impacted Sites

Individual Impact

Individuals associated with up to two populations may experience impacts that causes take ranging from harassment to death (poisoning, smothering). Depending on a particular situation, individual Madison Cave isopods may be able to move away from the source of the stressor (e.g., sediment pulse), which would result in only temporary impacts to individuals. However, as stated above, NiSource and the Service are unable to quantify the number of individuals that are likely to be taken by NiSource activities and are therefore using habitat (surface and estimated associated subsurface) as a surrogate.

Population Impact

As stated above, limited information on the connectivity of Madison Cave isopod populations prevents an understanding of how impacts at a given site may relate to broader populations. Sites that may be impacted could be rapidly recolonized if the site was part of a larger population, or they could be eliminated with little chance of subsequent recolonization.

Recent efforts to improve knowledge of the species' range have resulted in an improved understanding of its distribution. However, within the distribution, little is known about the abundance, density, and habitat connectivity and use. As a result, there are few data upon which to base estimates of potential impacts, and a relatively poor understanding of the natural variability in abundance, density, and occurrence.

Existing data on abundance of Madison Cave isopod at a site are summarized below (Orndorff and Hutchins 2007):

- King Irvin's well population estimate density = 95
- Madison Saltpetre Cave population estimate = 360 – 1,020
- Steger's Fissure population estimate = 2,240 - 3,420

NiSource does not anticipate extirpation of any currently known populations, as populations likely have larger geographic extents than currently mapped. However, take of individuals from populations is anticipated.

NiSource activities may contribute towards many other ongoing stressors to Madison Cave isopods which cumulatively could result in extirpation of a population. NiSource and the Service anticipate potential impacts to one currently known and one additional unknown population. NiSource and the Service know that there are other sources of sedimentation in areas where there are currently extant Madison Cave isopod sites. The additional source of sedimentation/contaminants provided by NiSource is not anticipated to result in the extirpation of the Lime Kiln Cave population. However, the unknown assumed population may occur in close proximity to the existing or future ROW and there is potential for extirpation to this population.

Genetic Impacts/Implications

Fong and Hutchins (2006) determined the number of genetic populations of Madison Cave isopod by studying the within and between site cytochrome oxicase *c* subunit I (COI) mitochondrial gene variation. They collected samples from nine sites in four counties: Jefferson, West Virginia, Warren, Virginia, Rockingham, Virginia, and Augusta, Virginia. The results indicated three distinct lineages (haplotype groups) corresponding to three geographic areas, northern, western, and southern groups. None of the groups shared any haplotypes and the data strongly indicated there are at least three genetic units. Although there were significant differences between the three geography areas in this study, they were not different enough to warrant speciation. However, Hutchins (2007) believes the three genetic units should be treated as Evolutionarily Significant Units.

The NiSource covered lands intersect the Northern genetic group as identified in Fong and Hutchins. NiSource does not anticipate any isolation of portions of the Northern genetic unit from each other due to the location of the covered activities (near the surface) versus the depth of Madison cave isopod occurrences.

6.2.3.6 Compensatory Mitigation

NiSource is anticipating take of individuals from two populations (Lime Kiln Cave and one unknown population). As mitigation for this, NiSource shall protect habitat for two populations of Madison Cave isopods. Sites containing surface karst features will be protected and the surface karst features will be restored (if needed). Protected sites must contain either a cave or spring known to provide habitat for the Madison Cave isopod and its immediate recharge area, or a minimum of five surface karst features and a 300-foot buffer around each feature. Where the term "protection" appears in this Section, please refer to Section 6.2 for a further definition and the requirements for securing conservation of mitigation lands and other real property interests.

Sites for protection shall be determined in either of two ways:

1. NiSource can fund a qualified hydro-geologist to delineate the immediate recharge area around the identified cave/spring. The Service shall review the proposed plans to ensure their adequacy.
2. NiSource can work with partners (e.g., USGS, Virginia DNR, and Service) to permanently protect sites that are already (or soon to be) identified.

NiSource, the Service, States, and TCF are currently developing prioritization schemes to rank future proposed projects. However, current thinking on priorities includes protecting intact forest and multiple surface karst features within large contiguous parcels.

Unknown Occurrence Mitigation

NiSource shall protect key parcels (minimum of 25 acres) in the drainage area immediately around a known Madison Cave isopod site. NiSource shall restore 300-foot buffers around each karst feature on the parcel. This will protect the surface karst features from future disturbance which is very important in areas with high development threats.

Lime Kiln Occurrence Mitigation

NiSource shall protect and restore (if needed) a minimum of 25 acres immediately around the Lime Kiln Cave.

If that is not possible, NiSource will follow mitigation requirements for unknown occurrences (*see* above).

Mandatory Measures

For all the Mitigation described under the above headings, each mitigation project shall include:

(1) development of a restoration, management and monitoring plan for Service review and approval including (a) the current status of the surface features and Madison Cave isopod population (whatever is known) at the site; (b) a general location map; (c) a detailed site map showing: property boundaries, any encumbrances (rights-of-way) on the property, karst features; (d) timeline of activities; (e) description of activities including measures designed to minimize impacts to Madison Cave isopods during restoration and management; (f) adaptive management strategy; (g) plan to monitor success of project; and (h) estimated costs (restoration, management, and monitoring);

Restoration activities may include slope stabilization, clean-up (removal of dumped trash) of karst features and the surrounding area, planting native species (minimum 300-foot buffer), and associated measures such as fencing and posting, installing gates on open throats, and reducing channel flows/restoring hydrology within protected lands to increase water quality that flows to Madison Cave isopod sites. Enhancement may include planting in unstable surfaces or in thinly vegetated areas in the watershed surrounding the karst feature.

The anticipated range of parcel size necessary to accomplish this protection is between 5-15 acres per feature or 25-75 acres per project (dependent upon size and configuration of features). Actual restoration acreage will be determined for a specific site and included in the restoration plan for Service review and approval.

(2) Long-term management and protection - A description of protection is provided in Section 6.2 and **Appendix P** provides a template easement.

(3) Appropriate Timing - As more fully described in Chapters 5 and 8, NiSource will initiate a suitable mitigation project prior to commencing the activity causing the impact.

6.2.4 Clubshell Mussel

The clubshell mussel (*Pleurobema clava*) was listed as an endangered species by the Service in 1993 (Service 1993a). Once deemed "extremely common" and widespread, the clubshell is now considered "imperiled" (NatureServe 2007a). For unknown reasons, many of the remaining clubshell populations do not appear to be reproducing in locations where many other species of freshwater mussels show evidence of recent recruitment. The clubshell is now limited to a few populations distributed within a highly restricted range, although population numbers can be high in localized areas (Service 2009a).

Impacts and potential resulting take of clubshell are likely to occur in the following counties: Franklin, Madison, and Pickaway counties, Ohio; Armstrong and Clarion counties, Pennsylvania; and Braxton, Clay, and Doddridge counties, West Virginia.

Adult freshwater mussels are filter-feeders, siphoning phytoplankton, diatoms, and other microorganisms from the water column. Mussels tend to grow relatively rapidly for the first few years, and then their growth slows appreciably at sexual maturity (when energy is being diverted from growth to reproductive activities). There is ongoing discussion among scientists concerning the life span of mussels, but as a group, they are generally acknowledged to be long-lived organisms. Clubshells are relatively long-lived with life spans of 20 years or more (Service 2009a).

The clubshell likely reaches sexual maturity between three and five years of age, as does the closely related Tennessee clubshell (*Pleurobema oviforme*). Males of the genus *Pleurobema* release sperm into the water in April, May, and June, and downstream females uptake the sperm with incoming water (Weaver et al. 1991). Fertilization takes place internally, and the resulting zygotes develop within the gills into specialized larvae termed glochidia.

The minute bivalve glochidia develop over a period of days to months. This species is thought to be a short-term summer brooder, having a spring or early summer fertilization period with the glochidia being released during the summer. Glochidia must come into contact with a specific host fish, usually within 24 hours, in order for their survival to be ensured. Without the proper host fish, the glochidia will perish (Service 1994). After a certain amount of time (from hours to weeks), depending on water temperature and species, the glochidium transforms to a juvenile and drops off the host fish. The juvenile then burrows into the substrate or attaches to a larger object with a byssal thread (Service 1994).

In part because clubshell, like virtually all freshwater mussels, relies on this parasitic larval stage, it probably experiences very low annual juvenile survival. Jantzen et al. (2001) report greater than 99 percent mortality for glochidia. Though not specific to clubshell, this estimate and the estimates of survival that follow are likely typical for clubshell and most mussels in North America. Probability of survival from mussel glochidium to benthic recruit has been estimated to range from 1 $x10^{-6}$ (Young and Williams 1984) to 39 x 10^{-6} (Haag 2002). Transition from glochidium to juvenile represents a very large bottleneck—a single female's reproductive output is reduced from thousands of glochidia to < 1 offspring per year (Berg et al. 2008). The low fecundity suggests the need for a large population to produce a large annual cohort (Musick 1999).

Potential fish hosts for the clubshell include: the striped shiner (*Notropis chrysocephalus*), central stoneroller (*Campostoma anomalum*), blackside darter (*Percina maculata*), and logperch (*Percina caprodes*), which have been shown capable of serving as hosts for the clubshell under laboratory conditions (Watters and O'Dee 1997, O'Dee and Watters 2000). It is likely that additional untested fish species can be used by clubshell glochidia in the wild (Service 2009a).

Extant clubshell populations occur in relatively small streams to medium-sized rivers (Service 2009a). It inhabits coarse sand and fine gravel substrates in shallow riffles and runs with moderate current. It is commonly found at depths of less than three feet. Because up to 70 percent of a clubshell population can be distributed below the substrate surface (Smith et al. 2001), this species is presumed to be highly dependent on interstitial flow for oxygen and food (Service 2009a). The clubshell requires clean substrate and flowing water and cannot tolerate mud or slack water conditions (NatureServe 2007a).

6.2.4.1 Activities and Impact Analysis

Few mussel species have declined in numbers as drastically as the clubshell mussel, which was once widespread and common. The decline of this species undoubtedly is not due to any one cause, but to several compounding problems. The recovery plan identified four primary factors responsible for the decline of clubshell populations: siltation, impoundments, in-stream sand and gravel mining, and pollutants (Service 1994).

The 5-Year Review (Service 2009a) lists ongoing threats to the clubshell. These include water quality degradation from point and non-point sources, particularly in small tributaries that have limited capability to dilute and assimilate sewage, agricultural runoff, and other pollutants. In addition, the species is affected by hydrologic and water quality alterations resulting from the operation of impoundments. A variety of in-stream activities continue to threaten clubshell populations, including sand and gravel dredging, gravel bar removal, bridge construction, and pipeline construction. Coal, oil, and natural gas resources are present in a number of the watersheds that are known to support clubshell. Exploration and extraction of these energy resources can result in increased siltation, a changed hydrograph, and altered water quality even at a distance from the mine or well field. Land-based development near streams of occurrence often results in loss of riparian habitat and increased storm water runoff, which combine to increase sedimentation. Because clubshell often live below the gravel surface, this species may be exceptionally sensitive to the increased siltation, which fills the spaces within the gravel, and blocks the interstitial flow of oxygen and food. Development has also resulted in an increased number of sewage treatment plants in drainages that support clubshell as well as an increase in the amount of sewage discharged from existing plants.

There is a growing belief that emissions of greenhouse gases are linked to climate change. The extent of warming and the resulting changes in rainfall patterns that may occur is not known with certainty at this time. NiSource has addressed the potential for impacts to clubshell from water temperature increase and other possible manifestations of climate change in Chapter 10.

Some of the remaining populations of clubshell are small and geographically isolated. The patchy distributional pattern of populations in short river reaches makes them much more susceptible to extirpation from single catastrophic events.

NiSource Activities Potentially Affecting Clubshell

NiSource activities that may affect clubshell are those that potentially cause take and derive: (1) from stream crossing actions (affecting the streambed and riparian corridor); and (2) upland disturbing (sediment related) *aggregate impacts*. Aggregate impacts are defined as those impacts that derive from multiple NiSource activities that individually do not rise to the level of take, but taken together over time may result in negative effects that NiSource has agreed to compensate for. One example would be the combined sediment impacts of access road maintenance, culvert replacement, grading, and restoration efforts over the 50-year permit duration.

Pitt, Clark, and Lake (2007) evaluated a study of the Menomonee River watershed in Wisconsin. They found that the 3.3 percent of the area disturbed by construction contributed the greatest amount of sediment at the river mouth compared to any other land use (50% of all the suspended sediments). In the southeast Wisconsin Regional Planning area, the same authors found that construction covered only 2% of the surface area, but contributed 26% of the sediment to inland waters. By comparison, agriculture was 72% of land use and contributed only 45% of the sediments. Owens et al. (2000) found that in Wisconsin even small (0.34 and 1.72 acres) construction sites had rates of erosion that were 10 times those of typical rural or urban land uses. Various factors including topography, rainfall intensity, soil type, soil compaction, time of year, and erosion control measures influence the rate. Both studies recognize that even small construction projects (for reference National Pollutant Discharge Elimination System Phase II regulations regulate sites above one acre in urban areas) and small overall construction footprints in a watershed can cause significant detrimental impacts to local waterbodies.

Although the effects from many NiSource O&M and new construction activities are sediment related (e.g., grading, regrading, tree clearing, repair, culvert replacement, etc.), it is not expected that any of these activities, as routinely implemented, will result in a large single discharge of sediment. In addition, negative consequences are likely lessened because most covered activities are outside of urban areas where storm sewers carry sediments directly to receiving waters and vegetated buffers are less available. NiSource also implements multiple sediment control measures on its ground-disturbing projects (*see* ECS, **Appendix B**). However, none of these measures are 100% effective and effectiveness varies even with properly implemented measures. For example, properly installed silt fences in Alabama did not achieve sediment reduction to the same level as an undisturbed reference site (Pitt, Clark, and Lake 2007). Non-point sediment impacts are difficult to measure and impacts may occur as a result of numerous activities over many years. Nevertheless, NiSource believes that these activities, although reduced to the maximum extent practicable, may result in harm and harassment of clubshell.

The following O&M activities may impact clubshell: pipeline corridor presence, vehicle operation, access road culvert replacement, access road maintenance, off-ROW clearing, mechanical repair and fill in the ROW, in-stream stabilization, tree clearing, herbicide application, hydrostatic testing, pipeline abandonment, and well abandonment. These activities may result in a variety of stressors to clubshell including: sedimentation, chemical contaminants, increased water temperature, crushing, substrate compaction, altered flow, burying substrate, and introduction of invasive species (**Appendix M, Table 6.2.4.1-1**).

These stressors, in turn, may negatively impact the clubshell in a variety of ways. Sedimentation at levels that would be expected from O&M activities may degrade habitat and could over time disrupt clubshell biology (*see* discussion on burying below) or ecological relationships (e.g., host fish). As discussed above, clubshell may be particularly sensitive to sedimentation because of its predisposition to burrow into the substrate. Chemical contaminants have some potential to cause harm or mortality to mussels, but could also affect algae (fertilizers and herbicides) and plankton that provide food for mussels and host fish and affect water quality. The loss of riparian habitat may reduce shade on the stream, potentially altering water temperature, and may also affect trophic function by reducing inputs into the stream from overhanging trees. Crushing is self-explanatory. Since mussels are benthic organisms, substrate compaction can make habitat less suitable for both adult and juvenile mussels. Altered stream flow can change habitat and food availability. Similarly, burying habitat can fill the interstitial space in the sand and gravel and preclude normal processes when adult mussels burrow into the substrate. This can be even more harmful to juvenile mussels that immediately burrow into the substrate after dropping from host fish. Many species bury themselves completely during the winter months and it is estimated that 70% of clubshell can be buried at any time (Service 2009a). The introduction of invasive species primarily involves the accidental introduction of zebra mussels or other harmful invasives into habitat previously not contaminated or contaminated at a low level with these invasives. Where habitat is suitable for large populations of zebra mussels (typically water with less flow such as lakes or navigation pools in large rivers) zebra mussels have the potential to eliminate native mussel populations. All clubshell populations in medium-sized rivers (i.e., Allegheny River, French Creek, Green River, Tippecanoe River, and Elk River) occur downstream of reservoirs or natural lakes (Service 2009a).

New construction activities that may impact clubshell are: wet-ditch crossing activities, access road construction, grading, HDD, hydrostatic testing (withdrawal and discharge), regrading, fertilizer application, erosion control devices, herbaceous and woody vegetation clearing, stream bank contouring, installation and removal of stream crossing structures, trenching-related impacts, waste pits, minor spill events (major spill events are addressed outside the context of the MSHCP), in-stream stabilization, and vegetation disposal. The following stressors are associated with new construction activities: sedimentation, altered flow, chemical contaminants, entrapment, increase in water temperature, water level reduction, introduction of invasive species, substrate compaction, and crushing (**Table 6.2.4.1-1**).

The stressors from new construction mostly overlap those of O&M and may have the same impacts although in some cases the impact could be acute rather than chronic (e.g., sedimentation from stream crossing activities could likely have an acute effect on mussels immediately downstream, while sedimentation from the pipeline corridor presence, or access road replacement, could likely occur slowly over the 50-year life of the permit). Entrapment from the withdrawal of water for hydrostatic testing poses a slight risk to juvenile mussels, gametes that are released into the water column during reproduction, and to glochidia, which could be entrapped if small host fish were sucked through or trapped during water withdrawal. NiSource expects that take will be very limited in terms of both amount and level of take with implementation of mandatory AMMs. Water level reduction could impact clubshell occurring in smaller streams, particularly if withdrawal for hydrostatic testing were to occur during already low flow.

The most direct threat to clubshell involves excavation for installing or repairing pipelines across inhabited streams. If present, this excavation could cause direct lethal take of clubshell by crushing and excavating individuals and by causing lethal and sub-lethal (harassment and harm) sediment impacts to individuals downstream of the work area. Access road construction could have similar impacts to individuals. In-channel construction (e.g., in-stream stabilization or bank contouring) could also take individuals.

An alternative to open-cut excavation is HDD. However, under certain conditions, HDD can cause fracturing of the stream bottom. This fracturing can result in the release of drilling muds from the bore hole into the stream (frac-out), which could impact clubshell. Drilling muds are composed primarily of water and bentonite and the slurry or drilled solids cut from the bore hole. More advanced drilling muds typically contain various additives including long-chain polymers and detergents. In low pH environments, soda ash is sometimes added to raise the pH (in the bore hole) to an optimum level of about 9 (Najafi and Gokhale 2005). No studies were found that have evaluated the toxicity of HDD drilling muds to mussels. However, freshwater mussels appear to exhibit more sensitivity to some pollutants than do the organisms typically used in toxicity testing. As a result, some of the water quality criteria established by the EPA to protect aquatic life may not be protective of mussels (Service 2009a). It is likely that in high concentrations additives used to raise pH and detergents could cause harm. Minor frac-outs, however, which would involve very small quantities of drilling muds (and even smaller amounts of potentially toxic materials) would, based on our experience, be similar to background levels of sediment from natural events and not be expected to cause take (harm or mortality) of mussels. Any spill that would result in observed take would be handled outside the context of the MSHCP.

Impacts to clubshell habitat may also be a consequence of both O&M and new construction activities. Activities involving excavation in the stream channel (e.g., installing or removing pipeline) could have significant impacts to both the habitat in the construction area and downstream. Impacts may involve acute sediment impacts that, as described above, could render the habitat unsuitable for adult or juvenile mussels. NiSource's expectation is that some of the habitat would likely recover over a period of months (Villella 2005), but some impacts could persist for months or years until such time as high flows or storm flows moved the sediment downstream. This flow is particularly important for clubshell, which typically burrows completely beneath the substrate and depends on the movement of water through coarse sands and gravels (Service 2009a). Fine sediments that clog interstitial spaces could make habitat unavailable for mussels. Other activities (e.g., installation of in-stream stabilization, stream bank contouring, pipeline presence) could have long-term direct impacts on habitat and long-term indirect impacts through altered flow.

The activities that occur within the impact zone of the crossing action (e.g., crushing from equipment preparing a site for excavation, in-stream restoration) are calculated in the algorithm for crossing actions used to estimate take (described in Section 6.2.4.4 below). The remaining impacts are classified as aggregate and involve: (1) low-level sedimentation impacts to mussels and mussel habitat and host fish and host fish habitat from the pipeline corridor presence; ROW mechanical repair; ROW fill; vegetation clearing; access road maintenance, upgrading, and construction; installation and maintenance of culverts under access roads; grading; restoration (bank contouring); regrading, stabilization and restoration; low-level frac-out; open trenches; trench dewatering; trench water diversion structures; vehicle operation; waste pit berms; well abandonment (restoration); (2) chemical contaminants from hydrostatic testing, regrading, stabilization, and restoration (fertilizer); SPCC (spill event); (3) altered flow from in-stream stabilization measures; pipeline corridor presence; (4) increase in water temperature from pipeline corridor presence; tree and shrub clearing; and (5) substrate compaction from vehicle operation. These are chronic low-level impacts that combine together or with non-NiSource impacts to potentially degrade clubshell habitat and cause impacts over the proposed 50-year permit life.

An adaptive management program is necessary for a species with significant uncertainties and high levels of risk. *See* Section 7.6.4.4 for the proposed adaptive management program for the clubshell.

6.2.4.2 Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicants should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; see also the Service's HCP Handbook at 3-20 (stating "HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery tools"; "contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the clubshell. With these general goals in mind, the main clubshell conservation objective for ROW maintenance and O&M activities is to avoid or minimize impacts to known or presumed occupied habitat (e.g., minimize impacts to stream banks and bed) and avoid/minimize impact to clubshell (e.g., crushing, killing, sedimentation). The main clubshell conservation objective for all construction projects (i.e., off existing ROW) is to avoid or minimize impacting known or presumed occupied habitat (e.g., through project planning, use of trenchless installation) and avoid/minimize impact to clubshell (e.g., crushing, killing, sedimentation). Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that cannot be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 – Contribute toward maintenance and/or restoration of viable populations of clubshell mussels.

Rationale: The clubshell (Pleurobema clava) was widespread throughout most of the Ohio River and Maumee River drainages prior to 1800. This species now exist in eight to ten isolated populations, most of which are small and peripheral (Service 1994). The largest remaining clubshell population is in the Tippecanoe River of Indiana. The clubshell recovery plan (Service 1991) calls for protecting and restoring viable populations in 10 drainages, comprised of both peripheral and central populations to maintain genetic variability, and be extensive and abundant enough to survive a single adverse ecological event. A viable population is defined as a naturally reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural environmental changes. Theoretical considerations by Franklin (1980) and Soule (1980) indicate that 500 breeding individuals represent a minimum population level (effective population size) that would contain sufficient genetic variation to enable that population to evolve and respond to natural habitat changes. These populations should include as many subpopulations as possible to maintain whatever fraction of the original genetic variability now remains. The following drainages are identified as necessary for achieving recovery (Service 1994): Tippecanoe River, Indiana; East Fork West Branch St. Joseph River, Minnesota, Ohio; Fish Creek, Indiana, Ohio; Green River, Kentucky; Little Darby Creek, Ohio; Elk River, West Virginia; French Creek, Pennsylvania; and Allegheny River, Pennsylvania.

Objective 1 - Where habitat has been degraded, restore and/or protect riparian habitat specifically for the conservation of clubshell mussels.

Objective 2 - Where habitat has been degraded, restore and/or protect water and substratum quality.

Objective 3 - Partner with stakeholders having responsibility and/or expertise in clubshell mussel conservation and recovery, and contribute resources to those efforts and programs in priority areas for mussel recovery.

Objective 4- Propagate, augment, enhance, and/or restore clubshell mussels where appropriate where habitat conditions, genetic information, and other necessary parameters indicate this is an appropriate action.[20]

Goal 2 - Determine, through research, feasible mechanisms to enhance extant populations, including augmenting and/or reestablishing clubshell mussels into historic habitats and implement those mechanisms consistent with Goal 1.

Rationale: Mussel propagation technology and subsequent translocation are fast becoming important tools in the recovery of native populations (Garner 1999). Most existing populations are likely below the number needed to maintain long-term viability. These populations may be able to expand naturally if environmental conditions are improved. However, some populations may be too small to recover and may need to be supplemented to reach and maintain a viable size. Translocation may entail: (1) bolstering small populations through artificial infestations or in-vitro cultures from the same population where the reason for the depressed status of the population is understood, (2) bolstering small populations with individuals from a larger population, and/or (3) introducing individuals to an area where they have been extirpated (Service 1994).

Objective 1- Develop necessary genetic information for propagation and reintroduction of clubshell mussels.

Objective 2 - Identify and prioritize streams suitable for augmentation, translocation, and/or reintroduction, and those most easily protected from further threats.

Goal 3 - Develop and implement a program to monitor population status, including demographics and habitat conditions.

6.2.4.3 Measures to Avoid and Minimize Impacts

These measures apply to “may affect” counties in Section 6.2.4 and the maps in **Appendix G, Figure 6.2.4.3-1** for the clubshell mussel.

These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Measures in *italic* font text will be applied on a case-by-case basis depending on the requirements of the activity. These requirements include

[20] At the time of the development of this MSHCP, propagating and augmenting clubshell is a very low priority. The genetics of this species is poorly understood and habitat limits are even more poorly understood. Augmentation may be likely to result in substantial mortality and should be considered experimental.

consideration of customer and business needs, practicality, and effectiveness as more fully described in Chapter 5 of this MSHCP. Details on selecting the appropriate waterbody crossing method are provided in Section 5.2.1.1.

Surveys to Evaluate Presence and Relocation of Species in NiSource Action Areas

1. A survey can be conducted to determine the presence of this mussel species. Mussel survey protocols designed to detect endangered mussels that often occur in low densities; protocols as of 2009 are provided in **Appendix L**. Survey methodologies must be evaluated at minimum every five years and updated to the most effective survey methods currently available. If the most current methodology implemented by a biologist, qualified to conduct the survey, does not indicate the presence of the species, it will be classified as unoccupied habitat and the AMMs will not be mandatory.[21]

If a survey is not completed, presence will be assumed. In that case, all suitable habitat would be treated as occupied, and all mandatory AMMs must be followed. NiSource or its contractors will follow the Service approved relocation plan as referenced below. Survey and relocation may be implemented in the same time period (as one action) as long as both survey and relocation protocols are followed (general relocation protocols are identified in **Appendix L**, but may be modified in conjunction with Service Field Office based on conditions).

Relocation may be implemented only if: (1) all required permits are in place, (2) a Service approved relocation plan documenting all relevant protocols including how and where the mussels will be moved is in place, (3) a contingency plan is in place to conduct additional consultation with the Service should the actual field survey not reflect the conditions identified in the approved relocation plan, and (4) a monitoring program to evaluate the effects of the relocation is in place. Relocation will include at least all individuals of the federally endangered species identified in the impact area and may include other species based on the assessment of the Service Field Office and other regulatory agencies. A copy of the survey and any reports will also be included in the annual report submitted to the Service.

Pre-Construction Planning: Preparation of an EM&CP

2. A detailed EM&CP will be prepared for any activity with potential effects (e.g., streambed or stream bank disturbance, impacts to riparian habitat, activities causing sediment) within 100 feet of the ordinary high water mark of occupied mussel habitat. The plan will incorporate the relevant requirements of the NGTS ECS and include site-specific details particular to the project area and potential impact. The waterbody crossing will be considered "high-quality" for the purpose of preparing this plan regardless of the actual classification. The plan will be strongly oriented towards minimizing streambed and riparian disturbance (including minimization of tree clearing within 25 feet of the crossing [**Figure 24, ECS**]), preventing downstream sedimentation (including redundant erosion and sediment control devices, which would be designed to protect mussel resources as appropriate), and weather monitoring by the Environmental Inspector to ensure work is not begun with significant precipitation in the forecast. The

[21] However, NiSource may implement some of these measures if appropriate to protect potentially suitable habitat.

plan will comprehensively address all activities needed to complete the work and minimize take of mussels in occupied habitat including crossing the streams during dry periods when practical and using dry-ditch crossing techniques for intermittent streams leading to mussel habitat. The EM&CP will include the frac-out avoidance and contingency plans described in AMM #3 below. The EM&CP will also include a sediment control component for uplands that drain to and impact occupied habitat. Detailed erosion control plans will be developed specific to slopes greater than or equal to 30 percent leading directly to occupied habitat. These plans will include techniques such as hard or soft trench plugs, temporary sediment barriers, a wider trench at the slope base, and/or temporary slope drains (plastic). In areas with less than a 30 percent slope, ECS and AMM erosion control measures protective of mussels will be implemented. The plan will be approved in writing by NiSource NRP personnel prior to project implementation and will include a tailgate training session for all on-site project personnel to highlight the environmental sensitivity of the habitat and any mussel AMMs that must be implemented.

Streambed Construction

3. For activities in occupied habitat, install new or replacement pipelines and major repairs under the river bottom using HDD or other trenchless methods rather than open trenching unless the crossing evaluation report prepared in accordance with Section 5.2.1.1 and **Appendix J** indicates otherwise. Drilling should be carefully undertaken and a plan should be in place to minimize and address the risk of in-stream disturbance due to frac-outs. The plan should also specifically reference mussel resources in the vicinity of the crossing as a key conservation concern and include specific measures identified in the NGTS ECS, from standard industry practices, or other mutually agreed-upon practices to protect this resource. The plan will also include a frac-out impact avoidance plan which will evaluate the site in terms not only of feasibility of conducting HDD, but the likelihood of large scale frac-out and its effects on mussels, and actions to address a large scale frac-out in occupied habitat. The plan should also consider the potential effects on mussels if drilling fluids are released into the environment. The plan must contain all information required for a FERC Section 7c filing at a minimum.

If, after detailed engineering studies (e.g., geotechnical, physiological, topographical, and economic), it is determined (and agreed to by NRP personnel) that an HDD is not feasible, a report will be prepared and included in the annual report submitted to the Service. However, due to the potentially significant amount of take that might occur for Ohio River crossings, open trenching in this river is not a “covered activity” as part of the NiSource MSHCP.

4. Install pipeline to the minimum depth described in the ECS and maintain that depth at least 10 feet past the high water line to avoid exposure of pipeline by anticipated levels of erosion based on geology and watershed character. Additional distance may be required should on-site conditions (i.e., outside bend in the waterbody, highly erosive stream channel, anticipated future upstream development activities in the vicinity, etc.) dictate a reasonable expectation that the stream banks could erode and expose the pipeline facilities. Less distance may be utilized if terrain or geological conditions (long, steep bank or solid rock) will not allow for a 10-foot setback. These

conditions and the response thereto will be documented in the EM&CP and provided as part of the annual report to the Service.

5. For repairs in occupied habitat, do not install in-channel repairs (bendway weirs, hardpoints, concrete mats, fill for channel relocation, or other channel disturbing measures) except when measures in AMM #3 above are not feasible from an engineering design perspective, and then, only in conjunction with a stream restoration plan based on Rosgen (*see* Wildland Hydrology 2009 http://www.wildlandhydrology.com/html/references_.html) or other techniques mutually agreed upon by NiSource and the Service that result in no direct or lethal take of listed mussels.

6. Conduct replacements/repairs from a lay barge or temporary work bridges of the minimum length necessary to conduct the replacements/repairs rather than operating heavy equipment (e.g., backhoes, bulldozers) in-stream. Temporary construction and equipment bridges are not to be confused with stone or fill causeways with pipe structures, which should not be employed in known or presumed occupied waterbodies.

7. Remove equipment bridges as soon as practicable (this is typically interpreted to be a few days to a few weeks unless there are extenuating circumstances) after repair work and any site restoration is completed

8. As part of the routine pipeline inspection patrols, visually inspect all stream crossings in occupied habitat at least yearly for early indications of erosion or bank destabilization associated with or affecting the pipeline crossing that is resulting, or would before the next inspection cycle, likely result in sediment impacts to mussel habitat beyond what would be expected from background stream processes. If such bank destabilization is observed, it will be corrected in accordance with the ECS. Follow-up inspections and restabilization will continue until the bank is stabilized (generally two growing seasons).

Stream Bank Conservation

9. Do not construct culvert and stone access roads and appurtenances (including equipment crossing) across the waterbody or within the riparian zone. Temporary equipment crossings utilizing equipment pads or other methods that span the waterbody are acceptable provided that in-stream pipe supports are not needed.

10. For equipment crossings of small streams, use half pipes of sufficient number and size that both minimize impacts to stream bed and minimize flow disruption to both upstream and downstream habitat (**ECS, Figure 22**).

11. *Reserved.*

Pipeline Abandonment

12. Abandon pipelines in place to avoid in-stream disturbance that would result from pipeline removal unless the abandonment would be detrimental to endangered mussels.

Contaminants

13. As described in the ECS section on “Spill Prevention, Containment and Control,” site staging areas for equipment, fuel, materials, and personnel at least 300 feet from

the waterway, if available, to reduce the potential for sediment and hazardous spills entering the waterway. If sufficient space is not available, a shorter distance can be used with additional control measures (e.g., redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials). If a reportable spill has impacted occupied habitat:

a. follow spill response plan; and
b. call the appropriate Service Field Office to report the release, in addition to the National Response Center (800-424-8802).

14. Ensure all imported fill material is free from contaminants (this would include washed rock or other materials that could significantly affect the pH of the stream) that could affect the species or habitat through acquisition of materials at an appropriate quarry or other such measures.

15. For storage well activities, use enhanced and redundant measures to avoid and minimize the impact of spills from contaminant events in known or presumed occupied streams. These measures include, for example, waste pit protection, redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials, and a spill response plan provided to the Service as part of the annual report. These measures will be included in the EM&CP prepared for the activity.

16. Do not use fertilizers or herbicides within 100 feet of known or presumed occupied habitat. Fertilizer and herbicides will not be applied if weather (e.g., impending storm) or other conditions (e.g., faulty equipment) would compromise the ability of NiSource or its contractors to apply the fertilizer or herbicide without impacting presumed occupied mussel habitat. The EM&CP prepared for this activity (AMM# 2 above) will document relevant EPA guidelines for application.

Withdrawal and Discharge of Water

17. Hydrostatic test water and/or water for storage well O&M will not be obtained from known or presumed occupied habitat unless other water sources are not reasonably available. To prevent desiccation of mussels, water from known or presumed occupied habitat will be withdrawn in a manner that will not visibly lower the water level as indicated by water level height on the stream channel bank. Employ appropriately sized screens, implement withdrawal rates, and maintain withdrawal point sufficiently above the substrate to minimize impacts to the species.

18. Do not discharge hydrostatic test water directly into known or presumed occupied habitat. Discharge water in the following manner (in order of priority and preference):

a. Discharge water down gradient of occupied habitat unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.
b. If those circumstances occur, discharge water into uplands >300 feet from occupied habitat unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.

c. If those circumstances occur, discharge water as far from occupied habitat as practical and utilize additional sediment and water flow control devices (**Figures 6A&B, 7, 8, 14A&B; ECS**) to minimize effects to the waterbody.

Travel for O&M Activities

19. Do not drive across known or presumed occupied streams – walk these areas or visually inspect from bank and use closest available bridge to cross stream.

Zebra Mussels and Other Invasives

20. Clean all equipment (including pumps, hoses, etc.) that have been in a perennial waterbody for more than four hours within the previous seven days and will work in occupied or potential federally listed mussel habitat; following established guidelines to remove zebra mussels (and other potential exotic or invasive species) before entering a known or presumed occupied stream for a federally listed mussel, which is not known to be infested with zebra mussels (**Appendix L**). Do not discharge any water for other sources that might be contained in equipment (e.g. ballast water, hoses, sumps, or other containment). It is important to follow these guidelines even if work is not occurring in the immediate vicinity of these mussels since, once introduced into a watershed, invasive species could move and eventually affect the federally listed mussels.

6.2.4.4 Calculation of Incidental Take

Incidental take was calculated for the clubshell using the following simple algorithm:

Stream Width x Impact Length (lethal and sub-lethal wet-ditch or dry-ditch model) x Percent Suitable Habitat = Acres of Habitat Impacted

Acres of Habitat Impacted x Clubshell Density = Impacts to Individuals

Operating Facts:

The stream crossing method will be determined by NiSource as described in Section 5.2.1.1. Take is calculated based on using the wet-ditch stream crossing method for large streams (over 100 feet in width) except the Ohio River (only HDD is included as a covered activity) and using the dry-ditch method for remaining streams.

Take of mussels from the NiSource covered activities would occur primarily from impacts directly associated with the installation, repair or removal of pipeline across occupied stream habitat. On occasion, NiSource will also use access fords/equipment bridges across streams which are not entirely within the existing ROW. These fords/equipment bridges are typically 15 feet in width and are commonly used by the landowner for other purposes. If the fords/equipment bridges are existing, then NiSource and the Service have determined that its effects on endangered mussels are insignificant and discountable. However, the construction and use of a new fords/equipment bridges will have take that NiSource would be responsible to mitigate for. It is also likely that NiSource will need to cross one or more of these streams in a location other than the existing pipeline corridor. The impacts from these crossings would be separate from and additional to those accounted for above. An additional amount of take (approximately 15%), calculated based upon the percentage of times that

NiSource has looped pipelines at different stream crossing locations in the past, has been added to account for these mitigation requirements.

Key Assumptions:

NiSource used a reasonable worst case scenario with regard to its stream crossing activities and aggregate sediment impacts causing activities that could affect clubshell. The entire area that would be impacted by covered activities (e.g., where multiple pipelines are in close proximity to each other) was identified and used for the total acreage calculation. Eight large and nine small stream crossing areas throughout the covered lands could affect clubshell over the proposed 50-year ITP.

A density of 0.23 clubshell per square meter was used based on data collected at five qualitatively sampled sites on the Allegheny River between Tidioute and Tionesta in Pennsylvania (Service 2004). Clubshell populations are known from scattered locations in the middle Allegheny River near the towns of Oil City, Parker, and East Brady, near where the NiSource pipeline crosses, downstream to river mile 58. In many of these locations, mussel population data are based solely on qualitative surveys, and clubshell appear to be relatively less abundant than the other more common species with which it co-occurs in the Allegheny River. A density of 0.23 likely overestimates the clubshell where impacts are a possibility within the NiSource project area, but it provides some margin of error and is the best available estimate.

Take was calculated separately for large streams (>100 feet wide) and small streams (≤100 feet wide) to accommodate the two main stream crossing methods, wet-ditch and dry-ditch respectively. The average width at the pipeline crossing of large streams was 280 feet, and the average width at the pipeline crossing of small streams was 36 feet. Stream width data were visually analyzed using one meter resolution leaf-on aerial photographs.

There is little direct discussion of suitable habitat in the literature and apparently little consensus among biologists on what this number should be. The percent suitable habitat was based on the evaluation of a small number of studies that indirectly addressed how much of the stream substrate is occupied by mussels when a mussel assemblage is present (Hastie et al. 2000, Hastie et al. 2003, and Morales et al. 2006), and discussion with Service biologists and a consulting biologist experienced in surveying mussels (Villella 2009). Morales et al., who were looking at mussels in an upstream reach of the Mississippi, and Hastie et al., conducting research in a small Scottish stream mapped the presence of mussels and indicated areas of the substrate that contained animals and areas that did not. Non-occupied areas may be unsuitable for various reasons (e.g., sheer forces during high flows, unstable or otherwise unsuitable substrate, areas that are regularly de-watered, etc.). Anderson (2000), examining mussels upstream and downstream of an existing bridge across the Allegheny River at Foxburg, Pennsylvania, looked at three reaches of the river, upstream of the bridge (total area 3.3 acres), immediately downstream of the bridge (total area 7.28 acres), and further downstream (total area 7.44 acres). In those three areas he found that the mussel bed covered approximately 1.12 acres upstream (34%), 1.79 acres immediately downstream (25%) and 3.7 acres further downstream (50%).

Mussel experts who provided input on this question could only suggest that this metric is site-dependent and variable according to a number of factors. Therefore, in an extant mussel assemblage, the percent of the substrate within the stream banks that is occupied lies somewhere between 0% (since the starting premise is that mussels are present) and 100%. Within a mussel assemblage, endangered mussels would be presumed to cover less area since they are frequently (but not always) a rare component of those assemblages.

NiSource and the Service recognize the limitations of this metric as applied to any one stream. Some streams may have nearly 100% of the bottom occupied by an endangered mussel at a given density and other streams may have almost no presence, as in small remnant populations. Another factor to consider is how the NiSource impact zone overlaps a mussel assemblage. It is likely that in some cases, NiSource impacts will fall completely within the limits of a mussel assemblage. In other cases, the NiSource impact zone will fall partly within an area of mussels and partly within an area outside of an assemblage, given that mussels are distributed discontinuously within occupied streams. NiSource and the Service believe that if applied across all of the streams in the watershed, and across the entire length of stream for which impacts are estimated, that a central estimate should be employed in determining a reasonable worst case scenario. Therefore, take was calculated using the estimate that clubshell would occupy 50% of the stream bottom at the estimated density for this species.[22]

The impact area was calculated using both the sediment transport model and the dry-ditch model. The sediment transport model estimates a lethal impact area covered by 0.236 inches of sediment. A sediment plume is predicted to extend further downstream corresponding to a harm/harassment area having a 600 mg/l concentration of suspended sediment (Ellis 1936; Aldridge et al.1987). The dry-ditch model estimates a 75-foot lethal zone and a 100-foot harm/harassment zone downstream of the coffer dams.

A sediment transport estimation methodology was developed to aid in identifying the effects of open-cut waterbody crossing activities on mussels within suitable habitats. Because of the large number of streams within the project area, ENSR hydrologists and biologists with input from the Service and NiSource developed a simplified procedure to formulate and quantify the three processes of: (1) suspended sediment supply to a stream from site disturbance, (2) instream transport and dispersion of the sediment by representative size fractions, and (3) sediment deposition on the streambed. Three sites (the Duck River in Tennessee, the Elk River in West Virginia, and the James River in Virginia) were selected for application of the estimation procedure. Site selection was based on: (1) a list of "may-affect" stream crossings for the NiSource project, (2) the availability of nearby USGS stream gauge data and related measurements, and (3) a likelihood of moderate flow conditions (discharge, depth and width, velocity) during the anticipated construction season (July through December). Moderate flow conditions may be the most significant in terms of potential effects of

[22] The use of a central value (50%) in the reasonable worst case scenario take calculation (model) is based on the best available information and will be revisited as new information becomes available.

sediment deposition on mussel beds. Under the procedure, small discharges and slower flow velocities or shallow depths generally will not result in the calculation of sediment transport and deposition at distances as great as in the larger streams. Very large rivers, such as the Ohio and Tennessee rivers, absorb sediment inputs within their background conditions and disperse them fairly quickly within the cross-section to levels below the criteria. Although general in nature, NiSource and the Service believe this model is suitable for use in developing a reasonable worst case scenario across the streams and species in the MSHCP. Additional details of this methodology are presented in **Appendix L**.

This methodology assumes successful implementation of the NGTS ECS and uses construction parameters and available physical and hydrologic environmental characteristics of three streams. Stream flow conditions (discharge, depth and width, velocity) during the anticipated construction season (July through December) were also considered.

Another factor was the recognized criteria for mussel mortality (i.e., a burial depth of 0.236 inches or more and a suspended sediment concentration of 600 mg/l or more) (Ellis 1936; Aldridge et al.1987). NiSource and the Service evaluated the potential impacts of NiSource actions on host fish and glochidia and coordinated that analysis with Service Field Offices and concluded that the impacts on host fish and glochidia would be insignificant and discountable. Select waterbodies with the highest potential for significant transport were analyzed in greater detail. Those with the resulting longest transport distances that met mussel mortality criteria were selected to define the impact area with an error margin for the mussel species in the MSHCP.

NiSource proposes to use a dry-ditch methodology for stream crossing where technically and otherwise feasible (current technology permits this on streams of approximately 100 feet wide or less). The 75 feet within the coffer dam (lethal impact zone) plus 100 feet downstream (lethal impact/harm zone using the aforementioned sediment depth and suspended sediment values) were used to determine the action area for each crossing. NiSource and the Service recognize that there is some level of uncertainty associated with the sediment transport estimation methodology, both in terms of the predictive power of the methodology and to what extent sediments might impact mussels in any particular location. NiSource will evaluate the performance of both methodologies downstream of crossings using adaptive management.

The take calculation for clubshell mussel is presented in **Table 6.2.4.4-1**. As shown, the above-described impacts result in the reasonable worst case scenario impacts to approximately 166 acres of habitat. This translates into take of approximately 77,302 clubshell over the 50-year life of the permit. The 77,302 clubshell estimated to be taken is important for an understanding of the impact on the species. It is not, however, the best method for identifying the amount of mitigation necessary to fully compensate for the impact of the take. Because the effects on habitat are more easily and accurately assessed, they better reflect the impact of the take. NiSource has therefore used acres as the basis for mitigation.

In addition, aggregate impacts from various sediment-causing activities could have long term and significant impacts on the same 166 acres and additional acres (removed from the immediate stream crossing sites), particularly in conjunction with other non-NiSource development activities in the watershed. NiSource calculated aggregate take based on the total acreage of NiSource pipeline corridor (using a 50-foot average width) overlapping the range of the clubshell. The total riparian area protected will be 8.1 acres, which is calculated as the total area of NiSource pipeline ROW in all impacted watersheds (86,791 acres), multiplied by the average of the percentage of area the pipeline impacts in each watershed (0.279%), divided by the total number of impacted watersheds 30). This provides an index of how prevalent NiSource pipelines are in the affected watersheds and therefore a surrogate for the sediment and associated impacts on mussels.

$$\frac{86791 \times 0.00279}{30} = \mathbf{8.1}$$

The take calculations presented here are designed to reflect a reasonable worst case scenario across the entire range of potentially affected streams. It is a reasonable worst case, but not certain, for example, that NiSource would actually conduct covered activities at all the locations affecting clubshell over the 50-year permit duration. Take is based on the assumption that clubshell occur in the aforementioned densities, over the estimated stream width, and occupied habitat percentage described above at every stream crossing. It is possible that some crossings may have higher or lower densities and more or less suitable habitat than modeled. However, the proposed calculations produce a reasonable worst case scenario over the life of the MSHCP, although it is likely not accurate for any one stream at a given point in time.

6.2.4.5 Impact of Take Analysis

The clubshell was historically known across nine states in the Wabash, Ohio, Kanawha, Kentucky, Green, Monongahela, and Allegheny rivers and their tributaries (NatureServe 2007a). Today, reaches of only 21 streams support or might still support clubshell mussels in Indiana, Kentucky, Michigan, Ohio, Pennsylvania, and West Virginia. It is thought that this species is now extirpated in the Cumberland and Tennessee river systems in Tennessee, and it may or may not be extirpated in New York (Service 2009a). However, the species continues to decline in half of the streams where it was present when listed as endangered in 1993. In some of these streams, such as Fish Creek, Hackers Creek, Pymatuning Creek, and Conneaut Outlet, the species appears to be nearly extirpated (Service 2009a). No global abundance has been estimated for the clubshell mussel due to problems associated with obtaining an unbiased and complete sample (NatureServe 2007a).

The draft 5-Year Review (Service 2009a) describes the overall status of the species in the remaining drainages where it is known to occur. In summary, clubshell appear to be restricted to 13 populations in the Ohio River and Lake Erie basins (Service 2009a, Appendix 1). Portions of 21 streams support or might still support the species. Evidence of recent successful recruitment has been reported in the Allegheny River, French Creek, LeBoeuf Creek, Muddy Creek, Tippecanoe River, Middle Branch of the North Fork Vermilion River, Green River, Elk River, Little Darby Creek, and Shenango River. Clubshell populations appear to be comprised of only older adults, and the populations appear to be in decline in the East Fork of the West Branch St.

Joseph River, Fish Creek, Hackers Creek, Walhonding River, Cassadaga Creek, Pymatuning Creek, Conneaut Outlet, and Conneauttee Creek. Finally, based on a single specimen, the clubshell could be exhibiting a range extension as a result of habitat management in Big Darby Creek, Ohio.

I. Genetic-Level Impacts

The draft 5-Year review summarizes the genetics work on clubshell. Tim King and Cheryl Morrison (USGS, Leetown, West Virginia) have been investigating the genetic structure of the clubshell with a focus on determining the genetic relatedness of the remaining populations. Their data indicate that clubshell populations in the Allegheny River, French Creek, and the St. Joseph River system are genetically diverse and have not undergone a bottleneck event sometimes evident after population recovery from a highly reduced abundance (Service 2009a). This suggests that these populations are genetically distinct and mixing should be avoided. Few genetic samples have been included from populations in the southern portion of the range of the clubshell, including the Tennessee and Cumberland River systems.

Petty (2005) states river systems can be considered habitat "islands" on the larger landscape; each river is separated from other rivers by habitat unsuitable for bivalves. Habitat fragmentation is common for freshwater species, causing disjunct gene pools (Mulvey et al. 1997). Population fragmentation is likely associated with loss or redistribution of genetic variability and is a concern for conservation biologists attempting to manage freshwater species (Templeton et al. 1990). It has been suggested that a minimum population size of 5,000 individuals might be necessary under natural conditions (restricted mating or overlap of generations) to avoid loss of genetic diversity of animal species (Schonewald-Cox et al. 1983). Based on current knowledge, there could be multiple clubshell populations that meet that definition. For example, the total population of clubshell in the upper 32.2 mi of the Allegheny River sampled by USGS may exceed 1,000,000 individuals (Zanatta and Murphy 2007). The Tippecanoe River and Little Darby River also likely have recruiting populations. It is also known, however, that the other remaining populations are much smaller and may not currently be reproducing. The loss of these populations could result in the loss of genetic diversity.

A once-large population of this species occurred throughout much of the Ohio River system. In this region, there were historically no absolute barriers preventing genetic interchange among its tributary sub-populations that occurred in various streams. With the completion of numerous dams on streams during the first-half of the 20th century, some mainstem clubshell populations were lost, and other populations became isolated (Service 2005). The principle genetic consequences of activities that reduce effective population size is the loss of genetic variance through genetic drift and consequently the potential reduction in the ability to adapt and a reduction in fitness through inbreeding depression (Jones, Hallerman, and Neves 2006, Schonewald-Cox et al. 1983). Genetic-level impacts are possible from NiSource activities under the MSHCP. The mechanism for these impacts is through the possible extirpation of small genetically diverse populations, which could reduce the genetic material available to future generations. Where NiSource activities would affect more robust populations, genetic impacts could be less severe in that the number of mussels impacted from a NiSource activity would be a much smaller percentage of the population.

II. Population-Level Impacts

This species occurs at a few locations in very large numbers and high densities (Service 2009a, Service 2004). Conversely, clubshell continues to decline in half of the streams where it was present when listed as endangered in 1993. In some of these streams, such as Fish Creek, Hackers Creek, Pymatuning Creek, and Conneaut Outlet, the species appears to be nearly extirpated (Service 2009a).

There are at least eight reproducing or stable populations of clubshell (Tippecanoe River, Middle Branch North Fork Vermillion River, Green River, Little Darby Creek, Elk River, Allegheny River, French Creek and tributaries, and Shenango River) along with eight small and less stable populations. Most of the latter are isolated and may not recover without external inputs (Service 2009a). It is possible, however, that even small apparently non-viable populations could after years at very low levels begin to reproduce (Anderson 2009). Therefore, although small isolated populations are vulnerable to losses resulting from events such as droughts, floods, toxicant spills, or other stochastic events, they are nonetheless important components in the conservation of the species. Impacts from NiSource activities at sites like the Meathouse Fork, where clubshell may already occur at very low densities, could be significant, but even in streams with small populations, clubshell, unlike northern riffleshell, may be widely spread out along the length of the stream (Anderson 2009). This would make extirpation from a NiSource crossing of a stream less likely for this species. Aggregate impacts over the life of the ITP could reduce the suitability of occupied habitat and habitat that could be colonized naturally or through enhancement and reintroduction. These impacts could also negatively affect clubshell population dynamics.

NiSource and the Service expect a different outcome for impacts to sites having more robust populations of clubshell (i.e., those in the Allegheny River system with thousands of individuals within a potential impact area). As an example, in 2000, the Kennerdell Bridge over the Allegheny River in Pennsylvania was replaced over a diverse mussel assemblage. Clubshell was found within the direct impact area, which encompassed 5,000 square meters at an estimated density of 0.08 mussels per square meter with an abundance of 345 individuals; and in the indirect impact area, which encompassed 15,000 square meters, at a total density of 0.16 mussels per square meter and a total abundance of 1,609 individuals (Villella 2005). Mussels were exposed to both construction-related impacts and relocation during this project. The second monitoring report (survey conducted in 2004) suggests that mussels including clubshell are recovering from construction (Villella 2005). While this bridge project was not directly comparable to a pipeline project, some of the key impacts (crushing, sedimentation, relocation) are similar to those expected from a NiSource river crossing. This study suggests that in areas with sufficient populations, construction-related impacts would not necessarily result in impacts from which the population could not recover.

