Biological Evaluation of the Renewable Fuel Standard Set Rule and Addendum

United States
Environmental Protection
Agency

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Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

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List of Acronyms and Abbreviations

Numerous acronyms and abbreviations are included in this document. The most commonly used ones are defined below.

BBD	Biomass-Based Diesel, which includes biodiesel and renewable diesel qualifying as advanced biofuel under the RFS program
CAA	Clean Air Act
CNG	Compressed Natural Gas
CRP	Conservation Reserve Program
DOE	U.S. Department of Energy
DPS	Designated Population Segments
EISA	Energy Independence and Security Act of 2007
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act of 2005
ESA	Endangered Species Act
ESU	Evolutionary Significant Units
FWS	Fish and Wildlife Service, U.S. Department of the Interior
GHG	Greenhouse Gas
GIS	Geographic Information System
LCA	Lifecycle Analysis
LCFS	Low Carbon Fuel Standard
LNG	Liquified Natural Gas
RPAs	Reasonable and prudent alternatives
NMFS	National Marine Fisheries Service, National Oceanic and Atmospheric Administration
PBFs	Physical and Biological features (PBFs)
PCEs	Primary Constituent Elements (PCEs)
RFS	Renewable Fuel Standard
RIA	Regulatory Impact Analysis

RIN	Renewable Identification Number
RNG	Renewable Natural Gas
RVO	Renewable Volume Obligation

I. Executive Summary

The Endangered Species Act requires federal agencies to consult with the Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) (hereafter "the Services") whenever the agency determines that a discretionary federal action may affect endangered or threatened species or designated critical habitat. The U.S. Environmental Protection Agency (EPA) has made such a determination for the Renewable Fuel Standard (RFS) rulemaking titled, "Renewable Fuel Standard (RFS) Program: Standards for 2023–2025 and Other Changes." A proposal for this rulemaking, also known as the "Set Rule," was published on December 30, 2022 (US EPA, 2022), and proposes RFS volume requirements and associated percentage standards for the years 2023, 2024, and 2025 as well as a series of important modifications to strengthen the RFS program. We are preparing to finalize this action, with some modifications from the proposal.

In this Biological Evaluation, we first provide a chronology of our interactions with the Services towards completing ESA consultation on the Set Rule, followed by an overview of the RFS program. We then describe in more detail the RFS Set Rule as well as the action area, defined by 50 CFR § 402.02 as the area within the U.S. that will be affected directly or indirectly by the Set Rule. EPA has determined that the production of crop-based feedstocks has the potential to affect endangered and threatened species (also referred to as "listed species" in this document) and critical habitat by contributing to land use changes that could, for example, lead to habitat loss or water quality impairments via runoff from agricultural lands. Therefore, for all species within the action area, we find that the Set Rule may affect listed species and critical habitat; thus, we are engaging in an ESA section 7 consultation with the Services. The action area we delineate is based on where crops of corn, soybean, and canola are currently grown in the U.S. and where we project that land use changes may occur, as well as the associated downstream areas that could be impacted by agricultural runoff and pollution from such crop areas. We focused our analyses on these three crops because they are used to produce the bulk of renewable fuel under the RFS: corn ethanol; soy biodiesel and renewable diesel; and canola biodiesel and renewable diesel.[1] Although the very broad scope of this analysis has required EPA to make a significant number of assumptions that have resulted in considerable uncertainty in the results, EPA found that the Set Rule action area overlaps with a total of 712 unique species: 672 FWS species, 32 NMFS species, and 8 that are both FWS and NMFS species. And because multiple species have Designated Population Segments (DPSs) or Evolutionary Significant Units (ESUs), a total of 810 populations are evaluated in this Biological Evaluation. The full list of species and populations can be found in Section V.

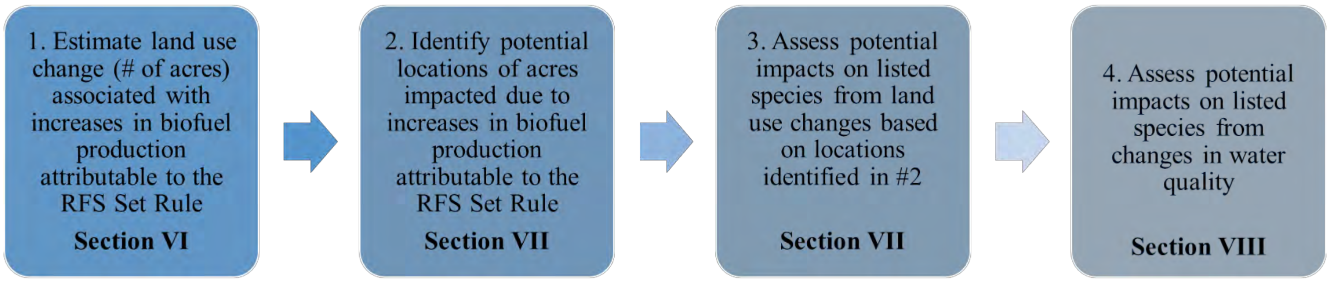
To further assess how the Set Rule may affect these species, we followed a four-step process to assess potential impacts, as depicted in Figure ES.1 below.[2] We followed the same stepwise process to assess potential impacts from corn (corn ethanol), soy (soy biodiesel), and

[1] Hereinafter, references to "soy biodiesel" and "canola biodiesel" will encompass both biodiesel and renewable diesel.

[2] This process diagram is a general description of how we approached the analyses. In the context of the discussion of potential changes in corn, soybean, and canola production we have provided process diagrams that are specific to each of these feedstocks.

canola (canola biodiesel). However, the methods used to complete each step varied to some degree for each of these three feedstock crops, primarily because we leveraged existing data and research that used different approaches and had varying levels of data availability.

Figure ES.1: Illustration of EPA's four-step process to assess potential impacts on threatened and endangered species due to increases in each of the three feedstock crops related to the RFS Set Rule. The sections of this Biological Evaluation that discuss each step are indicated in bold in the figure.



Step 1. Estimate land use change impacts attributable to the RFS Set Rule

There are many factors, including various economic and policy drivers, that influence the production of renewable fuels in the United States. In Section VI.A, for example, we discuss how the increases in historical corn ethanol production were driven by a wide range of factors in addition to the RFS Program.[3] As Step 1 for this Biological Evaluation, we made an attempt at estimating the land use changes associated with increases in the production of corn ethanol, soybean biodiesel, and canola biodiesel that could be attributable to the Set Rule alone. For comparison purposes, we estimated land use change in the U.S. from 2023–2025 for all crops, not just for corn, soybeans, and canola.

It is important to note the significant assumptions and high uncertainty inherent in estimating these acreage impact numbers at each and every step in the underlying causal relationship between the RFS standards and the effects that could result from increased production of crop-based feedstocks. For example, projecting the impact of increased biofuel demand on corn, soybean, and canola production is complicated by the fact that the majority of all three crops is used in non-biofuel markets; for further information on domestic use of corn and soybeans, see Sections VI.A.3 and VI, B.2. There is thus uncertainty in attributing the increased biofuel demand from the set rule to corn, soybean, and canola planting decisions. Further, the potential impacts of any RFS volume standards on species would be indirect and mediated through markets. The fact that farmers do not generally grow crops for specific end uses (e.g., earmarked for biofuel production vs. animal feed) nor do biofuel producers specify how much of the fuel they produce is attributable to the RFS rather than what they would have produced in the absence of the RFS program make our projections of the potential impacts of the

[3] Though this document in some cases looks at historical trends—for example, historical drivers of ethanol use—this Biological Evaluation assesses only potential future impacts of the Set Rule proposed volumes.

RFS program on species inherently uncertain. Without reliable data on these points, we cannot identify with any specificity parcels of land that may be converted to cropland, or any changes in water quality that may result from such conversion, that could be the result of the incremental demand for biofuels created by the RFS program. Thus, the impacts presented in this Biological Evaluation are somewhat hypothetical and are based on potential scenarios, which often represent to the worst-case scenarios, to conservatively compensate for the absence of specific land conversion and associated water quality impact data. Where present in our analyses, we detail the uncertainty associated with the various inputs and interpretations of our projections.

We note as well that the increased demand for biofuels does not necessarily result in increased plantings of corn, soybean, and canola for production. This is further explained in EPA's recent external review draft of the Third Triennial Report to Congress at sections 6 and 7. We are unable to quantify a discrete contribution of the RFS to increased crop-based feedstock production, as any of these increases could be a result of other factors, like increased yields and crop production for other non-biofuel uses. The discussion of estimates in this and later sections, are therefore uncertain given the lengthy causal chain between EPA setting the volume requirements under the RFS program, and any potential impacts on listed species and critical habitat, and any break in the causal chain would mean that the RFS Set rule did not cause the outcome contemplated by our analysis.

Our soybean biodiesel analyses provide an example of this uncertainty: out of the three feedstock categories, increases in soybean biodiesel from the RFS Set Rule are expected to have the greatest acreage impacts at an estimated 1.93 million acres of soybeans, which is ~1.2 million acres greater than the estimated acreage impacts from corn ethanol and canola biodiesel combined (Table ES.1). Importantly, however, our analyses suggest that the expected increased demand for these types of biofuels, driven by the Set Rule alone, could be met *fully* by changes in imports/exports or by projected increases in feedstock yields on existing soybean lands, rather than by converting new lands to crops. This again illustrates how EPA's analysis is based on a worst-case scenario.

To assess land use change impacts from corn ethanol, we leveraged analyses available in published literature combined with updated data to estimate the change in corn acres and total cropland per billion gallons of ethanol production. For soybean biodiesel, we developed a methodology comparing the historical relationship between domestic meat production and soybean crush to projected meat production and soybean crush; the difference between the two in future years provided a best guess at a projected increase in soybean demand for soybean oil used to produce biofuel. Finally, for canola biodiesel, we relied on modeling work from a recent RFS rulemaking that approved a new canola renewable diesel pathway. The results, which are based on a wide variety of assumptions, are shown in Table ES.1 below.

Table ES.1 Maximum potential acreage impacts for all crops in the U.S. due to increases in corn ethanol, soybean biodiesel, and canola biodiesel that can be attributed to EPA's Set Rule.

	Volume Increase in RFS Set Rule (billion gallons)			Maximum Potential Acreage Increase All Crops (million acres)		
	2023	2024	2025	2023	2024	2025
Corn ethanol	0.71	0.78	0.84	0.39	0.44	0.46
Soybean biodiesel	1.95	1.92	1.89	1.57	1.78	1.93
Canola biodiesel	0.24	0.24	0.24	0.26*	0.26*	0.26*

*Projected to occur in the North Dakota region

Table ES.1 indicates that the RFS Set Rule could potentially lead to an increase of as much as 2.65 million acres of cropland by 2025. This would constitute approximately 1% of the projected U.S. acreage for major field crops in 2025 (USDA, 2022). Again, it is important to note the significant assumptions and high uncertainty inherent in estimating these nationwide acreage impacts numbers, making this number, by definition, a worst-case scenario. The need for multiple assumptions underlying this assessment, and the inherent uncertainty contributed to our finding of NLAA, as described in Section IX

Step 2. Identify locations potentially impacted by increases in acres from the Set Rule

It was difficult to estimate with confidence the magnitude of the nationwide total cropland acreage changes associated with the Set Rule under Step 1 and as summarized in Table ES.1 due to the multiple uses of biofuel crops and the potential for global trade and substitutability of these crops in some markets. It was even more challenging to state with a high degree of confidence *where* those acreage increases might occur in the United States given the vast quantity of potential cropland in the U.S. and the multitude of factors that contribute to an individual farmer's decision whether to bring additional land into crop production. Even so, in order to conduct this Biological Evaluation, it was necessary for us to attempt to identify locations to better understand potential impacts of the Set Rule on listed species and critical habitat. This is the goal of Step 2.

For soybean biodiesel, we retained the services of a contractor (ICF) to develop a soybean-specific land selection model that used a series of weighted factors to prioritize the selection of lands for soybean production to provide a plausible best guess of where farmers might expand soybean crops. For example, lands that were closer to existing soybean fields and in states with larger soybean growth rates were weighted higher for selection. In contrast, areas that are permanently protected from conversion as well as forestlands and wetlands were assigned a lower weight in the land selection model. ICF used their model to select lands within a constrained soybean expansion area for various biofuel volume scenarios. For this Biological Evaluation, we focused on the two scenarios that most closely matched the 1.93 million acres maximum value from Table ES.1. Although we defined our action area separately from ICF's work, we found that greater than 99 percent of their modeled lands occurred within the action area defined for this Biological Evaluation.

In contrast, for the potential land-use changes associated with corn ethanol and canola biodiesel, EPA was not able to develop a similar land selection model. This was partially due to the fact that while the increase in demand for soybean oil is expected to result in increased planting of soybeans, the published literature and modeling we used to estimate the impacts of increased demand for corn and canola oil respectively suggest that any new cropland would not be limited to these crops. Instead, the published literature found that increases in demand for corn for ethanol production will result in an expansion of total cropland, and the modeling we used to estimate the impact of increased demand for canola oil found the demand increase would primarily result in cropland expansion for crops other than canola in the U.S. While there is value in using a model to select specific areas that could be converted, and it is a robust approach for assessing potential effects on listed species, it must be noted that economic-driven factors could lead to land use changes on any available lands within the action area that are separate and apart from any Set Rule volumes.

Faced with this high level of uncertainty, for corn ethanol and canola biodiesel we developed a probabilistic approach to select available lands for potential conversion within the action area. We defined four land cover classes: (1) shrubland, (2) grassland/herbaceous, (3) pasture/hay, and (4) emergent herbaceous wetlands. For corn ethanol, we used ArcGIS Pro and R[4] to randomly select 500,000 acres from among available and suitable land, which is a conservative approach given the 460,000 acres estimated in Table ES.1. We repeated the process 100 to 500 times to generate an estimated probability that any given acre of land would be converted to growing additional corn for the purpose of producing ethanol.

We applied this same probabilistic approach to assess potential impacts from canola biodiesel. To do so, we randomly selected 260,000 acres from among available and suitable land based on the values in Table ES.1. In addition, we constrained our analysis to the state of North Dakota based on the results of a separate modeling exercise that showed this state would be the primary area affected by potential land use change impacts related to canola biodiesel.

These locations of potential land use change do not identify actual conversion as a result of the RFS Set rule, but rather provide EPA with a tool to identify areas of potential impact.

Step 3. Identify potential impacts on listed species from land use changes

EPA's analysis of the potential impacts on listed species is based on predicting what quantities of land use change might occur and where those land use changes might manifest because of the Set Rule. This is because changes in the way that land is used to grow crops could impact listed species in several ways: non-cropland that is converted to cropland could result in adverse effects to the habitats or ranges of listed species; nearby habitats could be indirectly affected by dust or runoff created during the land conversion; and, after conversion, new cropland could affect listed species or habitat on both the land in question and nearby areas through sediment, pesticide, or fertilizer runoff. Similarly, in cases where additional crops are grown on existing cropland through various intensification measures such as double-cropping or

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[4] ArcGIS is a geographic information system software commonly used for mapping and spatial analyses. R is software commonly used for statistical computing and graphics.

increased fertilizer or pesticide use, there could be impacts on flora and fauna for that land and nearby areas. In evaluating potential impacts to species with critical habitat, it is especially important to assess whether effects would occur to essential Physical and Biological features (PBFs) or Primary Constituent Elements (PCEs) found within the boundary of the critical habitat. However, as described throughout this Biological Evaluation, the high level of uncertainty associated with the many assumptions we were required to make in our analyses prevented EPA from determining with reasonable certainty that any given listed species and/or critical habitat will be indeed impacted in any of these ways. As such, throughout this Biological Evaluation EPA uses terms such as "potential impacts" and "potential effects of the action."[5]

Despite these uncertainties, we conservatively used the maximum acreage impacts in Table ES.1 to assess the potential impacts that listed species and critical habitat might experience due to land use changes. Using the locations identified for potential land use change driven by increases in each feedstock crop (Step 2), we identified which listed species or critical habitat are present in or near the locations subject to potential land use change. Many of the species or populations that emerged as having relatively higher potential to be impacted in each of the feedstock crop analyses are discussed in detail in Sections VII.A-VII.C, and we assessed the aggregate impacts from all three analyses in Section VII.D of this Biological Evaluation. For the 10 species that had the greatest potential critical habitat impacts from land use changes alone, we found that 0.57 to 4.62 percent of their critical habitats could be potentially impacted (Table VII.D-1). When we added a 2,500-foot buffer to critical habitats, not surprisingly, the potential impact numbers for the top 10 impacted species went up and ranged from 4 to 13.5 percent (Table VII.D-2). Results also indicate that the top 10 species with ranges potentially impacted could see 2 to 13.7 percent of their range impacted, whether the range had a buffer or not (Tables VII.D-3 and VII.D-4). In total we identified 810 listed populations in the analyses. Of the 810 listed populations, we estimated that only 7 may have greater than 1% of their critical habitat converted to cropland (38 species had greater than 1% of critical habitat plus buffer converted) and 15 species may have greater than 1% of their range converted (14 species had greater than 1% of their range plus buffer converted). This "overlap analysis" is again, inherently uncertain, as any species' range or critical habitat could have more or less overlap with converted lands based on many unrelated factors that are impossible to more precisely define. Instead, this analysis provides EPA with guidance as to the species and critical habitat for which further analysis of taxa-specific and species-specific habitats, PBFs, and ranges is justified.

Since the numbers described above were estimated based on the maximum potential acreage increases from the Set Rule, these numbers likely represent the maximum potential acreage impacts to species' critical habitat and/or range. As discussed previously, we made conservative assumptions in our analyses throughout Steps 1 through 3. These conservative assumptions compound upon one another resulting in an overall *very* conservative analysis. Thus, it is possible that there may be no land use impacts at all to species/populations and their critical habitats due to the RFS Set Rule volumes. For example, there would likely be no impact

[5] This use of "effects" is thus not equivalent to the regulatory term "effects of the action" in 50 CFR 402.02.

were the volumes to be met through other means such as increasing imports or decreasing exports of biofuels or feedstocks. Further, it is important to consider species' life history information and, for critical habitat in particular, the PBFs/PCEs that are essential for the conservation of the listed species and whether or not such features could be affected by the RFS Set Rule. Clearly, not all land within the boundary of a critical habitat unit contains PCEs/PBFs. We explore this uncertainty in more detail in Section IX of this Biological Evaluation.

Step 4. Assess potential impacts on listed species from changes in water quality

To estimate the impact on water quality of the potential land use changes attributable to the Set Rule, we leveraged results from published literature that used the Soil and Water Assessment Tool (SWAT) to estimate the water quality impacts from observed increases in cropland in the Missouri River basin, and extrapolated those results to the Mississippi River Basin.

In particular, we relied on the Chen study that applied the SWAT to the Missouri River basin to estimate the water quality changes resulting from land use changes observed from 2008–2016 (Chen et al., 2021). The total quantity of land converted to cropland in the Missouri River basin during this time period was approximately 2.51 million acres, which is similar to the total maximum land conversion we are expecting from this action (compare Table ES.1 and Table VIII.A-1). Results show that, at the outlet of the Missouri River, the conversion of non-cropland to cropland could result in an increase in the total nitrogen (TN) and total phosphorus (TP) loads of up to 6.4% and 8.7%, respectively. The modeled increases in total nitrogen and phosphorus would represent increases of approximately 0.8% and 2.1% respectively at the Mississippi River outlet, if we assume as a worst-case that the modeled increase in nitrogen and phosphorus at the mouth of the Missouri River is equal to the increase in nitrogen and phosphorus at the Mississippi River outlet.

The Chen study did not consider the impact of increased use of pesticides, and no equivalent study on pesticide concentrations exists. While nitrogen, phosphorus, and suspended solids are not perfect analogs to the pesticides, they do share some important similarities. The application rates for both fertilizers (nitrogen and phosphorus) and pesticides are expected to be related to the projected potential changes in cropland. For example, we expect that any new land planted in corn would be treated with fertilizers and pesticides at the average national rate for all corn acres. Total fertilizer and pesticide use would therefore depend on the amount of fertilizer and pesticides used to produce the new crop relative to the previous use of the land (whether cropland or non-cropland) and the total projected land use changes. We therefore estimate that the increase in pesticides in aquatic environments would be approximately equal to the increases in nitrogen and phosphorus projected in the Chen study using SWAT.

These analyses suggest that, even if the maximum projected acreage impacts from the Set Rule (2.65 million acres total) were to occur, the water quality impacts will be small relative to total nutrient, sediment, and pesticide effects already happening at the mouth of the Mississippi and other larger water bodies within the action area. Also, effects are unlikely to negatively impact the NMFS species found within coastal regions and oceans, as the potential effects are insignificant relative to baseline conditions or are discountable (e.g., through diffusion of pollution before it reaches the areas of these species). Localized water quality impacts in freshwater ecosystems within the action area are also likely to be discountable as it is unlikely that species will be exposed to potential effects from the action caused by land use changes. EPA completed a qualitative analysis for some NMFS species in Section XI of this Biological Evaluation and this analysis supports this conclusion. We cannot say with certainty that impacts would occur, and if they did occur we cannot say with certainty where they would take place, despite our best efforts to assess this.

Finally, we note that EPA currently has several programs and funding opportunities designed to improve water quality. We therefore expect that these efforts, discussed further in Section VIII.B, will help to lessen any potential water quality impacts of increased cropland attributable to the Set Rule, if indeed such cropland increases come to pass.

NLAA Conclusion

EPA's analyses support a determination that the Set Rule may affect, but is not likely to adversely affect (NLAA), any of the 810 populations within the Set Rule action area or their critical habitat. Specific species determinations are discussed in Section IX after considering life history and PBF information by taxonomic groupings. Even if there could be impacts to certain PBFs/PCEs, we cannot say with reasonable certainty that any particular species will be impacted, again due to the numerous layers of uncertainty between the finalized RFS Set Rule volumes and on-the-ground, localized land use changes. As such, we find that effects on all species and critical habitat are discountable (i.e., extremely unlikely to occur) and/or insignificant, With the submission of this Biological Evaluation, EPA respectfully requests the Services' concurrence on EPA's effects determinations for the species and critical habitat detailed in Table V-1 that are not likely to be adversely affected by this federal action.

II. Consultation to Date

The following chronology summarizes EPA's engagement with the Services in support of this ESA section 7(a) consultation.

- March 23, 2021 – Meeting between EPA and the Services
- May 20, 2021 – Meeting between EPA and the Services
- August 24, 2021 – Meeting between EPA and the Services
- September 7, 2021 – Meeting between EPA and the Services
- September 21, 2021 – Meeting between EPA and the Services
- September 30, 2021 – Email from EPA to the Services requesting geospatial information related to listed or proposed endangered or threatened species and designated critical habitat in the potential action area.
- September 30, 2021 – Email from FWS to EPA providing information on the location of listed or proposed endangered or threatened species and designated critical habitat.
- November 15, 2021 – Email from NMFS to EPA providing information on the location of listed or proposed endangered or threatened species and designated critical habitat.
- November 16, 2021 – Meeting between EPA and the Services
- January 25, 2022 – Meeting between EPA and the Services
- February 22, 2022- Meeting between EPA and the Services
- March 8, 2022 – Meeting between EPA and the Services
- April 5, 2022 – Meeting between EPA and the Services
- May 3, 2022 – Meeting between EPA and the Services
- June 3, 2022 – Email from EPA to the Services to share ESA 7(d) Memorandum for the Renewable Fuel Standard Program: RFS Annual Rules ("2020-2022 RFS Final Rule")
- June 21, 2022 – Email from EPA to the Services to share draft Biological Evaluation chapters and request review
- June 28, 2022 – Meeting between EPA and the Services
- August 23, 2022 – Meeting between EPA and the Services
- September 6, 2022 – Meeting between EPA and the Services
- September 20, 2022 – Meeting between EPA and the Services
- October 18, 2022 – Meeting between EPA and the Services
- November 1, 2022 – Meeting between EPA and the Services
- November 15, 2022 – Meeting between EPA and the Services
- November 29, 2022 – Meeting between EPA and the Services
- December 1, 2022 – Email from EPA to the Services to share draft Biological Evaluation chapters and request review
- December 7, 2022 – Meeting between EPA and NMFS
- December 13, 2022 – Meeting between EPA and the Services
- January 10, 2023 – Meeting between EPA and the Services
- January 24, 2023 – Meeting between EPA and the Services
- January 31, 2023 – Meeting between EPA and the Services
- January 31, 2023 – Submittal of draft complete Biological Evaluation to Services with Request for Concurrence
- February 7, 2023 – Meeting between EPA and the Services

- February 14, 2023 – Meeting between EPA and the Services
- February 21, 2023 – Meeting between EPA and the Services
- February 28, 2023 – Meeting between EPA and the Services
- March 7, 2023 – Meeting between EPA and the Services
- March 14, 2023 – Meeting between EPA and the Services
- March 21, 2023 – Meeting between EPA and the Services
- March 28, 2023 – Meeting between EPA and the Services
- April 4, 2023 – Meeting between EPA and the Services
- April 11, 2023 – Meeting between EPA and the Services
- April 18, 2023 – Meeting between EPA and the Services
- April 25, 2023 – Meeting between EPA and the Services
- May 2, 2023 – Meeting between EPA and the Services
- May 9, 2023 – Meeting between EPA and the Services
- May 16, 2023 – Meeting between EPA and the Services
- May 19, 2023 – Submittal of revised draft of Biological Evaluation to Services with Request for Concurrence

III. The Renewable Fuel Standard (RFS)

Congress created the Renewable Fuel Standard (RFS) to reduce greenhouse gas emissions and enhance energy security through expanding the nation's use of renewable fuels. This program was created under the Energy Policy Act of 2005 (EPAct), which amended the Clean Air Act (CAA). The Energy Independence and Security Act of 2007 (EISA) further amended the CAA by expanding the RFS program. Under Clean Air Act section 211(*o*), the RFS program requires that certain minimum volumes of renewable fuel must be used in the transportation sector, for all years after 2005, with the goal of replacing or reducing the quantity of petroleum-based transportation fuel, heating oil, or jet fuel. 211(*o*) contains specific renewable fuel volume targets through 2022 and provides EPA with the authority for setting volumes for 2023 and beyond. However, the statute also provides EPA with the discretion to waive the volume requirements under specific circumstances. This section describes the operation of the RFS program, the conditions associated with the agency's available discretion, the historical production of renewable fuel, and factors affecting actual production and use of renewable fuel.

A. Statutory Requirements

The RFS program places an obligation on producers and importers of gasoline and diesel (hereafter simplified to "refiners") to utilize certain amounts of renewable fuel to replace fossil-based transportation fuels. The obligation is presented as a percentage standard that each refiner multiplies by its gasoline and diesel production and importation to determine the volume of renewable fuel for which it is responsible. The RFS program does not create an obligation for any individual party to produce or use any amount or type of renewable fuel. Instead, renewable fuel producers respond in typical market fashion to the demand for their products that is created by the RFS blending obligations placed upon refiners.

The applicable standards under the RFS program fall into four broad categories that are defined primarily by the estimated greenhouse gas (GHG) benefits achieved by each renewable fuel relative to the petroleum-based fuels that they replace. Some categories are also defined by additional criteria as shown below.

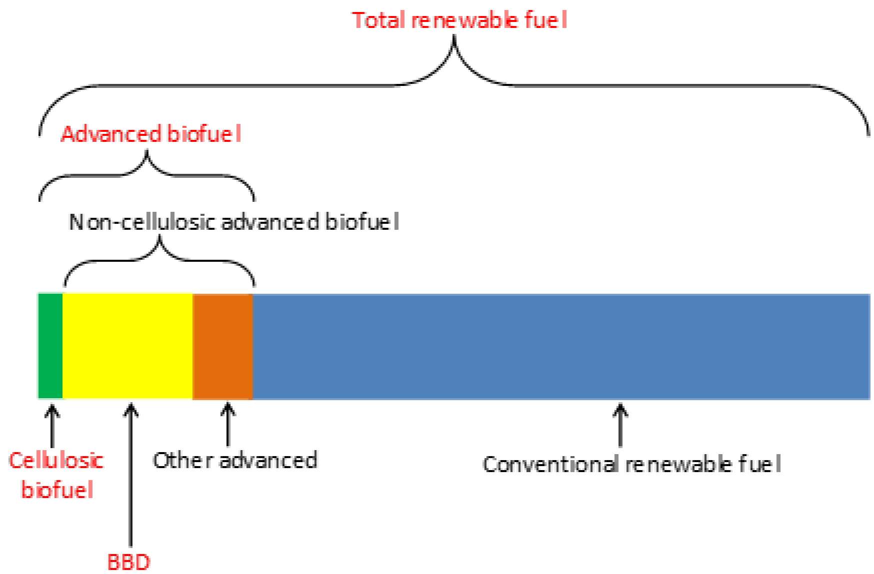
Table III.A-1: Statutory criteria for renewable fuel under the RFS program

Category	Minimum GHG reduction requirement	Other requirements and exclusions
Cellulosic biofuel	60%	Must be made from cellulose, hemi-cellulose, or lignin
Biomass-based diesel	50%	Includes only biodiesel and renewable diesel, but excludes any renewable fuel that is produced through co-processing a feedstock with petroleum
Advanced biofuel	50%	Excludes ethanol derived from corn starch
Renewable fuel	20%[a]	Must be made from qualifying renewable biomass

[a] Does not apply to "grandfathered" renewable fuel produced in a facility that was operational or under construction before December 2007.

As defined under the statute, these four categories are nested within one another. For instance, both cellulosic biofuel and biomass-based diesel (BBD) also count as advanced biofuel, and all advanced biofuel counts as renewable fuel. Since the nested nature of the categories necessarily means that there is some overlap between them, it is sometimes helpful to decompose the nested categories into mutually independent ones for discussion purposes. Thus, we may speak of non-cellulosic advanced biofuel rather than advanced biofuel, and speak of conventional renewable fuel rather than renewable fuel. The relationship between all categories, both those defined in the statute and the decomposed categories having some additional practical utility, are shown below.

Figure III.A-1: Relationship between categories of renewable fuel under the RFS[a]

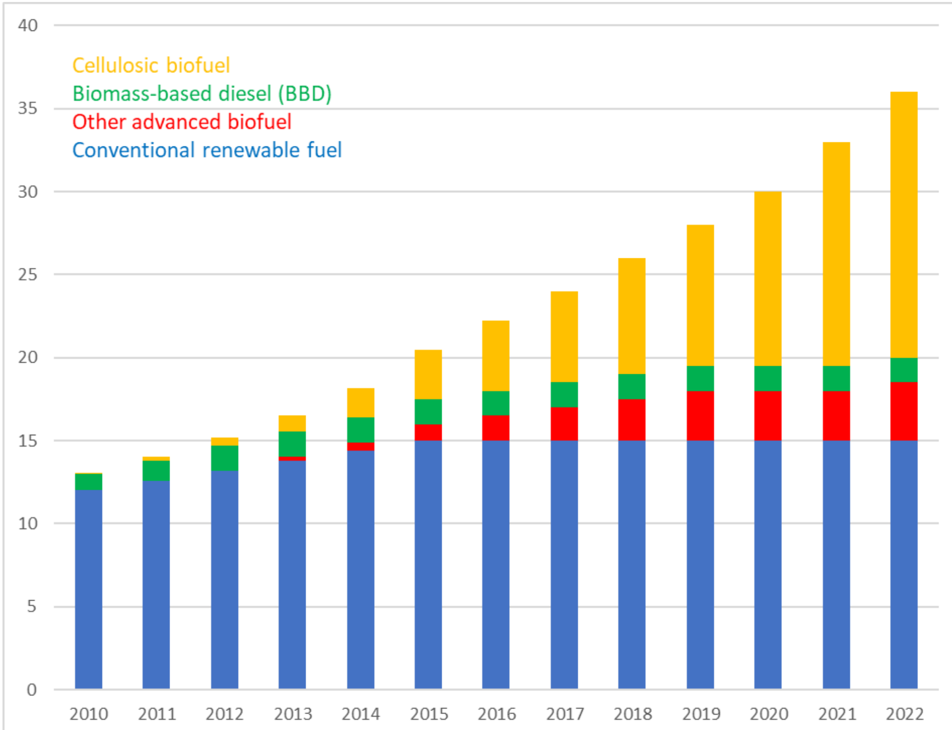


[a] Categories in red are those defined in the statute. Categories in black are sometimes helpful in differentiating between different renewable fuel types and their impacts.

Within the requirements and exclusions shown in Table III.A-1, the statute allows any renewable fuel made from any renewable biomass feedstock to qualify under the RFS program. Renewable biomass is defined in the statute. Thus, the applicable standards for each category do not require the production and consumption of any particular type of renewable fuel. The market's participants (refiners and importers of gasoline and diesel fuel, biofuel producers, fuel blenders, consumers, etc.) determine the mix of renewable fuel and feedstock types that end up being used as transportation fuel based on economic and other market factors in order to ensure that the RFS obligations are met.

The statute specifies volume targets for each of the four component categories of renewable fuel for years 2010 through 2022. These targets are shown below.

Figure III.A-2: EISA 2007 Volume Targets



The statutory volume targets shown above represent the applicable volume requirements unless EPA waives them in whole or in part as described in the next section. For years that the statute does not specify volume targets (i.e., 2013+ for BBD and 2023+ for all other categories), EPA must establish the applicable volume targets following certain processes, criteria, and standards specified in the statute.

To ensure that the applicable volumes of renewable fuel are used each year, CAA section 211(*o*)(3)(B)(i) requires EPA to set annual percentage standards. Because EPA was sued over its failure to meet the statutory deadline to set the 2023 standards, EPA is subject to a court-ordered deadline to finalize the 2023 standards—which are part of the RFS Set Rule which is the subject of this Biological Evaluation—by June 14, 2023 (*Growth Energy v. Regan*, 2022).

Notably, the RFS program does not regulate the conduct of farmers who plant crops that can then be utilized as feedstock to create renewable fuel. In order to participate in the program, renewable fuel producers must register with EPA, and keep records demonstrating only that the renewable fuel meets the statutory requirements[6] that the renewable fuel is produced from renewable biomass and used as transportation fuel in the United States. However, the program itself, and the standards promulgated in this action, do not require any action by or place any other requirements on any particular renewable fuel producer or farmer. The production of renewable fuels, their type, and the crop-based feedstocks used for many of them, like corn and

[6] These statutory requirements do not include impacts on endangered species.

soy, are not directly regulated by the RFS program. Instead these many decisions and the resulting planting and crop marketing and sales decisions made by farmers are the result of many market factors such as crop prices, demand for crops, and local conditions, meaning that farmers' decisions regarding the best use of their crops can change from month to month, year to year.

B. Discretion Available under the Statute

The statutorily prescribed volume targets in the Clean Air Act (CAA) section 211(*o*)(2)(B) can be modified by EPA in specified circumstances. CAA section 211(*o*)(7) provides EPA's waiver authorities. CAA section 211(*o*)(7)(A) provides EPA's "general waiver authorities," allowing EPA to waive the national quantity of renewable fuel in the statute in whole or in part upon a demonstration that the requirements would cause severe harm to the economy or environment of a State, region, or the United States, or a determination that there is an inadequate domestic supply. EPA can only waive volumes under this provision after notice and opportunity for comment, and after consultation with USDA and DOE. The statute does not prescribe how EPA is to determine the appropriate volume to waive.

EPA has never waived volumes on the basis of "severe harm" to the economy or the environment under the general waiver authority. However, in December 2015 EPA did waive volumes of total renewable fuel under a finding of "inadequate domestic supply." EPA was challenged on that action, and after review the U.S. Court of Appeals for the D.C. Circuit ruled that EPA had exceeded its authority in waiving volumes, holding that any waiver based on the "inadequate domestic supply" prong of 211(*o*)(7) would only be appropriate if there was an "inadequate domestic supply" of renewable fuel to obligated parties, and that EPA could not consider demand side-factors, including the supply of renewable fuel to consumers.

EPA has also received a number of administrative petitions requesting that we use our 211(*o*)(7) general waiver authority to reduce the RFS standard volumes, but to date EPA has not granted any of these petitions. As recently as January 2021, EPA sought comment on a number of petitions to waive the volumes under a finding of severe economic harm or a finding a severe environmental harm. In the notice, EPA referred to its prior interpretation of the statutory provision, including that 1) the harm must be caused by implementation of the RFS program itself; 2) the harm must be fairly certain to occur and not be merely speculative; 3) the harm must be severe; 4) the harm must be to an entire state, region, or the U.S. and not to a single industry; and 5) given the discretionary nature of the waiver authority, EPA will also consider benefits of the program. EPA sought comment on the elements of that interpretation (*86 FR 5182*, 2021). EPA reaffirmed that interpretation and denied the petitions for a waiver of the 2019 and 2020 RFS standards in a recent action (*87 FR 39600*, 2022; *87 FR 39620*, 2022).

CAA section 211(*o*)(7)(D) provides EPA with additional waiver authority, commonly referred to as the "cellulosic waiver authority." Under this authority, EPA shall reduce the volume of cellulosic biofuel when the projected volume of cellulosic biofuel production is less than the applicable volume of cellulosic biofuel. It also provides that EPA *may* reduce the applicable volume of renewable fuel and advanced biofuel by the same or lesser volume. Courts have indicated that EPA retains significant discretion in deciding whether to waive the advanced biofuel and total renewable fuel volumes, and by how much (*Americans for Clean Energy v.*

EPA, 2017; *American Fuel & Petrochemical Mfrs. v. EPA*, 2019). EPA has waived the cellulosic biofuel volume every year since the RFS2 program began in 2010, and has made commensurate reductions in the advanced biofuel and total renewable fuel requirements under the cellulosic waiver authority beginning in the 2016 compliance year, and each subsequent year, with the exception of the 2020–2021 compliance years.

Finally, CAA section 211(*o*)(7)(F) provides that EPA shall modify the applicable volumes of renewable fuel if certain triggers are met. This is commonly referred to as the "reset authority." In doing so, EPA is to analyze the same factors specified in CAA section 211(*o*)(2)(B)(ii). EPA used this authority in a rulemaking published on July 1, 2022 to modify the 2020–2022 volume requirements for all fuel types except biomass-based diesel (*87 FR 39600*, 2022).

EPA's waiver authorities, found in CAA section 211(*o*)(7), provide EPA with the discretion to waive the volume requirements if certain criteria are met as described above. While EPA has used those waiver authorities in past years to reduce the volume requirements below the targets specified in the statute, it does not intend to do so in the forthcoming rulemaking that will establish volume requirements for 2023–2025. Instead, EPA intends to use the set authority. Nevertheless, EPA retains the ability to reconsider promulgated rulemakings. EPA has, in the past, based on new information and drastically changed circumstances, revised standards after initially promulgating them using the waiver authorities.

We note that, regardless of the authority that EPA uses to establish nationwide volume requirements, EPA can only set the overall applicable volumes of renewable fuel that are required to be used. Which types of fuels from which feedstocks and in what quantities ultimately are used are all left up to the market, making it difficult to predict with any accuracy what each year's actual RFS fuel mix will be.

C. Historical Production of Renewable Fuel

The full list of renewable fuel types and feedstocks that qualify under the RFS is provided in Table 1 to Section 1426, part 80, Title 40 of the Code of Federal Regulations. In practice, however, certain renewable fuels have dominated the transportation fuels market while others have been used in very small quantities or not at all. The figure and tables below show the fuel types and feedstocks that were produced in the U.S. between 2016 and 2021 for cellulosic biofuel, non-cellulosic advanced biofuel, and conventional renewable fuel, along with the average contribution that each has made to the total volume over that timeframe (Figure III.C-1, Tables III.C-1, III.C-2, and III.C-3). Also included is a table showing the average proportions for crop-based versus non-crop-based feedstocks produced domestically (Table III.C-4). Fuel types and feedstocks not shown were produced in only negligible quantities or not at all.

Figure III.C-1: Fuel types that were produced in the U.S. from 2016–2021

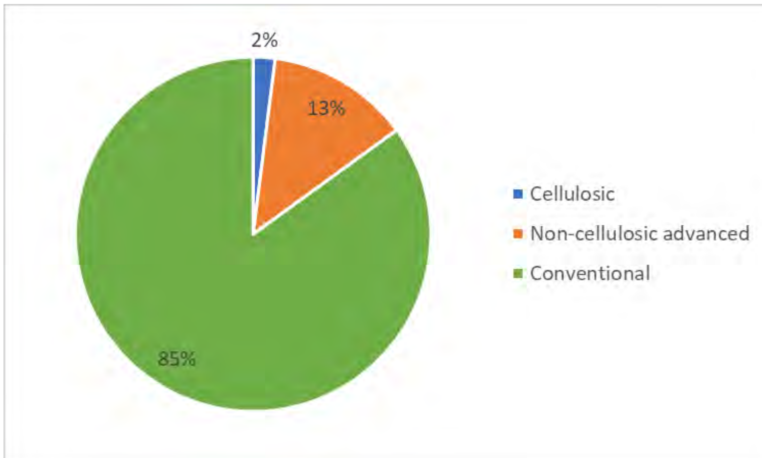


Table III.C-1: Fuel/feedstock combinations for cellulosic biofuel that were produced in the U.S. from 2016–2021

Fuel type	Feedstock	Average contribution to total
CNG/LNG[a]	Landfill	90%
CNG/LNG	Agricultural digester	6%
CNG/LNG	Waste treatment plant	3%
Ethanol	Agricultural Residues	1%
Ethanol	Annual Cover Crops	0.4%

[a] CNG = compressed natural gas; LNG = liquified natural gas

Table III.C-2: Fuel/feedstock combinations for non-cellulosic advanced biofuel that were produced in the U.S. from 2016–2021

Fuel type	Feedstock	Average contribution to total
Biodiesel	Soybean Oil	42%
Biodiesel	Waste Oils/Fats/Greases	16%
Renewable diesel	Waste Oils/Fats/Greases	14%
Biodiesel	Corn oil	9%
Biodiesel	Canola Oil	8%
Renewable diesel	Corn oil	5%
Renewable diesel	Soybean Oil	4%
Ethanol	Separated Food Wastes	1%
Gasoline/naphtha	Separated Food Wastes	1%
Gasoline/naphtha	Corn oil	0.3%
Jet fuel	Waste Oils/Fats/Greases	0.1%
Gasoline/naphtha	Waste Oils/Fats/Greases	0.1%
Heating oil	Separated Food Wastes	0.1%
LPG	Waste Oils/Fats/Greases	0.1%

Table III.C-3: Fuel/feedstock combinations for conventional renewable fuel that were produced in the U.S. between 2016 and 2021

Fuel type	Feedstock	Average contribution to total
Ethanol	Corn starch	>99%
Ethanol	Grain Sorghum	<1%

Table III.C-4: Average proportions from 2016-2021 for domestically produced feedstocks used to produced biofuel

	Cellulosic	Non-cellulosic advanced	Conventional
Crop-based	0.4%	55%	99.99%
Non-crop-based	99.6%	45%	0.01%

The historical proportions shown in the tables above do not necessarily represent what might be expected in the future. As discussed more fully in Section III, our projections of the possible mix of renewable fuel types that could be used in the near future are based on a combination of information about historical trends and a knowledge of feedstock availability, infrastructure, and various other opportunities and constraints for the future.

D. Factors Affecting Actual Production and Use of Renewable Fuel

Once EPA determines and establishes the overall volume requirements and associated percentage standards that will apply to RFS obligated parties (e.g., refiners and importers) for a particular year, the market determines precisely what renewable fuels are used. While generally one could expect that the market would supply the volumes that are required because this is the purpose and design of the RFS program, nevertheless there are several reasons that actual volumes consumed often differ from the regulated volumes.

The first is that the percentage standards are based on projected volumes of gasoline and diesel consumption which typically deviate to some degree from what actually occurs. In the event that the actual consumption of gasoline and diesel is lower than the projection that EPA used to set the applicable percentage standard in a given year, the obligations applicable to individual obligated parties are likewise lower, and the actual volumes of renewable fuel used as transportation fuel will fall short of the volumes EPA assumed in setting the percentage standards. Likewise, if the actual consumption of gasoline and diesel is higher than the projection that EPA used to set the applicable percentage standards, the actual volumes of renewable fuel used as transportation fuel will be higher. While the discrepancy typically falls within the range of a few percent, it can be much higher, as occurred in 2020 due to the impacts of the COVID-19 pandemic on fuel markets.

Another reason that the actual renewable fuel volumes used in a given year vary from the volumes at which EPA set the standards is related to the Renewable Identification Number (RIN) credit system that is used to demonstrate compliance with the RFS program. Obligated parties have the flexibility to over-comply in one year and bank RINs for future use, often called "carryover RINs," and then use those RINs to demonstrate compliance in the subsequent year rather than using RINs representing current year renewable fuel production. The nationwide total of carryover RINs grew dramatically in the early years of the RFS program, and obligated parties have at times drawn down this carryover RIN bank to help fulfill their obligations.

The third reason that the actual renewable fuel volumes in a given year may vary from the volumes atzwhich EPA set the standards is the regulatory flexibility that obligated parties are afforded through the statute to carry a deficit from one year to the next. This provision allows them to fall short of their obligation to blend renewable fuel into their gasoline and diesel in one year by as much as 20%, so long as they compensate for that shortfall in the following year.

Fourth, exemptions for small refineries due to disproportionate economic hardship may result in actual consumption of renewable fuels falling short of the intended volume requirements. These exemptions are permitted under CAA 211(*o*)(9)(B) and are evaluated on a refinery-by-refinery basis. In cases where a small refinery hardship exemption was granted after the applicable percentage standards were set, the percentage standards in years past remained unchanged but were then applicable to a smaller number of parties. These small refinery exemptions may have had some impact in some prior years, but are not anticipated to have any appreciable impact in the future based on a series of actions recently taken by EPA regarding implementation of the small refinery exemption program.

Finally, there are many market factors beyond the RFS program itself that affect the consumption of renewable fuel. These include crude oil prices, renewable fuel production costs (which are in turn a function of feedstock and process heat and power costs), tax subsidies, and the demand for renewable fuel created by other federal and state programs. The California Low-Carbon Fuel Standard (LCFS) program in particular has and will continue to drive various renewable fuel volumes, and several other states are now implementing their own LCFS programs.

Combined, all of these factors make it very difficult for EPA to predict with certainty exactly how many gallons of renewable fuel will be used for transportation in the United States in a given year, let alone what the relative mix of the renewable fuels types will be. EPA is required by statute to make an educated guess to implement the RFS program each year, but this inherent uncertainty is yet another reason why EPA is unable to predict with certainty the magnitude and location of potential land use changes that might be driven by the Set Rule volumes.

IV. Description of the Action and the Action Area

A. The RFS Set Rule Action

This Biological Evaluation addresses the impacts of an EPA action that would establish volume requirements for the use of renewable fuel in the transportation sector for years 2023–2025 under the RFS program. This action is commonly referred to as the "Set Rule."

As described in Section I.A, the Clean Air Act does not provide volume targets for years after 2022. Instead, CAA section 211(*o*)(2)(B)(ii) provides that EPA shall, for years beyond those specified in the statute, determine the applicable volumes of each of the renewable fuel types. This is commonly referred to as the "set authority." In doing so, EPA is to analyze a specified set of factors, but provides limited additional guidance to EPA regarding how to determine appropriate RFS volumes. For most of the fuel types, the statute provides no specific numerical requirements. EPA has used this authority to establish the biomass-based diesel volume beginning in 2013 and for each subsequent year. EPA will also do so for all other fuel types beginning in 2023.

The statute requires that EPA establish these targets based on an analysis of the following criteria:

- The impact of the production and use of renewable fuels on the environment, including on air quality, climate change, conversion of wetlands, ecosystems, wildlife habitat, water quality, and water supply;
- The impact of renewable fuels on the energy security of the U.S.;
- The expected annual rate of future commercial production of renewable fuels, including advanced biofuels in each category (cellulosic biofuel and BBD);
- The impact of renewable fuels on the infrastructure of the U.S., including deliverability of materials, goods, and products other than renewable fuel, and the sufficiency of infrastructure to deliver and use renewable fuel;
- The impact of the use of renewable fuels on the cost to consumers of transportation fuel and on the cost to transport goods; and
- The impact of the use of renewable fuels on other factors, including job creation, the price and supply of agricultural commodities, rural economic development, and food prices.

1. Proposed Action

EPA proposed applicable volume requirements for 2023–2025 on December 30, 2022 (*87 FR 80582*, 2022), and updated them for the final rule.

Table IV.A-1: Proposed Volume Targets (billion RINs)[a]

	2023	2024	2025
Cellulosic biofuel	0.72	1.42	2.13
Biomass-based diesel[b]	2.82	2.89	2.95
Advanced biofuel	5.82	6.62	7.43
Renewable fuel	20.82	21.87	22.68
Supplemental standard	0.25	n/a	n/a

[a] One RIN is equivalent to one ethanol-equivalent gallon of renewable fuel.
[b] The BBD volumes are in physical gallons (rather than RINs).

Again, as noted above in Section II.B regarding the historical RFS volume requirements, these proposed volume requirements are not requirements for the use of specific types of renewable fuels, and thus regulated parties can and will use a variety of different renewable fuel types as long as they meet the qualifications (see Table II.A-1). With the Set Rule, EPA will only set the overall applicable volumes of renewable fuel that are required to be used in 2023, 2024, and 2025. Which types of fuels from which feedstocks and in what quantities ultimately are used is all left up to the market. The highly uncertain land-use changes and species impacts projected in this Biological Evaluation are therefore built on top of significant uncertainty in these projections.

EPA has nonetheless projected a plausible mix of renewable fuel types that might be used to meet the proposed standards and plausible estimates of the portion of those individual fuel types that could be attributable to the RFS program as discussed in the Set Rule (as opposed to other economic, market, and regulatory factors). This potential mix is shown below.

Table IV.A-2: Projected Fuel Types Attributable to the RFS Set Rule Proposed Volumes (million gallons)[a]

	2023	2024	2025
CNG/LNG from biogas[a]	87	82	289
Diesel/jet fuel from wood waste/MSW	0	3	6
Biodiesel from soybean oil	728	695	661
Biodiesel from canola oil	240	240	240
Biodiesel from FOG[b]	200	200	200
Biodiesel from corn oil	120	120	120
Renewable diesel from soybean oil	1,048	1,048	1,054
Renewable diesel from FOG	275	329	388
Renewable diesel from corn oil	80	86	91
Ethanol from corn	706	776	840

[a] Provided in ethanol-equivalent gallons.
[b] FOG = Waste fats, oils, and greases.

The volumes in the table above represent those volumes that we believe might be attributable to the RFS program. They are less than the total volumes of these fuels that we project will actually be used for transportation in the U.S.

There are also a number of proposed regulatory changes included in the Set Rule intended to improve the operation of the RFS program. The regulatory changes relate to recordkeeping, reporting, and credit generation, and are therefore not expected to have any impact on volumes and therefore not on listed species or their habitats. These changes are:

- RFS Third-Party Oversight Enhancement
- Deadlines for Third-Party Engineering Reviews for Three-Year Updates
- RIN Apportionment in Anaerobic Digesters
- BBD Conversion Factor for Percentage Standards
- Flexibility for RIN Generation
- Changes to Tables in the CFR
- Prohibition on RIN Generation for Fuels Not Used in the Covered Location
- Biogas Regulatory Reform
- Separated Food Waste Recordkeeping Requirements
- Definition of Oceangoing Vessels
- Bond Requirement for Foreign RIN Generating Renewable Fuel Producers
- Definition of Produced from Renewable Biomass
- Limiting RIN Separation Amounts; and
- Technical Amendments.

2. Final Action

The final rule includes the following volume targets.

Table IV.A-3: Set Rule Volume Targets (billion RINs)[a]

	2023	2024	2025
Cellulosic biofuel	0.84	1.09	1.38
Biomass-based diesel[b]	2.82	2.89	3.20
Advanced biofuel	5.94	6.29	1.08
Renewable fuel	20.94	21.54	22.33
Supplemental standard	0.25	n/a	n/a

[a] One RIN is equivalent to one ethanol-equivalent gallon of renewable fuel.
[b] The BBD volumes are in physical gallons (rather than RINs).

As discussed above, we have projected a plausible mix of renewable fuel types that might be used to meet the final standards and plausible estimates of the portion of those individual fuel types that could be attributable to the RFS program as discussed in the Set Rule (as opposed to other economic, market, and regulatory factors).

Table IV.A-4: Projected Volumes of Renewable Fuel Types Attributable to the RFS Set Rule Final Volumes (million gallons)[a]

	2023	2024	2025
CNG/LNG from biogas[a]	495	688	932
Diesel/jet fuel from wood waste/MSW	0	0	0
Biodiesel from soybean oil	841	757	755
Biodiesel from canola oil	292	307	323
Biodiesel from FOG[b]	-101	-92	-113
Biodiesel from corn oil	46	63	20
Renewable diesel from soybean oil	457	671	729
Renewable diesel from FOG	99	90	110
Renewable diesel from corn oil	130	-64	-20
Ethanol from corn	660	731	787

[a] Provided in ethanol-equivalent gallons.
[b] FOG = Waste fats, oils, and greases.

The volumes in the table above represent those volumes that we believe might be attributable to the RFS program. They are less than the total volumesof each type of renewable fuel that we project will actually used for transportation in the U.S.. The table below shows the total volumes, along with the fraction of that total that might be attributable to the RFS program.

Table IV.A-5: Total Projected Volumes of Renewable Fuel Consumed, and Fraction Attributable to the RFS program (million gallons)[a]

	2023	2024	2025
CNG/LNG from biogas[a]	831 (59%)	1,039 (63%)	1,299 (68%)
Diesel/jet fuel from wood waste/MSW	0 (0%)	0 (0%)	0 (0%)
Biodiesel from soybean oil	982 (86%)	967 (78%)	953 (79%)
Biodiesel from canola oil	292 (100%)	307 (100%)	323 (100%)
Biodiesel from FOG[b]	321 (-32%)	303 (-31%)	285 (-40%)
Biodiesel from corn oil	115 (-40%)	89 (71%)	63 (32%)
Renewable diesel from soybean oil	457 (100%)	671 (100%)	883 (100%)
Renewable diesel from FOG	1,108 (9%)	1,074 (8%)	1,154 (10%)
Renewable diesel from corn oil	205 (63%)	239 (-27%)	272 (-7%)
Ethanol from corn	13,845 (5%)	13,955 (5%)	13,779 (6%)

[a] Provided in ethanol-equivalent gallons.
[b] FOG = Waste fats, oils, and greases.

Our analysis was performed using our assessment of the volumes of renewable fuel that would be supplied to meet the proposed volumes that is attributable to the RFS program. The RFS volumes targets we are finalizing for 2023 – 2025 are slightly different than the proposed volumes, as are the volumes of renewable fuel we project will be used to meet these volume targets that are attributable to the RFS program. The differences between the attributable volumes of canola biodiesel, soybean biodiesel, and corn ethanol from the proposed rule to the final rule are summarized in Table IV.A-6.

Table IV.A-6: Biofuel Volumes Attributable the RFS Program in the Proposed and Final RFS Set Rules (million gallons)

	2023		2024		2025	
	Proposal	Final	Proposal	Final	Proposal	Final
Biodiesel from Canola Oil	240	508	240	489	240	614
Biodiesel from Soybean Oil	1,607	1,298	1,720	1,429	1,694	1,485
Ethanol from Corn	706	660	776	731	840	787

Although the total RFS volumes we are finalizing for 2023–2025 are higher than the proposed volumes, the volumes of biodiesel produced from soybean oil and ethanol from corn attributable to the RFS program are lower in the final rule. Theis means that our analysis, which was conducted prior to and immediately after the proposal was issued, overestimates the impacts of the RFS volumes in 2023–2025 from these fuels on listed species. Conversely the attributable volume of biodiesel from canola oil is higher in the final Set rule. While these higher volumes would be expected to have directionally greater impacts on listed species, as we discuss in Section ____, all or nearly all of the canola oil projected to be used for biofuel production in the U.S. is projected to be imported from Canada, and thus is likely to have limited impacts on listed species in the U.S. Despite these changes to the attributable volumes in the Set final rule, our analyses are still applicable to the final volumes.

B. The Action Area

1. Potential Locations that Comprise the Action Area

The action area for a Biological Evaluation is the area within the U.S. where potential effects are reasonably expected to occur. In the case of the RFS Set Rule covered by this Biological Evaluation, the action area may encompass all locations in the United States where feedstocks used for renewable fuel are produced, transported, and used to produce biofuel that is consumed domestically. This potentially includes agricultural lands used for crop-based feedstocks as well as agricultural lands where crops used for non-biofuel purposes might be grown after being displaced from their current uses by the demand for biofuel production. It could further include lands used for non-crop based feedstocks such as landfills, agricultural digesters, waste treatment plants, restaurants, and other facilities where biogas and waste oils, fats, and greases are collected and processed. We describe our close examination of these potential components of the action area in the sections below.

While biofuels are also made from imported feedstocks, for the purposes of this Biological Evaluation and consistent with Section 7 of the Endangered Species Act, we focus on the potential effects to species and habitat caused by land use change impacts within, and not outside of, the United States.

2. Crop-Based Feedstocks

Biofuels created from crop-based feedstocks may affect listed species and designated critical habitat by contributing to habitat loss via land use change as well as water quality impairments via runoff from agricultural lands. Appendix A illustrates the very complex causal chain that would have to occur in order for this Biological Evaluation to conclude with certainty that the Set Rule may negatively affect listed species and critical habitat. It is these causal chains for each of the three feedstock crops—corn, soy, and canola—that are the focus of the following chapters.

The majority of biofuels produced and consumed in the United States are from crop-based feedstocks. As shown in Figure III.C-1, 80% of renewable fuel produced in the U.S. from 2016–2019 was made from conventional biofuel, of which nearly 100% constituted ethanol from crop-based corn starch (Table III.C-3). Another 18% of renewable fuel was made from non-cellulosic advanced biofuel (Figure III.C-1). Soybean, corn, and canola oils from crop-based feedstocks made up the majority (~68%) of the feedstocks used to produce non-cellulosic advanced biofuel (Table III.C-2). These data are from the years 2016–2020 and are representative of what was observed in 2021 and 2022 as well. In the proposed and final set rules we projected the volumes of different renewable fuel attributable to the RFS Set rule (see Table IV.A-2 and IV.A-4). The majority of the renewable fuel volumes attributable to the RFS program are projected to be produced from corn, soybeans, and canola, with smaller volumes of fuel produced from feedstocks not expected to impact listed species (biogas, MSW, and FOG).

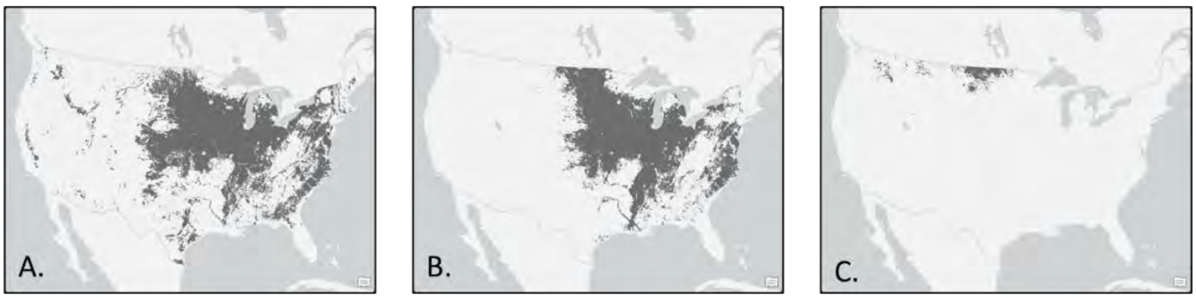
To examine where effects on listed species or critical habitat might be reasonably expected to occur, we focused the action area on the footprint of the U.S. where crop-based feedstocks are currently grown and could be grown in response to the RFS Set Rule. In 2007, EISA included the following in the definition of renewable biomass: "planted crops and crop residue from agricultural land cleared or cultivated at any time prior to the enactment of this sentence that is either actively managed or fallow, and non-forested." (EISA, 2007) In doing so, Congress set limits on where crops for biofuel could be grown to prevent the conversion of other lands for the sole purpose of producing crop-based feedstocks to meet the standards in the statute. Therefore, one approach for this Biological Evaluation might be to assume that the action area footprint includes all lands cleared or cultivated on or before 2007.

However, using the lands cultivated or cleared in 2007 would not account for potential indirect land use impacts that may occur when non-biofuel crops on 2007 lands are displaced by the demand for renewable fuel. Hypothetically, if such displacement were to occur, the demand for crops for non-biofuel purposes could be met by increasing yields on existing cultivated lands outside of the 2007 lands, or in yet-to-be cultivated lands. In delineating an action area to account for all potential effects of the RFS Set Rule, as part of a worst-case scenario, we attempt to capture these broader lands in the area of potential land use change as described in the following section. As required under the Endangered Species Act, our assessment of potential impacts on species and habitat is made in the context of a specific EPA action. This Biological Evaluation is designed to address the Set Rule which will establish standards for 2023–2025. As mentioned previously, we expect that corn, soybean, and canola will continue to be the predominant crop-based feedstocks produced domestically to meet the 2023–2025 volumes. To capture the broader action area that includes potential indirect land use impacts from displacement for biofuel demand, we believe that focusing on areas where corn, soybean and canola are currently grown or could be grown provides a more accurate depiction of the action area rather than using the 2007 lands alone, an approach that would not account for potential indirect land use impacts.

3. Identifying the Area of Potential Land Use Change

To better understand which species may be affected by crop-based feedstocks and land use impacts driven by the RFS program, we used ArcGIS Pro to delineate the area of potential land use change. We used the Cropland Data Layer (CDL) from the United States Department of Agriculture (USDA)'s National Agricultural Statistics Service and Agricultural Research Service (NASS) to identify areas used to grow the predominant crop-based feedstocks used domestically for biofuel production (corn, soybean, and canola) in 2020. The CDL is a 30-meter raster, crop-specific data layer produced annually based on satellite imagery and extensive agricultural ground truth. The year 2020 was chosen as it was the most recent year available at the start of our analysis. After downloading the 2020 CDL data layer, the corn, soy, and canola croplands were extracted (Figure IV.B-1) and converted to vector (polygon) data.

Figure IV.B-1: Corn (A), Soybean (B), and Canola (C) croplands extracted from the 2020 Cropland Data Layer.



We then applied a 15-acre minimum mapping unit (MMU) filter. Applying a MMU (also known as minimum unit of change) filter is considered a best practice when using the USDA's CDL for land use and land cover change analyses (Lark et al., 2017) and is an approach that has been used widely by other researchers (R. & R., 2010) (Peterson et al., 2010) (Copenhaver et al., 2021). The filter we used captures corn, soybean, and canola lands that are at least 15 acres in size. Using a MMU helps avoid random errors in the CDL where 30-m pixels may be misclassified. In addition, it removes small farm plot sizes that are unlikely to be used for commercial scale farming operations needed to support biofuel production, and instead would likely be planted for other reasons (e.g., hobby farms, deer feeding, etc.).

Applying a 15-acre MMU was also important to avoid compounding errors that would result from applying a 5-mile buffer (described below) to the area where all corn, soy, and canola are grown as captured by the CDL. For example, we noticed the CDL sometimes properly characterizes small hobby farms and deer feeding plots in the Upper Peninsula of Michigan, but in other instances erroneously characterizes such operations as large-scale farming operations, which we determined because we know that large-scale farming and biofuel production do not occur in that region. We wanted to apply a five-mile buffer as the next step in identifying our action area and doing so without a 15 MMU filter would capture large areas near those smaller plots of land where we are confident the RFS program does not play a role and therefore does not affect threatened and endangered species.

To apply a buffer, we used the ArcGIS buffer tool, which creates areas around features to a specified distance. It is used widely in a variety of environmental assessments, including endangered species analyses. For example, the Office of Chemical Safety and Pollution Prevention in EPA wrote a Revised Method (EPA, 2020) which describes applying a buffer of 2,600 feet to capture the off-site transport of pesticides.

For our analyses, we chose to apply a five-mile buffer as a way to capture potential indirect land use change effects that occur when lands that are not used to grow biofuel feedstocks are displaced by the demand for biofuel production. The resulting area is shown in Figure IV.B-2. In this Biological Evaluation, we refer to this area as the "area of potential land use change." In defining this area, we also considered which crops are most likely to be displaced by the demand for biofuel production by considering which crops are predominantly grown on new croplands (Lark et al., 2020). found that corn was the predominant crop planted on newly cultivated land from 2008–2016. Corn was most common in all years except 2014–2015, when soybeans were more prevalent. Together with wheat, these three crops were the first plantings on over 78% of all new croplands nationwide (Figure IV.B-3). Assuming the same trends continue beyond 2016, the area we defined and depicted in Figure IV.B-2 includes all corn and soy. Wheat is one of the most common crops to be replaced by corn or soybean, and we calculated that the area of potential land use change also contains over 80% of the wheat land cover from the 2020 CDL. Thus, this area of potential land use change with the five-mile buffer likely covers the majority of wheat and other Midwestern crops that may be displaced through indirect land use change effects.

To the extent that RFS volumes might have or will impact corn, soy, or canola plantings in the future, the commercial viability of increasing such plantings is almost certainly in and around the areas already being commercially harvested for these crops. Not only are the soil, water, and other climate conditions likely to be applicable, but the available infrastructure for planting, fertilizing, harvesting, storing, and transporting the crops is likely to be available in such areas. As described in later sections, EPA hired a contractor to model where soybean production expansion may occur in the future. The contractor used 2020 as the baseline year and projected cropland potential expansion through 2025. We took the results from their work and calculated that 99.89% of the projected expansion area fell within the area of potential land use change in Figure IV.B-2.

Further, it is important to note that within this area of potential land use change, it is possible that agricultural conversion would occur on lands that were once in cultivation, managed under the Conservation Reserve Program, or used for other uses such as pastureland. These lands already may not be suitable habitat with PBFs for species and therefore their conversion may not affect species at all. Based on a study from the Economic Research Service, 81% of former CRP land was put to some type of crop production, of which 57% transitioned to annual crop production, from 2013-2016. This conversion mainly occurred in the Corn Belt and the most common annual crops grown on expired CRP were soybeans, corn, and wheat. (Peoples Company, 2020).

Figure IV.B-2: The geographical region where corn, soybean, and canola may be grown to meet biofuel volumes as established by the RFS actions covering the years 2023-2025. This region was identified by extracting corn, soybean, and canola croplands from the 2020 USDA Cropland Data Layer, applying a 15-acre minimum mapping unit filter, and applying a five-mile buffer.

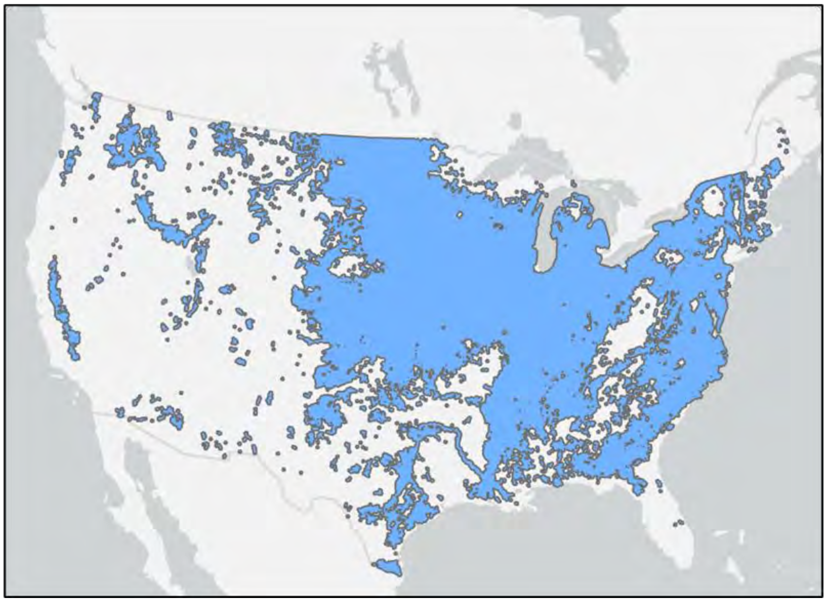
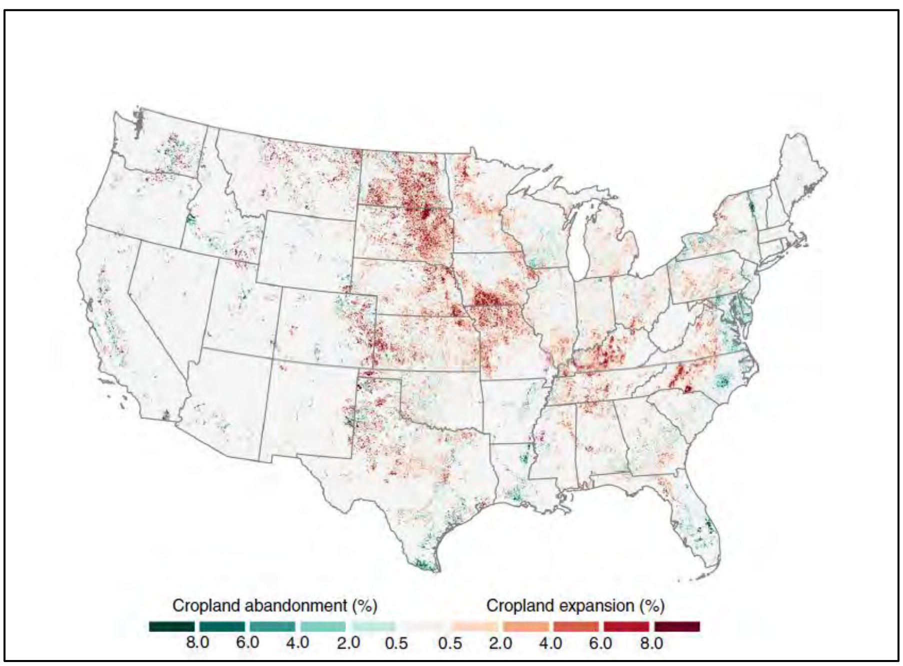


Figure IV.B-3 from Lark et al. (2020). Rates of net conversion calculated as gross cropland expansion minus gross cropland abandonment from 2008-2016.



4. Identifying Downstream Areas

If increased through land-use changes caused by the Set Rule, the production of crop-based feedstocks could potentially affect threatened and endangered species and critical habitat through agricultural non-point source pollution and water quality impacts. Generally, runoff from agricultural lands can transport excess nutrients (nitrogen and phosphorus), sediment, and pesticides (herbicides, insecticides, fungicides) into surrounding water bodies, contributing to water quality impairments in streams, rivers, lakes, and groundwater (Bales et al., 2010) (Mbonimpa et al., 2012) (Ryberg & Gilliom, 2015). These pollutants can persist in the environment for a long time and accumulate in estuaries and coastal regions. For instance, excess nutrients in the Gulf of Mexico and Chesapeake Bay contribute to dead zone (hypoxic) conditions in the summertime (Twomey et al., 2009). Species that rely on healthy watersheds and aquatic ecosystems may therefore be adversely impacted by such impairments.

To ensure that we properly considered the full potential effects from the RFS Set Rule, we took the area of potential land use change (shown in Figure IV.B-2) and expanded it to capture downstream regions that could be affected by agricultural non-point source pollution. To do so, we used the National Hydrography Dataset (NHD) Version 2 Catchment Data, NHD Version 2 Plus Attribute Flowline Value-Added Attributes, and the trace downstream tool on ArcGIS Pro. Using ArcGIS tools, points were allocated throughout the area of potential land use change and the following parameters and data were used to determine the downstream flow path from those points: slope and elevation, stream order, and velocity of flow.

The resulting action area for the RFS Set Rule is shown in Figure IV.B-4. To find which listed species and designated critical habitats are present within this area, we used the tabulate intersection tool on ArcGIS Pro. We used ArcGIS shapefiles of listed species' ranges and critical habitat that were provided to us by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service. The listed species with critical habitat and/or ranges within the action area are provided in the next section.

Figure IV.B-4: The action area for the RFS Set Rule

Figure III.B-4: The action area for the RFS Set Rule.

5. Non-Crop-Based Feedstocks

It is also important to consider the potential role that the Set Rule may have in impacting listed species and critical habitat through increases in non-crop-based feedstocks. As described below, we have made the determination that the production of these feedstocks does not affect listed species or critical habitat. We therefore did not alter the action area further to include effects from these feedstocks.

Waste fats, oils, and greases (FOG)

A fairly large portion (~45%) of non-cellulosic advanced biofuel in the U.S. is made from non-crop-based feedstocks (Table III.C-4). Non-crop-based feedstocks used to produce non-cellulosic advanced biofuel from 2016-2020 came from food wastes, waste oils, fats, and greases (Table III.C-2). Fats, oils, and greases (FOG) are generally byproducts of other food preparation industries that properly manage to avoid these potentially troublesome materials from entering drainpipes in the home or commercial food service operations. They are instead collected and either disposed of in landfills, recycled to produce various commercial products such as oleochemicals, or processed in wastewater treatment plants to produce biogas. An increasing portion has been used to produce biodiesel due to its low cost in comparison to crop-based feedstocks such as soybean oil and canola oil. However, this increasing use to produce renewable fuel has not resulted in an increase in their production, but only a change in their use/disposition. This can be seen in Table IV.A-4, as the no-RFS baseline analysis shows that, absent the RFS, the only thing that would change about the use of FOG is the produced renewable fuel. As a result, the production of FOG will not affect listed species or their habitats because no reasonably certain causal link can be established to the RFS Set Rule, and thus no causal impact on land use change or other environmental impact that can be attributed to the RFS Set Rule. As a result of this determination, this feedstock was not analyzed further.

Biogas

Cellulosic biofuel, has historically reflected a small portion (2%) of all renewable fuel produced in the U.S. (Figure III.C-1). Nearly all cellulosic biofuel produced from 2016-2020 was CNG or LNG for use in natural gas vehicles, which utilizes non-crop based feedstock. We anticipate that in the 2023–2025 Set Rule timeframe additional quantities of cellulosic biofuel will continue to be produced from biogas sourced from landfills and digesters.

Biogas from landfills is the largest source of cellulosic biofuel (92%), followed by biogas from agricultural digester and waste treatment plant sources (four and three percent, respectively; Table III.C-1). Neither landfills nor wastewater treatment plants are built for the purpose of producing biogas. Instead, they are built for the purpose of disposing of wastes, and biogas is a byproduct of their operation. Therefore, it is likely that no landfills or wastewater treatment plants will be built for the purpose of producing the biogas that would qualify as renewable fuel under the RFS program. However, some portion of the biogas that is already being produced, or would be produced in the 2023–2025 timeframe, is likely to be diverted from other uses to use as a transportation fuel.

Agricultural digesters, in contrast, are typically built for the purpose of generating biogas. Such digesters typically process manure or crop residue such as corn stover. We acknowledge that new agricultural digesters may be built. If new agricultural digesters are built, they will most likely be located on the grounds of existing farms on land already cleared and used for farming activities.

Capturing biogas for the purposes of producing renewable fuel prevents GHGs from escaping into the atmosphere. This is important as, for instance, municipal solid waste landfills are the third-largest source of human-related methane emissions in the United States (US EPA, 2019). Further, emissions from landfills and other sources that produce biogas are regulated by air quality standards.

As a result of these considerations, the production of biogas will not affect listed species or their habitats because no reasonably certain causal link can be established to the RFS Set Rule, and thus no causal impact on land use change or other environmental impact that can be attributed to the RFS Set Rule. As a result of this determination, this feedstock was not analyzed further.

Wood waste / Municipal Solid Waste (MSW)

These products are not produced for the purpose of providing feedstock for renewable fuel production. Furthermore, there are not any volumes set for these pathways, so no RINs will be generated on these products during the Set Rule years. Thus, there are no land-use change impacts of this feedstock, and we do not anticipate that the processing of these feedstocks into renewable fuel will result in impacts to listed species or their habitats. As a result, the production of wood wastes and MSW will not affect listed species or their habitats because no reasonably certain causal link can be established to the RFS Set Rule, and thus no causal impact on land use change or other environmental impact that can be attributed to the RFS Set Rule. As a result of this determination, this feedstock was not analyzed further.

Corn oil

Corn oil is a byproduct of ethanol production from corn. Ethanol production is based on fermentation of the starch found in corn, and the oil is not used in this process. Some oil is often left in the distiller's grains which are commonly sold as a high protein livestock feed. Oil that is extracted from the corn or distiller's grains has historically been used primarily for food products such as cooking oil and margarine, with lesser amounts used in industrial products. Over the last 15 years, a greater portion of corn oil has been diverted to use as a feedstock for the production of biodiesel due to its low cost. Similar to FOG, this increasing use to produce renewable fuel has not resulted in an increase in its production, but only a change in its use. Thus, there are no land-use change impacts of this feedstock, and we do not anticipate that the processing of these feedstocks into renewable fuel will result in impacts to listed species or their habitats. As a result, the production of corn oil will not affect listed species or their habitats because no reasonably certain causal link can be established to the RFS Set Rule, and thus no causal impact on land use change or other environmental impact that can be attributed to the RFS Set Rule. As a result of this determination, this feedstock was not analyzed further.

V. Listed Species That Are Found Within the Action Area

Our analyses on ArcGIS found 712 unique species located within the action area shown in Figure IV.B-4. Out of the 712 unique species, 672 are FWS species; 32 are NMFS species; and eight are both FWS and NMFS species. The eight species that are both FWS and NMFS species are the Gulf Sturgeon, Loggerhead Sea Turtle, Green Sea Turtle, Leatherback Sea Turtle, Hawksbill Sea Turtle, Kemp's Ridley Sea Turtle, Olive Ridley Sea Turtle, and Atlantic Salmon.

Though there are 712 unique species, some species have multiple DPSs or ESUs, culminating in a total of 810 unique populations found within the action area. It is important to assess populations separately, where applicable, as different species' populations may be found in different regions and could face different threats or rely on different PBFs or PCEs within their critical habitat. All 810 populations assessed in this Biological Evaluation have a listing status of endangered, threatened, proposed endangered, proposed threatened, candidate, or experimental population. A listing status of candidate represents populations that are under review for qualification under the ESA; experimental populations are reintroduced populations that are geographically separated from nonexperimental populations. This Biological Evaluation only includes experimental populations representing FWS species. Per guidance from NMFS, EPA does not consider NMFS experimental populations in this Biological Evaluation.

Table V-1 lists all populations and whether they have an associated designated critical habitat, range, or both critical habitat and range. Species populations are identified in Table V-I in the "DPS or ESU (if applicable)" column and listing status is also provided.

In the analyses supporting this Biological Evaluation, we evaluated not only the range of potentially affected populations but also critical habitat. These two data types must be considered separately. A range for a species is the geographical area where a particular species may be found. In contrast, critical habitat includes geographic regions that contain PBFs or PCE that are considered essential for the conservation of a listed species.

Table V-1. The FWS and NMFS listed populations found within the action area, whether they have an associated critical habitat (CH), range, or both CH and range, their Designated Population Segment (DPS) or Evolutionary Significant Unit (ESU), if applicable, and listing status [7]

FWS or NMFS Species	CH, Range, or Both	Common Name	Scientific Name	DPS or ESU (if applicable)	Listing Status
FWS	Range	Large-fruited sand-verbena	*Abronia macrocarpa*		Endangered
FWS	Both	San Mateo thornmint	*Acanthomintha obovata ssp. duttonii*		Endangered
FWS	Range	Gulf sturgeon	*Acipenser oxyrinchus (=oxyrhynchus) desotoi*		Threatened
FWS	Range	White sturgeon	*Acipenser transmontanus*		Endangered
FWS	Range	Northern wild monkshood	*Aconitum noveboracense*		Threatened
FWS	Range	Sensitive joint-vetch	*Aeschynomene virginica*		Threatened
FWS	Range	Sandplain gerardia	*Agalinis acuta*		Endangered
FWS	Both	Cumberland elktoe	*Alasmidonta atropurpurea*		Endangered
FWS	Range	Dwarf wedgemussel	*Alasmidonta heterodon*		Endangered
FWS	Range	Appalachian elktoe	*Alasmidonta raveneliana*		Endangered
FWS	Range	Sonoma alopecurus	*Alopecurus aequalis var. sonomensis*		Endangered
FWS	Range	Seabeach amaranth	*Amaranthus pumilus*		Threatened
FWS	Range	Fat threeridge (mussel)	*Amblema neislerii*		Endangered
FWS	Both	Ozark cavefish	*Amblyopsis rosae*		Threatened
FWS	Range	South Texas ambrosia	*Ambrosia cheiranthifolia*		Endangered
FWS	Range	Reticulated flatwoods salamander	*Ambystoma bishopi*		Endangered
FWS	Both	California tiger salamander	*Ambystoma californiense*	Central California	Threatened
FWS	Both	California tiger salamander	*Ambystoma californiense*	Santa Barbara County	Endangered
FWS	Both	California tiger salamander	*Ambystoma californiense*	Sonoma County	Endangered
FWS	Range	Frosted Flatwoods salamander	*Ambystoma cingulatum*		Threatened
FWS	Range	Santa Cruz long-toed salamander	*Ambystoma macrodactylum croceum*		Endangered
FWS	Range	Florida grasshopper sparrow	*Ammodramus savannarum floridanus*		Endangered

[7] In this Table, the FWS species listed first, followed by the 40 NMFS species (72 populations total). The eight species that are shared by the two agencies are listed more than once.

FWS	Range	Little amphianthus	*Amphianthus pusillus*		Threatened
FWS	Range	Large-flowered fiddleneck	*Amsinckia grandiflora*		Endangered
FWS	Range	Dixie Valley Toad	*Anaxyrus williamsi*		Endangered
FWS	Range	Painted snake coiled forest snail	*Anguispira picta*		Threatened
FWS	Range	Sonoran pronghorn	*Antilocapra americana sonoriensis*		Endangered
FWS	Range	Madison Cave isopod	*Antrolana lira*		Threatened
FWS	Range	Florida scrub-jay	*Aphelocoma coerulescens*		Threatened
FWS	Range	Price''s potato-bean	*Apios priceana*		Threatened
FWS	Range	Point Arena mountain beaver	*Aplodontia rufa nigra*		Endangered
FWS	Both	Lange's metalmark butterfly	*Apodemia mormo langei*		Endangered
FWS	Range	Georgia rockcress	*Arabis georgiana*		Threatened
FWS	Both	McDonald's rock-cress	*Arabis macdonaldiana*		Endangered
FWS	Range	Braun's rock-cress	*Arabis perstellata*		Endangered
FWS	Range	red tree vole	*Arborimus longicaudus*		Candidate
FWS	Both	Ouachita rock pocketbook	*Arcidens wheeleri*		Endangered
FWS	Range	Dwarf Bear-poppy	*Arctomecon humilis*		Endangered
FWS	Range	Franciscan manzanita	*Arctostaphylos franciscana*		Endangered
FWS	Range	Presidio Manzanita	*Arctostaphylos hookeri var. ravenii*		Endangered
FWS	Range	Pallid manzanita	*Arctostaphylos pallida*		Threatened
FWS	Range	Marsh Sandwort	*Arenaria paludicola*		Endangered
FWS	Range	Sacramento prickly poppy	*Argemone pleiacantha ssp. pinnatisecta*		Endangered
FWS	Range	Mead's milkweed	*Asclepias meadii*		Threatened
FWS	Range	Prostrate milkweed	*Asclepias prostrata*		Proposed Endangered
FWS	Both	Welsh's milkweed	*Asclepias welshii*		Threatened
FWS	Range	American hart's-tongue fern	*Asplenium scolopendrium var. americanum*		Threatened
FWS	Range	Pecos assiminea snail	*Assiminea pecos*		Endangered
FWS	Range	Shivwits milk-vetch	*Astragalus ampullarioides*		Endangered
FWS	Range	Guthrie's (=Pyne's) ground-plum	*Astragalus bibullatus*		Endangered
FWS	Range	Sentry milk-vetch	*Astragalus cremnophylax var. cremnophylax*		Endangered
FWS	Both	Holmgren milk-vetch	*Astragalus holmgreniorum*		Endangered
FWS	Range	Mancos milk-vetch	*Astragalus humillimus*		Endangered
FWS	Range	Peirson's milk-vetch	*Astragalus magdalenae var. peirsonii*		Threatened

FWS	Range	Jesup''s milk-vetch	*Astragalus robbinsii var. jesupii*		Endangered
FWS	Range	Coastal dunes milk-vetch	*Astragalus tener var. titi*		Endangered
FWS	Range	Star cactus	*Astrophytum asterias*		Endangered
FWS	Range	Anthony's riversnail	*Athearnia anthonyi*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Anthony's riversnail	*Athearnia anthonyi*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Anthony's riversnail	*Athearnia anthonyi*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Range	Texas ayenia	*Ayenia limitaris*		Endangered
FWS	Range	Hairy rattleweed	*Baptisia arachnifera*		Endangered
FWS	Range	Coffin Cave mold beetle	*Batrisodes texanus*		Endangered
FWS	Range	Helotes mold beetle	*Batrisodes venyivi*		Endangered
FWS	Range	Virginia round-leaf birch	*Betula uber*		Threatened
FWS	Range	Sonoma sunshine	*Blennosperma bakeri*		Endangered
FWS	Range	Shale barren rock cress	*Boechera serotina*		Endangered
FWS	Range	Decurrent false aster	*Boltonia decurrens*		Threatened
FWS	Range	Rusty patched bumble bee	*Bombus affinis*		Endangered
FWS	Range	Franklin's bumble bee	*Bombus franklini*		Endangered
FWS	Both	Columbia Basin Pygmy Rabbit	*Brachylagus idahoensis*		Endangered
FWS	Both	Marbled murrelet	*Brachyramphus marmoratus*		Threatened
FWS	Both	Conservancy fairy shrimp	*Branchinecta conservatio*		Endangered
FWS	Range	Longhorn fairy shrimp	*Branchinecta longiantenna*		Endangered
FWS	Range	Vernal pool fairy shrimp	*Branchinecta lynchi*		Threatened
FWS	Both	Hungerford's crawling water Beetle	*Brychius hungerfordi*		Endangered

FWS	Range	Houston toad	*Bufo houstonensis*		Endangered
FWS	Range	Red knot	*Calidris canutus rufa*		Threatened
FWS	Range	Texas poppy-mallow	*Callirhoe scabriuscula*		Endangered
FWS	Range	San Bruno elfin butterfly	*Callophrys mossii bayensis*		Endangered
FWS	Range	Tiburon mariposa lily	*Calochortus tiburonensis*		Threatened
FWS	Range	Benton County cave crayfish	*Cambarus aculabrum*		Endangered
FWS	Both	Big Sandy crayfish	*Cambarus callainus*		Threatened
FWS	Range	Slenderclaw crayfish	*Cambarus cracens*		Endangered
FWS	Range	Hell Creek Cave crayfish	*Cambarus zophonastes*		Endangered
FWS	Range	Slender campeloma	*Campeloma decampi*		Endangered
FWS	Range	Ivory-billed woodpecker	*Campephilus principalis*		Endangered
FWS	Range	Gray wolf	*Canis lupus*	U.S. – multiple states	Endangered
FWS	Both	Gray wolf	*Canis lupus*	Minnesota	Threatened
FWS	Range	Mexican wolf	*Canis lupus baileyi*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Mexican wolf	*Canis lupus baileyi*	U.S.A. (portions of AZ and NM)	Experimental Population, Non-Essential
FWS	Range	Red wolf	*Canis rufus*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Red wolf	*Canis rufus*	U.S.A. (portions of NC and TN)	Experimental Population, Non-Essential
FWS	Range	Small-anthered bittercress	*Cardamine micranthera*		Endangered
FWS	Both	Loggerhead sea turtle	*Caretta caretta*		Threatened
FWS	Range	Golden sedge	*Carex lutea*		Endangered
FWS	Both	Navajo sedge	*Carex specuicola*		Threatened
FWS	Range	Tiburon paintbrush	*Castilleja affinis ssp. neglecta*		Endangered
FWS	Range	Fleshy owl's-clover	*Castilleja campestris ssp. succulenta*		Threatened
FWS	Both	golden paintbrush	*Castilleja levisecta*		Threatened
FWS	Range	California jewelflower	*Caulanthus californicus*		Endangered
FWS	Range	Gunnison sage-grouse	*Centrocercus minimus*		Threatened
FWS	Range	Fragrant prickly-apple	*Cereus eriophorus var. fragrans*		Endangered

FWS	Both	Hoover's spurge	*Chamaesyce hooveri*		Threatened
FWS	Both	Piping Plover	*Charadrius melodus*	Great Lakes Watershed	Endangered
FWS	Both	Piping Plover	*Charadrius melodus*	Atlantic Coast and Northern Great Plains	Threatened
FWS	Both	Western snowy plover	*Charadrius nivosus nivosus*		Threatened
FWS	Range	Shortnose Sucker	*Chasmistes brevirostris*		Endangered
FWS	Range	June sucker	*Chasmistes liorus*		Threatened
FWS	Range	Green sea turtle	*Chelonia mydas*		Threatened
FWS	Both	Pygmy fringe-tree	*Chionanthus pygmaeus*		Endangered
FWS	Range	Ben Lomond spineflower	*Chorizanthe pungens var. hartwegiana*		Endangered
FWS	Both	Monterey spineflower	*Chorizanthe pungens var. pungens*		Threatened
FWS	Range	Scotts Valley spineflower	*Chorizanthe robusta var. hartwegii*		Endangered
FWS	Range	Robust spineflower	*Chorizanthe robusta var. robusta*		Endangered
FWS	Range	Sonoma spineflower	*Chorizanthe valida*		Endangered
FWS	Range	Laurel dace	*Chrosomus saylori*		Endangered
FWS	Range	Florida golden aster	*Chrysopsis floridana*		Endangered
FWS	Range	Salt Creek Tiger beetle	*Cicindela nevadica lincolniana*		Endangered
FWS	Both	Ohlone tiger beetle	*Cicindela ohlone*		Endangered
FWS	Both	Robber Baron Cave Meshweaver	*Cicurina baronia*		Endangered
FWS	Both	Madla Cave Meshweaver	*Cicurina madla*		Endangered
FWS	Range	Government Canyon Bat Cave meshweaver	*Cicurina vespera*		Endangered
FWS	Range	Fountain thistle	*Cirsium fontinale var. fontinale*		Endangered
FWS	Range	Pitcher's thistle	*Cirsium pitcheri*		Threatened
FWS	Range	Sacramento Mountains thistle	*Cirsium vinaceum*		Threatened
FWS	Range	Wright's marsh thistle	*Cirsium wrightii*		Proposed Threatened
FWS	Range	Florida perforate cladonia	*Cladonia perforata*		Endangered
FWS	Range	Presidio clarkia	*Clarkia franciscana*		Endangered
FWS	Range	Springville clarkia	*Clarkia springvillensis*		Threatened
FWS	Range	Morefield''s leather flower	*Clematis morefieldii*		Endangered
FWS	Range	Alabama leather flower	*Clematis socialis*		Endangered
FWS	Range	Pigeon wings	*Clitoria fragrans*		Threatened
FWS	Range	Yellow-billed Cuckoo	*Coccyzus americanus*		Threatened

FWS	Range	Etonia rosemary	*Conradina etonia*		Endangered
FWS	Range	Apalachicola rosemary	*Conradina glabra*		Endangered
FWS	Range	Cumberland rosemary	*Conradina verticillata*		Threatened
FWS	Range	Salt marsh bird's-beak	*Cordylanthus maritimus ssp. maritimus*		Endangered
FWS	Range	Soft bird's-beak	*Cordylanthus mollis ssp. mollis*		Endangered
FWS	Range	Palmate-bracted bird's beak	*Cordylanthus palmatus*		Endangered
FWS	Range	Ozark big-eared bat	*Corynorhinus (=Plecotus) townsendii ingens*		Endangered
FWS	Range	Virginia big-eared bat	*Corynorhinus (=Plecotus) townsendii virginianus*		Endangered
FWS	Range	Lee pincushion cactus	*Coryphantha sneedii var. leei*		Threatened
FWS	Range	Sneed pincushion cactus	*Coryphantha sneedii var. sneedii*		Endangered
FWS	Range	Pygmy Sculpin	*Cottus paulus (=pygmaeus)*		Threatened
FWS	Range	Grotto Sculpin	*Cottus specus*		Endangered
FWS	Range	Ozark Hellbender	*Cryptobranchus alleganiensis bishopi*		Endangered
FWS	Range	diamond Darter	*Crystallaria cincotta*		Endangered
FWS	Range	Okeechobee gourd	*Cucurbita okeechobeensis ssp. okeechobeensis*		Endangered
FWS	Range	Spectaclecase (mussel)	*Cumberlandia monodonta*		Endangered
FWS	Range	Santa Cruz cypress	*Cupressus abramsiana*		Threatened
FWS	Range	Gowen cypress	*Cupressus goveniana ssp. goveniana*		Threatened
FWS	Range	Jones Cycladenia	*Cycladenia humilis var. jonesii*		Threatened
FWS	Range	Guadalupe Orb	*Cyclonaias necki*		Proposed Endangered
FWS	Range	Texas pimpleback	*Cyclonaias petrina*		Proposed Endangered
FWS	Range	Utah prairie dog	*Cynomys parvidens*		Threatened
FWS	Range	Blue shiner	*Cyprinella caerulea*		Threatened
FWS	Range	Desert pupfish	*Cyprinodon macularius*		Endangered
FWS	Range	Western fanshell	*Cyprogenia aberti*		Proposed Threatened
FWS	Range	Fanshell	*Cyprogenia stegaria*		Endangered
FWS	Range	Leafy prairie-clover	*Dalea foliosa*		Endangered
FWS	Range	Monarch butterfly	*Danaus plexippus*		Endangered
FWS	Range	Beautiful pawpaw	*Deeringothamnus pulchellus*		Endangered
FWS	Range	Rugel's pawpaw	*Deeringothamnus rugelii*		Endangered
FWS	Range	Baker's larkspur	*Delphinium bakeri*		Endangered
FWS	Range	Yellow larkspur	*Delphinium luteum*		Endangered

FWS	Range	Lost River sucker	*Deltistes luxatus*		Endangered
FWS	Range	Leatherback sea turtle	*Dermochelys coriacea*		Endangered
FWS	Range	Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*		Threatened
FWS	Range	Longspurred mint	*Dicerandra cornutissima*		Endangered
FWS	Range	Lakela's mint	*Dicerandra immaculata*		Endangered
FWS	Range	Devils River minnow	*Dionda diaboli*		Threatened
FWS	Range	Giant kangaroo rat	*Dipodomys ingens*		Endangered
FWS	Range	Fresno kangaroo rat	*Dipodomys nitratoides exilis*		Endangered
FWS	Range	Tipton kangaroo rat	*Dipodomys nitratoides nitratoides*		Endangered
FWS	Range	Iowa Pleistocene snail	*Discus macclintocki*		Endangered
FWS	Range	Dromedary pearlymussel	*Dromus dromas*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Dromedary pearlymussel	*Dromus dromas*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Dromedary pearlymussel	*Dromus dromas*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Range	Eastern indigo snake	*Drymarchon couperi*		Threatened
FWS	Range	Smooth coneflower	*Echinacea laevigata*		Threatened
FWS	Both	Black lace cactus	*Echinocereus reichenbachii var. albertii*		Endangered
FWS	Both	Acuña Cactus	*Echinomastus erectocentrus var. acunensis*		Endangered
FWS	Range	Delta green ground beetle	*Elaphrus viridis*		Threatened
FWS	Range	Spring pygmy sunfish	*Elassoma alabamae*		Threatened
FWS	Range	Lacy elimia (snail)	*Elimia crenatella*		Threatened
FWS	Range	Puritan tiger beetle	*Ellipsoptera puritana*		Threatened
FWS	Both	Chipola slabshell	*Elliptio chipolaensis*		Threatened
FWS	Range	Yellow lance	*Elliptio lanceolata*		Threatened

FWS	Range	Altamaha Spinymussel	*Elliptio spinosa*		Endangered
FWS	Range	Purple bankclimber (mussel)	*Elliptoideus sloatianus*		Threatened
FWS	Range	Southwestern willow flycatcher	*Empidonax traillii extimus*		Endangered
FWS	Range	Southern sea otter	*Enhydra lutris nereis*		Threatened
FWS	Both	Cumberlandian combshell	*Epioblasma brevidens*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Cumberlandian combshell	*Epioblasma brevidens*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Cumberlandian combshell	*Epioblasma brevidens*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Both	Oyster mussel	*Epioblasma capsaeformis*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Oyster mussel	*Epioblasma capsaeformis*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Oyster mussel	*Epioblasma capsaeformis*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Range	Curtis pearlymussel	*Epioblasma florentina curtisii*		Endangered
FWS	Range	Yellow blossom (pearlymussel)	*Epioblasma florentina florentina*	Wherever found; Except where listed as Experimental Populations	Endangered

FWS	Range	Yellow blossom (pearlymussel)	*Epioblasma florentina florentina*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Tan riffleshell	*Epioblasma florentina walkeri (=E. walkeri)*		Endangered
FWS	Range	Upland combshell	*Epioblasma metastriata*		Endangered
FWS	Range	Purple Cat''s paw (=Purple Cat''s paw pearlymussel)	*Epioblasma obliquata*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Purple Cat''s paw (=Purple Cat''s paw pearlymussel)	*Epioblasma obliquata*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Southern acornshell	*Epioblasma othcaloogensis*		Endangered
FWS	Range	Southern combshell	*Epioblasma penita*		Endangered
FWS	Range	White catspaw (pearlymussel)	*Epioblasma perobliqua*		Endangered
FWS	Range	Northern riffleshell	*Epioblasma rangiana*		Endangered
FWS	Range	Green blossom (pearlymussel)	*Epioblasma torulosa gubernaculum*		Endangered
FWS	Range	Tubercled blossom (pearlymussel)	*Epioblasma torulosa torulosa*	Wherever found; Except where listed as Experimental Populations	Endangered

FWS	Range	Tubercled blossom (pearlymussel)	*Epioblasma torulosa torulosa*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Both	Snuffbox mussel	*Epioblasma triquetra*		Endangered
FWS	Range	Turgid blossom (pearlymussel)	*Epioblasma turgidula*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Turgid blossom (pearlymussel)	*Epioblasma turgidula*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Kern mallow	*Eremalche kernensis*		Endangered
FWS	Both	Streaked Horned lark	*Eremophila alpestris strigata*		Threatened
FWS	Range	Hawksbill sea turtle	*Eretmochelys imbricata*		Endangered
FWS	Range	Willamette daisy	*Erigeron decumbens*		Endangered
FWS	Both	Spotfin Chub	*Erimonax monachus*	Wherever found; Except where listed as Experimental Populations	Threatened
FWS	Range	Spotfin Chub	*Erimonax monachus*	U.S.A. (TN-specified portions of the Tellico River	Experimental Population, Non-Essential
FWS	Range	Spotfin Chub	*Erimonax monachus*	U.S.A. (AL, TN-specified portions of Shoal Creek	Experimental Population, Non-Essential
FWS	Range	Spotfin Chub	*Erimonax monachus*	U.S.A. (TN-specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Range	Slender chub	*Erimystax cahni*		Threatened
FWS	Range	Umtanum desert buckwheat	*Eriogonum codium*		Threatened

FWS	Both	Gypsum wild-buckwheat	*Eriogonum gypsophilum*		Threatened
FWS	Range	Clay-Loving wild buckwheat	*Eriogonum pelinophilum*		Endangered
FWS	Both	San Mateo woolly sunflower	*Eriophyllum latilobum*		Endangered
FWS	Range	Arizona eryngo	*Eryngium sparganophyllum*		Endangered
FWS	Range	Contra Costa wallflower	*Erysimum capitatum var. angustatum*		Endangered
FWS	Range	Menzies' wallflower	*Erysimum menziesii*		Endangered
FWS	Range	Ben Lomond wallflower	*Erysimum teretifolium*		Endangered
FWS	Range	Minnesota dwarf trout lily	*Erythronium propullans*		Endangered
FWS	Range	bluemask darter	*Etheostoma akatulo*		Endangered
FWS	Range	Slackwater darter	*Etheostoma boschungi*		Threatened
FWS	Range	Vermilion darter	*Etheostoma chermocki*		Endangered
FWS	Range	Relict darter	*Etheostoma chienense*		Endangered
FWS	Range	Etowah darter	*Etheostoma etowahae*		Endangered
FWS	Range	Fountain darter	*Etheostoma fonticola*		Endangered
FWS	Both	Yellowcheek Darter	*Etheostoma moorei*		Endangered
FWS	Range	Niangua darter	*Etheostoma nianguae*		Threatened
FWS	Range	Candy darter	*Etheostoma osburni*		Endangered
FWS	Range	Duskytail darter	*Etheostoma percnurum*	Wherever found	Endangered
FWS	Range	Duskytail darter	*Etheostoma percnurum*	The Tellico River, between the backwaters of the Tellico Reservoir (approximately Tellico River mile 19 (30.4 kilometers) and Tellico River mile 33 (52.8 kilometers), near the Tellico Ranger Station, Monroe County, Tennessee.	Experimental Population, Non-Essential
FWS	Range	Duskytail darter	*Etheostoma percnurum*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Both	Rush Darter	*Etheostoma phytophilum*		Endangered
FWS	Range	Bayou darter	*Etheostoma rubrum*		Threatened
FWS	Range	Cherokee darter	*Etheostoma scotti*		Threatened
FWS	Both	Maryland darter	*Etheostoma sellare*		Endangered
FWS	Range	Kentucky arrow darter	*Etheostoma spilotum*		Threatened
FWS	Range	Cumberland darter	*Etheostoma susanae*		Endangered
FWS	Both	Trispot darter	*Etheostoma trisella*		Threatened
FWS	Range	Boulder darter	*Etheostoma wapiti*	Wherever found	Endangered

FWS	Range	Boulder darter	*Etheostoma wapiti*	Shoal Creek (from Shoal Creek mile 41.7 (66.7 km)) at the mouth of Long Branch, Lawrence County, TN, downstream to the backwaters of Wilson Reservoir (Shoal Creek mile 14 (22 km)) at Goose Shoals, Lauderdale County, AL, including the lower 5 miles (8 km) of all tributaries that enter this reach	Experimental Population, Non-Essential
FWS	Range	Island marble Butterfly	*Euchloe ausonides insulanus*		Endangered
FWS	Both	Tidewater goby	*Eucyclogobius newberryi*		Endangered
FWS	Both	Florida bonneted bat	*Eumops floridanus*		Endangered
FWS	Range	Smith's blue butterfly	*Euphilotes enoptes smithi*		Endangered
FWS	Range	Telephus spurge	*Euphorbia telephioides*		Threatened
FWS	Both	Taylor's (=whulge) Checkerspot	*Euphydryas editha taylori*		Endangered
FWS	Both	Salado Salamander	*Eurycea chisholmensis*		Threatened
FWS	Both	San Marcos salamander	*Eurycea nana*		Threatened
FWS	Both	Georgetown Salamander	*Eurycea naufragia*		Threatened
FWS	Range	Texas blind salamander	*Eurycea rathbuni*		Endangered
FWS	Range	Barton Springs salamander	*Eurycea sosorum*		Endangered
FWS	Both	Jollyville Plateau Salamander	*Eurycea tonkawae*		Threatened
FWS	Both	Austin blind Salamander	*Eurycea waterlooensis*		Endangered
FWS	Range	Northern Aplomado Falcon	*Falco femoralis septentrionalis*		Endangered
FWS	Both	Big Creek Crayfish	*Faxonius peruncus*		Proposed Threatened
FWS	Both	St. Francis River Crayfish	*Faxonius quadruncus*		Proposed Threatened
FWS	Range	Gentner's Fritillary	*Fritillaria gentneri*		Endangered
FWS	Range	Tapered pigtoe	*Fusconaia burkei*		Threatened
FWS	Range	Shiny pigtoe	*Fusconaia cor*	Wherever found; Except where listed as Experimental Populations	Endangered

FWS	Range	Shiny pigtoe	*Fusconaia cor*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Shiny pigtoe	*Fusconaia cor*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Range	Finerayed pigtoe	*Fusconaia cuneolus*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Finerayed pigtoe	*Fusconaia cuneolus*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Finerayed pigtoe	*Fusconaia cuneolus*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Both	Narrow pigtoe	*Fusconaia escambia*		Threatened
FWS	Range	Atlantic pigtoe	*Fusconaia masoni*		Threatened
FWS	Both	false spike	*Fusconaia mitchelli*		Proposed Endangered
FWS	Range	Longsolid	*Fusconaia subrotunda*		Proposed Threatened
FWS	Range	Blunt-nosed leopard lizard	*Gambelia silus*		Endangered
FWS	Both	San Marcos gambusia	*Gambusia georgei*		Endangered
FWS	Range	Pecos gambusia	*Gambusia nobilis*		Endangered
FWS	Range	Illinois cave amphipod	*Gammarus acherondytes*		Endangered
FWS	Both	Noel's Amphipod	*Gammarus desperatus*		Endangered
FWS	Range	No common name	*Geocarpon minimum*		Threatened
FWS	Range	Spreading avens	*Geum radiatum*		Endangered

FWS	Both	Humpback chub	*Gila cypha*		Threatened
FWS	Both	Bonytail	*Gila elegans*		Endangered
FWS	Range	Gila chub	*Gila intermedia*		Endangered
FWS	Range	Chihuahua chub	*Gila nigrescens*		Threatened
FWS	Range	Yaqui chub	*Gila purpurea*		Endangered
FWS	Both	Virgin River Chub	*Gila seminuda (=robusta)*		Endangered
FWS	Range	Monterey gilia	*Gilia tenuiflora ssp. arenaria*		Endangered
FWS	Range	Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*		Proposed Threatened
FWS	Range	Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*		Endangered
FWS	Range	bog turtle	*Glyptemys muhlenbergii*		Threatened
FWS	Both	Desert tortoise	*Gopherus agassizii*		Threatened
FWS	Range	Gopher tortoise	*Gopherus polyphemus*		Threatened
FWS	Range	Yellow-blotched map turtle	*Graptemys flavimaculata*		Threatened
FWS	Range	Ringed map turtle	*Graptemys oculifera*		Threatened
FWS	Range	Bartram's stonecrop	*Graptopetalum bartramii*		Threatened
FWS	Both	Whooping crane	*Grus americana*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Whooping crane	*Grus americana*	U.S.A. (CO, ID, FL, NM, UT, and the western half of Wyoming)	Experimental Population, Non-Essential
FWS	Range	Whooping crane	*Grus americana*	U.S.A. (AL, AR, CO, FL, GA, ID, IL, IN, IA, KY, LA, MI, MN, MS, MO, NC, NM, OH, SC, TN, UT, VA, WI, WV, western half of WY)	Experimental Population, Non-Essential
FWS	Range	Whooping crane	*Grus americana*	U.S.A (Southwestern Louisiana)	Experimental Population, Non-Essential
FWS	Both	Mississippi sandhill crane	*Grus canadensis pulla*		Endangered
FWS	Range	North American wolverine	*Gulo gulo luscus*		Proposed Threatened
FWS	Range	Rock gnome lichen	*Gymnoderma lineare*		Endangered
FWS	Both	California condor	*Gymnogyps californianus*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	California condor	*Gymnogyps californianus*	U.S.A. (specific portions of Arizona, Nevada, and Utah)	Experimental Population, Non-Essential
FWS	Range	Northeastern beach tiger beetle	*Habroscelimorpha dorsalis dorsalis*		Threatened
FWS	Range	Showy stickseed	*Hackelia venusta*		Endangered

FWS	Both	Finelined pocketbook	*Hamiota altilis*		Threatened
FWS	Range	Southern Sandshell	*Hamiota australis*		Threatened
FWS	Range	Orangenacre mucket	*Hamiota perovalis*		Threatened
FWS	Range	Shinyrayed pocketbook	*Hamiota subangulata*		Endangered
FWS	Range	Harper's beauty	*Harperocallis flava*		Endangered
FWS	Range	Todsen's pennyroyal	*Hedeoma todsenii*		Endangered
FWS	Range	Roan Mountain bluet	*Hedyotis purpurea var. montana*		Endangered
FWS	Range	Virginia sneezeweed	*Helenium virginicum*		Threatened
FWS	Both	Pecos (=puzzle, =paradox) sunflower	*Helianthus paradoxus*		Threatened
FWS	Range	Schweinitz's sunflower	*Helianthus schweinitzii*		Endangered
FWS	Both	Whorled Sunflower	*Helianthus verticillatus*		Endangered
FWS	Range	Swamp pink	*Helonias bullata*		Threatened
FWS	Range	bog buck moth	*Hemileuca maia menyanthevora*		Proposed Endangered
FWS	Range	Cracking pearlymussel	*Hemistena lata*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Cracking pearlymussel	*Hemistena lata*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Cracking pearlymussel	*Hemistena lata*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Both	Dakota Skipper	*Hesperia dacotae*		Threatened
FWS	Range	Marin dwarf-flax	*Hesperolinon congestum*		Threatened
FWS	Both	Comal Springs riffle beetle	*Heterelmis comalensis*		Endangered
FWS	Range	Dwarf-flowered heartleaf	*Hexastylis naniflora*		Threatened
FWS	Range	Neches River rose-mallow	*Hibiscus dasycalyx*		Threatened
FWS	Range	Slender rush-pea	*Hoffmannseggia tenella*		Endangered

FWS	Range	Santa Cruz tarplant	*Holocarpha macradenia*		Threatened
FWS	Both	Mountain golden heather	*Hudsonia montana*		Threatened
FWS	Both	Rio Grande Silvery Minnow	*Hybognathus amarus*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Rio Grande Silvery Minnow	*Hybognathus amarus*	Rio Grande, from Little Box Canyon (approximately 10.4 river miles downstream of Fort Quitman, TX) to Amistad Dam; and on the Pecos River, from its confluence with Independence Creek to its confluence with the Rio Grande	Experimental Population, Non-Essential
FWS	Range	Lakeside daisy	*Hymenoxys herbacea*		Threatened
FWS	Range	Texas prairie dawn-flower	*Hymenoxys texana*		Endangered
FWS	Both	Delta smelt	*Hypomesus transpacificus*		Threatened
FWS	Both	Fender's blue butterfly	*Icaricia icarioides fenderi*		Endangered
FWS	Range	Mission blue butterfly	*Icaricia icarioides missionensis*		Endangered
FWS	Range	Yaqui catfish	*Ictalurus pricei*		Threatened
FWS	Range	Peter's Mountain mallow	*Iliamna corei*		Endangered
FWS	Range	Holy Ghost ipomopsis	*Ipomopsis sancti-spiritus*		Endangered
FWS	Range	Dwarf lake iris	*Iris lacustris*		Threatened
FWS	Range	Louisiana quillwort	*Isoetes louisianensis*		Endangered
FWS	Range	Black spored quillwort	*Isoetes melanospora*		Endangered
FWS	Range	Mat-forming quillwort	*Isoetes tegetiformans*		Endangered
FWS	Range	Small whorled pogonia	*Isotria medeoloides*		Threatened
FWS	Both	Koster's springsnail	*Juturnia kosteri*		Endangered
FWS	Range	Pink mucket (pearlymussel)	*Lampsilis abrupta*		Endangered
FWS	Range	Guadalupe Fatmucket	*Lampsilis bergmanni*		Proposed Endangered
FWS	Both	Texas fatmucket	*Lampsilis bracteata*		Proposed Endangered
FWS	Range	Higgins eye (pearlymussel)	*Lampsilis higginsii*		Endangered
FWS	Range	Arkansas fatmucket	*Lampsilis powellii*		Threatened
FWS	Range	Neosho Mucket	*Lampsilis rafinesqueana*		Endangered
FWS	Range	Speckled pocketbook	*Lampsilis streckeri*		Endangered