Table 6.2.4.4-1 Take Calculations for Aquatic Species

Species	Number of individuals impacted	*Acres of impact to stable/reproducing population habitat*	*Acres of impact to small/isolated population habitat*	Maximum acres impacted	*Minimum restoration acres*	*Protection acres (assumes restoration at minimum levels)*	Total mitigation acres at minimum restoration (assumes maximum impacts)	Total mitigation acres at 100% restoration (assumes maximum impacts)
Sheepnose	**25,346**	*102.8*	*147.7*	**250.4**	*486.4*	*486.4*	**972.8**	**1945.6**
Fanshell	**57,320**	*0.0*	*283.2*	**283.2**	*477.9*	*477.9*	**955.7**	**1911.5**
Clubshell	**77,302**	*164.8*	*1.2*	**166.0**	*187.5*	*187.5*	**375.0**	**749.9**
Northern Riffleshell	**33,452**	*24.1*	*141.2*	**165.3**	*442.2*	*442.2*	**884.4**	**1768.8**
James Spiny	**19,416**	*0.0*	*12.8*	**12.8**	*19.2*	*57.6*	**76.7**	**38.4**
Nashville Crayfish	**23,171**	*4.0*	*0.0*	**4.0**	*2.0*	*2.0*	**4.0**	**4.0**

NOTES

italicized items are summed to produce the following value (A + B = C)

A	*B*	**C**

differences of 0.1 acres from expected are due to rounding

In summary, it is reasonable to conclude that small, isolated populations could be significantly impacted where NiSource activities intersect stream reaches providing habitat for those populations. Reduced populations may take several decades to recover, even if no further degradation occurs. However, because clubshell is likely more widely distributed than some other endangered mussels in the same habitat, it is less likely that, under a reasonable worst case scenario entire populations would be lost. Large robust populations could also be affected by NiSource activities and the existing large populations are undoubtedly important for the long-term conservation of this species. With AMMs and other measures in place, however, NiSource and the Service do not expect NiSource activities to have a significant negative impact on those populations. The Kennerdell Bridge may provide a model for how these populations will react to impacts from NiSource activities. Clubshell may be particularly susceptible to sedimentation. Therefore, aggregate impacts may be particularly detrimental to this species. Based on the 5-Year Review, there are nine known populations of northern riffleshell and eight additional populations with low or unknown numbers. Of these 17 populations, eight are thought to be reproducing populations. NiSource would affect three of these (including the large Allegheny River population) and one is completely outside of the covered lands. NiSource has the potential to affect two populations having low or unknown numbers. In other words, NiSource would potentially affect five of the 17 populations currently identified and three of the eight considered to be reproducing.

NiSource and the Service anticipate both individual and potential population impacts to clubshell from acute and chronic impacts associated with NiSource activities. These impacts over the life of the ITP suggest that the impact of the taking of the clubshell from NiSource activities will be marginally greater than the estimated loss of individuals and habitat. This results from: (1) impacts to three of stable/reproducing populations of clubshell (Allegheny River, Little Darby Creek, and Elk River); (2) additional impacts to two small populations with low numbers and diminished capacity to recover from impacts; and (3) long-term sediment impacts to habitat, a stressor to which this species may be particularly vulnerable.

6.2.4.6 Compensatory Mitigation

NiSource will mitigate for the impact of take of clubshell resulting from its actions in the covered lands. This take is anticipated to occur in two ways. The first is the impact of take that may result from direct loss of individuals or habitat from stream crossing activities employed to install new pipeline, or repair or replace existing pipeline. The second kind of take is aggregate, which would result primarily from sedimentation from non-aquatic activities within the watershed, and secondarily from loss of riparian habitat, and other similar comparatively minor and indirect impacts detailed above. Where the term “protection” appears below, please refer to Section 6.2 for a further definition and the requirements for securing conservation of mitigation lands and other real property interests.

Before mitigation occurs, NiSource must undertake restoration activities at certain impacted areas. Although these constitute minimization measures for the purpose of the MSHCP, the required mitigation discussed below, in part builds upon these efforts. In all cases where stream crossings occur, NiSource will restore the disturbed stream bed and riparian area within its ROW resulting from its activities. Restoration will occur during the same construction season (next appropriate planting season for riparian restoration) as impacts unless there are extenuating circumstances and the Service is informed of those issues. The basic restoration will be conducted in accordance with standard industry specifications as defined in the ECS and required by FERC and other relevant regulatory agencies. This will involve, at a minimum, restoration of any impacts to the depth, flow, channel bottom, and/or banks as nearly as practical back to the pre-activity condition. Vegetation restoration must be with site-appropriate native species.

Mitigation at Restored Streambed and Riparian Areas

As the initial step in compensatory mitigation, NiSource will enhance the restored stream substrate within the construction zone to habitat that is optimal for clubshell mussels. This would typically involve either replacement or importation of clean, appropriately sized material for mussel re-colonization. NiSource will also enhance, where feasible, any pre-construction deficiencies associated with the depth, flow, bank stability, or riparian vegetation that would be detrimental to mussel re-colonization, survival, and reproduction. NiSource expects the enhancement of the substrate to result in more opportunities for recruitment of clubshell by providing suitable settling habitat for juvenile mussels. Enhancement serves as one component of NiSource's overall mitigation program, but does not wholly compensate for the impact of take because it has the potential to be disturbed in the future. Therefore, additional compensatory mitigation (riparian restoration) is required as discussed in detail below.

Mitigation for Aggregate Take Activities

In addition to the requirements above, NiSource will provide mitigation to compensate for sediment producing and other indirect impact producing activities (Aggregate Take). NiSource will initiate mitigation for Aggregate Take within the first seven years after the incidental take permit has been issued to ensure adequate and timely compensation for O&M activities in the watersheds where impacts would likely occur over the life of the ITP. Mitigation for Aggregate Take will focus on habitat impacts as a surrogate for individual take and use habitat protection/restoration as the mitigation option. The protection or restoration of riparian habitat is designed to reduce the sediment impacts to clubshell by buffering occupied streams. NiSource expects this to result in improved survival and reproduction of mussels in the mitigation area.

Implement protection and restoration of riparian buffers associated with occupied clubshell habitat within the Allegheny River or Little Darby Creek watersheds adjacent to existing clubshell populations or another priority stream identified in collaboration with the Service. Mitigation should provide additional benefits to the species at the identified site (i.e., sites that are already secure, or at the other end of the spectrum, sites where there is little opportunity to improve the habitat should not be considered). The total riparian area protected to mitigate for aggregate take will be 8.1 acres.

A 1:1 ratio is appropriate for this species because the aggregate impacts from NiSource activities to both the population and the habitat are expected to be comparatively minor.

Sideboards: (a) there must be a minimum 50-foot-wide to a maximum 150-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams generally should have wider buffers;[23] (b) the vegetative buffer must meet minimum NRCS standards - for water quality and riparian corridors (**Appendix L**); (c) at least 50% of the total riparian buffer must be restored (i.e., cropland or other highly erosive landuse planted to meet NRCS standards- this 1:1 ratio of restoration to protection reflects the purpose of the aggregate take mitigation to address sediment impacts specifically); (d) instabilities in the riparian zone (e.g., gullies, bank erosion, etc.) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be minimal earth disturbance on the restoration sites; (e) individual mitigation sites must be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); (f) water quality, instream habitat, and instream connectivity must be evaluated in terms of long-term viability of the clubshell population within the mitigation area; (g) mitigation projects must be completed no more than three years after initiation; and (h) riparian buffers must be permanently protected in fee or by easement (consistent with the template language in **Appendix P**).

Mitigation When NiSource Relocates Clubshell (AMM # 1)

NiSource has the option described in AMM #1 to relocate mussels as part of a stream crossing project. If the relocation is successful, as discussed in AMM #1, the following mitigation is required in addition to the enhancement and aggregate take mitigation described above. When implemented with the other required mitigation and in concert with mussel relocation described in AMM #1, and if the sideboards and Service guidelines are followed, this option would fully compensate for the impact of take by conserving mussels which would otherwise be killed or harmed. In addition, habitat at the relocation site will be protected and enhanced. NiSource can initiate this mitigation option at any time but not later than during the same period as a new project likely to result in take is started.

Find, relocate, and monitor clubshell and other mussels within the assemblage impacted by the project to a suitable site upstream or downstream of the impact zone, and restore riparian habitat at the site of relocation, or at an upstream location as near to the mussel relocation site as possible, at a 1:1 ratio of the acreage amount of in-stream habitat impacted.[24]

Sideboards: (a) follow the most current protocols for mussel location, transport, relocation, and monitoring, but the last monitoring cycle must occur no earlier than the

[23] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

[24] A 1:1 ratio is appropriate because the primary thrust of the mitigation is the relocation of the mussels – the restoration is an additional step to improve what will already be suitable habitat (otherwise mussels could not be relocated there).

fifth year of relocation; (b) there must be a minimum of 75% survival of relocated clubshell mussels after five years or additional mitigation will be required; (c) if less than 75% survival rate for clubshell is achieved at five years, NiSource will be responsible to implement riparian restoration at the ratios indicated in new construction take mitigation below, minus any riparian restoration completed for the relocation; (d) sideboards for riparian restoration will follow those described in sideboards for new construction mitigation below; (e) suitable habitat must meet basic mussel requirements of depth, substrate, flow, water quality, host fish presence, and riparian vegetation (existing or post-mitigation restoration); (f) suitability of a site will be determined in coordination with the Service; and (g) NiSource will provide a report to the Service one year after relocation and again after the fifth year post relocation on the status of the relocated clubshell mussels.

Mitigation for New Construction Take when Clubshell is not Relocated

The selection of which mitigation option NiSource will implement to compensate for New Construction Take will be based upon the highest need of the species at the time the mitigation becomes necessary, as recommended by NiSource to the Service for its approval or declination. For clubshell, initially there is only one option available. Mitigation for New Construction Take of clubshell must follow the mitigation option guidelines and sideboards outlined below. Mitigation for new construction will fully compensate for the impact of take by protecting and restoring the riparian zones that moderate water temperature, provide nutrient inputs, and reduce sediments and other contaminants along occupied streams, thereby improving the quality of the habitat. NiSource expects this to translate into increased survival and reproduction of mussels in the mitigation area.

Protect and Restore Existing Clubshell Habitat: Protect and restore riparian buffers adjacent to occupied clubshell habitat. Because of the impact of take on this species, the mitigation amount required is a 1.5:1 ratio of the acreage amount of instream habitat impacted by stream crossing(s) of the Allegheny River (PA), the Elk River (WV), or Little Darby Creek (OH) (stable populations). For impacts to Big Darby Creek (OH) or Meathouse Fork (WV), the 1.5:1 mitigation ratio will be increased by a multiplier of 1.5 to compensate for greater impacts to small isolated populations that may have less resilience. For impacts to streams not listed here, NiSource, in coordination with the Service, will determine whether the population is stable and recruiting or small and isolated and apply the appropriate mitigation ratios. For all riparian restoration, a multiplier of 3 will be used to account for the time it takes riparian restorations to mature, stabilize, and become fully functional.

Stable/Recruiting Populations

Protection Ratio = 1.5:1

Restoration Ratio = 1.5 (x3):1 = 4.5:1

Small Isolated Populations

Protection Ratio = 1.5 (x1.5):1 = 2.25:1

Restoration Ratio = 1.5 (x3) (x1.5):1 = 6.75:1

Sideboards: (a) habitat acquired or restored must benefit an extant population of clubshell; (b) projects must be in one or more of the following priority watersheds: Green River (KY), Little Darby Creek (OH), Elk River (WV), French Creek (PA), Allegheny River (PA) or other high priority watershed identified by the Service; (c) projects can be completed before take of clubshell occurs but not later than two years after the take occurs; (d) there must be a minimum 50 foot wide to maximum 150 foot wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams generally should have wider buffers;[25] (e) instabilities in the riparian zone (e.g., gullies, bank erosion) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be limited earth disturbance on the restoration sites; (f) the vegetative buffer must meet minimum NRCS standards for water quality and riparian corridors (**Appendix L**); (g) at least 25% of the total riparian buffer must be restored (i.e., cropland or other highly erosive landuse planted to meet NRCS standards); (h) individual mitigation sites must be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); and (i) habitat acquired or restored must be permanently protected (*see* Section 6.0 for the definition of protection) in fee or by easement following easement guidelines (**Appendix P**).

Mitigation Options for Possible Future Consideration

These options are not fully documented since they would not be immediately available to NiSource. These measures are not deemed acceptable mitigation at this time for various reasons, including the availability of complete science to implement them. At the time of consideration, the Service and NiSource would determine whether or not a major amendment would be required before they could be implemented. The amount of mitigation required for these options would be determined as part of the amendment authorizing their use.

Identify Augmentation, Expansion, or Reintroduction Streams and Conserve, Restore, and Enhance Habitat for Augmentation, Expansion, or Reintroduction: Using Service-approved methodology, identify sites within the range of the clubshell that with restoration could be suitable for augmentation, expansion or reintroduction efforts and protect, and where necessary restore, streambed and riparian habitat specifically for the successful augmentation, expansion, or reintroduction of clubshell mussels.

Sideboards: (a) sites for this mitigation should be selected and site plans developed based on factors including extant clubshell population size, demographic composition, and population trend data (where applicable), potential site threats, habitat suitability, and any other limiting factor that might decrease the likelihood of long-term benefits from population augmentation, expansion, or reintroduction efforts (*see* McGregor 2005 for work initiated in Kentucky for clubshell and other mussels); (b) work will be

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[25] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

coordinated with the Service at the time initiated; (c) final products will be directly applicable to Service or other efforts to augment, expand, or reintroduce clubshell mussels; (d) habitat acquired or restored must be permanently protected; (e) habitat acquired or restored must be tied to and benefit an augmented, expanded, or reintroduced population of clubshell; and (f) projects must be completed either before impacts to clubshell occur or within two years after impacts.

Develop Genetic Information for Conservation of Clubshell: The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations developing genetic information, necessary in part to avoid the deleterious effects of mixing distinct populations (Neves 2004), on source and receiving populations for the propagation or augmentation/expansion/reintroduction of clubshell mussels and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow all Service guidance and regulations on acquiring and analyzing genetic information; (b) the products developed will be directly applicable to augmentation/reintroduction of clubshell; and (c) projects must be completed either before impacts to clubshell occur or within two years after impacts.

Propagate Clubshell: The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations based on who are leading the development of, improving, or implementing propagation technology and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg. 56916-56922, September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the entity will work with the Service to ensure that there exists, or will exist in the near future, a suitable site for reintroduction/expansion/augmentation of a clubshell population with the propagated mussels; and (d) projects must be completed either before impacts to clubshell occur or within two years after impacts.

Augment/Reintroduce Clubshell:[26] The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations who are augmenting or expanding clubshell populations or reintroducing clubshell into their historic range and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg. 56916-56922, September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the reintroduction/expansion/augmentation will occur in a suitable site approved by the Service; (d) the mitigation must include monitoring of populations and habitat conditions to evaluate the effort and assess the long-term viability of the

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[26] This is not a recommended strategy at the time of development of the MSHCP. Habitat conservation should take precedence over augmentation/reintroduction. Most clubshell populations are declining due, presumably, to habitat degradation. Putting more clubshell in to streams with degraded habitat could result in increased clubshell mortality. The proposed research would be critical to reach a point that additional augmentation/reintroduction is likely to succeed.

augmented/expanded/reintroduced clubshell population(s); and (e) projects must be completed either before impacts to clubshell occur or within two years after impacts.

6.2.4.7 Additional Actions Available to NiSource to Benefit the Species

NiSource is committed to implement AMMs and mitigation. In addition there are other important actions that NiSource may choose to initiate on its own or in concert with state agencies, non-government organizations, or other entities to further benefit this species. These would not in any way alter the requirements for compensatory mitigation, but may fit into NiSource's landscape-level approach to conservation.

Fund Research[27]

Identify and map activities or practices within each ecosystem that may affect the clubshell and its host fish at known sites, and at potential augmentation/reintroduction sites.

Determine contaminant sensitivity for each life stage, particularly sedimentation.

Surveying and monitoring

Implement a quantitative monitoring program at sites within the reproducing populations to assess the reproductive condition of these populations.

6.2.5 Northern Riffleshell Mussel

The northern riffleshell (*Epioblasma torulosa rangiana*) was listed as an endangered species by the Service on February 22, 1993 (Service 1993b). The current distribution shows a reduction greater than 95% of its former range (Service 1993b), primarily due to loss of habitat. In some places, however, otherwise diverse mussel assemblages occur within the historic range of the northern riffleshell from which they are absent (Service 2009b). This suggests either unknown habitat or other unknown factors are causing extirpation. The northern riffleshell is now sparsely distributed within a highly restricted range, although population numbers can be high in localized areas.

Impacts and potential resulting take of northern riffleshell are likely to occur in the following counties: Pickaway County, Ohio; Armstrong and Clarion counties, Pennsylvania; and Kanawha County, West Virginia.

Adult freshwater mussels are filter-feeders, siphoning phytoplankton, diatoms, and other microorganisms from the water column. Mussels tend to grow relatively rapidly for the first few years, and then their growth slows appreciably at sexual maturity (when energy is being diverted from growth to reproductive activities). There is ongoing discussion among scientists concerning the life span of mussels, but as a

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[27] Refer to the *National Strategy for the Conservation of Native Freshwater Mussels* compiled by the National Native Mussel Conservation Committee (1998) for additional information on conserving North America's imperiled mussel fauna. Shute et al. (1997) also outlined management and conservation considerations for imperiled mussels and other aquatic organisms, while incorporating ecosystem management into the equation.

group, they are generally acknowledged to be long-lived organisms. Northern riffleshells, however, have a relatively short life-span for freshwater mussels living for only 7 to 15 years (Rodgers et al. 2001, Crabtree and Smith 2009).

Most mussels, including the northern riffleshell, generally have separate sexes. Age at sexual maturity for the northern riffleshell is unknown, but is estimated in other mussel species to occur after a few years. Males expel clouds of sperm into the water column, which are drawn in by females through their incurrent siphons. Fertilization takes place internally, and the resulting zygotes develop within the gills into specialized larvae termed glochidia. This species, based on data from the tan riffleshell (*Epioblasma florentina walkeri*), is a long-term brooder with gravid females overwintering to release glochidia in late spring (Rodgers et al. 2001). Glochidia must come into contact with a specific host fish, usually within 24 hours, in order for their survival to be ensured. Without the proper host fish, the glochidia will perish (Service 1994). Northern riffleshell glochidia, as in many species of mussels, will parasitize the fishes' gill tissues for a few weeks. Newly metamorphosed juveniles then detach to begin a free-living existence on the stream bottom. In another critical stage, unless released in suitable habitat, they will die.

In part because northern riffleshell, like virtually all freshwater mussels, relies on this parasitic larval stage, it probably experiences very low annual juvenile survival. Jantzen, et al. (2001) report greater than 99% mortality for glochidia. Though not specific to northern riffleshell, this estimate and the estimates of survival that follow are likely typical for northern riffleshell and most mussels in North America. Probability of survival from mussel glochidium to benthic recruit has been estimated to range from 1×10^{-6} (Young and Williams 1984) to 39×10^{-6} (Haag 2002). Transition from glochidium to juvenile represents a very large bottleneck—a single female's reproductive output is reduced from thousands of glochidia to <1 offspring per year (Berg et al. 2008). The low fecundity suggests the need for a large population to produce a large annual cohort (Musick 1999).

Watters (1996) and O'Dee and Watters (2000) conducted host suitability studies that identified four fish species on which northern riffleshell glochidia develop into juveniles: banded darter (*Etheostoma zonale*), bluebreast darter (*E. camurum*), brown trout (*Salmo trutta*), and banded sculpin (*Cottus carolinae*). McNichols, et al. (2007) reported that Iowa darters (*Etheostoma exile*), Johnny darters (*Etheostoma nigrum*), and mottled sculpin (*Cottus bairdi*) also transformed northern riffleshell glochidia. These studies did not test all of the fish species that are native to the range of the northern riffleshell. Further, these fish species do not occur in all habitats that support northern riffleshell. Therefore, there are probably other, as yet unidentified, suitable fish host species for the northern riffleshell – most likely several species of *Etheostoma* and *Percina* (Zanatta and Murphy 2007).

The northern riffleshell occurs in a wide variety of streams, large and small, preferring runs with a bottom composed of firmly packed sand and fine to coarse gravel (Service 1995). Northern riffleshell mussels also require swiftly moving, well-oxygenated water (Carman and Goforth 2000).

6.2.5.1 Activities and Impact Analysis

The 1994 recovery plan identified four primary factors responsible for the decline of northern riffleshell populations: siltation, impoundment, instream sand and gravel mining, and pollutants (Service 1994).

The draft 5-Year Review (Service 2009b) lists ongoing threats to the northern riffleshell. Ongoing threats to the northern riffleshell include water quality degradation from point and non-point sources, particularly in tributaries that have limited capability to dilute and assimilate sewage, agricultural runoff, and other pollutants. In addition, the species is affected by hydrologic and water quality alterations resulting from the operation of impoundments. A variety of instream activities continue to threaten northern riffleshell populations, including sand and gravel dredging, gravel bar removal, bridge construction, and pipeline construction. These can change streambed configuration and result in long-lasting altered stream flow patterns degrading habitat, often some distance from the disturbance. Exploration and extraction of coal, oil, and gas resources can result in increased siltation, a changed hydrograph, and altered water quality, even at a distance from the mine or well field.

Land-based development near streams of occurrence often results in loss of riparian habitat and increased storm water runoff, which combine to increase sedimentation. *Epioblasma*, including northern riffleshell, appear to be exceptionally sensitive to the increased siltation and associated turbidity caused by changing land use (Peacock et al. 2005). Development has also increased the number of sewage treatment plants in drainages that support northern riffleshell, and increased the amount of sewage discharged from existing plants. Some potential exists for impacts from zebra mussels, particularly where northern riffleshell populations and zebra mussel habitat coincide (e.g., pools in large rivers) (Service 2009b).

There is a growing belief that emissions of greenhouse gases are linked to climate change. The extent of warming and the resulting changes in rainfall patterns that may occur is not known with certainty at this time. NiSource has addressed the potential for impacts to northern riffleshell from water temperature increase and other possible manifestations of climate change in Chapter 10.

Finally, large populations appear to be necessary for the long-term conservation of this species. Smaller populations in multiple streams have declined or become extirpated since listing (Service 2009b).

NiSource Activities Potentially Affecting Northern Riffleshell

NiSource activities affecting northern riffleshell are hereafter characterized as those that may cause take and derive: (a) from the stream crossing actions (affecting the streambed and riparian corridor), and (b) upland-disturbing (sediment-related) *aggregate impacts*. Aggregate impacts are defined as those impacts that derive from multiple NiSource activities that individually do not rise to the level of take, but taken together over time result in negative effects that NiSource has agreed to compensate. One example would be the combined sediment impacts of access road maintenance, culvert replacement, grading, and restoration efforts over the 50-year permit duration.

Pitt, Clark, and Lake (2007) evaluated a study of the Menomonee River watershed in Wisconsin. They found that the 3.3% of the area disturbed by construction contributed the greatest amount of sediment at the river mouth compared to any other land use (50% of all the suspended sediments). In the southeast Wisconsin Regional Planning area the same authors found that construction covered only 2% of the surface area, but contributed 26% of the sediment to inland waters. By comparison, agriculture was 72% of land use and contributed only 45% of the sediments. Owens et al. (2000) found that in Wisconsin even small (0.34 and 1.72 acres) construction sites had rates of erosion that were 10 times those of typical rural or urban land uses. Various factors including topography, rainfall intensity, soil type, soil compaction, time of year, and erosion control measures influence the rate. Both studies recognize that even small construction projects (for reference National Pollutant Discharge Elimination System Phase II regulations regulate sites above one acre in urban areas) and small overall construction footprints in a watershed can cause significant detrimental impacts to local waterbodies.

Although the effects from many NiSource O&M and new construction activities are sediment related (e.g., grading, regrading, tree clearing, repair, culvert replacement, etc.), it is not expected that any of these activities, as routinely implemented, will result in large single discharges of sediment. In addition, negative consequences are likely lessened because most covered activities would be outside of urban areas where storm sewers carry sediments directly to receiving waters and vegetated buffers are less available. NiSource also implements multiple sediment control measures on their ground disturbing projects (*see* the ECS, **Appendix B**); however, none of these measures is 100% effective and effectiveness varies even with properly implemented measures. For example, properly installed silt fences in Alabama did not achieve sediment reduction to the same level as an undisturbed reference site (Pitt, Clark, and Lake 2007). Non-point sediment impacts are difficult to measure and impacts may occur as a result of numerous activities over many years. Nevertheless, NiSource believes that these activities, although reduced to the maximum extent practicable, may result in harm and harassment of northern riffleshell.

The following O&M activities may impact northern riffleshell: pipeline corridor presence, vehicle operation, access road culvert replacement, access road maintenance, off-ROW clearing, mechanical repair and fill in ROW, in-stream stabilization, tree clearing, herbicide application, hydrostatic testing, pipeline abandonment, and well abandonment. These activities may result in a variety of stressors to northern riffleshell including: sedimentation, chemical contaminants, increased water temperature, crushing, substrate compaction, altered flow, burying substrate, and introduction of invasive species (**Appendix M, Table 6.2.5.1-1**).

These stressors, in turn, may negatively impact the northern riffleshell in a variety of ways. Sedimentation at levels that would be expected from O&M activities will contribute habitat degradation and could over time disrupt northern riffleshell biology (*see* the discussion on burying below) or ecological relationships (e.g., host fish). The 5-Year Review for northern riffleshell notes that *Epioblasma* species, including northern riffleshell appear to be "exceptionally sensitive" to siltation and turbidity caused by changes in land use (Service 2009b). Chemical contaminants (fertilizers and herbicides) have some potential to cause harm or mortality to mussels, but more likely could affect algae and plankton that provide food for mussels and host fish and affect water quality. The loss of riparian habitat reduces shade on the stream, potentially altering water temperature, and may also affect trophic function by reducing inputs into the stream from the overhanging trees. Crushing is self explanatory. Since mussels are benthic organisms, substrate compaction can make habitat less suitable for both adult and juvenile mussels. Altered stream flow can change habitat and food availability. Similarly, burying habitat can fill the interstitial spaces in the gravels and preclude normal processes when adult mussels burrow into the substrate. This can be even more harmful to juvenile northern riffleshell that immediately burrow into the substrate after dropping from host fish. Many species, including northern riffleshell, bury themselves completely during the winter months and it is estimated that nearly 50% of a population of northern riffleshells can be buried at any time (Service 2009b). The introduction of invasive species primarily involves the accidental introduction of zebra mussels or other harmful invasives into habitat previously not contaminated or contaminated at a low level with these invasives. Where habitat is suitable for large populations of zebra mussels (typically water with less flow like lakes or navigation pools in large rivers), zebra mussels have the potential to cause harm and mortality to native mussels.

New construction activities that may impact northern riffleshell are: wet-ditch crossing activities, access road construction, grading, HDD, hydrostatic testing (withdrawal and discharge), re-grading, fertilizer application, erosion control devices, herbaceous and woody vegetation clearing, stream bank contouring, installation and removal of stream crossing structures, trenching related impacts, waste pits, minor spill events (major spill events are addressed outside the context of the MSHCP), in-stream stabilization, and vegetation disposal. The following stressors are associated with new construction activities: sedimentation, altered flow, chemical contaminants, entrapment, increase in water temperature, water level reduction, introduction of invasive species, substrate compaction, and crushing (**Table 6.2.5.1-1**).

The stressors from new construction mostly overlap those of O&M and could have the same impacts, although in some cases the impact might be acute rather than chronic (e.g., sedimentation from stream crossing activities could have an acute effect on mussels immediately downstream, while sedimentation from the pipeline corridor presence, or access road replacement, would likely occur slowly over the 50-year life of the permit). Entrapment from the withdrawal of water for hydrostatic testing poses a slight risk to juvenile mussels, gametes that are released into the water column during reproduction, and also to glochidia, which could be entrapped if small host fish were sucked through or trapped during water withdrawal. NiSource expects that take will be very limited in terms of both amount and level of take with implementation of mandatory AMMs. Water level reduction could impact northern riffleshell occurring in smaller streams, particularly if withdrawal for hydrostatic testing were to occur during already low flow.

The most direct threat involves excavation for installing or repairing pipelines across inhabited streams (note that NiSource has agreed that crossings in storage well counties would not exceed the crossings calculated for the existing one-mile corridors in those counties). If present, this could cause direct lethal take of northern riffleshell by crushing and excavating individuals, and by causing lethal and sub-lethal (harassment and harm) sediment impacts to individuals downstream of the work area. Access road construction could have similar impacts to individuals. In-channel construction (e.g., in-stream stabilization or bank contouring) could also take individuals.

An alternative to open-cut excavation is HDD. However, under certain conditions, HDD can cause fracturing of the stream bottom. This can result in release of drilling muds from the bore hole into the stream (frac-out) which could impact northern riffleshell. Drilling muds are composed primarily of water and bentonite, and the slurry or drilled solids cut from the bore hole. More advanced drilling muds typically contain various additives including long-chain polymers and detergents. In low pH environments, soda ash is sometimes added to raise the pH (in the bore hole) to an optimum level of about 9 (Najafi and Gokhale 2005). No studies were found that have evaluated the toxicity of HDD drilling muds to mussels. However, freshwater mussels appear to exhibit more sensitivity to some pollutants than do the organisms typically used in toxicity testing. As a result, some of the water quality criteria established by the EPA to protect aquatic life may not be protective of mussels (Service 2009b). It is likely that in high concentrations additives used to raise pH and detergents could cause harm. Minor frac-outs, however, which would involve very small quantities of drilling muds (and even smaller amounts of potentially toxic materials) would, based on our experience, be similar to background levels of sediment from natural events and not be expected to cause take (harm or mortality) of mussels. Any spill that would result in observed take would be handled outside the context of the MSHCP.

Impacts to northern riffleshell habitat could also be a consequence of both O&M and new construction activities. Activities involving excavation in the stream channel (e.g., install or remove pipeline) could have significant impacts to both the habitat in the construction area and downstream. Impacts could involve acute sediment impacts that, as described above, could render the habitat unsuitable for adult or juvenile mussels. NiSource’s expectation is that some of the habitat would likely recover over a period of months (Villella 2005), but some impacts could persist for months or years until such time as high flows or storm flows moved the sediment downstream. This is particularly important for riffleshell, which typically burrows completely beneath the substrate, relying on water to percolate between the sediment particles (Service 2009b). Fine sediments that clog interstitial spaces could make habitat unavailable for mussels. Other activities (e.g., installation of in-stream stabilization, stream bank contouring, pipeline presence) could have long-term direct impacts on habitat and long-term indirect impacts through altered flow.

The activities that occur within the impact zone of the crossing action (e.g., crushing from equipment preparing a site for excavation) are calculated in the algorithm for crossing actions used to estimate take (described in Section 6.2.5.4 below). The remaining impacts are classified as aggregate and involve: (1) low-level sedimentation impacts to mussels, mussel habitat, host fish, and host fish habitat from the pipeline corridor presence; ROW mechanical repair; ROW fill; vegetation clearing; access road maintenance, upgrading, and construction; installation and maintenance of culverts under access roads; grading; restoration (in-stream); restoration (bank contouring); regarding, stabilization and restoration; low-level frac-out; open trenches; trench dewatering; trench water diversion structures; vehicle operation; waste pit berms; well abandonment (restoration); (2) entrapment of mussels from hydrostatic testing; (3) chemical contaminants from hydrostatic testing, re-grading, stabilization, and restoration (fertilizer); SPCC (spill event); (4) altered flow from in-stream stabilization measures; pipeline corridor presence; (5) increase in water temperature from pipeline corridor presence; tree and shrub clearing; (6) substrate compaction from vehicle operation. These are chronic low-level impacts that combine together or with non-NiSource impacts to potentially degrade northern riffleshell habitat and cause impacts over the proposed 50-year permit life.

An adaptive management program is necessary for a species with significant uncertainties and high levels of risk. *See* Section 7.6.4.4 for the proposed adaptive management program for the Northern riffleshell.

6.2.5.2 Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend to permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicant should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; *see also* the Service's HCP Handbook at 3-20 ("HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery tools"; "contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the northern riffleshell. With these general goals in mind, the main northern riffleshell conservation objective for ROW maintenance and O&M activities is to avoid or minimize impacts to known or presumed occupied habitat (e.g., minimize impacts to stream banks and bed) and avoid/minimize impact to northern riffleshell (e.g., crushing, killing, sedimentation). The main northern riffleshell conservation objective for all construction projects (i.e., off existing ROW) is to avoid or minimize impacting known or presumed occupied habitat (e.g., through project planning, use of trenchless installation) and avoid/minimize impact to northern riffleshell (e.g., crushing, killing, sedimentation). Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that can not be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 – Contribute toward management of northern riffleshell mussel populations and their habitats within the Ohio River Basin, in support of federal and state recovery efforts. Because so few recruiting populations exist, it is essential to the survival and eventual recovery of this species that extant populations and occupied habitat be given priority for protection.

Rationale: The northern riffleshell was widespread throughout most of the Ohio River and Maumee River drainages prior to 1800. This species now exists in eight to ten isolated populations, most of which are small and peripheral (Service 1994). The largest remaining northern riffleshell population is in the French Creek (Pennsylvania). The Northern Riffleshell Recovery Plan (Service 1994) calls for protecting and restoring viable populations in 10 drainages, comprised of both peripheral and central populations to maintain genetic variability, and be extensive and abundant enough to survive a single adverse ecological event. A viable population is defined as a naturally reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural environmental changes. Theoretical considerations by Franklin (1980) and Soulé (1980) indicate that 500 breeding individuals represent a minimum population level (effective population size) that would contain sufficient genetic variation to enable that population to evolve and respond to natural habitat changes. These populations should include as many subpopulations as possible to maintain whatever fraction of the original genetic variability now remains.

Objective 1 - Where habitat has been degraded, restore and/or protect riparian habitat specifically for the conservation of northern riffleshell mussels.

Objective 2 - Propagate, augment, enhance and/or restore northern riffleshell mussels where appropriate habitat conditions, genetic information, and other necessary parameters indicate this is an appropriate action.

Objective 3 - Where habitat has been degraded, restore and/or protect water and substratum quality.

Objective 4 - Partner with stakeholders having responsibility and/or expertise in northern riffleshell mussel conservation and recovery, and contribute resources to those efforts and programs in priority areas for mussel recovery.

Goal 2 - Determine, through research, feasible mechanisms to enhance extant populations, including augmenting and/or reestablishing northern riffleshell into historic habitats and implement those mechanisms consistent with Goal 1.

Rationale: Mussel propagation technology and subsequent translocation are fast becoming important tools in the recovery of native populations (Garner 1999). Most existing populations are likely below the number needed to maintain long-term viability. These populations may be able to expand naturally if environmental conditions are improved. However, some populations may be too small to recover and may need to be supplemented to reach and maintain a viable size. Translocation may entail: (1) bolstering small populations through artificial infestations or in-vitro cultures from the same population where the reason for the depressed status of the *population is understood, (2) bolstering small populations with individuals from a larger population, and/or (3) introducing individuals to an area where they have been extirpated (Service 1994).*

Objective 1- Develop necessary genetic information to support propagation and reintroduction of northern riffleshell mussels.

Objective 2 - Identify and prioritize streams suitable for augmentation, translocation, and reintroduction, and those most easily protected from further threats.

Goal 3 - Develop and implement a program to monitor population status, including demographics and habitat conditions.

6.2.5.3 Measures to Avoid and Minimize Impacts

These measures apply to the counties listed in Section 6.2.5 and the maps in **Appendix G, Figure 6.2.5.3-1** for the northern riffleshell mussel

These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Measures in *italic* font text will be applied on a case-by-case basis depending on the requirements of the activity. These requirements include consideration of customer and business needs, practicality, and effectiveness as more fully described in Chapter 5 of this MSHCP. Details on selecting the appropriate waterbody crossing method are provided in Section 5.2.1.1.

<u>Surveys to Evaluate Presence and Relocation of Species in NiSource Action Areas</u>

1. A survey can be conducted to determine the presence of this mussel species. Mussel survey protocols designed to detect endangered mussels that often occur in low densities; protocols as of 2009 are provided in **Appendix L**. Survey methodologies must be evaluated at minimum every five years and be updated to the most effective survey methods currently available. If the most current methodology implemented by a biologist, qualified to conduct the survey, does not indicate the presence of the species, it will be classified as unoccupied habitat and the AMMs will not be mandatory.[28]

If a survey is not completed, presence will be assumed. In that case, all suitable habitat would be treated as occupied, and all mandatory AMMs must be followed. NiSource or its contractors will follow the Service approved relocation plan as referenced below. Survey and relocation may be implemented in the same time period (as one action) as long as both survey and relocation protocols are followed (general relocation protocols are identified in **Appendix L**, but may be modified in conjunction with Service Field Office based on conditions).

Relocation may be implemented only if: (1) all required permits are in place, (2) a Service-approved relocation plan documenting all relevant protocols including how and where the mussels will be moved is in place, (3) a contingency plan is in place to conduct additional consultation with the Service should the actual field survey not reflect the conditions identified in the approved relocation plan, and (4) a monitoring

[28] However, NiSource may implement some of these measures if appropriate to protect potentially suitable habitat.

program to evaluate the effects of the relocation is in place. Relocation will include at least all individuals of the federally endangered species identified in the impact area and may include other species based on the assessment of the Service Field Office and other regulatory agencies. A copy of the survey and any reports will also be included in the annual report submitted to the Service.

Pre-Construction Planning: Preparation of an EM&CP

2. A detailed EM&CP will be prepared for any activity with potential effects (e.g., streambed or stream bank disturbance, impacts to riparian habitat, activities causing sediment) within 100 feet of the ordinary high water mark of occupied mussel habitat. The plan will incorporate the relevant requirements of the NGTS ECS and include site-specific details particular to the project area and potential impact. The waterbody crossing will be considered as "high-quality" for the purpose of preparing this plan regardless of the actual classification. The plan will be strongly oriented towards minimizing streambed and riparian disturbance (including minimization of tree clearing within 25 feet of the crossing [**Figure 24, ECS**]), preventing downstream sedimentation (including redundant erosion and sediment control devices that would be designed to protect mussel resources as appropriate), and weather monitoring by the Environmental Inspector to ensure work is not begun with significant precipitation in the forecast. The plan will comprehensively address all activities needed to complete the work and minimize take of mussels in occupied habitat including crossing the streams during dry periods when practical and using dry-ditch crossing techniques for intermittent streams leading to mussel habitat. The EM&CP will include the frac-out avoidance and contingency plans described in AMM#3 below. The EM&CP will also include a sediment control component for uplands that drain to and impact occupied habitat. Detailed erosion control plans will be developed specific to slopes greater than or equal to 30% leading directly to occupied habitat. These plans will include techniques such as hard or soft trench plugs, temporary sediment barriers, a wider trench at the slope base, and/or temporary slope drains (plastic). In areas with less than a 30% slope, ECS and AMM erosion control measures protective of mussels will be implemented. The plan will be approved in writing by NiSource NRP personnel prior to project implementation and will include a tailgate training session for all on-site project personnel to highlight the environmental sensitivity of the habitat and any mussel AMMs which must be implemented.

Streambed Construction

3. For activities in occupied habitat, install new or replacement pipelines and major repairs under the river bottom using horizontal directional drilling (HDD) or other trenchless methods rather than open trenching unless the crossing evaluation report prepared in accordance with Section 5.2.1.1 and **Appendix J** indicates otherwise. Drilling should be carefully undertaken and a plan should be in place to minimize and address the risk of in-stream disturbance due to frac-outs. The plan should also specifically reference mussel resources in the vicinity of the crossing as a key conservation concern and include specific measures identified in the NGTS ECS, from standard industry practices, or other mutually agreed-upon practices to protect this resource. The plan will also include a frac-out impact avoidance plan, which will evaluate the site in terms not only of feasibility of conducting HDD, but the likelihood

of large scale frac-out and its effects on mussels, and actions to address a large-scale frac-out in occupied habitat. The plan should also consider the potential effects on mussels if drilling fluids are released into the environment. The plan must contain all information required for a FERC Section 7(c) filing at a minimum.

If, after detailed engineering studies (e.g., geotechnical, physiological, topographical, and economic), it is determined (and agreed to by NRP personnel) that an HDD is not feasible, a report will be prepared and included in the annual report submitted to the Service. However, due to the potentially significant amount of take that might occur for Ohio River crossings, open trenching in this river is not a "covered activity" as part of the NiSource MSHCP.

4. Install pipeline to the minimum depth described in the ECS and maintain that depth at least 10 feet past the high water line to avoid exposure of pipeline by anticipated levels of erosion based on geology and watershed character. Additional distance may be required should on-site conditions (i.e., outside bend in the waterbody, highly erosive stream channel, anticipated future upstream development activities in the vicinity) dictate a reasonable expectation that the stream banks could erode and expose the pipeline facilities. Less distance may be utilized if terrain or geological conditions (long, steep bank or solid rock) will not allow for a 10-foot setback. These conditions and the response thereto will be documented in the EM&CP and provided as part of the annual report to the Service.

5. For repairs in occupied habitat, do not install in-channel repairs (bendway weirs, hardpoints, concrete mats, fill for channel relocation, or other channel disturbing measures) except when measures in AMM#3 above are not feasible from an engineering design perspective, and then, only in conjunction with a stream restoration plan based on Rosgen (*see* Wildland Hydrology 2009 http://www.wildlandhydrology.com/html/references_.html) or other techniques mutually agreed upon by NiSource and the Service that result in no direct or lethal take of listed mussels.

6. Conduct replacements/repairs from a lay barge or temporary work bridges of the minimum length necessary to conduct the replacements/repairs rather than operating heavy equipment (e.g., backhoes, bulldozers) in-stream. Temporary construction and equipment bridges are not to be confused with stone or fill causeways with pipe structures, which should not be employed in known or presumed occupied waterbodies.

7. Remove equipment bridges as soon as practicable (this is typically interpreted to be a few days to a few weeks unless there are extenuating circumstances) after repair work and any site restoration is completed

8. As part of the routine pipeline inspection patrols, visually inspect all stream crossings in occupied habitat at least yearly for early indications of erosion or bank destabilization associated with or affecting the pipeline crossing that is resulting, or would before the next inspection cycle, likely result in sediment impacts to mussel habitat beyond what would be expected from background stream processes. If such bank destabilization is observed, it will be corrected in accordance with the ECS. Follow-up inspections and restabilization will continue until the bank is stabilized (generally two growing seasons).

Stream Bank Conservation

9. Do not construct culvert and stone access roads and appurtenances (including equipment crossing) across the waterbody or within the riparian zone. Temporary equipment crossings utilizing equipment pads or other methods that span the waterbody are acceptable provided that in-stream pipe supports are not needed.

10. For equipment crossings of small streams, use half pipes of sufficient number and size that both minimize impacts to streambed and minimize flow disruption to both upstream and downstream habitat (**ECS, Figure 22**).

11. *Reserved.*

Pipeline Abandonment

12. Abandon pipelines in place to avoid in-stream disturbance that would result from pipeline removal unless the abandonment would be detrimental to endangered mussels.

Contaminants

13. As described in the ECS section on "Spill Prevention, Containment and Control," site staging areas for equipment, fuel, materials, and personnel at least 300 feet from the waterway, if available, to reduce the potential for sediment and hazardous spills entering the waterway. If sufficient space is not available, a shorter distance can be used with additional control measures (e.g., redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials). If a reportable spill has impacted occupied habitat:

a. follow spill response plan; and

b. call the appropriate Service Field Office to report the release, in addition to the National Response Center (800-424-8802).

14. Ensure all imported fill material is free from contaminants (this would include washed rock or other materials that could significantly affect the pH of the stream) that could affect the species or habitat through acquisition of materials at an appropriate quarry or other such measures.

15. For storage well activities, use enhanced and redundant measures to avoid and minimize the impact of spills from contaminant events in known or presumed occupied streams. These measures include, for example, waste pit protection, redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials, and a spill response plan provided to the Service as part of the annual report. These measures will be included in the EM&CP prepared for the activity.

16. Do not use fertilizers or herbicides within 100 feet of known or presumed occupied habitat. Fertilizer and herbicides will not be applied if weather (e.g., impending storm) or other conditions (e.g., faulty equipment) would compromise the ability of NiSource or its contractors to apply the fertilizer or herbicide without impacting presumed occupied mussel habitat. The EM&CP prepared for this activity (AMM#2 above) will document relevant EPA guidelines for application.

Withdrawal and Discharge of Water

17. Hydrostatic test water and/or water for storage well O&M will not be obtained from known or presumed occupied habitat unless other water sources are not reasonably available. To prevent desiccation of mussels, water from known or presumed occupied habitat will be withdrawn in a manner that will not visibly lower the water level as indicated by water level height on the stream channel bank. Employ appropriately sized screens, implement withdrawal rates, and maintain withdrawal point sufficiently above the substrate to minimize impacts to the species.

18. Do not discharge hydrostatic test water directly into known or presumed occupied habitat. Discharge water in the following manner (in order of priority and preference):

a. Discharge water down gradient of occupied habitat unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.

b. If those circumstances occur, discharge water into uplands >300 feet from occupied habitat unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.

c. If those circumstances occur, discharge water as far from occupied habitat as practical and utilize additional sediment and water flow control devices (**Figures 6A&B, 7, 8, 14A&B; ECS**) to minimize effects to the waterbody.

Travel for O&M Activities

19. Do not drive across known or presumed occupied streams – walk these areas or visually inspect from bank and use closest available bridge to cross stream.

Zebra Mussels and Other Invasives

20. Clean all equipment (including pumps, hoses, etc.) that have been in a perennial waterbody for more than four hours within the previous seven days and will work in occupied or potential federally listed mussel habitat; following established guidelines to remove zebra mussels (and other potential exotic or invasive species) before entering a known or presumed occupied stream for a federally listed mussel, which is not known to be infested with zebra mussels (**Appendix L**). Do not discharge any water for other sources that might be contained in equipment (e.g. ballast water, hoses, sumps, or other containment). It is important to follow these guidelines even if work is not occurring in the immediate vicinity of these mussels since, once introduced into a watershed, invasive species could move and eventually affect the federally listed mussels.

6.2.5.4 Calculation of Incidental Take

Incidental take was calculated for the northern riffleshell using the following simple algorithm:

Stream Width x Impact Length (lethal and sub-lethal wet-ditch or dry-ditch model) x Percent Suitable Habitat = Acres of Habitat Impacted

Acres of Habitat Impacted x northern riffleshell Density = Impacts to Individuals

Operating Facts:

The stream crossing method will be determined by NiSource as described in Section 5.2.1.1. Take is calculated based on using the wet-ditch stream crossing method for large streams (over 100 feet in width) except the Ohio River (only HDD is included as a covered activity) and using the dry-ditch method for remaining streams.

Take of mussels from the NiSource covered activities would occur primarily from impacts directly associated with the installation, repair, or removal of pipeline across occupied stream habitat. On occasion, NiSource will also use access fords/equipment bridges across streams that are not entirely within the existing ROW. These fords/equipment bridges are typically 15 feet in width and are commonly used by the landowner for other purposes. If the fords/equipment bridges exist, then NiSource and the Service have determined that its effects on endangered mussels are insignificant and discountable. However, the construction and use of a new fords/equipment bridges will have take that NiSource would be responsible to mitigate for. It is also likely that NiSource will need to cross one or more of these streams in a location other than the existing pipeline corridor. The impacts from these crossings would be separate from, and additional to, those accounted for above. An additional amount of take (approximately 15%), calculated based upon the percentage of times that NiSource has looped pipelines at different stream crossing locations in the past, has been added to account for these mitigation requirements.

Key Assumptions:

NiSource used a reasonable worst case scenario with regard to its stream crossing activities and aggregate sediment impact causing activities that could affect northern riffleshell. The entire area that would be impacted by covered activities (e.g., where multiple pipelines are in close proximity to each other) was identified and used for the total acreage calculation. Eight large and five small stream crossing areas throughout the covered lands could affect northern riffleshell over the proposed 50-year ITP.

Based on the estimated density near the towns of Parker and East Brady and the nearly universally low densities documented at other non-Allegheny River populations, a density of 0.1 mussels per square meter was used to calculate take for this species. Northern riffleshells do exist at very high densities (7.57 northern riffleshells per square meter) in the Allegheny River near the Venango and Forest County Line in Pennsylvania (Service 2009b). NiSource, however, does not cross the Allegheny River in this area but further downstream where densities are much lower.

Take was calculated separately for large streams (>100 feet wide) and small streams (≤100 feet wide) to accommodate the two main stream crossing methods, wet-ditch and dry-ditch respectively. The average width at the pipeline crossing of large streams was 280 feet and the average width at the pipeline crossing of small streams was 36 feet. Stream width data were visually analyzed using one meter resolution leaf-on aerial photographs.

There is little discussion of suitable habitat in the literature and no consensus among biologists on what this number should be. The percent suitable habitat was based on the evaluation of a small number of studies that indirectly addressed how much of the stream substrate is occupied by mussels when a mussel assemblage is present (Hastie, et al. 2000, Hastie, et al. 2003, and Morales et al. 2006), and discussion with Service biologists and a consulting biologist experienced in surveying mussels (Villella 2009). Morales et al., who were looking at mussels in an upstream reach of the Mississippi, and Hastie et al., conducting research in a small Scottish stream mapped the presence of mussels and indicated areas of the substrate that contained animals and areas that did not. Non-occupied areas may be unsuitable for various reasons (e.g., sheer forces during high flows, unstable or otherwise unsuitable substrate, areas that are regularly de-watered, etc.). Anderson (2000), examining mussels upstream and downstream of an existing bridge across the Allegheny River at Foxburg, Pennsylvania, looked at three reaches of the river, upstream of the bridge (total area 3.3 acres), immediately downstream of the bridge (total area 7.28 acres), and further downstream (total area 7.44 acres). In those three areas he found that the mussel bed covered approximately 1.12 acres upstream (34%), 1.79 acres immediately downstream (25%) and 3.7 acres further downstream (50%).

Mussel experts who provided input on this question could only suggest that this metric is site-dependent and variable according to a number of factors. Therefore, in an extant mussel assemblage, the percent of the substrate within the stream banks that is occupied lies somewhere between 0% (since the starting premise is that mussels are present) and 100%. Within a mussel assemblage, endangered mussels would be presumed to cover less area since they are frequently (but not always) a rare component of those assemblages.

NiSource and the Service recognize the limitations of this metric as applied to any one stream. Some streams may have nearly 100% of the bottom occupied by an endangered mussel at a given density and other streams may have almost no presence, as in small remnant populations. Another factor to consider is how the NiSource impact zone overlaps a mussel assemblage. It is likely that in some cases, NiSource impacts will fall completely within the limits of a mussel assemblage. In other cases, the NiSource impact zone will fall partly within an area of mussels and partly within an area outside of an assemblage, given that mussels are distributed discontinuously within occupied streams. NiSource and the Service believe that if applied across all of the streams in the watershed, and across the entire length of stream for which impacts are estimated, that a central estimate should be employed in determining a reasonable worst case scenario. Therefore, take was calculated using the estimate that northern riffleshell would occupy 50% of the stream bottom at the estimated density for this species.[29]

The impact area was calculated using both the sediment transport model and the dry-ditch model. The sediment transport model estimates a lethal impact area covered

[29] The use of a central value (50%) in the reasonable worst case scenario take calculation (model) is based on the best available information and will be revisited as new information becomes available.

by 0.236 inches of sediment. A sediment plume is predicted to extend further downstream corresponding to a harm/harassment area having a 600 mg/l concentration of suspended sediment (Ellis 1936; Aldridge et al.1987). The dry-ditch model estimates a 75-foot lethal zone and a 100-foot harm/harassment zone downstream of the coffer dams.

A sediment transport estimation methodology was developed to aid in identifying the effects of open-cut waterbody crossing activities on mussels within suitable habitats. Because of the large number of streams within the project area, ENSR hydrologists and biologists, with input from the Service and NiSource, developed a simplified procedure to formulate and quantify the three processes of (1) suspended sediment supply to a stream from site disturbance; (2) instream transport and dispersion of the sediment by representative size fractions; and (3) sediment deposition on the streambed. Three sites (the Duck River in Tennessee, the Elk River in West Virginia, and the James River in Virginia) were selected for application of the estimation procedure. Site selection was based on: (1) a list of "may-affect" stream crossings for the NiSource project; (2) the availability of nearby USGS stream gauge data and related measurements; and (3) a likelihood of moderate flow conditions (discharge, depth and width, velocity) during the anticipated construction season (July through December). Moderate flow conditions may be the most significant in terms of potential effects of sediment deposition on mussel beds. Under the procedure, small discharges and slower flow velocities or shallow depths generally will not result in the calculation of sediment transport and deposition at distances as great as in the larger streams. Very large rivers, such as the Ohio and Tennessee rivers, absorb sediment inputs within their background conditions and disperse them fairly quickly within the cross-section to levels below the criteria. Although general in nature, NiSource and the Service believe this model is suitable for use in developing a reasonable worst case scenario across the streams and species in the MSHCP. Additional details of this methodology are presented in **Appendix L**.

This methodology assumes successful implementation of the NGTS ECS and uses construction parameters and available physical and hydrologic environmental characteristics of three streams. Stream flow conditions (discharge, depth and width, velocity) during the anticipated construction season (July through December) were also considered.

Another factor was the recognized criteria for mussel mortality (i.e., a burial depth of 0.236 inches or more and a suspended sediment concentration of 600 mg/l or more) (Ellis 1936; Aldridge et al.1987). NiSource and the Service evaluated the potential impacts of NiSource actions on host fish and glochidia, and coordinated that analysis with Service Field Offices, and concluded that the impacts on host fish and glochidia would be insignificant and discountable. Select waterbodies with the highest potential for significant transport were analyzed in greater detail. Those with the resulting longest transport distances that met mussel mortality criteria were selected to define the impact area with an error margin for the mussel species in the MSHCP.

NiSource proposes to use a dry-ditch methodology for stream crossing where technically and otherwise feasible (current technology permits this on streams of approximately 100 feet wide or less). The 75 feet within the coffer dam (lethal impact zone) plus 100 feet downstream (lethal impact/harm zone using the aforementioned sediment depth and suspended sediment values) were used to determine the action area for each crossing. NiSource and the Service recognize that there is some level of uncertainty associated with the sediment transport estimation methodology, both in terms of the predictive power of the methodology and to what extent sediments might impact mussels in any particular location. NiSource will evaluate the performance of both methodologies downstream of crossings using adaptive management.

The take calculation for northern riffleshell mussel is presented in **Table 6.2.4.4-1**. As shown, the above described impacts result in the reasonable worst case scenario of impacts to approximately 165.3 acres of habitat. This translates into take of approximately 33,452 northern riffleshell over the 50-year life of the permit. The 33,452 northern riffleshell estimated to be taken is important for an understanding of the impact on the species. It is not, however, the best method for identifying the amount of mitigation necessary to fully compensate for the impact of the take. Because the effects on habitat are more easily and accurately assessed, they better reflect the impact of the take. NiSource has therefore used acres as the basis for mitigation.

In addition, aggregate impacts from various sediment causing activities could have long-term and significant impacts on the same 165.3 acres and additional acres (removed from the immediate stream crossing sites), particularly in conjunction with other development activities in the watershed. NiSource calculated aggregate take based on the total acreage of NiSource pipeline corridor (using a 50-foot average width) overlapping the range of the northern riffleshell. The total riparian area protected will be 6.1 acres, which is calculated as the total area of NiSource pipeline ROW in all impacted watersheds (45,529 acres), multiplied by the average of the percentage of area the pipeline impacts in each watershed (0.214%), and divided by the total number of impacted watersheds (16). This provides an index of how prevalent NiSource pipelines are in the affected watersheds and therefore a surrogate for the sediment and associated impacts on mussels.

$$\frac{45529 \times 0.00214}{16} = \mathbf{6.1}$$

The take calculations presented here are designed to reflect a reasonable worst case scenario across the entire range of potentially affected streams. It is a reasonable worst case, but not certain, for example, that NiSource would actually conduct covered activities at all the locations affecting northern riffleshell over the 50-year permit duration. Take is based on the assumption that northern riffleshell occur in the aforementioned densities, over the estimated stream width, and occupied habitat percentage described above at every stream crossing. It is possible that some crossings may have higher or lower densities and more or less suitable habitat than modeled. However, the proposed calculations produce a reasonable worst case scenario over the life of the MSHCP, although it is likely not accurate for any one stream at a given point in time.

6.2.5.5 Impact of Take Analysis

Historically, the northern riffleshell was found in Illinois, Indiana, Kentucky, Michigan, Ohio, Pennsylvania, West Virginia, and western Ontario. It was widespread in the Ohio River basin in rivers such as the Ohio, Allegheny, Scioto, Kanawha, Little Kanawha, Licking, Kentucky, Wabash, White, Vermillion, Mississinewa, Tippecanoe, Tennessee, Green, and Salt rivers (Service 1993b). Its range also included the Maumee River basin, and in tributaries of western Lake Erie (Carman and Goforth 2000). The current range includes drainages in multiple states, although it has contracted to just a few streams (Service 2009b). Northern riffleshells still survive in the Green River in Edmondson and Hart counties, Kentucky; French Creek in Crawford, Venango, and Mercer counties, Pennsylvania; Allegheny River in Warren and Forest Counties, Pennsylvania; LeBoeuf Creek in Erie County, Pennsylvania; Detroit River in Wayne County Michigan; and Big Darby Creek in Pickaway County, Ohio (Service 1995).

The draft 5-Year Review (Service 2009b) describes the overall status of the species in the remaining drainages where it is known to occur. In summary, northern riffleshells appear to be restricted to four, successfully recruiting populations in the Ohio and St. Lawrence River Basins, specifically the East Branch Sydenham River, Allegheny River, French Creek, and Ausable River populations. The Elk River population is probably extant, but recruitment has not been documented recently. Since the species was listed as endangered, populations in Fish Creek, Detroit River, Green River, and Tippecanoe River have undergone severe declines and recent surveys failed to locate living specimens. Recent augmentation efforts have restored northern riffleshell to Big Darby Creek and a population of several thousand is extant there (Smith-Castro 2009). Although additional surveys are ongoing, northern riffleshells may have been extirpated from these systems. A significant range contraction would occur with the loss of the northern riffleshell from these rivers, eliminating Indiana (note that the Indiana Department of Natural Resources mussel biologist believes northern riffleshell to be extirpated in Indiana), Ohio, Michigan, Kentucky, and West Virginia from the species' range.

I. Genetic-Level Impacts

David Zanatta and associates at the Royal Ontario Museum have been investigating the genetic structure of the northern riffleshell with a focus on determining the genetic relatedness of three of the remaining four reproducing populations. The data indicate that populations in the Allegheny River, French Creek, and the East Branch Sydenham River may have a relatively recent common ancestry (Zanatta and Murphy 2007). Due to extreme rarity, no genetic samples could be obtained from populations further downstream in the Ohio River system. If extant, these populations may differ genetically from the three reproducing populations remaining to the north. The expression of genetic differences between northern populations centered on Lake Erie and those few remaining in the lower Ohio River may be found in the apparently more resilient nature of the northern populations (Service 2009b).

Petty (2005) states river systems can be considered habitat "islands" on the larger landscape; each river is separated from other rivers by habitat unsuitable for bivalves. Habitat fragmentation is common for freshwater species, causing disjunct gene pools (Mulvey et al. 1997). Population fragmentation is likely associated with loss or redistribution of genetic variability and is a concern for conservation biologists attempting to manage the genetic legacy of freshwater bivalve species (Petty 2005). It has been suggested that a minimum population size of 5,000 individuals might be necessary under natural conditions (restricted mating or overlap of generations) to avoid loss of genetic diversity of animal species (Schonewald-Cox et al. 1983). Based on current knowledge, there is at least one northern riffleshell population that meets that definition; the northern riffleshell occurs across 66 miles of the Allegheny River with population densities at some sites reaching 7.57 individuals per square meter and more than six million animals (Villella 2005). The other remaining populations are likely well below this threshold.

A once diffuse population of this species occurred throughout much of the Ohio River watershed, and historically, there were presumably no absolute barriers preventing genetic interchange among its tributary sub-populations that occurred in various streams. With the completion of numerous impoundments on rivers, some northern riffleshell populations were lost, and other populations became isolated. The principle genetic consequences of activities that reduce effective population size is the loss of genetic variance through genetic drift and consequently the potential reduction in the ability to adapt, and a reduction in fitness through inbreeding depression (Jones, Hallerman, and Neves 2006, Schonewald-Cox et al. 1983). Genetic-level impacts are possible from NiSource activities under the MSHCP. The mechanism for these impacts is primarily through the possible extirpation of a small genetically diverse population, which could reduce the genetic material available to future generations. Where NiSource activities would affect more robust populations, genetic impacts could be less severe in that the number of mussels impacted from a NiSource activity would be a much smaller percentage of the population.

II. Population-Level Impacts

The species occurs at a few locations in very large numbers and high densities. For example, the total population of northern riffleshell in the Allegheny River may exceed 6,500,000 individuals (Villella 2005). It remains unclear, but the population in Big Darby Creek may now also be stable with the recent augmentation there. The Elk River population, however, may be very small. Populations possibly nearing extinction in the Elk River, and the recently augmented population of Big Darby Creek, as well as, the less densely populated section of the Allegheny River could be impacted by NiSource activities.

All known populations within the project area outside the Allegheny River system (and possibly Big Darby Creek) are small and are likely declining with limited or no recruitment at this time. Moreover, it is unlikely that without external inputs that they could ever completely recover based on the low density of most other remaining populations and the space between populations. It is possible, however, that even small apparently non-viable populations could after years at very low levels begin to reproduce (Anderson 2009). Therefore, although small isolated populations are vulnerable to losses resulting from events such as droughts, floods, toxicant spills, or other stochastic events, they are nonetheless important components in the conservation of the species. Impacts from NiSource activities at sites like the Elk River where northern riffleshell may already occur at very low densities, and where reproduction may already be affected could cause extirpation where a NiSource crossing coincided with the few remaining individuals (Anderson 2009). In addition, aggregate impacts over the life of the ITP could reduce the suitability of occupied habitat and habitat that could be colonized naturally or through enhancement and reintroduction. These impacts could also negatively affect northern riffleshell population dynamics.

NiSource and the Service expect a different outcome for impacts to sites having more robust populations of northern riffleshell (i.e., those in the Allegheny River system with thousands of individuals within a potential impact area). As an example, in 2000, the Kennerdell Bridge over the Allegheny River in Pennsylvania was replaced over a diverse mussel assemblage. Northern riffleshell was found within the direct impact area, which encompassed 5,000 square meters at an estimated density of 0.08 mussels per square meter with an abundance of 345 individuals; and in the indirect impact area, which encompassed 15,000 square meters, at a total density of 0.16 mussels per square meter and a total abundance of 1609 individuals (Villella 2005). Mussels were exposed to both construction related impacts and relocation during this project. The second monitoring report (survey conducted in 2004) suggests that mussels including northern riffleshell are recovering from construction (Villella 2005). While this bridge project was not directly comparable to a pipeline project, some of the key impacts (crushing, sedimentation, relocation) are similar to those expected from a NiSource river crossing. This study suggests that in areas with sufficient populations, construction-related impacts would not necessarily result in impacts from which the population could not recover.

In summary, it is reasonable to conclude that small, isolated populations in streams where direct impacts to northern riffleshell might occur from NiSource activities could be significantly impacted or even extirpated. Large robust populations could also be affected by NiSource activities and large populations appear to be necessary for the long-term conservation of this species. With AMMs and other measures in place, however, NiSource and the Service do not expect these impacts to have significant negative impacts on those populations. The Kennerdell Bridge may provide a model for how these populations will react to impacts from NiSource activities. Northern riffleshell may be particularly susceptible to permanent, temporary, and intermittent forms of environmental degradation. Therefore, aggregate impacts from sedimentation may have more of an impact on this species than other mussels. Reduced populations may take several decades to recover, even if no further degradation occurs (Service 2009b). Based on the 5-Year Review, there are nine known populations of northern riffleshell and four additional assumed populations that may or may not be extant. Of these 13 populations, four are thought to be reproducing populations. NiSource would potentially affect only one of these (the large Allegheny River population) and two are completely outside of the covered lands. NiSource has the potential to affect one population where reproduction is uncertain and one population that may or may not be extant. In other words, NiSource would potentially affect three of the 13 populations currently identified and only one of the four known to be reproducing.

NiSource and the Service anticipate both individual and potential population impacts to the northern riffleshell from acute and chronic impacts associated with NiSource activities. These impacts, over the life of the ITP, suggest that the impact of the taking of the northern riffleshell from NiSource activities will be greater than the estimated loss of individuals and habitat. This results from: (a) the potential impacts (including significant numbers of individuals) to one of the four known reproducing populations; (b) the potential for loss of one or more small isolated populations, which may be important for the long-term viability of the species; and (c) long-term sediment impacts to habitat, a stressor to which this species may be particularly vulnerable.

6.2.5.6 Compensatory Mitigation

NiSource will mitigate for the impact of take of northern riffleshell resulting from its actions in the covered lands. This take is anticipated to occur in two ways. The first is the impact of take that may result from direct loss of individuals or habitat from stream crossing activities employed to install new pipeline, or repair or replace existing pipeline. The second kind of take is aggregate, which would result primarily from sedimentation from non-aquatic activities within the watershed, and secondarily from loss of riparian habitat, and other similar comparatively minor and indirect impacts detailed above. Where the term "protection" appears below, please refer to Section 6.2 for a further definition and the requirements for securing conservation of mitigation lands and other real property interests.

Before mitigation occurs, NiSource must undertake restoration activities at certain impacted areas. Although these constitute minimization measures for the purpose of the MSHCP, the required mitigation discussed below, in part builds upon these efforts. In all cases where stream crossings occur, NiSource will restore the disturbed streambed and riparian area within its ROW resulting from its activities. Restoration will occur during the same construction season (next appropriate planting season for riparian restoration) as impacts unless there are extenuating circumstances and the Service is informed of those issues. The basic restoration will be conducted in accordance with standard industry specifications as defined in the ECS and required by FERC and other relevant regulatory agencies. This will involve, at a minimum, restoration of any impacts to the depth, flow, channel bottom, or banks as nearly as practical back to the pre-activity condition. Vegetation restoration must be with site-appropriate native species.

Mitigation at Restored Streambed and Riparian Areas

As the initial step in compensatory mitigation, NiSource will enhance the restored stream substrate within the construction zone to habitat that is optimal for northern riffleshell mussels. This would typically involve either replacement or importation of clean, appropriately sized material for mussel re-colonization. NiSource will also enhance, where feasible, any pre-construction deficiencies associated with the depth, flow, bank stability, or riparian vegetation that would be detrimental to mussel re-colonization, survival, and reproduction. NiSource expects the enhancement of the substrate to result in more opportunities for recruitment of northern riffleshell by providing suitable settling habitat for juvenile mussels. Enhancement serves as one component of NiSource's overall mitigation program, but does not wholly compensate for the impact of take because it has the potential to be disturbed in the future. Therefore, additional compensatory mitigation (riparian restoration) is required as discussed in detail below.

Mitigation for Aggregate Take Activities

In addition to the requirements above, NiSource will provide mitigation to compensate for sediment-producing and other indirect impact-producing activities (Aggregate Take). NiSource will initiate mitigation for Aggregate Take within the first seven years after the incidental take permit has been issued to ensure adequate and timely compensation for O&M activities in the watersheds where impacts would likely occur over the life of the ITP. Mitigation for Aggregate Take will focus on habitat impacts as a surrogate for individual take and use habitat protection/restoration as the mitigation option. The protection or restoration of riparian habitat is designed to reduce the sediment impacts to northern riffleshell by buffering occupied streams. NiSource expects this to result in improved survival and reproduction of mussels in the mitigation area.

Implement protection and restoration of riparian buffers associated with occupied northern riffleshell habitat within the Allegheny River or Big Darby Creek watersheds adjacent to existing northern riffleshell populations or another priority stream identified in collaboration with the Service. Mitigation should provide additional benefits to the species at the identified site (i.e., sites that are already secure, or at the other end of the spectrum, sites where there is little opportunity to improve the habitat, should not be considered). The total riparian area protected to mitigate for aggregate take will be 6.1 acres.

A 1:1 ratio is appropriate for this species because the aggregate impacts from NiSource activities to both the population and the habitat are expected to be comparatively minor.

Sideboards: (a) there must be a minimum 50-foot-wide to a maximum 150-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams generally should have wider buffers;[30] (b) the vegetative buffer must meet minimum NRCS standards - for water quality and riparian corridors (**Appendix L**); (c) at least 50% of the total riparian buffer must be restored (i.e., cropland or other highly erosive land use planted to meet NRCS standards - this 1:1 ratio of restoration to protection reflects the purpose of the aggregate take mitigation to address sediment impacts specifically); (d) instabilities in the riparian zone (e.g., gullies, bank erosion) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be minimal earth disturbance on the restoration sites; (e) individual mitigation sites must be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); (f) water quality, instream habitat, and instream connectivity must be

[30] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

evaluated in terms of long-term viability of the northern riffleshell population within the mitigation area; (g) mitigation projects must be completed no more than three years after initiation; and (h) riparian buffers must be permanently protected in fee or by easement (consistent with the template language in **Appendix P)**.

Mitigation When NiSource Relocates Northern riffleshell (AMM#1)

NiSource has the option described in AMM #1 to relocate mussels as part of a stream crossing project. If the relocation is successful, as discussed in AMM #1, Mitigation Option B would be required in addition to the enhancement and aggregate take mitigation described above. When implemented with the other required mitigation and in concert with mussel relocation described in AMM #1, and if the sideboards and Service guidelines are followed, this option would fully compensate for the impact of take by conserving mussels that would otherwise be killed or harmed. In addition, habitat at the relocation site will be protected and enhanced. NiSource can initiate this mitigation option at any time but not later than during the same period as a new project likely to result in take is started.

Find, relocate, and monitor all northern riffleshell and other mussels within the assemblage impacted by the project to a suitable site upstream or downstream of the impact zone, and restore riparian habitat at the site of relocation, or at an upstream location as near to the mussel relocation site as possible, at a 1:1 ratio of the acreage amount of in-stream habitat impacted.[31]

Sideboards: (a) follow the most current protocols for mussel location, transport, relocation, and monitoring, but the last monitoring cycle must occur no earlier than the fifth year of relocation; (b) there must be a minimum of 75% survival of relocated northern riffleshell mussels after five years or additional mitigation will be required; (c) if less than 75% survival rate for northern riffleshell is achieved at five years, NiSource will be responsible to implement riparian restoration at the ratios indicated in new construction take mitigation below, minus any riparian restoration completed for the relocation; (d) sideboards for riparian restoration will follow those described in sideboards for new construction mitigation below; (e) suitable habitat must meet basic mussel requirements of depth, substrate, flow, water quality, host fish presence, and riparian vegetation (existing or post-mitigation restoration); (f) suitability of a site will be determined in coordination with the Service; and (g) NiSource will provide a report to the Service one year after relocation and again after the fifth year post relocation on the status of the relocated northern riffleshell mussels.

Mitigation for New Construction Take when Northern riffleshell is not Relocated

In these instances, there will be two avenues to mitigation, Option A or Option B, below. Mitigation Option A will directly and immediately increase mussel populations by reintroducing captive-reared individuals to suitable habitat, or adding to

[31] A 1:1 ratio is appropriate because the primary thrust of the mitigation is the relocation of the mussels – the restoration is an additional step to improve what will already be suitable habitat (otherwise mussels could not be relocated there).

them to existing populations. Long-term population gains are also expected to accrue from reproduction of introduced mussels. Mitigation Option B will fully compensate for the impact of take by protecting and restoring the riparian zones that moderate water temperature, provide nutrient inputs, and reduce sediments and other contaminants along occupied streams, thereby improving the quality of the habitat. NiSource expects this to translate into increased survival and reproduction of mussels in the mitigation area.

NiSource will be responsible to implement either Option A or B for any discrete action that results in take, although over several years and multiple projects, both options might be employed. For Years 1-3 of the permit, the Service has determined that the priority for northern riffleshell is Option A.

After that, the selection of which mitigation option NiSource will implement to compensate for New Construction Take will be based upon the highest need of the species at the time the mitigation becomes necessary. The Service will make the final determination on which of the options best meets the needs of the species prior to NiSource take in any year (*see* Chapter 5).

Mitigation for New Construction Take of northern riffleshell must follow the mitigation option guidelines and sideboards outlined below.

Mitigation Option A: Propagate and Augment, Expand, or Reintroduce Northern riffleshell:[32] Implement propagation technology and augment, expand or reintroduce northern riffleshell to previously identified and Service approved suitable habitat within its historic range inside the NiSource project area. The number of individuals required for successful mitigation has at least three important components. The first is identifying a site that provides the best possible habitat conditions and meets biogeographic requirements (e.g., to establish a new population). The second requirement involves a minimum number of individuals that must be placed in the habitat to provide the best chance for long-range survival and reproduction of the augmented, expanded, or reintroduced mitigation population. Crabtree and Smith (2009) found mean abundances of northern riffleshells in a healthy system (French Creek) at sites they considered viable ranging from 336–16,633 individuals. NiSource impacts will likely be small by comparison and initial mussel numbers at the mitigation site (s) will typically fall toward the lower end of this range (using the mitigation ratios outlined below). The third component is age of the individuals placed into the habitat. Individuals that are 2-3 years old have higher survival rates than younger, smaller mussels (Crabtree and Smith 2009). In fact, there is precedent for losing entire cohorts of thousands of first year mussels (Bob Anderson personal communication 13 September 2010). NiSource will focus its mitigation effort on rearing mussels that have a high probability of survival. The goal will be to establish a stable mitigation site(s)

[32] By propagating significant numbers of juveniles in laboratory or hatchery settings, population augmentation, expansion, or reintroduction into historical habitats will become much more feasible (see the Kentucky Freshwater Mollusk Controlled Propagation Plan McGregor 2005 for a good discussion of this process); and in 2006, Dr. Tom Watters at The Ohio State University was awarded a Section 6 Grant to begin this work (Service Region 3 Website http://www.fws.gov/midwest/Endangered/grants/2006/s6OH_E-10-R_2006.html).

that over time foster northern riffleshell reproduction and expand. NiSource will be permitted to mitigate for impacts at one or more sites that occur within any 4-digit Hydrologic Unit at a mitigation site within that 4-digit Hydrologic Unit provided a suitable mitigation site as agreed to by the Service is available. The Service may permit (or require) mitigation for impacts occurring outside the 4-digit Hydrologic Unit where the mitigation site resides on a case by case basis.

NiSource must ensure a ratio of 2.5:1 mussels introduced into suitable stream as defined below for each mussel taken (either documented or estimated) from the Allegheny River or Big Darby Creek and a ratio of 2.5:1(x1.5):1 ratio for mussels taken in the Elk River to compensate for the variable impact of take of that population. A multiplier of 1.5 is used for all mitigation to compensate for the failure of some of the introduced animals to survive the transplanting process, however, NiSource will ensure through follow-up surveys that the mitigation site (s) maintain at minimum the number of mussels that reflect the baseline ratio of mussels restored to those taken (i.e., in the case of impacts to a stable/recruiting population, 2.5:1; and in the case of impacts to a small isolated population 3.75:1).

Stable/Recruiting Populations 2.5 (x1.5):1 = 3.75:1

Small Isolated Populations 2.5 (x1.5) (x1.5):1 = 5.625:1

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg. 56916-56922, September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the entity will work with the Service to ensure that there exists or will exist in the near future a suitable site for reintroduction, expansion, or augmentation of a northern riffleshell population with the propagated mussels (the restoration site must already be sufficiently protected as determined by the Service to minimize risk to the reintroduced mussels or the site must be protected as determined necessary by the Service as part of the mitigation); (d) the reintroduction, expansion, or augmentation must occur in one of the following priority watersheds: Big Darby Creek (OH); Elk River (WV), French Creek (PA), or Allegheny River (PA), or other suitable site approved by the Service; (e) all introduced mussels will be a minimum of 2-3 years old; (f) the mitigation must include monitoring of populations and habitat conditions (**Appendix L**) to evaluate the effort and assess the long-term viability of the augmented/expanded/reintroduced northern riffleshell population(s); and (g) projects must be completed either before impacts to northern riffleshell occur or within two years after impacts.

Mitigation Option B: Protect and Restore Existing Northern Riffleshell Habitat
Protect and restore protect riparian buffers associated with occupied northern riffleshell habitat. Because of the impact of take on this species, the mitigation amount required is a 2.5:1 ratio of the acreage amount of instream habitat impacted by stream crossing(s) of the Allegheny River (PA) or Big Darby Creek (OH). For stream crossings of the Elk River (WV), the 2.5:1 mitigation ratio will be increased by a multiplier of 1.5 to compensate for greater impacts to small isolated populations that may have less resilience. For impacts to streams not listed here, NiSource in coordination with the Service will determine whether the population is stable and recruiting or small and

isolated and apply the appropriate mitigation ratios. For all riparian restoration, a multiplier of 3 will be used to account for the time it takes riparian restorations to mature, stabilize, and become fully functional.

Stable/Recruiting Populations

Protection Ratio = 2.5:1

Restoration Ratio = 2.5 (x3):1 = 7.5:1

Small Isolated Populations

Protection Ratio = 2.5 (x1.5):1 = 3.75:1

Restoration Ratio = 2.5 (x3) (x1.5):1 = 11.25:1

Sideboards: (a) habitat acquired or restored must benefit an extant population of northern riffleshell; (b) projects must be in one or more of the following priority watersheds: Green River (KY), Little Darby Creek (OH), Elk River (WV), French Creek (PA), Allegheny River (PA) or other high priority watershed identified by the Service; (c) projects can be completed before take of northern riffleshell occurs but not later than two years after the take occurs; (d) there must be a minimum 50-foot-wide to maximum 150-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams should generally have wider buffers;[33] (e) instabilities in the riparian zone (e.g., gullies, bank erosion, etc.) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be limited earth disturbance on the restoration sites; (f) the vegetative buffer must meet minimum NRCS standards for water quality and riparian corridors (**Appendix L**); (g) at least 25% of the total riparian buffer must be restored (i.e., cropland or other highly erosive land use planted to meet NRCS standards); and (h) individual mitigation sites must be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); (i) habitat acquired or restored must be permanently protected (*see* Section 6.0 for the definition of protection) in fee or by easement following easement guidelines (**Appendix P**).

Mitigation Options for Possible Future Consideration

These options are not fully documented since they would not be immediately available to NiSource. These measures are not deemed acceptable mitigation at this time for various reasons including the availability of complete science to implement them. At the time of consideration, the Service and NiSource would determine whether a major amendment would be required before they could be implemented. The amount of mitigation required for these options would be determined as part of the amendment authorizing their use.

[33] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

Identify Augmentation, Expansion, or Reintroduction Streams and Conserve, Restore, and Enhance Habitat for Augmentation, Expansion, or Reintroduction: Using Service approved methodology, identify sites within the range of the northern riffleshell that with restoration could be suitable for augmentation, expansion or reintroduction efforts and protect, and where necessary restore, streambed and riparian habitat specifically for the successful augmentation, expansion, or reintroduction of northern riffleshell mussels.

Sideboards: (a) sites for this mitigation should be selected and site plans developed based factors including extant northern riffleshell population size, demographic composition, and population trend data (where applicable), potential site threats, habitat suitability, and any other limiting factor that might decrease the likelihood of long-term benefits from population augmentation, expansion, or reintroduction efforts (*see* McGregor 2005 for work initiated in Kentucky for clubshell and other mussels); (b) work will be coordinated with the Service at the time initiated; (c) final products will be directly applicable to Service or other efforts to augment, expand, or reintroduce northern riffleshell mussels; (d) habitat acquired or restored must be permanently protected; (e) habitat acquired or restored must be tied to and benefit an augmented, expanded, or reintroduced population of northern riffleshell; and (f) projects must be completed either before impacts to northern riffleshell occur or within two years after impacts.

Develop Genetic Information for Conservation of Northern riffleshell: The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations developing genetic information to determine the relationship of northern riffleshell mussels in the Allegheny/Great Lakes populations and those remaining elsewhere in the Ohio River basin and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow all Service guidance and regulations on acquiring and analyzing genetic information; (b) the products developed will be directly applicable to augmentation/reintroduction of northern riffleshell; and (c) projects must be completed either before impacts to northern riffleshell occur or within two years after impacts.

Augment/Reintroduce Northern riffleshell: The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations who are augmenting or expanding northern riffleshell populations or reintroducing northern riffleshell into their historic range and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg. 56916-56922, September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the reintroduction/expansion/augmentation will occur in a suitable site approved by the Service; (d) the mitigation must include monitoring of populations and habitat conditions to evaluate the effort and assess the long-term viability of the augmented/expanded/reintroduced northern riffleshell population(s); and (e) projects must be completed either before impacts to northern riffleshell occur or within two years after impacts.

6.2.5.7 Additional Actions Available to NiSource to Benefit the Species

NiSource is committed to implement AMMs and mitigation. In addition there are other important actions that NiSource may choose to initiate on its own or in concert with state agencies, non-government organizations, or other entities to further benefit this species. These would not in any way alter the requirements for compensatory mitigation, but may fit into NiSource's landscape-level approach to conservation.

Fund research[34]

Identify and map activities or practices within each ecosystem that may affect the northern riffleshell and its host fish at known sites, and at potential augmentation/reintroduction sites.

Determine contaminant sensitivity for each life stage, particularly sedimentation.

Surveying and monitoring

Complete surveys of the Green River, Elk River, and Big Darby Creek to determine if northern riffleshell are still extant in these streams.

6.2.6 Fanshell Mussel

The fanshell mussel (*Cyprogenia stegaria*) was listed as an endangered species by the Service on June 21, 1990 (Service 1990a). A recovery plan was published in 1991 (Service 1991a). The fanshell has been reduced to only a few stable populations. Most of the remaining populations are small and geologically isolated. Fanshell were once widespread throughout their historical range, but have become extremely rare, and it is believed that only three reproducing populations are currently in existence (NatureServe 2007a). An estimated 471.2 miles of rivers throughout the United States currently contain populations of fanshell, which represents 10% of its historic range (Jones and Neves 2002).

Impacts and potential resulting take of fanshell are likely to occur in the following counties: Bracken, Nicholas, Pendleton, and Robertson counties, Kentucky; Coshocton, Meigs, Morgan, Muskingum, and Washington counties, Ohio; Hardin County, Tennessee; and Jackson and Kanawha counties, West Virginia.

Adult freshwater mussels are filter-feeders, siphoning phytoplankton, diatoms, and other microorganisms from the water column. Mussels tend to grow relatively rapidly for the first few years, and then their growth slows appreciably at sexual maturity (when energy is being diverted from growth to reproductive activities). There

[34] Refer to the *National Strategy for the Conservation of Native Freshwater Mussels* compiled by the National Native Mussel Conservation Committee (1998) for additional information on conserving North America's imperiled mussel fauna. Shute et al. (1997) also outlined management and conservation considerations for imperiled mussels and other aquatic organisms, while incorporating ecosystem management into the equation.

is ongoing discussion among scientists concerning the life span of mussels, but as a group, they are generally acknowledged to be long-lived organisms. Little information regarding the age of fanshell exists, but studies have found age ranges of fanshell from 6 to 26 years (Jones and Neves 2002).

Most mussels, including the fanshell, have separate sexes. Males expel clouds of sperm into the water column, which are drawn in by females through their incurrent siphons. Fertilization takes place internally, and the resulting zygotes develop into specialized larvae termed glochidia inside the water tubes of their gills.

The minute bivalve glochidia develop over a period of days to months. This species is thought to be a long-term brooder that holds glochidia over-winter for release in the spring (Jones and Neves 2002). Glochidia must come into contact with a specific host fish, usually within 24 hours, in order for their survival to be ensured. Without the proper host fish, the glochidia will perish (Service 1994). After a certain amount of time (from hours to weeks), depending on water temperature and species, the glochidium transforms to a juvenile and drops off the host fish. Newly metamorphosed juveniles then drop off to begin a free-living existence on the stream bottom. Unless dropped off in suitable habitat, they will die. Thus, the complex life history of the fanshell and other mussels has many weak links that may prevent successful reproduction and/or recruitment of juveniles into existing populations (NatureServe 2007a).

In part because fanshell, like virtually all freshwater mussels, relies on this parasitic larval stage, it probably experiences very low annual juvenile survival. Jantzen et al. (2001) report greater than 99 percent mortality for glochidia. Though not specific to fanshell, this estimate and the estimates of survival that follow are likely typical for fanshell and most mussels in North America. Probability of survival from mussel glochidium to benthic recruit has been estimated to range from 1×10^{-6} (Young and Williams 1984) to 39×10^{-6} (Haag 2002). Transition from glochidium to juvenile represents a very large bottleneck—a single female's reproductive output is reduced from thousands of glochidia to <1 offspring per year (Berg, et al. 2008). The low fecundity suggests the need for a large population to produce a large annual cohort (Musick 1999).

Known host fish of the fanshell include: mottled sculpin (*Cottus bairdi*), banded sculpin (*Cottus carolinae*), greenside darter (*Etheostoma blennioides*), snubnose darter (*Etheostoma simoterum*), banded darter (*Etheostoma zonale*), tangerine darter (*Percina aurantiaca*), blotchside logperch (*Percina burtoni*), logperch (*Percina caprodes*), and Roanoke darter (*Percina roanoka*) (Service 2007b).

The fanshell inhabits the shoals and riffles of medium to large rivers, often in relatively deep water (Service 2003). It has been reported primarily from relatively deep water in sandy or gravelly substrate with moderate to strong current (Service 2003). Some accounts also have this species occupying shallower water habitats (NatureServe 2007a; Parmalee and Bogan 1998).

6.2.6.1 Activities and Impacts Analysis

Conservation of the fanshell is particularly problematic, in part because as Jones and Neves (2002) noted, even the more robust populations of this species seem to occur at low densities. The Service has identified impacts of impoundments, navigation projects, pollution, and habitat alterations, such as gravel and sand dredging, that directly affected the species and reduced or eliminated its fish host as the major contributors to the decline of this species (Service 1991a).

The main threats to the fanshell are habitat degradation and a decline in water quality, impoundments, stream flow alteration, habitat alteration, dredging, and navigation projects affecting both the species and its host fish (Service 1991a). Other impacts to the mussel population includes runoff from oil and gas exploration, wastewater discharges and water supply development, and land-use practices such as coal mining and spills from a riverside coal-fired power plant (Service 2007b). The population in the Green River is somewhat protected in Mammoth Cave National Park, but has been threatened by runoff from oil and gas exploration and production sites, and by an upstream reservoir (Service 1990a, Service 1991a). The steady decline of naiads in the Clinch River has been attributed to land-use practices along the river, as well as impacts from coal mining and spills from a riverside coal-fired power plant resulting in two mussel kills (Service 2007b). The Licking River population of fanshell has been threatened by the effects of wastewater discharges and plans for water supply development. Incidental take of the fanshell where it is co-located with commercially harvested mussel beds is also attributed to its decline (Service 1990a, Service 1991a).

There is a growing belief that emissions of greenhouse gases are linked to climate change. The extent of warming and the resulting changes in rainfall patterns that may occur is not known with certainty at this time. NiSource has addressed the potential for impacts to fanshell from water temperature increase and other possible manifestations of climate change in Chapter 10.

Existing data (NatureServe 2007a) indicate that many of the remaining populations are remnant and comprised of older individuals. These small, isolated populations are particularly vulnerable extirpation due to losses resulting from events such as droughts, floods, toxic spills, or other stochastic events.

NiSource Activities Potentially Affecting Fanshell

NiSource activities that may affect fanshell are hereafter characterized as those that potentially cause take and derive: (a) from the stream crossing actions (affecting the streambed and riparian corridor), and (b) upland-disturbing (sediment-related) *aggregate impacts*. Aggregate impacts are defined as those impacts that derive from multiple NiSource activities that individually do not rise to the level of take, but taken together over time may result in negative effects that NiSource has agreed to compensate for. One example would be the combined sediment impacts of access road maintenance, culvert replacement, grading, and restoration efforts over the 50-year permit duration.

Pitt, Clark, and Lake (2007) evaluated a study of the Menomonee River watershed in Wisconsin. They found that the 3.3% of the area disturbed by construction contributed the greatest amount of sediment at the river mouth compared to any other land use (50% of all the suspended sediments). In the southeast Wisconsin Regional Planning area the same authors found that construction covered only 2% of the surface area, but contributed 26% of the sediment to inland waters. By comparison, agriculture was 72% of land use and contributed only 45% of the sediments. Owens et al. (2000) found that in Wisconsin even small (0.34 and 1.72 acres) construction sites had rates of erosion that were 10 times those of typical rural or urban land uses. Various factors including topography, rainfall intensity, soil type, soil compaction, time of year, and erosion control measures influence the rate. Both studies recognize that even small construction projects (for reference National Pollutant Discharge Elimination System Phase II regulations regulate sites above one acre in urban areas) and small overall construction footprints in a watershed can cause significant detrimental impacts to local waterbodies.

Although the effects from many NiSource O&M and new construction activities are sediment related (e.g., grading, regrading, tree clearing, repair, culvert replacement,), it is not expected that any of these activities, as routinely implemented, will result in large single discharges of sediment. In addition, negative consequences are likely lessened because most covered activities would be outside of urban areas where storm sewers carry sediments directly to receiving waters and vegetated buffers are less available. NiSource also implements multiple sediment control measures on their ground-disturbing projects (see the ECS, **Appendix B**). However, none of these measures is 100% effective and effectiveness varies even with properly implemented measures. For example, properly installed silt fences in Alabama did not achieve sediment reduction to the same level as an undisturbed reference site (Pitt, Clark, and Lake 2007). Non-point sediment impacts are difficult to measure and impacts may occur as a result of numerous activities over many years. Nevertheless, NiSource believes that these activities, although reduced to the maximum extent practicable, may result in harm and harassment of fanshell.

The following O&M activities may impact fanshell: pipeline corridor presence, vehicle operation, access road culvert replacement, access road maintenance, off-ROW clearing, mechanical repair and fill in ROW, in-stream stabilization, tree clearing, herbicide application, hydrostatic testing, pipeline abandonment, and well abandonment. These activities may result in a variety of stressors to fanshell including: sedimentation, chemical contaminants, increased water temperature, crushing, substrate compaction, altered flow, burying substrate, and introduction of invasive species (**Appendix M, Table 6.2.6.1-1**).

These stressors, in turn, may negatively impact the fanshell in a variety of ways. Sedimentation at levels that would be expected from O&M activities may degrade habitat and could over time disrupt fanshell biology or ecological relationships (e.g., host fish). Chemical contaminants have some potential to cause harm or mortality to mussels, but could also affect algae (fertilizers and herbicides) and plankton that provide food for mussels and host fish and affect water quality. The loss of riparian habitat reduces shade on the stream potentially altering water temperature and may also affect trophic function by reducing inputs into the stream from the overhanging trees. Crushing is self explanatory. Since mussels are benthic organisms, substrate compaction can make habitat less suitable for both adult and juvenile mussels. Altered stream flow can change habitat and food availability. Similarly, burying habitat can fill the interstitial spaces in the sands and gravels, and preclude normal processes when adult mussels burrow into the substrate. This can be even more harmful to juvenile mussels that immediately burrow into the substrate after dropping from host fish. The introduction of invasive species primarily involves the accidental introduction of zebra mussels or other harmful invasives into habitat previously not contaminated or contaminated at a low level with these invasives. Where habitat is suitable for large populations of zebra mussels (typically water with less flow like lakes or navigation pools in large rivers), zebra mussels have the potential to eliminate native mussel populations.

New construction activities that may impact fanshell are: wet-ditch crossing activities, access road construction, grading, HDD, hydrostatic testing (withdrawal and discharge), re-grading, fertilizer application, erosion control devices, herbaceous and woody vegetation clearing, stream bank contouring, installation and removal of stream crossing structures, trenching-related impacts, waste pits, minor spill events (major spill events are addressed outside the context of the MSHCP), in-stream stabilization, and vegetation disposal. The following stressors are associated with new construction activities: sedimentation, altered flow, chemical contaminants, entrapment, increase in water temperature, water level reduction, introduction of invasive species, substrate compaction, and crushing (**Table 6.2.6.1-1**).

The stressors from new construction mostly overlap those of O&M and may have the same impacts, although in some cases the impact could be acute rather than chronic (e.g., sedimentation from stream crossing activities could likely have an acute effect on mussels immediately downstream, while sedimentation from the pipeline corridor presence, or access road replacement, could likely occur slowly over the 50-year life of the permit). Entrapment from the withdrawal of water for hydrostatic testing poses a slight risk to juvenile mussels, gametes that are released into the water column during reproduction, and also to glochidia which could be entrapped if small host fish were sucked through or trapped during water withdrawal. NiSource expects that take will be very limited in terms of both amount and level of take with implementation of mandatory AMMs. Water level reduction could impact fanshell occurring in smaller streams, particularly if withdrawal for hydrostatic testing were to occur during already low flow.

The most direct threat involves excavation for installing or repairing pipelines across inhabited streams. If present, this could cause direct lethal take of fanshell by crushing and excavating individuals, and by causing lethal and sub-lethal (harassment and harm) sediment impacts to individuals downstream of the work area. Access road construction could have similar impacts to individuals. In-channel construction (e.g., in-stream stabilization or bank contouring) could also take individuals.

An alternative to open-cut excavation is HDD. However, under certain conditions, HDD can cause fracturing of the stream bottom. This can result in release of drilling muds from the bore hole into the stream (frac-out) which could impact fanshell. Drilling muds are composed primarily of water and bentonite and the slurry or drilled solids cut from the bore hole. More advanced drilling muds typically contain various additives including long-chain polymers and detergents. In low pH environments, soda ash is sometimes added to raise the pH (in the bore hole) to an optimum level of about 9 (Najafi and Gokhale 2005). No studies were found that have evaluated the toxicity of HDD drilling muds to mussels. However, freshwater mussels appear to exhibit more sensitivity to some pollutants than do the organisms typically used in toxicity testing. As a result, some of the water quality criteria established by the EPA to protect aquatic life may not be protective of mussels (Service 2009a). It is likely that in high concentrations additives used to raise pH and detergents could cause harm. Minor frac-outs, however, which would involve very small quantities of drilling muds (and even smaller amounts of potentially toxic materials) would, based on our experience, be similar to background levels of sediment from natural events and not be expected to cause take (harm or mortality) of mussels. Any spill that would result in observed take would be handled outside the context of the MSHCP.

Impacts to fanshell habitat may also be a consequence of both O&M and new construction activities. Activities involving excavation in the stream channel (e.g., installing or removing pipeline) could have significant impacts to both the habitat in the construction area and downstream. Impacts may involve acute sediment impacts that, as described above, could render the habitat unsuitable for adult or juvenile mussels. NiSource's expectation is that some of the habitat would likely recover over a period of months (Villella 2005), but some impacts could persist for months or years until such time as high flows or storm flows moved the sediment downstream. Fine sediments that clog interstitial spaces could make habitat unavailable for mussels. Other activities (e.g., installation of in-stream stabilization, stream bank contouring, pipeline presence) could have long-term direct impacts on habitat and long-term indirect impacts through altered flow.

The activities that occur within the impact zone of the crossing action (e.g., crushing from equipment preparing a site for excavation, in-stream restoration) are calculated in the algorithm for crossing actions used to estimate take (described in Section 6.2.6.4 below). The remaining impacts are classified as aggregate and involve: (1) low-level sedimentation impacts to mussels and mussel habitat and host fish and host fish habitat from the pipeline corridor presence; ROW mechanical repair; ROW fill; vegetation clearing; access road maintenance, upgrading, and construction; installation and maintenance of culverts under access roads; grading; restoration (bank contouring); regrading, stabilization and restoration; low-level frac-out; open trenches; trench dewatering; trench water diversion structures; vehicle operation; waste pit berms; well abandonment (restoration); (2) chemical contaminants from hydrostatic testing, regrading, stabilization, and restoration (fertilizer); SPCC (spill event); (3) altered flow from in-stream stabilization measures; pipeline corridor presence; (4) increase in water temperature from pipeline corridor presence; tree and shrub clearing; and (5) substrate compaction from vehicle operation. These are chronic low-level impacts that combine together or with non-NiSource impacts to potentially degrade fanshell habitat and cause impacts over the proposed 50-year permit life.

An adaptive management program is necessary for a species with significant uncertainties and high levels of risk. *See* Section 7.6.4.4 for the proposed adaptive management program for the fanshell.

6.2.6.2 Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicant should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; *see also* the Service's HCP Handbook at 3-20 (stating "HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery tools"; "contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the fanshell. With these general goals in mind, the main fanshell conservation objective for ROW maintenance and O&M activities is to avoid or minimize impacts to known or presumed occupied habitat (e.g., minimize impacts to stream banks and bed) and avoid/minimize impact to fanshell (e.g., crushing, killing, sedimentation). The main fanshell conservation objective for all construction projects (i.e., off existing ROW) is to avoid or minimize impacting known or presumed occupied habitat (e.g., through project planning, use of trenchless installation), and avoid/minimize impact to fanshell (e.g., crushing, killing, sedimentation). Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that can not be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 – Contribute toward management of fanshell mussel populations and/or their habitats within the Ohio River Basin, in support of federal and state recovery efforts. Because so few populations exist, it is essential to the survival and eventual recovery of this species that extant populations and occupied habitat be given priority for protection.

Rationale: The Fanshell Mussel Recovery Plan (Service 1991a) calls for protecting and restoring a minimum of 12 distinct viable populations within the Ohio River Basin. This freshwater mussel historically occurred in the Ohio River and many of its large tributaries in Pennsylvania, West Virginia, Ohio, Indiana, Illinois, Kentucky, Tennessee, Alabama, and Virginia. A viable population is defined as a naturally reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural environmental changes. Theoretical considerations by Franklin (1980) and Soule (1980) indicate that 500 breeding individuals represent a minimum population level (effective population size) that would *contain sufficient genetic variation to enable that population to evolve and respond to natural habitat changes. The populations shall be distributed throughout the Ohio River basin as follows: two in the upper Tennessee River system, two in the middle to lower Tennessee River system, one in the Cumberland River system, three in a Kentucky tributary to the Ohio River other than the Cumberland River, one in the Allegheny River system, one in the lower Muskingum or Walhonding River system, one in the Kanawha River system, and one in the Wabash River system. These populations must be separated to the extent that it is unlikely that a single event would eliminate or significantly reduce more than one of these populations.*

Objective 1 – Where habitat has been degraded, restore and/or protect riparian habitat specifically for the conservation of fanshell mussels.

Objective 2 - Where habitat has been degraded, restore and/or protect water and substratum quality.

Objective 3 - Propagate, augment, enhance and/or restore fanshell mussels where appropriate where habitat conditions, genetic information, and other necessary parameters indicate this is an appropriate action.

Objective 4 - Partner with stakeholders having responsibility and/or expertise in fanshell mussel conservation and recovery, and contribute resources to those efforts and programs in priority areas for mussel recovery.

Goal 2 - Determine, through research, feasible mechanisms to enhance extant populations, including augmenting and reestablishing fanshell mussels into historic habitats and implement those mechanisms consistent with Goal 1.

Rationale: Mussel propagation technology and subsequent translocation are fast becoming important tools in the recovery of native populations (Garner 1999). Most existing populations are likely below the number needed to maintain long-term viability. These populations may be able to expand naturally if environmental conditions are improved. However, some populations may be too small to recover and may need to be supplemented to reach and maintain a viable size.

Objective 1 - Identify and prioritize streams suitable for augmentation, translocation, and/or reintroduction, and those most easily protected from further threats.

Objective 2 - Develop necessary genetic information for propagation and reintroduction of fanshell mussels.

Goal 3 - Develop and implement a program to monitor population levels and habitat conditions.

Rationale: During and after conservation actions are implemented, the status of the species and its habitat must be monitored to assess any progress toward recovery. This should be conducted on a biennial schedule.

6.2.6.3 Measures to Avoid and Minimize Impacts

These measures apply to “may affect” counties in Section 6.2.6 and the maps in **Appendix G, Figure 6.2.6.3-1** for the fanshell mussel.

These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Measures in *italic* font text will be applied on a case-by-case basis depending on the requirements of the activity. These requirements include consideration of customer and business needs, practicality, and effectiveness as more fully described in Chapter 5 of this MSHCP. Details on selecting the appropriate waterbody crossing method are provided in Section 5.2.1.1.

Surveys to Evaluate Presence and Relocation of Species in NiSource Action Areas

1. A survey can be conducted to determine the presence of this mussel species. Mussel survey protocols designed to detect endangered mussels that often occur in low densities; protocols as of 2009 are provided in **Appendix L**. Survey methodologies must be evaluated at minimum every five years and be updated to the most effective survey methods currently available. If the most current methodology implemented by a biologist, qualified to conduct the survey, does not indicate the presence of the species, it will be classified as unoccupied habitat and the AMMs will not be mandatory.[35]

If a survey is not completed, presence will be assumed. In that case, all suitable habitat would be treated as occupied, and all mandatory AMMs must be followed. NiSource or its contractors will follow the Service approved relocation plan as referenced below. Survey and relocation may be implemented in the same time period (as one action) as long as both survey and relocation protocols are followed (general relocation protocols are identified in **Appendix L**, but may be modified in conjunction with Service Field Office based on conditions).

Relocation may be implemented only if: (1) all required permits are in place, (2) a Service-approved relocation plan documenting all relevant protocols including how and where the mussels will be moved is in place, (3) a contingency plan is in place to conduct additional consultation with the Service should the actual field survey not reflect the conditions identified in the approved relocation plan, and (4) a monitoring program to evaluate the effects of the relocation is in place. Relocation will include at least all individuals of the federally endangered species identified in the impact area and may include other species based on the assessment of the Service Field Office and other regulatory agencies. A copy of the survey and any reports will also be included in the annual report submitted to the Service.

Pre-Construction Planning: Preparation of an EM&CP

2. A detailed EM&CP will be prepared for any activity with potential effects (e.g., streambed or stream bank disturbance, impacts to riparian habitat, activities causing sediment) within 100 feet of the ordinary high water mark of occupied mussel habitat. The plan will incorporate the relevant requirements of the NGTS ECS and include site-specific details particular to the project area and potential impact. The waterbody crossing will be considered "high-quality" for the purpose of preparing this plan regardless of the actual classification. The plan will be strongly oriented towards minimizing stream bed and riparian disturbance (including minimization of tree

[35] However, NiSource may implement some of these measures if appropriate to protect potentially suitable habitat.

clearing within 25 feet of the crossing [**Figure 24, ECS**]), preventing downstream sedimentation (including redundant erosion and sediment control devices that would be designed to protect mussel resources as appropriate), and weather monitoring by the Environmental Inspector to ensure work is not begun with significant precipitation in the forecast. The plan will comprehensively address all activities needed to complete the work and minimize take of mussels in occupied habitat including crossing the streams during dry periods when practical and using dry-ditch crossing techniques for intermittent streams leading to mussel habitat. The EM&CP will include the frac-out avoidance and contingency plans described in AMM #3 below. The EM&CP will also include a sediment control component for uplands that drain to and impact occupied habitat. Detailed erosion control plans will be developed specific to slopes greater than or equal to 30 percent leading directly to occupied habitat. These plans will include techniques such as hard or soft trench plugs, temporary sediment barriers, a wider trench at the slope base, and/or temporary slope drains (plastic). In areas with less than a 30 percent slope, ECS and AMM erosion control measures protective of mussels will be implemented. The plan will be approved in writing by NiSource NRP personnel prior to project implementation and will include a tailgate training session for all on-site project personnel to highlight the environmental sensitivity of the habitat and any mussel AMMs which must be implemented.

Streambed Construction

3. For activities in occupied habitat, install new or replacement pipelines and major repairs under the river bottom using HDD or other trenchless methods rather than open trenching unless the crossing evaluation report prepared in accordance with Section 5.2.1.1 and **Appendix J** indicates otherwise. Drilling should be carefully undertaken and a plan should be in place to minimize and address the risk of in-stream disturbance due to frac-outs. The plan should also specifically reference mussel resources in the vicinity of the crossing as a key conservation concern and include specific measures identified in the NGTS ECS, from standard industry practices, or other mutually agreed-upon practices to protect this resource. The plan will also include a frac-out impact avoidance plan that will evaluate the site in terms not only of feasibility of conducting HDD, but the likelihood of large scale frac-out and its effects on mussels, and actions to address a large scale frac-out in occupied habitat. The plan should also consider the potential effects on mussels if drilling fluids are released into the environment. The plan must contain all information required for a FERC Section 7(c) filing at a minimum.

If, after detailed engineering studies (e.g., geotechnical, physiological, topographical, and economic), it is determined (and agreed to by NRP personnel) that an HDD is not feasible, a report will be prepared and included in the annual report submitted to the Service. However, due to the potentially significant amount of take that might occur for Ohio River crossings, open trenching in this river is not a “covered activity” as part of the NiSource MSHCP.