FWS	Range	Alabama lampmussel	*Lampsilis virescens*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Alabama lampmussel	*Lampsilis virescens*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Banbury Springs limpet	*Lanx sp.*		Endangered
FWS	Both	Carolina heelsplitter	*Lasmigona decorata*		Endangered
FWS	Range	Burke's goldfields	*Lasthenia burkei*		Endangered
FWS	Both	Contra Costa goldfields	*Lasthenia conjugens*		Endangered
FWS	Range	Eastern Black rail	*Laterallus jamaicensis ssp. jamaicensis*		Threatened
FWS	Range	Beach layia	*Layia carnosa*		Threatened
FWS	Both	Fleshy-fruit gladecress	*Leavenworthia crassa*		Endangered
FWS	Both	Kentucky glade cress	*Leavenworthia exigua laciniata*		Threatened
FWS	Range	Birdwing pearlymussel	*Lemiox rimosus*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Birdwing pearlymussel	*Lemiox rimosus*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Birdwing pearlymussel	*Lemiox rimosus*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Range	Ocelot	*Leopardus (=Felis) pardalis*		Endangered
FWS	Range	Barneby ridge-cress	*Lepidium barnebyanum*		Endangered
FWS	Both	Slickspot peppergrass	*Lepidium papilliferum*		Threatened

FWS	Range	Kemp's ridley sea turtle	*Lepidochelys kempii*		Endangered
FWS	Range	Olive ridley sea turtle	*Lepidochelys olivacea*		Threatened
FWS	Both	Vernal pool tadpole shrimp	*Lepidurus packardi*		Endangered
FWS	Range	Scaleshell mussel	*Leptodea leptodon*		Endangered
FWS	Range	Mexican long-nosed bat	*Leptonycteris nivalis*		Endangered
FWS	Range	Round rocksnail	*Leptoxis ampla*		Threatened
FWS	Range	Interrupted (=Georgia) Rocksnail	*Leptoxis foremani*		Endangered
FWS	Range	Plicate rocksnail	*Leptoxis plicata*		Endangered
FWS	Range	Painted rocksnail	*Leptoxis taeniata*		Threatened
FWS	Range	Prairie bush-clover	*Lespedeza leptostachya*		Threatened
FWS	Range	Lyrate bladderpod	*Lesquerella lyrata*		Threatened
FWS	Range	Spring Creek bladderpod	*Lesquerella perforata*		Endangered
FWS	Range	San Francisco lessingia	*Lessingia germanorum (=L.g. var. germanorum)*		Endangered
FWS	Range	Heller's blazingstar	*Liatris helleri*		Threatened
FWS	Range	Huachuca water-umbel	*Lilaeopsis schaffneriana var. recurva*		Endangered
FWS	Range	Western lily	*Lilium occidentale*		Endangered
FWS	Range	Butte County meadowfoam	*Limnanthes floccosa ssp. californica*		Endangered
FWS	Range	Pondberry	*Lindera melissifolia*		Endangered
FWS	Range	Cylindrical lioplax (snail)	*Lioplax cyclostomaformis*		Endangered
FWS	Range	Lee County cave isopod	*Lirceus usdagalun*		Endangered
FWS	Both	Kincaid's Lupine	*Lupinus sulphureus ssp. kincaidii*		Threatened
FWS	Range	Clover (Tidestrom''s) lupine	*Lupinus tidestromii*		Endangered
FWS	Range	Lotis blue butterfly	*Lycaeides argyrognomon lotis*		Endangered
FWS	Range	Karner blue butterfly	*Lycaeides melissa samuelis*		Endangered
FWS	Both	Canada Lynx	*Lynx canadensis*		Threatened
FWS	Range	Rough-leaved loosestrife	*Lysimachia asperulaefolia*		Endangered
FWS	Range	White birds-in-a-nest	*Macbridea alba*		Threatened
FWS	Both	Peppered chub	*Macrhybopsis tetranema*		Endangered
FWS	Range	Suwannee alligator snapping turtle	*Macrochelys suwanniensis*		Proposed Threatened
FWS	Range	Alligator snapping turtle	*Macrochelys temminckii*		Proposed Threatened
FWS	Range	Walker's manioc	*Manihot walkerae*		Endangered

FWS	Range	Louisiana pearlshell	*Margaritifera hembeli*		Threatened
FWS	Range	Alabama pearlshell	*Margaritifera marrianae*		Endangered
FWS	Range	Mohr's Barbara's buttons	*Marshallia mohrii*		Threatened
FWS	Range	Royal marstonia (snail)	*Marstonia ogmorhaphe*		Endangered
FWS	Range	Armored snail	*Marstonia pachyta*		Endangered
FWS	Both	Pacific Marten, Coastal Distinct Population Segment	*Martes caurina*		Threatened
FWS	Range	Alameda whipsnake (=striped racer)	*Masticophis lateralis euryxanthus*		Threatened
FWS	Range	Spikedace	*Meda fulgida*		Endangered
FWS	Range	Alabama moccasinshell	*Medionidus acutissimus*		Threatened
FWS	Range	Coosa moccasinshell	*Medionidus parvulus*		Endangered
FWS	Range	Gulf moccasinshell	*Medionidus penicillatus*		Endangered
FWS	Range	Ochlockonee moccasinshell	*Medionidus simpsonianus*		Endangered
FWS	Range	Suwannee moccasinshell	*Medionidus walkeri*		Threatened
FWS	Both	Waccamaw silverside	*Menidia extensa*		Threatened
FWS	Range	Spruce-fir moss spider	*Microhexura montivaga*		Endangered
FWS	Range	Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*		Endangered
FWS	Range	Michigan monkey-flower	*Mimulus michiganensis*		Endangered
FWS	Range	MacFarlane's four-o'clock	*Mirabilis macfarlanei*		Threatened
FWS	Range	San Joaquin wooly-threads	*Monolopia (=Lembertia) congdonii*		Endangered
FWS	Range	Black-footed ferret	*Mustela nigripes*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Black-footed ferret	*Mustela nigripes*	U.S.A. (WY and specified portions of AZ, CO, MT, SD, and UT,	Experimental Population, Non-Essential
FWS	Range	Wood stork	*Mycteria americana*		Threatened
FWS	Range	Gray bat	*Myotis grisescens*		Endangered
FWS	Range	Northern Long-Eared Bat	*Myotis septentrionalis*		Endangered
FWS	Both	Indiana bat	*Myotis sodalis*		Endangered
FWS	Range	Spreading navarretia	*Navarretia fossalis*		Threatened

FWS	Range	Black warrior (=Sipsey Fork) Waterdog	*Necturus alabamensis*		Endangered
FWS	Both	Neuse River waterdog	*Necturus lewisi*		Threatened
FWS	Range	Saint Francis' satyr butterfly	*Neonympha mitchellii francisci*		Endangered
FWS	Range	Mitchell's satyr Butterfly	*Neonympha mitchellii mitchellii*		Endangered
FWS	Range	Sand skink	*Neoseps reynoldsi*		Threatened
FWS	Both	Colusa grass	*Neostapfia colusana*		Threatened
FWS	Range	Riparian woodrat (=San Joaquin Valley)	*Neotoma fuscipes riparia*		Endangered
FWS	Range	Atlantic salt marsh snake	*Nerodia clarkii taeniata*		Threatened
FWS	Range	Copperbelly water snake	*Nerodia erythrogaster neglecta*		Threatened
FWS	Range	American burying beetle	*Nicrophorus americanus*	Wherever found; Except where listed as Experimental Populations	Threatened
FWS	Range	American burying beetle	*Nicrophorus americanus*	In southwestern Missouri, the counties of Cedar, St. Clair, Bates, and Vernon.	Experimental Population, Non-Essential
FWS	Range	Britton's beargrass	*Nolina brittoniana*		Endangered
FWS	Range	Palezone shiner	*Notropis albizonatus*		Endangered
FWS	Range	Smalleye Shiner	*Notropis buccula*		Endangered
FWS	Range	Cahaba shiner	*Notropis cahabae*		Endangered
FWS	Both	Arkansas River shiner	*Notropis girardi*		Threatened
FWS	Both	Cape Fear shiner	*Notropis mekistocholas*		Endangered
FWS	Range	Sharpnose Shiner	*Notropis oxyrhynchus*		Endangered
FWS	Both	Pecos bluntnose shiner	*Notropis simus pecosensis*		Threatened
FWS	Both	Topeka shiner	*Notropis topeka (=tristis)*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Topeka shiner	*Notropis topeka (=tristis)*	U.S.A. (MO-specified portions of Little Creek, Big Muddy Creek, and Spring Creek watersheds in Adair, Gentry, Harrison, Putnam, Sullivan, and Worth Counties	Experimental Population, Non-Essential
FWS	Both	Smoky madtom	*Noturus baileyi*	Wherever found	Endangered

FWS	Range	Smoky madtom	*Noturus baileyi*	The Tellico River, between the backwaters of the Tellico Reservoir (approximately Tellico River mile 19 (30.4 kilometers) and Tellico River mile 33 (52.8 kilometers), near the Tellico Ranger Station, Monroe County, Tennessee	Experimental Population, Non-Essential
FWS	Range	Chucky Madtom	*Noturus crypticus*		Endangered
FWS	Both	Yellowfin madtom	*Noturus flavipinnis*	Wherever found; Except where listed as Experimental Populations	Threatened
FWS	Range	Yellowfin madtom	*Noturus flavipinnis*	U.S.A. (TN-specified portions of the Tellico River	Experimental Population, Non-Essential
FWS	Range	Yellowfin madtom	*Noturus flavipinnis*	U.S.A. (TN, VA-specified portions of the Holston River and watershed	Experimental Population, Non-Essential
FWS	Range	Yellowfin madtom	*Noturus flavipinnis*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Both	Carolina madtom	*Noturus furiosus*		Endangered
FWS	Both	Frecklebelly madtom	*Noturus munitus*		Proposed Threatened
FWS	Range	Neosho madtom	*Noturus placidus*		Threatened
FWS	Range	Pygmy madtom	*Noturus stanauli*	Wherever found	Endangered
FWS	Range	Pygmy madtom	*Noturus stanauli*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers)	Experimental Population, Non-Essential
FWS	Range	Scioto madtom	*Noturus trautmani*		Endangered
FWS	Range	Chittenango ovate amber snail	*Novisuccinea chittenangoensis*		Threatened
FWS	Range	Eskimo curlew	*Numenius borealis*		Endangered
FWS	Both	Poweshiek skipperling	*Oarisma poweshiek*		Endangered
FWS	Range	Choctaw bean	*Obovaria choctawensis*		Endangered
FWS	Range	Ring pink (mussel)	*Obovaria retusa*		Endangered
FWS	Range	Round hickorynut	*Obovaria subrotunda*		Proposed Threatened
FWS	Range	Columbian white-tailed deer	*Odocoileus virginianus leucurus*		Threatened
FWS	Both	Antioch Dunes evening-primrose	*Oenothera deltoides ssp. howellii*		Endangered
FWS	Range	Apache trout	*Oncorhynchus apache*		Threatened

FWS	Range	Lahontan cutthroat trout	*Oncorhynchus clarkii henshawi*		Threatened
FWS	Range	Greenback Cutthroat trout	*Oncorhynchus clarkii stomias*		Threatened
FWS	Range	Rio Grande cutthroat trout	*Oncorhynchus clarkii virginalis*		Candidate
FWS	Range	Gila trout	*Oncorhynchus gilae*		Threatened
FWS	Range	Bakersfield cactus	*Opuntia treleasei*		Endangered
FWS	Range	Nashville crayfish	*Orconectes shoupi*		Endangered
FWS	Both	San Joaquin Orcutt grass	*Orcuttia inaequalis*		Threatened
FWS	Both	Hairy Orcutt grass	*Orcuttia pilosa*		Endangered
FWS	Range	Slender Orcutt grass	*Orcuttia tenuis*		Threatened
FWS	Both	Sacramento Orcutt grass	*Orcuttia viscida*		Endangered
FWS	Range	Canby's dropwort	*Oxypolis canbyi*		Endangered
FWS	Range	Fassett's locoweed	*Oxytropis campestris var. chartacea*		Threatened
FWS	Range	Squirrel Chimney Cave shrimp	*Palaemonetes cummingi*		Threatened
FWS	Range	Alabama cave shrimp	*Palaemonias alabamae*		Endangered
FWS	Both	Kentucky cave shrimp	*Palaemonias ganteri*		Endangered
FWS	Range	Jaguar	*Panthera onca*		Endangered
FWS	Range	Papery whitlow-wort	*Paronychia chartacea*		Threatened
FWS	Range	James spinymussel	*Parvaspina collina*		Endangered
FWS	Range	Tar River spinymussel	*Parvaspina steinstansana*		Endangered
FWS	Range	Siler pincushion cactus	*Pediocactus (=Echinocactus,=Utahia) sileri*		Threatened
FWS	Range	Brady pincushion cactus	*Pediocactus bradyi*		Endangered
FWS	Range	San Rafael cactus	*Pediocactus despainii*		Endangered
FWS	Range	Knowlton's cactus	*Pediocactus knowltonii*		Endangered
FWS	Both	Fickeisen plains cactus	*Pediocactus peeblesianus ssp. fickeiseniae*		Endangered
FWS	Range	Littlewing pearlymussel	*Pegias fabula*		Endangered
FWS	Range	Fisher	*Pekania pennanti*		Endangered
FWS	Range	Blowout penstemon	*Penstemon haydenii*		Endangered
FWS	Range	White-rayed pentachaeta	*Pentachaeta bellidiflora*		Endangered
FWS	Both	Amber darter	*Percina antesella*		Endangered
FWS	Range	Goldline darter	*Percina aurolineata*		Threatened
FWS	Range	Pearl darter	*Percina aurora*		Threatened
FWS	Both	Conasauga logperch	*Percina jenkinsi*		Endangered

FWS	Range	Leopard darter	*Percina pantherina*		Threatened
FWS	Range	Roanoke logperch	*Percina rex*		Endangered
FWS	Range	Tricolored bat	*Perimyotis subflavus*		Proposed Endangered
FWS	Both	Choctawhatchee beach mouse	*Peromyscus polionotus allophrys*		Endangered
FWS	Both	Alabama beach mouse	*Peromyscus polionotus ammobates*		Endangered
FWS	Range	Southeastern beach mouse	*Peromyscus polionotus niveiventris*		Threatened
FWS	Both	St. Andrew beach mouse	*Peromyscus polionotus peninsularis*		Endangered
FWS	Both	Perdido Key beach mouse	*Peromyscus polionotus trissyllepsis*		Endangered
FWS	Range	Red Hills salamander	*Phaeognathus hubrichti*		Threatened
FWS	Range	Yreka phlox	*Phlox hirsuta*		Endangered
FWS	Range	Short-tailed albatross	*Phoebastria (=Diomedea) albatrus*		Endangered
FWS	Range	Blackside dace	*Phoxinus cumberlandensis*		Threatened
FWS	Range	Snake River physa snail	*Physa natricina*		Endangered
FWS	Both	White Bluffs bladderpod	*Physaria douglasii ssp. tuplashensis*		Threatened
FWS	Range	Missouri bladderpod	*Physaria filiformis*		Threatened
FWS	Both	Short's bladderpod	*Physaria globosa*		Endangered
FWS	Both	Zapata bladderpod	*Physaria thamnophila*		Endangered
FWS	Range	Red-cockaded woodpecker	*Picoides borealis*		Endangered
FWS	Range	Godfrey's butterwort	*Pinguicula ionantha*		Threatened
FWS	Range	Whitebark pine	*Pinus albicaulis*		Threatened
FWS	Both	Yadon's piperia	*Piperia yadonii*		Endangered
FWS	Both	Black pinesnake	*Pituophis melanoleucus lodingi*		Threatened
FWS	Both	Louisiana pinesnake	*Pituophis ruthveni*		Threatened
FWS	Range	Ruth's golden aster	*Pityopsis ruthii*		Endangered
FWS	Both	Woundfin	*Plagopterus argentissimus*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Woundfin	*Plagopterus argentissimus*	Gila R. drainage, AZ, NM	Experimental Population, Non-Essential
FWS	Both	Magnificent ramshorn	*Planorbella magnifica*		Proposed Endangered
FWS	Range	White fringeless orchid	*Platanthera integrilabia*		Threatened

FWS	Range	Eastern prairie fringed orchid	*Platanthera leucophaea*		Threatened
FWS	Range	Western prairie fringed Orchid	*Platanthera praeclara*		Threatened
FWS	Range	White wartyback (pearlymussel)	*Plethobasus cicatricosus*		Endangered
FWS	Range	Orangefoot pimpleback (pearlymussel)	*Plethobasus cooperianus*	Wherever found	Endangered
FWS	Range	Orangefoot pimpleback (pearlymussel)	*Plethobasus cooperianus*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Range	Sheepnose Mussel	*Plethobasus cyphyus*		Endangered
FWS	Range	Cheat Mountain salamander	*Plethodon nettingi*		Threatened
FWS	Range	Shenandoah salamander	*Plethodon shenandoah*		Endangered
FWS	Both	Canoe Creek Clubshell	*Pleurobema athearni*		Endangered
FWS	Range	Clubshell	*Pleurobema clava*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Clubshell	*Pleurobema clava*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Black clubshell	*Pleurobema curtum*		Endangered
FWS	Range	Southern clubshell	*Pleurobema decisum*		Endangered
FWS	Range	Dark pigtoe	*Pleurobema furvum*		Endangered
FWS	Range	Southern pigtoe	*Pleurobema georgianum*		Endangered
FWS	Range	Georgia pigtoe	*Pleurobema hanleyianum*		Endangered
FWS	Range	Flat pigtoe	*Pleurobema marshalli*		Endangered
FWS	Range	Ovate clubshell	*Pleurobema perovatum*		Endangered
FWS	Range	Rough pigtoe	*Pleurobema plenum*		Endangered
FWS	Range	Oval pigtoe	*Pleurobema pyriforme*		Endangered
FWS	Range	Fuzzy pigtoe	*Pleurobema strodeanum*		Threatened
FWS	Range	Heavy pigtoe	*Pleurobema taitianum*		Endangered
FWS	Range	Rough hornsnail	*Pleurocera foremani*		Endangered
FWS	Range	Slabside Pearlymussel	*Pleuronaia dolabelloides*		Endangered
FWS	Range	Cumberland pigtoe	*Pleuronaia gibber*		Endangered

FWS	Range	Gila topminnow (incl. Yaqui)	*Poeciliopsis occidentalis*		Endangered
FWS	Range	Audubon's crested caracara	*Polyborus plancus audubonii*		Threatened
FWS	Range	Lewton's polygala	*Polygala lewtonii*		Endangered
FWS	Range	Tiny polygala	*Polygala smallii*		Endangered
FWS	Range	Sandlace	*Polygonella myriophylla*		Endangered
FWS	Range	Scotts Valley Polygonum	*Polygonum hickmanii*		Endangered
FWS	Range	Virginia fringed mountain snail	*Polygyriscus virginianus*		Endangered
FWS	Range	Mount Hermon June beetle	*Polyphylla barbata*		Endangered
FWS	Both	Texas Hornshell	*Popenaias popeii*		Endangered
FWS	Range	Fat pocketbook	*Potamilus capax*		Endangered
FWS	Range	Inflated heelsplitter	*Potamilus inflatus*		Threatened
FWS	Range	Hickman's potentilla	*Potentilla hickmanii*		Endangered
FWS	Range	Mexican blindcat (catfish)	*Prietella phreatophila*		Endangered
FWS	Range	Maguire primrose	*Primula maguirei*		Threatened
FWS	Range	Alabama red-bellied turtle	*Pseudemys alabamensis*		Endangered
FWS	Range	Plymouth Redbelly Turtle	*Pseudemys rubriventris bangsi*		Endangered
FWS	Range	Hartweg's golden sunburst	*Pseudobahia bahiifolia*		Endangered
FWS	Range	San Joaquin adobe sunburst	*Pseudobahia peirsonii*		Threatened
FWS	Range	Black-capped petrel	*Pterodroma hasitata*		Proposed Threatened
FWS	Range	Hawaiian petrel	*Pterodroma sandwichensis*		Endangered
FWS	Range	Harperella	*Ptilimnium nodosum*		Endangered
FWS	Range	Triangular Kidneyshell	*Ptychobranchus greenii*		Endangered
FWS	Range	Southern kidneyshell	*Ptychobranchus jonesi*		Endangered
FWS	Range	Fluted kidneyshell	*Ptychobranchus subtentus*		Endangered
FWS	Both	Colorado pikeminnow	*Ptychocheilus lucius*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Colorado pikeminnow	*Ptychocheilus lucius*	Salt and Verde R. drainages, AZ	Experimental Population, Non-Essential
FWS	Range	Florida panther	*Puma (=Felis) concolor coryi*		Endangered
FWS	Range	Gulf Coast jaguarundi	*Puma yagouaroundi cacomitli*		Endangered
FWS	Range	Arizona Cliffrose	*Purshia (=Cowania) subintegra*		Endangered

FWS	Range	Bruneau Hot springsnail	*Pyrgulopsis bruneauensis*		Endangered
FWS	Range	Chupadera springsnail	*Pyrgulopsis chupaderae*		Endangered
FWS	Range	Socorro springsnail	*Pyrgulopsis neomexicana*		Endangered
FWS	Both	Roswell springsnail	*Pyrgulopsis roswellensis*		Endangered
FWS	Range	Rabbitsfoot	*Quadrula cylindrica cylindrica*		Threatened
FWS	Both	Rough rabbitsfoot	*Quadrula cylindrica strigillata*		Endangered
FWS	Range	Winged Mapleleaf	*Quadrula fragosa*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Winged Mapleleaf	*Quadrula fragosa*	U.S.A. (AL-specified portions of the Tennessee River	Experimental Population, Non-Essential
FWS	Range	Stirrupshell	*Quadrula stapes*		Endangered
FWS	Range	California clapper rail	*Rallus longirostris obsoletus*		Endangered
FWS	Range	Yuma Ridgway''s rail	*Rallus obsoletus yumanensis*		Endangered
FWS	Range	Chiricahua leopard frog	*Rana chiricahuensis*		Threatened
FWS	Both	California red-legged frog	*Rana draytonii*		Threatened
FWS	Both	Oregon spotted frog	*Rana pretiosa*		Threatened
FWS	Both	dusky gopher frog	*Rana sevosa*		Endangered
FWS	Range	Southern Mountain Caribou DPS	*Rangifer tarandus ssp. caribou*		Endangered
FWS	Range	Autumn Buttercup	*Ranunculus aestivalis (=acriformis)*		Endangered
FWS	Range	Round Ebonyshell	*Reginaia rotulata*		Endangered
FWS	Range	Salt marsh harvest mouse	*Reithrodontomys raviventris*		Endangered
FWS	Both	[no common name] Beetle	*Rhadine exilis*		Endangered
FWS	Both	[no common name] Beetle	*Rhadine infernalis*		Endangered
FWS	Range	Tooth Cave ground beetle	*Rhadine persephone*		Endangered
FWS	Range	Leedy's roseroot	*Rhodiola integrifolia ssp. leedyi*		Threatened
FWS	Range	Chapman rhododendron	*Rhododendron chapmanii*		Endangered
FWS	Range	Michaux's sumac	*Rhus michauxii*		Endangered
FWS	Range	Knieskern's Beaked-rush	*Rhynchospora knieskernii*		Threatened
FWS	Range	Miccosukee gooseberry	*Ribes echinellum*		Threatened
FWS	Both	Everglade snail kite	*Rostrhamus sociabilis plumbeus*		Endangered

FWS	Range	Bunched arrowhead	*Sagittaria fasciculata*		Endangered
FWS	Range	Kral's water-plantain	*Sagittaria secundifolia*		Threatened
FWS	Both	Atlantic salmon	*Salmo salar*		Endangered
FWS	Both	Bull Trout	*Salvelinus confluentus*		Threatened
FWS	Range	Green pitcher-plant	*Sarracenia oreophila*		Endangered
FWS	Range	Alabama canebrake pitcher-plant	*Sarracenia rubra ssp. alabamensis*		Endangered
FWS	Range	Mountain sweet pitcher-plant	*Sarracenia rubra ssp. jonesii*		Endangered
FWS	Range	Pallid sturgeon	*Scaphirhynchus albus*		Endangered
FWS	Range	Alabama sturgeon	*Scaphirhynchus suttkusi*		Endangered
FWS	Range	Clay reed-mustard	*Schoenocrambe argillacea*		Threatened
FWS	Range	Barneby reed-mustard	*Schoenocrambe barnebyi*		Endangered
FWS	Range	Shrubby reed-mustard	*Schoenocrambe suffrutescens*		Endangered
FWS	Range	American chaffseed	*Schwalbea americana*		Endangered
FWS	Range	Northeastern bulrush	*Scirpus ancistrochaetus*		Endangered
FWS	Range	Tobusch fishhook cactus	*Sclerocactus brevihamatus ssp. tobuschii*		Threatened
FWS	Range	Pariette cactus	*Sclerocactus brevispinus*		Threatened
FWS	Range	Colorado hookless Cactus	*Sclerocactus glaucus*		Threatened
FWS	Range	Mesa Verde cactus	*Sclerocactus mesae-verdae*		Threatened
FWS	Range	Uinta Basin hookless cactus	*Sclerocactus wetlandicus*		Threatened
FWS	Range	Florida skullcap	*Scutellaria floridana*		Threatened
FWS	Range	Large-flowered skullcap	*Scutellaria montana*		Threatened
FWS	Both	Ocmulgee skullcap	*Scutellaria ocmulgee*		Proposed Threatened
FWS	Range	golden-cheeked warbler	*Setophaga chrysoparia*		Endangered
FWS	Range	Keck's Checker-mallow	*Sidalcea keckii*		Endangered
FWS	Range	Nelson's checker-mallow	*Sidalcea nelsoniana*		Threatened
FWS	Range	Wenatchee Mountains checkermallow	*Sidalcea oregana var. calva*		Endangered
FWS	Range	Fringed campion	*Silene polypetala*		Endangered
FWS	Range	Spalding's Catchfly	*Silene spaldingii*		Threatened
FWS	Range	Eastern Massasauga (=rattlesnake)	*Sistrurus catenatus*		Threatened
FWS	Range	White irisette	*Sisyrinchium dichotomum*		Endangered

FWS	Range	Houghton's goldenrod	*Solidago houghtonii*		Threatened
FWS	Range	Short's goldenrod	*Solidago shortii*		Endangered
FWS	Range	Blue Ridge goldenrod	*Solidago spithamaea*		Threatened
FWS	Both	Hine's emerald dragonfly	*Somatochlora hineana*		Endangered
FWS	Both	Buena Vista Lake ornate Shrew	*Sorex ornatus relictus*		Endangered
FWS	Both	Alabama cavefish	*Speoplatyrhinus poulsoni*		Endangered
FWS	Range	Silverspot	*Speyeria nokomis nokomis*		Proposed Threatened
FWS	Range	Behren's silverspot butterfly	*Speyeria zerene behrensii*		Endangered
FWS	Range	Oregon silverspot butterfly	*Speyeria zerene hippolyta*		Threatened
FWS	Range	Myrtle's silverspot butterfly	*Speyeria zerene myrtleae*		Endangered
FWS	Both	Gierisch mallow	*Sphaeralcea gierischii*		Endangered
FWS	Range	Gentian pinkroot	*Spigelia gentianoides*		Endangered
FWS	Range	Virginia spiraea	*Spiraea virginiana*		Threatened
FWS	Range	Ute ladies'-tresses	*Spiranthes diluvialis*		Threatened
FWS	Range	Navasota ladies-tresses	*Spiranthes parksii*		Endangered
FWS	Range	Longfin Smelt	*Spirinchus thaleichthys*		Candidate
FWS	Range	California least tern	*Sterna antillarum browni*		Endangered
FWS	Range	Roseate tern	*Sterna dougallii dougallii*	Atlantic Coast south to NC, Canada, Bermuda	Endangered
FWS	Range	Roseate tern	*Sterna dougallii dougallii*	Western Hemisphere and adjacent oceans, including USA (FL, PR, VI), where not listed as endangered	Endangered
FWS	Range	Flattened musk turtle	*Sternotherus depressus*		Threatened
FWS	Both	Bracted twistflower	*Streptanthus bracteatus*		Proposed Threatened
FWS	Range	Tiburon jewelflower	*Streptanthus niger*		Endangered
FWS	Both	Northern spotted owl	*Strix occidentalis caurina*		Threatened
FWS	Both	Mexican spotted owl	*Strix occidentalis lucida*		Threatened
FWS	Both	Peck's cave amphipod	*Stygobromus (=Stygonectes) pecki*		Endangered
FWS	Both	Comal Springs dryopid beetle	*Stygoparnus comalensis*		Endangered
FWS	Range	California seablite	*Suaeda californica*		Endangered
FWS	Range	Riparian brush rabbit	*Sylvilagus bachmani riparius*		Endangered
FWS	Range	California freshwater shrimp	*Syncaris pacifica*		Endangered

FWS	Range	Penasco least chipmunk	*Tamias minimus atristriatus*		Proposed Endangered
FWS	Range	Tooth Cave pseudoscorpion	*Tartarocreagris texana*		Endangered
FWS	Range	Bliss Rapids snail	*Taylorconcha serpenticola*		Threatened
FWS	Both	Government Canyon Bat Cave spider	*Tayshaneta microps*		Endangered
FWS	Range	Tooth Cave spider	*Tayshaneta myopica*		Endangered
FWS	Range	Kretschmarr Cave mold beetle	*Texamaurops reddelli*		Endangered
FWS	Range	Cokendolpher Cave Harvestman	*Texella cokendolpheri*		Endangered
FWS	Range	Bee Creek Cave harvestman	*Texella reddelli*		Endangered
FWS	Range	Bone Cave harvestman	*Texella reyesi*		Endangered
FWS	Range	Cooley's meadowrue	*Thalictrum cooleyi*		Endangered
FWS	Both	Northern Mexican gartersnake	*Thamnophis eques megalops*		Threatened
FWS	Range	Giant garter snake	*Thamnophis gigas*		Threatened
FWS	Both	Narrow-headed gartersnake	*Thamnophis rufipunctatus*		Threatened
FWS	Range	San Francisco garter snake	*Thamnophis sirtalis tetrataenia*		Endangered
FWS	Range	Cumberland monkeyface (pearlymussel)	*Theliderma intermedia*	Wherever found; Except where listed as Experimental Populations	Endangered
FWS	Range	Cumberland monkeyface (pearlymussel)	*Theliderma intermedia*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Range	Cumberland monkeyface (pearlymussel)	*Theliderma intermedia*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Appalachian monkeyface (pearlymussel)	*Theliderma sparsa*	Wherever found	Endangered
FWS	Range	Appalachian monkeyface (pearlymussel)	*Theliderma sparsa*	USA (TN - specified portions of the French Broad and Holston Rivers)	Experimental Population, Non-Essential

FWS	Range	Howell''s spectacular thelypody	*Thelypodium howellii ssp. spectabilis*		Threatened
FWS	Range	Alabama streak-sorus fern	*Thelypteris pilosa var. alabamensis*		Threatened
FWS	Range	Socorro isopod	*Thermosphaeroma thermophilus*		Endangered
FWS	Both	Olympia pocket gopher	*Thomomys mazama pugetensis*		Threatened
FWS	Both	Tenino pocket gopher	*Thomomys mazama tumuli*		Threatened
FWS	Range	Yelm pocket gopher	*Thomomys mazama yelmensis*		Threatened
FWS	Range	Ashy dogweed	*Thymophylla tephroleuca*		Endangered
FWS	Range	Loach minnow	*Tiaroga cobitis*		Endangered
FWS	Range	Florida torreya	*Torreya taxifolia*		Endangered
FWS	Range	Last Chance townsendia	*Townsendia aprica*		Threatened
FWS	Range	Pale lilliput (pearlymussel)	*Toxolasma cylindrellus*		Endangered
FWS	Both	West Indian Manatee	*Trichechus manatus*		Threatened
FWS	Range	Showy Indian clover	*Trifolium amoenum*		Endangered
FWS	Range	Monterey clover	*Trifolium trichocalyx*		Endangered
FWS	Range	Persistent trillium	*Trillium persistens*		Endangered
FWS	Range	Relict trillium	*Trillium reliquum*		Endangered
FWS	Range	Zayante band-winged grasshopper	*Trimerotropis infantilis*		Endangered
FWS	Range	Flat-spired three-toothed Snail	*Triodopsis platysayoides*		Threatened
FWS	Both	Texas fawnsfoot	*Truncilla macrodon*		Proposed Threatened
FWS	Both	Greene's tuctoria	*Tuctoria greenei*		Endangered
FWS	Both	Solano grass	*Tuctoria mucronata*		Endangered
FWS	Range	Tulotoma snail	*Tulotoma magnifica*		Threatened
FWS	Range	Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*		Endangered
FWS	Range	Grizzly bear	*Ursus arctos horribilis*		Threatened
FWS	Range	Bachman's warbler (=wood)	*Vermivora bachmanii*		Endangered
FWS	Range	Rayed Bean	*Villosa fabalis*		Endangered
FWS	Both	Purple bean	*Villosa perpurpurea*		Endangered
FWS	Range	Cumberland bean (pearlymussel)	*Villosa trabalis*	Wherever found; Except where listed as Experimental Populations	Endangered

FWS	Range	Cumberland bean (pearlymussel)	*Villosa trabalis*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
FWS	Range	Cumberland bean (pearlymussel)	*Villosa trabalis*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
FWS	Range	Least Bell's vireo	*Vireo bellii pusillus*		Endangered
FWS	Range	San Joaquin kit fox	*Vulpes macrotis mutica*		Endangered
FWS	Range	Carter's mustard	*Warea carteri*		Endangered
FWS	Both	Razorback sucker	*Xyrauchen texanus*		Endangered
FWS	Range	Tennessee yellow-eyed grass	*Xyris tennesseensis*		Endangered
FWS	Both	New Mexico meadow jumping mouse	*Zapus hudsonius luteus*		Endangered
FWS	Both	Preble's meadow jumping mouse	*Zapus hudsonius preblei*		Threatened
FWS	Both	Texas wild-rice	*Zizania texana*		Endangered
NMFS	Range	Shortnose sturgeon	*Acipenser brevirostrum*		Endangered
NMFS	Both	Sturgeon, Green	*Acipenser medirostris*	Southern	Threatened
NMFS	Both	Sturgeon, Atlantic (Gulf subspecies)	*Acipenser oxyrinchus (=oxyrhynchus) desotoi*		Threatened
NMFS	Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	Carolina	Endangered
NMFS	Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	Chesapeake Bay	Endangered
NMFS	Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	Gulf of Maine	Threatened
NMFS	Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	New York Bight	Endangered
NMFS	Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	South Atlantic	Endangered
NMFS	Both	Elkhorn coral	*Acropora palmata*		Threatened
NMFS	Range	Guadalupe fur seal	*Arctocephalus townsendi*		Threatened
NMFS	Range	Sei Whale	*Balaenoptera borealis*		Endangered
NMFS	Range	Blue Whale	*Balaenoptera musculus*		Endangered
NMFS	Range	Fin Whale	*Balaenoptera physalus*		Endangered
NMFS	Range	Rice’s Whale	*Balaenoptera ricei*	Gulf of Mexico	Endangered
NMFS	Range	Oceanic Whitetip Shark	*Carcharhinus longimanus*		Threatened

NMFS	Both	Loggerhead Sea Turtle	*Caretta caretta*	Northwest Atlantic Ocean	Endangered
NMFS	Range	Loggerhead Sea Turtle	*Caretta caretta*	North Pacific Ocean	Endangered
NMFS	Range	Green Sea Turtle	*Chelonia mydas*	North Atlantic	Threatened
NMFS	Range	Green Sea Turtle	*Chelonia mydas*	East Pacific	Threatened
NMFS	Both	Leatherback Sea Turtle	*Dermochelys coriacea*		Endangered
NMFS	Range	Hawskbill Sea Turtle	*Eretmochelys imbricata*		Endangered
NMFS	Both	North Atlantic Right Whale	*Eubalaena glacialis*		Endangered
NMFS	Range	North Pacific Right Whale	*Eubalaena japonica*		Endangered
NMFS	Both	Steller Sea Lion	*Eumetopias jubatus*	Western	Endangered
NMFS	Both	Abalone, black	*Haliotis cracherodii*		Endangered
NMFS	Range	Kemp's Ridley Sea Turtle	*Lepidochelys kempii*		Endangered
NMFS	Range	Olive Ridley Sea Turtle	*Lepidochelys olivacea*	All other areas	Threatened
NMFS	Range	Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Mexico's Pacific coast breeding colonies	Endangered
NMFS	Range	Giant Manta Ray	*Manta birostris*		Threatened
NMFS	Both	Humpback Whale	*Megaptera novaeangliae*	Central America	Endangered
NMFS	Both	Humpback Whale	*Megaptera novaeangliae*	Mexico	Threatened
NMFS	Range	Humpback Whale	*Megaptera novaeangliae*	Western North Pacific	Endangered
NMFS	Both	Coho Salmon	*Oncorhynchus (=Salmo) kisutch*	Central California coast	Endangered
NMFS	Both	Coho Salmon	*Oncorhynchus (=Salmo) kisutch*	Lower Columbia River	Threatened
NMFS	Both	Coho Salmon	*Oncorhynchus (=Salmo) kisutch*	Oregon coast	Threatened
NMFS	Both	Coho Salmon	*Oncorhynchus (=Salmo) kisutch*	Southern Oregon & Northern California coasts (SONCC)	Threatened
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	California Central Valley	Threatened
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Central California coast	Threatened
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Lower Columbia River	Threatened
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Middle Columbia River	Threatened
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Northern California	Threatened
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Puget Sound	Threatened
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Snake River Basin	Threatened
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	South-Central California coast	Threatened

NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Southern California	Endangered
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Upper Columbia River	Threatened
NMFS	Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Upper Willamette River	Threatened
NMFS	Both	Salmon, sockeye	*Oncorhynchus (=Salmo) nerka*	Ozette Lake	Threatened
NMFS	Both	Salmon, sockeye	*Oncorhynchus (=Salmo) nerka*	Snake River	Endangered
NMFS	Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	California coastal	Threatened
NMFS	Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Central Valley spring-run	Threatened
NMFS	Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Lower Columbia River	Threatened
NMFS	Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Puget Sound	Threatened
NMFS	Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Sacramento River winter-run	Endangered
NMFS	Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Snake River fall-run	Threatened
NMFS	Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Snake River spring/summer-run	Threatened
NMFS	Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Upper Columbia River spring-run	Endangered
NMFS	Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Upper Willamette River	Threatened
NMFS	Both	Chum Salmon	*Oncorhynchus keta*	Columbia River	Threatened
NMFS	Both	Chum Salmon	*Oncorhynchus keta*	Hood Canal summer-run	Threatened
NMFS	Both	Coral, lobed star	*Orbicella annularis*		Threatened
NMFS	Both	Coral, mountainous star	*Orbicella faveolata*		Threatened
NMFS	Both	Boulder star coral	*Orbicella franksi*		Threatened
NMFS	Both	Whale, killer	*Orcinus orca*	Southern Resident	Endangered
NMFS	Range	Sperm Whale	*Physeter macrocephalus (= catodon)*		Endangered
NMFS	Range	Smalltooth sawfish	*Pristis pectinata*	U.S. portion of range	Endangered
NMFS	Range	False Killer Whale	*Pseudorca crassidens*	Main Hawaiian Islands Insular	Endangered
NMFS	Range	Sunflower sea star	*Pycnopodia helianthoides*		Proposed Threatened
NMFS	Both	Salmon, Atlantic	*Salmo salar*	Gulf of Maine	Endangered
NMFS	Both	Bocaccio	*Sebastes paucispinis*	Puget Sound/ Georgia Basin	Endangered
NMFS	Both	Rockfish, yelloweye	*Sebastes ruberrimus*	Puget Sound/ Georgia Basin	Threatened
NMFS	Range	Scalloped Hammerhead	*Sphyrna lewini*	Central & Southwest Atlantic	Threatened
NMFS	Both	Eulachon	*Thaleichthys pacificus*	Southern	Threatened

Upon further discussion with NMFS, EPA did not include many of the marine and coastal NMFS species in additional analyses or discussions in this Biological Evaluation due to discountable or insignificant effects potentially attributed to land use changes from the RFS Set Rule. Potential consequences from the action pertaining to water quality (e.g., pesticide exposure, as discussed in more detail in later sections) and species' responses to such potential effects are discountable for populations that are found in offshore or circumpolar regions, far enough away from the pollution source where exposure would not likely occur due to dilution in marine waters.

This applies to the following cetaceans (and their associated critical habitats) which receive NLAA determinations because effects, if any, are discountable: Sei Whale, Rice's Whale Gulf of Mexico population, Blue Whale, Finback Whale, all listed Humpback Whale DPSs, and Sperm Whale.

Other marine NMFS species that fully or partially reside or have critical habitat in more shallow, coastal waters could be exposed to water quality effects caused by potential land use changes driven by the RFS Set Rule. Although exposure is possible, we do not anticipate adverse effects to these species because their responses to that exposure would be undetectable and not measurable relative to baseline conditions and would not rise to the level of take. In the case of pesticide exposure attributed to the RFS Set Rule, the risk of bioaccumulation and/or biomagnification in larger animals (e.g., North Atlantic Right Whale) would be very low. For species whose critical habitat PBFs include prey availability, potential impacts are insignificant for species whose prey are wholly marine. Additionally, we anticipate that any potential effects from the RFS Set Rule would not meaningfully reduce the prey populations and food sources found in more freshwater or estuarine ecosystems, and thus not adversely affect the listed species who rely on those food sources. For other PBFs, such as nearshore reproductive habitat (e.g., for many sea turtles), potential effects would also be undetectable and not measurable.

Species that receive insignificant effects due to reasons as described above include: the North Atlantic Right Whale, Killer Whale (Southern Resident population), North Pacific Right Whale, False Killer Whale Main Hawaiian Islands Insular population). Olive Ridley Sea Turtle (Mexico's Pacific coast breeding colonies and all other areas populations), Leatherback Sea Turtle, Loggerhead Sea Turtle (Northwest Atlantic Ocean and North Pacific Ocean populations), Green Sea Turtle (North Atlantic and East Pacific populations), Hawksbill Sea Turtle, Kemp's Ridley Sea Turtle, Elkhorn Coral, Lobed Star Coral, Mountainous Star Coral, Boulder Star Coral, Steller Sea lion (Western population), Guadalupe Fur Seal, Oceanic Whitetip Shark, Scalloped Hammerhead Shark (Central & Southwest Atlantic population), and Giant Manta Ray. Though the Southern Resident Killer whale depends on salmon for food (e.g., the Chinook salmon), the potential effects of the RFS Set Rule on these salmon populations are also considered to be discountable, as discussed in later sections. As such, this group of marine and coastal species is not further evaluated in the ensuing analyses for this Biological Evaluation.

VI. Changes in Land Use Attributable to the RFS Set Rule

As discussed in the preceding sections, the RFS volume requirements for 2023–2025 may affect listed species primarily by increasing demand for corn, soybean, and canola feedstock crops used to produce biofuels. The increased demand for these crops could impact listed species in two different but inter-related ways. First, increased demand for these crops could result in an increase in the amount of land used to produce these crops. This increase in the amount of land used to produce corn, soybeans, and canola could come from cropland currently being used to produce other crops or from the conversion of non-cropland to cropland. These land use changes could impact species with critical habitat or ranges on this land. Further, increased production of these crops could result in an increase in the quantity of fertilizer, herbicides, pesticides, and sediment in waterways that are close to or downstream of land used to produce these crops. This could negatively affect species that live in or near the impacted waterways. Increased production of these crops could also result in direct and indirect impacts to terrestrial species that use crop lands or lands adjacent to them.

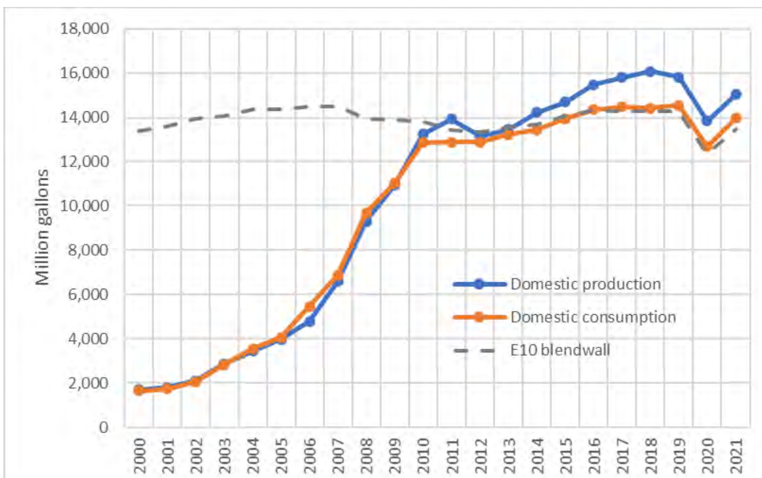
This section discusses a plausible projection of land use changes associated with the RFS volume requirements for 2023–2025. In particular, for the purposes of carrying out this Biological Evaluation, we projected the land use changes associated with increased demand for corn, soybeans, and canola for biofuel production, and the portion of those land use changes attributable to the Set Rule. To project land use changes associated with increased demand for biofuels we used the best available data and analytical techniques from the published literature. The types of data and information on the impact of biofuel demand on crop production that is publicly available differs significantly for each of the three crops analyzed. These differences have led to different methodologies to project the land use change associated with each of three crops considered, though all methodologies were designed to address the same issues and steps in connecting the Set Rule with potential impacts on species and habitats as shown in Figure ES.1. We provide an overview of the methodologies used to project land use change associated with increased demand for corn, soybean oil, and canola, and the results of these analyses. In Sections VII and VIII, we discuss in more detail the potential impacts on listed species and critical habitat from the estimated land use changes (Section VII), and the potential impacts on listed species and critical habitat from changes in water quality (Section VIII).

A. Corn Production Potentially Attributable to the RFS Set Rule

Before assessing the impacts of the Set Rule on ethanol production and thus corn production for the period 2023–2025, we first provide some historical context on the factors that have contributed to the growth in domestic ethanol production since the RFS program began in 2006. This historical context helps to explain why only a small portion of ethanol production (about 5%) in the 2023–2025 timeframe is reasonably certain to occur as a direct result of the standards established through the Set Rule. Specifically, but for the RFS Set Rule, the volumes of corn ethanol could be about 5% lower than those that we project will be consumed in the 2023–2025 timeframe.

As shown in Figure II.C-1, conventional renewable fuel has represented about 85% of all biofuel between 2016 and 2021. Table II.C-3 shows that the conventional renewable fuel pool is comprised of greater than 99% corn-based ethanol. Ethanol production increased significantly between 2006 and 2010, after which it increased more slowly due to constraints arising from legal limits on the amount of ethanol that can be blended into gasoline, as well as other constraints related to the vehicles permitted to use higher ethanol blends and the number of retail service stations that offer those blends. More specifically, gasoline that can be used in any vehicle or engine can contain no more than 10% ethanol. The “E10 blendwall” is the amount of ethanol that would be consumed if all gasoline contained 10% ethanol. Total ethanol use can exceed the E10 blendwall only insofar as consumers choose to buy either E15 (gasoline containing 15% ethanol, which can only be used in model year 2001 or later light duty vehicles) or E85 (fuel containing 51–83% ethanol which can only be used in flex-fuel vehicles). However, the number of retail service stations offering E15 and/or E85 has remained very low in comparison to the total number of service stations offering E10. The graph below shows that ethanol consumption has remained very close to the E10 blendwall since 2012.

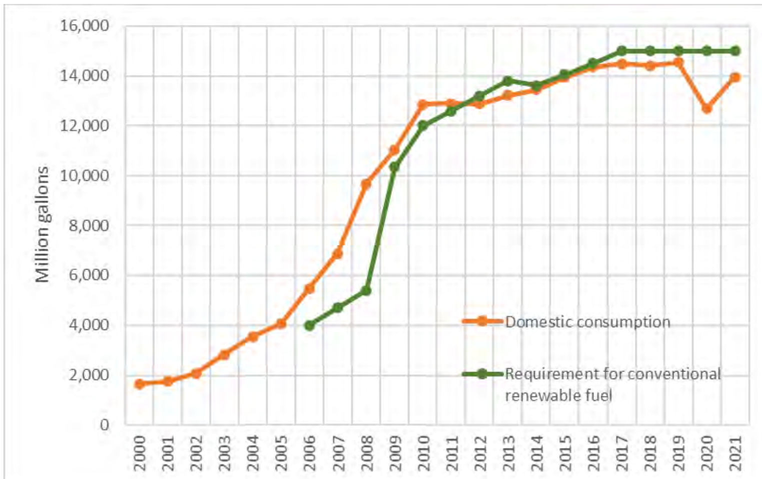
Figure VI.A-1: Historical Ethanol Production and Consumption



In more recent years, domestic ethanol production has exceeded domestic ethanol consumption in large part due to the constraints associated with the E10 blendwall. Excess ethanol production was exported to supply foreign markets.

At the same time that ethanol production and consumption were growing, Congress established the RFS program and included requirements that the use of biofuel in transportation fuel increased over time.

Figure VI.A-2: Ethanol Consumption and RFS Volume Requirement for Conventional Renewable Fuel[a]



[a] For years 2006 – 2009, there was only a single RFS volume requirement that applied to all renewable fuels. For 2010 and beyond, the values represent the implied volume requirement for conventional renewable fuel that was the basis for the applicable percentage standards.

While the growth in ethanol production over time coincided with the increase in applicable standards under the RFS program, further analysis detailed below reveals that the RFS standards were only responsible for a small portion of that growth, and that the level of growth attributable to the RFS program differed from year to year. Other non-RFS factors and drivers are responsible for most of the growth in ethanol production and consumption since 2000 (EPA, 2022a) (EPA, 2022b). Further, when looking to the future action addressed by this Biological Evaluation, the analysis demonstrates that the RFS program would likely be responsible for only about 5-6% of total ethanol production, namely that associated with consumption as E15 and/or E85; E10 would continue to be used even in the absence of the RFS program. These topics are discussed in detail in the following sections.

There are four primary sources of evidence supporting the conclusions that the increase in ethanol consumption shown in Figure VI.A-2 was not driven by the RFS program. The first source of evidence is that ethanol consumption had begun increasing before the RFS program came into existence. The Energy Policy Act which created the RFS program was enacted in August of 2005, and the first applicable regulatory requirements for the use of renewable fuel under the then-new RFS program did not go into effect until 2007. Yet by the end of 2006, ethanol consumption had already increased by about 80% relative to the 2000 level.

Second, actual consumption of ethanol exceeded the requirements of the RFS program between 2007 and 2011, often by a wide margin. Since the RFS program was intended drive increases in the use of renewable fuel in the transportation sector, one would expect that actual use of renewable fuel would be close to the applicable standards if the RFS program was operating in this way. The fact that actual consumption exceeded the applicable standards means that the RFS program was not driving consumption. Instead, it was factors other than the RFS program that were driving consumption.

Third, the price of RINs, the currency of the RFS program and the means through which refiners demonstrate compliance with the RFS standards, were very low until 2013.

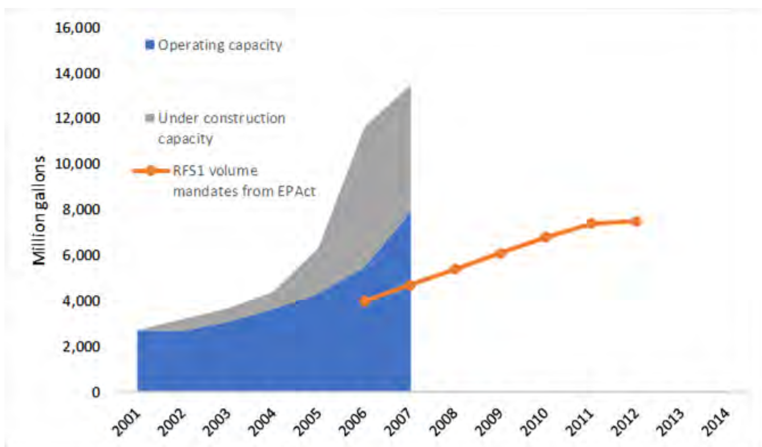
Figure VI.A-3: Historical weekly RIN prices for conventional renewable fuel[a] (predominantly corn ethanol in $/gal)

Source: OPIS (2010-2022) and the EPA-Moderated Transaction System (EMTS) (2010-2022)
[a] RINs representing conventional renewable fuel are designated as having a D code of 6 ("D6") in the RFS regulations, to distinguish them from RINs representing cellulosic biofuel (D3 and D7), biomass-based diesel (D4) and advanced biofuel (D5).

RIN prices represent the difference between the supply and demand given all available subsidies, the availability of carryover RINs from previous years, and any other market and policy factors. Not only do RINs operate as the currency of the RFS program, but they are also the means through which biofuel production and consumption is incentivized. When RIN prices are near zero, the RFS program is providing no additional incentive to the market to use biofuels, and the RFS is said to be non-binding. In reality, RIN prices are never precisely zero, as all parties who own or trade RINs must expend resources (e.g., employee time) in meeting the regulatory recordkeeping and reporting requirements as well as transaction cost incurred in trading RINs. When RIN prices are above these transactional costs of several cents per RIN, the RFS is said to be binding, which means that the RFS program may be at least partly responsible for the ethanol consumption in that year. Higher RIN prices in recent years are primarily a function of the total renewable fuel standard being met with renewable fuel that also qualifies advanced biofuel. These advanced biofuels have generally be used to meet the total renewable fuel standard due to limited ability for market factors (including high RIN prices) to incentivize the use of ethanol blends containing greater than 10% ethanol. Because greater incentives are needed to increase the use of advanced biofuels as well as ethanol blends containing greater than 10% ethanol, the RIN prices associated with increasing volumes of these fuels are higher. Thus, the higher RIN prices are primarily due to the higher RIN prices for the marginal gallon of conventional renewable fuel.

Finally, ethanol production capacity in the early years of the RFS program far exceeded what would have been needed to meet the original RFS volume requirements, often referred to as RFS1.[8]

Figure VI.A-4: Ethanol Production Capacity Though the End of 2007



The Energy Independence and Security Act (EISA), which established the RFS2 Program, was enacted in December of 2007. Thus prior to this date, investors would only have had the RFS1 volume requirements on which to base their investment decisions, and could not have based decisions to invest in new ethanol production facilities on the RFS2 volume requirements as they did not yet exist. Nevertheless, new construction rose dramatically in the years prior to and including 2007 to levels far above the highest level promised under RFS1; the 2012 requirement under RFS1 was 7.5 billion gallons, while the sum of operating and under construction capacity at the end of 2007 was 13.4 billion gallons. This suggests that investors were responding to future outlooks for ethanol demand that were based on factors beyond the RFS1 standards.

The remainder of this section discusses the various market factors other than the RFS program that likely contributed to the increased use of ethanol after 2006, the factors we believe will drive ethanol use in the near future, and the associated impacts of all factors on corn growth.

[8] That is, the RFS volume targets for 2006 - 2012 established in the Energy Policy Act of 2005.

1. Factors Contributing to Increased Ethanol Production in the Past

While there is a clear correlation between the applicable RFS standards and historical ethanol production as shown in Figure VI.A-2, this correlation does not indicate that the RFS standards were entirely responsible for the increase in ethanol. There were also multiple other factors that contributed to the increase in ethanol production, particularly in the early years of the RFS program when growth in ethanol was highest, i.e. 2006–2010. These factors include:

- The phaseout of methyl tertiary butyl ether (MTBE) as a gasoline additive
- Other federal programs which required or otherwise incentivized the use of ethanol in gasoline, such as the reformulated gasoline (RFG) program and the oxygenated fuels (Oxyfuels) program
- Increases in crude oil prices
- The federal excise tax credit for ethanol
- State ethanol mandates and programs that incentivized the use of ethanol in gasoline
- State tax incentives for ethanol and grants for constructing new ethanol facilities
- The value of ethanol as a low-cost contributor to the octane rating of gasoline

What follows is a summary of the most important of these factors. A more detailed discussion of each of these factors and how they have affected renewable fuel production can be found in the draft Third Biofuels Report to Congress, released on December 15, 2022, and in the Draft Regulatory Impact Analysis associated with the proposed standards under the RFS program for 2023–2025 (US EPA Center for Public Health & Environmental Assessment & Clark, 2023) (EPA, 2022a).