4. Install pipeline to the minimum depth described in the ECS and maintain that depth at least 10 feet past the high water line to avoid exposure of pipeline by anticipated levels of erosion based on geology and watershed character. Additional distance may be required should on-site conditions (i.e., outside bend in the waterbody, highly

erosive stream channel, anticipated future upstream development activities in the vicinity, etc.) dictate a reasonable expectation that the stream banks could erode and expose the pipeline facilities. Less distance may be utilized if terrain or geological conditions (long, steep bank or solid rock) will not allow for a 10-foot setback. These conditions and the response thereto will be documented in the EM&CP and provided as part of the annual report to the Service.

5. For repairs in occupied habitat, do not install in-channel repairs (bendway weirs, hardpoints, concrete mats, fill for channel relocation, or other channel disturbing measures), except when measures in AMM #3 above are not feasible from an engineering design perspective, and then, only in conjunction with a stream restoration plan based on Rosgen (*see* Wildland Hydrology 2009 http://www.wildlandhydrology.com/html/references_.html) or other techniques mutually agreed upon by NiSource and the Service that result in no direct or lethal take of listed mussels.

6. Conduct replacements/repairs from a lay barge or temporary work bridges of the minimum length necessary to conduct the replacements/repairs rather than operating heavy equipment (e.g., backhoes, bulldozers) in-stream. Temporary construction and equipment bridges are not to be confused with stone or fill causeways with pipe structures, which should not be employed in known or presumed occupied waterbodies.

7. Remove equipment bridges as soon as practicable (this is typically interpreted to be a few days to a few weeks unless there are extenuating circumstances) after repair work and any site restoration is completed

8. As part of the routine pipeline inspection patrols, visually inspect all stream crossings in occupied habitat at least yearly for early indications of erosion or bank destabilization associated with or affecting the pipeline crossing that is resulting, or would before the next inspection cycle, likely result in sediment impacts to mussel habitat beyond what would be expected from background stream processes. If such bank destabilization is observed, it will be corrected in accordance with the ECS. Follow-up inspections and restabilization will continue until the bank is stabilized (generally two growing seasons).

Stream Bank Conservation

9. Do not construct culvert and stone access roads and appurtenances (including equipment crossing) across the waterbody or within the riparian zone. Temporary equipment crossings utilizing equipment pads or other methods that span the waterbody are acceptable provided that in-stream pipe supports are not needed.

10. For equipment crossings of small streams, use half pipes of sufficient number and size that both minimize impacts to stream bed and minimize flow disruption to both upstream and downstream habitat (**ECS, Figure 22**).

11. *Reserved.*

Pipeline Abandonment

12. Abandon pipelines in place to avoid in-stream disturbance that would result from pipeline removal unless the abandonment would be detrimental to endangered mussels.

Contaminants

13. As described in the ECS section on "Spill Prevention, Containment and Control," site staging areas for equipment, fuel, materials, and personnel at least 300 feet from the waterway, if available, to reduce the potential for sediment and hazardous spills entering the waterway. If sufficient space is not available, a shorter distance can be used with additional control measures (e.g., redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials). If a reportable spill has impacted occupied habitat:

a. follow spill response plan; and
b. call the appropriate Service Field Office to report the release, in addition to the National Response Center (800-424-8802).

14. Ensure all imported fill material is free from contaminants (including washed rock or other materials that could significantly affect the pH of the stream) that could affect the species or habitat through acquisition of materials at an appropriate quarry or other such measures.

15. For storage well activities, use enhanced and redundant measures to avoid and minimize the impact of spills from contaminant events in known or presumed occupied streams. These measures include, for example, waste pit protection, redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials, and a spill response plan provided to the Service as part of the annual report. These measures will be included in the EM&CP prepared for the activity.

16. Do not use fertilizers or herbicides within 100 feet of known or presumed occupied habitat. Fertilizer and herbicides will not be applied if weather (e.g., impending storm) or other conditions (e.g., faulty equipment) would compromise the ability of NiSource or its contractors to apply the fertilizer or herbicide without impacting presumed occupied mussel habitat. The EM&CP prepared for this activity (AMM #2 above) will document relevant EPA guidelines for application.

Withdrawal and Discharge of Water

17. Hydrostatic test water and/or water for storage well O&M will not be obtained from known or presumed occupied habitat unless other water sources are not reasonably available. To prevent desiccation of mussels, water from known or presumed occupied habitat will be withdrawn in a manner that will not visibly lower the water level as indicated by water level height on the stream channel bank. Employ appropriately sized screens, implement withdrawal rates, and maintain withdrawal point sufficiently above the substrate to minimize impacts to the species.

18. Do not discharge hydrostatic test water directly into known or presumed occupied habitat. Discharge water in the following manner (in order of priority and preference):

a. Discharge water down gradient of occupied habitat unless on-the-ground circumstances (e.g. man-made structures, terrain, other sensitive resources) prevent such discharge.

b. If those circumstances occur, discharge water into uplands >300 feet from occupied habitat unless on-the-ground circumstances (e.g. man-made structures, terrain, other sensitive resources) prevent such discharge.

c. If those circumstances occur, discharge water as far from occupied habitat as practical and utilize additional sediment and water flow control devices (**Figures 6A&B, 7, 8, 14A&B; ECS**) to minimize effects to the waterbody.

Travel for O&M Activities

19. Do not drive across known or presumed occupied streams – walk these areas or visually inspect from bank and use closest available bridge to cross stream.

Zebra Mussels and Other Invasives

20. Clean all equipment (including pumps, hoses, etc.) that have been in a perennial waterbody for more than four hours within the previous seven days and will work in occupied or potential federally listed mussel habitat; following established guidelines to remove zebra mussels (and other potential exotic or invasive species) before entering a known or presumed occupied stream for a federally listed mussel, which is not known to be infested with zebra mussels (**Appendix L**). Do not discharge any water for other sources that might be contained in equipment (e.g. ballast water, hoses, sumps, or other containment). It is important to follow these guidelines even if work is not occurring in the immediate vicinity of these mussels since, once introduced into a watershed, invasive species could move and eventually affect the federally listed mussels.

6.2.6.4 Calculation of Incidental Take

Incidental take was calculated for the fanshell using the following simple algorithm:

Stream Width x Impact Length (lethal and sub-lethal wet-ditch or dry-ditch model) x Percent Suitable Habitat = Acres of Habitat Impacted

Acres of Habitat Impacted x Fanshell Density = Impacts to Individuals

Operating Facts:

The stream crossing method will be determined by NiSource as described in Section 5.2.1.1. Take is calculated based on using the wet-ditch stream crossing method for large streams (over 100 feet in width) except the Ohio River (only HDD is included as a covered activity) and using the dry-ditch method for remaining streams.

Take of mussels from the NiSource covered activities would occur primarily from impacts directly associated with the installation, repair or removal of pipeline across occupied stream habitat. On occasion, NiSource will also use access fords/equipment bridges across streams that are not entirely within the existing ROW. These fords/equipment bridges are typically 15 feet in width and are commonly used by the landowner for other purposes. If the fords/equipment bridges are existing, then NiSource and the Service have determined that its effects on endangered mussels are insignificant and discountable. However, the construction and use of a new fords/equipment bridges will have take that NiSource would be responsible to mitigate for. It is also likely that NiSource will need to cross one or more of these streams in a location other than the existing pipeline corridor. The impacts from these crossings would be separate from, and in addition to, those accounted for above. An additional amount of take (approximately 15%), calculated based upon the percentage of times that NiSource has looped pipelines at different stream crossing locations in the past, has been added to account for these mitigation requirements.

Key Assumptions:

NiSource used a reasonable worst case scenario with regard to its stream crossing activities and aggregate sediment impacts causing activities that could affect fanshell. The entire area that would be impacted by covered activities (e.g., where multiple pipelines are in close proximity to each other) was identified and used for the total acreage calculation. Eighteen large and six small stream crossing areas throughout the covered lands could affect fanshell over the proposed 50-year ITP.

Fanshell have been collected using quadrat sampling from a stable population in the Tennessee River at densities of 0.02 to 0.04 mussels per square meter over a 20 year period (Jones and Neves 2002). Surveys by the Kentucky Department of Fish and Wildlife Resources in the Licking River, among the healthiest fanshell populations, found densities of 0.14 to 3.15 mussels per square meter. Because NiSource does not impact the major extant populations in the Clinch or Green rivers, and if it impacts the Licking River, it would be peripheral, it is logical to use a density more representative of the impacted populations while providing for some margin of error. Therefore, a density of 0.1 fanshell per square meter was used for this analysis.

Take was calculated separately for large streams (>100 feet wide) and small streams (≤100 feet wide) to accommodate the two main stream crossing methods, wet-ditch and dry-ditch respectively. The average width at the pipeline crossing of large streams was 793 feet and the average width at the pipeline crossing of small streams was 37 feet. Stream width data were visually analyzed using one meter resolution leaf-on aerial photographs.

There is little discussion of suitable habitat in the literature and no consensus among biologists on what this number should be. The percent suitable habitat was based on the evaluation of a small number of studies that indirectly addressed how much of the stream substrate is occupied by mussels when a mussel assemblage is present (Hastie et al. 2000, Hastie et al. 2003, and Morales et al. 2006), and discussion with Service biologists and a consulting biologist experienced in surveying mussels (Villella 2009). Morales et al., who were looking at mussels in an upstream reach of the Mississippi, and Hastie et al., conducting research in a small Scottish stream, mapped the presence of mussels and indicated areas of the substrate that contained animals and areas that did not. Non-occupied areas may be unsuitable for various reasons (e.g., sheer forces during high flows, unstable or otherwise unsuitable substrate, areas that are regularly de-watered, etc.). Anderson (2000), examining mussels upstream and downstream of an existing bridge across the Allegheny River at Foxburg, Pennsylvania, looked at three reaches of the river, upstream of the bridge (total area 3.3 acres), immediately downstream of the bridge (total area 7.28 acres), and further downstream (total area 7.44 acres). In those three areas, he found that the mussel bed covered approximately 1.12 acres upstream (34%), 1.79 acres immediately downstream (25%) and 3.7 acres further downstream (50%).

Mussel experts who provided input on this question could only suggest that this metric is site-dependent and variable according to a number of factors. Therefore, in an extant mussel assemblage, the percent of the substrate within the stream banks that is occupied lies somewhere between 0% (since the starting premise is that mussels are present) and 100%. Within a mussel assemblage, endangered mussels would be presumed to cover less area since they are frequently (but not always) a rare component of those assemblages.

NiSource and the Service recognize the limitations of this metric as applied to any one stream. Some streams may have nearly 100% of the bottom occupied by an endangered mussel at a given density and other streams may have almost no presence, as in small remnant populations. Another factor to consider is how the NiSource impact zone overlaps a mussel assemblage. It is likely that in some cases, NiSource impacts will fall completely within the limits of a mussel assemblage. In other cases, the NiSource impact zone will fall partly within an area of mussels and partly within an area outside of an assemblage, given that mussels are distributed discontinuously within occupied streams. NiSource and the Service believe that if applied across all of the streams in the watershed, and across the entire length of stream for which impacts are estimated, that a central estimate should be employed in determining a reasonable worst case scenario. Therefore, take was calculated using the estimate that fanshell would occupy 50% of the stream bottom at the estimated density for this species.[36]

The impact area was calculated using both the sediment transport model and the dry-ditch model. The sediment transport model estimates a lethal impact area covered by 0.236 inches of sediment. A sediment plume is predicted to extend further downstream corresponding to a harm/harassment area having a 600 mg/l concentration of suspended sediment (Ellis 1936; Aldridge et al.1987). The dry-ditch model estimates a 75-foot lethal zone and a 100-foot harm/harassment zone downstream of the coffer dams.

A sediment transport estimation methodology was developed to aid in identifying the effects of open-cut waterbody crossing activities on mussels within suitable habitats. Because of the large number of streams within the project area, ENSR hydrologists and biologists, with input from the Service and NiSource, developed a simplified procedure to formulate and quantify the three processes of (1) suspended sediment supply to a stream from site disturbance; (2) instream transport and dispersion of the sediment by representative size fractions; and (3) sediment deposition on the streambed. Three sites (the Duck River in Tennessee, the Elk River in West Virginia, and the James River in Virginia) were selected for application of the estimation procedure. Site selection was based on (1) a list of "may-affect" stream crossings for the NiSource project; (2) the availability of nearby USGS stream gauge data and related

[36] The use of a central value (50%) in the reasonable worst case scenario take calculation (model) is based on the best available information and will be revisited as new information becomes available.

measurements; and (3) a likelihood of moderate flow conditions (discharge, depth and width, velocity) during the anticipated construction season (July through December). Moderate flow conditions may be the most significant in terms of potential effects of sediment deposition on mussel beds. Under the procedure, small discharges and slower flow velocities or shallow depths generally will not result in the calculation of sediment transport and deposition at distances as great as in the larger streams. Very large rivers, such as the Ohio and Tennessee rivers, absorb sediment inputs within their background conditions and disperse them fairly quickly within the cross-section to levels below the criteria. Although general in nature, NiSource and the Service believe this model is suitable for use in developing a reasonable worst case scenario across the streams and species in the MSHCP. Additional details of this methodology are presented in **Appendix L**.

This methodology assumes successful implementation of the NGTS ECS and uses construction parameters and available physical and hydrologic environmental characteristics of three streams. Stream flow conditions (discharge, depth and width, velocity) during the anticipated construction season (July through December) were also considered.

Another factor was the recognized criteria for mussel mortality (i.e., a burial depth of 0.236 inches or more and a suspended sediment concentration of 600 mg/l or more) (Ellis 1936; Aldridge et al. 1987). NiSource and the Service evaluated the potential impacts of NiSource actions on host fish and glochidia, coordinated that analysis with Service Field Offices, and concluded that the impacts on host fish and glochidia would be insignificant and discountable. Select waterbodies with the highest potential for significant transport were analyzed in greater detail. Those with the resulting longest transport distances that met mussel mortality criteria were selected to define the impact area with an error margin for the mussel species in the MSHCP.

NiSource proposes to use a dry-ditch methodology for stream crossing where technically and otherwise feasible (current technology permits this on streams of approximately 100 feet wide or less). The 75 feet within the coffer dam (lethal impact zone) plus 100 feet downstream (lethal impact/harm zone using the aforementioned sediment depth and suspended sediment values) were used to determine the action area for each crossing. NiSource and the Service recognize that there is some level of uncertainty associated with the sediment transport estimation methodology, both in terms of the predictive power of the methodology and to what extent sediments might impact mussels in any particular location. NiSource will evaluate the performance of both methodologies downstream of crossings using adaptive management.

The take calculation for fanshell mussel is presented in **Table 6.2.4.4-1**. As shown, the above described impacts result in the reasonable worst case scenario take of impacts to approximately 283.2 acres of habitat. This translates into take of approximately 57,320 fanshell over the 50-year life of the permit. In addition, aggregate impacts from various sediment-causing activities could have long-term and significant impacts on the same and additional acres, particularly in conjunction with other development activities in the watershed. The 57,320 fanshell estimated to be taken is important for an understanding of the impact on the species. It is not, however, the best method for identifying the amount of mitigation necessary to fully compensate for the impact of the take. Because the effects on habitat are more easily and accurately assessed, they better reflect the impact of the take. NiSource has therefore used acres as the basis for mitigation.

In addition, aggregate impacts from various sediment-causing activities could have long term and significant impacts on the same 283.2 acres and additional acres (removed from the immediate stream crossing sites), particularly in conjunction with other development activities in the watershed. NiSource calculated aggregate take based on the total acreage of NiSource pipeline corridor (using a 50-foot average width) overlapping the range of the fanshell. The total riparian area protected will be 11.1 acres, which is calculated as the total area of NiSource pipeline ROW in all impacted watersheds (49,009 acres), multiplied by the average of the percentage of area the pipeline impacts in each watershed (0.339%), divided by the total number of impacted watersheds (15). This provides an index of how prevalent NiSource pipelines are in the affected watersheds and therefore a surrogate for the sediment and associated impacts on mussels.

$$\frac{49009 \times 0.00339}{15} = \mathbf{11.1}$$

The take calculations presented here are designed to reflect a reasonable worst case scenario across the entire range of potentially affected streams. It is a reasonable worst case, but not certain, for example, that NiSource would actually conduct covered activities at all the locations affecting fanshell over the 50-year permit duration. Take is based on the assumption that fanshell occur in the aforementioned densities, over the estimated stream width, and occupied habitat percentage described above at every stream crossing. It is possible that some crossings may have higher or lower densities and more or less suitable habitat than modeled. However, the proposed calculations produce a reasonable worst case scenario over the life of the MSHCP, although it is likely not accurate for any one stream at a given point in time.

6.2.6.5 Impact of Take Analysis

Historically, the fanshell mussel was considered endemic to the eastern highlands east of the Mississippi River. It was widely distributed in the Tennessee, Cumberland, and Ohio River systems (Parmalee and Bogan, 1998). It was found in the Ohio River and many of its large tributaries in Pennsylvania, West Virginia, Ohio, Indiana, Illinois, Kentucky, Tennessee, Alabama, and Virginia (Service 1991a).

The fanshell is now sparsely distributed across eight states. The Clinch River (Hancock County, Tennessee and Scott County, Virginia), the Green River (Hart and Edmonson counties, Kentucky), and the Licking River (Kenton, Campbell, and Pendleton counties, Kentucky) are believed to be the only reproducing populations. In addition, based on collections of a few older individuals in the 1980s, the Muskingum River (Morgan and Washington Counties, Ohio), the Walhonding River (Coshocton County, Ohio), the Wabash River (White County, Illinois and Posey and Wabash counties, Indiana), the East Fork White River (Martin County, Indiana), the Tippecanoe River (Tippecanoe County, Indiana), the Kanawha River (Fayette County, West Virginia), Tygart's Creek (Greenup and Carter counties, Kentucky), the Barren River (Allen and Barren counties, Kentucky), the Cumberland River (Smith County, Tennessee), and the Tennessee River (Rhea, Meigs, and Hardin counties, Tennessee) may have small remnant (apparently non-reproducing) populations (Service 1990a, Service1991a). Survey information also indicates that the species has been found in the Salt River (tributaries to the Ohio River) and in the Allegheny River in Pennsylvania (NatureServe 2007a).

I. Genetic-Level Impacts

Basic life history data, estimates of population size, and assessments of population genetic structure are lacking or sparse for many endangered mussel species (Jones, Hallerman, and Neves 2006). Little is known about the genetics of the fanshell. However, there are studies in progress at the Virginia Tech Cooperative Research Unit in Virginia that provide opportunities to evaluate population genetic variation in fanshell from the remaining populations in the Clinch River, Tennessee; Green River, Licking River, Kentucky River, and Rolling Fork River, Kentucky; and Tennessee River below Pickwick Dam, Tennessee. (*See* Virginia Tech http://www.fishwild.vt.edu/mussel/projects/genetics/projects_genetics3.html, accessed July 14, 2009). The best available information does not suggest that significant genetic differences exist among populations within the NiSource covered lands. NiSource will, however, work with the Service and other partners to assess and act on new information as it is developed.

Petty (2005) states river systems can be considered habitat "islands" on the larger landscape; each river is separated from other rivers by habitat unsuitable for bivalves. Habitat fragmentation is common for freshwater species, causing disjunct gene pools (Mulvey et al. 1997). Population fragmentation is likely associated with loss or redistribution of genetic variability and is a concern for conservation biologists attempting to manage freshwater species (Templeton et al. 1990). It has been suggested that a minimum population size of 5,000 individuals might be necessary under natural conditions (restricted mating or overlap of generations) to avoid loss of genetic diversity of animal species (Schonewald-Cox et al. 1983). Based on current knowledge, most of the remaining fanshell populations would not meet this threshold. The Clinch River fanshell population extends over about 86 river miles (Ahlstedt 1986), although the density has declined significantly over the past several years. The Green River and Licking River populations might meet the threshold, although there are no estimates of total populations in those rivers. Other populations are smaller and may not currently be reproducing. The loss of these populations could result in the loss of genetic diversity.

During historical times, the fanshell was widely distributed in the Ohio, Wabash, Cumberland, and Tennessee rivers and their larger tributaries in Pennsylvania, Ohio, West Virginia, Illinois, Indiana, Kentucky, Tennessee, Alabama, and Virginia (Service 1991a). In this region, there were historically no absolute barriers preventing genetic interchange among its tributary sub-populations that occurred in various streams. With the completion of numerous dams during the first-half of the 20th century, some mainstem fanshell populations were lost, and other populations became isolated. The principle genetic consequences of activities that reduce effective population size is the loss of genetic variance through genetic drift and consequently the potential reduction in the ability to adapt and a reduction in fitness through inbreeding depression (Jones, Hallerman, and Neves 2006; Schonewald-Cox et al. 1983). Genetic-level impacts are possible from NiSource activities under the MSHCP. The mechanism for these impacts is through the possible extirpation of small genetically diverse populations, which could reduce the genetic material available to future generations. Where NiSource activities would affect more robust populations, genetic impacts could be less severe in that the number of mussels impacted from a NiSource activity would be a much smaller percentage of the population.

II. Population-Level Impacts

Good range-wide population estimates for the fanshell mussel do not exist, but this species appears to be restricted to three, successfully recruiting populations in three states (Virginia, Tennessee, and Kentucky), specifically the Clinch River, Green River and Licking River populations and additional non-reproducing populations in five states. Fanshell has continued to decline even in one of its stronghold populations in the Clinch River. Most other remaining fanshell populations are small and based on available evidence, non-reproducing.

The fanshell population in the Green River is likely the best of the three remaining reproducing populations. Fresh-dead fanshells of various age classes from juvenile to adult have recently (1987 and 1988) been found in muskrat middens along the Green River (Service 2003). The Clinch River fanshell population extends over about 86 river miles (Ahlstedt 1986). However, a TVA (1988) survey reported that the fanshell comprised less than one percent of the mussels collected at 11 Clinch River quantitative sampling sites in 1979 and 1988 (Service 1991a). The TVA also reported that overall mussel abundance in the Clinch River has decreased from an average of 11.64 mussels per square meter in 1979 to 6.0 mussels per square meter in 1988 (Service 1991a). A reproducing population of the fanshell in the Licking River is supported only in the lower portion of the drainage (Service 1990a, Service 1991a). In the Licking River, live and fresh-dead individuals of several year classes have been collected (Service 2003).

Take from stream crossing activities, depending on the location and extent of the impact area and on how robust and spread out the population is within the stream, could negatively affect, further reduce the viability, or even extirpate one or more fanshell populations. In addition, aggregate impacts over the life of the ITP could reduce both the suitability of occupied habitat and habitat that could be colonized naturally or through enhancement and reintroduction. These impacts could also negatively affect fanshell population dynamics.

In summary, it is reasonable to conclude that small, isolated populations could be significantly impacted where NiSource activities intersect stream reaches providing habitat for those populations. Moreover, even the more robust fanshell populations have comparatively low densities and overall numbers. Reduced populations, particularly if comprised of older individuals, as many fanshell populations likely are, may take several decades to recover even if no further degradation occurs. NiSource is not expected to impact any of the three remaining reproducing populations of fanshell. Like all mussels, fanshell are vulnerable to sedimentation and aggregate impacts would undoubtedly be detrimental to this species. Based on the best available information, there are 13 known populations of fanshell; three of these are thought to be stable, reproducing populations and 10 are thought to be small and possibly non-reproducing populations. NiSource would not affect any of the stable, reproducing populations and potentially would affect four of the small, possibly non-reproducing populations. In other words, NiSource would potentially affect four of the 13 known populations, but none of those that are currently considered stable and reproducing.

NiSource and the Service anticipate both individual and potential population impacts to fanshell from acute and chronic impacts associated with NiSource activities. These impacts over the life of the ITP suggest that the impact of the taking of the fanshell from NiSource activities will be somewhat greater than the estimated loss of individuals and habitat. This results from: (a) absence of NiSource impacts to any of the remaining three stable/reproducing populations of fanshell (Clinch River, Green River, or Licking River); (b) impacts to four small populations (including both of the extant Ohio populations) with low numbers and diminished capacity to recover from impacts; and (c) long-term sediment impacts to fanshell populations and habitat.

6.2.6.6 Compensatory Mitigation

NiSource will mitigate for the impact of take of fanshell resulting from its actions in the covered lands. This take is anticipated to occur in two ways. The first is the impact of take that may result from direct loss of individuals or habitat from stream crossing activities employed to install new pipeline, or repair or replace existing pipeline. The second kind of take is aggregate, which would result primarily from sedimentation from non-aquatic activities within the watershed, and secondarily from loss of riparian habitat, and other similar comparatively minor and indirect impacts detailed above. Where the term "protection" appears below, please refer to Section 6.2 for a further definition and the requirements for securing conservation of mitigation lands and other real property interests.

Before mitigation occurs, NiSource must undertake restoration activities at certain impacted areas. Although these constitute minimization measures for the purpose of the MSHCP, the required mitigation discussed below, in part builds upon these efforts. In all cases where stream crossings occur, NiSource will restore the disturbed streambed and riparian area within its ROW resulting from its activities. Restoration will occur during the same construction season (next appropriate planting season for riparian restoration) as impacts unless there are extenuating circumstances and the Service is informed of those issues. The basic restoration will be conducted in accordance with standard industry specifications as defined in the ECS and required by FERC and other relevant regulatory agencies. This will involve, at a minimum, restoration of any impacts to the depth, flow, channel bottom, or banks as nearly as practical back to the pre-activity condition. Vegetation restoration must be with site-appropriate native species.

Mitigation at Restored Streambed and Riparian Areas

As the initial step in compensatory mitigation, NiSource will enhance the restored stream substrate within the construction zone to habitat that is optimal for fanshell mussels. This would typically involve either replacement or importation of clean, appropriately sized material for mussel re-colonization. NiSource will also enhance, where feasible, any pre-construction deficiencies associated with the depth, flow, bank stability, or riparian vegetation that would be detrimental to mussel re-colonization, survival, and reproduction. NiSource expects the enhancement of the substrate to result in more opportunities for recruitment of fanshell by providing suitable settling habitat for juvenile mussels. Enhancement serves as one component of NiSource's overall mitigation program, but does not wholly compensate for the impact of take because it has the potential to be disturbed in the future. Therefore, additional compensatory mitigation (riparian restoration) is required as discussed in detail below.

Mitigation for Aggregate Take Activities

In addition to the requirements above, NiSource will provide mitigation to compensate for sediment-producing and other indirect impact producing activities (Aggregate Take). NiSource will initiate mitigation for Aggregate Take within the first seven years after the incidental take permit has been issued to ensure adequate and timely compensation for O&M activities in the watersheds where impacts would likely occur over the life of the ITP. Mitigation for Aggregate Take will focus on habitat impacts as a surrogate for individual take and use habitat protection/restoration as the mitigation option. The protection or restoration of riparian habitat is designed to reduce the sediment impacts to fanshell by buffering occupied streams. NiSource expects this to result in improved survival and reproduction of mussels in the mitigation area.

Implement protection and restoration of riparian buffers associated with occupied fanshell habitat within the Green River (KY) or the Licking River (KY) watersheds adjacent to existing fanshell habitat or another priority stream identified in collaboration with the Service. Mitigation should provide additional benefits to the species at the identified site (i.e., sites that are already secure or, at the other end of the spectrum, sites where there is little opportunity to improve the habitat should not be considered). The total riparian area protected to mitigate for aggregate take will be 11.1 acres.

A 1:1 ratio is appropriate for this species because the aggregate impacts from NiSource activities to both the population and the habitat are expected to be comparatively minor.

Sideboards: (a) there must be a minimum 50-foot-wide to a maximum 150-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams generally should have wider buffers;[37] (b) the vegetative buffer must meet minimum NRCS standards - for water quality and riparian corridors (**Appendix L**); (c) at least 50% of the total riparian buffer must be restored (i.e., cropland or other highly erosive land use planted to meet NRCS standards - this 1:1 ratio of restoration to protection reflects the purpose of the aggregate take mitigation to address sediment impacts specifically); (d) instabilities in the riparian zone (e.g., gullies, bank erosion that undermine the functioning of the restoration must be repaired

[37] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

before planting vegetation, otherwise there should be minimal earth disturbance on the restoration sites; (e) individual mitigation sites must be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); (f) water quality, instream habitat, and instream connectivity must be evaluated in terms of long-term viability of the fanshell population within the mitigation area; (g) mitigation projects must be completed no more than three years after initiation; and (h) riparian buffers must be permanently protected in fee or by easement (consistent with the template language in **Appendix P**).

Mitigation When NiSource Relocates Fanshell (AMM #1)

NiSource has the option described in AMM #1 to relocate mussels as part of a stream crossing project. If the relocation is successful, as discussed in AMM #1, the following mitigation is required in addition to the enhancement and aggregate take mitigation described above. When implemented with the other required mitigation and in concert with mussel relocation described in AMM #1, and if the sideboards and Service guidelines are followed, this option would fully compensate for the impact of take by conserving mussels that would otherwise be killed or harmed. In addition, habitat at the relocation site will be protected and enhanced. NiSource can initiate this mitigation option at any time but not later than during the same period as a new project likely to result in take is started.

Find, relocate, and monitor all fanshell and other mussels within the assemblage impacted by the project to a suitable site upstream or downstream of the impact zone, and restore riparian habitat at the site of relocation, or at an upstream location as near to the mussel relocation site as possible, at a 1:1 ratio of the acreage amount of in-stream habitat impacted.[38]

Sideboards: (a) follow the most current protocols for mussel location, transport, relocation, and monitoring, but the last monitoring cycle must occur no earlier than the fifth year of relocation; (b) there must be a minimum of 75% survival of relocated fanshell mussels after five years or additional mitigation will be required; (c) if less than 75% survival rate for fanshell is achieved at five years, NiSource will be responsible to implement riparian restoration at the ratios indicated in new construction take mitigation below, minus any riparian restoration completed for the relocation; (d) sideboards for riparian restoration will follow those described in sideboards for new construction mitigation below; (e) suitable habitat must meet basic mussel requirements of depth, substrate, flow, water quality, host fish presence, and riparian vegetation (existing or post-mitigation restoration); (f) suitability of a site will be determined in coordination with the Service; and (g) NiSource will provide a report to the Service one year after relocation and again after the fifth year post relocation on the status of the relocated fanshell mussels.

[38] A 1:1 ratio is appropriate because the primary thrust of the mitigation is the relocation of the mussels – the restoration is an additional step to improve what will already be suitable habitat (otherwise mussels could not be relocated there).

Mitigation for New Construction Take when Fanshell is not Relocated

The selection of which mitigation option NiSource will implement to compensate for new construction take will be based upon the highest need of the species at the time the mitigation becomes necessary, as recommended by NiSource to the Service for its approval or declination. For fanshell, initially there is only one option available. Mitigation for New Construction Take of fanshell must follow the mitigation option guidelines and sideboards outlined below. Mitigation for new construction will fully compensate for the impact of take by protecting and restoring the riparian zones that moderate water temperature, provide nutrient inputs, and reduce sediments and other contaminants along occupied streams, thereby improving the quality of the habitat. NiSource expects this to translate into increased survival and reproduction of mussels in the mitigation area

Protect and Restore Existing Fanshell Habitat: Protect and restore riparian buffers adjacent to occupied fanshell habitat. Because of the impact of take on this species, the mitigation amount required is a 1.5:1 ratio of the acreage amount of instream habitat impacted by stream crossing(s). For impacts to Muskingum River (Ohio), Walhonding River (Ohio), Tygart's Creek (Kentucky), or the Barren River (Kentucky) the 1.5:1 mitigation ratio will be increased by a multiplier of 1.5 to compensate for greater impacts to small isolated populations that may have less resilience. For impacts to streams not listed here, NiSource in coordination with the Service will determine whether the population is stable and recruiting or small and isolated and apply the appropriate mitigation ratios. For all riparian restoration, a multiplier of 3 will be used to account for the time it takes riparian restorations to mature, stabilize, and become fully functional.

Stable/Recruiting Populations (None)

Protection Ratio = 1.5:1

Restoration Ratio = 1.5 (x3):1 = 4.5:1

Small Isolated Populations

Protection Ratio = 1.5 (x1.5):1 = 2.25:1

Restoration Ratio = 1.5 (x3) (x1.5):1 = 6.75:1

Sideboards: (a) habitat acquired or restored must benefit an extant population of fanshell; (b) projects must be in one or more of the following priority watersheds: the upper Tennessee River system, middle to lower Tennessee River system, the Cumberland River system, a Kentucky tributary to the Ohio River other than the Cumberland River, the Allegheny River system, the lower Muskingum or Walhonding River system, the Kanawha River system, and the Wabash River system or other high priority watersheds identified by the Service (this list will be updated using the most recent 5-Year reviews as available); (c) projects can be completed before take of fanshell occurs but not later than two years after the take occurs; (d) there must be a minimum 50-foot-wide to maximum 150-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams generally should have wider buffers;[39] (e) instabilities in the riparian zone (e.g., gullies, bank erosion, etc.) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be limited earth disturbance on the restoration sites; (f) the vegetative buffer must meet minimum NRCS standards for water quality and riparian corridors (**Appendix L**); (g) at least 25% of the total riparian buffer must be restored (i.e., cropland or other highly erosive land use planted to meet NRCS standards); (h) individual mitigation sites must be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); and (i) habitat acquired or restored must be permanently protected (*see* Section 6.0 for the definition of protection) in fee or by easement following easement guidelines (**Appendix P**).

Mitigation Options for Possible Future Consideration

These options are not fully documented since they would not be immediately available to NiSource. These measures are not deemed acceptable mitigation at this time for various reasons including the availability of complete science to implement them. At the time of consideration, the Service and NiSource would determine whether a major amendment would be required before they could be implemented. The amount of mitigation required for these options would be determined as part of the amendment authorizing their use.

Identify Augmentation, Expansion, or Reintroduction Streams and Conserve, Restore, and Enhance Habitat for Augmentation, Expansion, or Reintroduction: Using Service approved methodology, identify sites within the range of the fanshell that with restoration could be suitable for augmentation, expansion, or reintroduction efforts and protect, and where necessary restore, streambed and riparian habitat specifically for the successful augmentation, expansion, or reintroduction of fanshell mussels.

Sideboards: (a) sites for this mitigation should be selected and site plans developed based factors including extant fanshell population size, demographic composition, and population trend data (where applicable), potential site threats, habitat suitability, and any other limiting factor that might decrease the likelihood of long-term benefits from population augmentation, expansion, or reintroduction efforts (*see* McGregor 2005 for work initiated in Kentucky for clubshell and other mussels); (b) work will be coordinated with the Service at the time initiated; (c) final products will be directly applicable to Service or other efforts to augment, expand, or reintroduce fanshell mussels; (d) habitat acquired or restored must be permanently protected; (e) habitat acquired or restored must be tied to and benefit an augmented, expanded, or reintroduced population of fanshell; and (f) projects must be completed either before impacts to fanshell occur or within two years after impacts.

Develop Genetic Information for Conservation of Fanshell: The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations developing genetic

[39] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

information, necessary in part to avoid the deleterious effects of mixing distinct populations (Neves 2004), on source and receiving populations for the propagation or augmentation/expansion/reintroduction of fanshell mussels and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow all Service guidance and regulations on acquiring and analyzing genetic information; (b) the products developed will be directly applicable to augmentation/reintroduction of fanshell; and (c) projects must be completed either before impacts to fanshell occur or within two years after impacts.

Propagate Fanshell: The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations based who are leading the development of, improving, or implementing propagation technology and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg. 56916-56922, September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the entity will work with the Service to ensure that there exists or will exist in the near future a suitable site for reintroduction/expansion/augmentation of a fanshell population with the propagated mussels; and (d) projects must be completed either before impacts to fanshell occur or within two years after impacts.

Augment/Reintroduce Fanshell:[40] The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations who are augmenting or expanding fanshell populations or reintroducing fanshell into their historic range and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg. 56919-56922, September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the reintroduction/expansion/augmentation will occur in a suitable site approved by the Service; (d) the mitigation must include monitoring of populations and habitat conditions to evaluate the effort and assess the long-term viability of the augmented/expanded/reintroduced fanshell population(s); and (e) projects must be completed either before impacts to fanshell occur or within two years after impacts.

6.2.6.7 Additional Actions Available to NiSource to Benefit the Species

NiSource is committed to implement AMMs and mitigation. In addition there are other important actions that NiSource may choose to initiate on its own or in concert with state agencies, non-government organizations, or other entities to further benefit this species. These would not in any way alter the requirements for

[40] This is not a recommended strategy at the time of development of the MSHCP. Habitat conservation should take precedence over augmentation/reintroduction. Most clubshell populations are declining due, presumably, to habitat degradation. Putting more clubshell in to streams with degraded habitat could result in increased clubshell mortality. The proposed research would be critical to reach a point that additional augmentation/reintroduction is likely to succeed.

compensatory mitigation, but may fit into NiSource's landscape-level approach to conservation.

Fund research[41]

Identify and map activities or practices within each ecosystem that may affect the fanshell and its host fish at known sites, and at potential augmentation/reintroduction sites.

Determine contaminant sensitivity for each life stage, particularly sedimentation.

Surveying and monitoring

Implement a quantitative monitoring program at sites within the reproducing populations to assess the reproductive condition of these populations.

6.2.7 James Spinymussel

The James spinymussel (*Pleurobema collina*) was listed as an endangered species by the Service in 1988 (Service 1988). A recovery plan was published in 1990 (Service 1990b). The James spinymussel (JSM) is native to the James River system in Virginia and West Virginia, as well as the Dan and Mayo River drainages of the Roanoke River basin in North Carolina and the Tar River (NatureServe 2007a). The majority of the decline of JSM has taken place over the last 20 years. It is currently documented in only a few creeks and small rivers in the upper James River drainage in Virginia and Roanoke drainage in North Carolina.

Impacts and potential take of JSM are likely to occur in the following counties in Virginia: Albemarle, Alleghany, Botetourt, Goochland, Greene, Orange, Powhatan, and Rockbridge.

Adult freshwater mussels are filter-feeders, siphoning phytoplankton, diatoms, and other microorganisms from the water column. Mussels tend to grow relatively rapidly for the first few years, and then their growth slows appreciably at sexual maturity (when energy is being diverted from growth to reproductive activities). There is ongoing discussion among scientists concerning the life span of mussels, but as a group, they are generally acknowledged to be long-lived organisms. Hove and Neves (1994), who studied the life history of the JSM from 1987 to 1989, evaluated age class structure from 100 JSM found in muskrat middens and concluded a range from three to 19 years with the mean age of eight years. They estimated adult mean annual mortality at 15.6% per year.

Most mussels, including the JSM, have separate sexes. Males expel clouds of sperm into the water column, which are drawn in by females through their incurrent siphons. Fertilization takes place internally, and the resulting zygotes develop within the gills into specialized larvae termed glochidia.

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[41] Refer to the *National Strategy for the Conservation of Native Freshwater Mussels* compiled by the National Native Mussel Conservation Committee (1998) for additional information on conserving North America's imperiled mussel fauna. Shute et al. (1997) also outlined management and conservation considerations for imperiled mussels and other aquatic organisms, while incorporating ecosystem management into the equation.

The minute bivalve glochidia are brooded over a period of days to months in only the outer gills of JSM. The JSM is a tachytictic (short-term) brooder; its eggs are fertilized in the spring and glochidia are released in spring and summer. Glochidia must come into contact with a specific host fish, usually within 24 hours, in order for their survival to be ensured. Without the proper host fish, the glochidia will perish (Service 1994). After a certain amount of time (from hours to weeks), depending on water temperature and species, the glochidium transforms to a juvenile and drops off the host fish and settles into the river bottom.

Like other mussels, the JSM probably experiences very low annual juvenile survival. Hove and Neves (1994) concluded that the mean fecundity of JSM is lower that most other studied mussels. They found an average fecundity of 13,407 brooded eggs per female of which 12,423 matured into larval glochidia (as compared to up to 3,000,000 for other species). In part because JSM, like virtually all freshwater mussels, relies on this parasitic larval stage, it probably experiences very low annual juvenile survival. Jantzen et al. (2001) report greater than 99% mortality for glochidia. Though not specific to JSM, this estimate and the estimates of survival that follow are likely typical for JSM and most mussels in North America. Probability of survival from mussel glochidium to benthic recruit has been estimated to range from 1×10^{-6} (Young and Williams 1984) to 39×10^{-6} (Haag 2002). Transition from glochidium to juvenile represents a very large bottleneck—a single female's reproductive output is reduced from thousands of glochidia to <1 offspring per year (Berg et al. 2008). The low fecundity suggests the need for a large population to produce a large annual cohort (Musick 1999).

Identified host fish of the JSM include: bluehead chub (*Nocomis leptocephalus*), rosyside dace (*Clinostomus funduloides*), blacknose dace (*Rhinichthys atratulus*), mountain redbelly dace (*Phoxinus oreas*), rosefin shiner (*Notropis ardens*), satinfin shiner (*Notropis analostanus*), stoneroller (*Capostoma anomalum*) (USFWS 1990b), and possibly the swallowtail shiner (*Notropis procne*) (NatureServe 2007a).

This species lives in stream sites that vary in width from 10 to 75 feet and depth of 0.5 to three feet. It requires a slow to moderate water current with clean sand and cobble bottom sediments. The JSM is limited to areas of unpolluted water, and may be more susceptible to competition from Asian clam species when its habitat is disturbed (Service 1990b).

6.2.7.1 Activities and Impacts Analysis

The endangered JSM has experienced a precipitous decline over the past two decades. The species appears to be extirpated from 90% of its historic range, with survival documented in only a few small tributaries to the James River. Its restricted distribution leaves it vulnerable to a variety of threats. The recovery plan identified sedimentation, competition with the Asian clam, impoundments, and pollution as primarily responsible for the decline JSM (Service 1990b).

The draft 5-Year Review (Service 2009c) lists ongoing threats to the JSM. It states that all populations are threatened by one or more of the following: sedimentation and siltation that comes with agricultural, silvicultural, and development activities, contaminants (both point and non-point sources), and a general lack of public awareness about the JSM, its occurrence and biological significance in aquatic ecosystem. Petty (2005) states that potential competition with the introduced Asian clam, and predation by muskrats have exacerbated the effects of habitat alteration. She also references increasing spatial separation among populations as a threat to JSM.

There is a growing belief that emissions of greenhouse gases are linked to climate change. The extent of warming and the resulting changes in rainfall patterns that may occur is not known with certainty at this time. NiSource has addressed the potential for impacts to JSM from water temperature increase and other possible manifestations of climate change in Chapter 10.

The remaining populations of JSM are generally small and geographically isolated. The patchy distributional pattern of populations in short river reaches makes them much more susceptible to extirpation from single catastrophic events.

NiSource Activities Potentially Affecting JSM

NiSource activities that may affect JSM are hereafter characterized as those that potentially cause take and derive: (a) from the stream crossing actions (affecting the streambed and riparian corridor); and (b) upland-disturbing (sediment-related) *aggregate impacts*. Aggregate impacts are defined as those impacts that derive from multiple NiSource activities that individually do not rise to the level of take, but taken together over time may result in negative effects that NiSource has agreed to compensate for. One example would be the combined sediment impacts of access road maintenance, culvert replacement, grading, and restoration efforts over the 50-year permit duration.

Pitt, Clark, and Lake (2007) evaluated a study of the Menomonee River watershed in Wisconsin. They found that the 3.3% of the area disturbed by construction contributed the greatest amount of sediment at the river mouth compared to any other land use (50% of all the suspended sediments). In the southeast Wisconsin Regional Planning area the same authors found that construction covered only 2% of the surface area, but contributed 26% of the sediment to inland waters. By comparison, agriculture was 72% of land use and contributed only 45% of the sediments. Owens et al. (2000) found that in Wisconsin even small (0.34 and 1.72 acres) construction sites had rates of erosion that were 10 times those of typical rural or urban land uses. Various factors including topography, rainfall intensity, soil type, soil compaction, time of year, and erosion control measures influence the rate. Both studies recognize that even small construction projects (for reference National Pollutant Discharge Elimination System Phase II regulations regulate sites above one acre in urban areas) and small overall construction footprints in a watershed can cause significant detrimental impacts to local waterbodies.

Although the effects from many NiSource O&M and new construction activities are sediment related (e.g., grading, regrading, tree clearing, repair, culvert replacement, etc.), it is not expected that any of these activities, as routinely implemented, will result in large single discharges of sediment. In addition, negative consequences are likely lessened because most covered activities would be outside of urban areas where storm sewers carry sediments directly to receiving waters and vegetated buffers are less available. NiSource also implements multiple sediment control measures on our ground-disturbing projects (*see* the ECS, **Appendix B**), however, none of these measures is 100% effective and effectiveness varies even with properly implemented measures. For example, properly installed silt fences in Alabama did not achieve sediment reduction to the same level as an undisturbed reference site (Pitt, Clark, and Lake 2007). Non-point sediment impacts are difficult to measure and impacts may occur as a result of numerous activities over many years. Nevertheless, NiSource believes that these activities, although reduced to the maximum extent practicable, may result in harm and harassment of JSM.

The following O&M activities may impact JSM: pipeline corridor presence, vehicle operation, access road culvert replacement, access road maintenance, off-ROW clearing, mechanical repair and fill in ROW, in-stream stabilization, tree clearing, herbicide application, hydrostatic testing, pipeline abandonment, and well abandonment. These activities may result in a variety of stressors to JSM including: sedimentation, chemical contaminants, increased water temperature, crushing, substrate compaction, altered flow, burying substrate, and introduction of invasive species (**Appendix M, Table 6.2.7.1-1**).

These stressors, in turn, may negatively impact the JSM in a variety of ways. Sedimentation at levels that would be expected from O&M activities may degrade habitat and could over time disrupt JSM biology (see the discussion on burying below) or ecological relationships (e.g., host fish). As discussed above, JSM may be particularly sensitive to sedimentation because of its predisposition to burrow into the substrate. Increased levels of suspended sediment can cause the filter feeding mussels to cease feeding and close their valves. Excessive silt also affects behavior and may eventually lead to suffocation through oxygen depletion or interference with the gills (Ellis 1936). Chemical contaminants have some potential to cause harm or mortality to mussels, but could also affect algae (fertilizers and herbicides) and plankton that provide food for mussels and host fish and affect water quality. The loss of riparian habitat reduces shade on the stream potentially altering water temperature and may also affect trophic function by reducing inputs into the stream from the overhanging trees. Crushing is self explanatory. Since mussels are benthic organisms, substrate compaction can make habitat less suitable for both adult and juvenile mussels. Altered stream flow can change habitat and food availability. Similarly, burying habitat can fill the interstitial spaces in the sands and gravels and preclude normal processes when adult mussels burrow into the substrate. This can be even more harmful to juvenile mussels that immediately burrow into the substrate after dropping from host fish (the adults of many species also bury themselves completely during the winter months). Finally, the introduction of invasive species, in the case of JSM, primarily the Asian clam, or other harmful invasive species, into habitat previously not contaminated or contaminated at a low level, can result in competition for resources and direct harmful impacts.

New construction activities that may impact JSM are: dry-ditch crossing activities, access road construction, grading, HDD, hydrostatic testing (withdrawal and discharge), re-grading, fertilizer application, erosion control devices, herbaceous and woody vegetation clearing, stream bank contouring, installation and removal of stream crossing structures, trenching related impacts, waste pits, minor spill events (major spill events are addressed outside the context of the MSHCP), in-stream stabilization, and vegetation disposal. The following stressors are associated with new construction activities: sedimentation, altered flow, chemical contaminants, entrapment, increase in water temperature, water level reduction, introduction of invasive species, substrate compaction, and crushing (**Table 6.2.7.1-1**).

The stressors from new construction mostly overlap those of O&M and may have the same impacts although in some cases the impact could be acute rather than chronic (e.g., sedimentation from stream crossing activities could likely have an acute effect on mussels immediately downstream, while sedimentation from the pipeline corridor presence, or access road replacement, could likely occur slowly over the 50-year life of the permit). Entrapment from the withdrawal of water for hydrostatic testing poses a slight risk to juvenile mussels, gametes that are released into the water column during reproduction, and also to glochidia, which could be entrapped if small host fish were sucked through or trapped during water withdrawal. NiSource expects that take will be very limited in terms of both amount and level of take with implementation of mandatory AMMs. Water level reduction could impact JSM occurring in smaller streams particularly if withdrawal for hydrostatic testing were to occur during already low flow.

The most direct threat involves excavation for installing or repairing pipelines across inhabited streams. If present, this could cause direct lethal take of JSM by crushing and excavating individuals, and by causing lethal and sub-lethal (harassment and harm) sediment impacts to individuals downstream of the work area. Access road construction could have similar impacts to individuals. In-channel construction (e.g., in-stream stabilization or bank contouring) could also take individuals.

An alternative to open-cut excavation is HDD. However, under certain conditions, HDD can cause fracturing of the stream bottom. This can result in release of drilling muds from the bore hole into the stream (frac-out), which could impact JSM. Drilling muds are composed primarily of water and bentonite and the slurry or drilled solids cut from the bore hole. More advanced drilling muds typically contain various additives including long-chain polymers and detergents. In low pH environments, soda ash is sometimes added to raise the pH (in the bore hole) to an optimum level of about 9 (Najafi and Gokhale 2005). No studies were found that have evaluated the toxicity of HDD drilling muds to mussels. However, freshwater mussels appear to exhibit more sensitivity to some pollutants than do the organisms typically used in toxicity testing. As a result, some of the water quality criteria established by the EPA to protect aquatic life may not be protective of mussels (Service 2009c). It is likely that in high concentrations additives used to raise pH and detergents could cause harm. Minor frac-outs (less than a few hundred gallons), however, which would involve very small quantities of drilling muds (and even smaller amounts of potentially toxic materials), would based on our experience be similar to background levels of sediment from natural events and not be expected to cause take (harm or mortality) of mussels. Any spill that would result in observed take would be handled outside the context of the MSHCP.

Impacts to JSM habitat may also be a consequence of both O&M and new construction activities. Activities involving excavation in the stream channel (e.g., install or remove pipeline) could have significant impacts to both the habitat in the construction area and downstream. Impacts may involve acute sediment impacts that, as described above, could render the habitat unsuitable for adult or juvenile mussels. NiSource's expectation is that some of the habitat would likely recover over a period of months (Villella 2005), but some impacts could persist for months or years until such time as high flows or storm flows moved the sediment downstream. Fine sediments that clog interstitial spaces could make habitat unavailable particularly for juvenile mussels. Other activities (e.g., installation of in-stream stabilization, stream bank contouring, pipeline presence) could have long-term direct impacts on habitat and long-term indirect impacts through altered flow.

The activities that occur within the impact zone of the crossing action (e.g., crushing from equipment preparing a site for excavation) are calculated in the algorithm for crossing actions used to estimate take (described in Section 6.2.7.4 below). The remaining impacts are classified as aggregate and involve: (1) low-level sedimentation impacts to mussels and mussel habitat and host fish and host fish habitat from the pipeline corridor presence; ROW mechanical repair; ROW fill; vegetation clearing; access road maintenance, upgrading, and construction; installation and maintenance of culverts under access roads; grading; restoration (in-stream); restoration (bank contouring); regrading, stabilization and restoration; minor frac-out; open trenches; trench dewatering; trench water diversion structures; vehicle operation; waste pit berms; well abandonment (restoration); (2) regrading, stabilization, and restoration (fertilizer); minor spill; (3) altered flow from in-stream stabilization measures; pipeline corridor presence; (4) increase in water temperature from pipeline corridor presence; tree and shrub clearing; and (5) substrate compaction from vehicle operation. These are chronic low-level impacts that combine together or with non-NiSource impacts to potentially degrade JSM habitat and may cause impacts over the proposed 50-year permit life.

An adaptive management program is necessary for a species with significant uncertainties and high levels of risk. *See* Section 7.6.4.4 for the proposed adaptive management program for the JSM.

6.2.7.2 Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend to permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicant should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; *see also* the Service's HCP Handbook at 3-20 ("HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery tools";

"contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the JSM. With these general goals in mind, the main JSM conservation objective for ROW maintenance and O&M activities is to avoid or minimize impacts to known or presumed occupied habitat (e.g., minimize impacts to stream banks and bed) and avoid/minimize impact to JSM (e.g., crushing, killing, sedimentation). The main JSM conservation objective for all construction projects (i.e., off existing ROW) is to avoid or minimize impacting known or presumed occupied habitat (e.g., through project planning, use of trenchless installation) and avoid/minimize impact to JSM (e.g., crushing, killing, sedimentation). Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that cannot be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 – Contribute toward management of JSM mussel populations and their habitats within the James River Basin, in support of federal and state recovery efforts. Because so few recruiting populations exist, it is essential to the survival and eventual recovery of this species that extant populations and occupied habitat be given priority for protection.

Rationale: The JSM Recovery Plan (Service 1990b) calls for protecting and restoring viable populations of the species in two additional rivers or three river segments within the James River drainage. Each river or river segment will contain at least three population centers that are dispersed to the extent that a single adverse event would be unlikely to eliminate JSM from its natural or re-established location. Much of the best habitat of JSM is within the proclamation boundaries of the Jefferson or George Washington National Forests. A viable population is defined as a naturally reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural environmental changes. Theoretical considerations by Franklin (1980) and Soulé (1980) indicate that 500 breeding individuals represent a minimum population level (effective population size) that would contain sufficient genetic variation to enable that population to evolve and respond to natural habitat changes. These populations must be separated to the extent that it is unlikely that a single event would eliminate or significantly reduce more than one of these populations.

Objective 1 - Where habitat has been degraded, restore and/or protect riparian habitat specifically for the conservation of the JSM.

Objective 2 - Enhance and/or restore JSM habitat or populations where habitat conditions, genetic information, and other necessary parameters indicate this is an appropriate action.

Objective 3 - Where habitat has been degraded, restore and/or protect water and substratum quality.

Objective 4 - Partner with stakeholders having responsibility and/or expertise in JSM conservation and recovery, and contribute resources to those efforts and programs in priority areas for mussel recovery.

Goal 2 - Determine, through research, feasible mechanisms to enhance extant populations, including augmenting and reestablishing the JSM into historic habitats and implement those mechanisms consistent with Goal 1 (Service 1990b).

Rationale: Mussel propagation technology and subsequent translocation are fast becoming important tools in the recovery of native populations (Garner 1999). Severe range restriction and overall population declines characterize the status of this species. As such, recovery may not be possible without augmenting some extant populations and/or reintroducing populations into suitable habitats within its historical range.

Objective 1 - Coordinate with stakeholders to identify extant populations and prioritize streams suitable for augmentation and reintroduction.

Goal 3 - Develop and implement a program to monitor population levels and habitat conditions (Service recovery task).

Rationale: During and after conservation actions are implemented, the status of the species and its habitat must be monitored to assess any progress toward recovery.

6.2.7.3 Measures to Avoid and Minimize Impacts

These measures apply to "may affect" counties in 6.2.7 and the maps in **Appendix G, Figure 6.2.7.3-1** for the JSM.

These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Measures in *italic* font text will be applied on a case-by-case basis depending on the requirements of the activity. These requirements include consideration of customer and business needs, practicality, and effectiveness as more fully described in Chapter 5 of this MSHCP. Details on selecting the appropriate waterbody crossing method are provided in Section 5.2.1.1.

<u>Surveys to Evaluate Presence and Relocation of Species in NiSource Action Areas</u>

1. A survey can be conducted to determine the presence of this mussel species. Mussel survey protocols designed to detect endangered mussels that often occur in low densities; protocols as of 2009 are provided in **Appendix L**. Survey methodologies must be evaluated at minimum every five years and be updated to the most effective survey methods currently available. If the most current methodology implemented by a biologist, qualified to conduct the survey, does not indicate the presence of the species, it will be classified as unoccupied habitat and the AMMs will not be mandatory.[42]

If a survey is not completed, presence will be assumed. In that case, all suitable habitat would be treated as occupied, and all mandatory AMMs must be followed. NiSource or its contractors will follow the Service-approved relocation plan as referenced below.

[42] However, NiSource may implement some of these measures if appropriate to protect potentially suitable habitat.

Survey and relocation may be implemented in the same time period (as one action) as long as both survey and relocation protocols are followed (general relocation protocols are identified in **Appendix L**, but may be modified in conjunction with Service Field Office based on conditions).

Relocation may be implemented only if: (1) all required permits are in place, (2) a Service-approved relocation plan documenting all relevant protocols including how and where the mussels will be moved is in place, (3) a contingency plan is in place to conduct additional consultation with the Service should the actual field survey not reflect the conditions identified in the approved relocation plan, and (4) a monitoring program to evaluate the effects of the relocation is in place. Relocation will include at least all individuals of the federally endangered species identified in the impact area and may include other species based on the assessment of the Service Field Office and other regulatory agencies. A copy of the survey and any reports will also be included in the annual report submitted to the Service.

Pre-Construction Planning: Preparation of an EM&CP

2. A detailed EM&CP will be prepared for any activity with potential effects (e.g., stream bed or stream bank disturbance, impacts to riparian habitat, activities causing sediment) within 100 feet of the ordinary high water mark of occupied mussel habitat. The plan will incorporate the relevant requirements of the NGTS ECS and include site-specific details particular to the project area and potential impact. The waterbody crossing will be considered "high-quality" for the purpose of preparing this plan regardless of the actual classification. The plan will be strongly oriented towards minimizing stream bed and riparian disturbance (including minimization of tree clearing within 25 feet of the crossing [**Figure 24, ECS**]), preventing downstream sedimentation (including redundant erosion and sediment control devices, which would be designed to protect mussel resources as appropriate), and weather monitoring by the Environmental Inspector to ensure work is not begun with significant precipitation in the forecast. The plan will comprehensively address all activities needed to complete the work and minimize take of mussels in occupied habitat including crossing the streams during dry periods when practical and using dry-ditch crossing techniques for intermittent streams leading to mussel habitat. The EM&CP will include the frac-out avoidance and contingency plans described in AMM #3 below. The EM&CP will also include a sediment control component for uplands that drain to and impact occupied habitat. Detailed erosion control plans will be developed specific to slopes greater than or equal to 30% leading directly to occupied habitat. These plans will include techniques such as hard or soft trench plugs, temporary sediment barriers, a wider trench at the slope base, and/or temporary slope drains (plastic). In areas with less than a 30% slope, ECS and AMM erosion control measures protective of mussels will be implemented. The plan will be approved in writing by NiSource NRP personnel prior to project implementation and will include a tailgate training session for all on-site project personnel to highlight the environmental sensitivity of the habitat and any mussel AMMs that must be implemented.

<u>Streambed Construction</u>

3. For activities in occupied habitat, install new or replacement pipelines and major repairs under the river bottom using HDD or other trenchless methods rather than open trenching unless the crossing evaluation report prepared in accordance with Section 5.2.1.1 and **Appendix J** indicates otherwise. Drilling should be carefully undertaken and a plan should be in place to minimize and address the risk of in-stream disturbance due to frac-outs. The plan should also specifically reference mussel resources in the vicinity of the crossing as a key conservation concern and include specific measures identified in the NGTS ECS, from standard industry practices, or other mutually agreed-upon practices to protect this resource. The plan will also include a frac-out impact avoidance plan, which will evaluate the site in terms not only of feasibility of conducting HDD, but the likelihood of large scale frac-out and its effects on mussels, and actions to address a large scale frac-out in occupied habitat. The plan should also consider the potential effects on mussels if drilling fluids are released into the environment. The plan must contain all information required for a FERC Section 7(c) filing at a minimum.

If, after detailed engineering studies (e.g., geotechnical, physiological, topographical, and economic), it is determined (and agreed to by NRP personnel) that an HDD is not feasible, a report will be prepared and included in the annual report submitted to the Service. However, due to the potentially significant amount of take that might occur for Ohio River crossings, open trenching in this river is not a "covered activity" as part of the NiSource MSHCP.

4. Install pipeline to the minimum depth described in the ECS and maintain that depth at least 10 feet past the high water line to avoid exposure of pipeline by anticipated levels of erosion based on geology and watershed character. Additional distance may be required should on-site conditions (i.e., outside bend in the waterbody, highly erosive stream channel, anticipated future upstream development activities in the vicinity, etc.) dictate a reasonable expectation that the stream banks could erode and expose the pipeline facilities. Less distance may be utilized if terrain or geological conditions (long, steep bank or solid rock) will not allow for a 10-foot setback. These conditions and the response thereto will be documented in the EM&CP and provided as part of the annual report to the Service.

5. For repairs in occupied habitat, do not install in-channel repairs (bendway weirs, hardpoints, concrete mats, fill for channel relocation, or other channel disturbing measures) except when measures in AMM #3 above are not feasible from an engineering design perspective, and then, only in conjunction with a stream restoration plan based on Rosgen (*see* Wildland Hydrology 2009 http://www.wildlandhydrology.com/html/references_.html) or other techniques mutually agreed upon by NiSource and the Service that result in no direct or lethal take of listed mussels.

6. Conduct replacements/repairs from a lay barge or temporary work bridges of the minimum length necessary to conduct the replacements/repairs rather than operating heavy equipment (e.g., backhoes, bulldozers) in-stream. Temporary construction and *equipment bridges are not to be confused with stone or fill causeways with pipe structures, which should not be employed in known or presumed occupied waterbodies.*

7. Remove equipment bridges as soon as practicable (this is typically interpreted to be a few days to a few weeks unless there are extenuating circumstances) after repair work and any site restoration is completed

8. As part of the routine pipeline inspection patrols, visually inspect all stream crossings in occupied habitat at least yearly for early indications of erosion or bank destabilization associated with or affecting the pipeline crossing that is resulting, or would before the next inspection cycle, likely result in sediment impacts to mussel habitat beyond what would be expected from background stream processes. If such bank destabilization is observed, it will be corrected in accordance with the ECS. Follow-up inspections and restabilization will continue until the bank is stabilized (generally two growing seasons).

9. Do not construct culvert and stone access roads and appurtenances (including equipment crossing) across the waterbody or within the riparian zone. Temporary equipment crossings utilizing equipment pads or other methods that span the waterbody are acceptable provided that in-stream pipe supports are not needed.

10. For equipment crossings of small streams, use half pipes of sufficient number and size that both minimize impacts to streambed and minimize flow disruption to both upstream and downstream habitat (**ECS, Figure 22**).

<u>Timing Restrictions to Minimize Impact to Reproducing Populations</u>

11. Impacts to the mussel reproductive period will be avoided by implementing a Time of Year (TOY) restriction from May 15 – July 31 of any year on any instream work (not including the installation or removal of equipment bridges) in the following JSM streams:

Upper James Watershed - Allegheny Co.
- Potts Creek

S. Fork Rivanna River Watershed - Albemarle Co.
- Moormans River
- Rocky Creek
- Wards Creek
- Piney Creek
- Buck Mountain Creek

N. Fork Rivanna River Watershed - Greene / Orange Co.
- Lynch Run
- Roach Run
- Swift Run
- Blue Run
- Preddy Creek
- Burnley Brook

For the remaining JSM rivers, creeks, and tributaries at least 70% of the individual project activities that affect the channel will be completed with a TOY restriction from May 15 through July 15 to avoid impacts to the JSM during the reproductive period. Of these 70% of projects, additional mitigation will be provided for those that occur from July 15 through July 31. The other 30% of the project's activities that affect the channel of the JSM streams can occur any time but will be subject to additional mitigation.

Pipeline Abandonment

12. Abandon pipelines in place to avoid in-stream disturbance that would result from pipeline removal unless the abandonment would be detrimental to endangered mussels.

Contaminants

13. As described in the ECS section on "Spill Prevention, Containment and Control," site staging areas for equipment, fuel, materials, and personnel at least 300 feet from the waterway, if available, to reduce the potential for sediment and hazardous spills entering the waterway. If sufficient space is not available, a shorter distance can be used with additional control measures (e.g., redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials). If a reportable spill has impacted occupied habitat:

a. follow spill response plan; and

b. call the appropriate Service Field Office to report the release, in addition to the National Response Center (800-424-8802).

14. Ensure all imported fill material is free from contaminants (including washed rock or other materials that could significantly affect the pH of the stream) that could affect the species or habitat through acquisition of materials at an appropriate quarry or other such measures.

15. For storage well activities, use enhanced and redundant measures to avoid and minimize the impact of spills from contaminant events in known or presumed occupied streams. These measures include, for example, waste pit protection, redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials, and a spill response plan provided to the Service as part of the annual report. These measures will be included in the EM&CP prepared for the activity.

16. Do not use fertilizers or herbicides within 100 feet of known or presumed occupied habitat. Fertilizer and herbicides will not be applied if weather (e.g., impending storm) or other conditions (e.g., faulty equipment) would compromise the ability of NiSource or its contractors to apply the fertilizer or herbicide without impacting presumed occupied mussel habitat. The EM&CP prepared for this activity (AMM #2 above) will document relevant EPA guidelines for application.

Withdrawal and Discharge of Water

17. Hydrostatic test water and/or water for storage well O&M will not be obtained from known or presumed occupied habitat unless other water sources are not reasonably available. To prevent desiccation of mussels, water from known or presumed occupied habitat will be withdrawn in a manner that will not visibly lower the water level as indicated by water level height on the stream channel bank. Employ appropriately sized

screens, implement withdrawal rates, and maintain withdrawal point sufficiently above the substrate to minimize impacts to the species.

18. Do not discharge hydrostatic test water directly into known or presumed occupied habitat. Discharge water in the following manner (in order of priority and preference):

a. Discharge water down gradient of occupied habitat unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.
b. If those circumstances occur, discharge water into uplands >300 feet from occupied habitat unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.
c. If those circumstances occur, discharge water as far from occupied habitat as practical and utilize additional sediment and water flow control devices (**Figures 6A&B, 7, 8, 14A&B; ECS**) to minimize effects to the waterbody.

Travel for O&M Activities

19. Do not drive across known or presumed occupied streams – walk these areas or visually inspect from bank and use closest available bridge to cross stream.

Zebra Mussels and Other Invasives

20. Clean all equipment (including pumps, hoses, etc.) that have been in a perennial waterbody for more than four hours within the previous seven days and will work in occupied or potential federally listed mussel habitat; following established guidelines to remove zebra mussels (and other potential exotic or invasive species) before entering a known or presumed occupied stream for a federally listed mussel, which is not known to be infested with zebra mussels (**Appendix L**). Do not discharge any water for other sources that might be contained in equipment (e.g. ballast water, hoses, sumps, or other containment). It is important to follow these guidelines even if work is not occurring in the immediate vicinity of these mussels since, once introduced into a watershed, invasive species could move and eventually affect the federally listed mussels.

6.2.7.4 Calculation of Incidental Take

Incidental take was calculated for the JSM using the following simple algorithm:

Stream Width x Impact Length (lethal and sub-lethal wet-ditch or dry-ditch model) x Percent Suitable Habitat = Acres of Habitat Impacted

Acres of Habitat Impacted x JSM Density = Impacts to Individuals

Operating Facts:

The stream crossing method will be determined by NiSource as described in Section 5.2.1.1. Take is calculated based on using the dry-ditch (i.e., dam and pump using coffer dams) method for all streams potentially occupied by JSM, because NiSource has agreed to only cross JSM streams using the dry-ditch approach unless HDD would prove, based on the analysis described in AMM #4, to be an acceptable approach. In cases where the analysis indicates HDD, it would be the preferred crossing method.

On occasion, NiSource will also use access fords/equipment bridges across streams that are not entirely within the existing ROW. These fords/equipment bridges are typically 15 feet in width and are commonly used by the landowner for other purposes. If the fords/equipment bridges are existing, then NiSource and the Service have determined that its effects on endangered mussels are insignificant and discountable. However, the construction and use of a new fords/equipment bridges will have take that NiSource would be responsible to mitigate for. It is also likely that NiSource will need to cross one or more of these streams in a location other than the existing pipeline corridor. The impacts from these crossings would be separate from and additional to those accounted for above. An additional amount of take (approximately 15%), calculated based upon the percentage of times that NiSource has looped pipelines at different stream crossing locations in the past, has been added to account for these mitigation requirements.

Key Assumptions:

NiSource used a reasonable worst case scenario with regard to its stream crossing activities and aggregate sediment impacts causing activities that could affect JSM. The entire area that would be impacted by covered activities (e.g., where multiple pipelines are in close proximity to each other) was identified and used for the total acreage calculation. Four large and 91 small stream crossing areas throughout the covered lands could affect JSM over the proposed 50-year ITP.

A density of 0.5 JSM per square meter will be used across all streams in the calculation of take. In 2006, Virginia Department of Game and Inland Fisheries and partners conducted quantitative surveys of an apparently stable and reproducing population in Johns Creek, a tributary to Craig Creek near Maggie, Virginia that yielded 1.8 JSM per square meter indicating a density of approximately 860 mussels (Service 2009c). Johns Creek is one of the best remaining populations and densities in other streams are likely to be much lower. The over-arching trend in density and abundance, according to the draft 5-Year review, is that individuals usually number less than 10 at any one reach or site occurrence, and often just one individual is found (Service 2009c). The estimate of 0.5 reflects the concern that as yet unknown, comparatively robust populations of JSM may be extant in the James River watershed.

There is little discussion of suitable habitat in the literature and no consensus among biologists on what this number should be. The percent suitable habitat was based on the evaluation of a small number of studies that indirectly addressed how much of the stream substrate is occupied by mussels when a mussel assemblage is present (Hastie et al. 2000; Hastie et al. 2003; and Morales et al. 2006) and discussion with Service biologists and a consulting biologist experienced in surveying mussels (Villella 2009). Morales et al., who were looking at mussels in an upstream reach of the Mississippi, and Hastie et al., conducting research in a small Scottish stream mapped the presence of mussels and indicated areas of the substrate that contained animals and areas that did not. Non-occupied areas may be unsuitable for various reasons (e.g., sheer forces during high flows, unstable or otherwise unsuitable substrate, areas that are regularly de-watered). Anderson (2000), examining mussels upstream and downstream of an existing bridge across the Allegheny River at Foxburg, Pennsylvania, looked at three reaches of the river, upstream of the bridge (total area 3.3

acres), immediately downstream of the bridge (total area 7.28 acres), and further downstream (total area 7.44 acres). In those three areas, he found that the mussel bed covered approximately 1.12 acres upstream (34%), 1.79 acres immediately downstream (25%) and 3.7 acres further downstream (50%).

Mussel experts who provided input on this question could only suggest that this metric is site-dependent and variable according to a number of factors. Therefore, in an extant mussel assemblage, the percent of the substrate within the stream banks that is occupied lies somewhere between 0% (since the starting premise is that mussels are present) and 100%. Within a mussel assemblage, endangered mussels would be presumed to cover less area since they are frequently (but not always) a rare component of those assemblages.

NiSource and the Service recognize the limitations of this metric as applied to any one stream. Some streams may have nearly 100% of the bottom occupied by an endangered mussel at a given density and other streams may have almost no presence, as in small remnant populations. Another factor to consider is how the NiSource impact zone overlaps a mussel assemblage. It is likely that in some cases, NiSource impacts will fall completely within the limits of a mussel assemblage. In other cases, the NiSource impact zone will fall partly within an area of mussels and partly within an area outside of an assemblage, given that mussels are distributed discontinuously within occupied streams. NiSource and the Service believe that if applied across all of the streams in the watershed, and across the entire length of stream for which impacts are estimated, that a central estimate should be employed in determining a reasonable worst case scenario. In the case of JSM, however, Service biologists in the Virginia Field Office recommend a higher estimate of suitable habitat based on experience with this species. Therefore, take was calculated using the estimate that JSM would occupy 75% of the stream bottom at the estimated density for this species.[43]

The impact area was calculated using both the sediment transport model and the dry-ditch model. The sediment transport model estimates a lethal impact area covered by 0.236 inches of sediment. A sediment plume is predicted to extend further downstream corresponding to a harm/harassment area having a 600 mg/l concentration of suspended sediment (Ellis 1936; Aldridge et al.1987). The dry-ditch model estimates a 75-foot lethal zone and a 100-foot harm/harassment zone downstream of the coffer dams.

A sediment transport estimation methodology was developed to aid in identifying the effects of open-cut waterbody crossing activities on mussels within suitable habitats. Because of the large number of streams within the project area, ENSR hydrologists and biologists, with input from the Service and NiSource, developed a simplified procedure to formulate and quantify the three processes of: (1) suspended sediment supply to a stream from site disturbance; (2) instream transport and dispersion of the sediment by representative size fractions; and (3) sediment deposition on the

[43] The use of a central value (75%) in the reasonable worst case scenario take calculation (model) is based on the best available information and will be revisited as new information becomes available.

streambed. Three sites (the Duck River in Tennessee, the Elk River in West Virginia, and the James River in Virginia) were selected for application of the estimation procedure. Site selection was based on: (1) a list of "may-affect" stream crossings for the NiSource project; (2) the availability of nearby USGS stream gauge data and related measurements; and (3) a likelihood of moderate flow conditions (discharge, depth and width, velocity) during the anticipated construction season (July through December). Moderate flow conditions may be the most significant in terms of potential effects of sediment deposition on mussel beds. Under the procedure, small discharges and slower flow velocities or shallow depths generally will not result in the calculation of sediment transport and deposition at distances as great as in the larger streams. Very large rivers, such as the Ohio and Tennessee rivers, absorb sediment inputs within their background conditions and disperse them fairly quickly within the cross-section to levels below the criteria. Although general in nature, NiSource and the Service believe this model is suitable for use in developing a reasonable worst case scenario across the streams and species in the MSHCP. Additional details of this methodology are presented in **Appendix L**.

This methodology assumes successful implementation of the NGTS ECS and uses construction parameters and available physical and hydrologic environmental characteristics of three streams. Stream flow conditions (discharge, depth and width, velocity) during the anticipated construction season (July through December) were also considered.

Another factor was the recognized criteria for mussel mortality (i.e., a burial depth of 0.236 inches or more and a suspended sediment concentration of 600 mg/l or more) (Ellis 1936; Aldridge et al.1987). NiSource and the Service evaluated the potential impacts of NiSource actions on host fish and glochidia, coordinated that analysis with Service Field Offices, and concluded that the impacts on host fish and glochidia would be insignificant and discountable. Select waterbodies with the highest potential for significant transport were analyzed in greater detail. Those with the resulting longest transport distances that met mussel mortality criteria were selected to define the impact area with an error margin for the mussel species in the MSHCP.

NiSource proposes to use a dry-ditch methodology for stream crossing where technically feasible (current technology permits this on streams of approximately 100 feet wide or less). It is presumed that all stream crossings affecting JSM will be crossed using dry-ditch technology. The 75 feet within the coffer dams (lethal impact zone) plus 100 feet downstream (lethal impact/harm zone using the aforementioned sediment depth and suspended sediment values) were used to determine the action area for each crossing. NiSource and the Service recognize that there is some level of uncertainty associated with the sediment transport estimation methodology, both in terms of the predictive power of the methodology and to what extent sediments might impact mussels in any particular location. NiSource will evaluate the performance of both methodologies downstream of crossings using adaptive management.

There is no designated critical habitat for this species. Take of JSM mussels from the NiSource covered activities would occur primarily from impacts directly associated with the installation, repair, or removal of pipeline across occupied stream habitat. In addition to these impacts, other NiSource activities may result in take. Most of these activities occur within the impact zone and are calculated with and included in the crossing actions used to estimate take below.

The take calculation for JSM mussel is presented in **Table 6.2.4.4-1**. As shown, the above-described impacts result in the reasonable worst case scenario of impacts to approximately 12.8 acres of habitat. This translates into take of approximately 19,416 JSM over the 50-year life of the permit. The 19,416 JSM estimated to be taken is important for an understanding of the impact on the species. It is not, however, the best method for identifying the amount of mitigation necessary to fully compensate for the impact of the take. Because the effects on habitat are more easily and accurately assessed, they better reflect the impact of the take. NiSource has therefore used acres as the basis for mitigation.

In addition, aggregate impacts from various sediment-causing activities could have long-term and significant impacts on the same 12.8 acres and additional acres (removed from the immediate stream crossing sites), particularly in conjunction with other development activities in the watershed. NiSource calculated aggregate take based on the total acreage of NiSource pipeline corridor (using a 50-foot average width) overlapping the range of the JSM. The total riparian area protected will be 1.5 acres, which is calculated as the total area of NiSource pipeline ROW in all impacted watersheds (3,834 acres) multiplied by the average of the percentage of area the pipeline impacts in each watershed (0.152%), divided by the total number of impacted watersheds (four). This provides an index of how prevalent NiSource pipelines are in the affected watersheds and therefore a surrogate for the sediment and associated impacts on mussels.

$$\frac{3834 \times 0.00152}{4} = \mathbf{1.5}$$

The take calculations presented here are designed to reflect a reasonable worst case scenario across the entire range of potentially affected streams. It is a reasonable worst case, but not certain, for example, that NiSource would actually conduct covered activities at all the locations affecting JSM over the 50-year permit duration. Take is based on the assumption that JSM occur in the aforementioned densities, over the estimated stream width, and occupied habitat percentage described above at every stream crossing. It is possible that some crossings may have higher or lower densities and more or less suitable habitat than modeled. However, the proposed calculations produce a reasonable worst case scenario over the life of the MSHCP, although it is likely not accurate for any one stream at a given point in time.

6.2.7.5 Impact of Take Analysis

The JSM was native to the James River system in Virginia and West Virginia, as well as the Dan and Mayo river drainages of the Roanoke River basin in North Carolina and the Tar River (NatureServe 2007a). It is currently documented in only a few creeks and small rivers in the upper James River basin; and in the Roanoke River basin, within the last 10 years, the species was found in the Dan River (North Carolina), the South Fork Mayo River (Virginia), and the Mayo River (North Carolina).

The draft 5-Year Review (Service 2009c) describes the overall status of the species in the remaining drainages where it is known to occur. The Craig Creek mainstem distribution is patchy with low density suggesting decline in the Craig Creek mainstem. The Patterson Creek JSM population may be extirpated. In Johns Creek, a tributary to Craig Creek**,** the population appears stable and reproducing just upstream of Maggie, Virginia with a total population estimated at approximately 860 mussels. JSM is present, but there are insufficient data to evaluate stability, reproduction and true density in Dicks Creek. There are insufficient data on the density and distribution of the JSM population in the James River mainstem to completely evaluate status at this time. However, it appears to be extirpated, as it did at the time the JSM Recovery Plan was written. There is not enough information to assess whether the JSM is stable, declining, or increasing in the Rivanna River drainage. In the Maury River drainage, the species appears stable and recruiting only at Mill Creek. For the Calfpasture, Little Calfpasture, Maury River mainstem, Potts Creek mainstem, and Catawba Creek mainstem the species appears extirpated. Twelve live JSM were found in 2004 and 2005 in the Pedlar River. In addition, new occurrences have been discovered in Little Oregon Creek, a tributary to Dicks Creek, the Bullpasture River, the Cowpasture River, but these new occurrences represented a handful of individuals. Twenty individuals of various age classes were found at multiple locations in Swift Run and a tributary, although the distribution is patchy. Four tributaries of the Rivanna River also support one known location of JSM, but densities are low. In 2004, a small number of JSM were discovered at two locations in the Hardware River. Finally, there are discoveries of JSM in three reaches in the Roanoke River drainage. Additional discoveries of this species in the James River watershed have, in virtually every case, been small and patchily distributed.

I. Genetic-Level Impacts

The 5-Year review summarizes the genetics work of Petty (2005), and the following facts stand out: (1) based on morphological, anatomical reproductive similarities, similar fish host specificity, and many shared mitochondrial and nuclear DNA genetic sequences, the JSM is the same species throughout its range in the Dan River sub-basin of the Roanoke River basin and James River basin; (2) at this time the Dan River sub-basin and James populations should be managed as separate management units because they are subject to reduced gene flow with no potential for exchange, and evidence genetic distinctiveness of several haplotype frequencies; (3) genetic haplotype frequency data indicate no reason to restrict reciprocal exchanges of JSM from the Dan and South Fork Mayo Rivers' in the Roanoke drainage; (4) Ward's Creek JSM appears to be isolating and evidences a loss of genetic diversity (smallest number of haplotypes); and (5) analysis of allele frequency at microsatellite loci is recommended before reciprocal exchanges among the South Fork Mayo, Dan and South Fork Potts populations is recommended (Service 2009c).

Petty (2005) states river systems can be considered habitat "islands" on the larger landscape; each river is separated from other rivers by habitat unsuitable for bivalves. Habitat fragmentation is common for freshwater species, causing disjunct gene pools (Mulvey et al. 1997). Population fragmentation is likely associated with loss or redistribution of genetic variability and is a concern for conservation biologists attempting to manage freshwater species (Templeton et al. 1990). It has been suggested that a minimum population size of 5,000 individuals might be necessary under natural conditions (restricted mating or overlap of generations) to avoid loss of genetic diversity of animal species (Schonewald-Cox et al. 1983). The likelihood is high that the majority of the populations of JSM are below the effective population size required to maintain long-term genetic and population viability (Service 2009c).

The principle genetic consequences of activities that reduce effective population size is the loss of genetic variance through genetic drift and consequently the potential reduction in the ability to adapt and a reduction in fitness through inbreeding depression (Jones, Hallerman, and Neves 2006; Schonewald-Cox et al. 1983). Genetic-level impacts are possible from NiSource activities under the MSHCP. NiSource activities may also negatively influence recruitment.

II. Population-Level Impacts

There are no good population estimates for the JSM. It is known that this species occurs at low densities (often less than 10 individuals per assemblage) and that even populations that are considered stable like those in Johns Creek, Mill Creek, South Fork Potts Creek, and the South Fork Mayo River support only about 300-800 individuals over each creek (Service 2009c).

Limited knowledge of abundance and range at the time of listing makes it difficult to determine whether the JSM populations, over the long term, are increasing, stable, or declining. The species appears to be reproducing throughout much of the range known at this time due to the fact that current records submitted by surveyors include live specimen shell measurements, which imply age (Service 2009c). More information is available to suggest that JSM may be considered stable and reproducing in Johns Creek, South Fork Potts Creek, Mill Creek, and the Roanoke River drainage. However, densities are low even in these waterways, and lower still at most other occurrences. It is possible that even small apparently non-viable populations could after years at very low levels begin to reproduce (Anderson 2009). Therefore, although small isolated populations are vulnerable to losses resulting from events such as droughts, floods, toxicant spills, or other stochastic events, they are nonetheless important components in the conservation of the species.

Take from stream crossing activities, depending on the location and on how robust and spread out within the stream the population is, could negatively affect, further reduce the viability, or even extirpate one or more JSM populations. The draft 5-Year Review states that JSM habitat in all occupied watersheds has been modified through the input of sediments to some extent (Service 2009c). Recruitment reduction or failure is a potential problem for virtually all JSM populations, a potential condition exacerbated by its reduced range and increasingly isolated populations (Service 1990c). Aggregate impacts over the life of the ITP could further reduce the suitability of both occupied habitat and habitat that could be colonized naturally or through enhancement and reintroduction. These impacts could also negatively affect JSM population dynamics.

In summary, it is reasonable to conclude that small, isolated populations, could be significantly impacted where NiSource activities intersect stream reaches providing habitat for those populations. Moreover, even the more robust JSM populations have comparatively low densities and overall numbers. Reduced populations, particularly if comprised of older individuals, as many JSM populations likely are, may take several decades to recover even if no further degradation occurs. Based on the 5-Year Review, there are 20 known populations of JSM; however for purposes of the MSHCP, all streams in the James River watershed are assumed to harbor JSM. Seven known populations are possibly extirpated. Of the 20 known populations, three are considered to be reproducing populations; the reproductive status of an additional five known populations is undetermined. NiSource would not affect any of the known reproducing populations and only one of the undetermined reproductive status populations. NiSource would affect three known populations considered small, isolated, or non-reproducing. In other words, NiSource would potentially affect four of the 20 known populations, but would not directly impact the best remaining populations (Johns Creek, South Fork Potts Creek, Mill Creek, and the Roanoke River drainage) of JSM. NiSource would affect approximately 79 additional streams in the James River watershed that are assumed to be JSM habitat.

Individual and potential population impacts to JSM from acute and chronic impacts associated with NiSource activities are possible. These impacts over the life of the ITP suggest that the impact of the taking of the JSM from NiSource activities will be greater than the simple take estimate of loss of individuals and habitat. This results from: (a) impacts to multiple populations including possible impacts to currently unknown populations with low numbers and diminished capacity to recover from impacts; (b) long-term sediment impacts to JSM populations and habitat; and (c) the narrow geographic limits of this species; but ameliorated because there would be no NiSource impacts to key stable/reproducing populations of JSM (Johns Creek, South Fork Potts Creek, Mill Creek, and the Roanoke River drainage).

6.2.7.6 Compensatory Mitigation

NiSource will mitigate for the impact of take of JSM resulting from its actions in the covered lands. This take is anticipated to occur in two ways. The first is the impact of take that may result from direct loss of individuals or habitat from stream crossings activities employed to install new pipeline, or repair or replace existing pipeline. The second kind of take is aggregate, which would result primarily from sedimentation from non-aquatic activities within the watershed, and secondarily from loss of riparian habitat, and other similar comparatively minor and indirect impacts detailed above. Where the term “protection” appears below, please refer to Section 6.2 for a further definition and the requirements for securing conservation of mitigation lands and other real property interests.

Before mitigation occurs, NiSource must undertake restoration activities at certain impacted areas. Although these constitute minimization measures for the purpose of the MSHCP, the required mitigation discussed below, in part builds upon these efforts. In all cases where stream crossings occur, NiSource will restore the disturbed streambed and riparian area within its ROW resulting from its activities. Restoration will occur during the same construction season (next appropriate planting season for riparian restoration) as impacts unless there are extenuating circumstances and the Service is informed of those issues. The basic restoration will be conducted in accordance with standard industry specifications as defined in the ECS and required by FERC and other relevant regulatory agencies. This will involve at minimum restoration of any impacts to the depth, flow, channel bottom, or banks, as nearly as practical, back to the pre-impact condition. Vegetation restoration must be with site-appropriate native species.

Mitigation at Restored Streambed and Riparian Areas

As the initial step in compensatory mitigation, NiSource will enhance the restored stream substrate within the construction zone to habitat that is optimal for JSM mussels. This would typically involve either replacement or importation of clean, appropriately sized material for mussel re-colonization. NiSource will also enhance, where feasible, any pre-construction deficiencies associated with the depth, flow, bank stability, or riparian vegetation that would be detrimental to mussel re-colonization, survival, and reproduction. NiSource expects the enhancement of the substrate to result in more opportunities for recruitment of JSM by providing suitable settling habitat for juvenile mussels. Enhancement serves as one component of NiSource's overall mitigation program, but does not wholly compensate for the impact of take because it has the potential to be disturbed in the future. Therefore, additional compensatory mitigation (riparian restoration) is required as discussed in detail below.

Because the ITP spans 50 years and it is uncertain when impacts would occur and mitigation would become necessary, NiSource will have some flexibility to implement one (or more) of the Tier 1 mitigation options for New Construction Take. NiSource can initiate mitigation for New Construction Take at any time, but not later than during the same period, as a new project likely to result in take is started. The selection of which Tier 1 mitigation option NiSource will implement to compensate for New Construction Take will be based upon the highest need of the species at the time the mitigation becomes necessary, as recommended by NiSource (*see* Section 5.3.4) to the Service for its approval or declination. The Service will make the final determination on which of the Tier 1 options best meets the needs of the species. Mitigation for New Construction Take of JSM must follow the Tier 1 mitigation option guidelines and sideboards outlined below.

All of the Tier 1 Options and the mitigation for aggregate take will address key conservation needs of this species and when implemented following the sideboards and required amounts will fully compensate for the impact of Aggregate Take and New Construction Take covered under the MSHCP.

Mitigation for Aggregate Take Activities

In addition to the requirements above, NiSource will provide mitigation to compensate for sediment-producing and other indirect impact-producing activities (Aggregate Take). NiSource will initiate mitigation for Aggregate Take within the first seven years after the incidental take permit has been issued to ensure adequate and timely compensation for O&M activities in the watersheds where impacts would likely occur over the life of the ITP. Mitigation for Aggregate Take will focus on habitat impacts as a surrogate for individual take and use habitat protection/restoration as the mitigation option. The protection or restoration of riparian habitat is designed to reduce the sediment impacts to JSM by buffering occupied streams. NiSource expects this to result in improved survival and reproduction of mussels in the mitigation area.

Implement protection and restoration that benefits an extant population of JSM (coordinate with the Service and the Virginia Department of Game and Inland Fisheries about documented occurrences). Mitigation should provide additional benefits to the species at the identified site (i.e., sites that are already secure, or at the other end of the spectrum, sites where there is little opportunity to improve the habitat, should not be considered). The total riparian area protected to mitigate for aggregate take will be 1.5 acres.

A 1:1 ratio is appropriate for this species because the aggregate impacts from NiSource activities to both the population and the habitat are expected to be comparatively minor.

Sideboards: (a) there must be a minimum 50-foot-wide to a maximum 150-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams generally should have wider buffers;[44] (b) the vegetative buffer must meet minimum NRCS standards - for water quality and riparian corridors (**Appendix L**); (c) at least 50% of the total riparian buffer must be restored (i.e., cropland or other highly erosive land use planted to meet NRCS standards - this 1:1 ratio of restoration to protection reflects the purpose of the aggregate take mitigation to address sediment impacts specifically); (d) instabilities in the riparian zone (e.g., gullies, bank erosion) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be minimal earth disturbance on the restoration sites; (e) individual mitigation sites must be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); (f) water quality, instream habitat, and instream connectivity must be evaluated in terms of long-term viability of the JSM population within the mitigation area; (g) mitigation projects must be completed no more than three years after initiation; and (h) riparian buffers must be permanently protected in fee or by easement following easement guidelines (**Appendix P**).

Mitigation When NiSource Relocates JSM (AMM #1)

NiSource has the option described in AMM #1 to relocate mussels as part of a stream crossing project. If the relocation is successful, as discussed in AMM #1, the following mitigation is required in addition to the enhancement and aggregate take mitigation described above. When implemented with the other required mitigation and in concert with mussel relocation described in AMM #1, and if the sideboards and Service guidelines are followed, this option would fully compensate for the impact of take by conserving mussels that would otherwise be killed or harmed. In addition, habitat at the relocation site will be protected and enhanced. NiSource can initiate this

[44] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

mitigation option at any time but not later than during the same period as a new project likely to result in take is started.

Find, relocate, and monitor all JSM and other mussels within the assemblage impacted by the project to a suitable site upstream or downstream of the impact zone, and restore riparian habitat at the site of relocation, or at an upstream location as near to the mussel relocation site as possible, at a 1:1 ratio of the acreage amount of in-stream habitat impacted.[45]

Sideboards: (a) follow the most current protocols for mussel location, transport, relocation, and monitoring, but the last monitoring cycle must occur no earlier than the fifth year of relocation; (b) there must be a minimum of 75% survival of relocated JSM mussels after five years or additional mitigation will be required; (c) if less than 75% survival rate for JSM is achieved at five years, NiSource will be responsible to implement riparian restoration at the ratios indicated in new construction take mitigation below, minus any riparian restoration completed for the relocation; (d) sideboards for riparian restoration will follow those described in sideboards for new construction mitigation below; (e) suitable habitat must meet basic mussel requirements of depth, substrate, flow, water quality, host fish presence, and riparian vegetation (existing or post-mitigation restoration); (f) suitability of a site will be determined in coordination with the Service; and (g) NiSource will provide a report to the Service one year after relocation and again after the fifth year post relocation on the status of the relocated JSM mussels.

Mitigation for New Construction Activities when JSM is not Relocated

The selection of which mitigation option NiSource will implement to compensate for New Construction Take will be based upon the highest need of the species at the time the mitigation becomes necessary, as recommended by NiSource to the Service for its approval or declination. For JSM, initially there is only one option available. Mitigation for new construction take of JSM must follow the mitigation option guidelines and sideboards outlined immediately below including the enhanced mitigation ratios for projects affecting habitat during the period 15 May to 31 July. Mitigation for new construction take will fully compensate for the impact of take by protecting and restoring the riparian zones that moderate water temperature, provide nutrient inputs, and reduce sediments and other contaminants along occupied streams, thereby improving the quality of the habitat. NiSource expects this to translate into increased survival and reproduction of mussels in the mitigation area.

Protect and Restore Existing JSM Habitat. Protect and restore riparian buffers associated with occupied JSM habitat (coordinate with the Service and the Virginia Department of Game and Inland Fisheries about documented occurrences). Because of the impact of take on this species, the mitigation amount required is a 2.0:1 ratio of the acreage amount of instream habitat impacted by stream crossings affecting

[45] A 1:1 ratio is appropriate because the primary thrust of the mitigation is the relocation of the mussels – the restoration is an additional step to improve what will already be suitable habitat (otherwise mussels could not be relocated there).

stable/recruiting populations (none at the time of issuance of the ITP). For stream crossings of all other JSM streams the mitigation ratio will be increased by a multiplier of 1.5 to compensate for greater impacts to small isolated populations that may have less resilience. In addition, a multiplier of 3.0 will be applied to habitat that is only protected and not restored.

Stable/Recruiting Populations

Buffer Restoration Ratio = 2.0:1

Stream Preservation Ratio = 2.0 (x3):1 = 6:1

Small Isolated Populations

Buffer Restoration Ratio = 2.0 (x1.5):1 = 3.0:1

Stream Preservation = 2.0 (x3) (x1.5):1 = 9:1

Mitigation Enhancement for Activities Affecting Habitat from 15 May to 31 July:

Stable/Recruiting Populations

Buffer Restoration Ratio 2.0 (x 2.0):1 = 4.0:1

Buffer Preservation Ratio = 2.0 (x 3.0) (x 2.0):1 = 12:1

Small Isolated Populations

Buffer Restoration Ratio = 2.0 (x 1.5) (x 2.0):1 = 6:1

Buffer Preservation Ratio = 2.0 (x 3.0) (x 1.5) (x 2.0):1 = 18:1

Sideboards: (a) habitat acquired or restored must benefit an extant population of JSM; (b) projects must be in the James River watershed – NiSource will coordinate with the Virginia Field Office prior to project impacts to identify the highest priority subwatersheds for mitigation; (c) projects can be completed before take of JSM occurs but not later than two years after the take occurs; (d) buffer restoration denotes establishment of buffer areas where none were previously present. Preservation denotes the protection in perpetuity of riparian areas adjacent to streams as necessary to ensure protection and enhancement of the overall stream. There must be a minimum 50-foot-wide to maximum 150-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams generally should have wider buffers[46] – buffer establishment includes planting native species and associated measures such as fencing, posting, and livestock exclusion; (e) instabilities in the riparian zone (e.g., gullies, bank erosion, etc.) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be limited earth disturbance on the restoration sites; (f) the vegetative buffer must meet minimum NRCS standards for water quality and riparian corridors (**Appendix L**); (g) at least 25% of the total riparian buffer must be restored (i.e., cropland or other highly erosive land use planted to meet NRCS standards); (h) individual mitigation sites must

[46] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); and (i) habitat acquired or restored must be permanently protected in fee or by easement following easement guidelines (**Appendix P**).

Mitigation Options for Possible Future Consideration

These options are not fully documented since they would not be immediately available to NiSource. These measures are not deemed acceptable mitigation at this time for various reasons including the availability of complete science to implement them. At the time of consideration, the Service and NiSource would determine whether a major amendment would be required before they could be implemented. The amount of mitigation required for these options would be determined as part of the amendment authorizing their use.

Identify Augmentation, Expansion, or Reintroduction Streams and Conserve, Restore, and Enhance Habitat for Augmentation, Expansion, or Reintroduction: Using Service-approved methodology, identify sites within the range of the JSM that, with restoration, could be suitable for augmentation, expansion, or reintroduction efforts and protect and, where necessary restore, stream-bed and riparian habitat specifically for the successful augmentation, expansion, or reintroduction of JSM mussels.

Sideboards: (a) sites for this mitigation should be selected and site plans developed based upon factors including extant JSM population size, demographic composition, and population trend data (where applicable), potential site threats, habitat suitability, and any other limiting factor that might decrease the likelihood of long-term benefits from population augmentation, expansion, or reintroduction efforts (see McGregor 2005 for work initiated in Kentucky for JSM and other mussels); (b) work will be coordinated with the Service at the time initiated; (c) final products will be directly applicable to Service or other efforts to augment, expand, or reintroduce JSM mussels; (d) habitat acquired or restored must be permanently protected; (e) habitat acquired or restored must be tied to and benefit an augmented, expanded, or reintroduced population of JSM; and (f) projects must be completed either before impacts to JSM occur or within two years after impacts.

Develop Genetic Information for Conservation of JSM: The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations developing genetic information, necessary in part to avoid the deleterious effects of mixing distinct populations (Neves 2004), on source and receiving populations for the propagation or augmentation/expansion/reintroduction of JSM mussels and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow all Service guidance and regulations on acquiring and analyzing genetic information; (b) the products developed will be directly applicable to augmentation/reintroduction of JSM; and (c) projects must be completed either before impacts to JSM occur or within three years after impacts.

Propagate JSM:[47] The Mitigation Panel will identify and engage partner organizations based upon who is leading the development of, improving, or implementing propagation technology and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg. 56916-56922, September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the entity will work with the Service to ensure that there exists or will exist in the near future a suitable site for reintroduction/expansion/augmentation of a JSM population with the propagated mussels; and (d) projects must be completed either before impacts to JSM occur or within two years after impacts.

Augment/Reintroduce JSM:[48] The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations who are augmenting or expanding JSM populations or reintroducing JSM into their historic range and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg. 56916-56922, September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the reintroduction/expansion/augmentation will occur in a suitable site approved by the Service; (d) the mitigation must include monitoring of populations and habitat conditions to evaluate the effort and assess the long-term viability of the augmented/expanded/reintroduced JSM population(s); and (e) projects must be completed either before impacts to JSM occur or within two years after impacts.

6.2.7.7 Additional Actions Available to NiSource to Benefit the Species

NiSource is committed to implement AMMs and mitigation. In addition there are other important actions that NiSource may choose to initiate on its own or in concert with state agencies, non-government organizations, or other entities to further benefit this species. These would not in any way alter the requirements for compensatory mitigation, but may fit into NiSource's landscape level approach to conservation.

[47] This is not a high priority for the Service Virginia Field Office at this time because protocols and plans necessary to conduct these activities effectively are currently lacking. Efforts are under way to begin the process of developing appropriate methods.

[48] This is not a recommended strategy at the time of development of the MSHCP. Habitat conservation should take precedence over augmentation/reintroduction. Most JSM populations are declining due, presumably, to habitat degradation. Putting more JSM in to streams with degraded habitat could result in increased JSM mortality. The proposed research would be critical to reach a point that additional augmentation/reintroduction is likely to succeed.

Fund research[49]

Identify and map activities or practices within each ecosystem that may affect the JSM and its host fish at known sites, and at potential augmentation/reintroduction sites.

Determine contaminant sensitivity for each life stage, particularly sedimentation.

Surveying and monitoring

Implement a quantitative monitoring program at sites within the reproducing populations to assess the reproductive condition of these populations.

6.2.8 Sheepnose Mussel

The sheepnose mussel (*Plethobasus cyphyus*) was listed as an endangered species by the Service in 2012 (Service 2012). It has been extirpated or reduced to isolated populations throughout much of its former range. Historically, the sheepnose occurred throughout much of the Mississippi River system with the exception of the upper Missouri River system, and most lowland tributaries in the lower Mississippi River system. This species is known from the Mississippi, Ohio, Cumberland, Tennessee, and Ohio mainstems, and scores of tributary streams rangewide. The sheepnose was historically known from 77 streams (including one canal) in 15 states, although it may always have been comparatively rare (Service 2002a).

Impacts and potential resulting take of sheepnose are likely to occur in the following counties: Madison, Clark, Fayette, Bath, Rowan, Nicholas, Pendleton, Bracken, Mason, Lewis, Greenup, and Boyd counties, Kentucky; Clermont, Brown, Adams, Scioto, Lawrence, Gallia, Meigs, and Washington counties, Ohio; Wayne, Cabell, Mason, Jackson, and Wood counties, West Virginia; and Sunflower County, Mississippi.

Adult freshwater mussels are filter-feeders, siphoning phytoplankton, diatoms, and other microorganisms from the water column. Mussels tend to grow relatively rapidly for the first few years, and then their growth slows appreciably at sexual maturity (when energy is being diverted from growth to reproductive activities). There is ongoing discussion among scientists concerning the life span of mussels, but as a group, they are generally acknowledged to be long-lived organisms. Sheepnose are relatively long-lived with life spans of 20 years or more (Service 2009a).

Most mussels, including the sheepnose, have separate sexes. Males expel clouds of sperm into the water column, which are drawn in by females through their incurrent siphons. Fertilization takes place internally, and the resulting zygotes develop into specialized larvae termed glochidia inside the water tubes of their gills.

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[49] Refer to the *National Strategy for the Conservation of Native Freshwater Mussels* compiled by the National Native Mussel Conservation Committee (1998) for additional information on conserving North America's imperiled mussel fauna. Shute et al. (1997) also outlined management and conservation considerations for imperiled mussels and other aquatic organisms, while incorporating ecosystem management into the equation.

The minute bivalve glochidia develop over a period of days to months. This species is thought to be a short-term summer brooder, having a spring or early summer fertilization period with the glochidia being released during the summer. Glochidia must come into contact with a specific host fish, usually within 24 hours, in order for their survival to be ensured. Without the proper host fish, the glochidia will perish (Service 2002a). After a certain amount of time (from hours to weeks), depending on water temperature and species, the glochidium transforms to a juvenile and drops off the host fish. The juvenile then burrows into the substrate or attaches to a larger object with a byssal thread (Service 1994).

In part because sheepnose, like virtually all freshwater mussels, relies on this parasitic larval stage. Jantzen et al. (2001) report greater than 99% mortality for glochidia. Though not specific to sheepnose, this estimate and the estimates of survival that follow are likely typical for sheepnose and most mussels in North America. Probability of survival from mussel glochidium to benthic recruit has been estimated to range from 1 $x10^{-6}$ (Young and Williams 1984) to 39 x 10^{-6} (Haag 2002). Transition from glochidium to juvenile represents a very large bottleneck—a single female's reproductive output is reduced from thousands of glochidia to <1 offspring per year (Berg, et al. 2008). The low fecundity suggests the need for a large population to produce a large annual cohort (Musick 1999).

Little is known regarding host fishes of the sheepnose mussel. The sauger (*Stizostedion canadense*) is one known natural host, but others are assumed to be available. A new host fish, the central stoneroller (*Campostoma anomalum*), was recently confirmed by Watters (NatureServe 2007a).

The sheepnose is primarily a larger-stream species. It occurs primarily in shallow shoal habitats with moderate to swift currents over coarse sand and gravel (Service 2002a). Habitats with sheepnose may also have mud, cobble, and boulders. Specimens in larger rivers may occur in deep runs (Service 2002a).

6.2.8.1 Activities and Impacts Analysis

The decline of the sheepnose in the Mississippi River system and other mussel species in the eastern United States is primarily the result of habitat loss and degradation. These losses have been well documented since the mid-19th century. Chief among the causes of decline are impoundments, channelization, chemical contaminants, mining, and sedimentation (Service 2002a).

The status assessment (Service 2002a) lists numerous ongoing threats to the sheepnose. Many of these are the same activities that have caused the historic decline of this species. Much of the sheepnose habitat has already been impounded, but impoundments, if constructed in sheepnose habitat, would continue to be a threat. Channel maintenance on large rivers continues to be a threat where that coincides with sheepnose habitat. Chemical contaminants, from both point sources and spills, and the impacts of chronic low-level contamination, continue to impact sheepnose. A variety of mining activities have the potential to affect sheepnose including coal and sand and gravel mining. Sedimentation and the various stressors that it produces continue to threaten mussels, including sheepnose, throughout the covered lands. Development poses a threat to sheepnose in specific areas when it is in close proximity to occupied habitat.

There is a growing belief that emissions of greenhouse gases are linked to climate change. The extent of warming and the resulting changes in rainfall patterns that may occur is not known with certainty at this time. NiSource has addressed the potential for impacts to sheepnose from water temperature increase and other possible manifestations of climate change in Chapter 10.

In the vast majority of streams with extant populations, the sheepnose appears to be uncommon at best. Small population size and/or restricted stream reaches of current occurrence are a real threat to the sheepnose due to the negative aspects of genetics of small, geographically isolated populations.

NiSource Activities Potentially Affecting Sheepnose

NiSource activities that may affect sheepnose are hereafter characterized as those that potentially cause take and derive: (a) from the stream crossing actions (affecting the streambed and riparian corridor), and (b) upland disturbing (sediment-related) *aggregate impacts*. Aggregate impacts are defined as those impacts that derive from multiple NiSource activities that individually do not rise to the level of take, but taken together over time may result in negative effects that NiSource has agreed to compensate for. One example would be the combined sediment impacts of access road maintenance, culvert replacement, grading, and restoration efforts over the 50-year permit duration.

Pitt, Clark, and Lake (2007) evaluated a study of the Menomonee River watershed in Wisconsin. They found that the 3.3% of the area disturbed by construction contributed the greatest amount of sediment at the river mouth compared to any other land use (50% of all the suspended sediments). In the southeast Wisconsin Regional Planning area, the same authors found that construction covered only 2% of the surface area, but contributed 26% of the sediment to inland waters. By comparison, agriculture was 72% of land use and contributed only 45% of the sediments. Owens et al. (2000) found that in Wisconsin even small (0.34 and 1.72 acres) construction sites had rates of erosion that were 10 times those of typical rural or urban land uses. Various factors including topography, rainfall intensity, soil type, soil compaction, time of year, and erosion control measures influence the rate. Both studies recognize that even small construction projects (for reference National Pollutant Discharge Elimination System Phase II regulations regulate sites above one acre in urban areas) and small overall construction footprints in a watershed can cause significant detrimental impacts to local waterbodies.