MTBE phaseout

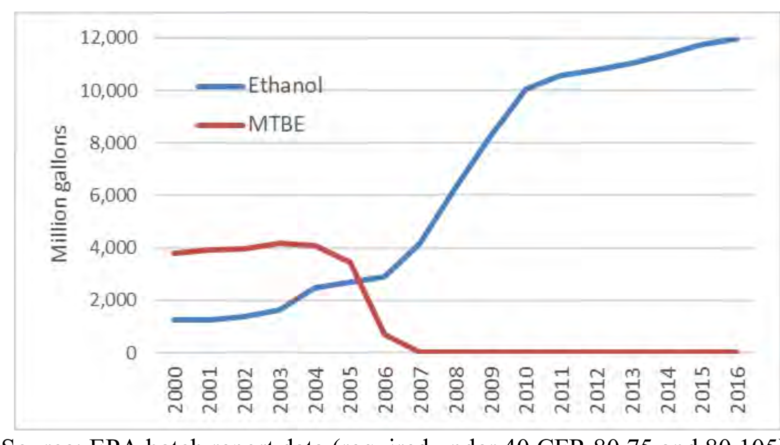
In the years leading up to enactment of the Energy Policy Act (EPAct) of 2005, which established the RFS program, MTBE was the preferred oxygenate because it was less expensive than ethanol on a volumetric basis, could be shipped in pipelines, and had no impact on the Reid Vapor Pressure (RVP) of gasoline.[9] However, concern at the time was growing about the environmental effects of MTBE, specifically groundwater contamination resulting from leaking underground storage tanks. The California Air Resources Board (CARB) made a formal request to EPA in 1999 for a waiver from the requirement to use oxygenates in reformulated gasoline. The governor of California issued an executive order in March 1999 to ban MTBE in the state's gasoline by the end of 2002; and, by 2000, the replacement of MTBE by ethanol was underway in California. By the end of July 2005, before the passage of the Energy Policy Act in August, 17 states had some form of partial or complete ban on MTBE use. These states represented 41% of the domestic gasoline consumption in 2005. From 2001-2005, domestic ethanol production increased from 1.8 to 3.9 billion gallons per year. This rate was over five times the annual average rate from the previous two decades and was driven in large part by the move away from MTBE.

[9] Oxygenates are any hydrocarbon fuels which also contain oxygen as part of the molecular structure, and which can be blended into gasoline. The most common oxygenates are alcohols and ethers. They generally help fuels to combust more thoroughly.

At the federal level, multiple bills banning MTBE were considered by Congress, but none were ultimately adopted. At the same time, Congress also considered providing liability protection for refiners using MTBE under the premise that refiners had no choice but to use an oxygenate in the RFG and Oxyfuels Programs, and that the EPA had implicitly approved of the use of MTBE as an oxygenate given that MTBE was the most widely available and often the least expensive oxygenate available when the RFG program was originally implemented. The potential for some sort of liability protection, as well as the lack of sufficient infrastructure for distributing and blending ethanol to coastal urban areas during this period, may have encouraged refiners to continue using MTBE despite state bans and concerns expressed by the EPA and the public.

The Energy Policy Act of 2005, which included the RFS program along with many other provisions, was signed into law on August 8, 2005, and effectively (though not by mandate) ended all use of MTBE in gasoline. Although the EPAct did not include a nationwide ban on the use of MTBE as had previous bills that Congress considered, neither did it include any form of liability protection that had been sought after by refiners who blended MTBE into gasoline. Instead, EPAct eliminated the oxygen requirement for federal RFG and created the RFS Program. Although the oxygen requirement for RFG was removed, the emission standards were neither eliminated nor modified, and the use of an oxygenate continued to be the most economical way to meet those emission standards. The combination of these changes in the EPAct, in addition to the lack of any explicit or implicit liability protection, meant that refiners had little incentive to continue using MTBE. Alternatives to MTBE existed in the form of different ethers and alcohols, but many such alternatives also raised water quality concerns. As a result, refiners eliminated their use of MTBE and instead began using ethanol to meet their various obligations under the RFG, oxyfuels, and other fuels programs. The result was that MTBE use in federal RFG areas outside California dropped by nearly 80% between 2005 and 2006, while the use of ethanol increased dramatically in the same timeframe.

Figure VI.A-5: Consumption of MTBE and ethanol in all gasoline outside of California



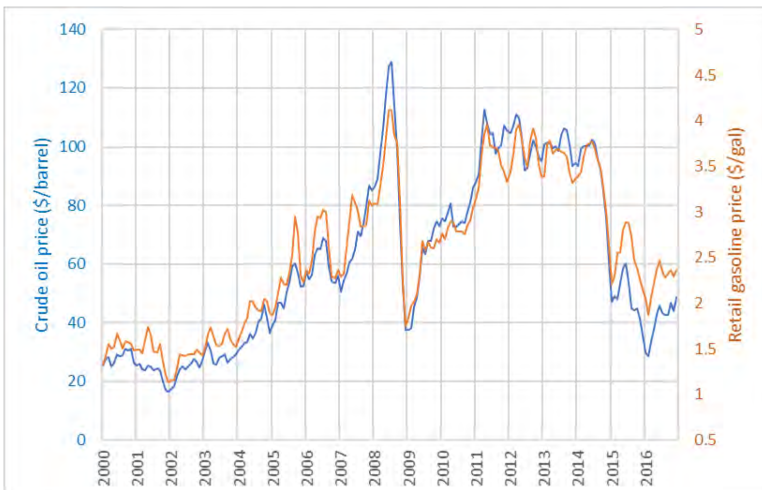
Source: EPA batch report data (required under 40 CFR 80.75 and 80.105).

Notably, the first year in which a regulatory requirement for the use of biofuel existed under the RFS program was 2007, after most of the transition from MTBE to ethanol had occurred. Thus the increase in ethanol consumption which occurred between 2000 and 2006, shown in Figure VI.A-2, can be attributed primarily to the phaseout of MTBE.

Crude oil prices

Oil prices have complex and important associations with many kinds of economic activity, including gasoline, ethanol, and corn production. This dynamic has implications for the economics of ethanol as an additive to gasoline: it becomes cheaper to make gasoline with ethanol than gasoline without ethanol as crude oil prices, and thus gasoline prices, increase relative to ethanol. Thus, as crude oil prices increased, ethanol as E10 became more attractive by comparison.

Figure VI.A-6: Historical Prices of Crude Oil and Gasoline



Source: Energy Information Administration

Crude oil prices began increasing noticeably in 2004 after many years of being relatively low. Gasoline prices followed in tandem, rising as the global economy rapidly expanded before crashing with the financial crisis of 2008–2009. Accordingly, during the years between 2004 and 2008, ethanol became increasingly attractive as a result of rising gasoline prices. Market inertia and refiners' increasing reliance on ethanol to boost the octane of gasoline are at least partly responsible for the fact that ethanol use did not fall coincident with the drop in crude oil prices in 2008 and 2009. Thereafter, crude oil prices increased again until 2014 when crude oil prices dropped again and remained lower than the previous year levels. However, by this time, the nationwide gasoline pool was essentially all E10 and the infrastructure, contract agreements, and refinery operations had all become oriented towards supplying E10. As a result, changes in crude oil prices after about 2014 had little impact on the use of ethanol as E10.

State mandates and incentives

Several states implemented mandates for the use of ethanol in the same time frame that ethanol consumption nationwide was increasing.

Table VI.A-1: State Mandates for the Use of Ethanol[a]

State	Blend Requirement	First Applicable Year	Last Applicable Year
Minnesota	10%[b]	1997	Still in effect
Hawaii	10%[c]	2006	2015
Oregon	10%	2007	Still in effect
Missouri	10%	2008	Still in effect
Washington	2%	2009[d]	Still in effect
Florida	10%	2011	2013

[a] Does not include biodiesel mandates or mandates for ethanol use in state vehicle fleets.
[b] Between 1997 and 2002, the Minnesota requirement was 2.7wt% oxygen and was not specific to ethanol. Nevertheless, ethanol was the primary oxygenate used. Between 2003 and 2012, the requirement was for 10vol% ethanol. For 2013 and thereafter, the requirement was for 10vol% "conventional biofuel," of which ethanol was the primary option available.
[c] This requirement applied to 85% of gasoline sold in Hawaii.
[d] Actual start date was 12/1/2008.

Most of these state ethanol requirements included some exemptions such as for aviation gasoline, gasoline used in nonroad and marine engines, and/or premium gasoline.

Additionally, a variety of state programs provided some form of economic incentive to build or expand corn ethanol production facilities between 2005 and 2018. These programs included grants, loans, tax credits, and rebates of varying sizes and applicability, with various beginning and ending dates. These state programs were legally independent of the RFS Program and may have been implemented even if the RFS Program had not existed. Thus, they may have helped to expand ethanol production capacity.

Table VI.A-2: State incentives for corn ethanol production

State	Title	Type
AL	Agriculturally Based Fuel Production Wage and Salary Tax Credit	Tax credit/exemption
AR	Biofuels Industry Development Grants	Grant
AR	Biofuels Production Incentive	Rebate
CA	Alternative Fuel Production Tax Credits	Tax credit/exemption
FL	Ethanol and Biodiesel Fuel Production Grant	Grant
GA	Ethanol Motor Fuel Production Tax Credit	Tax credit/exemption
GA	Ethanol Production Investment Tax Credits	Tax credit/exemption
IA	Ethanol Production Incentive	Tax credit/exemption
IA	Biofuel Production Facility Tax Credit	Tax credit/exemption
IA	Ethanol Production Incentive	Tax credit/exemption
IL	Alternative Fuel Grants and Rebates	Grant/rebate
IL	Alternative Fuel Loan Program	Loan
IL	Alternative Fuel Production Tax Credit	Tax credit/exemption
IN	Alternative Fuel Production Facility Tax Exemption	Tax credit/exemption
KS	Biofuels Production Tax Credit	Tax credit/exemption
KY	Ethanol Production Tax Credit	Tax credit/exemption
ME	Ethanol Production Tax Credit	Tax credit/exemption
MN	Alternative Fuel Production Loans	Loan
MN	Biofuel Production Facility Tax Credit	Tax credit/exemption
MS	Renewable Fuel Production Facility Tax Credit	Tax credit/exemption
NC	Biofuels Production Tax Exemption	Tax credit/exemption
NC	Biofuels Production Incentive	Grant
ND	Ethanol Production Incentive	Rebate
OH	Alternative Fuel Development and Deployment Grants	Grant
OR	Biofuels Production Tax Credit	Tax credit/exemption
PA	Renewable Energy Property Tax Credit	Tax credit/exemption
PA	Biofuels Investment Tax Credit	Tax credit/exemption
TN	Alternative Fuel Production Tax Incentives	Tax credit/exemption
TX	Biofuels Production Facility Grants	Grant
TX	Biofuels Business Planning Grants	Grant
TX	Ethanol Production Incentive	Rebate
WA	Renewable Fuel Production Grants	Grant
WA	Biofuels Production Incentive Fund	Loan

Source: U.S. Department of Energy (DOE), Alternative Fuels Data Center

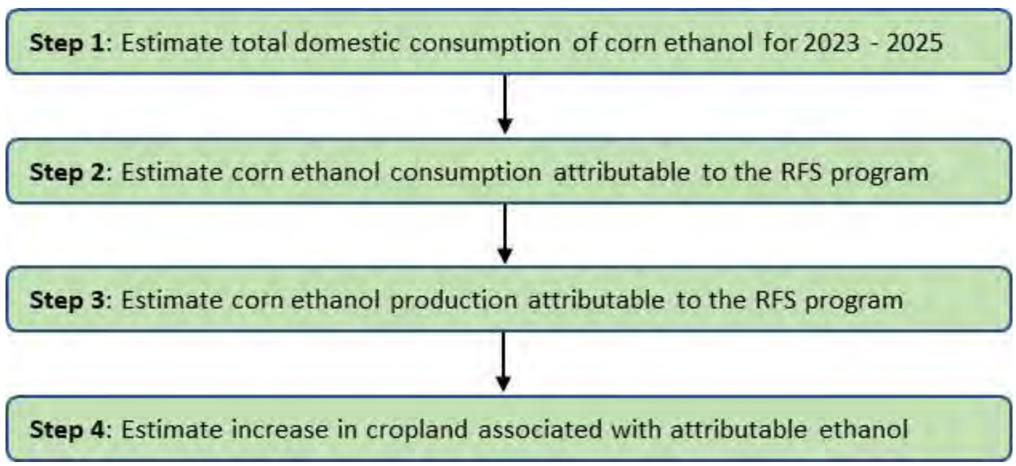
Finally, California's Low Carbon Fuel Standard (LCFS) program was legislated in 2007 but did not go into effect until 2011. Beginning in 2011 the LCFS requires that the average carbon intensity of gasoline decrease each year. Ethanol is one means of meeting the applicable requirements, and thus the LCFS provides an additional incentive to use ethanol.

In summary, the vast majority of ethanol consumption has been driven by factors other than the RFS program in past years. Many of these factors are expected to continue into the 2023–2025 timeframe for which standards will be established through the RFS Set Rule and which are the focus of this Biological Evaluation. As a result, the vast majority of ethanol consumption in the 2023–2025 timeframe is expected to continue to be driven by these other factors rather than by the Set Rule.

2. Potential Impacts of the RFS Set Rule on Ethanol Production

Our estimation of the impacts of future ethanol production attributable to the standards established through the Set rule on species and habitat is complicated by a multitude of factors as discussed in detail in Appendix A. Our assessment of the impact of potential increased corn ethanol consumption attributable to the Set Rule begins with estimating the total increase in cropland attributable to increased corn ethanol consumption (See Figure ES.1). Figure VI.A-7 provides and illustration of the steps we have taken to estimate the increase in total cropland due to the increase ethanol consumption attributable to the Set Rule.[10]

Figure VI.A-7: Process for Estimating Impacts of Corn Ethanol on Cropland



Note that the end result of this process is an estimate of national-level cropland changes that may occur as a result of the Set Rule. Following this process we estimate the potential overlap with critical habitats and species ranges, and then finally make a determination as to whether that potential overlap may have any negative impacts.

This Section VI.A.2 addresses Steps 1 through 3. Section VI.A.3 provides some additional historical context about the relationship between corn production and ethanol production prior to addressing Step 4 in Section VI.A.4. Section VI.A.5 addresses some of the uncertainties associated with estimating the amount of corn production that can be attributed to the RFS program.

[10] Figure VI.A-7 differs from Figure 1 in Appendix A because they represent two different perspectives on the connection between the applicable standards under the RFS program and impacts on species and habitat. Figure VI.A-7 provides an overview of the methodology that was used to make quantified estimates of the impact of the RFS standards in the Set Rule on cropland for the purposes of this Biological Evaluation. Figure 1 in Appendix A, in contrast, provides a more comprehensive picture of all the factors that affect ethanol consumption in addition to the applicable standards under the RFS program, and is used only in a qualitative fashion.

The proposed volume requirements for 2023 through 2025 include an implied volume requirement for conventional renewable fuel that is slightly higher than in previous years. For 2017–2022, EPA established an implied volume requirement of 15 billion gallons.[11,12] For 2023–2025, the implied volume requirement is proposed at 15.25 billion gallons (US EPA, 2022a). However, as for previous years, not all of this volume is expected to be comprised of corn ethanol. Actual corn ethanol consumption in the near future is expected to be a function not of the implied volume requirement for conventional renewable fuel, but rather of total gasoline consumption and trends in the number of retail stations offering E15 and E85; in general terms, ethanol consumption is closely tied to the E10 blendwall. As a result, actual corn ethanol consumption will very likely be considerably lower than 15.25 billion gallons, with other renewable fuels, primarily biodiesel, making up the difference between that 15.25 billion gallon target and the E10 blendwall.

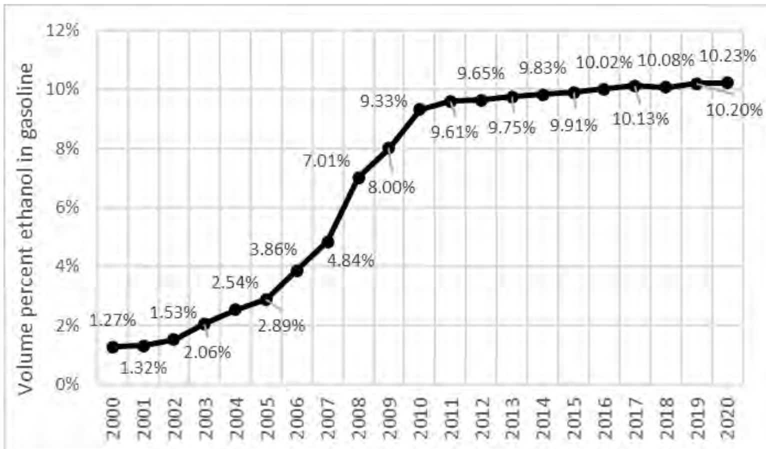
As discussed above, growth in the use of E15 and E85 has been fairly slow. Higher consumption of E15 has been limited in the past by availability of terminals where it can be blended and legal concerns on the part of retail station owner regarding liability for misfueling (the use of higher ethanol blends in vehicles or engines not designed for them), as well as retail infrastructure limitations. Higher consumption of E85 has been limited in the past by limited sales of flex fuel vehicles (FFVs) and consumers consistently choosing to refuel with E10 rather than E85. But the most significant constraint for both E15 and E85 sales has been the relatively small number of retail stations that offer them.

As shown in Figure VI.A-1, growth in ethanol consumption slowed dramatically as it approached the E10 blendwall. The nationwide average ethanol concentration, based on the total volumes of ethanol and gasoline consumption from EIA, makes this effect even more evident.

[11] 2021 was an exception. Since the applicable standards were set in 2022, the implied volume requirement for 2021 was set at the level that was actually consumed in 2021. Also, while the 2020 implied volume requirement was originally set at 15 billion gallons [see 85 FR 7016 (February 6, 2020)] it was revised downward in 2022 to the level of actual consumption [see 87 FR 39600 (July 1, 2022)].

[12] For 2022, the applicable standards included a "supplemental standard" of 250 million gallons intended to address a court remand of the 2016 standards. While the implied conventional renewable fuel volume requirement was technically 15 billion gallons for 2022, the inclusion of the supplemental standard meant that the volume requirement was effectively 15.25 billion gallons for 2022. This is also true for the 2023 standards.

Figure VI.A-8: Nationwide Average Concentration of Ethanol in Gasoline



Source: EIA's Monthly Energy Review

The annual increase in the average ethanol concentration slowed considerably after 2010 as it approached 10.00%. Ongoing increases in the use of E15 and E85 have brought the average ethanol concentration above 10.00% in recent years, but their use continues to be constrained by limited offerings at retail. In the near future, we expect the annual rate of increase in the nationwide average ethanol concentration would be similar to what it has been in recent years, and thus might reach about 10.5% by 2025.

For the purposes of a Biological Evaluation, the impact of a federal action is determined in part by assessing what would occur in the absence of that action as a means to identify the consequences that would not occur but for the proposed federal action. Or, as expressed by 50 C.F.R. §§ 402.2 and 402.17, a particular consequence must be "reasonably certain to occur" for it to be caused by the agency action under review. As illustrated above, the absence of the RFS program or the Set Rule would not mean the absence of ethanol in our nation's fuel. Most of the factors contributing to the historical use of ethanol (as detailed in Section V.A.1) would continue in the future, even were the RFS program to cease to exist or EPA not to adopt the Set Rule. In addition, market inertia would likely drive the continued use of ethanol at nearly current levels absent the RFS program, at least in the short term. In the absence of the RFS program, any attempt to reduce the use of ethanol would incur additional costs to switch back to producing finished gasoline (E0) rather than blendstocks for oxygenate blending (BOBs) for E10. Furthermore, refiners would have to not only replace the lost volume but also adjust their refining operations to produce gasoline that meets the minimum octane and emissions requirements, without the addition of ethanol. While refiners could likely produce some quantity of E0 gasoline using existing equipment, recent refinery modeling conducted by MathPro on behalf of EPA concluded that if ethanol were removed from the entire conventional gasoline pool, refiners would have to invest significant capital in some combination of alkylation, isomerization, and reforming units to meet the minimum octane requirements for gasoline (US EPA, 2018). There would also be costs associated with making the necessary adjustment to the distribution system to accommodate larger volumes of E0 in a system that is currently oriented towards E10. Given such economic dynamics, we expect that most parties would seek to avoid these additional costs and instead continue supplying E10.

Modeling conducted by MathPro and internal EPA analyses have confirmed that the market would continue supplying E10 in the future even if the RFS program were to cease to exist (US EPA, 2022b). Sales and consumption of higher level ethanol blends, such as E15 and E85, would fall significantly, most likely to levels dictated by the incentives and requirements of other state and local requirements. Small volumes of E0 would continue to be produced to meet the demand from, for instance, owners of recreational marine engines whose concerns about engine damage compel them to seek out and pay a premium for ethanol-free gasoline. This small volume of E0 would mean that the nationwide average ethanol concentration in gasoline would be slightly less than 10%; in the Set Rule proposal analysis of the "No RFS" baseline we estimate it to be 9.95% (US EPA, 2022e).[13]

As shown in the table below, in comparison to projected future ethanol concentrations under the RFS program, we estimate that the RFS program would be responsible for 5-6% of ethanol consumption in the 2023–2025 timeframe.

Table VI.A-3: Fraction of Ethanol Consumption Attributable to the RFS Program

	Average ethanol concentration of all gasoline		Approximate fraction of ethanol consumption attributable to the RFS program[a]
	Under the RFS program	If the RFS program ceased to exist	
2023	10.44% [b]	9.95%	4.82%
2024	10.49% [b]	9.95%	5.30%
2025	10.53% [b]	9.95%	5.76%

[a] This approximation is based on the simple difference between the % ethanol in the previous two columns. A more accurate value would include the influence of the change in total gasoline consumption if some ethanol is removed from the gasoline pool. However, the difference is very small.
[b] EPA projection provided in the Set Rule proposal

Note that a scenario in which the RFS program ceased to exist in the future is not the same as a scenario in which the RFS program had never existed. If the RFS program had not been instituted by EPAct of 2005 it is possible but not reasonably certain that ethanol consumption would have risen more slowly or may not have reached a poolwide average ethanol concentration of 10%, other factors driving ethanol consumption notwithstanding.

The fraction of ethanol consumption attributable to the Set Rule shown in Table VI.A-3 can be translated into volumes of ethanol consumption. The corresponding volumes of ethanol are shown below. The estimation of these ethanol consumption volumes complete Step 2 of Figure VI.A-7.

[13] Specifically, see Table VI.G-1, footnote b, on page 80629. The presence of 2,128 mill gal of E0 brings the poolwide average denatured ethanol concentration down from 10.1% to 9.95%.

Table VI.A-4: Volume of Ethanol Consumption Potentially Attributable to the Set Rule[14]

	Approximate fraction of ethanol consumption potentially attributable to the RFS program	Total estimated ethanol consumption (mill gal)	Volume of ethanol consumption potentially attributable to the RFS program (mill gal)
2023	4.82%	13,974 [a]	673
2024	5.30%	14,128 [a]	748
2025	5.76%	13,978 [a]	805

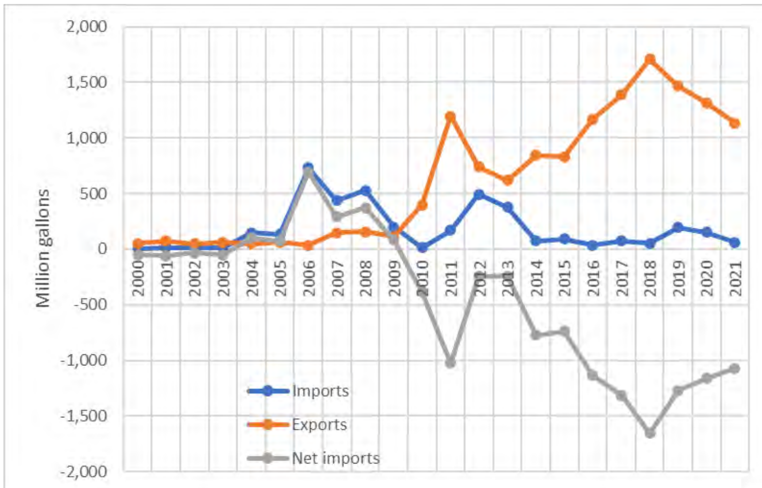
[a] EPA projection provided in the Set Rule proposal

We note that though the total volumes of ethanol consumption potentially attributable to the RFS program range from 673–805 million gallons from 2023–2025 the total estimated ethanol consumption volumes for 2023–2025 are approximately equal to total ethanol consumption in 2022, and significantly less than total ethanol production in 2022. According to the EIA Monthly Energy Review, U.S. ethanol production in 2022 was 15.37 billion gallons, and ethanol consumption was 13.98 billion gallons. This suggests that the renewable fuel volumes we are finalizing for 2023–2025 could likely be met with little or no additional ethanol production (and thus little to no conversion to cropland resulting from additional ethanol production) relative to 2022 levels.

While the EPA's actions to set standards for 2023–2025 would likely result in some consumption of ethanol higher than what would occur in the absence of the RFS program, those incremental volumes of consumption do not necessarily translate into equivalent volumes of production. Domestic ethanol production serves both domestic and foreign markets, and ethanol exports were considerably higher in 2021 than they were when the RFS program began in 2006.

14 The top-down methodology followed to determine these values likely results in a over-estimate of the volumes of ethanol consumed as E15 and E85. For example, a bottom-up estimate provided in Chapter 10.4.2 of the RIA for the final Set Rule yields an estimate of 383 million gallons of ethanol for 2025.

Figure VI.A-9: Imports and Exports of Ethanol



Source: EIA

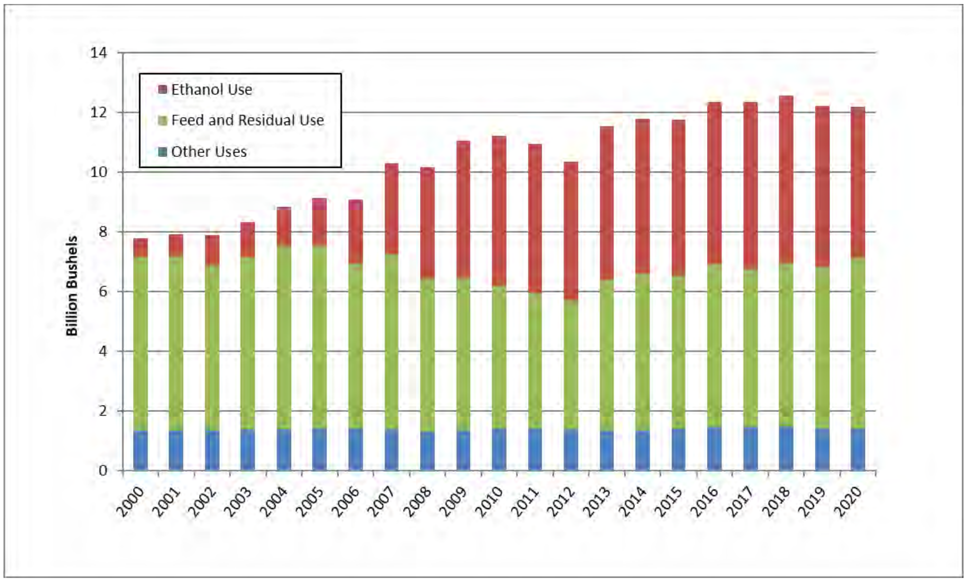
Ethanol exports are driven by two factors: foreign demand and domestic production in excess of domestic demand. Foreign demand is primarily a function of biofuel mandates and incentives in other countries and the relative economics of ethanol as a source of octane, while excess domestic production is a function of domestic production capacity and domestic consumption of ethanol. Insofar as domestic consumption of ethanol falls below production capacity, as has been the case historically and is expected to be the case through 2025, there is an incentive to find alternative markets in which to sell ethanol. This incentive increases if domestic demand falls. Thus, we estimate if the RFS program were to cease to exist, domestic consumption of ethanol would fall by the amounts shown in Table VI.A-4 and ethanol producers could be expected to seek to increase exports to offset the loss of domestic sales.

Exports of ethanol are difficult to project. However, it seems likely that at least a portion—and possibly all—of the ethanol volumes attributable to the Set Rule (Table VI.A-4) would continue to be produced and exported even if the RFS program were to cease to exist. As a result, ethanol production would most certainly change by an amount lower than the volumes in Table VI.A-4, and may possibly not change at all. Nevertheless, for the purposes of quantifying potential impacts in this Biological Evaluation, we have chosen to use the conservative assumption that the change in ethanol production that is potentially attributable to the Set Rule is identical to the change in ethanol consumption shown in Table VI.A-4. This assumption very likely overestimates the impact of the Set Rule on ethanol production. The estimation of these ethanol production volumes complete Step 3 of Figure VI.A-7.

3. Historical Corn Production and Ethanol Production

As the production of ethanol from corn increased over the last 20 years, production of corn also increased.

Figure VI.A-10: U.S. Corn Production and Portion Used for Fuel Ethanol, Feed, and Other Uses



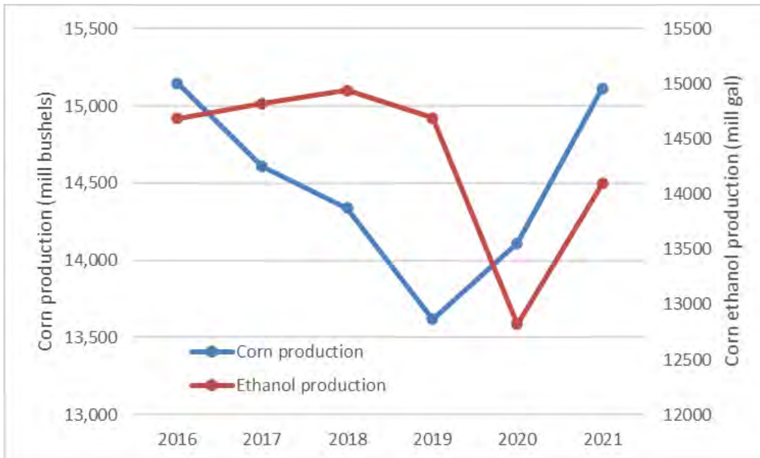
Source: DO"s Alternative Fuels Data Center (afdc.energy.gov/data. Original data taken from United States Department of Agriculture, Economic Research Service, Feed Grains Yearbook (ers.usda.gov/data-products/feed-grains-database/feed-grains-yearbook-tables)

However, during the period 2007–2012 when ethanol production increased most dramatically, corn used for non-ethanol purposes actually decreased. This observation suggests a shift in the corn market during this period, such that increases in ethanol production did not directly correspond to equivalent increases in corn production. Part of the reason could be that the production of ethanol also results in the production of distillers grains as a byproduct, and distillers grains are used as animal feed. Thus while whole corn used as animal feed may have decreased, the use of distillers grains as animal feed increased. The net result is that increased production of ethanol had a considerably smaller impact on the animal feed market than this graph might suggest.[15]

In more recent years, a correlation between ethanol production and corn production is even less evident.

[15] Distillers grains does not have precisely the same caloric content or nutritional value as whole corn, and farmers undoubtedly made other changes to animal feed mixes that could also have affected corn and other commodity markets.

Figure VI.A-11: Ethanol and Corn Production in Recent Years



Source for corn production: USDA Economic Research Service
Source for ethanol production: EP"s EPA Moderated Transaction System

If changes in ethanol production were directly correlated with corn production, we would expect to see them rise and fall in tandem. While this did seem to occur in 2019 and 2021, it did not occur in 2017, 2018, or 2020. These counterintuitive interactions are very likely the result of multiple factors affecting corn production in addition to ethanol production, and highlight the difficulty in determining whether and to what degree the ethanol volume changes shown in Table VI.A-4 would lead to changes in corn production. Notably, a number of researchers have attempted to estimate the impact that a change in ethanol production would have on corn production. As noted in Thompson et al., the range of outcomes is broad: one billion gallons of additional ethanol production would lead to between 0 and 110 million bushels of corn production (Food and Agricultural Policy Research Institute at University of Missouri, 2016).

4. Potential Impacts of Future RFS Standards on Corn Production and Land Use

This Section addresses Step 4 in Figure VI.A-7.

To the degree that the Set Rule, especially the annual required volumes for 2023–2025 analyzed by this Biological Evaluation may be responsible for a portion of total ethanol production, the next steps in the causation analysis are whether and to what degree corn production and the associated land use would also be affected.

As a bounding exercise prior to the investigation of a more accurate approach as discussed later, we start by estimating the area that would be impacted if the volumes shown in Table VI.A-4 are produced from corn grown entirely on newly planted acres in the U.S.

$$Million\ acres = (X\ mill\ gallons) \times \left(\frac{bushel}{Y\ gallons}\right) \times \left(\frac{acre}{Z\ bushel}\right) \qquad \text{Eq. 1}$$

This approach likely generates an unreasonably high estimate as there is substantial evidence indicating that a large share of the ethanol is produced from corn grown on existing cropland, and it does not account for changes in ethanol exports or diversion of corn from food/feed to ethanol production.

The values for X, Y, and Z are specific to each calendar year. The values for X are provided in Table VI.A-4. Moreover, the values for Y vary by ethanol production facility and the values for Z vary by county, but for the purposes of this assessment we have used the nationwide averages. The derivation of the values for Y and Z are provided in the two tables below.

Table VI.A-5: Ethanol Production Yield Estimates (term Y in Equation 1)

	Corn used to make ethanol (mill bushels)	Ethanol production (mill gal)	Ethanol yield (gal/bushel)
2023	5,462	15,822	2.90
2024	5,473	15,867	2.90
2025	5,493	15,910	2.90

Source: U.S. Agricultural Market Outlook, University of Missouri (March 2022)

Table VI.A-6: Crop Yield Estimates (term Z in Equation 1)

	Corn production (mill bushels)	Acres harvested[a] (mill acres)	Crop yield (bushel/acre)
2023	15,377	84.7	181.4
2024	15,739	85.7	183.6
2025	15,858	85.3	185.8

[a] Acres harvested are used in this calculation rather than acres planted to be consistent with the approach taken in the source data.
Source: U.S. Agricultural Market Outlook, University of Missouri (March 2022)

Using the values from Tables VI.A-4, VI.A-5, and VI.A-6, the maximum possible harvested corn land use impact of the action addressed in this Biological Evaluation can be estimated as shown below.

Table VI.A-7: Maximum Possible Direct Impact on Corn Acreage

	Volume of ethanol (X) (mill gal)	Ethanol production yield (Y) (gal/bushel)	Crop yield (Z) (bushel/acre)	Million acres
2023	706	2.90	181.4	1.3
2024	776	2.90	183.6	1.5
2025	840	2.90	185.8	1.6

This approach yields the maximum possible direct impact of ethanol production volumes on corn cropland that could possibly be attributable to the RFS program's Set Rule. At the same time, it does not take into account the complex interactions between different commodities and markets, nor does it include the indirect effects of cropland changes that may be driven by changes in corn prices. Some studies have investigated these other interactions, and they provide a more accurate way to estimate the impacts that the ethanol volumes shown in Table VI.A-4 would have on cropland. Rather than using the values estimated in Table VI.A-7 based on the simple but intuitive Equation 1 above, we have chosen to use the results from these more comprehensive studies for purposes of this Biological Evaluation.

As reviewed in the Draft Third Triennial Report to Congress on Biofuels, the most robust estimate available to date for the effect on corn ethanol production on corn acreage and cropland is from Li et al. (2019). This is the only study available to date using empirical data that explicitly separated the price effect from the ethanol effect on the estimates of land use change. Li et al. (2019) analyzed historical data to estimate the impact that a change in ethanol production volume might have on acres of corn or total crops planted (Li et al., 2018). That study separately investigated the impacts of increases in ethanol production volume on the need for more corn cropland, and also the impacts of changes in corn price on changes in total cropland (i.e., changes in cropland for other crops caused by the changes in corn). For the nation as a whole, that study concluded with the factors shown below.

Table VI.A-8: Effects of Changes in Cropland per Li et al. (2018)

		Corn cropland	Total cropland
Impacts of increases in ethanol production volumes	Acres per mill gal ethanol	884	599
Impacts of changes in corn prices	Acres per dollar	2,532	n/a
Impacts of changes in crop price index	Acres per index point	n/a	4,484

However, the impacts of corn price were modeled separately from, and thus are independent of, estimated impacts from changes in ethanol production volumes.

The 2018 Li study used data from 2003–-2014. Subsequently, the same research team repeated the analysis with additional data covering 2003–2018 (RTI International & Kahanna, 2021). Kahanna et al. found that the addition of more recent data resulted in a smaller impact of ethanol production on corn acreage and resulted in the impact of ethanol production on total cropland being not statistically different from zero. Thus the Kahanna analysis appears to conclude that increases in corn cropland have not resulted in increases in total cropland in the past. This could occur if farmers produced more corn by using their existing cropland differently, for instance reducing acres devoted to wheat or cotton while increasing acres devoted to corn.

Kahanna also investigated the impacts of corn price changes on cropland, but as with Li did not associate those price changes directly with changes in ethanol production volume. In its draft Third Triennial Biofuels Report to Congress, EPA extended the Li et al. (2019) analysis to associate the changes in corn and crop price with changes in ethanol volume (US EPA Center for Public Health & Environmental Assessment & Clark, 2023). Doing so enabled EPA to estimate the indirect impact of increases in ethanol production volume on cropland as mediated through the influence that those ethanol volumes have on corn and crop prices. The result is a more comprehensive representation of land use changes resulting from increases in ethanol production, with the direct impacts of ethanol volumes and the indirect impacts of corn prices being additive. The resulting factors are shown below, with the indirect effects of corn price converted into the same units as the direct ethanol production volume effects.

Table VI.A-9: Effects of Changes in Cropland per Kahanna et al. as Modified by EPA

		Corn cropland	Total cropland
Direct impact of increases in ethanol production volumes	Acres per mill gal ethanol	730	0
Indirect impact of increases in ethanol production volumes as mediated through changes in corn prices (for corn cropland) or crop price index (for total cropland)	Acres per mill gal ethanol	360	570

Based on this analysis, the ethanol volumes potentially attributable to the RFS program would have the cropland impacts shown below.

Table VI.A-10: Estimated Impact on Corn Acreage and Cropland Using Factors Derived by EPA (million acres)

	Volume of ethanol consumption attributable to the RFS program (mill gal)[a]	Corn cropland		Total cropland	
		Through ethanol volumes	Through corn prices	Through ethanol volumes	Through crop prices
2023	706	0.52	0.27	0	0.39
2024	776	0.57	0.27	0	0.44
2025	840	0.62	0.27	0	0.46

[a] From Table V.A-4

The estimated corn cropland impacts from Khanna (as modified by EPA) represent 1% or less of all corn acres planted as shown below.

Table VI.A-11: Fraction of Corn Acres Planted that Could Be Attributed to the RFS Program

	Total planted (million acres)[a]	Sum of direct and indirect corn land attributable to RFS (million acres)	Fraction
2023	92.9	0.79	0.9%
2024	93.9	0.84	0.9%
2025	93.5	0.89	1.0%

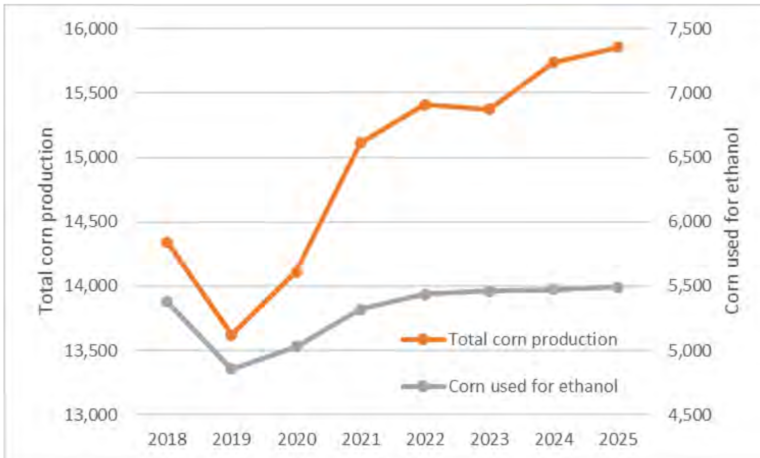
[a] Source: U.S. Agricultural Market Outlook, University of Missouri (March 2022)

As shown in Table VI.A-10, the estimates based on Khanna are that each billion gallons of corn ethanol increases cropland by 0.57 million acres in 2023–2025. As a point of comparison, we also considered estimates of land use change caused by increasing biofuel production to estimates form a recent study (Lark et al. 2022). This paper considered observed land use changes from 2008 – 2016, a time period of significant expansion of corn ethanol production. Based on this data, the paper estimated that an increase of 5.5 billion gallons of corn ethanol production per year was responsible for an increase of 6.1 million acres of total cropland. Using these values, we can calculate an expected increase of 1.1 million acres per billion gallons of ethanol produced. While these numbers are higher than the estimates based on Khanna (0.57 million acres per billion gallons of corn ethanol), we note that the Khanna estimates include a consideration of more recent data. Previous estimates of land use change using the same methodology as Khanna, but with a data set more comparable to that considered in Lark et al. (2022) estimated total cropland increases of 0.92 million acres per billion gallons of corn ethanol.[16] Thus, after accounting for the updated data set we believe the acreage estimates from Khanna are generally consistent with those estimated by Lark et al. (2022).

Despite the corn and total cropland acreage that may be attributable to the RFS program as shown in Table VI.A-10, we note that future increases in total corn production are likely to be driven primarily by demand for corn used for non-ethanol purposes. The University of Missouri's "U.S. Agricultural Market Outlook" projects that total corn production will increase through 2025 (University of Missouri, 2022). However, that increase is projected to be predominately the result in increases in demand for corn for non-ethanol purposes. Increases in the use of corn to produce ethanol is projected to be a considerably smaller portion of the total increases in corn production.

[16] These estimates are summarized in Table 6.10 of the External Review Draft of the Biofuels and the Environment Third Triennial Report to Congress.

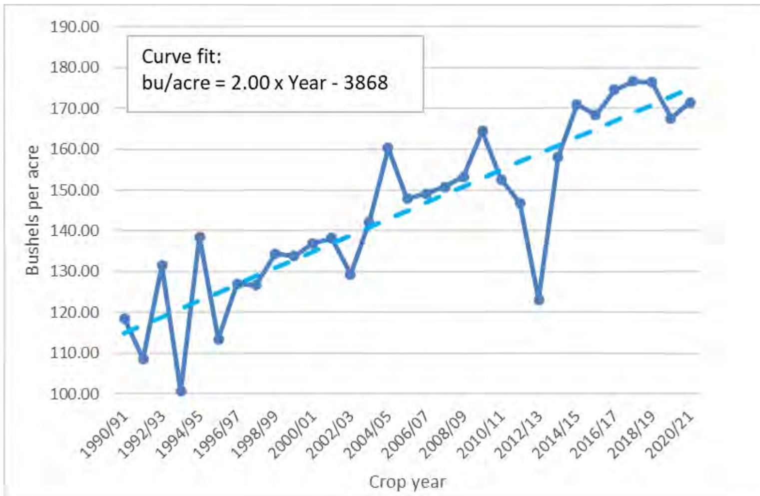
Figure VI.A-12: Corn projections from University of Missouri (million bushels)



Total corn production would increase by about 170 million bushels per year on average between 2022 and 2025, while corn production for ethanol would increase by only 18 million bushels per year on average over the same timeframe. This result indicates that the demand for non-ethanol uses of corn are anticipated to increase at a considerably faster rate than the demand for corn used to produce ethanol. While this result does not change the fact that some corn production can be attributed to the RFS program, it does indicate that any incremental impact on cropland used to grow corn for the purposes of producing ethanol would be small in comparison with increases in corn cropland for non-ethanol purposes. Consequently, corn production that may be attributable to the RFS program may not be meaningfully measurable or observable.

Finally, corn crop yields have generally increased over time, and this increase reduces the amount of new corn cropland that would be needed to grow the corn used to produce the ethanol volumes shown in Table VI.A-4. Between 1990 and 2020 corn crop yields have increased by an average of about 2 bushels per acre per year.

Figure VI.A-13: Trends in Corn Crop Yields



Source: USD''s Economic Research Service

We can approximate the impact that this annual increase in corn crop yields could have on corn used to produce ethanol by combining it with other average factors derived from the Tables VI.A-5 and VI.A-6 above.

$$493\ million\ gallons = (85\ mill\ acres) \times \left(\frac{2.9\ gal}{bushel}\right) \times \left(\frac{2\ bushel}{acre}\right) \qquad \text{Eq. 1}$$

Thus, each year the additional corn that can be produced through higher crop yields is equivalent to about 500 million gallons of ethanol. Over the period 2023–2025 that is the focus of this Biological Evaluation, the annual average increase in the volume of ethanol projected to be consumed is about 320 million gallons (US EPA, 2022d). Thus the increase in ethanol-equivalent corn production due to increases in crop yields exceeds the incremental amounts potentially consumed under the influence of the RFS program by a substantial margin.

We recognize that this simple comparison of corn crop yields to the demands of the RFS program ignores the use of corn for non-ethanol purposes. Indeed, as shown in Figure VI.A-5, demand for non-ethanol uses of corn is expected to increase through 2025, and annual increases in corn crop yields will also help to meet this increasing demand. Nevertheless, the fact that corn crop yields are expected to continue to increase in the future, and those increases are independent of demand created by the RFS program, we can expect that the need for additional corn cropland to meet the needs of the RFS program will be consequently diminished in the future.

5. Uncertainty in Estimating the Land Use Impacts of RFS-Driven Ethanol Consumption

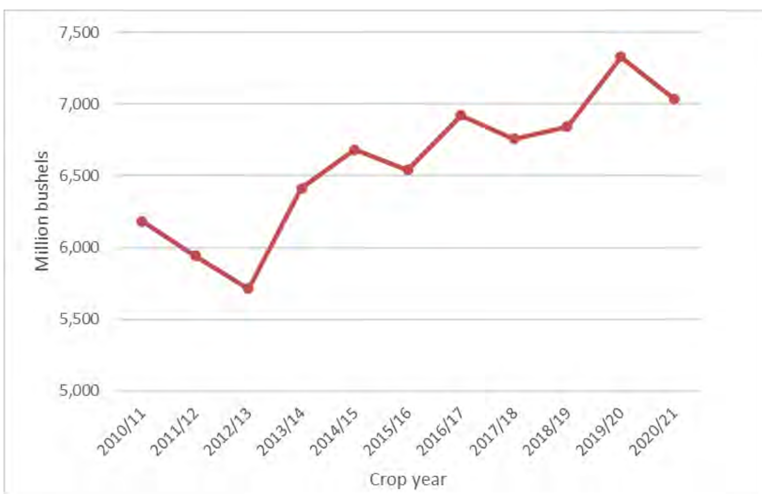
While we estimate that the Set Rule may be responsible for as much as 5-6% of ethanol consumption in the 2023–2025 timeframe as shown in Table VI.A-3, this ethanol volume would correspond to about 1% of the land devoted to growing corn as shown in Table VI.A-11. The ultimate impacts on species and habitat of ethanol consumption that can be attributed to the Set

Rule is very likely to be even smaller than these estimates imply, and there is reason to believe that they could be zero, as discussed below.

If the RFS program were to cease to exist, it is unlikely that ethanol production would decrease by the same amount as the reduction in domestic ethanol consumption. As discussed in Section VI.A.2, domestic ethanol producers could be expected to seek to increase exports to offset the loss of domestic sales. While domestic sales may be more profitable than exports, exports would nevertheless be expected to be profitable given the already high level of exports. This incentive alone has the potential to result in no change in domestic ethanol production at all despite the fact that domestic ethanol consumption could decrease by up to 6% if the RFS program were to cease to exist.

If there were some decrease in domestic ethanol production in the absence of the RFS program, there may nevertheless be no decrease in total corn production. This could occur in two ways. First, farmers may seek to increase exports of corn to offset the loss of a portion of their ethanol market. As with ethanol, while domestic sales of corn may be more profitable, exports would nevertheless be expected to be profitable given the already high level of corn exports. Second, the corn that would otherwise have been used for ethanol might be diverted to the domestic food and feed markets. Corn used for non-ethanol purposes in the U.S. has steadily increased since the 2012 drought.

Figure VI.A-14: Corn Consumed Domestically for Non-Ethanol Purposes



Source: USD''s Economic Research Service

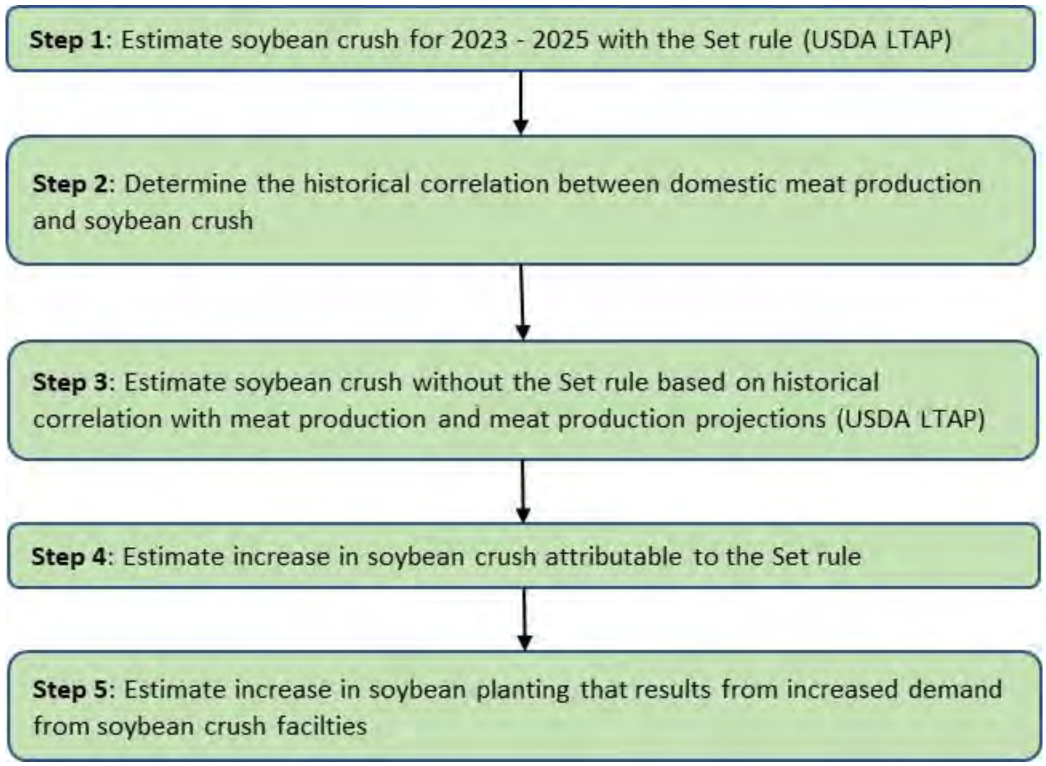
Such a shift between the use of corn for food and feed and the use of corn for ethanol appears to have occurred between 2007 and 2012 as shown in Figure VI.A-10 and thus could occur again in the 2023–2025 timeframe. While we cannot quantify the impacts of these two factors, it seems likely that together they would reduce the impact of the RFS program on acres devoted to corn production, already less than 1%, to significantly lower levels. Combined with the likelihood that ethanol production may in fact not change at all, the impact on corn production is likely to effectively be zero.

In conclusion, after analyzing all of the steps connecting the standards established through the RFS Set Rule and changes in land use as shown in Figure VI.A-7, and after a consideration of all factors that have impacted the production and consumption of corn and corn ethanol historically and which could be expected to also apply in the 2023–2025 timeframe as discussed in this Section VI.A, EPA has determined that the impacts of the Set Rule on corn cropland and the indirect effects on other cropland is highly likely to be very small. By extension, EPA has determined that while some impacts on listed species or their habitats could potentially occur as a result of the Set Rule, the consequences to the listed species or critical habitats could not be meaningfully measured, detected, or evaluated. Further, we note that as discussed in Section VI.A, ethanol consumption in 2023 – 2025 is projected to be approximately equal to ethanol consumption in 2022, which suggest that little to no additional cropland would be needed for ethanol production in 2023–2025. Nevertheless, in order to be thorough in the assessment of potential impacts on species and habitats, EPA made an effort to quantify those impacts using very conservative (i.e., worst-case) estimates of land use changes associated with corn ethanol production potentially attributed to the Set Rule. These efforts are discussed in Section VII.A below.

B. Soybean Production Potentially Attributable to the RFS Set Rule

After ethanol, the fuels produced in the largest quantities to satisfy RFS obligations are biodiesel, which displaces petroleum-based diesel fuel. Biodiesel is currently produced from a wide variety of feedstocks, including waste fats, oils, and greases (FOG), distillers corn oil, and virgin vegetable oils (see Table II.C-2). In the U.S., soybean oil is the vegetable oil used in the largest quantities for biodiesel production, while smaller amounts of these fuels are produced from canola oil. This section of the Biological Evaluation discusses the potential impact of the RFS volume requirements in 2023–2025 on domestic soybean production. The methodology used to project the impact of the Set Rule on soybean acreage in the U.S. is illustrated in Figure VI.B-1.

Figure VI.B-1: Process for Estimating Impacts of Soybean Biodiesel on Soybean Planting

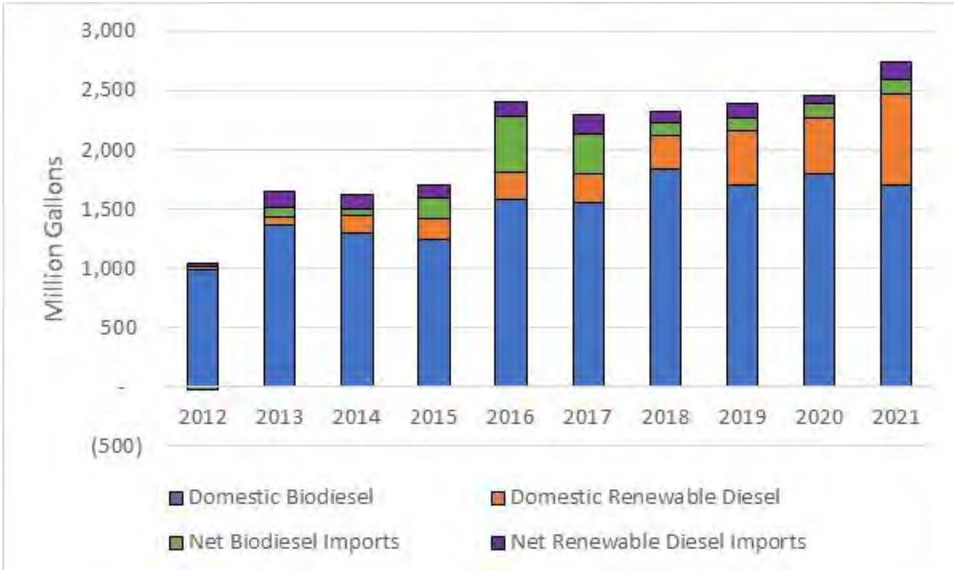


Sections VI.B.1 and VI.B.2 provide some historical context for the production of biodiesel and an overview of soybean markets and end uses. Section VI.B.3 discusses the impact of the RFS program on the use of soybean oil for biofuel production. Section IV.B.4 discusses interactions between biofuel production and soybean planting. Section VI.B.5 addresses Steps 1 through 5 of Figure VI.B-1.

1. Historical Biodiesel Production and Use

As with ethanol, there are many different factors that influence the domestic production and use of biodiesel in any given year. These factors include, but are not limited to, the relative pricing of vegetable oils and other feedstocks used to produce biodiesel and crude oil, federal tax credits, state and local mandates and incentives, and the RFS volume requirements. Due in large part to the federal and state incentives, including the RFS program, the production and use of biodiesel has increased significantly since 2011.

Figure VI.B-2: Historical Biodiesel Production and Imports (2012-2021)



Since 2016, about 53% of all biodiesel has been produced from crop-based feedstocks, the majority of which was soybean oil. Fats, oils, and greases (FOG) are waste products collected primarily from restaurants, animal processing facilities, and wastewater treatment plants, while corn oil is a byproduct of corn ethanol production.