Although the effects from many NiSource O&M and new construction activities are sediment related (e.g., grading, regrading, tree clearing, repair, culvert replacement, etc.), it is not expected that any of these activities, as routinely implemented, will result in large single discharges of sediment. In addition, negative consequences are likely lessened because most covered activities would be outside of urban areas where storm sewers carry sediments directly to receiving waters and vegetated buffers are less available. NiSource also implements multiple sediment control measures on their ground-disturbing projects (*see* ECS, **Appendix B**). However, none of these measures is 100% effective and effectiveness varies even with properly implemented measures. For example, properly installed silt fences in Alabama did not achieve sediment reduction to the same level as an undisturbed reference site (Pitt, Clark, and Lake 2007). Non-point sediment impacts are difficult to measure and impacts may occur as a result of numerous activities over many years. Nevertheless, NiSource believes that these activities, although reduced to the maximum extent practicable, may result in harm and harassment of sheepnose.

The following O&M activities may impact sheepnose: pipeline corridor presence, vehicle operation, access road culvert replacement, access road maintenance, off-ROW clearing, mechanical repair and fill in ROW, in-stream stabilization, tree clearing, herbicide application, hydrostatic testing, pipeline abandonment, and well abandonment. These activities may result in a variety of stressors to sheepnose including: sedimentation, chemical contaminants, increased water temperature, crushing, substrate compaction, altered flow, burying substrate, and introduction of invasive species (**Appendix M, Table 6.2.8.1-1**).

These stressors, in turn, may negatively impact the sheepnose in a variety of ways. Sedimentation at levels that would be expected from O&M activities may degrade habitat and could, over time, disrupt sheepnose biology (*see* discussion on burying below) or ecological relationships (e.g., host fish). As discussed above, sheepnose may be particularly sensitive to sedimentation because of its predisposition to burrow into the substrate. Chemical contaminants have some potential to cause harm or mortality to mussels, but could also affect algae (fertilizers and herbicides) and plankton that provide food for mussels and host fish and affect water quality. The loss of riparian habitat reduces shade on the stream potentially altering water temperature and may also affect trophic function by reducing inputs into the stream from the overhanging trees. Crushing is self explanatory. Since mussels are benthic organisms, substrate compaction can make habitat less suitable for both adult and juvenile mussels. Altered stream flow can change habitat and food availability. Similarly, burying habitat can fill the interstitial spaces in the sands and gravels and preclude normal processes when adult mussels burrow into the substrate. This can be even more harmful to juvenile mussels that immediately burrow into the substrate after dropping from host fish. The introduction of invasive species primarily involves the accidental introduction of zebra mussels or other harmful invasives into habitat previously not contaminated, or contaminated at a low level with these invasives. Where habitat is suitable for large populations of zebra mussels (typically water with less flow like lakes or navigation pools in large rivers), zebra mussels have the potential to eliminate native mussel populations.

New construction activities that may impact sheepnose are: wet-ditch crossing activities, access road construction, grading, HDD, hydrostatic testing (withdrawal and discharge), re-grading, fertilizer application, erosion control devices, herbaceous and woody vegetation clearing, stream bank contouring, installation and removal of stream crossing structures, trenching related impacts, waste pits, minor spill events (major spill events are addressed outside the context of the MSHCP), in-stream stabilization, and vegetation disposal. The following stressors are associated with new construction activities: sedimentation; altered flow; chemical contaminants; entrapment; increase in water temperature; water level reduction; introduction of invasive species; substrate compaction; and crushing (**Table 6.2.8.1-1**).

The stressors from new construction mostly overlap those of O&M and may have the same impacts, although in some cases the impact could be acute rather than chronic (e.g., sedimentation from stream crossing activities could likely have an acute effect on mussels immediately downstream, while sedimentation from the pipeline corridor presence or access road replacement could likely occur slowly over the 50-year life of the permit). Entrapment from the withdrawal of water for hydrostatic testing poses a slight risk to juvenile mussels, gametes that are released into the water column during reproduction, and also to glochidia, which could be entrapped if small host fish were sucked through or trapped during water withdrawal. NiSource expects that take will be very limited in terms of both amount and level of take with implementation of mandatory AMMs. Water level reduction could impact sheepnose, particularly if withdrawal for hydrostatic testing was to occur during already low flow, but this is unlikely because sheepnose is primarily a larger stream species.

The most direct threat involves excavation for installing or repairing pipelines across inhabited streams. If present, this could cause direct lethal take of sheepnose by crushing and excavating individuals, and by causing lethal and sub-lethal (harassment and harm) sediment impacts to individuals downstream of the work area. Access road construction could have similar impacts to individuals. In-channel construction (e.g., in-stream stabilization or bank contouring) could also take individuals.

An alternative to open-cut excavation is HDD. However, under certain conditions, HDD can cause fracturing of the stream bottom. This can result in release of drilling muds from the bore hole into the stream (frac-out) which could impact sheepnose. Drilling muds are composed primarily of water and bentonite and the slurry or drilled solids cut from the bore hole. More advanced drilling muds typically contain various additives including long-chain polymers and detergents. In low pH environments, soda ash is sometimes added to raise the pH (in the bore hole) to an optimum level of about 9 (Najafi and Gokhale 2005). No studies were found that have evaluated the toxicity of HDD drilling muds to mussels. However, freshwater mussels appear to exhibit more sensitivity to some pollutants than do the organisms typically used in toxicity testing. As a result, some of the water quality criteria established by the EPA to protect aquatic life may not be protective of mussels (Service 2009a). It is likely that in high concentrations additives used to raise pH and detergents could cause harm. Minor frac-outs, however, which would involve very small quantities of drilling muds (and even smaller amounts of potentially toxic materials) would, based on our experience, be similar to background levels of sediment from natural events and not be expected to cause take (harm or mortality) of mussels. Any spill that would result in observed take would be handled outside the context of the MSHCP.

Impacts to sheepnose habitat may also be a consequence of both O&M and new construction activities. Activities involving excavation in the stream channel (e.g., install or remove pipeline) could have significant impacts to both the habitat in the construction area and downstream. Impacts may involve acute sediment impacts that, as described above, could render the habitat unsuitable for adult or juvenile mussels. NiSource's expectation is that some of the habitat would likely recover over a period of months (Villella 2005), but some impacts could persist for months or years until such time as high flows or storm flows moved the sediment downstream. Fine sediments that clog interstitial spaces could make habitat unavailable for mussels. Other activities (e.g., installation of in-stream stabilization, stream bank contouring, pipeline presence) could have long-term direct impacts on habitat and long-term indirect impacts through altered flow.

The activities that occur within the impact zone of the crossing action (e.g., crushing from equipment preparing a site for excavation, in-stream restoration) are calculated in the algorithm for crossing actions used to estimate take (described in Section 6.2.8.4 below). The remaining impacts are classified as aggregate and involve: (1) low-level sedimentation impacts to mussels and mussel habitat and host fish and host fish habitat from the pipeline corridor presence; ROW mechanical repair; ROW fill; vegetation clearing; access road maintenance, upgrading, and construction; installation and maintenance of culverts under access roads; grading; restoration (bank contouring); regrading, stabilization and restoration; low-level frac-out; open trenches; trench dewatering; trench water diversion structures; vehicle operation; waste pit berms; well abandonment (restoration); (2) chemical contaminants from hydrostatic testing, regrading, stabilization, and restoration (fertilizer); SPCC (spill event); (3) altered flow from in-stream stabilization measures; pipeline corridor presence; (4) increase in water temperature from pipeline corridor presence; tree and shrub clearing; and (5) substrate compaction from vehicle operation. These are chronic low-level impacts that combine together or with non-NiSource impacts to potentially degrade sheepnose habitat and cause impacts over the proposed 50-year permit life.

An adaptive management program is necessary for a species with significant uncertainties and high levels of risk. *See* Section 7.6.4.4 for the proposed adaptive management program for the sheepnose.

6.2.8.2 Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend to permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicants should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; *see* also the Service's HCP Handbook at 3-20 ("HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery tools"; "contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the sheepnose. With these general goals in mind, the main sheepnose conservation objective for ROW maintenance and O&M activities is to avoid or minimize impacts to known or presumed occupied habitat (e.g., minimize impacts to stream banks and bed) and avoid/minimize impact to sheepnose (e.g., crushing, killing, sedimentation). The main sheepnose conservation objective for all construction projects (i.e., off existing ROW) is to avoid or minimize impacting known or presumed occupied habitat (e.g., through project planning, use of trenchless installation) and avoid/minimize impact to sheepnose (e.g., crushing, killing, sedimentation). Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that cannot be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 – Contribute toward maintenance and/or restoration of viable populations of sheepnose mussels.

Rationale: The Sheepnose Mussel Status Assessment Report (Service 2002a) calls for protecting and restoring a minimum of 12 distinct viable populations within the Ohio River Basin. This freshwater mussel historically occurred in the Ohio River and many of its large tributaries in Pennsylvania, West Virginia, Ohio, Indiana, Illinois, Kentucky, Tennessee, Alabama, and Virginia. A viable population is defined as a naturally reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural environmental changes. Theoretical considerations by Franklin (1980) and Soulé (1980) indicate that 500 breeding individuals represent a minimum population level (effective population size) that would contain sufficient genetic variation to enable that population to evolve and respond to natural habitat changes. The populations shall be distributed throughout the Ohio River basin as follows: two in the upper Tennessee River system, two in the middle to lower Tennessee River system, one in the Cumberland River system, three in a Kentucky tributary to the Ohio River other than the Cumberland River, one in the Allegheny River system, one in the lower Muskingum or Walhonding River system, one in the Kanawha River system, and one in the Wabash River system. These populations must be separated to the extent that it is unlikely that a single event would eliminate or significantly reduce more than one of these populations.

Objective 1 - Where habitat has been degraded, restore and/or protect riparian habitat specifically for the conservation of sheepnose mussels.

Objective 2 - Where habitat has been degraded, restore and/or protect water and substratum quality.

Objective 3 - Partner with stakeholders having responsibility and/or expertise in sheepnose mussel conservation and recovery, and contribute resources to those efforts and programs in priority areas for mussel recovery.

Objective 4 - Propagate, augment, enhance, and/or restore sheepnose mussels where appropriate where habitat conditions, genetic information, and other necessary parameters indicate this is an appropriate action.[50]

Goal 2 - Determine, through research, feasible mechanisms to enhance extant populations, including augmenting and reestablishing mussels into historic habitats and implement those mechanisms consistent with Goal 1.

Rationale: Mussel propagation technology and subsequent translocation are fast becoming important tools in the recovery of native populations (Garner 1999). Most existing populations are likely below the number needed to maintain long-term viability. These populations may be able to expand naturally if environmental conditions are improved. However, some populations may be too small to recover and may need to be supplemented to reach and maintain a viable size.

Objective 1 - Develop necessary genetic information for propagation and reintroduction of sheepnose mussels.

Objective 2 - Identify and prioritize streams suitable for augmentation, translocation, and reintroduction, and those most easily protected from further threats.

Goal 3 - Develop and implement a program to monitor population levels and habitat conditions.

Rationale: During and after conservation actions are implemented, the status of the species and its habitat must be monitored to assess any progress toward recovery. This should be conducted on a biennial schedule.

6.2.8.3 Measures to Avoid and Minimize Impacts

These measures apply to "may affect" counties in 6.2.8 and the maps in **Appendix G, Figure 6.2.8.3-1** for the sheepnose mussel.

These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Measures in *italic* font text will be applied on a case-by-case basis depending on the requirements of the activity. These requirements include consideration of customer and business needs, practicality, and effectiveness as more fully described in Chapter 5 of this MSHCP. Details on selecting the appropriate waterbody crossing method are provided in Section 5.2.1.1.

<u>Surveys to Evaluate Presence and Relocation of Species in NiSource Action Areas</u>

1. A survey can be conducted to determine the presence of this mussel species. Mussel survey protocols designed to detect endangered mussels that often occur in low densities; protocols as of 2009 are provided in **Appendix L**. Survey methodologies must be evaluated at minimum every five years and be updated to the most effective survey methods currently available. If the most current methodology implemented by a

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[50] At the time of the preparation of the MSHCP, propagating and augmenting sheepnose is a very low priority. The genetics of this species is poorly understood and multiple populations exist where conservation activities should be focused.

biologist, qualified to conduct the survey, does not indicate the presence of the species, it will be classified as unoccupied habitat and the AMMs will not be mandatory.[51]

If a survey is not completed, presence will be assumed. In that case, all suitable habitat would be treated as occupied, and all mandatory AMMs must be followed. NiSource or its contractors will follow the Service-approved relocation plan as referenced below. Survey and relocation may be implemented in the same time period (as one action) as long as both survey and relocation protocols are followed (general relocation protocols are identified in **Appendix L**, but may be modified in conjunction with Service Field Office based on conditions).

Relocation may be implemented only if: (1) all required permits are in place, (2) a Service-approved relocation plan documenting all relevant protocols including how and where the mussels will be moved is in place, (3) a contingency plan is in place to conduct additional consultation with the Service should the actual field survey not reflect the conditions identified in the approved relocation plan, and (4) a monitoring program to evaluate the effects of the relocation is in place. Relocation will include at least all individuals of the federally endangered species identified in the impact area and may include other species based on the assessment of the Service Field Office and other regulatory agencies. A copy of the survey and any reports will also be included in the annual report submitted to the Service.

<u>Pre-Construction Planning: Preparation of an EM&CP</u>

2. A detailed EM&CP will be prepared for any activity with potential effects (e.g., streambed or stream bank disturbance, impacts to riparian habitat, activities causing sediment) within 100 feet of the ordinary high water mark of occupied mussel habitat. The plan will incorporate the relevant requirements of the NGTS ECS and include site-specific details particular to the project area and potential impact. The waterbody crossing will be considered "high-quality" for the purpose of preparing this plan regardless of the actual classification. The plan will be strongly oriented towards minimizing streambed and riparian disturbance (including minimization of tree clearing within 25 feet of the crossing [**Figure 24, ECS**]), preventing downstream sedimentation (including redundant erosion and sediment control devices which would be designed to protect mussel resources as appropriate), and weather monitoring by the Environmental Inspector to ensure work is not begun with significant precipitation in the forecast. The plan will comprehensively address all activities needed to complete the work and minimize take of mussels in occupied habitat including crossing the streams during dry periods when practical and using dry-ditch crossing techniques for intermittent streams leading to mussel habitat. The EM&CP will include the frac-out avoidance and contingency plans described in AMM #3 below. The EM&CP will also include a sediment control component for uplands that drain to and impact occupied habitat. Detailed erosion control plans will be developed specific to slopes greater than or equal to 30% leading directly to occupied habitat. These plans will include techniques such as hard or soft trench plugs, temporary sediment barriers, a wider trench at the slope base, and/or temporary slope drains (plastic). In areas with less than a 30% slope, ECS

[51] However, NiSource may implement some of these measures if appropriate to protect potentially suitable habitat.

and AMM erosion control measures protective of mussels will be implemented. The plan will be approved in writing by NiSource NRP personnel prior to project implementation and will include a tailgate training session for all on-site project personnel to highlight the environmental sensitivity of the habitat and any mussel AMMs which must be implemented.

<u>Streambed Construction</u>

3. For activities in occupied habitat, install new or replacement pipelines and major repairs under the river bottom using HDD or other trenchless methods rather than open trenching unless the crossing evaluation report prepared in accordance with Section 5.2.1.1 and **Appendix J** indicates otherwise. Drilling should be carefully undertaken and a plan should be in place to minimize and address the risk of in-stream disturbance due to frac-outs. The plan should also specifically reference mussel resources in the vicinity of the crossing as a key conservation concern and include specific measures identified in the NGTS ECS, from standard industry practices, or other mutually agreed-upon practices to protect this resource. The plan will also include a frac-out impact avoidance plan which will evaluate the site in terms not only of feasibility of conducting HDD, but the likelihood of large scale frac-out and its effects on mussels, and actions to address a large scale frac-out in occupied habitat. The plan should also consider the potential effects on mussels if drilling fluids are released into the environment. The plan must contain all information required for a FERC Section 7(c) filing at a minimum.

If, after detailed engineering studies (e.g., geotechnical, physiological, topographical, and economic), it is determined (and agreed to by NRP personnel) that an HDD is not feasible, a report will be prepared and included in the annual report submitted to the Service. However, due to the potentially significant amount of take that might occur for Ohio River crossings, open trenching in this river is not a "covered activity" as part of the NiSource MSHCP.

4. Install pipeline to the minimum depth described in the ECS and maintain that depth at least 10 feet past the high water line to avoid exposure of pipeline by anticipated levels of erosion based on geology and watershed character. Additional distance may be required should on-site conditions (i.e., outside bend in the waterbody, highly erosive stream channel, anticipated future upstream development activities in the vicinity, etc.) dictate a reasonable expectation that the stream banks could erode and expose the pipeline facilities. Less distance may be utilized if terrain or geological conditions (long, steep bank or solid rock) will not allow for a 10-foot setback. These conditions and the response thereto will be documented in the EM&CP and provided as part of the annual report to the Service.

5. For repairs in occupied habitat, do not install in-channel repairs (bendway weirs, hardpoints, concrete mats, fill for channel relocation, or other channel-disturbing measures) except when measures in AMM #3 above are not feasible from an engineering design perspective, and then, only in conjunction with a stream restoration plan based on Rosgen (*see* Wildland Hydrology 2009 http://www.wildlandhydrology.com/html/references_.html) or other techniques

mutually agreed upon by NiSource and the Service that result in no direct or lethal take of listed mussels.

6. Conduct replacements/repairs from a lay barge or temporary work bridges of the minimum length necessary to conduct the replacements/repairs rather than operating heavy equipment (e.g., backhoes, bulldozers) in-stream. Temporary construction and equipment bridges are not to be confused with stone or fill causeways with pipe structures, which should not be employed in known or presumed occupied waterbodies.

7. Remove equipment bridges as soon as practicable (this is typically interpreted to be a few days to a few weeks unless there are extenuating circumstances) after repair work and any site restoration is completed

8. As part of the routine pipeline inspection patrols, visually inspect all stream crossings in occupied habitat at least yearly for early indications of erosion or bank destabilization associated with or affecting the pipeline crossing that is resulting, or would before the next inspection cycle, likely result in sediment impacts to mussel habitat beyond what would be expected from background stream processes. If such bank destabilization is observed, it will be corrected in accordance with the ECS. Follow-up inspections and restabilization will continue until the bank is stabilized (generally two growing seasons).

Stream Bank Conservation

9. Do not construct culvert and stone access roads and appurtenances (including equipment crossing) across the waterbody or within the riparian zone. Temporary equipment crossings utilizing equipment pads or other methods that span the waterbody are acceptable provided that in-stream pipe supports are not needed.

10. For equipment crossings of small streams, use half pipes of sufficient number and size that both minimize impacts to stream bed and minimize flow disruption to both upstream and downstream habitat (**ECS, Figure 22**).

11. *Reserved.*

Pipeline Abandonment

12. Abandon pipelines in place to avoid in-stream disturbance that would result from pipeline removal unless the abandonment would be detrimental to endangered mussels.

Contaminants

13. As described in the ECS section on "Spill Prevention, Containment and Control," site staging areas for equipment, fuel, materials, and personnel at least 300 feet from the waterway, if available, to reduce the potential for sediment and hazardous spills entering the waterway. If sufficient space is not available, a shorter distance can be used with additional control measures (e.g., redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials). If a reportable spill has impacted occupied habitat:

a. follow spill response plan; and

b. call the appropriate Service Field Office to report the release, in addition to the National Response Center (800-424-8802).

14. Ensure all imported fill material is free from contaminants (this would include washed rock or other materials that could significantly affect the pH of the stream) that could affect the species or habitat through acquisition of materials at an appropriate quarry or other such measures.

15. For storage well activities, use enhanced and redundant measures to avoid and minimize the impact of spills from contaminant events in known or presumed occupied streams. These measures include, for example, waste pit protection, redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials, and a spill response plan provided to the Service as part of the annual report. These measures will be included in the EM&CP prepared for the activity.

16. Do not use fertilizers or herbicides within 100 feet of known or presumed occupied habitat. Fertilizer and herbicides will not be applied if weather (e.g., impending storm) or other conditions (e.g., faulty equipment) would compromise the ability of NiSource or its contractors to apply the fertilizer or herbicide without impacting presumed occupied mussel habitat. The EM&CP prepared for this activity (AMM #2 above) will document relevant EPA guidelines for application.

Withdrawal and Discharge of Water

17. Hydrostatic test water and/or water for storage well O&M will not be obtained from known or presumed occupied habitat unless other water sources are not reasonably available. To prevent desiccation of mussels, water from known or presumed occupied habitat will be withdrawn in a manner that will not visibly lower the water level as indicated by water level height on the stream channel bank. Employ appropriately sized screens, implement withdrawal rates, and maintain withdrawal point sufficiently above the substrate to minimize impacts to the species.

18. Do not discharge hydrostatic test water directly into known or presumed occupied habitat. Discharge water in the following manner (in order of priority and preference):

a. Discharge water down gradient of occupied habitat unless on-the-ground circumstances (e.g. man-made structures, terrain, other sensitive resources) prevent such discharge.

b. If those circumstances occur, discharge water into uplands >300 feet from occupied habitat unless on-the-ground circumstances (e.g. man-made structures, terrain, other sensitive resources) prevent such discharge.

c. If those circumstances occur, discharge water as far from occupied habitat as practical and utilize additional sediment and water flow control devices (**Figures 6A&B, 7, 8, 14A&B; ECS**) to minimize effects to the waterbody.

Travel for O&M Activities

19. Do not drive across known or presumed occupied streams – walk these areas or visually inspect from bank and use closest available bridge to cross stream.

Zebra Mussels and Other Invasives

20. Clean all equipment (including pumps, hoses, etc.) that have been in a perennial waterbody for more than four hours within the previous seven days and will work in

occupied or potential federally listed mussel habitat; following established guidelines to remove zebra mussels (and other potential exotic or invasive species) before entering a known or presumed occupied stream for a federally listed mussel that is not known to be infested with zebra mussels (**Appendix L**). Do not discharge any water for other sources that might be contained in equipment (e.g. ballast water, hoses, sumps, or other containment). It is important to follow these guidelines even if work is not occurring in the immediate vicinity of these mussels since, once introduced into a watershed, invasive species could move and eventually affect the federally listed mussels.

6.2.8.4 Calculation of Incidental Take

Incidental take was calculated for the sheepnose using the following simple algorithm:

Stream Width x Impact Length (lethal and sub-lethal wet-ditch or dry-ditch model) x Percent Suitable Habitat = Acres of Habitat Impacted

Acres of Habitat Impacted x Sheepnose Density = Impacts to Individuals

Operating Facts:

The stream crossing method will be determined by NiSource as described in Section 5.2.1.1. Take is calculated based on using the wet-ditch stream crossing method for large streams (over 100 feet in width) except the Ohio River (only HDD is included as a covered activity) and using the dry-ditch method for remaining streams.

Take of mussels from the NiSource covered activities would occur primarily from impacts directly associated with the installation, repair, or removal of pipeline across occupied stream habitat. On occasion, NiSource will also use access fords/equipment bridges across streams that are not entirely within the existing ROW. These fords/equipment bridges are typically 15 feet in width and are commonly used by the landowner for other purposes. If the fords/equipment bridges are existing, then NiSource and the Service have determined that its effects on endangered mussels are insignificant and discountable. However, the construction and use of a new fords/equipment bridges will have take that NiSource would be responsible to mitigate for. It is also likely that NiSource will need to cross one or more of these streams in a location other than the existing pipeline corridor. The impacts from these crossings would be separate from and additional to those accounted for above. An additional amount of take (approximately 15%), calculated based upon the percentage of times that NiSource has looped pipelines at different stream crossing locations in the past, has been added to account for these mitigation requirements.

Key Assumptions:

NiSource used a reasonable worst case scenario with regard to its stream crossing activities and aggregate sediment impacts causing activities that could affect sheepnose. The entire area that would be impacted by covered activities (e.g., where multiple pipelines are in close proximity to each other) was identified and used for the total acreage calculation. Twenty-nine large and six small stream crossing areas throughout the covered lands could affect sheepnose over the proposed 50 year ITP.

Jenkinson and Ahlstedt (1988) cited in NatureServe 2006, indicate densities of 0.02-0.03 mussel/square meter are assumed to be representative of surviving populations of sheepnose. NiSource used 0.05 mussels per square meter to calculate take for this species and provide some margin of error to compensate for the possibility of slightly more robust populations at some sites. Sharp declines in population densities have been noted and sheepnose continues to be a very rare component of the fauna when present. Very rarely are more than a few individuals found at a particular site. Increasing rarity has been noted by qualitative sampling and by absence from commercial shell harvests (NatureServe 2006).

Take was calculated separately for large streams (>100 feet wide) and small streams (≤100 feet wide) to accommodate the two main stream crossing methods, wet-ditch and dry-ditch respectively. The average width at the pipeline crossing of large streams was 539 feet and the average width at the pipeline crossing of small streams was 34 feet. Stream width data were visually analyzed using one meter resolution leaf-on aerial photographs.

There is little discussion of suitable habitat in the literature and no consensus among biologists on what this number should be. The percent suitable habitat was based on the evaluation of a small number of studies that indirectly addressed how much of the stream substrate is occupied by mussels when a mussel assemblage is present (Hastie et al. 2000; Hastie et al. 2003; and Morales et al. 2006), discussion with Service biologists, and a consulting biologist experienced in surveying mussels (Villella 2009). Morales et al., who were looking at mussels in an upstream reach of the Mississippi, and Hastie et al., conducting research in a small Scottish stream mapped the presence of mussels and indicated areas of the substrate that contained animals and areas that did not. Non-occupied areas may be unsuitable for various reasons (e.g., sheer forces during high flows, unstable or otherwise unsuitable substrate, areas that are regularly de-watered, etc.). Anderson (2000), examining mussels upstream and downstream of an existing bridge across the Allegheny River at Foxburg, Pennsylvania, looked at three reaches of the river, upstream of the bridge (total area 3.3 acres), immediately downstream of the bridge (total area 7.28 acres), and further downstream (total area 7.44 acres). In those three areas he found that the mussel bed covered approximately 1.12 acres upstream (34%), 1.79 acres immediately downstream (25%) and 3.7 acres further downstream (50%).

Mussel experts who provided input on this question could only suggest that this metric is site-dependent and variable according to a number of factors. Therefore in an extant mussel assemblage, the percent of the substrate within the stream banks that is occupied lies somewhere between 0% (since the starting premise is that mussels are present) and 100%. Within a mussel assemblage, at risk mussels would be presumed to cover less area since they are frequently (but not always) a rare component of those assemblages.

NiSource and the Service recognize the limitations of this metric as applied to any one stream. Some streams may have nearly 100% of the bottom occupied by an at risk mussel at a given density and other streams may have almost no presence, as in small remnant populations. Another factor to consider is how the NiSource impact zone overlaps a mussel assemblage. It is likely that in some cases, NiSource impacts will fall completely within the limits of a mussel assemblage. In other cases, the NiSource impact zone will fall partly within an area of mussels and partly within an area outside of an assemblage, given that mussels are distributed discontinuously within occupied streams. NiSource and the Service believe that, if applied across all of the streams in the watershed, and across the entire length of stream for which impacts are estimated, that a central estimate should be employed in determining a reasonable worst case scenario. Therefore, take was calculated using the estimate that sheepnose would occupy 50% of the stream bottom at the estimated density for this species.[52]

The impact area was calculated using both the sediment transport model and the dry-ditch model. The sediment transport model estimates a lethal impact area covered by 0.236 inches of sediment. A sediment plume is predicted to extend further downstream corresponding to a harm/harassment area having a 600 mg/l concentration of suspended sediment (Ellis 1936; Aldridge et al.1987). The dry-ditch model estimates a 75-foot lethal zone and a 100-foot harm/harassment zone downstream of the coffer dams.

A sediment transport estimation methodology was developed to aid in identifying the effects of open-cut waterbody crossing activities on mussels within suitable habitats. Because of the large number of streams within the covered lands, ENSR hydrologists and biologists, with input from the Service and NiSource, developed a simplified procedure to formulate and quantify the three processes of (1) suspended sediment supply to a stream from site disturbance, (2) instream transport and dispersion of the sediment by representative size fractions, and (3) sediment deposition on the streambed. Three sites (the Duck River in Tennessee, the Elk River in West Virginia, and the James River in Virginia) were selected for application of the estimation procedure. Site selection was based on (1) a list of "may-affect" stream crossings for the NiSource project, (2) the availability of nearby USGS stream gauge data and related measurements, and (3) a likelihood of moderate flow conditions (discharge, depth and width, velocity) during the anticipated construction season (July through December). Moderate flow conditions may be the most significant in terms of potential effects of sediment deposition on mussel beds. Under the procedure, small discharges and slower flow velocities or shallow depths generally will not result in the calculation of sediment transport and deposition at distances as great as in the larger streams. Very large rivers, such as the Ohio and Tennessee rivers, absorb sediment inputs within their background conditions and disperse them fairly quickly within the cross-section to levels below the criteria. Although general in nature, NiSource and the Service believe this model is suitable for use in developing a reasonable worst case scenario across the streams and species in the MSHCP. Additional details of this methodology are presented in **Appendix L**.

This methodology assumes successful implementation of the NGTS ECS and uses construction parameters and available physical and hydrologic environmental characteristics of three streams. Stream flow conditions (discharge, depth and width,

[52] The use of a central value (50%) in the reasonable worst case scenario take calculation (model) is based on the best available information and will be revisited as new information becomes available.

velocity) during the anticipated construction season (July through December) were also considered.

Another factor was the recognized criteria for mussel mortality (i.e., a burial depth of 0.236 inches or more and a suspended sediment concentration of 600 mg/l or more) (Ellis 1936; Aldridge et al.1987). NiSource and the Service evaluated the potential impacts of NiSource actions on host fish and glochidia, coordinated that analysis with Service Field Offices, and concluded that the impacts on host fish and glochidia would be insignificant and discountable. Select waterbodies with the highest potential for significant transport were analyzed in greater detail. Those with the resulting longest transport distances that met mussel mortality criteria were selected to define the impact area with an error margin for the mussel species in the MSHCP.

NiSource proposes to use a dry-ditch methodology for stream crossing where technically and otherwise feasible (current technology permits this on streams of approximately 100 feet wide or less). The 75 feet within the coffer dam (lethal impact zone) plus 100 feet downstream (lethal impact/harm zone using the aforementioned sediment depth and suspended sediment values) were used to determine the action area for each crossing. NiSource and the Service recognize that there is some level of uncertainty associated with the sediment transport estimation methodology, both in terms of the predictive power of the methodology and to what extent sediments might impact mussels in any particular location. NiSource will evaluate the performance of both methodologies downstream of crossings using adaptive management.

The take calculation for sheepnose mussel is presented in **Table 6.2.4.4-1**. As shown, the above described impacts result in the reasonable worst case scenario of impacts to approximately 250.4 acres of habitat. This translates into take of approximately 25,346 sheepnose over the 50-year life of the permit. In addition, aggregate impacts from various sediment causing activities could have long-term and significant impacts on the same and additional acres, particularly in conjunction with other development activities in the watershed. The 25,346 sheepnose estimated to be taken is important for an understanding of the impact on the species. It is not, however, the best method for identifying the amount of mitigation necessary to fully compensate for the impact of the take. Because the effects on habitat are more easily and accurately assessed, they better reflect the impact of the take. NiSource has therefore used acres as the basis for mitigation.

In addition, aggregate impacts from various sediment causing activities could have long-term and significant impacts on the same 250.4 acres and additional acres (removed from the immediate stream crossing sites), particularly in conjunction with other development activities in the watershed. NiSource calculated aggregate take based on the total acreage of NiSource pipeline corridor (using a 50-foot average width) overlapping the range of the sheepnose. The total riparian area protected will be 15.1 acres, which is calculated as the total area of NiSource pipeline ROW in all impacted watersheds (79,309 acres), multiplied by the average of the percentage of area the pipeline impacts in each watershed (0.381%), and divided by the total number of impacted watersheds (20). This provides an index of how prevalent NiSource pipelines are in the affected watersheds and therefore a surrogate for the sediment and associated impacts on mussels.

$$\frac{79{,}309 \times 0.00381}{20} = \mathbf{15.1}$$

The take calculations presented here are designed to reflect a reasonable worst case scenario across the entire range of potentially affected streams. It is a reasonable worst case, but not certain, for example, that NiSource would actually conduct covered activities at all the locations affecting sheepnose over the 50-year permit duration. Take is based on the assumption that sheepnose occur in the aforementioned densities, over the estimated stream width, and occupied habitat percentage described above at every stream crossing. It is possible that some crossings may have higher or lower densities and more or less suitable habitat than modeled. However, the proposed calculations produce a reasonable worst case scenario over the life of the MSHCP, although it is likely not accurate for any one stream at a given point in time.

6.2.8.5 Impact of Take Analysis

The sheepnose historically occurred in Alabama, Arkansas, Illinois, Indiana, Iowa, Kentucky, Minnesota, Mississippi, Missouri, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin (Service 2002a). According to Parmalee and Bogan (1998) and Neves (1991), the sheepnose has been extirpated throughout much of its former range or reduced to isolated populations; it has been eliminated from two thirds of the total number of streams in which it was historically known (Service 2002a). The majority of the remaining populations are small and geographically isolated. Its global abundance is estimated at 2,500 to 10,000 individuals (NatureServe 2007a).

The status assessment (Service 2002a) describes the overall status of the species in the remaining drainages where it is known to occur. Populations of the sheepnose were generally considered extant if live or fresh dead specimens have been collected since the mid-1980s. Extant populations of the sheepnose are known from 26 streams in 14 states. The 26 extant sheepnose populations occur in the following 14 states (with streams): Alabama (Tennessee River), Illinois (Mississippi, Kankakee, Ohio [contra Cummings and Mayer 1997], Wabash rivers), Indiana (Ohio, Wabash, Tippecanoe, Eel rivers), Iowa (Mississippi River), Kentucky (Ohio, Licking, Kentucky, Green, Cumberland rivers), Minnesota (Mississippi, St. Croix rivers), Mississippi (Big Sunflower River), Missouri (Mississippi, Meramec, Bourbeuse, Osage Fork Gasconade rivers), Ohio (Ohio, Muskingum rivers), Pennsylvania (Allegheny River), Tennessee (Tennessee, Holston, Clinch, Powell rivers), Virginia (Clinch, Powell rivers), West Virginia (Ohio, Kanawha rivers), and Wisconsin (Mississippi, St. Croix, Chippewa, Flambeau, Wisconsin rivers). In summary, several extant populations are thought to exhibit some level of population viability. The western portion of the range, which would be unaffected by NiSource activities, include the Chippewa and Flambeau rivers, Lower portion of the Wisconsin River, Meramec River, and Bourbeuse River. In the eastern portion of the sheepnose range, viable populations are thought to occur in the Ohio mainstem, Allegheny River, Muskingum River, Kanawha River, Green River, Eel River, Tippecanoe River, Clinch River, and Big Sunflower River.

I. Genetic-Level Impacts

Neither NiSource nor the Service is aware of any genetic research on this species.

Petty (2005) states river systems can be considered habitat "islands" on the larger landscape; each river is separated from other rivers by habitat unsuitable for bivalves. Habitat fragmentation is common for freshwater species, causing disjunct gene pools (Mulvey et al. 1997). Population fragmentation is likely associated with loss or redistribution of genetic variability and is a concern for conservation biologists attempting to manage the genetic legacy of freshwater bivalve species (Petty 2005). It has been suggested that a minimum population size of 5,000 individuals might be necessary under natural conditions (restricted mating or overlap of generations) to avoid loss of genetic diversity of animal species (Schonewald-Cox et al. 1983). Based on current knowledge, there may be no sheepnose populations that meet this criterion. Even at its most abundant in the Meramec River, a late 1970s study found only 39 live sheepnose over 18 sampled sites and the maximum number from any one sample site was 18 (Service 2002a). A survey of the Clinch River, the other concentration of sheepnose, in the late 1970s and early 1980s, yielded only 61 live mussels from 29 survey sites (Service 2002a). There are more recruiting sheepnose populations across a wider range than other MSHCP species, but even the stable populations are comparatively small and there does not appear to be a real stronghold for this species like the Allegheny for clubshell and northern riffleshell. The loss of any of these populations could have negative consequences for the genetic diversity of the sheepnose.

A once diffuse population of this species occurred throughout much of the upper two-thirds of the Mississippi River system and in several larger tributary systems. In this region, there were historically no absolute barriers preventing genetic interchange among its tributary sub-populations that occurred in various streams. With the completion of numerous dams and other habitat perturbations during the first-half of this 20th century, sheepnose populations were lost, and other populations became isolated (Service 2002a). The principle genetic consequences of activities that reduce effective population size is the loss of genetic variance through genetic drift and consequently the potential reduction in the ability to adapt and a reduction in fitness through inbreeding depression (Jones, Hallerman, and Neves 2006; Schonewald-Cox et al. 1983). Genetic-level impacts could be possible from NiSource activities under the MSHCP. The mechanism for these impacts is through the extirpation of small potentially genetically diverse populations, which could reduce the genetic material available to future generations.

II. Population-Level Impacts

The extirpation of the sheepnose from more than 50 streams provides stark evidence that substantial population losses have occurred (Service 2002a). Several extant populations, however, are thought to exhibit some level of population viability (e.g., Chippewa, Flambeau, Wisconsin, Meramec, Bourbeuse, Muskingum, Green, Tippecanoe, Clinch rivers) (Service 2002a). Unfortunately, even the strongest populations of sheepnose seem to hold few individuals. Most populations of sheepnose are more vulnerable being disjunct, isolated, and apparently in decline. It is possible, however, that even small apparently non-viable populations could after years at very low levels begin to reproduce (Anderson 2009). Therefore although small isolated populations are vulnerable to losses resulting from events such as droughts, floods, toxicant spills, or other stochastic events, they may be nonetheless important components in the conservation of the species.

NiSource activities under the MSHCP could directly impact three recruiting populations: the Ohio River mainstem (Kentucky, Ohio, and West Virginia), the Big Sunflower River in Mississippi, and the Muskingum River in Ohio. NiSource activities could also affect populations not currently thought to be recruiting in the Licking and Kentucky rivers, Kentucky and the Walhonding River, Ohio. It is relevant to this analysis that several recruiting populations in the western part of the range including the Chippewa, Flambeau, Wisconsin, Meramec, Bourbeuse, Tippecanoe, and Eel and the Clinch river population in the east would not be subject to impacts from the NiSource MSHCP.

Take from stream crossing activities depending on the location and extent of the impact area, and on how robust and spread out within the stream the population could negatively affect, further reduce the viability, or even extirpate one or more sheepnose populations. In addition, aggregate impacts over the life of the ITP could reduce the suitability of occupied habitat and habitat that could be colonized naturally or through enhancement and reintroduction. These impacts could also negatively affect sheepnose population dynamics.

In summary, it is reasonable to conclude that small, isolated populations, could be significantly impacted where NiSource activities intersect stream reaches providing habitat for those populations. Moreover, even the more robust sheepnose populations have comparatively low densities and overall numbers. Reduced populations, particularly if comprised of older individuals, as many sheepnose populations likely are, may take several decades to recover even if no further degradation occurs. Like all mussels, sheepnose are vulnerable to sedimentation and aggregate impacts may be detrimental to this species. Based on the sheepnose status assessment, there are 12 known populations of sheepnose in the area of the MSHCP (counting the Ohio, Kentucky, and West Virginia Ohio River populations separately). Of these 12 populations, eight are thought to be reproducing populations. NiSource would potentially affect five of these. NiSource has the potential to affect an additional three smaller populations where reproduction is uncertain. There are, however, approximately 26 additional populations (counting populations in different parts of some larger rivers separately) that are completely outside of the NiSource MSHCP area and where no NiSource impacts are possible. Of these 26, eight are thought to be stable and reproducing. In summary, of the approximately 30 known sheepnose populations, NiSource would potentially affect eight, including five currently identified as reproducing.

NiSource and the Service anticipate both individual and potential population impacts to the sheepnose from acute and chronic impacts associated with NiSource projects. These impacts over the life of the project suggest that the impact of the taking of the sheepnose from NiSource activities will be greater than the loss of some individuals or habitat. This results from: (a) impacts to three stable/reproducing populations of sheepnose (Ohio River, Muskingum River, and Big Sunflower River) all of which have depressed numbers of individuals; (b) impacts to an additional three smaller populations also with low numbers and diminished capacity to recover from impacts; and (c) long-term sediment impacts to sheepnose habitat and populations; but ameliorated because there would be no impacts to more than 10 recruiting populations (and more than a dozen small populations) many of which exist outside of the covered lands.

6.2.8.6 Compensatory Mitigation

NiSource will mitigate for the impact of take of sheepnose resulting from its actions in the covered lands. This take is anticipated to occur in two ways. First, the impact of take which may result from direct loss of individuals or habitat from stream crossings activities employed to install new pipeline, or repair or replace existing pipeline. The second kind of take is aggregate, which would result primarily from sedimentation from non-aquatic activities within the watershed, and secondarily loss of riparian habitat, and other similar comparatively minor and indirect impacts detailed above. Where the term "protection" appears below, please refer to Section 6.2 for a further definition and the requirements for securing conservation of mitigation lands and other real property interests.

Before mitigation occurs, NiSource must undertake restoration activities at certain impacted areas. Although these constitute minimization measures for the purpose of the MSHCP, the required mitigation discussed below, in part builds upon these efforts. In all cases where stream crossings occur, NiSource will restore the disturbed streambed and riparian area within its ROW resulting from its activities. Restoration will occur during the same construction season (next appropriate planting season for riparian restoration) as impacts unless there are extenuating circumstances and the Service is informed of those issues. The basic restoration will be conducted in accordance with standard industry specifications as defined in the ECS and required by FERC and other relevant regulatory agencies. This will involve at minimum restoration of any impacts to the depth, flow, channel bottom or banks, as nearly as practicable, back to the pre-impact condition. Vegetation restoration must be with site-appropriate native species.

Mitigation at Restored Streambed and Riparian Areas

As the initial step in compensatory mitigation, NiSource will enhance the restored stream substrate within the construction zone to habitat that is optimal for sheepnose mussels. This would typically involve either replacement or importation of clean, appropriately sized material for mussel re-colonization. NiSource will also enhance, where feasible, any pre-construction deficiencies associated with the depth, flow, bank stability, or riparian vegetation that would be detrimental to mussel re-colonization, survival, and reproduction. NiSource expects the enhancement of the substrate to result in more opportunities for recruitment of sheepnose by providing suitable settling habitat for juvenile mussels. Enhancement serves as one component of NiSource's overall mitigation program, but does not wholly compensate for the impact of take because it has the potential to be disturbed in the future. Therefore, additional compensatory mitigation (riparian restoration) is required as discussed in detail below.

Implement protection and restoration of riparian buffers associated with occupied sheepnose habitat within the Ohio River (KY, OH, and WV), Green River (KY), Kanawha River (WV), Muskingum River (OH), Allegheny River (PA), or the Big Sunflower River (MS) watersheds adjacent to existing sheepnose populations or another priority stream identified in collaboration with the Service. Mitigation should provide additional benefits to the species at the identified site (i.e., sites that are already secure, or at the other end of the spectrum, sites where there is little opportunity to improve the habitat should not be considered). The total riparian area protected to mitigate for aggregate take will be 15.1 acres.

A 1:1 ratio is appropriate for this species because the aggregate impacts from NiSource activities to both the population and the habitat are expected to be comparatively minor.

Sideboards: (a) there must be a minimum 50-foot-wide to a maximum 150-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams generally should have wider buffers;[53] (b) the vegetative buffer must meet minimum NRCS standards for water quality and riparian corridors (**Appendix L**); (c) at least 50% of the total riparian buffer must be restored (i.e., cropland or other highly erosive landuse planted to meet NRCS standards; this 1:1 ratio of restoration to protection reflects the purpose of the aggregate take mitigation to address sediment impacts specifically); (d) instabilities in the riparian zone (e.g., gullies, bank erosion,) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be minimal earth disturbance on the restoration sites; (e) individual mitigation sites must be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); (f) water quality, instream habitat, and instream connectivity must be evaluated in terms of long-term viability of the sheepnose population within the mitigation area; (g) mitigation projects must be completed no more than three years after initiation; and (h) riparian buffers must be permanently protected in fee or by easement (consistent with the template language in **Appendix P)**.

Mitigation When NiSource Relocates Sheepnose (AMM #1)

NiSource has the option described in AMM #1 to relocate mussels as part of a stream crossing project. If the relocation is successful, as discussed in AMM #1, the following mitigation is required in addition to the enhancement and aggregate take mitigation described above. When implemented with the other required mitigation and in concert with mussel relocation described in AMM #1, and if the sideboards and Service guidelines are followed, this option would fully compensate for the impact of take by conserving mussels that would otherwise be killed or harmed. In addition,

[53] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

habitat at the relocation site will be protected and enhanced. NiSource can initiate this mitigation option at any time but not later than during the same period as a new project likely to result in take is started.

Find, relocate, and monitor all sheepnose and other mussels within the assemblage impacted by the project to a suitable site upstream or downstream of the impact zone, and restore riparian habitat at the site of relocation, or at an upstream location as near to the mussel relocation site as possible, at a 1:1 ratio of the acreage amount of in-stream habitat impacted.[54]

Sideboards: (a) follow the most current protocols for mussel location, transport, relocation, and monitoring, but the last monitoring cycle must occur no earlier than the fifth year of relocation; (b) there must be a minimum of 75% survival of relocated sheepnose mussels after five years or additional mitigation will be required; (c) if less than 75% survival rate for sheepnose is achieved at five years, NiSource will be responsible to implement riparian restoration at the ratios indicated in new construction take mitigation below, minus any riparian restoration completed for the relocation; (d) sideboards for riparian restoration will follow those described in sideboards for new construction mitigation below; (e) suitable habitat must meet basic mussel requirements of depth, substrate, flow, water quality, host fish presence, and riparian vegetation (existing or post-mitigation restoration); (f) suitability of a site will be determined in coordination with the Service; and (g) NiSource will provide a report to the Service one year after relocation and again after the fifth year post relocation on the status of the relocated sheepnose mussels.

Mitigation for New Construction Take when Sheepnose is not Relocated

The selection of which mitigation option NiSource will implement to compensate for New Construction Take will be based upon the highest need of the species at the time the mitigation becomes necessary, as recommended by NiSource to the Service for its approval or declination. For sheepnose, initially there is only one option available. Mitigation for New Construction Take of sheepnose must follow the mitigation option guidelines and sideboards outlined below. Mitigation for new construction will fully compensate for the impact of take by protecting and restoring the riparian zones that moderate water temperature, provide nutrient inputs, and reduce sediments and other contaminants along occupied streams, thereby improving the quality of the habitat. NiSource expects this to translate into increased survival and reproduction of mussels in the mitigation area.

Protect and Restore Existing Sheepnose Habitat: Protect and restore riparian buffers adjacent to occupied sheepnose habitat. Because of the impact of take on this species, the mitigation amount required is a 2.0:1 ratio of the acreage amount of instream habitat impacted by stream crossing(s) of the Ohio River (Kentucky, Ohio, West Virginia), Muskingum River (Ohio), and the Big Sunflower River (Mississippi) (stable

[54] A 1:1 ratio is appropriate because the primary thrust of the mitigation is the relocation of the mussels – the restoration is an additional step to improve what will already be suitable habitat (otherwise mussels could not be relocated there).

populations). For impacts to Kentucky River (Kentucky), Licking River (Kentucky), and Walhonding River (Ohio) the 2.0:1 mitigation ratio will be increased by a multiplier of 1.5 to compensate for greater impacts to small isolated populations that may have less resilience. For impacts to streams not listed here, NiSource in coordination with the Service will determine whether the population is stable and recruiting or small and isolated and apply the appropriate mitigation ratios. For all riparian restoration, a multiplier of 3 will be used to account for the time it takes riparian restorations to mature, stabilize, and become fully functional.

Stable/Recruiting Populations

Protection Ratio = 2.0:1

Restoration Ratio = 2.0 (x3):1 = 6:1

Small Isolated Populations

Protection Ratio = 2.0 (x1.5):1 = 3:1

Restoration Ratio = 2.0 (x3) (x1.5):1 = 9:1

Sideboards: (a) habitat acquired or restored must benefit an extant population of sheepnose; (b) projects must be in one or more of the following priority watersheds: Ohio River (Kentucky, Ohio, and West Virginia), Green River (Kentucky), Kanawha River (West Virginia), Muskingum River (Ohio), Allegheny River (Pennsylvania), or the Big Sunflower River (Mississippi) or other high-priority watersheds identified by the Service (this list will be updated using the most recent 5-Year reviews as available); (c) projects can be completed before take of sheepnose occurs but not later than two years after the take occurs; (d) there must be a minimum 50-foot-wide to maximum 150-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams generally should have wider buffers;[55] (e) instabilities in the riparian zone (e.g., gullies, bank erosion, etc.) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be limited earth disturbance on the restoration sites; (f) the vegetative buffer must meet minimum NRCS standards for water quality and riparian corridors (**Appendix L**); (g) at least 25% of the total riparian buffer must be restored (i.e., cropland or other highly erosive landuse planted to meet NRCS standards); (h) individual mitigation sites must be a minimum of 750 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); and (i) habitat acquired or restored must be permanently protected in fee or by easement following easement guidelines (**Appendix P**).

Mitigation Options for Possible Future Consideration

These options are not fully documented since they would not be immediately available to NiSource. These measures are not deemed acceptable mitigation at this

[55] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, but less than 150 feet, additional buffer may be appropriate based on the stream size and can be added up to 150 feet at the 1:1 ratio.

time for various reasons including the availability of complete science to implement them. At the time of consideration, the Service and NiSource would determine whether or not a major amendment would be required before they could be implemented. The amount of mitigation required for these options would be determined as part of the amendment authorizing their use.

Identify Augmentation, Expansion, or Reintroduction Streams and Conserve, Restore, and Enhance Habitat for Augmentation, Expansion, or Reintroduction: Using Service approved methodology, identify sites within the range of the sheepnose that with restoration could be suitable for augmentation, expansion, or reintroduction efforts and protect, and where necessary restore, streambed and riparian habitat specifically for the successful augmentation, expansion, or reintroduction of sheepnose mussels.

Sideboards: (a) sites for this mitigation should be selected and site plans developed based factors including extant sheepnose population size, demographic composition, and population trend data (where applicable), potential site threats, habitat suitability, and any other limiting factor that might decrease the likelihood of long-term benefits from population augmentation, expansion, or reintroduction efforts (*see* McGregor 2005 for work initiated in Kentucky for clubshell and other mussels); (b) work will be coordinated with the Service at the time initiated; (c) final products will be directly applicable to Service or other efforts to augment, expand, or reintroduce sheepnose mussels; (d) habitat acquired or restored must be permanently protected; (e) habitat acquired or restored must be tied to and benefit an augmented, expanded, or reintroduced population of sheepnose; and (f) projects must be completed either before impacts to sheepnose occur or within two years after impacts.

Develop Genetic Information for Conservation of Sheepnose: The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations developing genetic information, necessary in part to avoid the deleterious effects of mixing distinct populations (Neves 2004), on source and receiving populations for the propagation or augmentation/expansion/reintroduction of sheepnose mussels and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow all Service guidance and regulations on acquiring and analyzing genetic information; (b) the products developed will be directly applicable to augmentation/reintroduction of sheepnose; and (c) projects must be completed either before impacts to sheepnose occur or within two years after impacts.

Propagate Sheepnose: The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations based who are leading the development of, improving, or implementing propagation technology and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg.56916-56922, September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the entity will work with the Service to ensure that there exists or will exist in the near future a suitable site for reintroduction/expansion/augmentation of a sheepnose population with the propagated mussels; and (d) projects must be completed either before impacts to sheepnose occur or within two years after impacts.

Augment/Reintroduce Sheepnose:[56] The Mitigation Panel (*see* Section 5.3.4) will identify and engage partner organizations who are augmenting or expanding sheepnose populations or reintroducing sheepnose into their historic range and provide funding based on the amount of take estimated or documented to occur as a result of the project.

Sideboards: (a) the identified entity will follow the Service policy on captive propagation and reintroduction (65 Fed. Reg. 56916-56922,September 20, 2000); (b) the entity will develop a captive rearing/propagation plan that will be approved by the Service; (c) the reintroduction/expansion/augmentation will occur in a suitable site approved by the Service; (d) the mitigation must include monitoring of populations and habitat conditions to evaluate the effort and assess the long-term viability of the augmented/expanded/reintroduced sheepnose population(s); and (e) projects must be completed either before impacts to sheepnose occur or within two years after impacts.