Table VI.B-1: Proportions of Feedstocks Used to Produce Domestic Biodiesel Between 2016 and 2021

	2016	2017	2018	2019	2020	2021	Average
Soy oil	46%	45%	49%	50%	56%	50%	50%
FOG	28%	29%	27%	28%	25%	29%	28%
Corn oil	13%	15%	15%	14%	11%	14%	14%
Canola oil	12%	11%	8%	8%	8%	8%	9%

Source: EPA-Moderated Transaction System (EMTS)

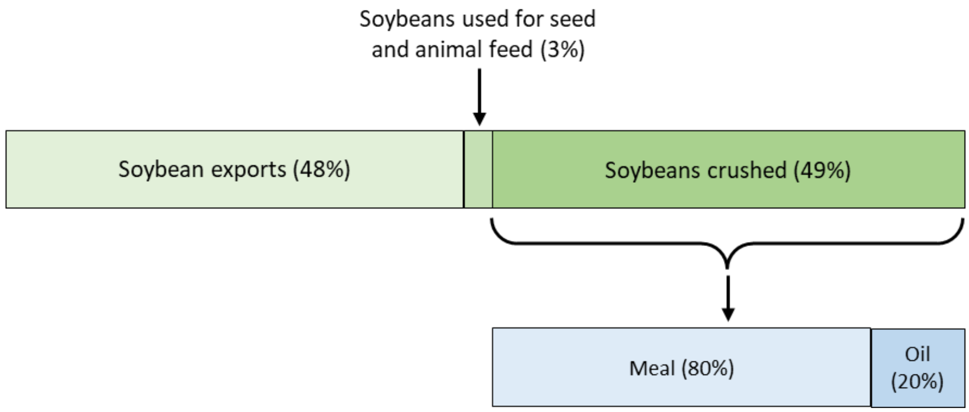
Since we do not anticipate any adverse impacts on species or their habitats for non-crop feedstocks such as FOG, and the production of such is not attributable to the RFS program, we have focused on the production of soybeans and canola for the purposes of this Biological Evaluation. However, in order to project the volumes of soy oil that might be used in the future to produce biodiesel, we have also projected potential volumes of FOG and corn oil.

2. Overview of Soybean Markets

Projecting the impact of the RFS program on soybean planting is complicated by the fact that there are multiple markets, and therefore multiple economic factors, that impact the demand for soybeans and soybean oil in the U.S. Therefore, before addressing our assessment of the impacts of the RFS program on soybean oil consumption and ultimately soybean plantings, we provide here an overview of the soybean market to provide context for the later discussion.

In the U.S., soybeans are grown for two primary purposes: export and crush, in roughly equal proportions (See Figure VI.B-3). Soybeans that are crushed yield meal and oil, with the oil comprising about 20% of the total mass crushed. Parties that use the soybean oil and meal produced by soybean crushers generally purchase these products from crushing facilities, rather than purchasing whole soybeans directly from soybean farmers.

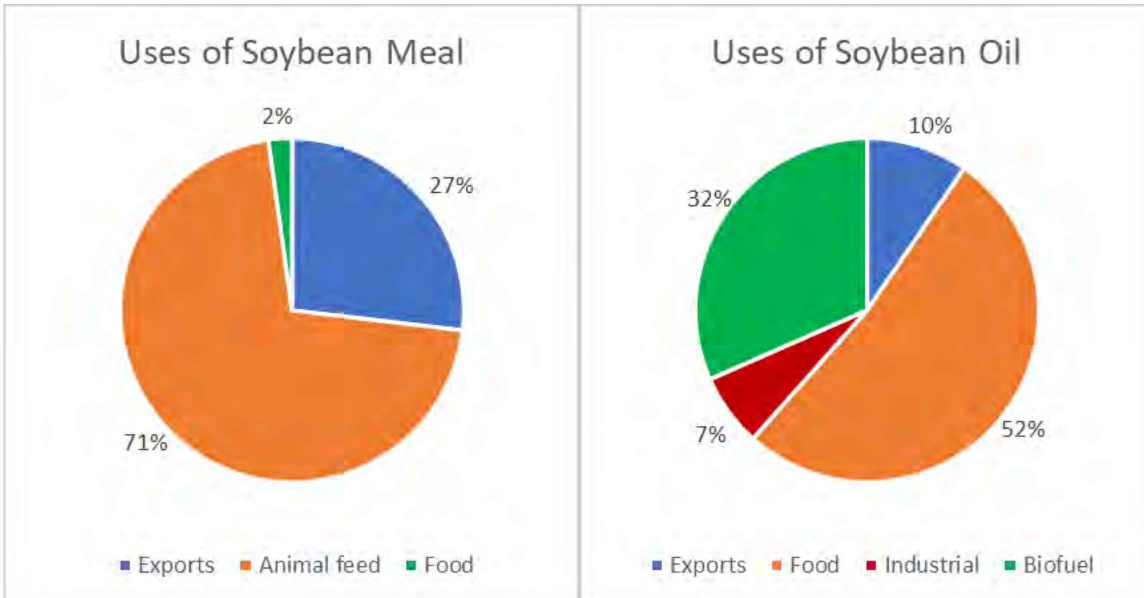
Figure VI.B-3: Typical Uses of Soybeans (Average 2016–-2021)



Source: USD’'s Economic Research Service

Like whole soybeans, some portion of both the meal and the oil are exported to meet foreign demand. In terms of domestic use, the remaining meal is used primarily for animal feed while the remaining oil is used for food, industrial purposes, and biofuel. Figure VI.B-4 shows the proportional uses of meal and oil on average for the years 2016–2021.

Figure VI.B-4: Markets for Soybeans that are Crushed (Average 2016—2021)



Source: USD’'s Economic Research Service

The use of soybean oil to produce biodiesel has accounted for an average of about 32% of all soy oil produced in the 2016–2021 timeframe. Since soy oil was produced from 49% of soybeans over the same timeframe, we could conclude that about 16% (32% × 49%) of total domestic soybean production was used for biofuel production. However, this calculation obscures an important aspect of the soybean market. With rare exceptions, the meal has had a higher market value than the oil over the last 30 years. This strongly implies that demand for soybean meal in the animal feed market has driven the amount of soybeans crushed, rather than demand for soybean oil. Historically soybean oil production has been a byproduct of the crushing process whose primary purpose was to produce meal. This fact has implications for whether and to what degree the demand for biofuel can be said to influence the production of soy oil and, consequently, the production of soybeans. For example, soybean production and soybean crush could increase in future years in response to increased demand for soybean meal for livestock feed. This increased soybean crush would result in increased production of soybean oil that could be used to produce biodiesel or renewable diesel, but in this case the increase in soybean production and soybean crush would be attributable to increased demand for soybean meal rather than to increased demand for biodiesel to meet the RFS volume requirements.

3. Potential Impact of the RFS program on Soybean Oil Use for Biofuel Production

To project the potential impacts of the proposed RFS volume requirements for 2023–2025 on soybean production, we first estimated the quantity of soybean oil that would be used for biofuel production in the absence of the RFS program. We then compared the quantities of soybean oil estimated to be used in the absence of RFS volume requirements in 2023–2025 to the quantity of soybean oil projected to be used to produce biofuels in the U.S. during these years with the RFS volume requirements in place.

While historically biodiesel has generally been more expensive to produce than petroleum-based diesel, in some situations the combination of available federal (non-RFS) and state incentives are sufficient to make the blending of biodiesel profitable despite its higher production costs. In other cases, states have enacted biodiesel use mandates so that minimum quantities of biodiesel must be used regardless of its higher cost.

To estimate the quantity of biodiesel that would likely be used in a given year absent the RFS volume requirements, we created a spreadsheet tool that compared the delivered cost of biodiesel and the cost of diesel in each state. This tool considered both the production cost of biodiesel produced from different feedstocks and the cost to distribute these fuels to each state, as well as the incentives available for their use in that state. Where the cost of biodiesel was projected to be lower than the reported cost of diesel fuel, or where there was a state mandate for the use of biodiesel, we projected that biodiesel would be used even in the absence of the RFS volume requirements. In situations where biodiesel cost less to supply than diesel, we projected that consumption of biodiesel in the absence of RFS volume requirements would have been equal to the volume of these fuels used actually used in that state in previous years. In these projections we used price projections from the Energy Information Administration and USDA. The methodology used to project biodiesel use in the absence of the RFS volume requirements is described in more detail in Chapter 2.1.3 of the draft regulatory impact analysis for the rule proposing RFS volume requirements for 2023–2025, and the results of that analysis are summarized in Table VI.B-2.

Table VI.B-2: Estimated Use of Biodiesel and Renewable Diesel without RFS Incentives

Feedstock	2023	2024	2025
Biodiesel (Million Gallons)			
Soybean Oil	199	199	199
FOG	147	147	147
Distillers Corn Oil	86	86	86
Canola Oil	0	0	0
Renewable Diesel (Million Gallons)			
Soybean Oil	0	0	0
FOG	390	390	390
Distillers Corn Oil	34	34	34
Canola Oil	0	0	0

After estimating the use of biodiesel in the U.S. in the absence of the RFS volume requirements, we next compared these values to the quantity of soybean oil projected to be used to produce biofuels in the U.S. in 2023–2025. Our projections of soybean oil used for biofuel production in this Biological Evaluation are taken from the projection of fuels used to meet the proposed RFS volume requirements in these years in the Set NPRM. These volumes are summarized in Table VI.B-3. Finally, we estimated the impact of the RFS volume requirements from 2023–2025 on the use of soybean oil for biofuel production by taking the difference between the quantity of soybean oil projected to be used for biofuel production and the volumes we estimate would have been or would be used for biofuel production in the absence of the RFS volume requirements. These volumes are summarized in Table VI.B-4.

Table VI.B-3: Domestic Biodiesel and Renewable Diesel Projected to Be Produced from Soybean Oil (million gallons)

	2023	2024	2025
Biodiesel	927	893	860
Renewable Diesel	1,026	1,026	1,032
Total	1,953	1,919	1,892

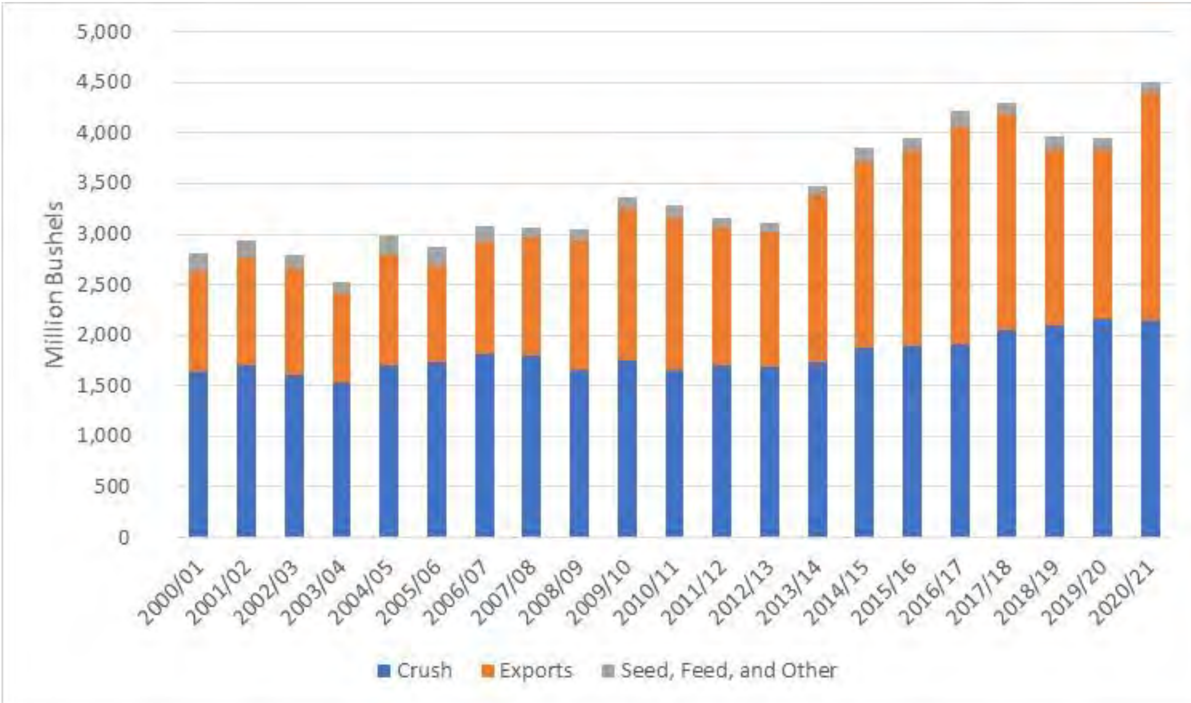
Table VI.B-4: Projected Impact of the RFS Volume Requirements on Use of Soybean Oil for Biofuel Production (million gallons)

	2023	2024	2025
Estimated Soybean Oil Use Without RFS Requirements	199	199	199
Actual/Projected Soybean Oil Use With RFS Requirements	1,953	1,919	1,892
Difference	1,754	1,720	1,693

4. Interactions Between Biofuel Production and Domestic Soybean Production

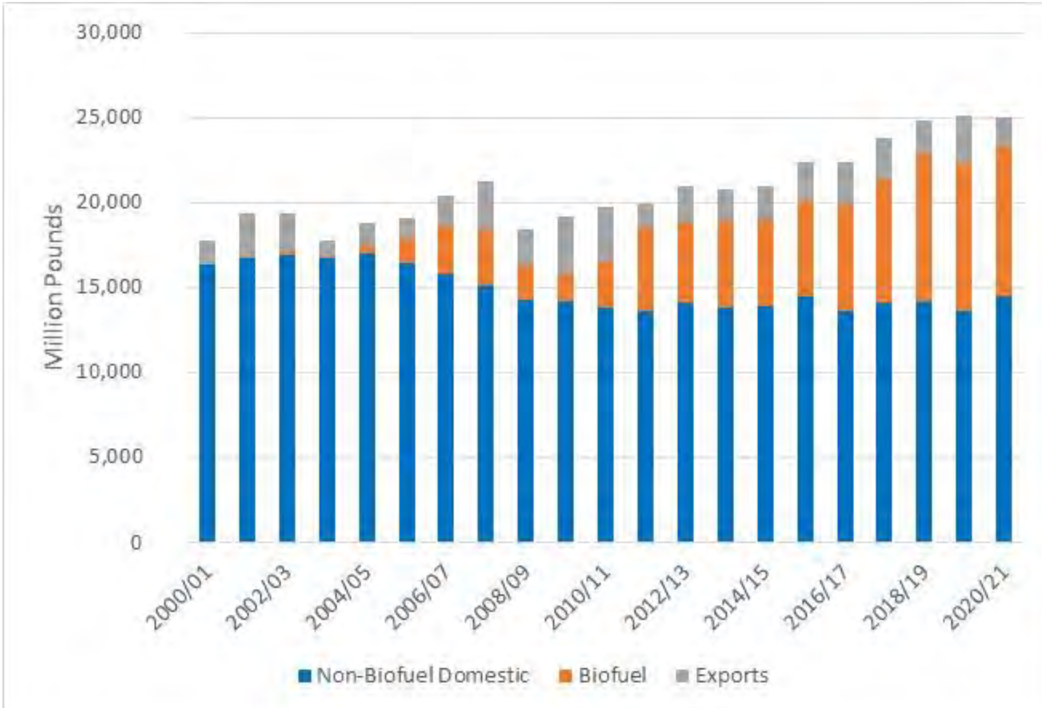
Estimating the impact of the RFS program on domestic soybean production is complicated by a number of factors. First, both soybeans and soybean oil have a number of different markets, each of which could potentially impact soybean production in the U.S. The primary uses for soybeans in the U.S. are crushing to produce soybean oil (used in a wide variety of domestic markets, including fuel, food, and industrial) and soybean meal (for domestic use as animal feed) and exports (for similar uses abroad), with a very small quantity of soybeans used for seed, feed, and other uses (See Figure VI.B-5). From the 2000/2001 crop year to the 2020/2021 crop year, domestic soybean crush has increased by approximately 500 million bushels, or approximately 30%. Soybean exports increased by nearly 1.3 billion bushels during this time period, an increase of over 120%. Soybeans used for seed, feed, and other uses have remained fairly consistent, decreasing slightly from 2000/2001 to 2020/2021 (see Figure VI.B-5). Because there are multiple demand drivers for increased soybean production, we cannot simply assume that the RFS program is responsible for the increase in soybean production since the inception of the RFS program. In fact, these data indicate that much of the increase in soybean production over the past 20 years has been driven by increased exports to meet demand in foreign markets, while a relatively small portion (approximately 30%) of the increase in soybean production has been due to increases in demand for soybean crushing to produce soybean meal and soybean oil.

Figure VI.B-5: U.S. Soybean End Uses



Similarly, the soybean oil that results from crushing is used in many markets beyond biofuel production. In addition to being used for biofuel production, soybean oil is used extensively in food production and industrial markets. Soybean oil is also exported for use in other countries. USDA reports total consumption of soybean oil, including the quantity of soybean oil used for biofuel production, as well as soybean oil exports. These data are summarized in Figure VI.B-6.

Figure VI.B-6: Soybean Oil End Uses

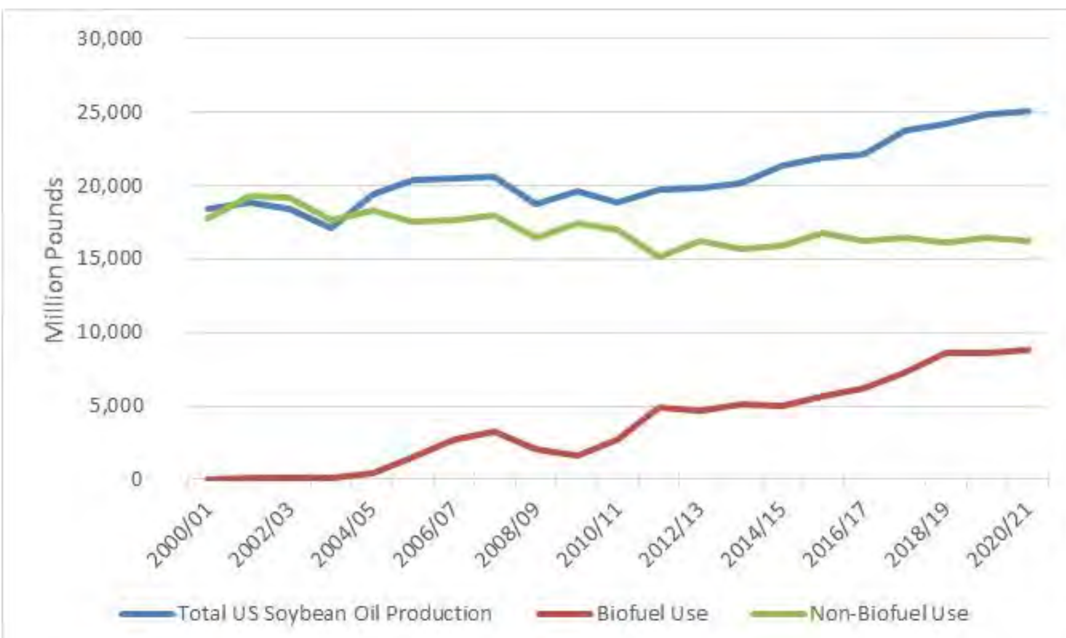


Historically, the amount of soybeans crushed has been driven by the demand for meal, with the oil being a byproduct. Consequently, the majority of the value of soybeans (historically approximately 70%) has come from the meal. Soybean oil has historically been a relatively low value byproduct of producing soybean meal for livestock feed. In fact, in the early years of the biodiesel industry one of the perceived benefits of biodiesel production was to provide another market for excess soy oil resulting from meal production. It provided a higher value market for excess soybean oil than the existing markets for food, cosmetics, and industrial applications, which in turn could reduce the prices for soybean-based animal feed and/or increase the price farmers received for soybeans (Schmidt, 2007). The fact that soybean oil is a minority component of the soybean, both by mass and value, suggests that it is highly unlikely that there is a direct relationship between demand for soybean oil for biofuel production and domestic soybean production.

Additionally, biodiesel and renewable diesel producers generally do not purchase soybeans directly from farmers. Instead, soybeans must first be processed at a crushing facility to separate the oil (which can be used as a feedstock for biofuel production) from the meal. While some biodiesel is produced at large integrated soybean processing facilities that also crush soybeans and produce a variety of end products, most biodiesel and renewable diesel producers purchase soybean oil from soybean crushing facilities. The need to crush soybeans before the soybean oil can be used to produce biofuels introduces another potentially limiting factor because existing crushing facilities are currently operating at or near capacity. Even in a scenario where production of biodiesel and renewable diesel were to increase significantly, the capacity of existing soybean crushing facilities could limit the quantity of soybean oil that can be produced domestically and used to produce biofuel. In such circumstances, increasing biodiesel and renewable diesel production would require sourcing feedstock from non-crop sources (FOG, distillers corn oil, etc.) or diverting soybean oil from other markets. In either case, because soybean crushing facilities are already operating at or near capacity there would be little or no increase in soybean demand from crushing facilities and thus little to no market signal for U.S. farmers to increase soybean production. Increasing soybean crushing capacity is therefore necessary for any increase in demand for soybean oil or meal to result in an increase in soybean planting. As discussed further in the following section, we have used USDA projections to estimate increases in soybean crushing capacity, and the resulting increase in soybean planting through 2025.

Notably, while the quantity of soybean oil produced in the U.S. has steadily increased since 2000/2001, these increases have been more modest than the increase in soybean oil that has been used for biofuel production during this same time period (see Figure VI.B-7). Since 2000/2001 approximately two-thirds of the soybean oil used to produce biofuels has come from increased soybean oil production, while approximately one third has come from diverting soybean oil from other markets to biofuel production. While some of the decrease in the use of soybean oil for non-biofuel uses may have been due to increased demand for biofuel production, other factors, such as the Food and Drug Administration's prohibition on the use of partially hydrogenated oils in food products, also impacted demand for soybean oil in non-biofuel markets (Center for Food Safety and Applied Nutrition, 2018).[17]

Figure VI.B-7: Domestic Soybean Oil Production and End Use



In summary, it is difficult to project with any degree of precision the likely impact of the RFS program on soybean planting in 2023–2025. This task is complicated by a variety of factors, including a wide variety of feedstocks that can be used to produce biodiesel and renewable diesel

[17] In 2013 FDA made a preliminary determination that partially hydrogenated oils are not generally recognized as safe for use in food. This determination was finalized in 2015. .

under the RFS program, the different markets for soybeans and soybean oil, and potential limitations in soybean crush capacity. These confounding factors make it difficult to project the degree to which any increase in demand for soybean oil attributable to the RFS program would induce farmers to increase soybean production in 2023–2025. This inherent uncertainty means that any projections of the potential impact of the RFS program on soybean plantings discussed next lack any ability to say, with certainty whether the soybean planting changes will occur, and secondarily, where they would occur.

5. Projecting the Potential Impact of the RFS program on Soybean Planting

Notwithstanding the challenges and uncertainties discussed in the preceding section, in order to complete the analyses required under the Endangered Species Act we have made an attempt to estimate the increase on soybean planting in 2023–2025 potentially attributable to the RFS program using the best available data. As discussed throughout this section, there is uncertainty associated with many of the inputs used to project the increase in soybean planting. Where possible we have identified the level of uncertainty associated with various elements of our projection, however in some cases (such as when we use projections from USDA) we are not able to quantify the uncertainty.

To estimate the potential impact of the RFS program on soybean planting we compared projected soybean planting in the U.S. in 2023–2025 with the RFS volume requirements in place to estimates of what soybean planting would have been in each year in the absence of the RFS volume requirements. To project data on soybean planting and other relevant factors such as soybean yields and soybean oil yields in future years with the RFS program in place we used USDA projections from their Long Term Agricultural Projections to 2031 (LTAP). Since it is a projection into the future for years for which EPA had not yet set the standards, there is some question as to the degree to which LTAP reflect the RFS program being in place. To verify that the LTAP was appropriate to use as a projection for soybean plantings and other relevant factors with the RFS volume requirements in place we compared the quantity of soybean oil projected to be used for biofuel production in the LTAP in 2023–2025 to our own estimates of the quantity of soybean oil that would be used to produce biofuels during this same time period from the proposed Set Rule. These quantities are shown in Table VI.B-5.

Table VI.B-5: Biofuel Projected to be Produced from Soybean Oil 2023–2025 (Million Gallons)

	2023	2024	2025
USDA LTAP[a]	1,510	1,540	1,550
EPA Set NPRM	1,950	1,920	1,890
Difference	440	380	340

[a] USDA's LTAP projects the pounds of soybean oil used to produce biofuel on an agricultural year basis. We have converted their agricultural year projections to calendar years, and converted pounds of soybean oil to gallons of biofuel assuming 7.6 pounds of soybean oil is used to produce one gallon of biofuel

While the quantities of biofuel that EPA projects will be produced from soybean oil from 2023–2025 are higher than the projections in USDA's LTAP, we note that there are important differences between these projections that can account for the higher EPA projections. EPA's projections include all biofuel produced from soybean oil, including imported biofuels. Conversely USDA's LTAP projects only the quantity of biofuels produced from soybean oil in the U.S. In previous years significant quantities of biofuels produced from soybean oil have imported. The maximum quantity of imported biofuel produced from soybean oil was approximately 425 million gallons in 2016, representing over 35% of all biofuel produced from soybean oil used in the U.S. in that year. This suggests that the USDA LTAP projections are consistent with our projections in the Set proposal. Therefore, we believe that it is appropriate to use the projections of soybean planting in the USDA LTAP as a valid projection of soybean plantings in 2023–2025 with the RFS volume requirements in place. Table VI.B-6. shows projected soybean plantings from 2023–2025 from USDA's LTAP.

Table VI.B-6: Estimated Soybean Planting with the RFS Volume Requirements

	2023	2024	2025
Million Acres	88.0	88.0	88.0

Next, we assessed the available data to project what soybean plantings would be in 2023–2025 in the absence of the RFS volume requirements. The total number of acres of soybeans projected to be planted in 2023–2025 in the absence of the RFS program can then be compared to the number of acres of soybeans projected to be planted in these years in USDA's LTAP to project the impact of the RFS volume requirements on soybean planting in these years. Determining what soybean plantings would be in the absence of RFS volume requirements, however, is not simple. We approached the task of estimating the impact of the RFS volume requirements on soybean planting by considering the mechanisms by which increased demand for biofuels could influence soybean planting. In general, increased demand for biofuels can increase demand for soybean oil as a feedstock for biofuel production, which could in turn result in higher soybean prices and incentivize farmers to increase soybean planting. However, as discussed above, historically the majority of the value of soybeans has been derived from the soybean meal, with the soybean oil representing an important but less valuable byproduct. In more recent years export markets have also played an increasing role in the demand for, and thus the price of, soybeans. Both of these factors (demand for soybean meal for livestock feed and demand for soybeans in the export) are expected to continue to influence demand for soybeans in future years. To increase soybean planting, increased biofuel demand would have to increase demand for soybean oil for biofuel production above and beyond what would already be produced as a byproduct of soybean meal production. A key element of our projection of what soybean planting would be in future years in the absence of the RFS program is projected meat production, since the soybean meal is used almost exclusively as livestock feed.

To estimate what soybean planting would be from 2023–2025 without the RFS volume requirements we considered actual and projected meat production in the U.S. in these years. We found that soybean planting, and especially soybean crush, has historically been well correlated with domestic meat production. This makes sense since, as noted above, historically the majority of the value of soybeans has been derived from the soybean meal that is sold as livestock feed. Thus, as meat production has increased, soybean crush and soybean planting have also increased. Using correlations between domestic meat production and soybean plantings and crush to inform our estimates of what soybean planting would have been or would be in the absence of RFS volume requirements also benefits from the fact that we do not expect the RFS volume requirements to appreciably impact domestic meat production.

USDA reports domestic meat production (red meat and poultry) starting in 1921. However, some of the data sets appear missing or incomplete prior to 1983. To estimate soybean plantings in the absence of RFS volume requirements we first considered the correlation between total red meat and poultry production[18] and soybean plantings as reported by USDA from 1983–2020 (USDA, 2022b). While data for 2021 is available, we chose not to include these data in our assessment of the relationship between meat production and soybean planting. This is because, as discussed further below, the price for soybean oil and the value of the soybean oil relative to the soybean meal produced when soybeans are crushed increased significantly in 2021 relative to historical norms (see Figure VI.B-9). This indicates that starting in 2021 demand for soybean oil, whether for biofuels or other markets, may be a bigger factor in the demand for soybeans from soybean crushing facilities and ultimately overall soybean demand relative to previous years.

We used the linear least squares regression function in Microsoft Excel to determine an equation to define the correlation between domestic meat production and soybean planting between 1983 and 2020 and to assess the strength of this correlation. The equation describing the correlation was used to project what soybean planting would have been in the absence of the RFS volume requirements based on projected meat production from 2023–2025.[19] The data described in this paragraph, including the linear regression, the equation used to estimate soybean planting from 2023–2025 in the absence of the RFS volume requirements using this methodology, and the strength of the correlation (the R^2 value), and lines representing the 95th

[18] Data on domestic meat production from USDA ERS Livestock and Meat Data, Meat Statistics Tables, Historical. The correlation was based on total red meat and poultry production. Red meat includes beef, veal, pork, and lamb and mutton. Poultry includes broilers, other chicken, turkey, and other poultry.
[19] Data on projected meat production obtained from the USDA LTAP to 2031. As discussed above, we believe it is reasonable to use the LTAP as a projection of soybean plantings with the RFS volume requirements, but since we do not expect the RFS volume requirements will appreciably impact meat production we also believe the LTAP is a reasonable projection of meat production in the absence of the RFS volume requirements.

confidence interval are shown in Figure VI.B-7. Soybean planting estimates for 2023–2025 using this equation and a comparison of these values and the estimated soybean planting with the RFS volume requirements in place (from USDA's LTAP) are shown in Table VI.B-8.

Figure VI.B-8: Domestic Meat Production vs. Soybean Planting

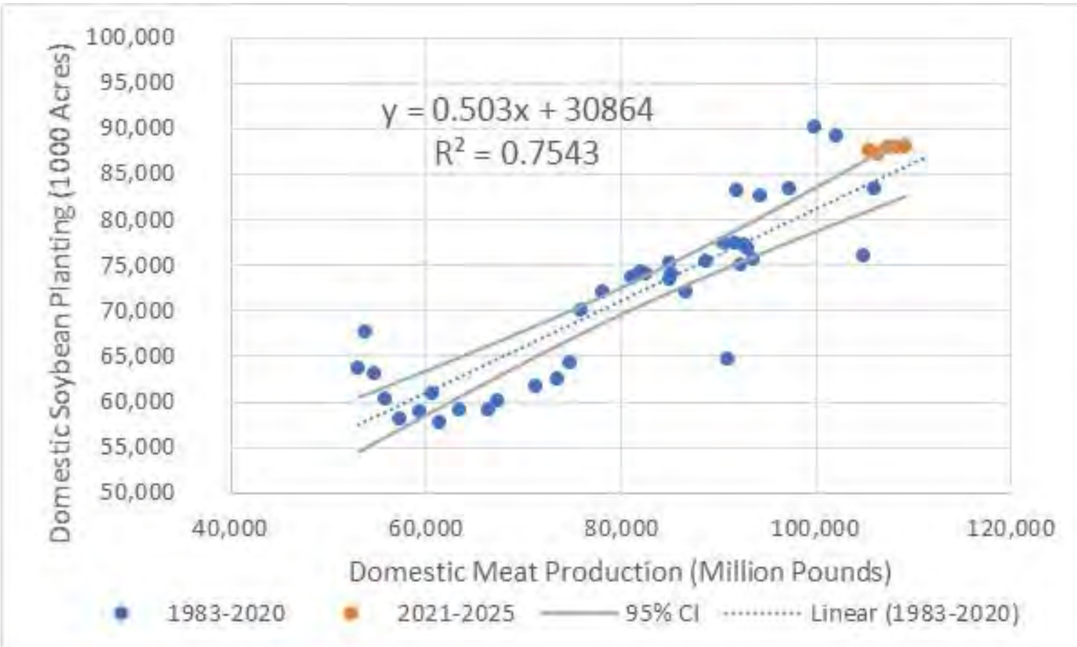


Table VI.B-7: Estimates of Soybean Planting With and Without RFS Volume Requirements Based on Soybean Planting Correlation (Million Acres)

	2023	2024	2025
No RFS Volume Requirements[a]	84.9	85.3	85.8
With RFS Volume Requirements[b]	88.0	88.0	88.0
Difference	3.1	2.7	2.2

[a] Based on correlation between domestic meat production and soybean planting
[b] From USDA's LTAP, shown in Table VI.B-6

While there appears to be a reasonably strong correlation between domestic meat production and soybean planting there also appear to be some shortcomings in using this method to estimating soybean planting. The largest problem with this correlation appears to be the fact that it does not accurately account for the impact of changes to soybean plantings to supply foreign markets. As shown in Figure VI.B-4, exports have become an increasingly important market for soybeans over the past 10-15 years. Through 2010 soybean exports, while not insignificant, were a relatively small portion of the domestic soybean market. From approximately 2010 through 2021 soybean exports increased significantly. The fact that this correlation does not account for changes in exports negatively impacts the strength of the correlation. This is particularly apparent when there are factors such as China's ban on U.S.

soybeans in 2019 that have a dramatic short-term impact on exports as seen in Figure VI.B-4. Despite these shortcomings, projecting soybean plantings based on a correlation with domestic meat consumption results in acreage estimates that, with the exception of 2019 and 2020, are at least directionally consistent with what would be expected.

As an alternative means of assessing soybean plantings in the absence of RFS volume requirements that is less impacted by external market factors such as soybean exports, we next considered the correlation between domestic meat production and soybean crushing. This correlation is of interest because both the livestock industry and the biofuel industry use soybean products that are produced when soybeans are crushed, soybean meal and soybean oil respectively, rather than whole soybeans. Because historically most of the value of the soybean comes from the soybean meal when soybeans are crushed, we would expect to see a strong correlation between domestic meat production and soybean crushing. If demand for soybean oil in recent and future years is increasing soybean crushing rates above and beyond what would be expected based on the historical correlation with meat production, we can likely attribute the increased crushing of soybeans to increased demand for biofuels.

As with the data on domestic meat production and soybean planting, we considered the correlation between total red meat and poultry production[20] and soybean crushing as reported by USDA from 1983–2020 (USDA, 2022b). During these years the value of the soybean oil was generally small relative to the value of the soybean meal produced when soybeans are crushed. As a result, we believe that it is reasonable to assume that during these years the quantity of soybean crushed was determined by demand for soybean meal for livestock feed rather than soybean oil for food or biofuel production. A correlation based on this data therefore can be used to project likely future soybean crushing if soybean crushing continues to be determined by demand for soybean meal, as we expect would be the case in the absence of the RFS volume requirements.

We used the linear least squares regression function in Microsoft Excel to determine an equation to define the correlation between domestic meat production and soybean crushing between 1983 and 2020 and to assess the strength of this correlation. The equation describing the correlation was used to project what soybean crushing would have been in the absence of the RFS volume requirements based on projected meat production from 2023–2025 in the absence of the RFS volume requirements using this methodology.[21] The data described in this paragraph, including the linear regression, the equation used to estimate soybean crushing from 2023–2025, the strength of the correlation (the R^2 value), and lines representing the 95th confidence interval are shown in Figure VI.B-8. Soybean crushing estimates for 2023–2025 using this equation and a comparison of these values and the projected soybean crushing with the RFS volume requirements in place (from USDA's LTAP) are shown in Table VI.B-9.

[20] Data on domestic meat production from USDA ERS Livestock and Meat Data, Meat Statistics Tables, Historical. The correlation was based on total red meat and poultry production.
[21] Data on projected meat production obtained from the USDA LTAP to 2031.

Figure VI.B-9: Domestic Meat Production Vs. Soybean Crushing

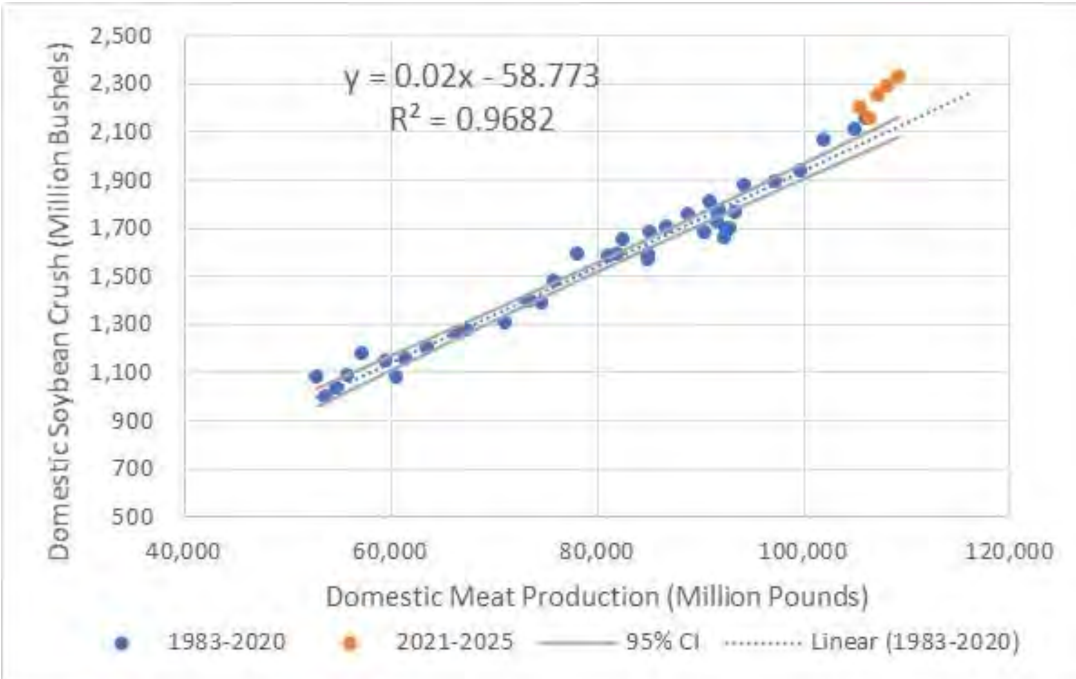


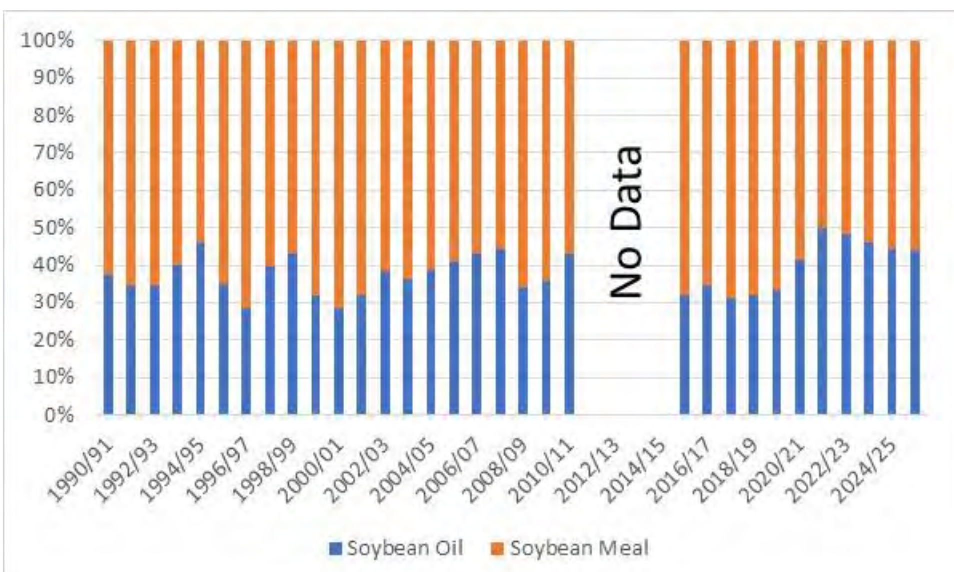
Table VI.B-8: Estimates of Soybean Crush With and Without RFS Volume Requirements Based on Correlation with Meat Production (Million Bushels)

	2023	2024	2025
No RFS Volume Requirements[a]	2,088	2,105	2,125
With RFS Volume Requirements[b]	2,250	2,290	2,328
Difference	162	185	203

[a] Based on correlation between domestic meat production and soybean crushing
[b] From USDA's LTAP

As expected, the correlation between domestic meat production and soybean crush is stronger than the correlation between domestic meat production and soybean planting. Unlike the correlation with soybean planting, external factors such as changes in trade policies by foreign countries do not appear to have an appreciable impact on the correlation with soybean crush. As anticipated, we see that in recent years as demand for biofuels has increased and the market has responded by crushing a greater quantity of soybeans than would have been expected based on the historical relationship between domestic meat production and soybean crushing. This same effect can also be seen in the actual/projected relative values of soybean meal and soybean oil. USDA data through 2020/2021 shows that the percent value from soybean oil in 2020/2021 was notably higher than in previous years, and projections of soybean meal and oil yields and prices from USDA's LTAP show that this trend is expected to continue in future years (See Figure VI.B-10).

Figure VI.B-10: Relative Value of Soybean Meal and Soybean Oil



We note, however, that during this time period demand for soybean oil in other markets is also expected to increase. According to USDA's LTAP, soybean oil used for food, feed, and other industrial uses is projected to increase by 400 million pounds, or approximately 130 million pounds per year, from the agricultural marketing year 2022/23 to 2025/26. The increase in demand for soybean oil in non-biofuel markets could also be responsible for a portion of the projected increase in soybean crushing beyond what would be expected based on the historical relationship between domestic meat production and soybean crushing. Because we are unable to determine the portion of increase in soybean crushing (relative to the historical observed relationship) attributable to the projected increase in demand for soybean oil in non-biofuel markets we have assumed that the entire increase is attributable to biofuel production. This assumption very likely over-estimates the impact of the RFS program on soybean crushing.

While the correlation between domestic meat production and soybean crushing gives us a reasonably robust way to project the impact of the RFS volume requirements on soybean crushing, estimating the impact that increased soybean crushing has on soybean planting presents another challenge. In one extreme case, we could assume that all of the additional soybeans that are crushed as a result of the RFS volume requirements are from acres that would not otherwise be planted. In the other extreme, we could assume that soybean yields increase and soybean exports decrease in response to additional demand from soybean crushing facilities, and that soybean planting does not change at all.

The most likely scenario lies between these two extremes. It is likely the RFS volume requirements will cause an increase in demand for soybean oil, and ultimately an increase in the price of both soybean oil and whole soybeans. This increase in the price of soybeans could result in a marginal decrease in the quantity of soybeans demanded in the export market relative to a scenario without the RFS volume requirements in place. Increasing soybean yields will likely result in greater soybean production from existing soybean acres, reducing (and potentially even eliminating) the need for an increase in soybean acreage to meet the increased demand for soybeans. At this time, we are unable to determine the degree to which increased demand for soybeans from crushing facilities would result in increased soybean planting vs. reduced soybean exports. Table VI.B-9 shows the expected impact on soybean planting under three different scenarios; one scenario where the entire increase in soybean demand is met by increased soybean planting, a scenario where 50% of the increased demand is met by increased soybean planting and 50% is met by reduced soybean exports, and a scenario where the entire increase in soybean demand results in reduced exports. We project that the scenario where 50% of the increased demand for soybeans from crush facilities is met via increased soybean planting and 50% is met by increased soybean yields and/or reduced exports is the most reasonable scenario to assume for further analysis, and have used the expected soybean planting increases from this scenario to inform the expected impact on listed species in this Biological Evaluation. This estimate is consistent with the USDA Agricultural Projections to 2031, which project a relatively small increase in soybean planting (from 87.2 million acres in the 2021/22 agricultural marketing year to 88.0 million acres in the 2025/26 marketing year) despite a projected increase in soybean crushing (from 2,190 million bushels in the 2021/22 agricultural marketing year to 2,350 million bushels in the 2025/26 agricultural marketing year).

Another important factor that must be considered when estimating changes in soybean planting attributable to increased demand for soybean oil for biofuel production is the degree to which new soybean acres are planted on land that is not currently being used to produce crops (extensification) or land that is currently being used to produce non-soybean crops (intensification). If new soybean acres are grown on land not currently being used to produce crops, we would expect total cropland in the U.S. to increase proportionally to the increase in soybean acres. That is, total U.S. cropland would be expected to increase by one acre for every new acre of soybeans that are planted on land that is not currently being used to produce crops. If, however, new soybean acres are planted on land currently being used to produce other crops, the situation is more complicated. In this case it is possible that the crops displaced by new soybean acres would instead be grown on land that is not currently being used to produce crops. Alternatively, it is possible that total production of the crops displaced by soybeans decreases. In the case where soybean acres are planted on land currently being used to produce other crops total U.S. cropland would be expected to increase by less than one acre for every new acre of soybeans that are planted. The analysis of cropland changes associated with corn ethanol production discussed in Section VI.A.4 found that total cropland increases were less than increases in corn planting. This suggests that in response to increasing corn ethanol production corn was planted on land previously used for other crops, and the amount of land used to produce these other crops decreased rather than moving to areas that were not previously cropland. While no such analysis has been conducted for soybean biodiesel, we believe a similar effect is likely.

At this time, we do not have sufficient information to estimate the quantity of new soybean acres that would be grown on land that is not currently being used to produce crops vs. land that is currently being used to produce non-soybean crops, nor do we have sufficient information to project whether production of non-soybean crops displaced by new soybean acres would decrease or shift to land not currently being used to produce crops. In the absence of this information, we have assumed a worst-case scenario; that every additional acre of soybeans attributable to the RFS volume requirements increases total U.S. cropland by one acre.

Table VI.B-9: Potential Soybean Planting Increases from RFS Volume Requirements (Million Acres)

Scenario	2023	2024	2025
100% New Planting	3.14	3.55	3.86
50% New Planting/ 50% Reduced Exports	1.57	1.78	1.93
100% Reduced Exports	0.00	0.00	0.00

The projections in Table VI.B-9 represent our best efforts to project the increase in soybean acreage in 2023–2025 that might possibly be attributable to the RFS volume requirements using the best data currently available. Nevertheless, there is significant uncertainty inherent in these projections. The projected acreage increases are based on an increase in soybean crushing calculated as the difference between a historical correlation between domestic meat production (for the scenario that represents soybean crushing in the absence of the RFS volume requirement) and a USDA projection of soybean crushing in future years (for the scenario that represents soybean crushing with the RFS volume requirements in place). While we believe both of these projections are reasonable, projecting future activity based on a correlation from historical data or projections that do not explicitly consider the RFS volume requirements introduces uncertainty to our projections. This uncertainty is compounded by the fact that we have no reliable data to inform our estimates of whether the increase in the quantity of soybeans processed at a crushing facility would result in reduced soybean exports or increased soybean production, and if it were to result in increased soybean production what effect this increase in production would have on total U.S. cropland. In general we have tended to make assumptions that would tend to over-estimate the impact of the RFS volume requirements on soybean planting and cropland expansion, and as such the acreage increases we have projected are likely over-estimates.

C. Canola Production Potentially Attributable to the RFS Set Rule

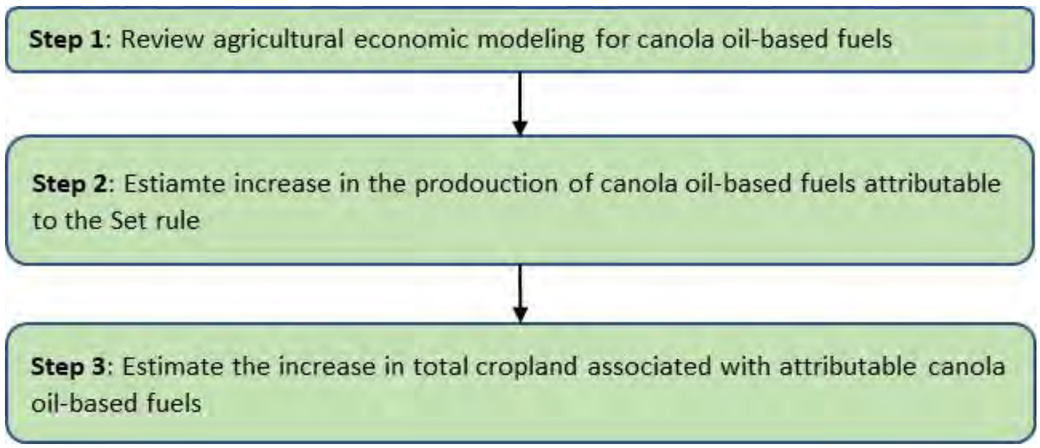
In the context of a recent final rulemaking (FRM) in response to an RFS pathway petition from the US Canola Association (USCA) to add canola oil-based pathways[22] to the program, EPA conducted an analysis of the impacts of consuming more canola oil-based biofuels in the United States (U.S.). This analysis was described in detail in the notice of proposed rulemaking (NPRM) (*87 FR 22823*, 2022) and summarized in the subsequent FRM (*87 FR 73956*, 2022).

This analysis was primarily comprised of agricultural economic modeling and included estimates of the U.S. cropland and other land cover changes which might result from an increase in U.S. consumption of canola oil-based fuels. We combine this analysis with recent estimates of the increase in canola oil-based fuels though 2025 associated with the RFS program. This estimate was produced for the 2023–2025 Set Proposed Rulemaking which is the focus of this

[22] As described in Table 1 of 40 CFR 80.1426, a renewable fuel pathway is defined for the purposes of the RFS program as a unique combination of three essential characteristics: a feedstock (e.g., corn starch, soybean oil, canola oil), a fuel production process (e.g., fermentation, transesterification, hydrotreating), and a finished fuel (e.g., ethanol, biodiesel, renewable diesel).

Biological Evaluation. Through the combination of these two analyses, we derive an estimate of the cropland impact of the use of canola oil-based fuels potentially attributable to the RFS program. Figure VI.C-1 illustrates the steps we used to estimate the increase in total cropland due to the increased consumption of canola oil-based fuels potentially attributable to the Set Rule.

Figure VI.C-1: Process for Estimating Impacts of Canola Oil-Based Fuels on Total Cropland in the U.S.



We first provide a summary of the agricultural economic modeling conducted for the canola oil pathways rulemaking to estimate the U.S. cropland and other land cover impacts of canola oil-based fuels (Sections VI.C.1 and VI.C.2). Following this, we describe the estimated volume of canola oil-based fuel production in the United States potentially attributable to the RFS program estimated for the Set Rulemaking (Section VI.C.3). Finally, we combine these two analyses to derive the total quantity of U.S. canola crop area potentially associated with this increase in fuel production (Section VI.C.4).

1. Description of EPA Agricultural Economic Modeling of Canola Oil-Based Fuels

In the recent canola oil-based fuel pathways FRM described above, EPA used the same biofuel lifecycle analysis methodology and modeling framework developed for the March 2010 RFS2 rule (*75 FR 14670*, 2010) and that was subsequently used for the September 2010 Canola Oil Rule (*75 FR 59622*, 2010).[23] The components of this methodology relevant to the present BE involve the use of domestic agricultural modeling to estimate emissions from land use change, crop production, and livestock in the U.S. This methodology was developed to estimate "lifecycle greenhouse gas emissions" as defined at section 211(*o*)(1)(H) of the Clean Air Act. It was used for the March 2010 RFS2 rule after an extensive peer review and public comment process.

[23] For information about our 2010 methodology and analysis see Section 2 of the regulatory impact analysis (RIA) for the March 2010 RFS2 rule and the associated lifecycle results (Docket Item No. EPA-HQ-OAR-2005-0161-3173).

This domestic agricultural modeling methodology uses the Forest and Agricultural Sector Optimization Model with Greenhouse Gases model (FASOM). Using this methodology, we modeled and evaluated a hypothetical canola oil demand shock scenario to estimate changes in domestic agricultural production, trade, and land use and associated GHG emissions associated with the biofuel pathway under consideration. In this demand shock scenario, U.S. domestic consumption of a specific biofuel pathway is assumed to increase by some amount relative to the volume of U.S. domestic consumption in a reference scenario.

EPA conducted two modeling scenarios in FASOM for this analysis.[24] The difference in GHG emissions between these two scenarios represents our estimate of the emissions from land use change, agricultural input, livestock, and other agricultural sector impacts associated with using canola oil as a biofuel feedstock. First, we ran an updated Control Case that reflected the updated assumptions for global canola oil production, yields, and trade.[25] In this Control Case, we assumed no canola oil-based biofuels were consumed in the U.S. Second, we conducted a shock scenario that assumed a 1.53 billion pound increase in canola oil production for use as feedstock to produce approximately 200 million gallons of canola oil-based fuels for U.S. consumption of in 2022 (hereafter the “Canola Case”), which was assumed to ramp up linearly from 2012 to 2022 (see Table VI.C-1).[26] According to USDA historical data, annual U.S. consumption of canola oil ranged from about 5.3 to 6.4 billion pounds over the period between 2015 and 2020 (USDA, 2022b). In addition, global canola/rapeseed seed annual exports ranged from approximately 32 to 38 billion pounds between 2015 and 2020 and canola/rapeseed oil exports ranged from about 9 to 13 billion pounds over the same period; this suggests substantial quantities of additional feedstock may be available for import to the U.S. market (USDA, n.d.). Based on data from the EPA Moderated Transaction System (EMTS) , the U.S. produced approximately 160 million gallons of canola oil biodiesel in 2020, and another 123 million gallons of biodiesel produced from a mix of feedstocks were imported from Canada, which likely included a portion from canola oil. Thus, the volume of hydrotreated canola oil-based fuels in the modeled shock is a similar order of magnitude as the volume of biodiesel currently produced from canola oil. Finally, according to EPA’s administrative data from the RFS program, about 1.5 billion RINs were generated for renewable diesel in 2019, equivalent to about 900 million gallons (US EPA, 2018a). Based on these data, we believe the magnitude of the assumed shock in the Canola Case is reasonable and appropriate.

All other assumptions were held constant between the Control Case and the Canola Case. The structure of this shock was designed to be consistent with the shock methodology approach used for EPA’s previous lifecycle GHG analyses of agricultural feedstocks under the RFS program.

[24] Complete sets of results for these FASOM modeling scenarios are available on the docket for the rulemaking they were conducted for: EPA-HQ-OAR-2021-0845.
[25] A memorandum describing these updates and referencing their sources is available on the docket EPA-HQ-OAR-2021-0845.
[26] Depending on the source of hydrotreating process data used, the size of the shock ranges from 187 million gallons of hydrotreated renewable fuel (based on GREET-2021) to 220 million gallons (based on data in petitions submitted pursuant to 40 CFR 80.1416 claimed as confidential business information).

Table VI.C-1 – Canola Oil Shock Scenario[27]

Year	Assumed Increase in USA Canola Oil Consumption for Biodiesel Production (Billion Pounds of Canola Oil)
2012	0.25
2017	0.9
2022 through 2057	1.53

EPA used FASOM to estimate, among other impacts, domestic land use change associated with using canola oil as a biofuel feedstock. The differences in modeled biofuel consumption outcomes between the Control Case and the Canola Case are described in Table VI.C-1. Unless otherwise stated, the data presented in the tables below are the calculated differences between the Control Case and the Canola Case (i.e., the model output value for a variable reported in the Canola Case minus the output value for that same variable reported in the Control Case). In this summary, we first describe the ways in which FASOM estimates the canola oil feedstock used to supply the biofuel shock would be sourced. We then describe the market adjustments in canola oil prices, supply, demand, and trade which FASOM estimates would be necessary to facilitate this sourcing of canola oil for fuel use. Following this, we describe the shifts in production of other crops, cropland use, and land use which FASOM estimates would occur as a result of the sourcing of canola oil for fuel use.