6.2.8.7 Additional Actions Available to NiSource to Benefit the Species

NiSource is committed to implement AMMs and mitigation. In addition there are other important actions that NiSource may choose to initiate on its own or in concert with state agencies, non-government organizations, or other entities to further benefit this species. These would not in any way alter the requirements for compensatory mitigation, but may fit into NiSource's landscape level approach to conservation.

Fund research[57]

Identify and map activities or practices within each ecosystem that may affect the sheepnose and its host fish at known sites, and at potential augmentation/reintroduction sites.

Determine contaminant sensitivity for each life stage, particularly sedimentation.

Surveying and monitoring

Complete surveys of the Green River, Elk River, and Big Darby Creek to determine if sheepnose are still extant in these streams.

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[56] This is not a recommended strategy at the time of development of the MSHCP. Habitat conservation should take precedence over augmentation/reintroduction. Most sheepnose populations are declining due, presumably, to habitat degradation. Putting more sheepnose in to streams with degraded habitat could result in increased sheepnose mortality. The proposed research would be critical to reach a point that additional augmentation/reintroduction is likely to succeed.

[57] Refer to the *National Strategy for the Conservation of Native Freshwater Mussels* compiled by the National Native Mussel Conservation Committee (1998) for additional information on conserving North America's imperiled mussel fauna. Shute et al. (1997) also outlined management and conservation considerations for imperiled mussels and other aquatic organisms, while incorporating ecosystem management into the equation.

6.2.9 Nashville Crayfish

The Nashville crayfish (*Orconectes shoupi*) was listed as endangered under the ESA on September 26, 1986 (Service 1986). A Recovery Plan for the species was completed in 1988 (Service 1989a). The Nashville crayfish is currently known to exist only in the Mill Creek watershed in Davidson and Williamson counties, Tennessee. The species is threatened by siltation, stream alterations, and general water quality deterioration resulting primarily from urban development. The species' limited distribution also makes it vulnerable to a single catastrophic event such as a toxic chemical spill (Service 1989a).

Impacts and potential take of Nashville crayfish are likely to occur in the following counties: Davidson and Williamson counties, Tennessee.

Little is known about the life history of Nashville crayfish or in fact most of the over 300 crayfish species (Muck 2002). To the extent that information is lacking about the Nashville crayfish, information about related crayfish species is relied upon. Muck (2002) studied one of the Nashville crayfish congeners, *Orconectes luteus*, which is a stream species found in Missouri, and Mitchell and Smock studied *O. virilis* found in the James River in Virginia. The discussion below, particularly as it relates to reproduction of Nashville crayfish, relies heavily on data from the study of *O. luteus* and therefore should be considered as the best data currently available.

The Nashville crayfish has been found in a wide range of environments including gravel and cobble runs, pools with up to approximately four inches of settled sediment, and under slabrocks and other cover. The species has also been found in small pools where the flow was intermittent. The substrate of Mill Creek and its tributaries, the primary waterbodies in which Nashville crayfish are found, are mainly bedrock covered in some areas with gravel and scattered limestone slabs. The pools, backwater areas, and stream margins of Mill Creek are covered with silt and sand. Riverweed (*Podostemum* spp.) occurs on rocks in some swift water areas, and water willow (*Justicia* spp.) occurs along some shallow gravel shoals. Much of the stream bank is vegetated with trees and shrubs (Service 1989a).

No data are available on home range size of the Nashville crayfish (NatureServe 2007b). Adult Nashville crayfish tend to be solitary, seeking cover under large rocks, logs, debris, or rubble; the largest individuals (Nashville crayfish can attain lengths of over six inches) generally select the largest cover available. Egg laying among Nashville crayfish is thought to occur in late winter and early spring with young released in early summer (Service 1989a; NatureServe 2007b). Females seek out large slabrocks when they are carrying eggs and young; these secluded places are also needed for molting. The species is apparently highly photosensitive and is usually found under cover during the day. Cover is aggressively defended; larger individuals drive smaller crayfish from their selected cover. Availability of cover may be a limiting factor in some areas (Service 1989a). Nashville crayfish are most active in the summer and although the activity level is low in winter, they have been known to move even under the occasional ice in Tennessee streams. The species is non-migratory.

Similar to other crayfish, this species is an opportunistic feeder that acts as a detritivore, piscivore, and browsing herbivore. An analysis of Nashville crayfish stomach contents found 41% materials identifiable as plant fragments and 26% parts of arthropods (NatureServe 2007b). Crayfish are preyed upon by a number of species, including particularly predatory fish.

The related species, *O. luteus,* spawn once a year and can reproduce both as young of the year (YOY) in their first year of life but more commonly spawn in their second year. Approximately one third of the YOY *O. luteus* (males and females) matured in their first year and were capable of reproduction. Evidence suggests that few *O. luteus* reproduce more than twice. Honan and Mitchell (1995) indicate that individuals of other Cambarid species breed only once during their lifetime, while others can reproduce up to four years. Mitchell and Smock (1991) studied *O. virilis* in the James River in Virginia. They estimated that while 89% of second year *O. virilis* were capable of reproduction, only 55% extruded eggs. Fecundity of Nashville crayfish is unknown, but may be related to size of the female (carapace length) as in *O. luteus* and other species. Muck (2002) indicates an average of 50 eggs per female for YOY *O. luteus* and 100 eggs for one-year-old females. Corey (1987) studying *O. propinquus* found a mean loss of 57.8% of potential reproduction (i.e., ova in ovaries to early stage III larva or independent crayfish). The maximum lifespan of the Nashville crayfish is estimated to be three years (NatureServe 2007b).

Corey (1987) discussing crayfish in general states: "Freshwater crayfish occur in large numbers, propagate rapidly, and are among the most energetically important benthic invertebrates feeding on detritus; in turn they are prey for many vertebrates (Crocker and Barr 1968)." Crayfish are preyed upon by a number of species, including particularly predatory fish. Rabeni (1992), who looked at fish predators and crayfish in an Ozark stream, indicates that a predator-prey model for *O. luteus* and *O. punctimanus* predicts that about one third of total crayfish production equaling half of those species biomass is consumed by centrarchid (e.g., smallmouth bass) predators during their vulnerable period. Maintenance of a population under this level of predation would suggest that crayfishes reproductive strategies allow maintenance of populations under a high yearly loss of individuals.

6.2.9.1 Activities and Impact Analysis

The primary threat to the continued existence of the Nashville crayfish is development in the Mill Creek drainage that results in destruction or alteration of the aquatic habitat. The human population of Davidson County grew by 1.5% between 2000 and 2006. Adjacent Williamson County grew by 27% in the same time period. As Nashville and surrounding areas have grown, commercial and residential developments have increased within the Mill Creek drainage. Development results in removal of riparian vegetation and canopy cover over the stream. Runoff from denuded areas results in heavy input of sediment into the stream and lack of canopy cover results in increased stream water temperature. Sediment settling, and filling in crevices and interstitial spaces under slab rocks, results in longer-term or permanent loss of habitat for crayfish (Service 2009d). Note, however, that Walton (2008) found sediment deposits throughout the watershed, and in his model they were not negatively correlated with the location of Nashville crayfish, which suggests that some amount of sediment may not be detrimental to this species. Another significant threat to the species' continued existence is the improper use or overuse of lawn insecticides. Intentional or inadvertent application of chemicals to the stream or runoff from yards after application has resulted in significant kills of aquatic organisms, including Nashville crayfish (Service 2009d).

The following NiSource O&M activities are anticipated to impact Nashville crayfish: pipeline corridor presence, tree clearing, mechanical repair in upland or wetland areas, instream stabilization, existing road maintenance, culvert replacement, clearing and ground disturbance for cathodic protection, and removal of abandoned pipe. These activities could result in a variety of stressors to Nashville crayfish including sedimentation, riparian tree removal, crushing, altered flow, increased water temperature, and facilitation of invasive species (**Appendix M, Table 6.2.9.1-1**). These stressors, in turn, negatively impact the crayfish in a variety of ways. Sedimentation at levels that would be expected from O&M activities could degrade habitat by filling in voids in the substrate, an essential component of the habitat. The loss of riparian habitat reduces shade on the stream potentially altering water temperature (possibly affecting crayfish physiology as well as habitat) and may also reduce available food by reducing inputs into the stream from the overhanging trees (note, however, that a model by Walton (2008) found canopy cover negatively correlated with finding Nashville crayfish). Crushing is self explanatory. Altered stream flow can change habitat and food availability. The facilitation of invasive species involves habitat changes that could make reaches of stream less suitable for Nashville crayfish and more suitable for other invasive species of crayfish, giving them a competitive advantage.

New construction activities that may impact Nashville crayfish are: tree, shrub, and herbaceous clearing; grading; regrading; water discharge related to hydrostatic testing; fertilizer application; temporary and permanent access roads; installation and removal of water diversion structures and equipment in stream (directly related to a stream crossing); minor frac-out (related to HDD stream crossing); and minor spill events (large frac-out and spill events are handled outside the context of the MSHCP). Stressors associated with new construction activities include: substrate removal, sedimentation, crushing, altered flow, chemical contaminants, facilitation of invasive species, and increased water temperature. Stressors uniquely associated with new construction could also negatively impact Nashville crayfish. Substrate removal could destroy or remove Nashville crayfish habitat within the stream. Chemical contaminants could harm or kill crayfish, or negatively affect food sources or other components of the ecosystem.

The most direct threat involves excavation for installing, repairing, or removing pipelines across inhabited streams. This is anticipated to cause lethal take of Nashville crayfish by dewatering habitat (through installation of coffer dams to conduct dry-ditch crossings) thereby desiccating the animals, and crushing them during excavation operations. Additional take (lethal take, harm, and harassment), could result from AMMs that would require NiSource to locate, collect, and move crayfish outside of the construction area (coffer dams).

Moving individuals in this fashion is frequently employed to minimize the impacts of activities in streams, but is thought to result in an un-quantified amount of lethal and sub-lethal take resulting from intra-specific competition, relocation to less suitable habitat, and increased risk of predation subsequent to relocation (Widlak 2009).

In the absence of specific data, NiSource has assumed a 50% level of take (including lethal take, harm, and harassment) of all of the relocated crayfish. As discussed in more detail below, NiSource and the Service think this central estimate is appropriate given that this is a methodology regularly employed (and thereby some level of success is implied) and that there are known, but unquantified, limitations. This will be evaluated under adaptive management beginning with the first impact of this type (*see* Section 7.6.4.1.1).

Installing, repairing, and removing pipelines are also anticipated to result in short-term effects to Nashville crayfish habitat. These impacts would be confined within the limits of the coffer dams and NiSource will restore the habitat upon completion of the project. Some harassment, and possibly harm, could result from the unavailability of the habitat during construction and restoration until it recovers to full suitability, which is anticipated to be days to weeks from the beginning of the impact through the post-restoration recovery.

An alternative to open-cut excavation is HDD. However, under certain conditions, HDD can cause fracturing of the stream bottom. This can result in release of drilling muds from the bore hole into the stream (frac-out), which may be toxic to Nashville crayfish. Drilling muds are composed primarily of water and bentonite and the slurry or drilled solids cut from the bore hole. More advanced drilling muds typically contain various additives including long-chain polymers and detergents. In low pH environments, soda ash is sometimes added to raise the pH (in the bore hole) to an optimum level of about 9 (Najafi and Gokhale 2005). No studies were found that have evaluated the toxicity of HDD drilling muds to Nashville crayfish. Minor frac-outs, however, which would involve very small quantities of drilling muds (and even smaller amounts of potentially toxic materials) would, based on our experience, be similar to background levels of sediment from natural events and not be expected to cause take (harm or mortality) of Nashville crayfish. Any spill that would result in observed take would be handled outside the context of the MSHCP. In addition, HDD less commonly results in dewatering of the channel. Nashville crayfish would likely survive temporary dewatering depending on the time of year. Evidence suggests crayfish move throughout the stream course seasonally and may even enter the subterranean environment to access water (Walton 2008).

NiSource activities affecting Nashville crayfish are hereafter characterized as those that may cause take and derive: (a) from the stream-crossing actions (affecting the streambed and riparian corridor), and (b) upland-disturbing (sediment-related) *aggregate impacts*. Aggregate impacts are defined as those impacts that derive from multiple NiSource sediment-producing activities that individually do not rise to the level of take, but taken together over time may result in take to the species within the project area. One example would be the combined sediment impacts of access road maintenance, culvert replacement, grading within non-riparian uplands, and restoration efforts over the 50-year permit duration.

Pitt, Clark and Lake (2007) evaluated a study of the Menomonee River watershed in Wisconsin. They found that the 3.3% of the area disturbed by construction contributed the greatest amount of sediment at the river mouth compared to any other land use (50% of all the suspended sediments). In the southeast Wisconsin Regional

Planning area, the same authors found that construction covered only 2% of the surface area, but contributed 26% of the sediment to inland waters. By comparison, agriculture was 72% of land use and contributed only 45% of the sediments. Owens et al. (2000) found that in Wisconsin even small (0.34 and 1.72 acres) construction sites had rates of erosion that were 10 times those of typical rural or urban land uses. Various factors including topography, rainfall intensity, soil type, soil compaction, time of year, and erosion control measures influence the rate. Both studies recognize that even small construction projects (for reference National Pollutant Discharge Elimination System Phase II regulations regulate sites above one acre in urban areas) and small overall construction footprints in a watershed can cause significant detrimental impacts to local waterbodies.

Although the effects from many NiSource O&M and new construction activities are sediment related (e.g., grading, regrading, tree clearing, repair, culvert replacement, etc.), it is not expected that any of these activities, as routinely implemented, will result in large single discharges of sediment. In addition, negative consequences are minimized because most NiSource activities under the MSHCP would be outside of urban areas where storm sewers carry sediments directly to receiving waters and vegetated buffers are less available. NiSource also implements multiple sediment control measures on their ground-disturbing projects (*see* the ECS). However, none of these measures is 100% effective and effectiveness varies even with properly implemented measures. For example, properly installed silt fences in Alabama did not achieve sediment reduction to the same level as an undisturbed reference site (Pitt, Clark, and Lake 2007). Non-point sediment impacts are difficult to measure and impacts will occur as a result of numerous activities over many years. Nevertheless, NiSource believes that these activities, although reduced to the maximum extent practicable, may result in harm and harassment of Nashville crayfish.

An adaptive management program is necessary for a species with significant uncertainties and high levels of risk. *See* Section 7.6.4.1 for the proposed adaptive management program for the Nashville crayfish.

6.2.9.2 Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicants should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; *see* also the Service's HCP Handbook at 3-20 (stating "HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery

tools"; "contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter, and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the Nashville crayfish. With these general goals in mind, the main conservation objective for ROW vegetation maintenance and all other O&M activities is to avoid or minimize impacts to occupied habitat for the Nashville crayfish (e.g., in-stream and within 300 feet of the occupied streams) and avoid or minimize impact to the individual crayfish. The main conservation objective for all construction projects is to avoid or minimize impacting occupied sites (e.g., through project routing) and avoid or minimize impact to the individual crayfish. Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that cannot be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 – Support protecting and maintaining existing viable populations of Nashville crayfish in the Mill Creek Basin.

Rationale: The Nashville Crayfish Recovery Plan (Service 1989a) calls for protection of the existing Mill Creek basin population. "By reintroduction of the species into some, as yet unknown, historic habitat or by discovery of an additional distinct population, there exist two distinct viable populations." According to the recovery plan, a viable population is a reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes. In addition, protection means "protect from human-related and natural threats that would be likely to cause the species' extinction in the foreseeable future".

Objective 1 – Protect, restore, and/or enhance existing Nashville crayfish habitat within the Mill Creek Basin that is capable of providing optimal breeding, feeding and sheltering habitat for Nashville crayfish.

Rationale: Nashville crayfish are only known to exist in the Mill Creek Basin in Davidson and Williamson counties, Tennessee. The species is threatened by siltation, stream alterations, and general water quality deterioration resulting from development pressures in the urbanized areas surrounding Nashvi1le, Tennessee. Protection, restoration, enhancement, and maintenance efforts should target benthic, riparian, or terrestrial habitat and could include planting riparian and upland vegetation, stabilizing stream banks, improving substrate conditions, and establishing habitat "connectivity" between populations.

Goal 2 – Protect, restore, establish, and/or enhance additional viable populations of Nashville crayfish at suitable locations within the Mill Creek basin.

Rationale: Although no other historic populations are presently known other than the Mill Creek Basin population, historic habitat may be found and may still be suitable for reintroductions. However, at this time it is not known if the extant population found in the Mill Creek Basin is suitable (genetically) for reintroduction.

Objective 1 – Protect, restore, enhance, and/or establish habitat at reintroduction sites that is capable of providing optimal breeding, feeding, and sheltering habitat for Nashville crayfish and other species of concern.

Rationale: In the Mill Creek Basin, Nashville crayfish have been found in a wide range of environments, including gravel and cobble runs, pools with up to approximately four inches of settled sediment, and under slab rocks and other cover. Mill Creek's substrate is mainly bedrock, which is covered in some areas with gravel and scattered limestone slabs. The pools, backwater areas, and stream margins are covered with silt and sand. Much of the stream bank is vegetated with trees and shrubs (Bouchard 1976). The species has also been found in small pools where the flow was intermittent (Stark 1986, Miller and Hartfield 1985). Gravel-cobble substrate provides good cover for juveniles (Stark 1986, Miller and Hartfield 1985). Females seek out large slab rocks when they are carrying eggs and young, and these secluded places are also needed for molting. The species is highly photosensitive and is usually found under cover during the day (Bouchard 1976). Canopy cover appears important, as O'Bara et al. (1985) reported that all sites they sampled had canopy cover of 60 to 90 percent. The species probably feeds on a variety of organic material, both plant and animal. This solitary species seeks out cover (large rocks, organic and man-made debris, rubble, etc.) with the largest individuals selecting the largest cover (Stark 1986; Miller and Hartfield 1985). Cover in some areas may be a limiting factor.

Objective 2 –Support other intensified and concentrated conservation programs in high priority Nashville crayfish areas, where those efforts have been identified by the Service as contributing significantly to recovery.

Objective 3 – Conduct outreach to landowners within and adjacent to NiSource covered lands and within the Mill Creek Basin to foster understanding of options for protecting and managing their land for the benefit of Nashville crayfish.

Rationale: According to the Nashville Crayfish Recovery Plan (Service 1989a), the assistance of Federal and State agencies as well as local governments will be essential to the recovery of the Nashville crayfish. Support of the local industrial and business community, as well as the local people, will be needed to meet the goal of recovering the species. Without a commitment from the people in the Mill Creek Basin who have an influence on habitat quantity and quality, recovery efforts will fail.

6.2.9.3 Measures to Avoid and Minimize Impacts

These measures apply to all known occupied and presumed occupied areas in the Mill Creek watershed in Davidson and Williamson counties, Tennessee (**Appendix G, Figure 6.2.9.3-1**). These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Measures in *italic* font text will be applied on a case-by-case basis depending on the requirements of the activity. These requirements include consideration of customer and business needs, practicality, and effectiveness as more fully described in Chapter 5 of this MSHCP. Details on selecting the appropriate waterbody crossing method are provided in Section 5.2.1.1.

Pre-construction Surveys within Suitable Habitat to Remove and Relocate Individuals

1. Stream crossing activities will occur between May 16 and September 30 to avoid the Nashville crayfish reproductive period. Within 24 hours prior to commencement of work: (1) the area to be trenched, the water diversion structure, and a 25-foot buffer on either end of the coffer dam location (potential work area) shall be surveyed (**Appendix L**) for Nashville crayfish by a qualified biologist; and (2) barriers to preclude re-entry of Nashville crayfish at the propose coffer dam location put into place. Any Nashville crayfish found during the survey must be removed upstream into suitable habitat (as per specifications below) prior to construction in the stream.

- Any crayfish collected will be removed and relocated by a qualified biologist approved under Federal and State permits to conduct such work.
- All crayfish collected shall be returned within one hour of collection to the stream into suitable habitat outside the area of potential impact and no less than 150 feet upstream from the project site. Suitable habitat generally requires conditions of depth, flow, substrate, channel morphology, and riparian vegetation analogous to that from which the individuals were removed.
- During construction, a biologist shall be available to, at a minimum, monitor Nashville crayfish movement into the construction area, move any Nashville crayfish threatened by construction activities, and to monitor in-stream construction activities for significant impacts from construction outside the limits of the cofferdams.
- Within 24 hours after the water diversion structures are constructed, but before excavation of the trench begins, another sweep will be made within the water diversion structures.

If an adequate survey effort (includes the initial sweep and an inspection of the dewatered area within the coffer dam) does not indicate the presence of crayfish, the stream crossing will be classified as unoccupied habitat and the AMMs would not be mandatory. However, NiSource may employ some of the AMMs to maintain the viability of the potentially suitable habitat.

Maintaining Suitable Habitat Characteristics

2. Utility line trenches shall be backfilled to within six inches of the original stream bottom with native material (stone or gravel). The remainder of the fill shall consist of slab rocks a minimum of 1.6 square feet.

Pre-Construction Planning: Preparation of an EM&CP

3. A detailed EM&CP will be prepared for any activity with potential effects (e.g., streambed or stream bank disturbance, impacts to riparian habitat, activities causing sediment) within 100 feet of the ordinary high water mark of occupied Nashville crayfish habitat. The plan will incorporate the relevant requirements of the NGTS ECS and include site-specific details particular to the project area and potential impact. The waterbody crossing will be considered "high-quality" for the purpose of preparing this plan regardless of the actual classification. One chapter of the plan will describe in

detail how NiSource will strive to avoid the take of Nashville crayfish in occupied habitat. It will provide information on how NiSource will minimize streambed and riparian disturbance since Nashville crayfish are very sensitive to loss of shade from riparian vegetation (including minimization of tree clearing within 25 feet of the crossing [**Figure 24, ECS**]), preventing downstream sedimentation (including redundant erosion and sediment control devices which would be designed to protect crayfish resources as appropriate), and weather monitoring by the Environmental Inspector to ensure work is not begun with significant precipitation in the forecast. The EM&CP will include the frac-out avoidance and contingency plans described in AMM #4 below. The EM&CP will also include a sediment control component for uplands reasonably likely to drain to and impact occupied habitat and specify detailed erosion control plans for slopes greater than or equal to 30% leading directly to occupied habitat. In areas with less than a 30% slope, ECS and AMM erosion control measures protective of mussels will be implemented. The plan will be approved in writing by NiSource NRP personnel prior to project implementation and will include a tailgate training session for all on-site project personnel to highlight the environmental sensitivity of the habitat and any Nashville crayfish AMMs that must be implemented.

Streambed Construction

4. For activities in occupied habitat, consider installing new or replacement pipelines and major repairs under the river bottom using HDD or other trenchless methods rather than open trenching (Section 5.2.1.1 and **Appendix J**). Drilling should be carefully undertaken and a plan should be in place to minimize and address the risk of in-stream disturbance due to frac-outs. The plan should also specifically reference crayfish resources in the vicinity of the crossing as a key conservation concern and include specific measures identified in the NGTS ECS, from standard industry practices, or other mutually agreed-upon practices by NiSource and the Service to protect this resource. The plan will also include a frac-out impact avoidance plan that will evaluate the specific site in terms not only of feasibility of conducting HDD, but the likelihood of large scale frac-out and its effects on Nashville crayfish, and actions to address a large scale frac-out in occupied habitat. The plan should also consider the potential effects on Nashville crayfish if drilling fluids are released into the environment. The plan must contain all information required for a FERC Section 7(c) filing at a minimum.

If, after detailed engineering studies (e.g., geotechnical, physiological, topographical, and economic), it is determined (and agreed to by NRP personnel) that an HDD or other trenchless method is not feasible, a report will be prepared and included in the annual report submitted to the Service.

5. Install pipeline to the minimum depth described in the ECS and maintain that depth at least 10 feet past the high water line to avoid exposure of pipeline by anticipated levels of erosion based on geology and watershed character. Additional distance may be required should on-site conditions (e.g., outside bend in the waterbody, highly erosive stream channel, anticipated future upstream development activities in the vicinity) dictate a reasonable expectation that the stream banks could erode and expose the pipeline facilities. Less distance may be utilized if terrain or geological conditions (long, steep bank or solid rock) will not allow for a 10-foot setback. These conditions

and the response thereto will be documented in the EM&CP and provided as part of the annual report to the Service.

6. For repairs in occupied habitat, do not install in-channel repairs (bendway weirs, hardpoints, concrete mats, fill for channel relocation, or other channel disturbing measures) except when an HDD as described in AMM#4 above is not feasible from an engineering perspective, and then, only in conjunction with a stream restoration plan based on Rosgen (*see* Wildland Hydrology 2009 http://www.wildlandhydrology.com/html/references_.html) or other techniques mutually agreed upon by NiSource and the Service that result in no direct or lethal take of Nashville crayfish.

7. Use dry-ditch dam and pump methodology (do not use limestone or any fill for coffer-dam bags that could affect pH or otherwise affect the water quality of occupied habitat) for all new construction and repair unless HDD is determined through AMM #4 above to be feasible.

8. Remove equipment bridges as soon as practicable (this is typically interpreted to be a few days to a few weeks unless there are extenuating circumstances) after repair work and any site restoration is completed.

9. As part of the routine pipeline inspection patrols, visually inspect all stream crossings in occupied habitat at least yearly for early indications of erosion or bank destabilization associated with or affecting the pipeline crossing that is resulting, or would before the next inspection cycle, likely result in sediment impacts to mussel habitat beyond what would be expected from background stream processes. If such bank destabilization is observed, it will be corrected in accordance with the ECS. Follow-up inspections and restabilization will continue until the bank is stabilized (generally two growing seasons).

Stream Bank Conservation

10. Do not construct culvert and stone access roads and appurtenances (including equipment crossings) across the waterbody or within the riparian zone. Temporary equipment crossings utilizing equipment pads or other methods that span the waterbody are acceptable provided that in-stream pipe supports are not needed.

Pipeline Abandonment

11. *Abandon pipelines in place to avoid in-stream disturbance that would result from pipeline removal unless the abandonment would be detrimental to endangered crayfish.*

Contaminants

12. As described in the ECS section on "Spill Prevention, Containment and Control," site staging areas for equipment, fuel, materials, and personnel at least 300 feet from the waterway, if available, to reduce the potential for sediment and hazardous spills entering the waterway. If sufficient space is not available, a shorter distance can be used with additional control measures (e.g., redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials). If a reportable spill has impacted occupied habitat:

a. follow spill response plan; and

b. call the appropriate Service Field Office to report the release, in addition to the National Response Center (800-424-8802).

13. Ensure all imported fill material is free from contaminants (this would include washed rock or other materials that could significantly affect the pH of the stream) that could affect the species or habitat through acquisition of materials at an appropriate quarry or other such measures.

14. Do not use fertilizers or herbicides within 100 feet of known or presumed occupied habitat. Fertilizer and herbicides will not be applied if weather (e.g., impending storm) or other conditions (e.g., faulty equipment) would compromise the ability of NiSource or its contractors to apply the fertilizer or herbicide without impacting presumed occupied Nashville crayfish habitat. The EM&CP prepared for this activity (AMM #3 above) will document relevant EPA guidelines for application.

Withdrawal and Discharge of Water

15. *Reserved.*

16. Do not discharge hydrostatic test water directly into known or presumed occupied habitat. Discharge water in the following manner (in order of priority and preference):

a. Discharge water down gradient of occupied habitat unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.
b. If those circumstances occur, discharge water into uplands >300 feet from occupied habitat unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.
c. If those circumstances occur, discharge water as far from occupied habitat as practical and utilize additional sediment and water flow control devices (**Figures 6A&B, 7, 8, 14A&B; ECS**) to minimize effects to the waterbody.

Travel for O&M Activities

17. Do not drive across streams – walk these areas or visually inspect from bank and use closest available bridge to cross stream.

Time-of-Year Restriction

18. Do not work in the stream channel of Nashville crayfish presumed or occupied habitat between 1 October and 15 May.

6.2.9.4 Calculation of Incidental Take

NiSource pipelines cross the mainstem of the Mill Creek at five distinct places. NiSource pipelines also cross the tributaries of the Mill Creek at nine additional places. Take was calculated based on a model that accounts for the number of specific activities (dry-ditch cuts) to occur at each of the crossings over the 50 years of the requested permit, as well as a number of other factors. Take is requested for 4.0 acres of Nashville crayfish habitat from stream crossing activities plus an additional 0.4 acres for activities causing aggregate impacts. Acres were used to calculate take and mitigation as it likely yields a more accurate estimate of the on-the-ground impacts, and lends itself more readily to developing appropriate mitigation. NiSource has, however, used the best available data to estimate impacts to individual animals (23,171 over the 50 year life of the permit) in order to provide data for the Service's analysis of impacts. This estimate is derived by estimating the number of stream crossings multiplied by the average stream width multiplied by the average number of crayfish per square meter; plus 15% for off-existing ROW impacts, as described below; and then multiplying by 0.5 to account for 50% successful relocation at the time of impact. Although technically all Nashville crayfish that are relocated (handled) would fall under the definition of take, all of these would be covered under a Service issued Section 10 (a)1(A) scientific collectors permit and only 50% (23,171) are estimated to suffer impacts that exceed the definition of insignificant and therefore would be subject to mitigation. NiSource believes that mitigating in acres of habitat is not only more practical at this time, developing long-lasting habitat for Nashville crayfish will over the life of the permit contribute more to recovery of this species.

In addition, aggregate impacts from various sediment causing activities could have long term and significant impacts on the same 4.0 acres and additional acres (removed from the immediate stream crossing sites), particularly in conjunction with other development activities in the watershed. NiSource calculated aggregate take based on the total acreage of NiSource pipeline corridor (using a 50-foot average width) overlapping the range of the Nashville crayfish. The total riparian area protected will be 0.4 acre, which is calculated as the total area of NiSource pipeline ROW in both impacted watersheds (225 acres), multiplied by the average of the percentage of area the pipeline impacts in each watershed (0.350%), divided by the total number of impacted watersheds (two watersheds). This provides an index of how prevalent NiSource pipelines are in the affected watersheds and therefore a surrogate for the sediment and associated impacts on Nashville crayfish.

$$\frac{225 \times 0.00350}{2} = \mathbf{0.4}$$

The detailed calculations are shown in **Table 6.2.4.4-1**. The value for the impact area is based on a "dry-ditch" stream crossing. A dry-ditch stream crossing employs the use of coffer dams as a means to by-pass stream flow around or through the work area so that there is essentially no contact between the work equipment and the water column. NiSource infrastructure through the Mill Creek watershed is composed of three separate pipelines for the most part oriented parallel to each other and within one approximately 100-foot-wide corridor.

Take of crayfish from the NiSource covered activities would occur primarily from impacts directly associated with the installation, repair, or removal of pipeline across occupied stream habitat. On occasion, NiSource will also use access fords/equipment bridges across streams that are not entirely within the existing ROW. These fords/equipment bridges are typically 15 feet in width and are commonly used by the landowner for other purposes. If the fords/equipment bridges are existing, then NiSource and the Service have determined that its effects on Nashville crayfish are insignificant and discountable. However, the construction and use of a new fords/equipment bridges will have take that NiSource would be responsible to mitigate for. It is also likely that NiSource will need to cross one or more of these streams in a location other than the existing pipeline corridor. The impacts from these crossings would be separate from, and additional to, those accounted for above. An additional amount of take (approximately 15%), calculated based upon the percentage of times that NiSource has looped pipelines at different stream crossing locations in the past, has been added to account for these mitigation requirements.

Stream Crossing Key Assumptions

An acceptable density of Nashville crayfish for use in the algorithm is 1.4 crayfish per square meter in the mainstem of Mill Creek and 1.5 crayfish per square meter in the tributaries (Service 2009e and Carpenter 2002). This is a low density compared to what Muck et al. (2002) found in their study of *O. luteus* in a Missouri stream. That species, which was the dominant and most abundant there, averaged 21 crayfish per square meter, but other crayfish species in the same stream were found in densities less than one third as high. Mitchell and Smock (1991) on the other hand, studying *O. virilis* in the James River in Virginia, found a maximum density in optimal habitat of only 0.6 crayfish per square meter. It is likely that impacts to the Mill Creek watershed that negatively affect Nashville crayfish have continued since 2002. Withers (2009) surveyed the Mill Creek watershed for Nashville crayfish and while he did not provide density estimates, he confirmed the presence of this species in the previously known reaches and tributaries. There is no reason to expect large changes in the density of this species where suitable habitat and the species itself persist.

Acceptable average stream widths for use in the algorithm to represent the mainstem of Mill Creek and its tributaries are 58 feet wide and 20 feet wide respectively (Service 2009e). These estimates are considered as reasonable based on the fact that they apply only to the Mill Creek watershed. There are only nine tributaries under consideration, and certain reaches that could affect the validity of the average do not provide suitable habitat and are not under consideration (e.g., the mouth of Mill Creek).

The impact area within the coffer dams (including a 5-foot buffer on each end) is 85 feet in length. In limestone bottom streams, and with the AMMs that NiSource has agreed to implement, it is a reasonable assumption that significant impacts will be contained within the coffer dams and a small buffer outside those dams to account for impacts associated with coffer dam placement. Nevertheless, NiSource will evaluate this assumption using adaptive management (*see* Chapter 7).

The last key assumption is that sweeps for Nashville crayfish would be conducted by a qualified biologist within 24 hours of constructing the coffer dams (*see* AMMs), and those sweeps would find and safely relocate 50% of the Nashville crayfish in the impact zone. The 50% figure accounts for two identified factors that affect success associated with the common practice of moving Nashville crayfish. The first is that since this species can hide under loose rock and in crevices, even qualified biologists who understand where and how to find it, would likely not remove every individual even from an area of only approximately 0.1 acre, which is the impact area of one mainstem crossing action. The second factor is that consultants working with Nashville crayfish suspect lethal and sub-lethal impacts associated with moving them even short distances (as in outside of cofferdams). This impact likely results from intra-specific competition and other stressors (Widlak 2009). No studies of this phenomenon are known. Although some take is likely sub-lethal, since the ratios of harass, harm, and kill are not known, it is assumed that the entire 50% impact is mortality. NiSource may be able to refine this through adaptive management over the life of the permit.

NiSource recognizes that the take calculations might be overestimates – they are designed to reflect a reasonable worst case scenario. It is unlikely, for example, that NiSource would actually conduct all the actions affecting Nashville crayfish over the 50-year permit duration in this small watershed. Some of the affected areas, due to outside factors, might also have many fewer Nashville crayfish than the 1.4 individuals per square meter used to calculate the reasonable worst case scenario take. It is also likely, however, that some sites will have higher densities. Therefore in some instances, take could exceed the estimate. However, NiSource and the Service think this represents a reasonable upper limit of the individuals and habitat of Nashville crayfish that NiSource would impact over the life of the MSHCP.

Although there is no designated critical habitat for this species, habitat alteration can lead to take of Nashville crayfish through harm or harassment. Impacts to in-stream habitat would not be expected to be long-term although small areas of riparian vegetation removal could require much longer to recover. Information is available that allows us to estimate the percentage of habitat potentially affected by NiSource actions under the MSHCP in the mainstem of Mill Creek. The draft 5-Year Review (Service 2009d) indicates that Nashville crayfish have been found to be evenly distributed over 23.5 miles of Mill Creek (the lower 0.8 mile and upper 2.5 miles are unsuitable). Based on that and using an average mainstem width of 58 feet, an approximately 2.1 acre impact on the mainstem represents impacts to only 1.3% of the available mainstem habitat. The data are not as readily available to estimate the tributary habitat potentially affected (the best available data do not provide a definitive answer to the question how many tributary streams hold Nashville crayfish). The potential NiSource impacts to all tributary streams would total only 1.2 acres. Based on this, the percentage of tributaries with Nashville crayfish impacted is also expected to be very low. Of the area impacted, all but a fraction (where the approximately 6-foot-wide trench would be dug) would be temporary lasting a few days while the area within the coffer dams was de-watered. Because most of the habitat for this species is bedrock, and because coffer dams and other AMMs will be employed, NiSource and the Service expect the sediment impacts on habitat specifically from the stream crossings to be insignificant.

Aggregate sediment impacts from NiSource construction activities, although expected to be significantly reduced by erosion control measures or trapped by existing vegetation, could, acting in concert with sediment produced from other activities, primarily urban development, negatively impact Nashville crayfish over the life of the ITP.

6.2.9.5 Impact of Take Analysis

The best available information indicates that the Nashville crayfish is endemic to the Mill Creek drainage in Davidson and Williamson counties on the outskirts of Nashville, Tennessee (Service 2009d). The original recovery plan indicated that the species may have occurred historically in Big Creek in Giles County (Elk River drainage), the South Harpeth River in Davidson County (Harpeth River drainage), and Richland Creek in Davidson County (Cumberland River drainage). The Big Creek and South Harpeth River records are believed to be the result of "bait bucket" introductions. The species was thought to be native to Richland Creek, but was displaced by a more competitive crayfish species. The 1989 revision to the recovery plan indicates that specimens collected from Richland Creek that were identified as Nashville crayfish were misidentified.

In 1999, a study was done to determine the current status of the Nashville crayfish in the Mill Creek watershed and to identify potential habitat in stream systems adjacent to Mill Creek (O'Bara unpublished). The species was found in Mill Creek, except in the lower 0.8-mile reach, which is influenced by water level fluctuations in the Cumberland River and in the upper 2.5-mile reach, which undergoes seasonal dewatering. The species was found to be evenly distributed in the remaining 23.5 miles of Mill Creek. Nashville crayfish were also found in eight of the 15 tributaries to Mill Creek. A study was done in 1999-2000 (Carpenter 2002) to determine density and distribution of the species. The results of mark/recapture sampling revealed population numbers of Nashville crayfish in the Mill Creek system overall (mainstem and tributaries) of 1,000 -2,000 individuals per 100 linear meters. Withers (2009) conducted additional distributional surveys for Nashville crayfish focused on the upper reaches of the Mill Creek drainage between 2005 and the winter of 2008-2009. He reported the crayfish from additional streams since 2005 and found it in more than 20 locations in both the upper and lower Mill Creek watersheds and at 110 occurrences overall (Withers 2009). These are believed to be the most current data available for this species.

I. Genetic-Level Impacts

Genetic studies have not been conducted on the species, so it is not currently known if there are multiple "populations" of Nashville crayfish in the Mill Creek drainage or if the species is represented by a single population (Service 2009d).

Little is known about the population biology of this species. Carpenter (2002) estimates suggest that the absolute number of individuals is not currently an important consideration in terms of the genetic well being of the mainstem population. Although there are some tributaries, particularly the smaller headwater sites with small (or no) Nashville crayfish populations (Withers 2009), the mainstem and major tributaries surveyed by (Carpenter 2002) were estimated to hold hundreds to as many as 2,000 Nashville crayfish per hundred linear meters of stream.

Hybridization among *Orconectes* species has been documented (Smith 1981; Perry et al. 2001). Genetic consequences of hybridization between an invasive and native species of crayfish can be dire (Perry et al. 2001). NiSource and the Service are not aware, however, that there are invasive species of crayfish in the Mill Creek drainage. Smith (1981) hypothesized that native species could hybridize, particularly when mates of the same species were unavailable. There are other native Orconectes species, *O. rhoadesi* and *O. durelli* in the Mill Creek system, but as discussed above, *O* *shoupi* remains abundant and we are not aware of hybridization among *O. shoupi* and these congeners.

The principle genetic consequences of activities that impact individuals or the habitat of a species include reduction in effective population size and the related; loss of genetic variance through genetic drift and its importance for adaptation; and fitness and its reduction through inbreeding depression (Schonewald-Cox et al. 1983).

It has been suggested that a minimum population size of 5,000 individuals might be necessary under natural conditions (restricted mating or overlap of generations) to avoid loss of genetic diversity (Schonewald-Cox et al. 1983).

NiSource estimates that the acres of take requested in the ITP could result in lethal impacts to as many as 14,006 crayfish of either sex or any age spread over five clustered impact sites in the mainstem of Mill Creek. NiSource further estimates that take spread across nine impact areas (one in each of nine tributary streams) could kill up to 9,165 additional crayfish. These lethal impacts could occur over the 50-year duration of the permit, but would likely be clustered in association with one or more projects.

The population structure of Nashville crayfish is unknown. Populations in tributaries may function as separate populations or the tributaries and mainstem may follow a metapopulation structure. That introduces some uncertainty into precisely how impacts from NiSource activities would affect Nashville crayfish populations. Nevertheless, because Nashville crayfish are vagile animals and because of the interconnectedness of the tributaries and mainstem, and based on what is known about the existing population as discussed earlier, and the proposed take of Nashville crayfishes, the proposed impacts from the NiSource covered activities are not expected to pose a significant genetic risk to Nashville crayfish.

II. Population-Level Impacts

Based on survey work in the last 10 years, the population of Nashville crayfish in the Mill Creek Watershed is estimated as 915 per 100 meters of tributary stream and 2,536 per 100 linear meters for the mainstem (mid-points of Carpenter's single-site estimates recommended by the Service's Cookeville Tennessee Field Office, 2009g) for a density of 1.4 to 1.5 Nashville crayfish per square meter (using an average mainstem width of 17.8 meters). Carpenter (2002) sampled roughly (based on evaluation of the map) 35 kilometers of the mainstem of Mill Creek beginning upstream of the confluence with the Cumberland River and ending near where the flow became intermittent. He captured Nashville crayfish at multiple sample sites within that approximately 35 kilometers. Using a low estimate of 1,000 crayfish per hundred meters of stream (10 crayfish per linear meter) to account for unevenness in distribution, Carpenter's work would suggest a population in the mainstem alone of approximately 350,000 animals, although it is important to understand that this is based on extrapolating estimates at discrete locations at different times of the year to the entire length of the mainstem. It may provide some information on its magnitude of the mainstem, but likely does not accurately reflect the total population in the Mill Creek system.

The existing NiSource pipeline, plus the one-mile corridor, bisects the range of this species and since the Nashville crayfish is endemic to the Mill Creek drainage, a significant portion of the species range. The NiSource infrastructure makes five crossings of the mainstem within what is certainly important Nashville crayfish habitat (survey sites 5 to 8 in Carpenters 2002 survey). NiSource impacts would not occur every year but a maximum of seven times over a 50-year period (although the seven impacts could be clustered in successive years in a worst case scenario). Moreover, it is likely that all impacts of looping projects would affect the mainstem Nashville crayfish populations in the same year. NiSource and the Service estimate that the reasonable worst case scenario take of Nashville crayfish would be 23,171 individuals or about 6.6% of just the mainstem population if the estimate of 350,000 animals is correct. It is important to consider that this take would occur over the 50-year life of the permit and does not represent a one-time reduction in the population by 6.6%. The impact in any one year would almost certainly be significantly less.

NiSource activities would cross nine tributary streams, however, would cross only six of the 12 tributaries documented as having populations of Nashville crayfish. As with the mainstem, these could be clustered in the same year. Carpenter (2002) identified Nashville crayfish (numbers captured in parentheses) in the following tributaries in 2002: Sims Branch (two), Sevenmile Creek (315), unnamed tributary to Sevenmile Creek (two), Sorghum Branch (two), Whittemore Branch (29), Collins Creek (61), Indian Creek (41), Edmundson Branch (12), Owl Creek (386), Owl Creek North (15), and Owl Creek Middle (two). Walton (2008) subsequently found Nashville crayfish in Holt Creek. Of the tributary streams identified by Carpenter (2002) as holding Nashville crayfish, reaches of the following fall within the one-mile corridor and are potentially impacted by NiSource activities: Collins Creek, Indian Creek, Owl Creek, Owl Creek North, Owl Creek Middle, Holt Creek. Withers (2009) identified three stream reaches as areas of high conservation priority: Indian Creek, Mill Creek upstream of downtown Nolensville, and Bittick Creek, an unnamed tributary to Mill Creek. Of these, however, only a short reach of Indian Creek falls within the one-mile corridor.

In summary, population-level impacts from the NiSource MSHCP would affect a fraction of the mainstem population of the Nashville crayfish if the five crossings of the mainstem were to occur at the same time, which they likely would. Depending on the population structure of Nashville crayfish, the crossing of tributaries could represent a greater impact to a population. Based on the population structure, impacts to the overall population would necessarily be less from a tributary crossing if the entire basin functions on a metapopulation or single population model, since a tributary crossing would typically involve only one crossing of a particular tributary with fewer individuals and less habitat impacted. Conversely, if the Mill Creek basin is comprised of multiple individual populations in the various tributary streams, which given the interconnectedness of the habitat and the mobility of the crayfish seems less likely, impacts could be more significant to a small tributary population from a single crossing.

NiSource anticipates potential impacts to both habitat and animals from acute (stream crossings for new construction and repair) and chronic (O&M and upland construction) activities associated with its projects. Existing data (Carpenter 2002) suggest that the population may be stable, though a stability undermined by the entire population being confined to a single drainage. Momot (1984) evaluated the response of multiple crayfish species to their particular ecosystems, paying particular attention to the influence of latitude, in part to understand the potential effects of exploitation (for food) on various species. He identified mid-latitude species, which would include Nashville crayfish as having high resilience to external stress. NiSource take of Nashville crayfish would overlap that of natural predation (estimated at 33% based on current knowledge of other species of stream crayfishes) but even if completely additive, NiSource and the Service do not expect it to be greater than the species ability to recover. Parkyn and Collier (2004) looked at a large flood event on crayfish in New Zealand. The species of crayfish impacted (*Paranephrops planifrons*) may be less resilient than Nashville crayfish requiring 18 months to two years to reproductive maturity with females reproducing only every second year. Even in a deforested area where virtually all of the crayfish were swept away, recovery measured as density (4 individuals per square meter) nearly reached pre-flood levels (4.8 individuals per square meter) by the third year after the event. Given the likely more resilient Nashville crayfish and the much less severe impacts of NiSource activities than the flood in New Zealand, NiSource and the Service would expect the population, given no other major perturbations, to recover from a NiSource impact within one to two years.

The impact of the taking of Nashville crayfish from these activities over the life of the ITP will be marginally greater than the actual losses to individuals and habitat. This conclusion is based on the following: (a) impacts to habitat are limited geographically; (b) impacts to habitat are minor in nature; (c) impacts to habitat are likely to recover quickly; (d) the number of individual take is a small percentage of the existing population; (e) although multiple streams could be affected in one year, total estimated worst case scenario impacts would be distributed over the life of the permit; (f) the assumed ability of this species to recover from the estimated take of individuals; (g) the inherent risk to the population because it occurs in only one watershed; (h) the uncertainty related to population structure and the possibility that impacts to tributary populations could have a greater impact than anticipated, and (i) the long-term sediment impacts of NiSource construction in a comparatively small and urbanizing watershed.

6.2.9.6 Compensatory Mitigation

NiSource will mitigate for the impact of take of Nashville crayfish resulting from its actions in the covered lands. This take is anticipated to occur in two ways. First, the impact which may result from direct loss of individuals or habitat from stream crossings activities employed to install new pipeline, or repair or replace existing pipeline. The second kind of take is aggregate, which would result primarily from sedimentation from non-aquatic activities within the watershed, and secondarily from loss of riparian habitat, and other similar comparatively minor and indirect impacts detailed above. Where the term "protection" appears below, please refer to Section 6.2 for a further definition and the requirements for securing conservation of mitigation lands and other real property interests.

Before mitigation occurs, NiSource must undertake restoration activities at certain impacted areas. Although these constitute minimization measures for the purpose of the MSHCP, the required mitigation discussed below, in part builds upon these efforts. In all cases where direct take (stream crossings) occur, NiSource will restore the streambed and will restore the riparian area within the ROW disturbed as a result of its activities. The restorations will be conducted in accordance with ECS, AMMs, and requirements of FERC and other relevant action agencies. This will involve at minimum restoration of any impacts to the depth, flow, channel bottom, or banks as nearly as practical back to the pre-impact condition. Vegetation restoration must be with site-appropriate native species. NiSource will restore the streambed immediately upon project completion (prior to the removal of the coffer dams) and the riparian area within the ROW disturbed as a result of its activities the next appropriate season for replanting the corridor unless there are extenuating circumstances and the Service is informed of those issues.

Mitigation of Restored Streambed and Riparian Areas

As the initial step in compensatory mitigation, NiSource will also enhance the restored site to promote additional conservation of Nashville crayfish (at minimum this will include the addition of slab rock at a minimum size per slab of 1.6 square feet (Walton 2008) within the 75 feet formerly enclosed by the coffer dams). NiSource will also enhance, where feasible, any pre-construction deficiencies associated with the depth, flow, bank stability, or riparian vegetation that would be detrimental to Nashville crayfish re-colonization, survival, and reproduction. NiSource expects the enhancement of the substrate to result in more opportunities for recruitment of Nashville crayfish by providing suitable sheltering habitat. Enhancement serves as one component of NiSource's overall mitigation program, but does not wholly compensate for the impact of take because it has the potential to be disturbed in the future. Therefore, additional compensatory mitigation (riparian restoration) is required as discussed in detail below.

Mitigation for Aggregate Take Activities

In addition to the requirements above, NiSource will provide mitigation to compensate for sediment producing and other indirect impact producing activities (Aggregate Take). NiSource will implement mitigation for Aggregate Take in its entirety in conjunction with the first new construction project for which mitigation is required to ensure adequate and timely compensation for O&M activities in the watersheds where impacts would likely occur over the life of the ITP. This mitigation will address the impact of take to Nashville crayfish using habitat as a surrogate for individuals since there is currently no capacity, nor to current knowledge plans to develop capacity, to captive rear Nashville crayfish. It will use habitat protection/restoration as the mitigation option. The protection or restoration of riparian habitat is designed to reduce the sediment impacts to Nashville crayfish by buffering occupied streams. NiSource expects this to result in improved survival and reproduction of Nashville crayfish in the mitigation area.

Restore and protect riparian buffers associated with occupied Nashville crayfish habitat within one of the priority areas identified by Withers (2009) Indian Creek, Mill Creek upstream of downtown Nolensville or Bittick Creek an unnamed tributary to Mill Creek, or another priority stream identified in collaboration with the Service. Mitigation should provide additional benefits to the species at the identified site (i.e., sites that are already secure, or at the other end of the spectrum, sites where there is little opportunity to improve the habitat should not be considered). If the priority streams become unsuitable or if NiSource is unable to find willing landowners to cooperate in mitigation, the Service will work with NiSource to identify other acceptable sites. The total riparian area protected to mitigate for aggregate take will be 0.4 acre.

Sideboards:

Because the aggregate mitigation area required is only 0.4 acre, aggregate mitigation will be combined with vegetative buffer mitigation for new construction impacts and adhere to the sideboards for new construction. Note that this would result in areas where there is riparian restoration and not in stream restoration since in-stream restoration is not a requirement for aggregate take. Riparian restoration to mitigate for aggregate take should complement and enhance as much as practical the mitigation for new construction take (e.g., address upstream gaps in the riparian corridor).

Mitigation for New Construction Take

Restore, enhance, and protect potential Nashville crayfish stream bed and riparian habitat within one of the priority areas identified by Withers (2009) Indian Creek, Mill Creek upstream of downtown Nolensville or Bittick Creek an unnamed tributary to Mill Creek, or another priority stream identified in collaboration with the Service on a 1:1[58] basis with the Nashville crayfish habitat area affected by its activities equaling a minimum of 4.0 acres. This equates to streambed and riparian restoration, enhancement, and protection for a length of 3,485 linear feet.

Sideboards:

<u>Vegetative Buffers:</u> (a) there must be a minimum 50- to a maximum 100-foot-wide vegetative buffer on both sides of mitigation stream reach, which should be based on stream width – larger streams should generally have wider buffers;[59] (b) instabilities in the riparian zone (e.g., gullies, bank erosion) that undermine the functioning of the restoration must be repaired before planting vegetation, otherwise there should be limited earth disturbance on the restoration sites; (c) the vegetative buffer must meet minimum NRCS standards for water quality and riparian corridors (**Appendix L**); (d) at least 25% of the total riparian buffer must be restored (i.e., cropland or other highly erosive landuse planted to meet NRCS standards for water quality and riparian corridors, *see* **Appendix L**).

<u>In Stream:</u> (a) slabrock has to be a minimum 1.6 feet in diameter; (b) the amount of slabrock installed must bring the restoration site to a density analogous with an existing high-quality Nashville crayfish occupied reference site agreed to by the Service; (c) the

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[58] A 1:1 ratio is appropriate for this species because the impacts from NiSource activities to both the population and the habitat are expected to be short in duration and comparatively minor.

[59] Note that if the riparian buffer in a reach averages less than 50 feet, additional riparian buffer would be appropriate and considered restoration. If the existing riparian buffer averages greater than 50 feet, no mitigation credit would be provided for adding additional buffer width except in unusual cases and based on prior coordination with the Service.

placement of slabrock must result in a spatial arrangement similar to that at an existing high-quality Nashville crayfish occupied reference site agreed to by the Service; (d) slabrock will be placed at time of construction whenever feasible to avoid additional impacts; (e) in-stream restoration will be carried out in accordance with the time of year restriction defined in AMM #18.

General: (a) individual mitigation sites must be a minimum of 500 feet of linear stream length and must be internally intact (i.e., there can be no unprotected or un-restored gaps greater than 100 feet on each bank at the conclusion of the mitigation project); (b) water quality, instream habitat, and instream connectivity must be evaluated in terms of long-term viability of the Nashville crayfish population within the mitigation area; (c) mitigation projects must be completed no more than three years after initiation; (d) the mitigation site(s) must be contiguous with or within dispersal distance of a known Nashville crayfish occupied area; (e) riparian (vegetative buffer) restoration and in-stream restoration must overlap (occur in the same stream reaches); (f) riparian buffers must be permanently protected (*see* Section 6.2 for the definition of protection) in fee or by easement (consistent with the template language in **Appendix P**).

6.2.9.7 Additional Actions Available to NiSource to Benefit the Species

NiSource is committed to implement AMMs and mitigation. In addition there are other important actions that NiSource may choose to initiate on its own or in concert with state agencies, non-government organizations, or other entities to further benefit this species. These would not in any way alter the requirements for compensatory mitigation, but may fit into NiSource's landscape-level approach to conservation.

Support Local Greenway Efforts

Work with Metro Parks on greenway or other restoration/protection projects.

Work with Century City to "restore" Sims Branch.

Public Outreach and Education

Implement environmental education efforts (e.g., provide funding to schools), which are important to effective recovery programs. Such education programs could seek to provide information to the public concerning the identification and conservation status of the Nashville crayfish and the management practices required for the protection of the species.

6.2.10 American Burying Beetle

The American burying beetle (*Nicrophorus americanus)* was listed as endangered in 1989 by the Service (Service 1989b). A recovery plan for the species was published in 1991 (Service 1991c). A 5-year review of the status of the American burying beetle was initiated on January 29, 2007 (Service 2008b) and completed in March 2008.

The American burying beetle is the largest species of its genus in North America, measuring 0.98-1.4 inches in length. It was formerly known as the giant carrion beetle.

The body of the American burying beetle is shiny black and has hardened protective wing covers (elytra) that meet in a straight line down the back. The elytra are smooth, shiny black, and each elytron has two scalloped shaped orange-red markings. The pronotum, or shield over the mid-section between the head and wings, is circular in shape with flattened margins and a raised central portion. The most diagnostic feature of the American burying beetle is the large orange-red marking on the raised portion of the pronotum, a feature shared with no other members of the genus in North America. The American burying beetle also has orange-red frons (a mustache-like feature) and a single orange-red marking on the top of the head (triangular in females and rectangular in males). Antennae are large, with notable orange clubs at the tips.

The American burying beetle is nocturnal (active at night), lives for only one year, and typically reproduces only once. During the winter months when temperatures are below 60°F, American burying beetles bury themselves in the soil to overwinter. When temperatures are above 60°F, they emerge from the soil and begin the mating and reproduction process. American burying beetles are scavengers, dependent on carrion for food and reproduction. They play an important role in breaking down decaying matter and recycling it back into the ecosystem. Reproduction involves burying a small vertebrate carcass (1-9 ounces; 35-250 grams), laying eggs on the carcass, and then larvae feeding on the carcass until mature. The American burying beetle is unusual in that both parents provide care to their young. American burying beetles must compete with other invertebrate species, as well as vertebrate species, for carrion. Even though American burying beetles are considered feeding habitat generalists, they have still disappeared from over 90% of their historic range. Habitat loss, alteration, and degradation have been attributed to the decline of the American burying beetle.

Habitat requirements for American burying beetles, particularly reproductive habitat requirements, are not fully understood at this time. The American burying beetle has been found in various types of habitat including oak-pine woodlands, open fields, oak-hickory forest, open grasslands, and edge habitat. Research indicates that American burying beetles are feeding habitat generalists. Data are lacking pertaining to American burying beetle reproductive habitat requirements, but species experts assume that they are more restrictive in selecting their reproductive habitat than feeding habitat.

The best available information indicates that the American burying beetle historically occurred in high densities throughout its range. The American burying beetle was recorded historically from at least 150 counties in 35 states in the eastern and central United States, as well as southern Ontario, Quebec, and Nova Scotia in Canada (Service 1991c). Its historical range includes most of temperate eastern North America. The easternmost record is from Nova Scotia, and the species has been recoded as far west as North Platte, Nebraska. A single Montana record is also known. The northernmost record is from the upper peninsula of Michigan, with the southern terminus of its range at Kingsville, Texas. In general, the historical occurrence of this species is poorly documented from higher elevations of the Appalachian region as well as from the southern Atlantic and Gulf of Mexico coastal plains.

However, there has recently been a dramatic range collapse for the species. It currently occupies less than 10% of its original range. The pattern of the American burying beetle's decline can be inferred from examination of known specimen documentation. East of the Appalachians, extending from New England and the Atlantic seaboard south to northern Florida, the most recent historical collections were in the 1940s. In New England and south through New Jersey, the last mainland specimens were collected in the 1920s. Further, except for the North Carolina and Maryland collections, all eastern records of American burying beetle since 1940 were collected from islands or peninsulas such as Long Island, New York and Martha's Vineyard in Massachusetts. All but one of these populations eventually became extirpated as well. Such data indicate that in the portion of its range east of the Appalachian Mountains, American burying beetle declined generally in a north to south direction and that this decline was well underway, if not nearly complete, by 1923.

Currently, the American burying beetle persists in a few widely separated, naturally occurring core populations: (1) on Block Island, off the southern coast of Rhode Island, where the species is apparently stable; and (2) in eastern Oklahoma, where it has been recorded in Latimer, Cherokee, Muskogee, and Sequoyah counties. Since 1980, individuals of American burying beetle have been recorded in southwestern Missouri and in the Platte River Valley in west-central Nebraska, as well as in Arkansas, Kansas, South Dakota, and Texas. However, these locations are not known to support established populations of American burying beetles. Other population locations that are being monitored include propagated American burying beetle release locations in Athens, Hocking, Morgan, Perry and Vinton counties, Ohio, and historic population centers in Mississippi and New Jersey. Likewise, these areas are not known to support established populations of American burying beetles.

A release of propagated American burying beetles was conducted on the Waterloo Wildlife Area (Waterloo WA) near where Vinton, Hocking, and Athens counties meet in Ohio (**Table 6.2.10-1**). Follow-up surveys of the released individuals revealed no individuals captured after over-wintering. It is anticipated that, if present, beetles occur in very low densities (Boyer 2008a, 2008b). The beetles were released each year for seven years in 1998 to 2000 and again from 2004 to 2007 (Service 2008b). The Waterloo WA release site was abandoned in 2008.

A new experimental release of American burying beetles was initiated in 2008 on the Wayne National Forest (Wayne NF) near where Perry, Morgan, and Athens counties meet and this population is treated as listed (Boyer 2008a, 2008b; USFS 2008). **This release site in the only place within the covered lands where American burying beetle occurs, therefore, the following analysis focuses on this site.**

The American burying beetle should be considered extant in Ohio within the 10-mile area of the 2008 Wayne NF release site. A mark-recapture survey of a South Dakota population of American burying beetle was conducted over nine days in June and nine days in August 2005 (Backlund et al. 2008). Based on data of 45 recaptures of 168 captured and marked individuals in June, and 77 captures of 323 marked in August, American burying beetles moved a maximum of 2.8 miles. In June only two recaptures approached that distance and in August only four recaptures were two miles or more (maximum 2.8 miles). Most beetles were recaptured at the original capture site or less than 0.5 miles away. Therefore, a 10 mile maximum dispersal distance, allowing for different habitat conditions and a longer period of activity than monitored in the South Dakota study, provides a reasonable margin of error. The release site on the Wayne NF is designated as a Future Old Forest Management area. This designation limits tree clearing, restricts collection of special forest products, does not allow for motorized recreation, limits signage, and specifically limits wildlife habitat management to treatments for the protection and recovery of federally listed species (USFS 2006). The desired future condition for a Future Old Forest Management Areas describes natural processes changing the composition of the management area, which suggests that this designation is unlikely to change. While this site may not be protected in perpetuity, the population was established at the Wayne NF Release Site under these conditions with the expectation that management practices would be sufficient to protect the population once established. The Forest Service has committed to allow for a total of five years on the project. The third release will occur in June 2010; releases and associated monitoring will occur in 2011 and 2012 as well. However, at present, no financial support is currently designated for the future releases.

It is possible that at some point in the future (within the 50-year MSHCP), American burying beetles will be reintroduced at The Wilds in Muskingum County near the intersection of Noble and Guernsey counties. At this time however, no releases are scheduled at The Wilds.

Table 6.2.10-1 Summary of American Burying Beetle Releases in Ohio

Date	# of Pairs	Location
7/24/98	29	Waterloo Wildlife Area (~Hocking/Athens/Vinton Co. intersection)
6/9/99	20 (+ 16 female)	Waterloo Wildlife Area (~Hocking/Athens/Vinton Co. intersection)
7/20/00	35 (+ 1 male)	Waterloo Wildlife Area (~Hocking/Athens/Vinton Co. intersection)
2001	None	
2002	None	
2003	None	
7/1/04	78	Waterloo Wildlife Area (~Hocking/Athens/Vinton Co. intersection)
6/28/05	140	Waterloo Wildlife Area (~Hocking/Athens/Vinton Co. intersection)
6/8/06	193 (+ 6 males)	Waterloo Wildlife Area (~Hocking/Athens/Vinton Co. intersection)
6/21/07	127	Waterloo Wildlife Area (~Hocking/Athens/Vinton Co. intersection)
2008	225	Wayne National Forest (~Athens, Perry, Morgan Co. intersection)

Fewer than 1,000 individuals persist in the Block Island population, the only remaining population known east of the Mississippi River, and the eastern Oklahoma populations are of uncertain size. The exact causes for the dramatic decline in the population are unclear. It has been suggested that past spraying of insecticides such as DDT, the presence of a non-native and species-specific pathogen (Service 1989b), and the loss of habitat (Service 1991c) may have influenced the American burying beetle populations. However, none of these theories adequately explains why the American burying beetle declined while congeneric species are still relatively common rangewide.

There is little doubt that habitat loss and alteration affect this species at local or even regional levels. These could account for the extirpation of populations once they become isolated from others. In this regard, a proposed highway, coal mining, and construction of natural gas pipelines may constitute continuing threats to the American burying beetle population.

Interspecific *Nicrophorus* competition may also affect populations at the local level. Congeneric species, with which the American burying beetle competes for carrion resources to some extent, may have actually increased (been released) in areas where the burying beetle has disappeared.

The prevailing theory regarding the species' decline involves habitat fragmentation. Fragmentation of large expanses of natural habitat that historically supported high densities of indigenous species may have been a contributing factor in the decline of the American burying beetle. Such habitat fragmentation could have changed the species composition and lowered the reproductive success of prey species required for optimum reproduction.

Likewise, by increasing the edge habitat there may have been a concomitant increase in the occurrence and density of vertebrate predators and scavengers such as the American crow, raccoon, fox, opossum, skunk, feral cats and even dogs. These species compete with the burying beetle for available carrion. In the Midwest, windbreaks, hedgerows, park development, and urban plantings have all provided new "edge" habitat for these scavengers. All these animals take carrion that may be suitable for the American burying beetle. In this way, fragmented habitats not only support fewer or lower densities of indigenous species that historically may have supported the burying beetle, but there is a great deal more competition for those limited resources among the "new" predator/scavenger community (Service 1991c).

6.2.10.1 Activities and Impact Analysis

The primary threats to the continued existence of the American burying beetle include habitat degradation, reduction in carrion prey base, and increased interspecific competition.

Impacts and potential resulting take of American burying beetles may occur within the following counties: Perry, Morgan, and Athens counties, Ohio. NiSource anticipates that the project will have **no effect** on this species in Gloucester County, New Jersey; Vinton County, Ohio; or Lafayette County, Mississippi.

Potential Threats to American Burying Beetle from NiSource Activities

Chemical contaminants

Contaminants contained in point and non-point discharges can degrade habitat quality and adversely impact beetle populations by causing individual mortality if such contamination reaches an individual beetle, or by contaminating carrion food sources, which could then be lethal if ingested by the beetles. Contaminant exposure could result from small spills associated with NiSource's vehicle operation, herbicide and fertilizer application, and storage well construction and operation. However, because the density of beetle populations is very low throughout the area and because the majority of construction will occur in existing ROWs where the habitat is unsuitable for American burying beetles, these impacts are considered unlikely to rise to the level of direct lethal take. However, there is a small possibility that other animals contaminated by such exposure could suffer lethal levels of contamination and provide a food resource to scavengers such as the burying beetle at some distance from the existing ROWs. Because burying beetles are known to be reliant upon larger animals (100 to 200 grams) in order to meet their reproductive needs, it is unlikely that most small spills as could be expected to occur in these operations would be lethal to animals of that size. Nevertheless, this type of threat is a possible source of take, albeit localized and likely discountable (i.e., affecting less than 1% of the total population).

Destruction of habitat

It is possible that actions related to vegetation management could have an adverse direct or indirect effect on American burying beetle populations. Tree trimming, along with other vegetation clearing actions, have the potential to create edge habitat which promotes the increase of competitive species that rely upon the same carrion resources as the burying beetle. It can also destroy habitat that is vital to sustain the populations of species that the beetle uses as a carrion resource. This may constitute indirect take in the form of reduced reproductive output.

Interspecific competition

Vegetation management practices within the occupied habitat of the American burying beetle have the potential to increase competition between it and other carrion-reliant beetles that share the area. American burying beetles are known to be reliant upon larger animals (100 to 200 grams) in order to meet their reproductive needs. Destruction of prey habitat will make it difficult for the American burying beetle to compete with other beetles that require smaller carrion in order to meet their needs. This may constitute indirect take in the form of reduced reproductive output.

The following NiSource O&M activities could impact the American burying beetle: off-ROW clearing including tree clearing, shrub clearing, and herbaceous vegetation clearing. These activities may result in a variety of stressors to the American burying beetle including habitat degradation, reduction in carrion prey base, and increased interspecific competition. New construction activities that may impact American burying beetle are: grading, temporary access roads, permanent access roads, on- and off- ROW clearing including tree clearing, shrub clearing, and herbaceous vegetation clearing. Stressors associated with new construction activities include: habitat degradation, reduction in carrion prey base, and increased interspecific competition (**Appendix M, Table 6.2.10.1-1**).

Many of the stressors resulting from both NiSource O&M and new construction activities are related to a reduction in carrion prey base, and increased interspecific competition due to fragmentation and increased edge habitat. However, most of these activities do not result in direct take, but rather may contribute to the overall degradation of the preferred habitat of this species and the resultant increase in vertebrate predators and scavengers that compete for the same carrion resources. Both

O&M and new construction activities could contribute to less suitable habitat for this species.

As more fully described in Section 6.2.10.4, NiSource is requesting incidental take coverage for four American burying beetles based on a calculation of impacts that includes the amount of suitable habitat intersected by the covered lands and an estimate of beetle density (*see* 6.2.10.4 below for a complete explanation). Take will be limited to four individuals over the life of the permit within the Wayne NF translocated population because NiSource will consistently implement the appropriate AMMs for specific covered activities. NiSource does not anticipate any direct take through death or injury. But potential for take through harm and/or harassment as that term is defined by the ESA regulations, does still exist due to the overall degradation of the preferred habitat of this species and the resultant increase in vertebrate predators and scavengers that compete for the same carrion resources (indirect impact).

6.2.10.2 Biological Goals and Objectives

Pursuant to the Service's Five Point Policy (65 Fed. Reg. 35242, June 1, 2000), NiSource and the Service cooperated in developing the Biological Goals and Objectives for the MSHCP. In doing so, we considered, among other relevant information, the recovery plans for those species for which a plan had been developed. NiSource, however, through the MSHCP and the ITP, is not required to recover the species. As stated in the preamble to the Policy:

> biological goals and objectives should be consistent with recovery but in a manner that is commensurate with the scope of the HCP....We do not explicitly require an HCP to recover listed species or contribute to the recovery objectives, but do not intend permit activities that preclude recovery....However, the extent to which an HCP may contribute to recovery is an important consideration in any HCP effort, and applicants should be encouraged to develop HCPs that produce a net positive benefit on a species. The Service can use recovery goals to frame the biological goals and objectives.

65 Fed. Reg. at 35243; *see also* the Service's HCP Handbook at 3-20 ("HCPs were designed by Congress to authorize incidental take, not to be mandatory recovery tools"; "contribution is often an integral product of an HCP, but is not an explicit statutory requirement").

As detailed in this Chapter and in other parts of this MSHCP, NiSource will, to the maximum extent practicable, minimize and mitigate the impacts of any incidental taking of the American burying beetle. With these general goals in mind, the main conservation objective is to avoid or minimize impacts to habitat of the American burying beetle and avoid or minimize impact to individual beetles, primarily through conducting activities outside the active season and minimizing ROW impacts. Following are specific biological goals and objectives of the MSHCP to be considered while developing compensatory mitigation for those impacts that can not be avoided or minimized. However, note that none of these is intended to obligate NiSource to recover this species.

Goal 1 - Protect and maintain extant populations of American burying beetles at priority locations, in support of federal and state recovery efforts (Service recovery task).

Goal 2 – Protect, establish, and/or maintain self-sustaining wild populations of American burying beetles at priority locations, including the Wayne National Forest Release Site (Service recovery task).

*Rationale: According to the American Burying Beetle Recovery Plan (*Service *1991c), the interim objective to reduce the threat of American burying beetle extinction requires (1) the protection and maintenance of extant populations in Rhode Island and the two populations in Oklahoma (Cherokee/Muskogee counties and Latimer County), and (2) re-establishing (or locating and protecting) at least two additional self-sustaining wild populations of 500 or more animals each, one in the eastern and one in the western part of the species' historical range. Geographical recovery areas include northeastern states, the southeastern states, the Midwest, and the Great Lakes states. Ideally, each primary population should contain several satellite occurrences to which beetles disperse and from which new habitats are colonized.*

Objective 1 – Protect, restore, enhance, and/or maintain habitat at priority locations that are capable of providing optimal breeding, feeding and sheltering habitat for American burying beetles.

Rationale: The American Burying Beetle Recovery Plan states "explore all measures necessary to provide long-term protection. Identify and implement measures as needed to provide known habitats with long-term protection. This may include acquisition of development rights and land or easement acquisition on a willing seller basis".

Objective 2 – Educate landowners within and adjacent to NiSource MSHCP covered lands that have suitable American burying beetle habitat to understand options for protecting and managing their land for the benefit of American burying beetles.

6.2.10.3 Measures to Avoid and Minimize Impacts

These measures only apply to all covered activities within the 10-mile area of the 2008 American burying beetle (ABB) release site on the Wayne NF (Wayne NF Release Site) near where Perry, Morgan, and Athens counties meet in Ohio (**Appendix G, Figure 6.2.10.3-1**). American burying beetles are expected to disperse a maximum of 10 miles from the Wayne NF Release Site. These species-specific measures supplement (and supersede where conflicting) the general BMPs specified in the NGTS ECS. Measures in standard font text will be applied for all activities. Measures in *italic* font text will be applied on a case-by-case basis depending on the requirements of the activity. These requirements include consideration of customer and business needs, practicality, and effectiveness as more fully described in Chapter 5 of this MSHCP.

NiSource will use the process outlined below in order to determine the suitability of ABB habitat and presence of the species. NiSource will then implement all relevant AMMs.

<u>Determining ABB Habitat Suitability within the Wayne NF Release Site</u>

1. Essentially, all habitats within 10 miles of the Wayne NF Release Site are considered suitable for American burying beetles unless one of the following criteria is satisfied. Covered activities implemented in areas meeting any of these criteria are

unlikely to adversely impact ABBs and NiSource can proceed without the need to employ ABB AMMs.

- NiSource total land disturbance of 1.2 acres or less in size.[60]
- Soil that is greater than 70% sand.
- Soil that is greater than 70% clay.
- Land where greater than 80% of the soil surface is comprised of rock.
- Land where greater than 80% of the subsurface soil structure within the top four inches is comprised of rock.
- Land that has already been developed and no longer exhibits surficial topsoil or leaf litter.
- Agricultural land that is tilled on at least an annual basis.
- Land in an existing right-of-way or along an existing roadway.
- Urban areas.
- Stockpiled soil.
- Wetlands (defined as sites exhibiting hydric soils and vegetation).

Surveys to Evaluate the Presence of ABBs within Suitable Habitat[61]

2. Surveys to Determine Presence/Absence within the Wayne NF Release Site

*NiSource will conduct surveys to determine presence or probable absence of ABBs within suitable habitat for site-specific new construction projects. The "American Burying Beetle Nicrophorus americanus Survey Guidance for Oklahoma - Updated May 20, 2009" provided in **Appendix L** should be applied. Results of completed surveys will be submitted to the Service as part of the annual report. The Service will accept the results of these surveys for the purposes of determining whether take must be addressed as provided in the NiSource MSHCP.*

Landowner permission is required to complete presence/absence surveys because surveys would take place outside of the immediate project footprint. If no ABBs are captured, no further AMMs are necessary. If ABBs are captured, the appropriate

[60] Using recently collected survey data, the Service derived densities of ABBs in their known range within Oklahoma. Using the effective trapping area and number of ABBs collected, they estimated average ABB densities to be 0.0084 ABBs/acre for their known range in Oklahoma. A standard z test was then used to determine the probability of encountering an individual ABB in a given area. They determined that disturbance of less than 1.2 acres would have, on average, no more than a one percent chance of impacting an individual ABB.

[61] Researchers conducting Presence/Absence surveys, as well as Bait Away and Trap and Relocate protocols for the American burying beetle must have a valid federal permit in their possession prior to their activities. In addition, these surveys and protocols are likely to be updated by the Service over time. The most recent versions of these documents must be used.

AMMs would apply. Alternatively, NiSource may elect to assume presence of ABBs in suitable habitat and apply the following AMMs.

Measures to Avoid and Minimize Impacts to ABBs in Known or Presumed Occupied Habitat

*3. NiSource will implement the Service's "American Burying Beetle Nicrophorus americanus Baiting Away Guidance For Projects in Oklahoma - Updated May 20, 2009" (**Appendix L**) to avoid and minimize impacts to ABBs in documented or presumed occupied habitat within the Wayne NF Release Site by using bait to lure ABBs out of the impact area. Landowner permission is required to complete this avoidance and minimization measure because application of this measure would take place outside of the immediate project footprint. Release sites will not occur in an area where future NiSource activities could potentially impact ABB mitigation efforts.*

4. If implementation of #3 is not possible, NiSource will implement the Service's "*American Burying Beetle Nicrophorus americanus Trapping and Relocating Guidance in Oklahoma - Updated May 20, 2009*" (**Appendix L**) within the construction work area to avoid and minimize impacts to ABBs in documented or presumed occupied habitat within the Wayne NF Release Site by relocating ABBs collected within or adjacent to the construction work area to protected areas within the Future old forest management area on the Wayne NF within the 10-mile release unit. The relocation site would meet the criteria for suitable habitat for this species and would be removed from potential NiSource and other foreseeable impacts. The exact location of relocation would be determined on a case-by-case basis in consultation with the Wayne NF and the Ohio Field Office.

6.2.10.4 Calculation of Incidental Take

Take of American burying beetle from NiSource activities would occur primarily from impacts directly associated and proximate in time to the installation of pipeline across occupied habitat. Take is requested at four individuals over the life of the permit.

More specifically, the take estimate was derived from the following factors: (1) intersection of the covered lands with the assumed presence of the beetle release location area (45,488 acres); (2) assumption that existing pipeline ROW, compressor stations, and other appurtenant facilities that would not be allowed to revert to natural vegetation are not suitable habitat for American burying beetle (3,838 acres); (3) percentage of covered lands likely to be impacted over the permit term (9.92 percent); (4) density estimate utilizing study results from a comprehensive capture program at an occupied location (Godwin and Minich 2005; one beetle per 189 acres); and (5) information provided by the Service on the very low anticipated density (assumed to be 10% of the density of a viable population in # 4 above) of the release population (Boyer 2008a, 2008b).

The take estimate was calculated as follows:

- 45,488 acres – 3,838 acres = 41,650 acres of suitable habitat in covered lands within 10-mile radius of release site.

- 41,650 acres x 9.92% = 4,132 acres of suitable habitat likely to be impacted over the life of the permit.
- (4,132 acres)[(1 ABB) / (189 acres)] = 22 ABBs
- 22 ABBs x 10% = 2.2 ABBs

Because take is estimated on the basis of individuals, and 0.2 individuals is not possible, 2.2 ABBs were rounded to three individuals. Since releases always occur as pairs in order to ensure the possibility of reproduction, and both individuals contribute to the rearing of offspring, these three individuals were rounded to two pair in order to allow for future reproductive success.

Because this take number is derived from the projected impact acres of off-ROW clearing (41,650 acres), including tree, shrub, and herbaceous vegetation clearing, and new construction over the permit term, it accounts for the initial impact of off-ROW clearing and new construction activities within the covered lands. The 41,650 number for off-ROW acres is used because ROW acres are assumed to be unsuitable habitat (mowed areas, areas with buildings, etc.).

For reporting purposes, it can be assumed that every one acre of presumed occupied habitat disturbed within the Wayne NF release site within Perry, Morgan, and Athens counties, Ohio, equates to take of 0.000096 individuals (one beetle per 10,413 acres of habitat):

41,650 acres of suitable habitat in covered lands in 10-mile radius of release site divided by 4 ABBs = 10,413 acres/1 ABB
1 ABB / 10,413 acres = 0.000096 ABBs/acre

6.2.10.5 Impact of Take Analysis

Population(s) Potentially Affected

The NiSource project crosses the 10-mile radius of the American burying beetle release site in Ohio and includes covered lands of 45,488 acres. The existing NiSource pipeline, plus the one-mile corridor, bisects the range of this species in Ohio. NiSource pipelines have the potential to affect a portion of the population of this species (**Figure 6.2.10.3-1**). This particular area is not part of the current core population centers of the American burying beetle. As discussed earlier, core populations currently exist in Rhode Island and Oklahoma. It is not known at this time whether this area will become a population center in the future. However, the other established populations will not be affected by the NiSource MSHCP.

Individual-Level Impacts

Take of American burying beetles from NiSource activities would occur primarily from impacts directly associated and proximate in time to the installation of pipeline across occupied habitat. As a result, individuals may experience impacts that range from minor nuisance (e.g., short-term nearby noise) to death (e.g., clearing of occupied habitat while beetles are present). While implementation of AMMs should significantly reduce the likelihood of direct take (i.e., mortality) occurring, it is still possible at low levels.

Clearing of occupied habitat will displace all beetles within the action area. This includes American burying beetles, as well as all other carrion reliant beetles that are present within the action area. These displaced beetles are expected to move into the remaining suitable habitat present immediately adjacent to the action area. Interspecific and intraspecific competition between displaced beetles and beetles within adjacent undisturbed areas may significantly increase as the displaced beetles attempt to locate new foraging areas. The feeding habits of American burying beetles are similar to those of other carrion reliant beetle species known to exist within the covered lands. Therefore, competition between those species may be pronounced as all species move quickly into adjacent habitat. It is likely that displaced individual beetles will experience lower survival rates (i.e., harm) when competing against other beetles that have already established territories and are familiar with the area. The displaced beetles will need to increase energy expenditures since they will be required to increase commuting distances to traditional foraging areas, and/or expend additional energy seeking new foraging sites. This increased energy expenditure is anticipated to "harm" and "harass" individuals by affecting fitness, nutrition, and reproductive success.

Take is requested at four individuals over the life of the permit. The basis for this request is explained above.

Population-Level Impacts

Animals

In 2008, 225 pairs of beetles were released at the site on the Wayne NF. No overwintering individuals were detected the following spring. However, the beetles were reproducing as evidenced by follow-up visits in the fall of 2008. It is not clear whether the beetles have dispersed over a larger area than the sampled area and were not detected or whether they did not survive the winter. Some studies suggest that densities lower than 0.02 can lead to difficulties with detectability. Therefore, it is possible that individuals may persist in the area in very low densities.

Releases of approximately 200 pairs (400 individuals) per year will continue for 5 more years, and possibly for the entire 50 year period. Assuming releases continue over 50 years at approximately 200 pairs (400 individuals) per year; this would result in 20,000 individuals released over the 50-year period. Alternatively, assuming that funding is identified for the full five-year release program and the only releases that occur are within the five years that the Wayne NF has committed to the reintroduction effort, a reasonable worst-case scenario, there would be approximately 2,000 individuals released.[62] These releases will continue based on the assumption that the population is persisting and the continued addition of new individuals will eventually produce a large enough population to sustain itself. The recovery goal set for a self-sustaining population outside of the two extant populations is 500 individuals (Block Island and Oklahoma).

A lack of data about the overwintering success of the current population limits the calculations that can be done to quantify impact. However, the evidence of

[62] It is assumed that funding for a full five year reintroduction effort is likely, but it is possible that the release would be less than 2,000 animals if funding falls short.

successful breeding may indicate a population is persisting at densities too low to detect. If this is true, NiSource and the Service would expect that the yearly additions of 200 pairs would bolster the population and decrease the amount of time needed to establish self-sustainability. In the event that the population is not persisting or is persisting at very low rate, the yearly addition of 200 pairs will never bring the population to self-sustainability. In either case, the proposed take of four beetles over a 50-year period within such a population is unlikely to significantly impact the reproductive output of the population or to impact the population viability. Therefore, based on what is known about the existing population and the proposed take of four American burying beetles, NiSource and the Service conclude that the proposed impacts from NiSource activities do not pose a significant risk to American burying beetle.

Habitat

There is no designated critical habitat for this species. Impacts to habitat, however, could have long-term effects on American burying beetle. Because individuals have been documented dispersing several miles from release sites and the beetles appear to be habitat generalists, the fragmentation from the construction of pipelines is not necessarily a barrier to travel or dispersal. However, the habitat requirements for reproduction appear to be more specific but are not well understood. These breeding habitat requirements may vary regionally throughout the range of the species. Soil type, soil compaction, and current land use appear to be factors that influence the suitability of areas as breeding habitat. The conversion of existing suitable breeding habitat to a ROW with compacted soil or to gas storage facilities could result in some reproductive loss. However, because the density of the species is so low and there is a wide variety of potentially suitable breeding habitat throughout the area, these impacts are considered discountable and are not likely to have significant impact on the viability of the population. For the American burying beetle, limiting habitat features can be thought to include the presence of carrion of a suitable size for reproduction (80-100 grams), vertebrate and invertebrate competitors for carrion, and adequate soil for carcass burial. Therefore, identifying suitable habitat requires an understanding of the vertebrate and invertebrate animal assemblages present, rather than just an understanding of the vegetation structure and plant species present.

Summary

Population-level impacts from NiSource activities could affect both animals and habitat. Because this population exists in such low densities, it is not likely subject to acute impacts (e.g., large contaminants spill) as these would not affect a significant portion of the population. Rather, it is more susceptible to indirect impacts from habitat fragmentation that creates edge habitat where increased populations of vertebrate scavengers may compete for limited carrion resources. It is expected that American burying beetle, like its congeners, is subject to significant predation on a yearly basis.

Habitat may also be stable over the near term but is subject to both acute and chronic impacts (e.g., development projects, spills, sedimentation) that if not checked will likely reduce both its amount and suitability over the long term.

Assuming that future releases are successful, population-level impacts from NiSource activities to this release population would affect only a small percentage (i.e., requested take of four beetles/500 beetles in a self-sustaining population) of the American burying beetle release population in this area and would likely be unnoticed against the loss of individuals every year from predation. It is expected that the population, given no other major perturbations, will recover from a NiSource impact within one year assuming that the released beetles continue to reproduce and overwinter. Similarly, habitat impacts are small compared to the overall amount of habitat available. It is expected that the population level impacts to American burying beetle to be within the range of normal disturbance and short-lived.

Genetic-Level Impacts

Overview of current genetic understanding of the species

Both the Block Island population and the largest geographically contiguous population in Arkansas and Oklahoma have low levels of genetic variation and most of the variation occurs within a single population (Kozol et al. 1994). There is no distinctive genetic variation between these populations, but the Arkansas-Oklahoma populations were found to be slightly more diverse than the Block Island population. Another study (Szalanski et al. 2000) examined five populations (Block Island, Arkansas, South Dakota, Oklahoma, and Nebraska) and found little evidence of unique genetic variation and no evidence to suggest that any of the five populations should be treated as a separate, independent focus for conservation.

Genetic issues currently affecting the species

The pattern of genetic variation observed in the American burying beetle is consistent with other species that have suffered from a founder effect, genetic drift, and inbreeding. Multiple bottleneck events, small population size and high levels of inbreeding are thought to be potential factors contributing to the pattern of diversity in American burying beetles. The small population in Block Island appears to be relatively stable, although other smaller unknown populations may exist in other areas. Small population sizes could result in individual populations disappearing. However, because there is little variation between populations, there is little risk of a reduction in the current levels of genetic variation.

In addition, 10 Nicrophorinae species were examined by Szalanski et al. 2000, and the American burying beetle formed a distinct clade with *N. orbicollis*. The authors suggest that because the American burying beetle is phylogenetically close to *N. orbicollis* the two species may be involved in more direct competition and that *N. orbicollis* may dominate in exploitative competition events due to its numerical abundance and extensive distribution.

Genetic impacts from the NiSource Project

The principle genetic consequences of activities that impact individuals or the habitat of a species include reduction in effective population size and the related: loss of genetic variance through genetic drift and its importance for adaptation; and fitness and its reduction through inbreeding depression.

Through an ITP, NiSource would be authorized to take up to four beetles of either sex or any age over the 50-year duration of their permit. This non-lethal take would be spread over the covered lands shown in **Figure 6.2.10.3-1**.

American burying beetles that have been reared in captivity have been released for several years in Ohio. The resulting population consists of the offspring of those individuals. Therefore, the genetic variation in the American burying beetle where take would occur consists of the same genetic variation that is found in source populations for the captively reared individuals. Assuming that the source populations persist, little genetic risk would be expected from take within this population of the offspring of captively reared individuals.

Based on what is known about the existing population as discussed earlier and the proposed take of four American burying beetles (*see* Individual Level Impacts), NiSource and the Service conclude that the proposed impacts from NiSource covered activities do not pose a significant genetic risk to American burying beetle.

6.2.10.6 Compensatory Mitigation

To fully compensate for the incidental take expected for the American burying beetle, NiSource shall contribute a one-time payment of $15,000 into the mitigation fund or directly to the third party undertaking the mitigation project. An estimated budget for the mitigation funding is shown below in **Table 6.2.10.6-1**. These moneys will be directed to fund a captive propagation and release of at least 200 pairs of American burying beetles into protected lands designated as Future Old Forest Management area within the existing Wayne NF Release Site as more fully described below. This release will be in addition to other already planned and funded releases. NiSource funding includes the monitoring of success of the release, and follow-up surveys the following spring to determine if the beetles have overwintered. This sum is based on the amount required to rear the beetles for one release (food, containers, supplies, etc.), as well as staff time required to rear the beetles and participate in the monitoring efforts.

Timing

Mitigation shall be initiated within the first three years of MSHCP implementation to allow for the release of American burying beetles prior to impact. The mitigation propagation, release and monitoring of 200 pairs will be in addition to what is already planned through 2012. The mitigation effort is designed to increase the ABB population so that when an impact does occur, the ABB population will be more suited (i.e., have more individuals)to absorb the impact without going below the population level that would exist without the mitigation.

The following section details what the funding will be spent on.

A. Captive Propagation

The Ohio State University, The Wilds, and the Cincinnati Zoo and Botanical Gardens are all authorized to rear American burying beetles in Ohio. Each organization may participate in propagation efforts for release on protected lands within the Wayne

Table 6.2.10.6-1 ABB Mitigation Budget Estimate

Item	Cost
Facility	$1,000.00
Materials	$1,000.00
Food	$500.00
Institutional Overhead	$500.00
Propagation Total	**$3,000.00**
Travel	$600.00
Biologists Time (15 @ $200/day)	$3,000.00
Materials	$500.00
Release Total	**$4,100.00**
Travel	$300.00
Biologists Time (5 @ $200/day)	$1,000.00
Materials	$500.00
Summer Monitoring Period Total	**$1,800.00**
Travel	$550.00
Biologists Time (5 @ $200/day @ 2 days)	$2,000.00
Materials	$500.00
Fall Monitoring Period Total	**$3,050.00**
Travel	$550.00
Biologists Time (5 @ $200/day @ 2 days)	$2,000.00
Materials	$500.00
Spring Monitoring Period Total	**$3,050.00**
Estimated Total	***$15,000.00***

National Forest release site. NiSource may fund any combination of these organizations to propagate a minimum of 200 American burying beetle pairs in the laboratory. The choice of institution for the propagation efforts will depend upon existing funding as well as their interest and willingness to participate in the project at the time. Additionally, propagation efforts may be conducted at multiple facilities and mitigation funds may be shared across institutions to ensure the successful rearing of a complete cohort of beetles for release.

The captive propagation protocol in Kozol 1992 will be followed. This protocol details the requirements for storage, temperature, lighting, feeding, and pairing of the captive beetles. Adjustments to this protocol will be made at the discretion of species experts based on successful implementation of captive propagation efforts in recent years.

Likewise, the release will follow standardized methods used by species experts in recent years, including providing each pair released with a suitable-sized carrion item, digging a small hole for the pair and the carrion item, overturning a bucket over the pair and the carrion item, and securing the buckets to prevent predator access to the pair and carrion item. The release will take place at the same location as other releases to decrease the time for the population to reach self-sustaining numbers, or if already reached to further bolster that population.

B. Monitoring

Monitoring the Release

American burying beetles will be monitored during the release, and 10 to 15 days after the release, to evaluate the beetle's immediate response to their new habitat. All released beetles will be marked for future success monitoring by clipping a notch on the elytra, or through other marking methods deemed appropriate by species experts. In addition, 5% of released beetles will be tracked using radiotelemetry techniques to determine travel distances and movement patterns of the released beetles.

Monitoring the Success of the Release

Previous research monitoring was conducted using mark-and-recapture methodology, which may be impractical over the long term. Thus, NiSource will undertake future monitoring efforts geared toward developing a population index using standardized trapping methodology.

Such monitoring will consist of standardized (equipment and location) pitfall arrays in conjunction with blacklighting during the peak seasonal and weather conditions for American burying beetle activity. Results of such monitoring will consist of total captures/suitable trap-nights (and/or captures/hours blacklight). An individualized marking scheme will be utilized to avoid multiple counting of recaptures.

Additionally, a second monitoring period in September or October will be conducted to determine whether the released individuals successfully reared offspring. Such monitoring will follow the same protocol as that described above.

C. Surveys

Surveys will be conducted between May 20 and June 20, the spring following release to assist with the Service's ABB release and reintroduction efforts.

The standardized survey protocols to determine presence/absence (i.e., The "*American Burying Beetle Nicrophorus americanus Survey Guidance for Oklahoma-Updated May 20, 2009*" provided in **Appendix L**) will be followed. Additional survey effort may be warranted to determine overwinter survival. Again, adjustments to this protocol will be made at the discretion of species experts based on successful survey efforts in recent years.

6.3 Effects on Critical Habitat

Critical habitat for a listed species is defined [50 C.F.R. § 17.3.] as:

> (i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of this Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas

> outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this Act, upon a determination by the Secretary that such areas are essential for the conservation of the species.

The regulations for section 4 of the ESA (50 CFR 424.12(b)) describe the "constituent elements" of critical habitat as "those that are essential to the conservation of the species" including, but not limited to, "roost sites, nesting grounds, spawning sites, feeding sites, seasonal wetland or dryland, water quality or quantity, host species or plant pollinator, geological formation, vegetation type, tide, and specific soil types." It is a species-specific geographic area designated by the Service (through publication in the Federal Register after proposal and public comment). It includes physical and biological characteristics that allow for life and successful reproduction of a species. More specifically, it includes: (1) space for individual and population growth and normal behavior; (2) cover or shelter; (3) food, water, air, light, minerals, or other nutritional or physiological requirements; (4) sites for breeding and rearing offspring; and (5) habitats that are protected from disturbances or are representative of the historic geographical and ecological distributions of a species. These areas may require special protection or management.

Of the species for which take is anticipated, critical habitat has not been designated for bog turtle, clubshell, fanshell, James spinymussel, Madison cave isopod, northern riffleshell, sheepnose (not listed), Nashville crayfish, or the American burying beetle.

Critical habitat has only been designated for the Indiana bat. But the MSHCP covered lands footprint does not intersect any areas currently designated as critical habitat for Indiana bat. A discussion is included below of critical habitat designated for this species.

<u>Indiana Bat</u>

Critical habitat was designated for the Indiana bat on September 24, 1976. The hibernacula nearest to the covered lands that is designated as critical habitat is Bat Cave, which is located approximately 3.5 miles from the covered lands footprint. In the Federal Register notice designating this cave as critical habitat, a description of swarming and staging habitat is not included; likewise, no primary constituent elements are described. The description solely entails the confines of the Bat Cave hibernacula. Based on the description of the Bat Cave and its location outside of the covered lands footprint, it is anticipated that the project would not modify or have any impact on Indiana bat critical habitat.

Of the species analyzed in the MSHCP and for which no effect or no adverse impact determinations have been made, critical habitat has been designated for Louisiana black bear, Oyster mussel, and Virginia big-eared bat. Only the Louisiana black bear has designated critical habitat within, or in close proximity to, the covered lands and is discussed further below. The critical habitat for Oyster mussel and Virginia big-eared bat are more than 20 and 1.2 miles, respectively, from the covered lands. It is not anticipated that any of the covered activities will have any effect on these species' critical habitats (*see* additional discussion in **Appendix F**, Conservation Frameworks).

<u>Louisiana black bear</u>

The covered lands cross areas designated as critical habitat for the Louisiana black bear. However, specific AMMs have been developed to avoid impacts or adverse modification to designated critical habitat (*see* **Appendix F**, Louisiana black bear Conservation Framework). Further, NiSource and the Service have determined that implementation of the covered activities, along with the required AMMs, is not likely to adversely affect the Louisiana black bear. The Service will be evaluating this determination and any other potential impacts to the Louisiana black bear in its Biological Opinion.

6.4 Overlap of Species Conservation Efforts

Given the covered lands footprint and the wide range of many of the species, there is considerable overlap among covered and non-covered species. **Table 6.4-1** lists MSHCP species that share the same area within covered lands (considering those species with species-specific AMMs). One hundred one counties/parishes support more than one MSHCP species (including Interior least tern, Louisiana black bear, Virginia big-eared bat, Cracking pearlymussel, Oyster mussel, Cumberland Monkeyface mussel, Birdwing Pearlymussel, Cheat Mountain Salamander, and Gray bat, species for which take is not requested, but for which AMMs are proposed). Twenty nine counties support three species. Three counties support four species. One county supports five species and another supports six.

Species overlap will provide opportunities for landscape-level conservation efforts. This is true for species (1) whose habitat requirements are the same (thus, the conservation measures are similar; e.g., multiple mollusks in the Duck River in Maury County, Tennessee) and (2) whose habitat requirements are distinct enough to avoid any conflicts between the conservation measures (e.g., conservation efforts for Indiana bat and sheepnose mussel in Bath County, Kentucky). This overlap will facilitate efforts to coordinate and aggregate individual conservation activities on a broader geographic scale to maximize the benefits to the MSHCP species.

However, for some species this overlap will require careful consideration of AMMs with timing restrictions. NiSource has determined that, with proper project planning, the timing restrictions for the various species that might inhabit the same geographic area can and will be met. Only one potential AMM conflict occurs for any overlapping species and this is between Madison cave isopod and James Spinymussel; the use of HDDs to cross the stream. However, given the karst terrain in the area where these species habitat's overlap (Rockbridge County, Virginia), it is highly unlikely that an HDD would be considered technically feasible. Thus, in Rockbridge County, Virginia streams will not be crossed using an HDD.

Table 6.4-1 Counties with Multiple MSHCP Species

State Name	County Name	Type	Species
Indiana	DeKalb	Take	Indiana Bat
		Take	Northern Riffleshell
		Take	Clubshell
	Marshall	Take	Clubshell
		Take	Indiana Bat
Kentucky	Adair	Take	Indiana Bat
		NLAA*	Gray Bat
	Allen	Take	Clubshell
		Take	Indiana Bat
		NLAA	Gray Bat
	Bath	Take	Clubshell
		Take	Indiana Bat
		Take	Northern Riffleshell
		Take	Sheepnose
	Bracken	Take	Clubshell
		Take	Fanshell
		Take	Indiana Bat
	Carter	Take	Indiana Bat
		NLAA	Gray Bat
	Clark	Take	Indiana Bat
		NLAA	Gray Bat
	Estill	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
	Fayette	Take	Indiana Bat
		NLAA	Gray Bat
	Garrard	Take	Indiana Bat
		Take	Sheepnose
		NLAA	Gray Bat
	Greenup	Take	Sheepnose
		Take	Indiana Bat
		NLAA	Gray Bat
	Jackson	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
	Lee	Take	Indiana Bat
		NLAA	Gray Bat
		NLAA	Virginia Big Eared Bat
	Letcher	Take	Indiana Bat
		NLAA	Gray Bat

State Name	County Name	Type	Species
	Lewis	Take	Indiana Bat
		Take	Sheepnose
	Madison	Take	Indiana Bat
		NLAA	Gray Bat
	Mason	Take	Sheepnose
		Take	Clubshell
		Take	Indiana Bat
	Menifee	Take	Indiana Bat
		NLAA	Gray Bat
		NLAA	Virginia Big Eared Bat
	Metcalfe	Take	Indiana Bat
		NLAA	Gray Bat
	Monroe	Take	Indiana Bat
		NLAA	Gray Bat
	Montgomery	Take	Indiana Bat
		NLAA	Gray Bat
	Morgan	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
	Nicholas	Take	Fanshell
		Take	Indiana Bat
		Take	Sheepnose
	Pendleton	Take	Northern Riffleshell
		Take	Indiana Bat
		Take	Fanshell
		Take	Clubshell
		Take	Sheepnose
	Powell	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
	Robertson	Take	Indiana Bat
		Take	Clubshell
		Take	Fanshell
	Rowan	Take	Sheepnose
		Take	Indiana Bat
		Take	Northern Riffleshell
		NLAA	Virginia Big Eared Bat
Louisiana	East Carroll	NLAA	Louisiana Black Bear
		NLAA	Interior Least Tern
	Madison	NLAA	Interior Least Tern
		NLAA	Louisiana Black Bear

State Name	County Name	Type	Species
Mississippi	Humphreys	Take	Sheepnose
		NLAA	Louisiana Black Bear
	Issaquena	NLAA	Louisiana Black Bear
		NLAA	Interior Least Tern
	Warren	NLAA	Louisiana Black Bear
		NLAA	Interior Least Tern
	Washington	NLAA	Interior Least Tern
		NLAA	Louisiana Black Bear
New Jersey	Hunterdon	Take	Bog Turtle
		Take	Indiana Bat
	Morris	Take	Bog Turtle
		Take	Indiana Bat
	Warren	Take	Bog Turtle
		Take	Indiana Bat
New York	Orange	Take	Indiana Bat
		Take	Bog Turtle
	Rockland	Take	Indiana Bat
		Take	Bog Turtle
Ohio	Adams	Take	Indiana Bat
		Take	Sheepnose
	Athens	Take	American Burying Beetle
		Take	Indiana Bat
		Take	Sheepnose
	Brown	Take	Indiana Bat
		Take	Sheepnose
	Clermont	Take	Sheepnose
		Take	Indiana Bat
	Coshocton	Take	Clubshell
		Take	Fanshell
		Take	Indiana Bat
		Take	Sheepnose
	Defiance	Take	Clubshell
		Take	Indiana Bat
	Delaware	Take	Clubshell
		Take	Indiana Bat
	Fairfield	Take	Clubshell
		Take	Indiana Bat
	Franklin	Take	Northern Riffleshell
		Take	Clubshell

State Name	County Name	Type	Species
		Take	Indiana Bat
	Gallia	Take	Indiana Bat
		Take	Sheepnose
	Greene	Take	Clubshell
		Take	Indiana Bat
	Hancock	Take	Clubshell
		Take	Indiana Bat
	Hocking	Take	Indiana Bat
		Take	American Burying Beetle
	Lawrence	Take	Indiana Bat
		Take	Sheepnose
	Madison	Take	Clubshell
		Take	Indiana Bat
		Take	Northern Riffleshell
	Meigs	Take	Fanshell
		Take	Indiana Bat
		Take	Sheepnose
	Morgan	Take	Fanshell
		Take	Indiana Bat
		Take	Sheepnose
	Muskingum	Take	Fanshell
		Take	Indiana Bat
	Pickaway	Take	Indiana Bat
		Take	Northern Riffleshell
		Take	Clubshell
	Scioto	Take	Sheepnose
		Take	Indiana Bat
	Trumbull	Take	Clubshell
		Take	Indiana Bat
	Tuscarawas	Take	Clubshell
		Take	Indiana Bat
	Union	Take	Clubshell
		Take	Indiana Bat
		Take	Northern Riffleshell
	Vinton	Take	American Burying Beetle
		Take	Indiana Bat
	Washington	Take	Fanshell
		Take	Indiana Bat
		Take	Sheepnose

State Name	County Name	Type	Species
Pennsylvania	Armstrong	Take	Clubshell
		Take	Northern Riffleshell
		Take	Indiana Bat
	Clarion	Take	Clubshell
		Take	Northern Riffleshell
	Monroe	Take	Bog Turtle
		Take	Indiana Bat
	York	Take	Indiana Bat
		Take	Bog Turtle
Tennessee	Davidson	Take	Nashville Crayfish
		NLAA	Gray Bat
	Hardin	Take	Clubshell
		Take	Fanshell
		Take	Indiana Bat
		NLAA	Cracking Pearlymussel
		NLAA	Gray Bat
	Lewis	Take	Indiana Bat
		NLAA	Gray Bat
	Macon	Take	Indiana Bat
		NLAA	Gray Bat
	Maury	Take	Indiana Bat
		NLAA	Gray Bat
		NLAA	Oyster mussel
		NLAA	Cumberland Monkeyface
		NLAA	Cracking Pearlymussel
		NLAA	Birdwing Pearlymussel
	McNairy	Take	Indiana Bat
		NLAA	Gray Bat
	Sumner	Take	Indiana Bat
		NLAA	Gray Bat
	Trousdale	Take	Indiana Bat
		NLAA	Gray Bat
	Wayne	Take	Indiana Bat
		NLAA	Cracking Pearlymussel
		NLAA	Gray Bat
	Williamson	Take	Indiana Bat
		Take	Nashville Crayfish
		NLAA	Gray Bat
	Wilson	Take	Indiana Bat

State Name	County Name	Type	Species
		NLAA	Gray Bat
Virginia	Albemarle	Take	Indiana Bat
		Take	James Spiny Mussel
	Alleghany	Take	James Spiny Mussel
		Take	Indiana Bat
	Augusta	Take	Indiana Bat
		Take	Madison Cave Isopod
		NLAA	Virginia Big Eared Bat
	Botetourt	Take	James Spiny Mussel
		Take	Indiana Bat
	Clarke	Take	Madison Cave Isopod
		Take	Indiana Bat
	Giles	Take	Indiana Bat
		Take	James Spiny Mussel
		NLAA	Virginia Big Eared Bat
	Greene	Take	Indiana Bat
		Take	James Spiny Mussel
	Rockbridge	Take	Indiana Bat
		Take	James Spiny Mussel
		Take	Madison Cave Isopod
	Rockingham	Take	Indiana Bat
		Take	Madison Cave Isopod
		NLAA	Virginia Big Eared Bat
	Warren	Take	Madison Cave Isopod
		Take	Indiana Bat
West Virginia	Braxton	Take	Northern Riffleshell
		Take	Indiana Bat
		Take	Clubshell
	Clay	Take	Clubshell
		Take	Indiana Bat
		Take	Northern Riffleshell
	Doddridge	Take	Clubshell
		Take	Indiana Bat
	Grant	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
	Hardy	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
	Jackson	Take	Fanshell
		Take	Indiana Bat

State Name	County Name	Type	Species
	Kanawha	Take	Fanshell
		Take	Indiana Bat
		Take	Clubshell
	Lewis	Take	Clubshell
		Take	Indiana Bat
	McDowell	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
	Pendleton	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
		NLAA	Cheat Mountain Salamander
	Preston	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
	Randolph	Take	Indiana Bat
		NLAA	Cheat Mountain Salamander
		NLAA	Virginia Big Eared Bat
	Tucker	Take	Indiana Bat
		NLAA	Virginia Big Eared Bat
		NLAA	Cheat Mountain Salamander

***Note:** NLAA = not likely to adversely affect.