2. Results of the Economic Modeling for Canola Oil Biofuels

The total quantity of canola oil required to produce the assumed marginal volume shock in the Canola Case was assumed to be approximately 1.53 billion pounds. To supply this quantity of canola oil to the biofuel production sector, FASOM made several market adjustments. Of the total 1.53 billion pounds required, FASOM estimated approximately 1.28 billion pounds would be supplied by increasing the total U.S. supply of canola oil via a combination of increased imports and increased domestic production. These 1.28 billion pounds would represent an approximately 28 percent increase in total domestic supplies of canola oil. FASOM estimates canola oil imports would increase by about 1.18 billion pounds. Domestic crushing of canola seed into meal and oil would produce about 0.1 billion pounds of additional canola oil. Domestic demand for non-fuel uses of canola oil, inclusive of all food uses (e.g., cooking, baking, salad dressings) and non-fuel industrial uses (e.g., industrial lubricants, cleaning products, cosmetics), would decrease by approximately 0.25 billion pounds to provide the remaining canola oil required to meet the 1.53-billion-pound shock. These shares of biofuel feedstock are summarized in Table VI.C-2.

[27] Note that, consistent with our existing methodology, the volume shock is implemented slightly differently in FASOM and FAPRI. For FASOM, which operates in 5-year time steps, the values in this table fully represent the assumptions used to implement the shock. For FAPRI, which operates in annual time steps, interim year assumption values are interpolated linearly to create a smooth "ramp-up" path for the volume shock. Further description of this methodology can be found in Chapter 2 of the Final Regulatory Impact Analysis associated with the March 2010 RFS2 rule (EPA-420-R-10-006).

Table VI.C-2 – Sources of Canola Oil for Biofuel Feedstock in the Canola Case

Feedstock Source	Quantity (Billion Pounds)	Percent of Total Volume Shock
Increased Imports	1.18	77%
Reduced Domestic Demand for Non-Fuel Uses	0.25	16%
Increased Domestic Production	0.1	7%
Total Volume Shock	1.53	100%

FASOM estimates canola oil imports would increase by approximately 40 percent in 2022 in response to the shock. Because modeled non-fuel uses of canola oil are not drawn on as significantly to provide feedstock for this shock, FASOM does not estimate there would be a significant need to backfill the domestic U.S. vegetable oil market. Domestic consumption of other vegetable oils therefore does not change significantly in these results. Following this, FASOM estimates virtually no changes in imports of other vegetable oils in these results. Increased demand for canola oil in response to the volume shock is estimated to cause the average price of canola oil for all uses to increase by approximately 24 percent in the Canola Case. This price increase would put downward pressure on other uses of canola oil, and non-biofuel domestic demand for canola oil is estimated to decrease by approximately 5.6 percent. FASOM estimates these higher prices would also induce domestic U.S. production of canola oil to increase by about 7 percent. Table VI.C-3 reports changes in supply, demand, and prices for canola oil in the Canola Case relative to the Control case. Changes for other modeled vegetable oils, specifically soybean oil and corn oil, are estimated to be in the range of 0.03 percent or less and are not presented here, though these results are available in the docket of the rulemaking for which this analysis was originally conducted.[28]

Table VI.C-3 – Canola Oil Market Responses in 2022 (in percentage changes)

	Percent Change from Control Case
Total Domestic Demand	-5.6%
U.S. Imports	38.9%
U.S. Production	7.0%
U.S. Price	24.1%

FASOM estimates the increase in canola oil production would result in an increase in canola seed crushing of approximately 253.5 million pounds, an increase in domestic canola oil production of about 7 percent compared to the Control Case. Most of this increase in canola crushing would be supplied through increased imports of whole canola seed. Of the total increase

[28] Further information is available in the documents, "Canola_FASOM results" and "FASOM HTML (full results)" available in docket EPA-HQ-OAR-2021-0845.

in canola seed supply to the crushing market, 87 percent is estimated to come from increased imports and 13 percent is estimated to come from increased domestic U.S. production. As observed above, the U.S. canola product markets are historically import-dependent. Based on this, we believe the response in FASOM is consistent with historical market patterns. However, FASOM estimates the increase in domestic crushing would also induce a response from domestic canola seed demands. FASOM estimates direct domestic uses of canola seed other than crushing would decrease by approximately 16 percent. Domestic canola seed production also responds, and FASOM estimates domestic production would increase by approximately 1 percent. These impacts are summarized in Table VI.C-4. This increase in U.S. canola seed production would be facilitated in part by a modeled expansion in canola harvested crop area of about 17,600 acres, or about 1.2 percent, in the U.S. in 2022 (see Table VI.C-5).

Table VI.C-4 – Canola Seed Market Responses in 2022 (in Million Pounds)

	Change from Control Case
Total Domestic Demand	-5.8 (-16%)
U.S. Imports	216.5 (20%)
U.S. Production	31.3 (1%)
U.S. Canola Seed Crushing	253.5 (7%)

These shifts in canola supply, demand, and trade would also have implications for production and consumption of other crops. The modeled increase in canola crushing also produces an additional 156 million pounds of canola meal, all of which FASOM estimates would be supplied to the domestic livestock market. This influx of meal would primarily displace corn in livestock diets. Corn consumption in the domestic feed market is estimated to decrease by about 306 million pounds (about 0.08 percent). This same dynamic can be observed in the FASOM results for commodity trade. As international trade partners increase exports of canola oil to the U.S., these exporters crush additional canola seed. This creates additional supplies of meal for these canola-producing nations, reducing their demands for corn as well. As a result, corn exports from the U.S. are estimated to decrease by about 271 million pounds (about 0.28 percent). On net, FASOM estimates that U.S. corn production would decline by about 589 million pounds and that corn harvested area would decline by about 49,100 acres, or about 0.06 percent (see Table VI.C-5).

Note that, as described further below in this section, we did not consider any of FASOM's estimated decreases in crop area when estimating the impacts on endangered species. This is a very conservative assumption which likely leads to an overstatement in the nationwide crop area impact of canola oil-based fuels on endangered species. However, as described earlier in this evaluation, we canola oil-based fuels and corn-based fuels may both expand production under Set rule volume standards. We believe ignoring the decline in corn area projected by FASOM improves alignment between our canola analysis and our corn analysis, where corn area increases within the study area. Therefore, while it leads to a very conservative estimate of nationwide crop area expansion attributable to canola oil, we believe it improves the overall scientific robustness of our findings with respect to potential impacts on endangered species.

Canola and wheat can be produced on the same type of land in high latitude agricultural systems like Canada and North Dakota, and many farmers rotate the two crops. In response to an increase in production of canola, farmers are likely to respond in one of two ways. One option is that total acres in wheat/canola rotation could increase. The other option is for canola to displace wheat area to some extent as farmers tilt rotations more heavily towards the former (e.g., canola-canola rotations rather than canola-wheat rotations). We observe these complex dynamics in the FASOM results for the Canola Case. To increase canola exports to the U.S. market, FASOM estimates the international market would decrease production of wheat, creating an opportunity for U.S. wheat producers to increase their exports. This impact is relatively marginal in comparison to the shock. However, FASOM estimates U.S. wheat exports would increase by about 174 million pounds, or about 0.18 percent. Domestic wheat production would increase by about 169 million pounds and the harvested area in wheat production (excluding wheat used for grazing) would expand by about 63,000 acres, or about 0.02 percent (see Table VI.C-5).

The modeling results also show some minor net shifts in other cropland as markets re-equilibrate in response to the shock, totaling about 28,100 harvested acres, or about 0.01 percent. Harvested crop area impacts are summarized in Table VI.C-5. The shock results in modeled net increase in total domestic harvested crop area of approximately 60,600 acres. This increase would require some shifting of land use from other uses to cropland; as discussed later in this section this land is shifted into cropland from pasture and cropland pasture on net.

Table VI.C-5 – Harvested Crop Area Responses in 2022 (in Thousand Acres) Change from Control

Canola	17.6 (1.2%)
Wheat	63 (0.02%)
Corn	-49.1 (-0.06%)
All Else	28.1 (0.01%)
Total	60.6 (0.02%)

Geographically, the modeled domestic response to the shock is concentrated in North Dakota. Canola production is estimated to increase in North Dakota by about 28.9 million pounds (about 1.4 percent) and canola crop area is estimated to expand by 16,300 acres (as discussed later in this section, this acreage comes from a mix of existing and new agricultural land). This accounts for about 92 percent of the total estimated increase in U.S. domestic canola production in the Canola Case. As North Dakota is the dominant producer of canola in the U.S., this modeled impact appears to be consistent with historical agricultural patterns. North Dakota is also a significant producer of wheat. As canola production is estimated to expand in North Dakota, FASOM estimated wheat production would shift to North Dakota region by about 218 million pounds, decreasing on net in all other regions by about 50 million pounds.

Canola is generally crushed near areas of cultivation and a majority of U.S. facilities that process canola seed are located in North Dakota (NOPA, 2022). Following this, as North Dakota canola production is estimated to expand to supply the canola shock, FASOM estimates the additional seed would be crushed into oil and meal in this region as well. This would expand regional supply of livestock feed and would decrease regional feed prices, relative to other regions of the U.S. FASOM estimates that this, in turn, would create incentives to shift livestock production to North Dakota and nearby states. Since livestock feed mixes require several different components, FASOM estimates this shift in livestock production towards North Dakota would also shift production of other feed crops (e.g., corn, soybeans, hay) into North Dakota. Production of these feed crops are estimated to increase by a total of 115,000 acres in 2022. The modeled changes in North Dakota crop area are summarized in Table VI.C-6. FASOM estimates net cropland in North Dakota would increase by 218,300 acres.[29]

Table VI.C-6 – Changes in North Dakota Crop Area in 2022 (in Thousand Acres) Change from Control Case

Canola	16.3 (1.39%)
Wheat	86.8 (1.42%)
All Else	115.2 (1.38%)
Total	218.3 (1.39%)

Within North Dakota, FASOM estimates that most this additional cropland (212,000 acres) would be taken from USDA Conservation Reserve Program (CRP) land and a smaller amount (7,000 acres) would be taken from cropland pasture. CRP land is essentially cropland which has been allowed to lie fallow to improve environmental health and quality (USDA, 2013). Cropland pasture is a USDA-defined category, describing land on which crops are planted but not harvested and on which animals are allowed to feed or graze (USDA, 2019).

As crop area expands in North Dakota in response to the shock and livestock production shifts to this region, FASOM estimates total crop area would decrease in the rest of the U.S. FASOM estimates this dynamic would primarily shift production from Iowa and Kansas to North Dakota, suggesting a relatively modest northwesterly shift overall. On net, national crop area is estimated to expand by 60,600 acres in 2022. The modeled state-level changes in total harvested crop area are summarized in Table VI.C-7.

[29] Note that FASOM does not track conversion of other land types to cropland by crop. This modeled expansion in North Dakota cropland is best understood as an increase in total cropland at the expense of other land uses rather than an expansion cropland for canola, wheat, or any other specific crop into previously uncropped area.

Table VI.C-7 – Changes in Regional Harvested Crop Area in 2022 (in Thousand Acres)

	Change from Control Case
North Dakota	218.3 (1.4%)
Iowa	-82.7 (-0.3%)
Kansas	-60.5 (-0.5%)
All Other Regions	-14.5 (-0.01%)
Total	60.6 (0.02%)

There are two important observations that can be drawn for comparing the projected changes in harvested crop areas in the U.S. (Table VI.C-5) and in North Dakota (Table VI.C-6). The first is that the projected change in total crop area in North Dakota is greater than the projected change in total crop area in the U.S. This indicates that there is a projected decrease in total crop area in the U.S. in states other than North Dakota. The FASOM estimates project that significant quantities of cropland shift from Iowa and Kansas to North Dakota in response to the shock in canola oil demand (see Table VI.C-7). By focusing our analyses on the projected change in harvested crop area we are assessing something akin to a worst-case scenario, as it is possible that rather than increasing harvested crop area in North Dakota and decreasing harvested crop area in Iowa, Kansas, and others states, farmers could instead respond by keeping this cropland in other states in production, thus decreasing the demand for new cropland in North Dakota. This alternative outcome seems even more plausible when considering the types of cropland expected to increase in the U.S. in response to the Canola shock. In the FASOM estimates both North Dakota and the U.S. as a whole saw larger increases in acreage for wheat and other crops than acreage for canola production. Because both wheat and other crops have greater ranges in the U.S. than canola, there is likely greater uncertainty in the geographic locations for increases in these crops. Taken together, these two observations suggest that the FASOM results may over-estimate land use changes in North Dakota because the estimated acreage increases could occur on cropland that is estimated to cease production in other states and because the estimated land use changes may occur in a broader geographic area than estimated, lessening the intensity of the estimated land use changes in North Dakota.

As FASOM estimates cropland would expand in North Dakota, the majority, about 212,000 acres, is estimated to shift into cropland status from land that is placed in CRP in the Control Case. The remaining area shifting into cropland status is estimated to shift from cropland pasture. As modeled crop production shifts on the margin out of Iowa and Kansas, FASOM estimates CRP area would increase in these regions to compensate for the decrease in North Dakota CRP area; nationwide CRP area does not change on net in our results. FASOM estimates pasture area would decrease nationwide as greater availability of livestock feed would slightly reduce demand for grazing. In some regions, FASOM estimates this previously grazed pastureland would be forested instead, leading to a modeled increase in forestland. The changes in total regional crop area are summarized in Table VI.C-8.

Table VI.C-8 – Changes in National Land Area in 2022 (in Thousand Acres)

	Change from Control Case
Cropland[30]	61 (0.02%)
Cropland Pasture	-57 (-0.07%)
Pasture	-36 (-0.04%)
Forest	32 (0.01%)

In summary, our FASOM results suggest that the production of 200 million gallons of canola oil-based fuels in the U.S. would result in an increase in North Dakota crop area of 218,300 acres, a decrease across all other regions of approximately 157,700 acres, and a net U.S. cropland increase of 60,600 acres. These results are summarized in Table VI.C-9. This results in an impact of approximately 1,092 acres per million gallons of fuel in North Dakota, and 305 acres per million gallons nationwide. This impact is substantially smaller than the estimates discussed for corn ethanol and soybean oil biodiesel discussed elsewhere in this Biological Evaluation. This difference is largely attributable to the significant U.S. reliance on imported canola oil to meet an increase in canola oil-fuel demand.

Table VI.C-9 – Change in Cropland Area per Million Gallons (in Thousand Acres)

	Area
North Dakota	218.3
Rest of U.S.	-158.7
National	60.6

3. Estimated Volume of Canola-Oil Based Fuels Attributable to the RFS Set Rule

In the context of the Set Rulemaking NPRM, EPA produced estimates of the volume of canola-based fuel that might be expected to be produced with and without the proposed volume regulations. These estimates are shown in Table VI.C-11 below. The quantities of canola oil feedstock expected to be used to produce these fuels were also estimated in the Set NPRM and are shown in Table VI.C-10 below.

[30] Note that cropland reported in national land area includes land that is planted but intentionally not harvested, e.g., crops grown for grazing. Land area totals will therefore differ slightly from the harvested crop area data discussed above.

Table VI.C-10: Domestic Biodiesel and Renewable Diesel Projected to Be Produced from Canola Oil (million gallons)

	2023	2024	2025
Biodiesel	240	240	240
Renewable Diesel	0	0	0
Total	240	240	240

Table VI.C-11 Potential Impact of the RFS Volume Requirements on Use of Canola Oil for Biofuel Production (million lbs)

	2023	2024	2025
Estimated Canola Oil Use Without RFS Requirements	0	0	0
Actual/Projected Canola Oil Use With RFS Requirements	1,824	1,824	1,824
Difference	1,824	1,824	1,824

EPA estimates that, with proposed RFS standards for 2023 through 2025 in place, approximately 240 million gallons per year biodiesel-equivalent (MGY) of canola oil-based fuels would be consumed in the U.S. Canola oil use to produce biofuel has been relatively constant in previous years, and as a result we project it will be relatively constant in the near future as well. EPA estimates that, without these standards in place, the volume of U.S. canola oil-based fuel consumption would be virtually zero. Therefore, we estimate that this full 240 MGY would be attributable to the RFS program. A more detailed discussion of our assessment of the projected volume of canola oil used to produce biofuel for 2023–2025 can be found in the RFS Set Rule proposal (*87 FR 80582*, 2022).

We acknowledge that there is significant uncertainty in this estimate and the attribution of it to the RFS program. Recently enacted incentives under the Inflation Reduction Act (IRA) are one source of this uncertainty. The IRA includes tax incentives for sustainable aviation fuel (SAF) which may create significant demand pull for these types of fuels even absent RFS standards. Like other vegetable oils, canola oil can be transformed into jet fuel via hydrotreating processes. Therefore, with these IRA SAF incentives in place in future years, financial incentives to consume canola oil-based biofuels may exist over the time frame of this analysis, even if the RFS program itself were to cease. At this time we do not have the tools that would allow us to incorporate a consideration of these uncertainties in our assessment of future consumption of canola oil for biofuel use. But we do acknowledge that their existence makes it appropriate to characterize the estimated impact of the RFS program on canola oil-based fuels as a relatively conservative estimate, probably closer to the upper bound of expected fuel demand pull than it is to the lower bound of expectations.

4. Estimated Potential Impact of Increased Canola-Based Fuels on U.S. Cropland

Using the estimated canola oil-based fuel volume potentially attributable to the RFS program and the estimated cropland cover impact of canola derived from our FASOM analysis, it is possible to derive an estimate of the quantity of cropland needed to produce the volume of canola oil attributable to the RFS program. This estimate is relative to a baseline representing a hypothetical scenario where the RFS program does not exist.

Assuming, firstly, that 240 MGY of canola oil-based biofuels can be attributed to the RFS program and, secondly, that the average U.S. cropland impact of canola oil-based fuels is 1,092 acres per million gallons of fuel in North Dakota, and 305 acres per million gallons nationwide, we estimate a total impact of 262,080 acres of cropland in North Dakota and 73,200 net acres nationwide are attributable to canola oil-based fuels produced due the RFS program. These results are summarized in Table VI.C-12.

Table VI.C-12 – Estimated change in total crop area attributable to canola oil-based fuels under the RFS program (in Million Acres)

	Area
North Dakota	0.26
National	0.07

VII. Land Use Change Potential Impacts on Listed Species

A. Potential Impacts from Increased Corn Production

1. Identifying Potential Locations of Acres Impacted (FWS Species)

Given the acreage of new cropland and corn estimated in Table VI.A-10 potentially attributable to the Set Rule, we next needed to identify the areas where those land conversion changes may occur in order to assess the potential impact on listed species and habitat (Step 2 of the process outlined in Figure ES.1). As discussed in more detail in Section VI.A.4, the total cropland impacts of increased ethanol demand are expected to be induced through market mediated effects and thus are not any more (or less) likely to occur near ethanol production facilities. Furthermore, there is no modeling tool that we are aware of at this time that can predict with any certainty the precise location of these likely very small land use changes.

Though we may not have been able to estimate the precise location of land conversions to corn or any cropland due to ethanol production that may be attributable to the Set Rule, we were able to use a probabilistic approach to estimate the potential overlap between cropland changes and critical habitats or listed species ranges. In essence, a probabilistic approach randomly selects lands for conversion from a defined set of available land that add up to the amounts in Table VI.A-10, which can subsequently be used to assess whether the species in those habitats or the habitats themselves could potentially be affected by those land conversions. If we repeat that random land-selection process a large number of times, we generate an estimated probability of impact for the land use change estimates potentially attributable to the Set Rule in Table VI.A-10. This overlap could indicate a modification to the geographical area that represents the species' critical habitat and, as such, could impact essential PBFs present in critical habitat. Not all land within the boundary of a critical habitat unit will have PCEs or PBFs. Additionally, given the uncertainty described below, such an overlap does not indicate that such a result is likely to occur.

As shown in the right two columns in Table VI.A-10, we estimated that 390,000–460,000 acres of noncropland may be converted to cropland between 2023 and 2025. Assuming the same trends found in Lark et al. 2015, most of this noncropland that is converted would likely be grassland including both native and planted grasslands, as well as lands that may have been previously used for pasture or hay or retired croplands planted to permanent vegetative cover through the Conservation Reserve Program. The conversions of such lands may involve new tillage and application of fertilizers and pesticides for the new crop. This may occur inside species' critical habitat and/or range, the former which may be detrimental to the species if PBFs within the critical habitat are affected, or it may be outside the critical habitat and/or range. It is possible that grassland within a critical habitat unit does not contain any PCEs or PBFs; on the other hand, such grasslands could have the potential to provide those PCEs/PBFs in the future if they were not converted. The same could be the case within other land cover types (not just grasslands).

Conversion outside the critical habitat and/or range may also affect the species through things such as pesticide drift or overland flow of nutrients or pesticides. A common buffer used to capture potential effects nearby to habitat is 2600 feet.[31] The effect of the conversion of one crop to another (e.g., wheat to corn, soy to corn), depends on the specific conversion considered, and the species under consideration (because some species may be more sensitive to the pesticides for one crop over another). Corn uses more fertilizers than most other crops, but the mixture of pesticides used may differ from crop to crop, with differing effects depending on the crop switch and species under consideration. For example, the rise of genetically engineered corn (e.g. Roundup Ready) facilitated greater adoption of glyphosate-based pesticides, which are less toxic to many non-plant species than many of the pesticides used earlier. Because of these complexities, and because we anticipate the largest potential effect on species to be from conversion of non-cropland habitat to any cropland, we focus on the increase in total cropland in Table VI.A-10 of 390,00–460,000 acres (rather than the increase in corn planting) as the effect to examine in terms of the impacts of land use change on listed species. Impacts on species from water quality impacts are discussed in Section VIII. Much of the increase in corn acreage in Table VI.A-10 is likely from cultivation of new cropland, and much of the new cropland is likely corn.

To assess the potential land use impacts on listed species from increased demand for corn ethanol using a probabilistic approach, we began with the area of potential land use change in Figure III.B-2 and overlayed that with the critical habitat and the range data provided by the Services. We first discuss results for FWS species and then NMFS species separately.

The largest estimated land conversion in Table VI.A-10 is for 2025, with an estimated increase of 460,000 acres of total cropland. To be conservative, we estimate the potential effect of conversion of 500,000 acres of available land to cropland in the area of potential land use change. Not all land in the area of potential land use change is likely to be converted to agriculture (e.g., urban areas, water, etc.). We used land cover classes from the National Land Cover Dataset (NLCD) to identify areas for potential conversion from non-cropland to cropland. Lark et al. (2015) found that the most common land cover type converted to crop production was grassland (77%), shrubland (8%), and idle land (8%). We used as the summation of four land cover classes and the most likely set of land for potential conversion:

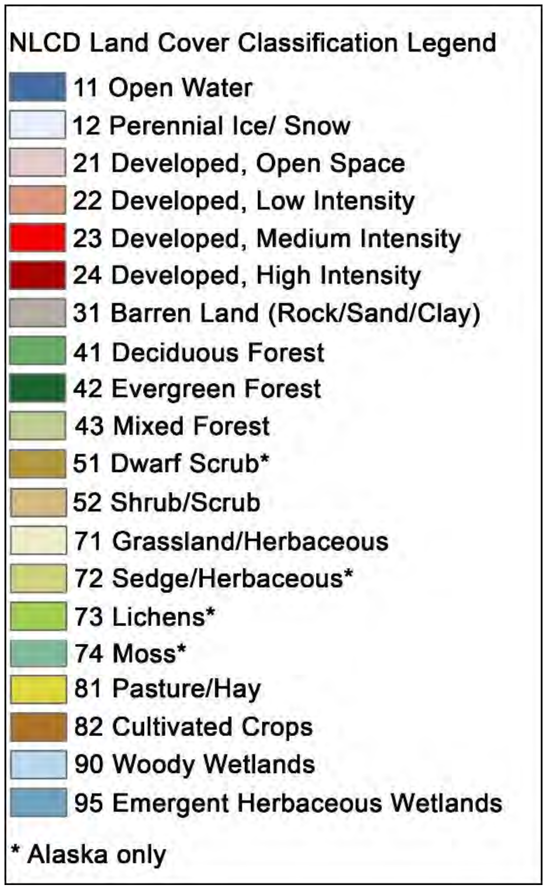
- shrub (NLCD class #52)
- grassland/herbaceous (#71)
- pasture/hay (#81)
- emergent herbaceous wetlands (#95)

Idle land is not a land cover class in the NLCD and is likely pasture/hay. Wetlands have a high conservation value for the ecosystem services that they provide and as habitat for many species, and emergent herbaceous wetlands are easier to convert to agriculture than wooded wetlands due

[31] From the EPA Revised Method for National Level Listed Species Biological Evaluations of Conventional Pesticides (US EPA, 2020): "The endpoint that results in the farthest distance from the treated field where any effect to the listed species or it's Prey, Pollination, Habitat, and/or Dispersal (PPHD) may occur relative to a specific listed species will be used to determine the off-site transport distance for that species. This distance is capped at 2600 feet (the area limit of the AgDRIFT model)."

to the absence of trees. Thus, to be conservative we included this land cover class. Other land cover classes are unlikely to be converted to cropland in the area of potential land use change. Forested areas are uncommon, more difficult to convert to agricultural production, and were found in Lark et al. (2015) to account for a small percentage (3%) of lands converted to agriculture. We therefore focus on the total of these four land cover classes as the source of land for potential conversion to cropland.

Figure VII.A-1: NLCD land cover classes for potential conversion.



In order to determine how the 500,000 acres of conversion were to be distributed, we considered the factors used to estimate the national-level acreage impacts shown in Table VI.A-10. These factors were derived from analyses originally completed by Li et al. (2019) and were expanded in the context of the draft Third Biofuels Report to Congress (Li et al., 2018) (US EPA Center for Public Health & Environmental Assessment & Clark, 2023). These effects manifest either through ethanol production or through price effects. Effects through ethanol production are simulated to occur closer to biorefineries (i.e., within 25 miles in Li et al (2019), while effects through price may occur anywhere in the action area. Since the effects were estimated to be dominated indirectly by price effects rather than directly through ethanol production, we simulated the conversion of 500,000 acres of available non-cropland to cropland randomly across the area of potential land use change.

We overlayed a 30-acre grid over the continental United States (CONUS) and randomly sampled 500,000 acres of available land in the area of potential land use change for conversion.[32] We then compared this with critical habitat to estimate the area of critical habitat estimated to be converted to cropland for each species. We repeated the 500,000 acre-conversion simulations 500 times to generate a distribution of probabilistic effects. We also ran simulations for conversion of 500,000 acres that included a 2600-foot buffer around critical habitat to account for pesticide drift or other potential effects nearby to species' critical habitat. Finally, conversion to cropland may impact a species even if it is well outside the critical habitat if it is within the range that the species occupies. Thus we repeated the above analyses using the range of species instead of the critical habitat. Because the ranges of species are much larger than the critical habitat, the simulations were much more computationally intensive. Thus we reduced the number of replicates for the range simulations to 100. In total, there were four scenarios run to assess effects on species critical habitat and range (Table VII.A-1) The results are summarized separately by critical habitat (CH) and range), and by the absence or presence of a buffer.

Table VII.A-1. List of scenarios for FWS species-level effects from increases in cropland

Scenario #	Total acres converted (acres)	Critical habitat (CH) or range (R)	Buffer	Replicate iterations
S1	500,000	CH	None	500
S2	500,000	CH	2600'	500
S3	500,000	R	None	100
S4	500,000	R	2600'	100

2. Potential Impacts on Listed Species and Critical Habitat (FWS species)

The probability analysis provides some indication about the likelihood that a change in land use that is attributable to the Set rule might occur within or near the geographical boundaries of a species' critical habitat or range. For instance, if the probability analysis found that, out of 500 iterations, 50 of them included land use changes on critical habitat, one might conclude that there is a 10% chance (50/500) of this occurring in actuality. Such conclusions necessarily include uncertainty, since a repeat of the 500 iterations might result in more or less than 50 occasions of overlap between land use change and critical habitat, and a larger or small number of total iterations can also affect the outcomes. Nevertheless, the probability analysis provides some indication of what one might expect to see once the standards in the Set Rule are put into effect.

For the analysis of critical habitat with no buffer (S1), we found that roughly 112 unique species that were impacted at least once across all 500 iterations of the 500,000-acre conversion

[32] The vast majority of U.S. farms are 10-49 acres or larger (USDA, 2019 Census, Figure 2). Thus, using a 30-acre grid size to capture areas for potential conversion is consistent with U.S. farms. We ran sensitivity analyses using a 15-acre grid and the results were not affected.

simulations. (Table VII.A-2). We found conversion of 4024 acres of critical habitat on average across all iterations (10th – 90th percentiles: 3480 – 4560 acres). Some species were impacted in only a few simulations, while others were impacted more frequently. To illustrate, although there were 112 species impacted in at least one simulation, there were 23 species impacted in 50% of the simulations and 2 species impacted in every simulation. There were 46 species that had some critical habitat converted in 5% or more of iterations. In addition to the frequency of impact across simulations, the magnitude of impact is relevant. We also tabulated the amount and percent of critical habitat impacted by species. We found that zero species had one percent or more on average of its critical habitat impacted (i.e., conversion within critical habitat), while 28 species had greater than 0.05% of critical habitat impacted on average. The Clay-Loving Wild Buckwheat saw the largest potential impacts to its critical habitat at an average of 0.4%.

For the analysis of critical habitat with a 2600' buffer (S2), we found that 145 unique species were impacted at least once across all 500 iterations, and 121 species had some critical habitat converted in 5% or more of iterations (Table VII.A-2). We found conversion of 7926 acres of critical habitat plus the 2600' buffer on average across all iterations (10th–90th percentiles: 7110–8730 acres). We found that 32 species had one percent or more of its critical habitat plus buffer potentially impacted (i.e., conversion within critical habitat or within 2600' of critical habitat). The Fleshy-Fruit Gladecress saw the largest potential impacts to its critical habitat plus buffer at an average of 13.6%.

For simulations with the buffer added, we deliberated what to use in the denominator when calculating % of species critical habitat or range impacted, whether the total area (i.e., critical habitat and buffer) or only the critical habitat or range area. We examined both approaches and chose the more conservative approach. We found that in these simulations the total area affected for a species often increased due to the inclusion of the buffer, but when the denominator includes the total area with buffer, the percent area affected decreased compared to the simulations without the buffer. This occurs because the addition of buffer in the denominator adds a large amount of non-critical habitat area. But when we keep the denominator the same as the simulations without the buffer (just the area of a species critical habitat or range) then we find that the percent area affected increased. Because the notion is that conversion near critical habitat (but not inside) actually affects critical habitat (e.g., through pesticide drift), we opted to use the version of the simulations that had only critical habitat in the denominator. This is a more conservative approach. This means that we may interpret these simulations to represent the acreage and percent of critical habitat affected by conversion in (no buffer) or near (with buffer) critical habitat. We believe that this is the best approach but recognize that others may be reasonable as well.

For the analysis of species range with no buffer (S3), we found that 582 unique species were impacted at least once across all 100 iterations (Table VII.A-2). Because nearly the entire CONUS is covered by the range of at least one listed species, it is expected that much of the projected land conversion would occur in the range of at least one listed species. Despite these estimated conversions of range, we found only four species had one percent or more of its range converted (Table VII.A-2). One of these species, the Scioto madtom, is listed as extinct by the International Union for Conservation of Nature and is currently proposed to be delisted by the

FWS (USDA, 2013). This species was also identified in scenario 4. The White catspaw saw the largest potential impacts to its range at an average of 7.4%.

For the analysis of species range with a 2600’ buffer (S4), we found that 581 unique species were impacted at least once across all 100 iterations. We found only three species had one percent or more of its range converted (Table VII.A-2), including the Scioto Madtom. The White catspaw again saw the largest potential impacts to its range at an average of 6.9%.

The top 20 species impacted as assessed by percent of critical habitat with a 2600’ buffer (S2) are shown in Table VII.A-3 (full results of all species are included as an excel sheet attached to this Biological Evaluation). We provide more information on the potentially impacted species further below, including information on species that have the largest potential impacts based on these acreage impact results alone (and not on other important information including PBFs for critical habitat).

Table VII.A-2. Summary of effects across scenarios from the corn ethanol probabilistic analysis (FWS species)

Scenario #	# Spp. impacted at least once	# spp. impacted in 5% or more of iterations	Average acreage of CH or range conversion (10th – 90th range)	Number of spp. with 1% or more of CH or range impacted on average	Common name of sp. with >1% of CH or range converted.
S1	112	46	4024 (3480 – 4560)	0	None
S2	145	121	7926 (7110 – 8730)	32	Fleshy-fruit gladecress, Slenderclaw crayfish, Devils River minnow, Slackwater darter, False spike, Roswell springsnail, Texas fawnsfoot, Guadalupe Orb, Noel's Amphipod, Koster's springsnail, Amber darter, Niangua darter, Texas pimpleback, Conasauga logperch, Rush Darter, Clay-Loving wild buckwheat, Yellow lance, Maryland darter, St. Francis River Crayfish, diamond Darter, Finelined pocketbook, San Marcos gambusia, Salt Creek Tiger beetle, Texas wild-rice, Carolina heelsplitter, Big Creek Crayfish, Frecklebelly madtom, Short's bladderpod, Canoe Creek Clubshell, Umtanum desert buckwheat, Peppered chub, Topeka shiner
S3	582	N/A*	N/A*	4	White catspaw (pearlymussel), Virginia round-leaf birch, Scioto madtom, San Marcos salamander
S4	581	N/A*	N/A*	3	White catspaw (pearlymussel), Virginia round-leaf birch, Scioto madtom

* These summarizing statistic results for the range scenarios (S3) and (S4) include 200+ species that are not considered in this Biological Evaluation because they have a listing status of resolved, under review, recovery, or undefined. As such, the results are not presented here as they provide a skewed assessment with the inclusion of those species.

Table VII.A-3. Summary of probabilistic results for the top 20 FWS species affected (ranked by the percent effect from S2, which depicts results from simulations for conversion of 500,000 acres that included a 2600-foot buffer around critical habitat to account for pesticide drift or other potential effects nearby to species' critical habitat)

		Acres affected of critical habitat (S1 and S2) or range (S3 and S4)				Percent affected of critical habitat (S1 and S2) or range (S3 and S4)			
Common name	Scientific name	S1	S2	S3	S4	S1	S2	S3	S4
Fleshy-fruit gladecress	*Leavenworthia crassa*	0	4.1	258.3	261.6	0	13.631	0.076	0.077
Slenderclaw crayfish	*Cambarus cracens*	0.1	41.5	246.3	252.6	0.028	9.767	0.112	0.115
Devils River minnow	*Dionda diaboli*	0	11.3	438.9	458.1	0	7.51	0.015	0.015
Slackwater darter	*Etheostoma boschungi*	0.9	56.3	520.5	528.3	0.105	6.588	0.072	0.073
false spike	*Fusconaia mitchelli*	0.5	116.6	3764.4	3823.8	0.018	4.388	0.047	0.047
Roswell springsnail	*Pyrgulopsis roswellensis*	0.1	3.1	49.2	40.8	0.17	4.336	0.048	0.04
Texas fawnsfoot	*Truncilla macrodon*	0.6	315.2	8411.7	8496.3	0.008	4.259	0.043	0.043
Guadalupe Orb	*Cyclonaias necki*	0.1	96.4	2589.3	2567.4	0.005	4.034	0.067	0.06'
Koster's springsnail	*Juturnia kosteri*	0.1	2.3	52.5	42.9	0.17	3.23	0.052	0.042
Amber darter	*Percina antesella*	0.2	12.9	153.6	159.6	0.044	3.154	0.024	0.025
Niangua darter	*Etheostoma nianguae*	0	37	3311.1	3319.8	0	2.823	0.071	0.071
Texas pimpleback	*Cyclonaias petrina*	0.4	104.3	2644.8	2614.8	0.011	2.611	0.03	0.03
Conasauga logperch	*Percina jenkinsi*	0	5.3	98.4	97.5	0	2.488	0.047	0.047
Rush Darter	*Etheostoma phytophilum*	0	0.7	531.9	550.5	0	2.428	0.037	0.039
Clay-Loving wild buckwheat	*Eriogonum pelinophilum*	0.5	2.9	339.3	332.1	0.397	2.383	0.102	0.1
Yellow lance	*Elliptio lanceolata*	0.5	65.5	2208	2184	0.017	2.318	0.036	0.036
Maryland darter	*Etheostoma sellare*	0	0.5	25.2	26.7	0	1.681	0.06	0.063
St. Francis River Crayfish	*Faxonius quadruncus*	2	133.9	239.4	225.6	0.025	1.616	0.029	0.027
diamond Darter	*Crystallaria cincotta*	0.2	30.5	232.8	234.6	0.012	1.574	0.019	0.019

Plants

Based on our analysis, the Fleshy-fruit gladecress could be impacted by pesticide drift from cropland expansion due to increases in corn ethanol from the RFS Set Rule. The S2 scenario suggests that, on average, 13.4% of the area representing this species' critical habitat plus a 2600-foot buffer could be affected. Found only in the state of Alabama, this endangered species has been primarily affected by habitat destruction with off-road vehicle use and agricultural conversion as threats to their growth. They tend to thrive in limestone outcroppings near forest edges as shade plants will inhibit their growth. The existing populations reside primarily on residential lands and in rocky outcrops in pasture fields (US FWS, 2020). While 13.4% of the Fleshy-fruit gladecress' critical habitat with a buffer may be affected, our analyses show that none (0%) of its critical habitat itself may be converted. Further, only a small percentage of its range (0.08%) may be converted.

The Clay-loving buckwheat is primarily affected by recreational vehicle traffic and livestock grazing. It is also impacted by other stressors including commercial and residential development, invasive species, and climate change. This endangered species is predominantly located in Colorado and the land they thrive on is described as barren and inhospitable to most vegetation. Because of this specific terrain, this plant has limited habitat and is highly fragmented. Currently there are numerous conservation efforts in place to mitigate stressors and enhance habitat conditions (US FWS, 2022). About 0.4 and 0.1 percent of this species' critical habitat and range, respectively, could be converted to agriculture based on our analysis. This could potentially contribute to more livestock grazing. However, it is unknown if any potential agricultural production would actually occur in many of these locations, since the lands where these species are found are barren with clay-rich soils which may present challenges for farming.

Aquatic Species

Many of the FWS species in Tables VII.A-2 and VII.A-3 are aquatic species. Although the probabilistic analysis we conducted was a land use change exercise, it is possible that these species were picked up if their critical habitat or range includes riparian or other surrounding lands. If land use changes were to occur in such locations, they could still impact the species by pesticide drift (demonstrated with scenarios 2 and 4) or localized water quality impacts. However, it is possible that land use changes may not impact the aquatic species at all if, for instance, a farmer uses best management conservation practices on the new cropland, or if the unique geomorphology of the land directs runoff to another location where the species is not present. At this time, we are unable to assess these factors fully, and therefore our interpretation of the results is likely more conservative than what may occur in reality.

Based on our results, one aquatic species that may be impacted is the Slenderclaw crayfish. Located in Alabama, this endangered species' critical habitat could be impacted by pesticide drift based on scenario two. A very small percentage of its critical habitat (0.03%) and range (0.1%) could be impacted directly. Historically, the largest impact to their critical habitat occurred with the construction of the dam for the Tennessee River. This dam created Lake Guntersville in 1939 which destroyed several habitats and isolated the two remaining populations from each other. The remaining two habitats have also experienced impacts from invasive species and water pollution, including pollution from upstream animal farming (US FWS, 2019).

The Noel's amphipod is another type of crustacean. Their habitat, located in New Mexico, has similarly been historically affected by water quality impacts. Their population is thought to exist only in the Bitter Lake National Wildlife Refuge. Because this endangered species is located entirely in a wildlife refuge, impacts from nearby land changes have been greatly reduced (US FWS, 2019a). Any land converted to corn cropland would likely be located a significant distance from their habitat.

Based on our analysis, the Devils river minnow may be impacted by pesticide drift from newly converted lands. None of its critical habitat, and only a small percentage of its range, however, could be directly impacted. This threatened fish is found in a small area of the Del Rio in southern Texas. Its range was at some point considerably larger but has shrunk due to pollutants entering the local aquifer and drought which impacts their reproductive grounds. A recovery plan has been implemented by several governmental agencies. This plan primarily revolves around ensuring land management by local ranges to prevent pollutants from reaching the river where these fish and other species are located (US FWS, n.d.-b).

Darters are small freshwater fish which tend to live along the bottom of rivers. Because of this bottom dwelling tendency, they are more susceptible to impacts on water quality than other species. They use the rocky or sandy bottom of waterways for protection and foraging. Any addition of silt due to soil erosion could impact their habitats. The Amber darter for example lives in two rivers in Georgia and Tennessee. This endangered species has been affected by water quality impacts including land change, urbanization, and extreme weather events due to climate change. These weather events cause changes in the flow of the rivers potentially disrupting their reproductive habitats. Recovery plans are in place. However, construction of a reservoir near one of their habitats has the potential to disrupt waterflow and further alter their existing habitat (US FWS, 2020a). The Amber Darter could see very small direct impacts to its critical habitat and range, based on our analyses.

Freshwater mussels are an important species in all ecosystems. They are filter feeders which means that they siphon their food from the water, eating mostly small organisms and organic materials. Similar to the discussion of darters above, freshwater mussels live along the bottom of waterways. This makes them susceptible to the impacts of poor water quality and pollution. The False spike, Guadalupe orb, and Texas Pimpleback are all proposed endangered freshwater mussel species with critical habitat found mostly in Texas. Habitat change for these mussels has been attributed to water flow inconsistency, with rivers being prone to both flood and drought. Inconsistent water flow can change the terrain on the river bottom where they tend to dwell in the gravel and cracks of rocks. The rivers also flow through areas of high agriculture and pastoral lands which both pump water from the habitats and contribute to water pollution. Recent conservation efforts have increased their focus on freshwater mussel populations. Recovery efforts with the Texas pimpleback for example, have been working to breed and redistribute these mussels into the waterways (Aubry & US FWS, 2021).

3. Identifying Potential Locations of Acres Impacted (NMFS Species)

We used the same general procedures for identifying potential locations of acres impacts from increased canola production as was used for identifying locations of acres impacted from increased corn production. The details of that analysis are described in section VII.A and relevant differences are summarized here.

The same analysis as described in section VII.A was applied. For convenience, we use the same scenario names (Table VII.A-4).

Table VII.A-4. List of scenarios for NMFS species-level effects from potential increases in cropland

Scenario #	Total acres converted (acres)	Critical habitat (CH) range (R)	Buffer	Replicate iterations
S1	500,000	CH	None	500
S2	500,000	CH	2600’	500
S3	500,000	R	None	100
S4	500,000	R	2600’	100

4. Potential Impacts on Listed Species and Critical Habitat (NMFS Species)

For the analysis of critical habitat with no buffer (S1), we found that 31 unique species populations were potentially impacted at least once across all 500 iterations, and the same 31 populations had some critical habitat potentially converted in 5% or more of iterations (Table VII.A-5). We found conversion of 12,686 total acres of critical habitat on average across all iterations (10^{th} – 90^{th} percentiles: 11,700 – 13,710 acres). We found that zero species had 0.1 percent or more of its critical habitat potentially impacted (i.e., conversion within critical habitat). The species with the greatest potential impact was the Chinook Salmon (Snake River fall-run) with 0.031% of its critical habitat potentially affected.

For the analysis of critical habitat with a 2600’ buffer (S2), we found that 31 unique species populations (the same as above) were potentially impacted at least once across all 500 iterations, and the same 31 populations had some critical habitat potentially converted in 5% or more of iterations (Table VII.A-5). We found conversion of 13,828 acres of critical habitat plus the 2600’ buffer on average across all iterations (10^{th} – 90^{th} percentiles: 12,780 – 14,850 acres). We found that zero species had 0.1 percent or more of its critical habitat potentially impacted (i.e., conversion within critical habitat or within 2600’ of critical habitat). The species with the greatest potential impact was the Chinook Salmon (Snake River fall-run population) with 0.034% of its critical habitat potentially affected.

For the analysis of species range with no buffer (S3), we found that 36 unique species were potentially impacted at least once across all 500 iterations, and 36 species had some of its range potentially converted in 5% or more of iterations (Table VII.A-5). We found conversion of 16,181 acres of range on average across all iterations (10th – 90th percentiles: 15,090 –17,250 acres). We found that zero species had 0.1 percent or more of its range potentially impacted. The species with the greatest potential impact was the Chinook salmon (Snake River fall-run) with 0.03 percent of its range potentially affected.

For the analysis of species range with a 2600' buffer (S4), we found that 36 unique species were potentially impacted at least once across all 500 iterations, and 36 species had some of its range potentially converted in 5% or more of iterations (Table VII.A-5). We found conversion of 17,210 acres of range plus the 2600' buffer on average across all iterations (10th–90th percentiles: 16,050–18,330 acres). We found that zero species had 0.1 percent or more of its range potentially impacted. The species with the greatest potential impact was the Chinook salmon (Snake River fall-run) with 0.033 percent of its range potentially affected.

The top 20 species impacted as assessed by percent of critical habitat with a 2600' buffer (S2) are shown in Table VII.A-6 (full results of all species are included as an excel sheet attached to this Biological Evaluation). We provide more information on the potentially impacted species further below, including information on species that have the largest potential impacts based on these acreage impact results alone (and not on other important information including PBFs for critical habitat).

Table VII.A-5. Summary of effects across scenarios

Scenario #	# populations impacted at least once	# populations impacted in 5% or more of iterations	Average acreage of CH or range conversion (10th – 90th range)	Number of populations with 0.1% or more of CH or range impacted on average	Common name of sp. with >0.1% of CH or range converted.
S1	31	31	12,686 (11,700-13,710)	0	None
S2	31	31	13,828 (12,780-14,850)	0	None
S3	36	36	16,181 (15,090 – 17,250)	0	None
S4	36	36	17,210 (16,050 – 18,330)	0	None

Table VII.A-6. Summary of probabilistic results for the top 20 NMFS populations affected (ranked by the percent effect from S2, which depicts results from simulations for conversion of 500,000 acres that included a 2600-foot buffer around critical habitat to account for pesticide drift or other potential effects nearby to species' critical habitat)

			Acres affected of critical habitat (S1 and S2) or range (S3 and S4)			
Common name	**Scientific name**	**Population name**	**S1**	**S2**	**S3**	**S4**
Chinook salmon	*Oncorhynchus tshawytscha*	Snake River fall-run	0.031	0.034	0.03	0.033
Steelhead	*Oncorhynchus mykiss*	Upper Columbia River	0.03	0.032	0.028	0.031
Chinook salmon	*Oncorhynchus tshawytscha*	Upper Columbia River spring-run	0.024	0.026	0.029	0.032
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	South Atlantic	0.023	0.025	0.019	0.021
Steelhead	*Oncorhynchus mykiss*	Upper Willamette River	0.021	0.023	0.022	0.023
Sockeye salmon	*Oncorhynchus (=Salmo) nerka*	Snake River	0.02	0.021	0.023	0.026
Atlantic sturgeon (Gulf subspecies)	*Acipenser oxyrinchus desotoi*	None	0.016	0.02	0.002	0.003
Chinook salmon	*Oncorhynchus tshawytscha*	Upper Willamette River	0.017	0.019	0.017	0.018
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Carolina	0.016	0.018	0.012	0.013
Steelhead	*Oncorhynchus mykiss*	Snake River Basin	0.014	0.015	0.014	0.015
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Gulf of Maine	0.012	0.014	0.002	0.002
Steelhead	*Oncorhynchus mykiss*	Middle Columbia River	0.012	0.013	0.013	0.014
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Chesapeake Bay	0.011	0.013	0.011	0.011
Atlantic sturgeon	*Acipenser oxyrinchus*	New York Bight	0.011	0.013	0.008	0.008

	oxyrinchus					
Chinook salmon	*Oncorhynchus tshawytscha*	Snake River spring/summer-run	0.011	0.012	0.013	0.014
Chinook salmon	*Oncorhynchus tshawytscha*	Sacramento River winter-run	0.009	0.011	0.009	0.009
Chum salmon	*Oncorhynchus keta*	Columbia River	0.009	0.01	0.006	0.007
Yelloweye rockfish	*Sebastes ruberrimus*	Puget Sound/ Georgia Basin	0.008	0.01	0.01	0.013
Steelhead	*Oncorhynchus mykiss*	California Central Valley	0.008	0.009	0.01	0.01
Chinook salmon	*Oncorhynchus tshawytscha*	Puget Sound	0.008	0.009	0.008	0.008

Fish (Salmonids)

Sturgeon are one of the most endangered species in the United States. There are currently 29 species, most live in the ocean and travel upriver during the spring and summer to spawn. In the corn probabilistic analysis, three species of sturgeon were identified with a low potential impact from the RFS rule: The Atlantic sturgeon (Gulf sturgeon), Green sturgeon and the Shortnose sturgeon.

The Gulf sturgeon is a sub-species of the Atlantic sturgeon. As the name suggest, this species resides primarily in the gulf region of Louisiana, Mississippi, and Florida, however, the larger Atlantic sturgeon species can range as far north as Canada. Populations of Gulf sturgeon have been impacted over the years from factor such a dam construction to water degradation. As sturgeon spawn in the rivers during the summer, dams can impede their cycle and have been known in some cases to separate some species above and below the obstacle. The remainder of the year, they live in the estuary, or mixed salt and freshwater region of the river and fully in the ocean during the winter months. Pollutants pose a significant effect to the gulf sturgeon. Impacts may be caused directly by impacting their organs and reproductive systems or indirectly by becoming incorporated into the food they eat (NOAA, 2022; U.S. Fish and Wildlife Service, n.d.-a).

The shortnose and green sturgeon share many characteristics of the gulf sturgeon discussed in the NMFS soybean section of this BE. This includes their living situations throughout the year (river and ocean migrations) and species stressors such as spawning route obstructions and sensitivity to water quality.

The shortnose sturgeon resides in Atlantic waters between Canada and Florida. Three large populations exist but there is a large gap between the southern and northern populations which keeps them completely separated. The shortnose sturgeon was overfished alongside the Atlantic sturgeon which impacted their numbers in the early 1900s. Unlike the Atlantic sturgeon, they tend to remain in their freshwater territories and spend a very short time in the ocean. Similar to other sturgeon species, their habitat is often disturbed by obstructions such as dams which prevent them from reaching their spawning grounds or reaching their food sources (NOAA, 2023a).

The green sturgeon differs from those we’ve discussed as they reside on the west coast and are one of only two that do. Although they can range from Alaska to Mexico, they are commonly found in the San Francisco area. Unlike their east coast relatives, this species spends the majority of their time in the estuaries or out in oceanic waters (NOAA, 2023d).

Cool, turbulent waters are needed for this subspecies to spawn. This has become a problem in recent years as access to these habitats needed for spawning have become harder to access. These issues include dams and altered water flows. Insufficient water availability has also affected this species. Once again, we refer to the sturgeon section as the steelhead trout has very similar habitat impacts.

Several subspecies of steelhead trout, most of which are either endangered or threated. The species we have evaluated for this Biological Evaluation are designated as threatened.

- Snake river basin
- Upper columbia river
- Middle columbia river
- Upper willamette river
- California central valley
- Puget sound

Like the sturgeon, steelhead trout live in cold oceanic waters and migrate into rivers or streams in order to spawn. A gravel base is required spawning as the female steelhead will dig a nest into the rocky material. Young steelhead remain in the rivers for a few years to feed on zooplankton before moving in the river estuary (NOAA, 2023b; NOAA, 2023c).

The bocaccio is a large Pacific coast rockfish commonly found in Punta Blanca, Baja California, and the Gulf of Alaska off Krozoff and the Kodiak Islands, yet most populations are found between Oregon and northern Baja California. The bocaccio, like most rockfish species, are an integral part of the aquatic food web. Larval bocaccio, for example, are a food source for juvenile salmon and other marine fish and seabirds. Since the bocaccio do not begin to produce offspring until they are 5 to 20 years old, their populations are largely dependent on the how many sexually mature fish were caught that season. As such, certain populations can be susceptible to overfishing. Their most significant stressors are from bycatch and bottom trawling gear, which destroys their sensitive rocky, cold-water coral and sponge habitats (NOAA Fisheries, 2022a; NOAA Fisheries, 2023a). Our analysis suggests that up to 0.009% and 0.013% of the Bocaccio's critical habitat and range, respectively, could potentially be impacted by the projected corn expansion area.

The Yelloweye rockfish is found along the western coast of North America from the Aleutian Islands to the Baja Peninsula. They are often solitary and inhabit steep rocky areas where they may shelter in nooks and crannies. This species is the longest living rockfish species, with some fish living as long as 150 years. Similar to the bocaccio, they grow very slowly and are late to mature. Due to this, their species depends on maintaining an extended population age structure, leaving them susceptible to habitat degradation and overfishing. In 2002, the National Marine Fisheries Service declared that the west coast yelloweye rockfish was being overfished. Since then, major recovery efforts have been undertaken, yet their population has been slow to rebound due to their slow maturation rate (NOAA Fisheries, 2023e). Our analysis suggests that up to 0.01% and 0.013% of the Yelloweye rockfish's critical habitat and range, respectively, could potentially be impacted by the projected corn expansion area.

The Chinook salmon is found in North America, ranging from the Monterey Bay area of California to the Chukchi Sea area of Alaska. The subpopulations covered as part of our regional assessment are the Central Valley spring-run, Puget Sound, Snake River fall-run, Snake River spring/summer-run, Upper Columbia River spring-run, and the Upper Willamette River. The

Chinook salmon is an anadromous fish, meaning they can live in both fresh and saltwater environments. Their early life is spent growing and feeding in freshwater streams, estuaries, and associated wetlands. The remainder of their life is spent foraging in the ocean before their return to the streams and tributaries where they spawn. Other than the Klamath River Fall stocks, the Chinook Salmon is not subject to overfishing, and since fishing gear used to catch Chinook salmon rarely contacts the ocean floor, fishing of this species rarely impacts other aquatic habitats. The main habitat issue for salmon recovery is restoring quality salmon habitat that once supported thriving and robust salmon runs (NOAA Fisheries, 2023b; NOAA Fisheries, 2023c). Our analysis suggests that up to 0.034% and 0.033% of the Chinook salmon's critical habitat and range, respectively, could potentially be impacted by the projected corn expansion area.

The Sockeye salmon is found along the west coast of North America, ranging from the Klamath River in Oregon to Point Hope in northwestern Alaska. The largest sockeye salmon populations are found in Kvichak, Naknek, Ugashik, Egegik, and Nushagak Rivers that flow in Alaska's Bristol Bray, as well as the Fraser River system in Canada. Like the Chinook salmon, this species is anadromous, where the youth are spawned and raised in rivers, followed by a migration to saltwater to feed, grow and mature before returning back to spawning fresh waters. Sockeye salmon are particularly vulnerable to habitat and migratory disruptions from blocked access to spawning grounds caused by dams and culverts (NOAA Fisheries, 2023d). Our analysis suggests that up to 0.021% and 0.026% of the sockeye salmon's critical habitat and range, respectively, could potentially be impacted by the projected corn expansion area.

B. Potential Impacts from Increased Soybean Production

1. Identifying Potential Locations of Acres Impacted (FWS and NMFS species)

In order to assess the potential impact on listed species and critical habitat for the changes in soy planting related to increased use of biomass-based diesel (BBD), EPA adapted the analysis of its contractor ICF to estimate where additional soy acres are likely to occur and overlay those results with species and habitat data using a quantitative GIS-based approach. EPA staff then performed additional analysis using the ICF results and other information to assess impacts on specific species.[33]

The ICF work evaluated a range of soy oil volume scenarios in two contexts: an extensification case where all additional acres were sited on land not previously cultivated, and an intensification case where the additional acres were made up through higher yields on existing soy fields or displacement of other crops. These scenario parameters were meant to bracket the potential scale and impacts of the 2023–25 standards. The acreage estimates we developed earlier in Section VI.B.5 align well with the extensification results of ICF's 100 and 250-million-gallon scenarios, and thus we believe those land use changes are relevant and useful in determining species impacts.

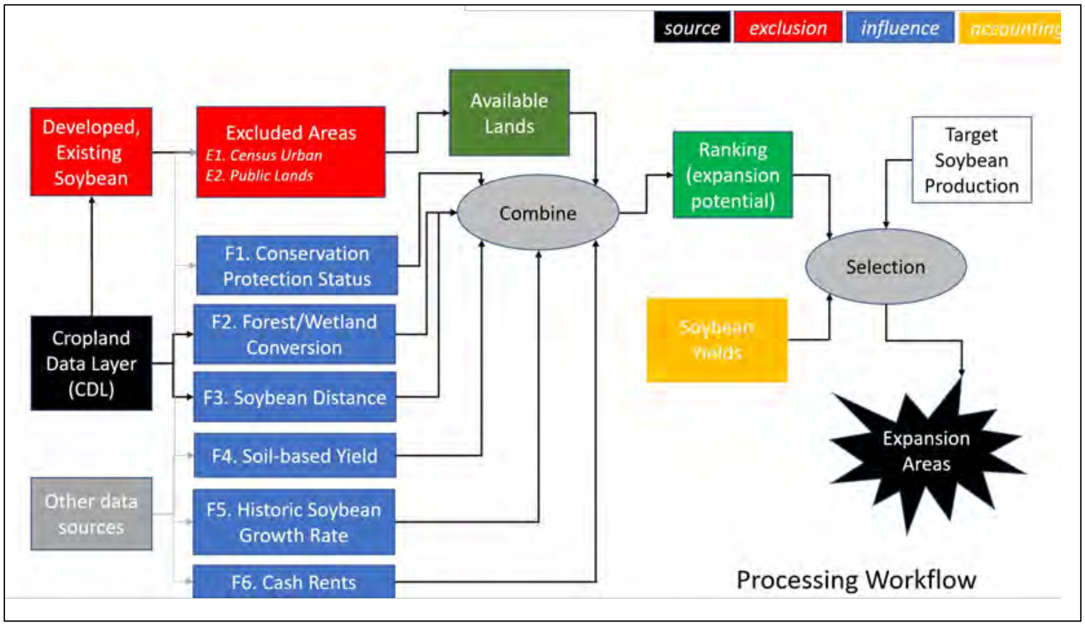
This section starts with a summary of the ICF work and its results, and then proceeds into the EPA assessment of potential species impacts. Copies of the ICF reports are available as an attachment to this Biological Evaluation.

Overview of ICF Workflow

The first step in determining the potential location and extent of soybean expansion areas was to compute a total acreage target by dividing the additional soybean demand by the projected crop yield in bushels per acre for the scenario year of 2025. A land selection model was then devised that assigned a rank to potential new acres based on a number of factors, and then added them to the expansion area according to their rank until the total acreage target was met. Figure VII.B-1 summarizes this workflow. The rest of Section VII.B will summarize key aspects of the analysis.

[33] Differing approaches were taken to assess habitat and species impacts of soy, corn, and canola expansions because of the types of information available and the timelines for different parts of the work.

Figure VII.B-1: Soy expansion workflow summary



Target Expansion Acreage

The first step in computing the target expansion acreage is converting the incremental biomass-based diesel (BBD) volume scenarios into bushels. This was done using a factor of 1.5 gallons BBD per bushel of soybeans, a factor derived from the crushing and conversion processes that is used throughout the RFS analyses. This factor means that 100 million and 250 million gallons will require 67 million and 167 million bushels, respectively. Note that this 1.5 value is not related to climate, soil quality, or other agricultural parameters.

The second piece of information is the soybean yield in bushels per acre. Using a regression of historical yield data from USDA for years 2000 to 2020, ICF projected a yield of 55 bushels/acre in the scenario year of 2025 (USDA, 2022b). Combining this yield with the required bushels above gives target expansion areas of 1.2 and 3.0 million acres for the 100-million and 250-million-gallon scenarios, respectively. Note that the final expansion area is somewhat larger than these figures due to downward adjustment of yields for new acres relative to the historical average for currently-producing acres. This is reasonable if we assume that the most suitable land for crop production is already in use. This adjustment is discussed further below.

Note also that the extensification scenario stipulated that the expansion acres must be accommodated in addition to all existing soybean producing farmland. Therefore, increased yields from existing soybean acres that might occur prior to 2025 were not considered available in the extensification scenarios. Thus, these acreage values could be considered upper-end estimates.

Location-Specific Crop Yields

USDA's Natural Resources Conservation Service (NRCS) publishes a national soil quality database that incorporates information from field studies and satellite surveys (NRCS, 2019). In addition, USDA's National Agricultural Statistics Service (NASS) publishes crop yield data for counties where crop production occurs (USDA NASS, n.d.). These data sources were combined to estimate soybean yields for potential expansion acres, including areas where no soy may have been grown historically. This information was used in the ranking of suitability of parcels for new soy planting, as discussed further in the ICF report. It was also used to adjust the weight of a particular acre of new soy, relative to the national average 55 bushels per acre noted above, before subtraction from the total acreage target.

Geographic Scope of Analysis

Before assessing specific locations where additional soy acres are likely to be sited, a review of recent soybean expansion at the state level was used to guide projections of where future soybean expansion would be expected to occur. Soybean acreage planting data from USDA NASS were used to produce average year-over-year increases in planted soybean acreage for each US state since 2007. The results are shown in Figure VII.B-2. States with a positive average year-over-year change and located within the Plains, Midwest, and Mississippi regions were selected as the geographic scope of potential new parcels for soy planing. This set of states roughly corresponds to those to the left of the line in Figure VII.B-2. A map of this area is shown in Figure VII.B-3, with included states in green and excluded states in red.

Figure VII.B-2: Average Year-Over-Year Change in Soybean Planting Acreage

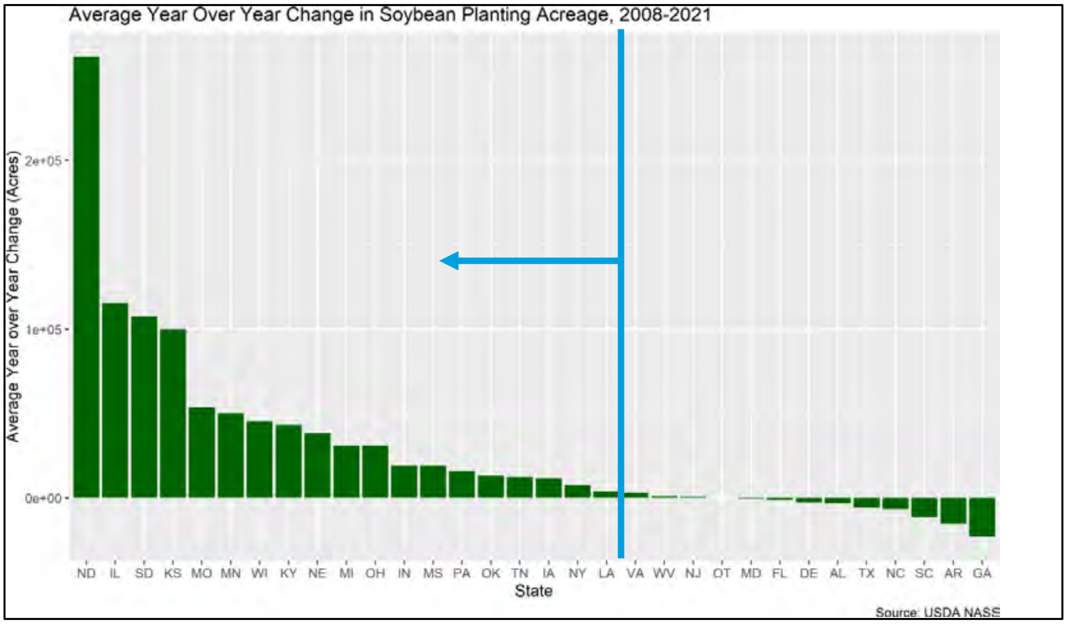
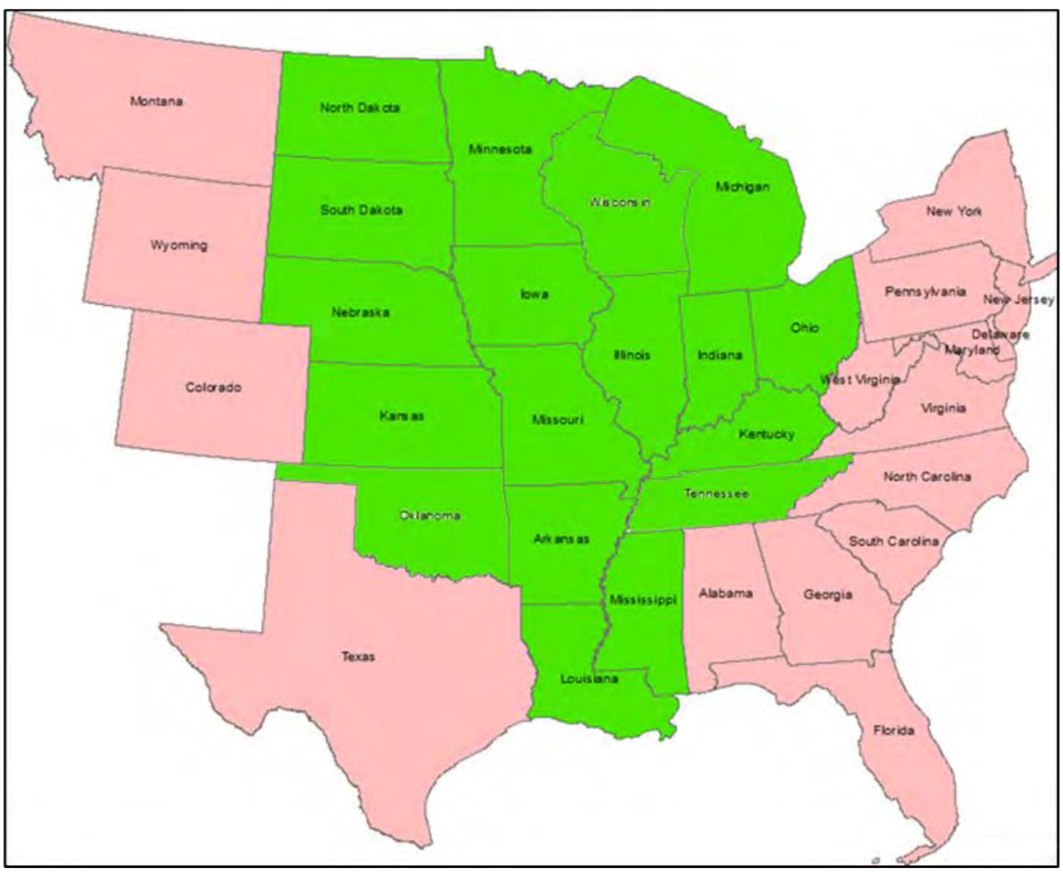


Figure VII.B-3: Map Showing Potential Soy Expansion Areas in Green



In addition to considering states with year-over-year increases in soybean planting, we also considered total soybean planting by state to confirm the geographic scope of our analysis. Total soybean planting by state is a relevant consideration since states that currently plant significant acres of soybeans are likely to be states that would see increased soybean planting in response to increased demand for soybean oil for biofuel production. There are several reasons we expect this would be the case. First, the fact that these states already dedicate significant acreage to soybean production strongly suggests that these states have the appropriate climates for soybean production. Second, these areas already have the necessary equipment and expertise required to plant, cultivate, and harvest soybeans. We expect that the marginal cost of soybean production would be much lower in areas that already produce significant quantities of soybeans and do not have to make the significant capital investments required to purchase the appropriate machinery for soybean production. Finally, areas that currently produce soybeans are much more likely to have the necessary infrastructure to bring additional soybeans to market. This infrastructure could include things such as access to soybean crushing facilities, access to established markets for soybeans, soybean oil, and soybean meal, and access to rail or barge terminals to transport soybeans to distant markets domestically or internationally.

To assess where soybeans are currently grown, we accessed the most recent NASS data for soybean acres harvested annually from 2018 – 2022. During this time approximately 94% percent of all acres of soybeans harvested were from the geographic region identified by ICF. This percentage we very consistent, ranging from a low of 93.81% in 2021 to a high of 94.44% in 2018. In 2022, the most recent year for which data are available, these states accounted for 94.23% of the total acres of soybeans harvested. Only one state outside of the geographic scope identified by ICF (North Carolina) accounted for more than 1% of the total acres of soybeans harvested in any year from 2018 – 2022. North Carolina accounted for a high of 2.03% of all soybeans harvested in the U.S. in 2019 and a low of 1.79% of all soybeans harvested in the U.S. in 2018. This analysis supports the geographic scope selected by ICF, as the vast majority of soybeans harvested annually within the U.S. (as well as nearly all the states that saw increasing soybean acreage, as shown in Figure VII.B-2) are within this geographic scope. The results of this state-by-state assessment are shown in Tables VII.B-1 and VII.B-2.

Table VII.B-1: Soybean Acres Harvested Acres by State

State(s)	2018	2019	2020	2021	2022
All States in the Geographic Scope	82,720,000	74,939,000	78,050,000	80,970,000	81,355,000
NORTH CAROLINA	1,570,000	1,520,000	1,570,000	1,640,000	1,690,000
PENNSYLVANIA	630,000	610,000	630,000	595,000	590,000
VIRGINIA	590,000	560,000	560,000	590,000	610,000
MARYLAND	515,000	475,000	465,000	485,000	510,000
ALABAMA	335,000	315,000	275,000	305,000	355,000
SOUTH CAROLINA	330,000	260,000	295,000	385,000	390,000
NEW YORK	325,000	225,000	312,000	320,000	325,000
DELAWARE	168,000	153,000	148,000	153,000	158,000
TEXAS	135,000	73,000	110,000	100,000	85,000
GEORGIA	130,000	86,000	95,000	135,000	160,000
NEW JERSEY	107,000	92,000	93,000	99,000	108,000
WEST VIRGINIA	27,000	0	0	0	N/A*
FLORIDA	12,000	0	0	0	N/A*
OTHER STATES	0	0	0	0	N/A*

*For 2022 the NASS database did not list a total for "Other States"
All data in Table VII.B-1 from USDA NASS database

Table VII.B-2: Percent of U.S. Soybean Acres Harvested Acres by State

State(s)	2018	2019	2020	2021	2022
All States in the Geographic Scope	94.44%	94.17%	93.83%	93.81%	94.23%
NORTH CAROLINA	1.79%	2.03%	1.90%	1.90%	1.96%
PENNSYLVANIA	0.72%	0.81%	0.76%	0.69%	0.68%
VIRGINIA	0.67%	0.75%	0.68%	0.68%	0.71%
MARYLAND	0.59%	0.63%	0.56%	0.56%	0.59%
ALABAMA	0.38%	0.35%	0.33%	0.35%	0.41%
SOUTH CAROLINA	0.38%	0.42%	0.36%	0.45%	0.45%
NEW YORK	0.37%	0.30%	0.38%	0.37%	0.38%
DELAWARE	0.19%	0.20%	0.18%	0.18%	0.18%
TEXAS	0.15%	0.10%	0.13%	0.12%	0.10%
GEORGIA	0.15%	0.11%	0.12%	0.16%	0.19%
NEW JERSEY	0.12%	0.12%	0.11%	0.11%	0.13%
WEST VIRGINIA	0.03%	0.00%	0.00%	0.00%	N/A*
FLORIDA	0.01%	0.00%	0.00%	0.00%	N/A*
OTHER STATES	0.00%	0.00%	0.00%	0.00%	N/A*

*For 2022 the NASS database did not list a total for "Other States"
All data in Table VII.B-2 from USDA NASS database

Cropland Data Layer Status

As this analysis focuses on cropland expansion, only lands that are in the Cropland Data Layer as uncultivated land cover categories were identified as potential suitable lands. Categories that are either currently in cropland production, idle lands, developed, or other land covers not suitable for conversion to agricultural production (e.g., open water) were not included as suitable land under this approach.

In addition, other areas that were fully excluded as potentially suitable land included core urban areas and federal public lands. In some instances, the Croplands Data Layer may show small pockets of uncultivated land cover within core urban areas, which would be unlikely areas for soybean expansion. A separate layer of urban cores from census data was used to exclude these areas as suitable habitat for extensification.[34] Federal public lands, available through a national data set were also excluded.[35]

This approach used the same National Land Cover Dataset (NLCD) as the corn analysis in Section VII.A.1, but slightly different logic. While the corn analysis selected four specific land categories to include (shrub, grassland/herbaceous, hay/pasture, emergent herbaceous wetlands), this analysis started with all categories, and then excluded several as unsuitable. In addition, forest and wetland categories, which were not excluded up front, were given low rankings such that they would not be added to expansion acreage until other types had been consumed (discussed more below).

Other Ranking Factors

The land selection model included additional ranking factors including conservation protection status, forest and wetlands constraint, distance to existing soybean fields, soils-based yield, historic soybean growth rates, and cash rents. These are described in more detail in the Appendices.

Land Selection Results

Table VII.B-1 summarizes the model results by NLCD land cover type, and Figure VII.B-4 shows the modeled soybean planting expansion areas that correspond to the 250-million-gallon scenario. A more detailed presentation of the results are included in the ICF reports.

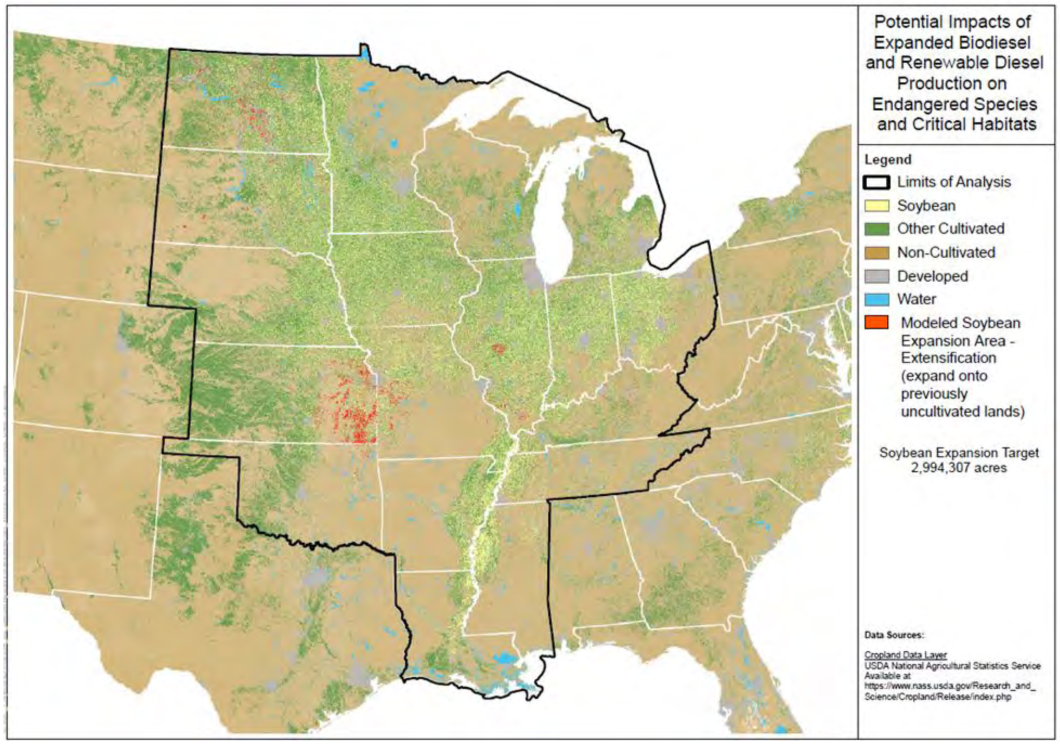
[34] See ICF (2021), Supplemental Figure 1-3
[35] See ICF (2021), Supplemental Figure 1-4

Table VII.B-1: Summary of Land Selection Results by Land Cover Type (Extensification)[36]

Land Cover Types	Total Area (Acres)	Acres and percent of total	
		100-million-gallon BBD scenario	250-million-gallon BBD scenario
Grassland / Pasture	142,969,840	1,420,758 (0.99%)	3,720,691 (2.60%)
Shrubland	11,700,016	24,019 (0.21%)	45,475 (0.39%)
Forest	163,761,230	48,966 (0.03%)	48,966 (0.03%)
Wetlands	60,134,738	9,905 (0.02%)	9,905 (0.02%)
Barren / Other	62,432,375	20,158 (0.03%)	37,464 (0.06%)
Totals	440,998,199	1,523,806 (0.35%)	3,862,501 (0.88%)

[36] See ICF (2022).

Figure VII.B-4: Modeled Soybean Expansion Areas (Red Color) for 250-Million-Gallon Scenario [37]



2. Potential Impacts on Listed Species and Critical Habitat (FWS species)

To evaluate potential impacts on listed species and critical habitat, ICF then calculated the area of overlap between the modeled soybean expansion areas with FWS listed species and critical habitat. We evaluated the potential species impacts based on two scenarios from ICF's work: the 100-million-gallon scenario (1,523,806 acres converted) and 250-million-gallon scenario (3,862,501 acres converted) which were discussed previously. We chose to focus on these two scenarios as they most closely match our maximum potential land use impact of 1.9 million acres from increases in soybean biodiesel.

ICF found that 203 ranges or critical habitat layers overlapped with the proposed affected area for soybean crop expansion under the 100-million-gallon (~1.5 million acres) scenario. They found 212 ranges or critical habitat layers that overlapped with the proposed affected area for soybean crop expansion in the 250-million-gallon (~3.8 million acres) scenario. The tables below list the top 10 species with the biggest direct impacts on their critical habitat, along with their range (on a percentage basis) for each of the two scenarios. The full results can be found in a supplemental Excel document attached with this Biological Evaluation. We provide more

[37] See ICF (2022)

information on the potentially impacted species further below, including information on species that have the largest potential impacts.

Table VII.B-2. Results from 100-Million-Gallon Scenario (~1.5 million acres) Critical Habitat Overlap with Potential Soybean Land Expansion

Common Name	Scientific Name	Direct Impacts (Acres)	Direct Impact (Percent of Critical Habitat)
Salt Creek Tiger beetle	Cicindela nevadica lincolniana	50	4.51%
Kentucky glade cress	Leavenworthia exigua laciniata	37	1.80%
Poweshiek skipperling	Oarisma poweshiek	412	1.56%
Dakota Skipper	Hesperia dacotae	199	0.98%
Piping Plover	Charadrius melodus	5036	0.35%
St. Francis River Crayfish	Faxonius quadruncus	16	0.19%
Big Creek Crayfish	Faxonius peruncus	14	0.16%
diamond Darter	Crystallaria cincotta	3	0.15%
Topeka shiner	Notropis topeka (=tristis)	24	0.15%
Cumberlandian combshell	Epioblasma brevidens	13	0.11%

Table VII.B-3. Results from 100-Million-Gallon Scenario (~1.5 million acres) Range Overlap with Potential Soybean Land Expansion

Common Name	Scientific Name	Direct Impacts (Acres)	Direct Impact (Percent of Range)
Neosho madtom	Noturus placidus	204,861	3.69%
Scioto madtom	Noturus trautmani	20	2.59%
Kentucky glade cress	Leavenworthia exigua laciniata	1,837	2.37%
Neosho Mucket	Lampsilis rafinesqueana	271,830	2.03%
Dakota Skipper	Hesperia dacotae	307,682	1.83%
Salt Creek Tiger beetle	Cicindela nevadica lincolniana	496	1.76%
Mead's milkweed	Asclepias meadii	279,319	1.36%
Lakeside daisy	Hymenoxys herbacea	11,879	0.61%
Short's bladderpod	Physaria globosa	24,515	0.57%
Rabbitsfoot	Quadrula cylindrica cylindrica	230,051	0.54%

Table VII.B-4. Results from the 250Million-Gallon Scenario (~3.8 million acres) Critical Habitat Overlap with Potential Soybean Land Expansion

Common Name	Scientific Name	Direct Impacts (Acres)	Direct Impact (Percent of Critical Habitat)
Salt Creek Tiger beetle	Cicindela nevadica lincolniana	50	4.51%
Kentucky glade cress	Leavenworthia exigua laciniata	65	3.16%
Poweshiek skipperling	Oarisma poweshiek	575	2.18%
Dakota Skipper	Hesperia dacotae	362	1.78%
Slender chub	Erimystax cahni	67	1.56%
Braun's rock-cress	Arabis perstellata	16	1.34%
Topeka shiner	Notropis topeka (=tristis)	168	1.02%
St. Francis River Crayfish	Faxonius quadruncus	79	0.95%
Big Creek Crayfish	Faxonius peruncus	68	0.80%
Piping Plover	Charadrius melodus	7,319	0.50%

Table VII.B-5. Results from the 250-Million-Gallon Scenario (~3.8 million acres) Range Overlap with Potential Soybean Land Expansion

Common Name	Scientific Name	Direct Impacts (Acres)	Direct Impact (Percent of Range)
Neosho madtom	Noturus placidus	751,709	13.55%
Neosho Mucket	Lampsilis rafinesqueana	926,403	6.91%
Kentucky glade cress	Leavenworthia exigua laciniata	4,609	5.96%
Illinois cave amphipod	Gammarus acherondytes	3,033	5.39%
Scioto madtom	Noturus trautmani	36	4.74%
Dakota Skipper	Hesperia dacotae	769,914	4.58%
Mead's milkweed	Asclepias meadii	933,947	4.56%
Rabbitsfoot	Quadrula cylindrica cylindrica	832,003	1.95%
Salt Creek Tiger beetle	Cicindela nevadica lincolniana	532	1.89%
Topeka shiner	Notropis topeka (=tristis)	443,951	1.50%

In assessing potential impacts to the species identified in this ICF analysis, it is important to recognize that the overlap percentage numbers represent the highest maximum impact that could occur due to the numerous conservative assumptions made in determining the number of acres potentially impacted by increases in soybean biodiesel (discussed in Section VI.B). We conservatively estimated that up to 1.9 million acres could be impacted from increases in soybean biodiesel from the RFS Set Rule. However, it is possible that the RFS Set rule will lead to zero acres being converted. For instance, as described in more detail in their report, ICF found that based on historical yield data, future projected soybean yield increases on existing soybean acres would be sufficient to meet the biofuel demands in both the 100-milliongallon and 250-million-gallon scenarios, as well as in another scenario with even larger acreage impacts (6 million acres) that were not assessed for this Biological Evaluation. There is a lengthy causal chain that influences on-the-ground soybean plantings, including economic drivers. Soybean biodiesel demands could also be met by reducing exports (Table VI.B-9). As such, we cannot say with reasonable certainty that species identified in this analysis will be impacted. Additionally, it is important to note that this assessment is based on the potential acreage impact results alone (and not on other important information including PBFs for critical habitat as discussed in more detail in Section IX).

Mussels and Water-dwelling Species

In this analysis completed by ICF, the Neosho mucket was identified as a species that could be affected. For instance, future soybean expansion could overlap with up to 6.91% with its range based on the 250-million-gallon scenario. The Neosho mucket is a type of freshwater mussel. Mussels are filter feeders and live on the bottom of waterways, where sediment and pollutants may accumulate in freshwater rivers and streams. In addition to the Neosho mucket, other species of freshwater mussels such as the madtom and pearly mussel were among the list of species that overlapped with the potential soybean expansion area.

The Neosho mucket is found in Illinois, Arkansas, Kansas, Missouri, and Oklahoma. Although they were historically found in rivers much more widespread, they are found primarily in 10 different river systems across the previously named states. They are often found in areas with swift current, though there are locations where it is found in areas that are near-shore or away from the main current. The species is threatened by impoundments, sedimentation, chemical contaminants, mining, invasive species, and changes in temperature, among other factors (US FWS, 2018).

In addition to mussels, many other species found in the ICF analysis are affected by changes in their habitats adjacent to water ways. Bottom dwelling animals are particularly susceptible to habitat changes. This includes crayfish and small fish such as the Neosho madtom which has the largest overlap in the 250-million-gallon scenario at 13.55% overlap with its range. Madtoms live on the rock covered bottoms of riverbeds and use this terrain as a feeding ground and as protection. Madtoms often bury themselves during the day to protect from predators and then forage at night. Water dwelling species can be affected when natural habitats near waterways are changed for agricultural purposes. Removal of grassland and trees allow soil erosion to increase. This can lead to changes in stream morphology which can impact creatures who use the river bottom for protection such as the madtom. Additional soil gain in rivers can also lead to flooding as there is less space available during heavy water flow.

The ICF analysis suggests that increases in soybean plantings near some water dwelling species' ranges and/or critical habitats could occur. This could contribute further stressors to the species (e.g., in the case of the Neosho mucket and Neosho madtom). However, as explained previously, these overlap numbers likely represent maximum potential impacts and due to various uncertainties, we cannot say with certainty if impacts will occur.

Plants

Two plants listed as endangered are within the potential affected area of soybean crop expansion: Kentucky glade cress and Mead's Milkweed. The Kentucky glade cress is currently found in only a few locations in Kentucky. This plant has mostly been impacted by residential expansion and tends to grow in rocky outcrops. This type of land is unlikely to be subject to cultivation for soybean production because it is not suitable for conversion to agricultural production.

Mead's Milkweed is an herb found predominantly in Midwest prairie habitats. Its habitat has been fragmented which threatens diversity and reproduction ability. Due to the location of its prime habitat, it has been heavily affected by agricultural conversion and other land development. This plant has the potential for overlap with additional soybean land expansion based on the two scenarios from ICF's work. Despite this potential, we cannot say for certain whether this species will be negatively impacted due to the high uncertainties and conservative assumptions made in our analyses. Additionally, in most states where mead's milkweed is found, strategic recovery efforts are in place. Steps have been taken to reintroduce this species in locations of its former habitat. Indiana and Wisconsin have successfully re-established habitats near cities such and Chicago and Madison (US FWS, 2003).

Other flowering plant species such as Braun's Rockcress and Short's Bladderpod were found to have a relatively smaller percentage of potential overlap with their critical habitat or range. The primary threats to these species, however, are not from agriculture. Braun's rockcress is threatened by development (home and road construction), competition from other plant species, grazing, as well as timber harvesting (US FWS, 2004). The Short's Bladderpod is threatened by habitat degradation from construction for transportation and utility rights-of ways, soil erosion, overstory shading, and invasive plants. Further, the Short's Bladderpod is often found on rocky and wooded slopes in wet forested areas of Kentucky and Tennessee which are not likely to be converted for agricultural purposes (*84 FR 33962*, 2019).

Insects

The spread and intensification of agriculture following World War II was a great boon to the US, helping feed a growing population and reinvigorating its post-war economy. But with the spread and intensification of agriculture also came major declines in insect biomass and diversity. Increased application of pesticides and fertilizers, great expansions of scale, and the increased fragmentation of wildlife habitats all proved to be prime drivers of insect population decline (Raven & Wagner, 2021). Insects, and the plants in which they depend on for sustenance, protection and hosting, might be more vulnerable to the expansion of soybean crop production relative to other types of organisms.

There are three insect species listed as endangered within the potential affected area of soybean crop expansion: the Poweshiek Skipperling, the Dakota Skipper, and the Salt Creek Tiger Beetle. There is also one threatened species that might be impacted: the American Burying Beetle.

The Poweshiek Skipperling inhabits prairie fens, grassy lake and stream margins, moist meadows, sedge meadows, and wet-to dry native prairies. Major stressors of this species include habitat loss and degradation of native prairies and prairie fens; flooding; and groundwater depletion, alteration, and contamination with pesticides and herbicides. Our analysis suggests that up to 2.18% of the Poweshiek Skipperling's critical habitat could be impacted by the projected soybean expansion area based on the 250-million-gallon scenario. Due to this species' susceptibility to land changes resulting from agricultural development, this species could potentially be impacted by the expansion of soybean croplands.

The Dakota Skipper is native to tallgrass and mixed grass prairies of the northern Great Plains. Once ranging from northeast Illinois to southern Saskatchewan, today Dakota Skippers are found only in small, scattered prairies in the Dakotas, Minnesota and southern Canada. This species' main stressor is habitat loss due to anthropogenic factors, primarily cultivation for agriculture. Our analysis suggests that up to 1.78% and 4.58% of the Dakota Skipper's critical habitat and range, respectively, could potentially be impacted by the 250-million-gallon scenario's projected soybean expansion area. The Dakota Skipper has been impacted by past cropland expansion and therefore any additional agricultural development has the potential to further impact their habitat. Again, however, due to the relatively low potential impacts and various uncertainties in our analyses, we cannot say for certain that they will be impacted.

The Salt Creek Tiger Beetle inhabits the salty muddy banks of the Little Salt Creek near Lincoln, NE. This beetle requires saline mud flats and exposed mud banks with salt deposits within saline wetlands and along stream edges for foraging, feeding, reproduction, and overwintering. Salt Creek Tiger Beetles depend on the presence of moist, muddy areas and are most often found within a few feet of a stream or wetland edge. Major stressors of the Salt Creek Tiger Beetle include habitat loss due to urbanization, bank stabilization, and agricultural development. Our analysis suggests that up to 4.51% and 1.89% of the Salt Creek Tiger Beetle's critical habitat and range, respectively, could potentially be impacted by the projected soybean expansion area under the 250-million-gallon analysis.

The American Burying Beetle can be found in various habitats, including open fields to grasslands to different types of forests. It is particularly vulnerable to habitat loss and fragmentation. Habitat fragmentation and deforestation especially have reduced populations of species that become carrion in which this species broods. Our analysis suggests that up to 0.78% of the American Burying Beetle's range could potentially be impacted by the projected soybean expansion area.

There are also various species of butterflies, bees, and dragonflies that may also be impacted by this proposal.

The Monarch Butterfly, the Mitchell's Satyr Butterfly, and the Karner Blue Butterfly are all threatened species that may be susceptible to population decline as a result of further agricultural expansion. The monarch butterfly may be impacted due to its reliance on Mead's Milkweed. Plants in the milkweed family are the sole host plant to the monarch butterfly's caterpillar, and as such are vitally important for the monarch butterfly's life cycle and overall species survival. Should the mead's milkweed be severely impacted by the potential cropland expansion, this could resultantly impact the populations of monarch butterfly and other pollinators that may inhabit those areas or make use of them on their migratory journeys (US FWS, 2021b). Our analysis suggests that up to 0.20% of the Monarch Butterfly's range could be impacted by the projected soybean expansion area. As for the Mitchell's Satyr Butterfly and the

Karner Blue Butterfly, the range that could potentially be impacted by projected soybean expansion is 0.14% and 0.14%, respectively.

The two other insect species, the Rusty Patched Bumble Bee and Hine's Emerald Dragonfly, are susceptible to habitat destruction or alteration, as well as increased pesticide usage. Our analysis suggests that up to 0.56% of the Rusty Patched Bumble Bee's range could be impacted by the projected soybean expansion area, and that up to 0.02% and 0.35% of Hine's Emerald Dragonfly's critical habitat and range, respectively, could potentially be impacted by the projected soybean expansion area.

Mammals

Since the rise of industrial agriculture, terrestrial mammalian populations have decreased significantly. While disease, climactic changes, and decreases in biological diversity as a result of increases in inbreeding have plagued many mammals, the loss of wild habitat due to agricultural development has also been a driver of mammalian population declines for nearly a century (Our World in Data, 2021).

There are three species listed as endangered within the potential affected area of soybean crop expansion: the Black-footed Ferret, the Northern Long-Eared Bat, and the Indiana Bat. There is also one threatened species that may be impacted: the Gray Bat. Other greater mammalian species, like the Canada Lynx and the Gray Wolf, are even less likely to be impacted.

The Black-footed Ferret inhabits intermountain prairies and grasslands wherever prairie dogs may be found. This is because ferrets are obligate associates of prairie dogs, using prairie dog burrows instead of their own. Resultantly, ferrets can typically be found in areas within high burrow density prairie dog colonies. The Black-footed ferret's main stressors include disease, drought, declining genetic fitness due to increased inbreeding and a reduction in genetic diversity, and prairie dog shooting and poisoning (US FWS, 2021b). Our analysis suggests that up to 0.09% of the Black-footed Ferret's range could potentially be impacted by the projected soybean expansion area.

The Northern Long-Eared Bat, the Indiana Bat, and the Gray Bat spend their winters hibernating in caves and mines, and during the summer and portions of fall and spring, they may be found roosting in colonies or singly underneath bark, in crevices or in cavities of both live and dead trees (US FWS, 2023). Our analysis suggests that up to 0.50% of the Northern Long-Eared Bat's range could potentially be impacted by the projected soybean expansion area; up to 0.25% and 0.26% of the Indiana Bat's critical habitat and range, respectively, could potentially be impacted by the projected soybean expansion area; and up to 0.46% of the Gray Bat's range could potentially be impacted by the projected soybean expansion. While there are many stressors to these bat species, the main threat is white-nose syndrome, caused by the fungus *Pseudogymnoascus destructans*. It is likely that had this disease not emerged, these three bats may not have been experiencing such large population declines.

Birds

Potential land use change may also mean habitat loss for birds. Especially for birds which have large migratory pathways, habitat changes lead to biodiversity implications and resource availability. Species such as the piping plover and whooping crane both have migratory pathways which overlap with potential expansion of soybean cropland mostly in the Midwest.

The piping plover is a small bird which tends to live along waterways such as lakes and wetlands. They are known to inhabit the Great Plains and the Great Lakes regions for part of the year. One of their populations that nests in great plains and has struggled with reproduction due to habitat changes. Although their populations have struggled, recovery plans have been enacted to protect their populations (US FWS, 2016). The analysis from ICF suggests that up to 0.5% of its critical impact could be impacted.

Similarly, whooping cranes have two separate populations which migrate long distances for the winter. One population breeds in Wisconsin with wintering areas spanning into Kentucky and Tennessee down into Florida. Their habitat consists primarily of wetland habitat which has a history of being converted to farmland. However, whooping crane population have primarily been impacted by hunting and egg collection. Recovery has been successful with crane reintroduction and wetland preservation actions (Smith et al., 2019).

3. Potential Impacts on Listed Species and Critical Habitat (NMFS species)

ICF did not include NMFS species in their overlap analyses. However, EPA was able to complete this by using ICF's modeled soybean expansion areas and GIS species data from NMFS. As was done for the FWS species, we used the two scenarios from ICF's work: the 100-million-gallon scenario (1,523,806 acres converted) and 250-million-gallon scenario (3,862,501 acres converted). We chose to focus on these two scenarios as they most closely match our maximum potential land use impact of 1.9 million acres from increases in soybean biodiesel.

The critical habitat layer of the Atlantic sturgeon (Gulf subspecies) was the only polygon found to overlap with the two expansion areas. We found that 0.003% and 0.007% of the Atlantic sturgeon (Gulf subspecies)'s critical habitat overlapped with the 100 million and 250-million-gallon scenarios, respectively.

The Gulf sturgeon as the name suggests, resides primarily in the gulf region of Louisiana, Mississippi, and Florida. This is a smaller area when compared to the larger Atlantic sturgeon species which can range as far north as Canada. Populations of Gulf sturgeon have been impacted over the years from factors such a dam construction to water degradation. As sturgeons spawn in the rivers during the spring and summer, dams can impede their cycle and have been known in some cases to separate some populations above and below the obstacle. After spawning they move to the estuary, or mixed salt and freshwater region of the river where it is cooler and they have better food sources. They tend to move fully in the ocean during the winter months (NOAA, 2022).

Pollutants pose a significant effect to the gulf sturgeon. Impacts may be caused directly by impacting their organs and reproductive systems or indirectly by becoming incorporated into the food they eat. These pollutants stem from industrial and agricultural activities which can be washed or discharged into the rivers and oceans. Climate change has also caused some changes to their environment. Changes in water temperature and levels can affect their habits and habitats. Weather events such as hurricanes are impactful especially with their increased frequency due to climate changes.

In addition to pollutants, physical barriers and impacts can affect the Gulf sturgeon. As mentioned above, dams are a significant threat to all sturgeons. This can also change the flow of the river where spawning occurs. Changes in water flow can alter habitat needed for reproduction and can destroy feeding areas. This is consequence of river dredging as well which is common activity with dam construction and on industrial use rivers near the Gulf of Mexico.

C. Potential Impacts from Increased Canola Production

1. Identifying Potential Locations of Acres Impacted

We used the same general procedures for identifying potential locations of acres impacts from increased canola production as was used for identifying locations of acres impacted from increased corn production. The details of that analysis are described in section VII.A and relevant differences are summarized here.

There were four key differences between the analysis of impacts from increased corn versus canola: (1) the geographic scope of the analysis, (2) the total acres of conversion simulated, and (3) the number of iterations. For the canola analysis, the geographic scope of the analysis was constrained to North Dakota as opposed to the entire area of potential land use change, as that is where the vast majority of new canola in the U.S. is expected to be cultivated (Table VI.C-12). The total acres of conversion simulated was 0.26 million acres, as opposed to 0.5 million acres for the impacts from corn production. The number of replicates for all scenarios was 500 because the geographic scope was smaller and thus allowed greater computational output. Other than those differences, the same analysis as described in section VII.A was applied. For convenience, we use the same scenario names (Table VII.A-1) but with "ND" at the end (e.g., S1-ND, Table VII.C-1).

Table VII.C-1. List of scenarios for species-level effects from potential increases in cropland in North Dakota

Scenario #	Total acres converted (acres)	Critical habitat (CH) range (R)	Buffer	Replicate iterations
S1-ND	260,000	CH	None	500
S2-ND	260,000	CH	2600’	500
S3-ND	260,000	R	None	500
S4-ND	260,000	R	2600’	500

2. Potential Impacts on Listed Species and Critical Habitat

For the analysis of critical habitat with no buffer (S1-ND), we found that 3 species were potentially impacted at least once across all 500 iterations, and the same species had some critical habitat potentially converted in 5% or more of iterations (Table VII.C-2). These three species are all FWS species and include: Piping plover (Atlantic Coast and Northern Great Plains population), Dakota skipper, and Poweshiek skipperling. We found conversion of 845 total acres of critical habitat on average across all iterations (10^{th} – 90^{th} percentiles: 600 – 1110 acres). We found that zero species had one percent or more of its critical habitat potentially impacted (i.e., conversion within critical habitat), with 1 species (Dakota skipper) with 0.33% of its critical habitat potentially impacted on average. The Piping plover (Atlantic Coast and Northern Great Plains population) and Poweshiek skipperling had 0.05 and 0.01 percent of their critical habitats potentially impacted, respectively.

For the analysis of critical habitat with a 2600’ buffer (S2-ND), we found that 3 species (the same as above) were potentially impacted at least once across all 500 iterations, and these 3 species had some critical habitat potentially converted in 5% or more of iterations (Table VII.C-2). We found conversion of 6535 acres of critical habitat plus the 2600’ buffer on average across all iterations (10^{th} – 90^{th} percentiles: 5850 - 7260 acres). We found that the Dakota skipper had 1.83% of its critical habitat with buffer potentially impacted (i.e., conversion within critical habitat or within 2600’ of critical habitat). On average, the Piping plover (Atlantic Coast and Northern Great Plains population) had 0.42% of its critical habitat with buffer potentially impacted; the Poweshiek skipperling had 0.09% of its critical habitat with buffer potentially impacted on average.

For the analysis of species range with no buffer (S3-ND), we found that 10 FWS species were potentially impacted at least once across all 500 iterations. We found that zero species had one percent or more of its range potentially impacted; all 10 species had between zero and 0.79% of their respective range potentially impacted on average.

For the analysis of species range with a 2600’ buffer (S4-ND), we found that 11 FWS species were potentially impacted at least once across all 500 iterations. We found that zero species had one percent or more of its range plus buffer potentially impacted; all 11 species had between zero and 0.88% of their respective range plus buffer potentially impacted on average.

Out of the 11 species identified in the two range analyses (i.e., in the S3-ND and/or in the S4-ND scenarios), only 8 had greater than zero percent of their range or range plus buffer impacted. These include: the Monarch butterfly, Northern Long-Eared Bat, Whooping crane (endangered population), Piping Plover (Atlantic Coast and Northern Great Plains population), Red knot, Dakota Skipper, Western prairie fringed Orchid, and Pallid sturgeon. The full results are included as an excel sheet attached to this Biological Evaluation.

Table VII.C-2. Summary of effects across scenarios for the North Dakota simulations

Scenario #	# spp. impacted at least once	# spp. impacted in 5% or more of iterations	Average acreage of CH conversion (10^{th} – 90^{th} range)	Number of spp. with 1% or more of CH or range impacted on average	Common name of sp. with >1% of CH or range converted.
S1-ND	3	3	845 (600-1110)	0	None
S2-ND	3	3	6535 (5850 – 7260)	1	Dakota skipper
S3-ND	10	N/A*	N/A*	0	None
S4-ND	11	N/A*	N/A*	0	None

* These summarizing statistic results for the range scenarios (S3-ND) and (S4-ND) include 5-8 species that are not considered in this Biological Evaluation because they have a listing status of resolved, under review, recovery, or undefined. As such, the results are not presented here as they provide a skewed assessment with the inclusion of those species.

On average, our analyses suggest that 0.33 and 0.79 percent of the Dakota skipper's critical habitat and range, respectively, could be directly impacted by increased cropland driven by increases in canola biodiesel. When a 2500-foot buffer is added, these numbers increase to 1.83 and 0.88 percent. The Dakota skipper was also identified in our soybean analysis and is discussed in more detail in that section (VII.B).

D. Total Potential Impacts of Increased Biofuel Crop Production

After individually estimating the impact of potential land use changes from non-cropland to cropland that could result from increased demand for each of the three biofuel feedstocks—

corn, soybean oil, and canola oil—we then considered the potential cumulative impacts for all three combined. It is these cumulative impacts, rather than the expected impacts from increased demand for corn, soybean oil, and canola oil individually (discussed in Sections VII.A–VII.C), along with the water quality impacts (discussed in Section VIII), that must be considered to understand potential impacts on listed species. These potential cumulative impacts, however, do not fully account for how the individual acreage assessments from increases corn ethanol, soybean oil, and canola oil described in Sections VI.A-VI.C interact with one another. For example, as described in Section VI.C, the results from economic modeling suggests that total acreage for corn cropland could actually decrease due to increases in canola oil. We do not account for this potential decrease in assessing the cumulative impacts; as such, the cumulative impacts include yet another level of conservative (and worst-case) estimating.

Tables VII.D-1 through VII.D-4 show the expected impacts for the 10 FWS species with the greatest expected impact (on a percentage basis) for each of the four scenarios we considered.[38] The full lists with the expected impacts on all of the FWS species with critical habitat or range in the action area has been provided as a separate file.

The only NMFS species that was present in more than one of the individual analyses was the Atlantic sturgeon (Gulf subspecies)' critical habitat. Based on the probabilistic results from the corn ethanol analysis and the conservative 250-million-gallon (~3.8 million acre) scenario from the ICF analysis, the cumulative impact for this species, in terms of maximum potential overlap, is 0.023% of its total critical habitat.

Table VII.D-1: FWS Species with the Highest Impact on Critical Habitat Based on Land Use Impact Analyses Alone

Species Common Name	Species Scientific Name	Percent Critical Habitat/Range Converted			
		Critical Habitat	Critical Habitat + Buffer	Range	Range + Buffer
Salt Creek Tiger beetle	Cicindela nevadica lincolniana	4.62%	5.82%	1.99%	1.99%
Kentucky glade cress	Leavenworthia exigua laciniata	3.16%	3.47%	6.00%	6.01%
Poweshiek skipperling	Oarisma poweshiek	2.34%	2.73%	0.68%	0.68%
Dakota Skipper	Hesperia dacotae	2.27%	4.21%	5.51%	5.59%
Slender chub	Erimystax cahni	1.56%	1.84%	0.02%	0.02%
Braun's rock-cress	Arabis perstellata	1.35%	2.16%	0.56%	0.56%
Topeka shiner	Notropis topeka (=tristis)	1.13%	2.07%	1.56%	1.56%
St. Francis River Crayfish	Faxonius quadruncus	0.98%	2.57%	0.68%	0.68%
Big Creek Crayfish	Faxonius peruncus	0.82%	2.02%	0.67%	0.67%
Piping Plover	Charadrius melodus	0.57%	1.11%	0.48%	0.48%

[38] The four scenarios are the impacts on critical habitat, the impacts on critical habitat with a 2600-foot buffer, the impacts on range, and the impacts on range with a 2600 foot-buffer. For the impacts on increased demand for soybean oil we do not have results for scenarios with the 2600-foot buffer. For the total expected impacts from all biofuel feedstocks we used the soybean results from the estimates on the critical habitat and range for the expected impacts on the critical habitat and range with the 2600-foot buffer.

Table VII.D-2: FWS Species with the Highest Impact on Critical Habitat (with 2600-Foot Buffer) Based on Land Use Impact Analyses Alone

Species Common Name	Species Scientific Name	Percent Critical Habitat/Range Converted			
		Critical Habitat	Critical Habitat + Buffer	Range	Range + Buffer
Fleshy-fruit gladecress	Leavenworthia crassa	0.00%	13.50%	0.08%	0.08%
Slenderclaw crayfish	Cambarus cracens	0.02%	9.78%	0.11%	0.11%
Devils River minnow	Dionda diaboli	0.00%	7.48%	0.02%	0.01%
Slackwater darter	Etheostoma boschungi	0.11%	6.58%	0.08%	0.08%
Salt Creek Tiger beetle	Cicindela nevadica lincolniana	4.62%	5.82%	1.99%	1.99%
Roswell springsnail	Pyrgulopsis roswellensis	0.14%	4.39%	0.04%	0.05%
false spike	Fusconaia mitchelli	0.02%	4.39%	0.05%	0.05%
Texas fawnsfoot	Truncilla macrodon	0.01%	4.26%	0.04%	0.04%
Dakota Skipper	Hesperia dacotae	2.27%	4.21%	5.51%	5.59%
Guadalupe Orb	Cyclonaias necki	0.00%	4.03%	0.07%	0.07%

Table VII.D-3: FWS Species with the Highest Impact on Range Based on Land Use Impact Analyses Alone

Species Common Name	Species Scientific Name	Percent Critical Habitat/Range Converted			
		Critical Habitat	Critical Habitat + Buffer	Range	Range + Buffer
Neosho madtom	Noturus placidus	#N/A	#N/A	13.67%	13.67%
White catspaw (pearlymussel)	Epioblasma perobliqua	#N/A	#N/A	7.44%	6.87%
Neosho Mucket	Lampsilis rafinesqueana	#N/A	#N/A	7.00%	7.00%
Scioto madtom	Noturus trautmani	#N/A	#N/A	6.35%	6.03%
Kentucky glade cress	Leavenworthia exigua laciniata	3.16%	3.47%	6.00%	6.01%
Dakota Skipper	Hesperia dacotae	2.27%	4.21%	5.51%	5.59%
Illinois cave amphipod	Gammarus acherondytes	#N/A	#N/A	5.43%	5.44%
Mead's milkweed	Asclepias meadii	#N/A	#N/A	4.62%	4.62%
Virginia round-leaf birch	Betula uber	#N/A	#N/A	2.14%	1.36%
Salt Creek Tiger beetle	Cicindela nevadica lincolniana	4.62%	5.82%	1.99%	1.99%

Table VII.D-4: FWS Species with the Highest Impact on Range (with 2600-Foot Buffer) Based on Land Use Impact Analyses Alone

Species Common Name	Species Scientific Name	Percent Critical Habitat/Range Converted			
		Critical Habitat	Critical Habitat + Buffer	Range	Range + Buffer
Neosho madtom	Noturus placidus	#N/A	#N/A	13.67%	13.67%
Neosho Mucket	Lampsilis rafinesqueana	#N/A	#N/A	7.00%	7.00%
White catspaw (pearlymussel)	Epioblasma perobliqua	#N/A	#N/A	7.44%	6.87%
Scioto madtom	Noturus trautmani	#N/A	#N/A	6.35%	6.03%
Kentucky glade cress	Leavenworthia exigua laciniata	3.16%	3.47%	6.00%	6.01%
Dakota Skipper	Hesperia dacotae	2.27%	4.21%	5.51%	5.59%
Illinois cave amphipod	Gammarus acherondytes	#N/A	#N/A	5.43%	5.44%
Mead's milkweed	Asclepias meadii	#N/A	#N/A	4.62%	4.62%
Rabbitsfoot	Quadrula cylindrica cylindrica	#N/A	#N/A	1.99%	1.99%
Salt Creek Tiger beetle	Cicindela nevadica lincolniana	4.62%	5.82%	1.99%	1.99%

Many of the species above are discussed in more detail in Sections VII.A–VII.C. These results linking potential land use changes and overlap with listed species is one piece of the puzzle in understanding potential effects attributed to the RFS Set Rule. Though they represent a worst-case scenario, and most species overall saw relatively small percentage impacts, it is also important to consider the potential consequences of these land use changes and the endpoints relevant to listed species in making effect determinations for this Biological Evaluation. For aquatic species, one important potential effect would be exposure to changes in water quality. We discuss potential water quality impacts in the next section, Section VIII. However, it is also important to consider other factors such as species' life histories and specific PBFs or PCEs present in their critical habitats. As was stated previously, not all land within a species' designated critical habitat contains PBFs or PCEs. We examine these factors more closely in Section IX where we make our final effect determinations for this Biological Evaluation.

VIII. Potential Impacts on Listed Species from Changes in Water Quality

In addition to contributing to agricultural intensification or the conversion of non-cropland to cropland within species' critical habitat and ranges, increased demand for biofuels can also negatively impact water quality. These water quality impacts are generally related to the land use changes to produce biofuel crops discussed in the previous sections. Water quality can be adversely impacted by the production of biofuel feedstocks, primarily due to the sediment, nutrients, and pesticides directly or indirectly released during the production of biofuel feedstocks. Increased production of crops used to produce biofuels can impact water quality at nearby edge-of-field streams and rivers as well as at a significant distance from the location of the land use change as contaminants associated with crop production travel downstream and into major waterways. This is particularly true for contaminants with greater mobility and contaminants that persist for longer time periods in soil and aquatic environments. This section begins by discussing the water quality impacts associated with crop production, and then uses the best available data to project potential impacts of the RFS volume requirements on water quality.

A. Potential Impact of Increased Crop Production on Water Quality

Increased crop production and expansion of new cropland leads to changes and increases in fertilizers and pesticides used to grow and protect these crops. Water quality assessments have often suggested that agriculture is a leading source of water quality problems. Although not intended by farmers, pollutants such as sediments, nutrients and pesticides travel from fields to sources of water such as rivers and streams. The most recent USGS SPARROW model (SPAtially Referenced Regression On Watershed attributes) found that fertilizers contributed to 25% of the total nitrogen (TN) and 39% of the total phosphorus (TP) to the Mississippi River drainage basin. For TN, an additional 18% was from N fixing crops such as soybean, alfalfa, clover, and other crops (Robertson & Saad, 2019). USGS has also studied the effects of pesticides in water through the National Water-Quality Assessment Project (NAWQA), which has indicated that the mere existence of agricultural land alone in a watershed is a reasonable predictor for the existence of surface level water contamination of common pesticides. In a sampling study testing sites in the Mississippi River Basin, USGS found that deethylatrazine, atrazine, and metolachlor alone were present in 100% of stream samples and a majority of all groundwater samples as well (Stark et al., 2000).

In addition to effects from fertilizers and pesticides, impacts may occur from soil disruption such as erosion and sedimentation. Soil erosion is often increased due to tillage and cultivation of land. Additionally, if previously vegetative land such as grassland is left uncovered, this may increase the amount of erosion leading to sedimentation in nearby water systems or municipal drainage. Increases in sediment in streams and rivers can raise streambeds which could lead to an increase in flooding. This also impacts the habitats of aquatic life especially those that are considered bottom dwellers such as freshwater mussels.

It is important to recognize that the existing land that may be converted or used to produce more cropland (e.g., through intensification of existing cropland) already affects water quality. Pasture or grazing land, for example, have effects on water quality as herbicides may be used on these lands and sediment transport could still be an issue. For example, based on California Pesticide Use Report database, in 2021 Amador County pasture land applied a variety of pesticides including glysophate as a weed control to their acreage. It can be noted that glysophate is a product listed for pesticide use on corn and soy cropland. Like other kinds of pesticides, these chemicals are known to drift from their place of application into local bodies of water.

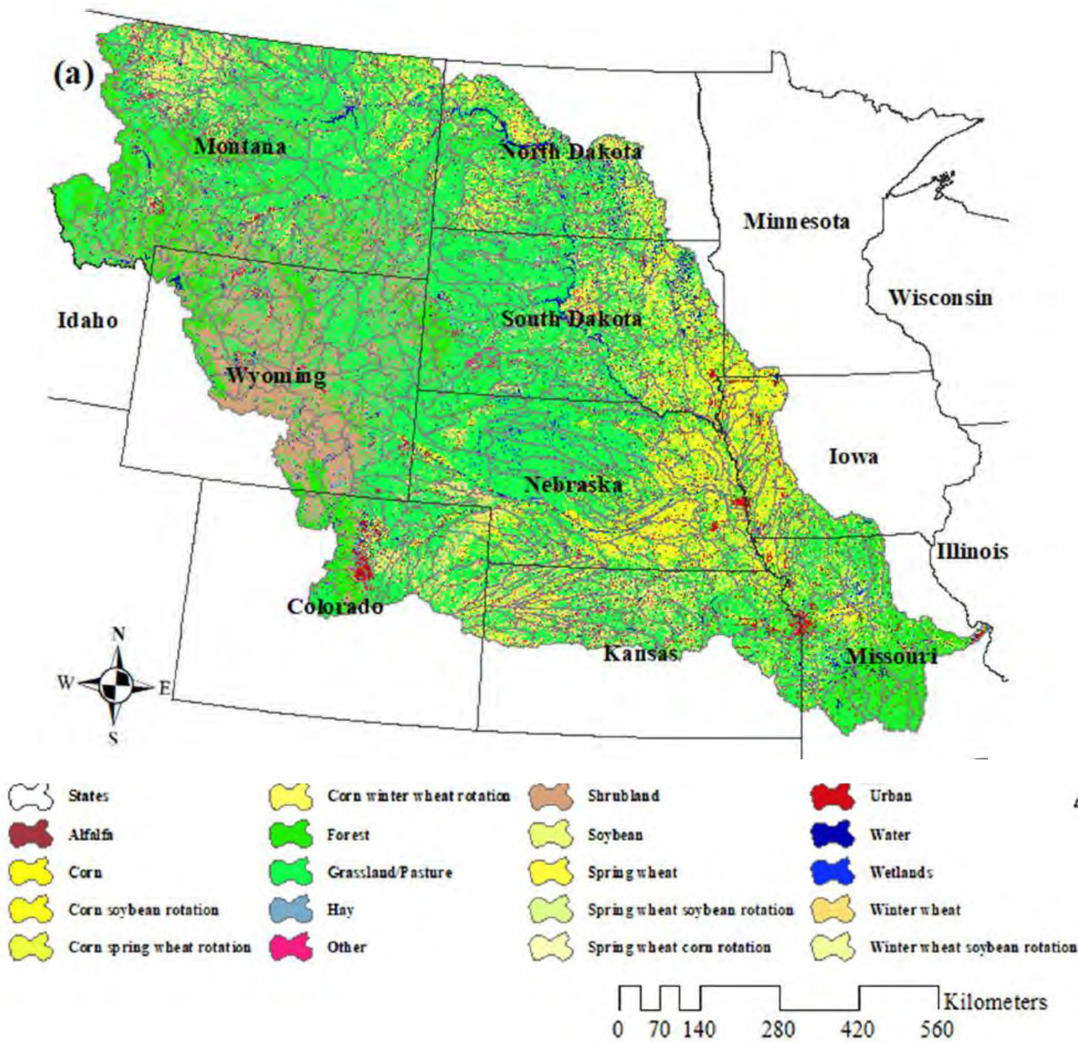
Unless managed correctly, pasture and rangelands may experience poor forage coverage and heavy traffic from animals. This can also cause soil erosion and sedimentation into local waterways and affect habitats of aquatic species downstream such as bottom feeding mollusks and fish such as the steelhead trout which spawns in rocky river bottoms. Additionally, urine and feces from animals on such lands can contribute to nutrient deposition in local waterways (Hubbard et al., 2004).

1. Estimated Potential Impacts of Increased Fertilizer Use

Estimating the impact of increasing crop production is inherently complex. The impact of crop production on water quality is impacted by a wide variety of different factors including agricultural practices, soil type, rainfall, and many others, which can vary widely depending on where biofuel crops are produced. Further, individual contaminants such as sediments, nitrogen, phosphorus, and various pesticides have differing characteristics that impact their mobility and persistence in soil and aquatic environments. To address the complexities associated with estimating changes in water quality various models have been developed, such as the Soil and Water Assessment Tool (SWAT). SWAT is a small watershed to river basin-scale model used to simulate the quality and quantity of surface and ground water and predict the environmental impact of land use, land management practices, and climate change. SWAT has been used in numerous peer reviewed publications to assess the water quality impacts in various regions of the United States and around the world (Wang et al., 2019).

In support of the upcoming Third Triennial Biofuels Report to Congress (RtC3) Chen et al applied the SWAT to the Missouri river basin to estimate the water quality changes resulting from land use changes due to all causes in recent years (Chen et al., 2021). The Missouri river basin (Figure VIII.A-1) was chosen as the geographic area for this analysis because this is the region in which some of the highest rates of grassland conversion to cropland occurred from 2008 – 2016 when the domestic production of biofuels, particularly ethanol, expanded greatly (Lark et al., 2020). Much of the observed increase in cropland during this time period was the result of the conversion of grassland to cropland to produce corn and soybeans.

Figure VIII.A-1: Modeling Domain in Chen et al. (2021) and the Land Cover Types



The SWAT modeling conducted in support of the RtC3 estimated the water quality changes associated with land use change in the Missouri river basin documented by Lark et al. from 2008 to 2016. The modeling considered three different scenarios where grassland[39] was converted to continuous corn, a corn/soybean rotation, and a corn/wheat rotation. The total quantity of land converted to cropland in the Missouri river basin during this time period was approximately 2.51 million acres. For the purposes of the SWAT modeling, all of the converted land was assumed to previously be grassland. The SWAT modeling considered the impact of this conversion to cropland on total suspended sediments, total nitrogen (including both dissolved and organic nitrogen) and total phosphorus (including both dissolved and organic phosphorus).

[39] Here "grassland" merely means land covered with grass. Lark et al. (2020) attempted to isolate lands that had been covered in grass for 25 years and assumed to be uncultivated for that entire period. There is uncertainty in how long these areas were covered in grass, and methods for estimating grassland and whether these lands represent long term grassland or areas that are intermittently utilized for pasture, hay, or other lightly managed areas (Dunn et al. 2018, Copenhaver et al. 2021).

While the SWAT modeling conducted in support of the RtC3 does not exactly match the land use changes we projected could result from the RFS volume requirements in 2023–2025, we believe it is a reasonable proxy and that it provides the best information available on the types of water quality impacts we may see from this action. The three scenarios considered in the SWAT analysis (conversion of grassland to continuous corn, corn/soybean rotation, and corn/wheat rotation) are consistent with the types of land conversion we expect would result from increasing biofuel demand. The total area converted from non-cropland to cropland in the SWAT modeling (2.51 million acres) is also similar to the total conversion we are expecting from this action (see Table VIII.A-1). We note, however, that in the SWAT analysis all 2.51 million acres of land conversion occurred in the Missouri river basin, while the projections of conversion to cropland attributable to the RFS volume requirements could occur on any available land in the action area, which is substantially larger than the Missouri river basin. By concentrating the entire quantity of cropland conversion in the Missouri river basin the use of the SWAT analysis for our purposes here is expected to estimate greater water quality impacts than if the cropland conversion occurred over a larger geographic area in multiple river basins. It is therefore reasonable to expect that the water quality impacts of the RFS volume requirements for 2023–2025 may be less than those estimated in the SWAT modeling conducted for the RtC3.

Table VIII.A-1: Projected Conversion to Cropland by Year (million acres)

		2023	2024	2025
Land Use Change Attributable To:	Corn Ethanol	0.39	0.44	0.46
	Soybean Biodiesel/RD	1.57	1.78	1.93
	Canola Biodiesel/RD[a]	0.26	0.26	0.26
	Total	2.22	2.48	2.65

[a] In this table We are using the projected land use change in North Dakota, rather than the lower national projected land use change, to represent a worst-case scenario.

As noted above, the model in Chen et al. (2021) was used to simulate three crop scenarios representing conversion of grassland (G): continuous corn (C), corn/soybean rotation (C/S), and corn/wheat rotation (C/W). Conversion to different types of cropland is important because there are significant differences in the average application rates of nitrogen and phosphorus between crops (See Figure VIII.A-2); for example, conversion to soybean would require less nitrogen application relative to corn, wheat, and cotton. Conversion was simulated only in locations of observed land use changes from Lark et al. (2020) and was summarized for two periods, 2008–2012 and 2008–2016. The SWAT model then estimated stream flow and riverine sediment and nutrient loads throughout HUC-8 watersheds in the Missouri River Basin (MORB). Changes observed in water quality continued to increase over the two periods, consistent with the magnitude of increased cropland conversion, as seen in Figure VIII.A-1. Historical cropland conversion from non-cropland during 2008-2012 was 0.77%, and 1.18% from 2008–2016 (Lark et al., 2020). The water quality changes observed with these associated numbers were of the same magnitude, as increases in nutrient loads increased by 1.5 times from 2008–2016 compared to 2008–2012[40].

[40] For more information on these results and the baseline scenario used in comparison to the different biofuel scenarios, see Chen et al. (2021)

Figure VIII.A-2: Fertilizer Application Rates for Different Crops

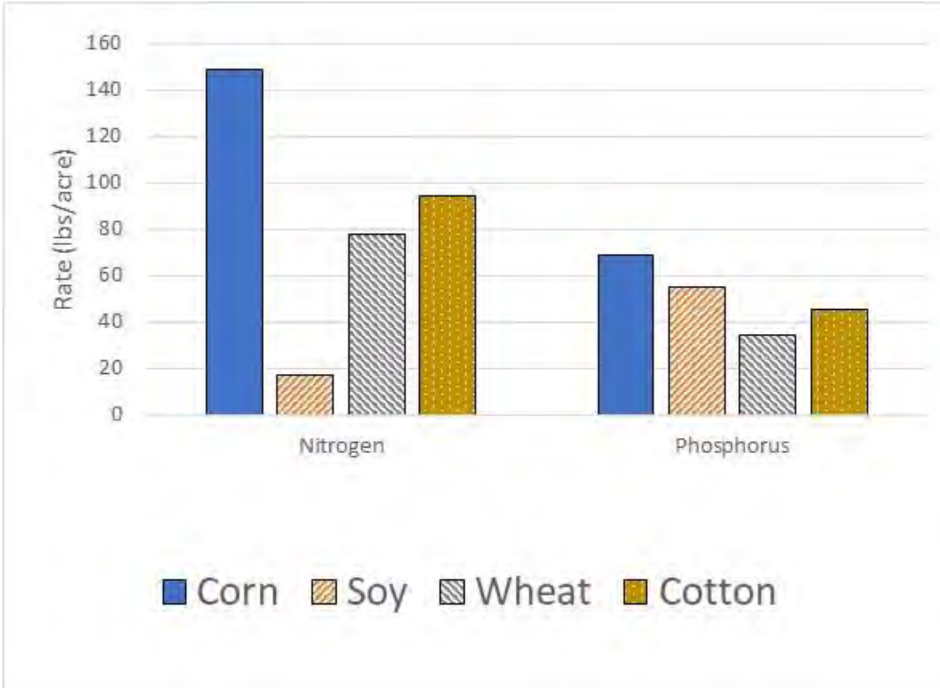
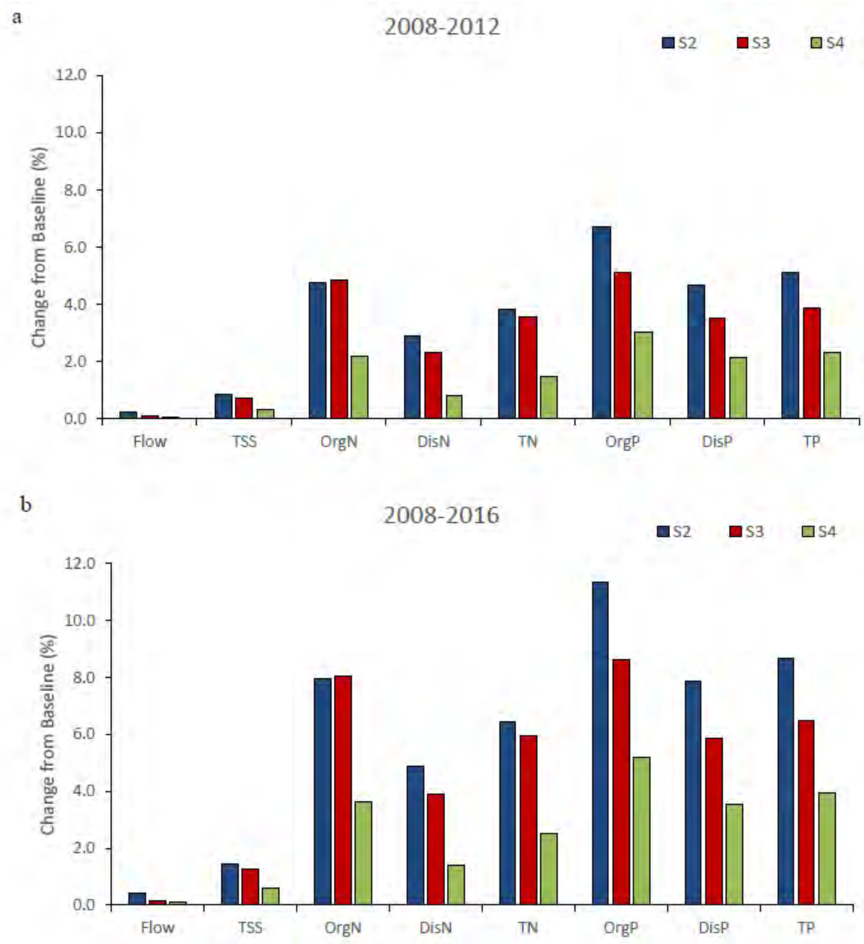


Figure VIII.A-3: Summary of the Results at the MORB Outlet. Shown are the mean annual changes in flow, total suspended sediment, organic nitrogen, dissolved nitrogen, total nitrogen, organic phosphorus, dissolved phosphorus, and total phosphorus between S1 and the different biofuel/cropland conversion scenarios.



At the outlet of the MORB, SWAT modeling showed that G to C conversion resulted in the greatest increase in TN and TP loads (6.4% and 8.7%, respectively), followed by G to C/S conversion (6.0% increase in TN and 6.5% increase in TP), and then G to C/W (2.5% increase in TN and 3.9% increase in TP). The greatest percentage increase in TN and TP occurred in the Dakotas, coinciding with the highest amount of grassland conversion. However, because of the relatively low percentage of cropland in these areas, they contributed relatively little TN and TP to total basin loads. Rather, "hotspots" of change predominantly in downstream collecting areas that are also cropland heavy states like Iowa, Missouri, Nebraska, and Kansas, contributed the bulk of TN and TP to basin-wide loads. Loading from existing cropland, grassland conversion, and precipitation are major factors in the contribution of land to nutrient loads. These results have implications for streams within the MORB as well as endangered and threatened species.

While Chen et al. (2021) provides a reasonable explanation for how nitrogen and phosphorus respond to increasing cropland conversion, it does not address how upstream tributaries, including small rivers and streams, may be affected by nearby cropland conversion. While absolute quantities of TN, TP, sediment, and some fertilizers may be higher at river junctions downstream, there is still some concern surrounding waterbodies that are directly adjacent to cropland. Concentrations in these small streams and tributaries can be higher despite lower total loading, as there is less dilution and degradation.

Another area of concern from increasing cropland for biofuel production is the contribution of fertilizers used on this new cropland to hypoxia in the Mississippi River and the Gulf of Mexico. Hypoxia is caused by excess nutrients, most especially nitrogen and phosphorus, entering the water from agricultural runoff and other point sources. These excess nutrients stimulate the growth of algae, which decomposes, consuming oxygen, and leading to fish die-offs and harm to aquatic life. Apart from the SWAT modeling discussed above, we are not aware of any modeling efforts or published efforts that have attempted to estimate the impact of the specific potential cropland increases we estimate could result from the RFS volume requirements in the Set Rule. In the absence of more specific data, we have used the results from the SWAT modeling discussed above to estimate the potential impact of increased crop production on the amount of nitrogen and phosphorus entering the Gulf of Mexico.

The SWAT modeling conducted for the RtC3 estimated the impact of increased cropland in the Missouri River basin observed from 2008–2016, which is similar in magnitude to the increase in cropland we project could be attributable to the RFS volume requirements in the Set Rule, on the nitrogen and phosphorus loads at the mouth of the Missouri River for several scenarios. To inform our understanding of the potential magnitude of this impact, we compared the results of these scenarios to the total nitrogen and phosphorus loads at the Mississippi River outlet. The total nitrogen load has been relatively stable since 1995 at approximately 1.5 million metric tons and the total phosphorus load has been relatively consistent since 2005 at approximately 0.15 million metric tons (Stackpoole et al., 2021). Thus, the modeled increases in total nitrogen (5,400–13,800 tons per year) and total phosphorus (1,500–3,400 tons per year) at the mouth of the Missouri River would represent an increase of 0.3%–0.8% and 0.9%–2.1% of total nitrogen and phosphorus respectively at the outlet of the Mississippi River. This would represent a minor increase in the total hypoxic area expected in the Gulf of Mexico- literature estimates range from a 56 to 80 percent reduction in nutrient loading to achieve a 5000 km^2 reduction in hypoxic area. A 20 percent total load reduction is estimated to reduce hypoxic area between 124,000 km^2 and 156,000 km^2 (Scavia, 2017).

These estimates of the percent increase in total nitrogen and phosphorus at the Mississippi River outlet that could potentially result from an increase in cropland to produce biofuels attributable to the RFS volume requirements make several key assumptions. First, they are based on worst-case scenario maximum land use acreage impacts that could be attributed to the RFS Set Rule. Second, the high end of the ranges presented represent a scenario where all of the new cropland is used to produce continuous corn. As discussed in Section VI, most of the increase in cropland is expected to be used for soybean production, with a smaller area expected to be used for wheat production. Lastly, as mentioned above, while Chen et al. (2021) provides a reasonable explanation for how nitrogen and phosphorus respond to increasing cropland conversion, it does not address how upstream tributaries, including small rivers and streams, may be affected by nearby cropland conversion, and how species that occur in such freshwater ecosystems may be impacted by potential effects. EPA completed a qualitative analysis in collaboration with NMFS, as described in Section IX, that examines this more closely for NMFS species.

2. Estimated Potential Impacts of Increased Pesticide Use

Listed species can also be impacted by a variety of pesticides that are commonly used in the production of biofuel crops such as corn and soybeans. Any increase in crop production that is attributable to the RFS volume requirements could therefore potentially impact listed species if the pesticides applied to this cropland was transported to local waterways and then downstream to larger streams and rivers. To consider the potential impact of increased use of pesticides we first identified the 15 most commonly used pesticides applied to corn, soybeans, and wheat (based on percent of crop acres treated). While wheat is not commonly used to produce biofuel in the US, the modeling conducted in support of the canola renewable diesel pathway indicated that an increase in wheat production is likely as increasing demand for canola renewable diesel resulted in canola displacing wheat in Canada causing additional wheat production in North Dakota.

After identifying the 15 pesticides most likely to be applied to corn, soybeans, and wheat we identified a movement rating, soil half-life, and aquatic half-life for each of the pesticides that was one of the top 15 most widely used pesticides for at least one of the three crops (Table VIII.A-2).[41] These characteristics inform the likelihood that the pesticides will transport from the field on which they are applied and end up on local waterways or streams and rivers downstream of new cropland. The movement rating of a pesticide indicates how likely the pesticide is to move in a solution with water below the root zone or to a field edge. Pesticides with higher movement ratings are more likely to move from the field on which they are applied to local waterways and are more likely to move from these local waterways to downstream rivers. Half-life is the time it takes for certain quantity of a pesticide to be reduced by half as it breaks down in the environment—whether that is in soil (soil half-life) or in water (aquatic half-life). Pesticides with higher movement ratings and/or longer half-lives are generally of greater concern, as these pesticides are more likely to be transported from the fields on which they are applied to waterways and will remain in waterways for more time when they reach the waterway.

[41] Information on the mobility rating, soil half-life, and aquatic half-life are summarized in the table below. Information in this table was collected from the University of Hertfordshire Pesticide Properties Database (http://sitem.herts.ac.uk/aeru/ppdb/), Oregon State University Pesticide Properties Database (http://npic.orst.edu/ingred/ppdmove.htm) and Pesticideinfo.org (https://pesticideinfo.org/).

Table VIII.A-2: Physical Properties of Pesticides Used for Corn, Soybeans, and Wheat

			Half-Life (Days)		2016 - 2020 Average Percent Applied			Average Quantity Applied (lbs/acre)		
Pesticide	Category	Movement Rating	Soil	Hydrolysis	Corn	Soy	Wheat	Corn	Soy	Wheat
2,4-D	Herbicide	Moderate	5-30	39	14%	19%	23%	0.06	0.13	0.13
ACETOCHLOR	Herbicide	Moderate	14	NA	30%	<9%	<6%	0.42	0.06	-
ATRAZINE	Herbicide	High	60	30	60%	<9%	<6%	0.62	0.01	0.00
AZOXYSTROBIN	Fungicide	Moderate/Low	78	31	7%	<9%	<6%	0.00	0.01	0.00
BICYCLOPYRONE	Herbicide	High	213	NA	7%	<9%	<6%	0.00	-	0.00
BROMOXYNIL	Herbicide	Very/Extremely Low	7	NA	<7%	<9%	16%	0.00	-	0.03
CHLORIMURON	Herbicide	High	40	NA	<7%	13%	<6%	-	0.00	-
CHLORSULFURON	Herbicide	High	10	1230	<7%	<9%	6%	-	-	0.00
CLETHODIM	Herbicide	Moderate	0.55	30	<7%	12%	<6%	0.00	0.01	-
CLOPYRALID	Herbicide	Very High	40	30	17%	<9%	10%	0.01	-	0.01
CLORANSULAM-METHYL	Herbicide	Moderate	11	175	<7%	10%	<6%	-	0.00	-
DICAMBA	Herbicide	Very High	14	30	18%	24%	11%	0.03	0.14	0.02
FLUMETSULAM	Herbicide	Moderate	45	NA	11%	<9%	<6%	0.00	0.00	-
FLUMIOXAZIN	Herbicide	Low	22	1	<7%	13%	<6%	0.00	0.01	-
FLUROXYPYR	Herbicide	Moderate	13	223	<7%	<9%	17%	0.00	-	0.02
FOMESAFEN	Herbicide	Very High	100	NA	<7%	21%	<6%	0.00	0.04	-
GLUFOSINATE	Herbicide	Low	7	NA	<7%	16%	<6%	0.01	0.09	-
GLYPHOSATE	Herbicide	Extremely Low	47	35	76%	81%	25%	0.81	1.08	0.38
IMAZETHAPYR	Herbicide	High - Very High	60 - 90	30	<7%	11%	<6%	0.00	0.01	-
ISOXAFLUTOLE	Herbicide	Moderate	0.9	NA	9%	<9%	<6%	0.00	-	-
LAMBDA-CYHALOTHRIN	Insecticide	Extremely Low	30	NA	<7%	9%	<6%	0.00	0.00	0.00
MCPA	Herbicide	Low - High	14 - 25	NA	<7%	<9%	12%	-	-	0.04
MESOTRIONE	Herbicide	Moderate	19.6	30	39%	<9%	<6%	0.04	0.00	-
METOLACHLOR/S-METOLACHLOR	Herbicide	High	90	200	30%	22%	<6%	0.35	0.26	-
METRIBUZIN	Herbicide	High	40	4760	<7%	19%	<6%	0.00	0.05	-
METSULFURON	Herbicide	High	30	NA	<7%	<9%	14%	-	-	0.00
PROPICONAZOLE	Fungicide	Moderate	110	30	7%	<9%	21%	0.01	0.00	0.01
PROTHIOCONAZOLE	Fungicide	Low	14.1	30	<7%	<9%	8%	0.00	0.00	0.01
PYRASULFOTOLE	Herbicide	Moderate	55.5	NA	<7%	<9%	9%	-	-	-
PYROXASULFONE	Herbicide	Moderate	22	NA	<7%	13%	<6%	0.00	0.02	0.00
SULFENTRAZONE	Herbicide	Mobile	541	291	<7%	21%	<6%	0.00	0.04	-
TEBUCONAZOLE	Fungicide	Low	63	28	<7%	<9%	15%	0.00	0.00	0.01
TEMBOTRIONE	Herbicide	Moderate	14.5	30	8%	<9%	<6%	0.01	-	-
THIENCARBAZONE-METHYL	Herbicide	Moderate	11.6	146	8%	<9%	12%	0.00	-	0.00
THIFENSULFURON	Herbicide	Moderate	12	NA	<7%	<9%	12%	0.00	0.00	0.00
TRIBENURON METHYL	Herbicide	Moderate	12	16	<7%	<9%	<6%	-	0.00	0.00

The SWAT modeling conducted in support of the RtC3 considered the impact of increased cropland on several contaminants that could affect listed species such as total suspended sediment, nitrogen, and phosphorus; the SWAT modeling did not consider the impact of increased use of pesticides. While the SWAT model is capable of modeling changes in pesticide concentrations expected to result from increased cropland for some pesticides, we are not aware of any existing SWAT modeling that explored the changes in pesticide concentrations that would be expected to result from the renewable fuel volume production increases or the land use changes we have estimated to potentially result from the Set Rule.

Nevertheless, we believe we can leverage the results of the SWAT modeling conducted for the RtC3 in the Missouri River Basin to inform our understanding of potential impacts of the RFS volume requirements in the Set Rule. As discussed previously, the SWAT modeling conducted for the RtC3 modeled changes in nitrogen, phosphorus, and total suspended solids from an observed increase in cropland that is comparable to what we have estimated could potentially result from the RFS volume requirements in the Set Rule. Nitrogen, phosphorus, and suspended solids are not perfect analogs to the pesticides we think will be used in increasing quantities as the result of the Set Rule. However, they do share some important similarities.

Nitrogen and phosphorus application rates vary by crop type and the characteristics of the cropland, but on average we would expect that the total application of nitrogen and phosphorus in the Missouri River basin is proportional to the increase in total cropland (e.g., a 10% increase in cropland would result in a 10% increase in the quantity of nitrogen and phosphorus applied to cropland across the entire area). Similarly, we would expect that, while pesticides are not universally applied to all new cropland, the increase in pesticide applications would be proportional to the increase in new cropland.

Further, nitrogen and phosphorus have differing mobilities. Nitrogen has a very high mobility and is therefore a reasonable surrogate for pesticides with similarly high mobilities. Phosphorus has a much lower mobility and is therefore a reasonable surrogate for pesticides with lower mobilities. With regard to aquatic half-life (i.e., how mobile they are in the water as opposed to on land), some pesticides may have aquatic half-lives that are comparable to the aquatic half-life of nitrogen or phosphorus.

Using the SWAT modeling results for nitrogen and phosphorus as surrogates for the impact of pesticides on water quality, we would expect any modeling to show similar changes in pesticide concentrations as a result of the RFS volume requirements. As with nitrogen and phosphorus, we would expect to see the greatest increases in pesticide total load at the mouth of the Missouri River downstream of the expected areas of conversion to cropland. Tributaries would see smaller overall increases, but greater overall changes in concentration.

Small, upland tributaries within the MORB and the Mississippi/Atchafalaya River Basin (MARB) (for example in North and South Dakota) are of concern, despite the relatively low absolute total increase in nitrogen and phosphorus seen in them. These areas, according to Chen et al., saw the greatest percentage increase in TN and TP due to grassland conversion into cropland. However, this also coincided with the largest amount of new cultivation in the entire MORB, much of which is not attributable to the RFS. As discussed in more detail in EPA's external review draft of the *Biofuels and the Environment: Third Triennial Report to Congress*, subbasins still maintained TSS, TP, and TN levels well below what is considered impactful to species, and well below that of the outlet of the MORB and other hotspots (US EPA Center for Public Health & Environmental Assessment & Clark, 2023). Further, as noted previously, these waterways are already impacted by pesticide use from existing cropland and other land uses.

Beyond the Missouri River basin, we may also expect to see new cropland in other watersheds, but likely to lesser extent relative to the MORB. This is because both because the Missouri River basin is the region in which we have seen the greatest conversion of non-cropland to cropland in recent years and because it contains a greater number of acres within the area of potential land use change (depicted in Figure IV.B-2) than any other HUC2 region in the U.S. (Table VIII.A-3). This means that, in the probabilistic analyses we conducted to assess potential land use changes from increases in corn ethanol from the Set Rule, there would be a higher chance of lands being randomly selected for conversion in the MORB relative to other regions as there is more land for the model to choose from within the MORB. We may also expect some potential land use changes and subsequent water quality effects to occur primarily in the broader Mississippi region, as depicted with the relatively higher area of potential land use change as a percent of total area for several HUC2 watersheds in that region (Table VIII.A-3) as well as the potential soybean expansion areas analyzed by ICF and explained in other sections of this Biological Evaluation. However, it is important to recognize that potential land use changes from the RFS Set Rule, especially due to increases from corn ethanol, could still occur in the other watersheds (e.g., Chesapeake Bay region), and understanding species' occurrence in those regions and potential responses to water quality-related effects is key to making species determinations for this Biological Evaluation. To explore this further, EPA worked with NMFS on a qualitative analysis that was based on the corn ethanol probabilistic results for NMFS species. This additional analysis is explained in more detail in Section IX.

Table VIII.A-3: Area of Potential Land Use Change as a Percent of Total Area in HUC2 Regions

HUC 2 Code	States	Name	Area of Potential Land Use Change in the Region (acres)	Area of Potential Land Use Change as a Percent of Total Area
10	CN,CO,IA,ID,KS,MN,MO,MT,ND,NE,SD,WY	Missouri Region	205,320,132	62%
07	IA,IL,IN,KY,MI,MN,MO,ND,SD,WI	Upper Mississippi Region	113,560,314	93%
03	AL,FL,GA,LA,MS,NC,SC,TN,VA	South Atlantic-Gulf Region	101,954,573	56%
05	IL,IN,KY,MD,NC,NY,OH,PA,TN,VA,WV	Ohio Region	81,614,228	78%
11	AR,CO,KS,LA,MO,NM,OK,TX	Arkansas-White-Red Region	76,366,961	48%
04	CN,IL,IN,ME,MI,MN,NH,NY,OH,PA,VT,WI	Great Lakes Region	62,402,626	30%
02	CT,DC,DE,MA,MD,NJ,NY,PA,RI,VA,VT,WV	Mid Atlantic Region	52,207,998	76%
08	AR,IL,KY,LA,MO,MS,TN	Lower Mississippi Region	42,779,650	63%
12	LA,NM,TX	Texas-Gulf Region	37,659,287	32%
09	CN,MN,MT,ND,SD	Souris-Red-Rainy Region	32,184,253	50%
17	CA,CN,ID,MT,NV,OR,UT,WA,WY	Pacific Northwest Region	29,781,861	14%
06	AL,GA,KY,MS,NC,SC,TN,VA,WV	Tennessee Region	18,829,385	72%
01	CN,CT,MA,ME,NH,NY,RI,VT	New England Region	12,852,085	26%
18	CA,MX,NV,OR	California Region	7,991,830	7%
16	CA,ID,NV,OR,UT,WY	Great Basin Region	6,174,304	7%
15	AZ,CA,MX,NM,NV,UT	Lower Colorado Region	4,381,121	4%
13	CO,MX,NM,TX	Rio Grande Region	3,805,981	3%
14	AZ,CO,NM,UT,WY	Upper Colorado Region	2,868,964	4%

B. Ongoing Mitigation Efforts

While the RFS volumes could potentially result in increases in the quantities of fertilizers and pesticides present in waterways, particularly in waterways located near the expected areas of cropland expansion, EPA is currently implementing a number of programs intended to reduce these types of impacts and to improve water quality. These efforts are not directly related to the

RFS program, but the ongoing efforts to reduce the impact of agriculture on water quality and to generally improve overall water quality are expected to reduce the impacts on water quality discussed in the preceding sections.

One of the programs EPA implements to improve water quality is the establishment of Total Maximum Daily Loads (TMDLs) for impaired waters. Under Section 303(d) of the Clean Water Act, each state must develop TMDLs for all the waters identified on their Section 303(d) list of impaired waters, according to their priority ranking on that list. TMDLs are the calculation of the maximum amount of a pollutant allowed to enter a waterbody, including from both point sources and non-point sources, so that the waterbody will meet and continue to meet water quality standards for that particular pollutant. TMDLs determine a pollutant target, allocate loads to the source(s) of the pollutant, and identify reductions needed to meet those loads. The TMDL process is important for improving water quality because it serves as a link in the chain between water quality standards and implementation of control actions designed to attain those standards. Non-point source load reduction actions are implemented through a wide variety of programs at the state, local and federal level. These programs may be regulatory, non-regulatory or incentive-based e.g., a cost-share program. In addition, waterbody restoration can be assisted by voluntary actions on the part of citizen and/or environmental groups.

EPA also provides funding for water quality improvement through a number of programs. The EPA Section 319 program provides grant money to the states, tribes, and territories to fund specific projects aimed at reducing the nonpoint source pollution. This program addresses the need for greater federal leadership to help focus state and local nonpoint source efforts. Under Section 319 of the Clean Water Act, states, territories and tribes receive grant money that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects. EPA also offers communities low-cost financing for a wide range of water quality infrastructure projects through the Clean Water State Revolving Fund. The recently passed Bipartisan Infrastructure Law also provided funding to improve water quality in a number of watersheds, including the Great Lakes, Chesapeake Bay, National estuary Program, Long Island Sound, Puget Sound, Columbia River Basin, and the Gulf of Mexico.

With regard to the Mississippi River Basin, the EPA has been working to combat hypoxia in the northern Gulf of Mexico for several decades. To address this issue, the EPA has implemented a number of programs and initiatives, most prominently the establishment of the Hypoxia Task Force (HTF), a partnership of federal, state, and tribal agencies that work together to reduce hypoxia in the Gulf of Mexico and improve water quality in the Mississippi River Basin. The HTF member states have developed nutrient reduction strategies that aim to meet the HTF goals, including reducing size of the zone by 2035.

The HTF members are USEPA (co-chair), USDA, DOI, USACE, NOAA, twelve states: Iowa (co-chair), Arkansas, Illinois, Indiana, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin, and a tribal representative. Established in 1997, it collaboratively works towards nutrient reduction goals, with funding from the Bipartisan Infrastructure Law most recently to help HTF states, tribes, and other partners support the 2008 action plan. This action plan affirmed six overarching principles; to encourage voluntary, incentive-based actions; utilize existing state and federal regulatory mechanisms; follow adaptive management; identify additional funding needs and sources during annual budget processes; identify barriers to market-based solutions; and to provide measurable outcomes. These goals are focused on reducing the size of the Gulf of Mexico hypoxic zone to less than 5000 square miles by 2035 with an interim target of reducing nutrient loads to the Gulf of Mexico by 20% by 2025 and to increase the quality of life of communities within the Mississippi/Atchafalaya river basin, especially those relying on agriculture, fisheries, and recreation sectors.

With the help of EPA funding, states and tribes have adopted a variety of remedial actions and programs to fight hypoxia. Among these are state cost share programs to advance conservation implementation, nutrient credit trading programs, implementation of TMDLs, and long-term monitoring programs. In its 2019/2021 Report to Congress, the HTF reported that more monitoring support was a priority for the task force in order to track how the HTF is meeting the interim 2025 and 2035 goals. In FY17 and FY18, EPA provided $94.9 million in grants to HTF states. The EPA Gulf of Mexico Division awarded $2 million for two grants in FY18 and $7.5 million for seven grants in FY 19 to fund projects that improved water quality and environmental education in the Gulf watershed. In FY 19 and FY20, EPA provided $2.4 million for direct grants to the 12 member states and starting in FY22, EPA is providing $60 million through FY26 to states, tribes and partners towards actions to reach the HTF goals. Monitoring programs already in place show a decline in total nitrogen from the MARB to the Gulf.

EPA is also working to improve the current ESA-FIFRA process for pesticides. This involves collaborations with the Services and U.S. Department of Agriculture (USDA). EPA has provided workplan entitled "Balancing Wildlife Protection and Responsible Pesticide Use: How EPA's Pesticide Program Will Meet its Endangered Species Act Obligations" which reflects EPA's experiences, assesses its future ESA workload, and describes administrative and other improvements that EPA will pursue or consider pursuing. This is a difficult task, considering that there are thousands of pesticide products and amendments and over 1,600 listed species in the United States. EPA's workplan and the associated update in 2022 reflects the Agency's most comprehensive thinking to date on how to create a sustainable ESA program for pesticides. The workplan involves several strategies relevant to registration and registration review activities and includes possible ESA programmatic initiatives. The registration and registration review efforts include proposed label language to expand the use of online endangered species protection bulletins. This online system allows EPA to implement geographically specific mitigation measures for listed species that are designed to focus protections in specific areas of need, thereby minimizing impacts of the mitigations to agriculture.

EPA is beginning registration review ESA pilots to incorporate early ESA mitigation measures into registration review decisions for carbaryl, methomyl, rodenticides and neonicotinoids. Some of the ESA strategies include identifying ESA mitigation measures for vulnerable species, incorporating early ESA mitigation measures for groups of pesticides rather than single pesticides, developing region-specific strategies, and exploring broad mitigation strategies for nonagricultural uses. Taken together, these efforts are intended to reduce the impacts of pesticide use on listed species.

IX. Framework and Species\Critical Habitat Determinations

The goal of the analyses presented herein is to link RFS Set Rule (the action) to estimates of the potential increases in biofuel demand that may be a result of the action and the corresponding potential increases in biofuel feedstock crop production necessitating land use changes to meet that demand. By using the maximum potential acreage impacts, we then assessed the potential locations of land use changes and linked that to potential species impacts by examining the areas that may be affected (on a percentage basis) relative to the total area of each species' critical habitat and/or range. In Section VII we present the analyses related to land use changes, and in Section VIII we present information related to potential changes in water quality associated with any land changes at both the edge-of-field and downstream levels. This Section IX takes our analyses a step further by assessing the potential effects of the action as they relate to endpoints specifically relevant to species, such as PBFs and PCEs of critical habitat and other pertinent life history information, to make final species determinations for this Biological Evaluation.

As an initial matter, we describe our interpretation of the thresholds for the various determinations we are making in this action following our analysis.

A. Framework for Species\Critical Habitat Determinations

Under Services' implementing regulations, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. In other words, if the agency fails to take the proposed action and the activity would still occur, there is no ''but for'' causation. Given the significant uncertainty associated with land use change impacts as a result of the set rule, particularly the inability to know what, if any, parcels of land which will actually be converted as a result of the Set Rule, it is correspondingly difficult to say, with certainty, whether the set rule may affect terrestrial listed species and critical habitat through this mechanism. Given this high degree of uncertainty, a "no effect" determination may be justified for some species and critical habitat.

However, in a worst-case scenario, some land may be converted as a result of the Set Rule, and this land conversion may impact listed species or critical habitat. We, therefore, in the alternative, conclude that the set rule may affect listed species or critical habitat. However, these effects are not likely to adversely affect listed species or critical habitat due to the limited nature of changes that may be attributable to the RFS Set Rule.

As to species and critical habitat at risk of potential impacts of the Set Rule as a result of water quality degredation, we determine that the RFS standard may affect some listed species and critical habitat. This is because certainty in the location of any such effects is not necessary to make such an effects determination. The RFS Set Rule may result in increases in pesticide and fertilizer applications, and these increases may affect some listed species and critical habitat as they transport through runoff to progressively larger bodies of water. However, we anticipate that such effects are not likely to adversely affect species and critical habitat given the limited nature of any such increases in pesticide and fertilizer quantities in the endpoint bodies of water.

B. FWS Species and Critical Habitats

The 672 FWS species (737 populations total) found within our action area were grouped into 14 taxonomic groupings that are commonly used by the FWS (US FWS, n.d.-c). Species within each of these taxonomic groups can be assessed together as they typically share similar patterns of survival and reproduction (i.e., life histories) and critical habitat PBFs/PCEs.

Insects

A total of 41 insect populations were found within the action area (Table IX.B-1). Based on the potential land use impact analyses described in previous sections, which were akin to a worst-case scenario, the Salt Creek Tiger Beetle, Poweshiek skipperling, Dakota Skipper, and Guadalupe Orb were some species that could see impacts from increases in corn ethanol, soy oil, and canola oil from the RFS Set Rule alone (Tables VII.D-1 to VII.D-4).

Out of the 41 insect populations found within the action area, 12 have critical habitat with associated PBFs. PBFs for listed insects may include natural plant communities and herbaceous, woody, and aquatic vegetation for refugia, resting, reproduction, and prey avoidance; wet-mesic, moist meadows river floodplain, depression wetlands or other aquatic or semi-aquatic environments for refugia and shelter, reproduction, and prey avoidance; specific soil types, such as loam, sandy loam, loamy sand, gravel, organic soils, other types of soils conducive to larval survival and specific vegetation; and specific host or nectar plants required for reproduction, feeding, and growth. Other insects, such as butterflies, may require dynamic habitats with trees and/or understory plants with a specific range of elevations, densities, and canopy cover.

It is well known that insects in general are vulnerable to pesticide exposure and toxicity effects. Additionally, insect species in the action area that have PBFs more closely associated with specific grassland habitats (e.g., the Poweshiek skipperling) may be more likely to be affected. However, this does not necessarily mean that PBFs will be affected; lands that were once used for pasture, hay, or were retired could serve as more ideal locations for conversion, and these lands are not likely to have essential PBFs. Due to this and due to the limited nature of changes attributable to the RFS Set Rule, potential effects on listed insects (as well as critical habitat PBFs) are insignificant or discountable.

Table IX.B-1. The 41 FWS insects and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects.

CH, Range, or Both	Common Name	Scientific Name	DPS (if applicable)	Listing Status
Range	Island marble Butterfly	*Euchloe ausonides insulanus*		Endangered
Range	Smith's blue butterfly	*Euphilotes enoptes smithi*		Endangered

Both	Taylor's (=whulge) Checkerspot	*Euphydryas editha taylori*		Endangered
Range	Northeastern beach tiger beetle	*Habroscelimorpha dorsalis dorsalis*		Threatened
Both	Dakota Skipper	*Hesperia dacotae*		Threatened
Both	Comal Springs riffle beetle	*Heterelmis comalensis*		Endangered
Both	Fender's blue butterfly	*Icaricia icarioides fenderi*		Endangered
Range	Mission blue butterfly	*Icaricia icarioides missionensis*		Endangered
Range	Lotis blue butterfly	*Lycaeides argyrognomon lotis*		Endangered
Range	Karner blue butterfly	*Lycaeides melissa samuelis*		Endangered
Range	Saint Francis' satyr butterfly	*Neonympha mitchellii francisci*		Endangered
Range	Mitchell's satyr Butterfly	*Neonympha mitchellii mitchellii*		Endangered
Range	American burying beetle	*Nicrophorus americanus*	Wherever found; Except where listed as Experimental Populations	Threatened
Range	American burying beetle	*Nicrophorus americanus*	In southwestern Missouri, the counties of Cedar, St. Clair, Bates, and Vernon.	Experimental Population, Non-Essential
Both	Poweshiek skipperling	*Oarisma poweshiek*		Endangered
Range	Mount Hermon June beetle	*Polyphylla barbata*		Endangered
Both	[no common name] Beetle	*Rhadine exilis*		Endangered
Both	[no common name] Beetle	*Rhadine infernalis*		Endangered
Range	Tooth Cave ground beetle	*Rhadine persephone*		Endangered
Both	Hine's emerald dragonfly	*Somatochlora hineana*		Endangered
Range	Behren's silverspot butterfly	*Speyeria zerene behrensii*		Endangered
Range	Oregon silverspot butterfly	*Speyeria zerene hippolyta*		Threatened
Range	Myrtle's silverspot butterfly	*Speyeria zerene myrtleae*		Endangered
Both	Comal Springs dryopid beetle	*Stygoparnus comalensis*		Endangered
Range	Kretschmarr Cave mold beetle	*Texamaurops reddelli*		Endangered
Range	Zayante band-winged grasshopper	*Trimerotropis infantilis*		Endangered
Both	Lange's metalmark butterfly	*Apodemia mormo langei*		Endangered
Range	Coffin Cave mold beetle	*Batrisodes texanus*		Endangered

Range	Helotes mold beetle	*Batrisodes venyivi*		Endangered
Range	Rusty patched bumble bee	*Bombus affinis*		Endangered
Range	Franklin's bumble bee	*Bombus franklini*		Endangered
Both	Hungerford's crawling water Beetle	*Brychius hungerfordi*		Endangered
Range	San Bruno elfin butterfly	*Callophrys mossii bayensis*		Endangered
Range	Salt Creek Tiger beetle	*Cicindela nevadica lincolniana*		Endangered
Both	Ohlone tiger beetle	*Cicindela ohlone*		Endangered
Range	Monarch butterfly	*Danaus plexippus*		Endangered
Range	Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*		Threatened
Range	Delta green ground beetle	*Elaphrus viridis*		Threatened
Range	Puritan tiger beetle	*Ellipsoptera puritana*		Threatened
Range	bog buck moth	*Hemileuca maia menyanthevora*		Proposed Endangered
Range	Silverspot	*Speyeria nokomis nokomis*		Proposed Threatened

Flowering Plants

The taxonomic group with the largest number of listed populations found within the action area is the flowering plants group. A total of 242 flowering plants were found within the action area (Table IX.B-2). Several species—including the Braun's rockcress, Fleshy-fruit gladecress, Mead's milkweed, and Virginia round-leaf birch—saw some of the relatively higher cumulative impacts (Tables VII.D-1 to VII.D-4) based on the potential land use change impact analyses.

Potential effects of the action that could harm flowering plants include, but are not limited to, effects on pollinators and seed dispersers, toxicity from pesticide exposure (e.g. herbicides), and loss of habitat. While some flowering plants may rely on abiotic pollination such as wind, others rely on biotic (e.g., insect or bat) pollination as their propagation strategy. The species that require biotic pollination may be indirectly affected if their pollinator populations are harmed by pesticide drift and/or habitat loss attributed to the RFS Set Rule. This may occur near lands that are newly cultivated for agriculture, as well as near lands that apply higher amounts of pesticides to increase crop yields. While insecticide drift could harm some pollinators, it is unlikely that it would significantly reduce the population. It is possible that herbicide drift to a certain distance may harm listed plants. However, it is challenging to say with a high degree of confidence where potential effects of the RFS Set Rule may occur at the local level, if at all. Converted fields are likely to be widely distributed across suitable farming land or in areas that are not suitable for listed species, even inf in a species' range, or areas that don't meet the definition of PBFs/PCEs. As such, EPA anticipates that effects to pollinators would be insignificant or discountable.

Another potential effect is habitat loss. Many listed flowering plants rely on certain landscape features that are essential for their conservation. For example, the Short's Bladderpod relies on the following PBFs within its critical habitat: (1) bedrock formations and outcrops of calcareous limestone on steeply sloped hillsides near the mainstream and tributary areas of the Kentucky and Cumberland rivers; (2) well-drained soils that are undisturbed and shallow or rocky; (3) low-level canopy forest communities with some openings that provide sufficient sunlight (US FWS Region 3, n.d.). Other species, such as the Braun's rockcress, are also found in similar environments as discussed in Section VII.B. While it is possible that such areas could be affected by erosion exacerbated by agriculture, these or other nearby areas would very likely not be suitable for agriculture conversion and therefore not be affected.

Other species that rely on PBFs that are present in pasture and grassland ecosystems (or comparable ecosystems—e.g., the Fleshy-fruit gladecress' cedar glade habitat) may be more likely to have PBFs that are affected. But as discussed previously, new conversion of agricultural lands could occur in areas that are already not very suitable for PBFs. For instance, areas that were once used for pasture, hay, or retired croplands planted to permanent vegetative cover through the Conservation Reserve Program could be some of the lands that would be converted for agriculture. Such lands are not likely to have the essential PBFs that those species require. For this and the other reasons stated above, and because we cannot say for certain that effects will occur, any potential effects to flowering plants (as well as critical habitat PBFs) are likely discountable or insignificant.

Table IX.B-2. The 242 FWS flowering plants and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects. None of these species have separate DPSs.

CH, Range, or Both	**Common Name**	**Scientific Name**	**Listing Status**
Range	Leafy prairie-clover	*Dalea foliosa*	Endangered
Range	Beautiful pawpaw	*Deeringothamnus pulchellus*	Endangered
Range	Rugel's pawpaw	*Deeringothamnus rugelii*	Endangered
Range	Baker's larkspur	*Delphinium bakeri*	Endangered
Range	Yellow larkspur	*Delphinium luteum*	Endangered
Range	Longspurred mint	*Dicerandra cornutissima*	Endangered
Range	Lakela's mint	*Dicerandra immaculata*	Endangered
Range	Smooth coneflower	*Echinacea laevigata*	Threatened
Both	Black lace cactus	*Echinocereus reichenbachii var. albertii*	Endangered
Both	Acuña Cactus	*Echinomastus erectocentrus var. acunensis*	Endangered
Range	Kern mallow	*Eremalche kernensis*	Endangered
Range	Willamette daisy	*Erigeron decumbens*	Endangered
Range	Umtanum desert buckwheat	*Eriogonum codium*	Threatened
Both	Gypsum wild-buckwheat	*Eriogonum gypsophilum*	Threatened

Range	Clay-Loving wild buckwheat	*Eriogonum pelinophilum*	Endangered
Both	San Mateo woolly sunflower	*Eriophyllum latilobum*	Endangered
Range	Arizona eryngo	*Eryngium sparganophyllum*	Endangered
Range	Contra Costa wallflower	*Erysimum capitatum var. angustatum*	Endangered
Range	Menzies' wallflower	*Erysimum menziesii*	Endangered
Range	Ben Lomond wallflower	*Erysimum teretifolium*	Endangered
Range	Minnesota dwarf trout lily	*Erythronium propullans*	Endangered
Range	Telephus spurge	*Euphorbia telephioides*	Threatened
Range	Gentner's Fritillary	*Fritillaria gentneri*	Endangered
Range	No common name	*Geocarpon minimum*	Threatened
Range	Spreading avens	*Geum radiatum*	Endangered
Range	Monterey gilia	*Gilia tenuiflora ssp. arenaria*	Endangered
Range	Bartram's stonecrop	*Graptopetalum bartramii*	Threatened
Range	Showy stickseed	*Hackelia venusta*	Endangered
Range	Harper's beauty	*Harperocallis flava*	Endangered
Range	Todsen's pennyroyal	*Hedeoma todsenii*	Endangered
Range	Roan Mountain bluet	*Hedyotis purpurea var. montana*	Endangered
Range	Virginia sneezeweed	*Helenium virginicum*	Threatened
Both	Pecos (=puzzle, =paradox) sunflower	*Helianthus paradoxus*	Threatened
Range	Schweinitz's sunflower	*Helianthus schweinitzii*	Endangered
Both	Whorled Sunflower	*Helianthus verticillatus*	Endangered
Range	Swamp pink	*Helonias bullata*	Threatened
Range	Marin dwarf-flax	*Hesperolinon congestum*	Threatened
Range	Dwarf-flowered heartleaf	*Hexastylis naniflora*	Threatened
Range	Neches River rose-mallow	*Hibiscus dasycalyx*	Threatened
Range	Slender rush-pea	*Hoffmannseggia tenella*	Endangered
Range	Santa Cruz tarplant	*Holocarpha macradenia*	Threatened
Both	Mountain golden heather	*Hudsonia montana*	Threatened
Range	Lakeside daisy	*Hymenoxys herbacea*	Threatened
Range	Texas prairie dawn-flower	*Hymenoxys texana*	Endangered
Range	Peter's Mountain mallow	*Iliamna corei*	Endangered
Range	Holy Ghost ipomopsis	*Ipomopsis sancti-spiritus*	Endangered
Range	Dwarf lake iris	*Iris lacustris*	Threatened
Range	Small whorled pogonia	*Isotria medeoloides*	Threatened
Range	Burke's goldfields	*Lasthenia burkei*	Endangered
Both	Contra Costa goldfields	*Lasthenia conjugens*	Endangered

Range	Beach layia	*Layia carnosa*	Threatened
Both	Fleshy-fruit gladecress	*Leavenworthia crassa*	Endangered
Both	Kentucky glade cress	*Leavenworthia exigua laciniata*	Threatened
Range	Barneby ridge-cress	*Lepidium barnebyanum*	Endangered
Both	Slickspot peppergrass	*Lepidium papilliferum*	Threatened
Range	Prairie bush-clover	*Lespedeza leptostachya*	Threatened
Range	Lyrate bladderpod	*Lesquerella lyrata*	Threatened
Range	Spring Creek bladderpod	*Lesquerella perforata*	Endangered
Range	San Francisco lessingia	*Lessingia germanorum (=L.g. var. germanorum)*	Endangered
Range	Heller's blazingstar	*Liatris helleri*	Threatened
Range	Huachuca water-umbel	*Lilaeopsis schaffneriana var. recurva*	Endangered
Range	Western lily	*Lilium occidentale*	Endangered
Range	Butte County meadowfoam	*Limnanthes floccosa ssp. californica*	Endangered
Range	Pondberry	*Lindera melissifolia*	Endangered
Both	Kincaid's Lupine	*Lupinus sulphureus ssp. kincaidii*	Threatened
Range	Clover (Tidestrom''s) lupine	*Lupinus tidestromii*	Endangered
Range	Rough-leaved loosestrife	*Lysimachia asperulaefolia*	Endangered
Range	White birds-in-a-nest	*Macbridea alba*	Threatened
Range	Walker's manioc	*Manihot walkerae*	Endangered
Range	Mohr's Barbara's buttons	*Marshallia mohrii*	Threatened
Range	Michigan monkey-flower	*Mimulus michiganensis*	Endangered
Range	MacFarlane's four-o'clock	*Mirabilis macfarlanei*	Threatened
Range	San Joaquin wooly-threads	*Monolopia (=Lembertia) congdonii*	Endangered
Range	Spreading navarretia	*Navarretia fossalis*	Threatened
Both	Colusa grass	*Neostapfia colusana*	Threatened
Range	Britton's beargrass	*Nolina brittoniana*	Endangered
Both	Antioch Dunes evening-primrose	*Oenothera deltoides ssp. howellii*	Endangered
Range	Bakersfield cactus	*Opuntia treleasei*	Endangered
Both	San Joaquin Orcutt grass	*Orcuttia inaequalis*	Threatened
Both	Hairy Orcutt grass	*Orcuttia pilosa*	Endangered
Range	Slender Orcutt grass	*Orcuttia tenuis*	Threatened
Both	Sacramento Orcutt grass	*Orcuttia viscida*	Endangered
Range	Canby's dropwort	*Oxypolis canbyi*	Endangered
Range	Fassett's locoweed	*Oxytropis campestris var. chartacea*	Threatened
Range	Papery whitlow-wort	*Paronychia chartacea*	Threatened

Range	Brady pincushion cactus	*Pediocactus bradyi*	Endangered
Range	San Rafael cactus	*Pediocactus despainii*	Endangered
Range	Knowlton's cactus	*Pediocactus knowltonii*	Endangered
Both	Fickeisen plains cactus	*Pediocactus peeblesianus ssp. fickeiseniae*	Endangered
Range	Blowout penstemon	*Penstemon haydenii*	Endangered
Range	White-rayed pentachaeta	*Pentachaeta bellidiflora*	Endangered
Range	Yreka phlox	*Phlox hirsuta*	Endangered
Both	White Bluffs bladderpod	*Physaria douglasii ssp. tuplashensis*	Threatened
Range	Missouri bladderpod	*Physaria filiformis*	Threatened
Both	Short's bladderpod	*Physaria globosa*	Endangered
Both	Zapata bladderpod	*Physaria thamnophila*	Endangered
Range	Godfrey's butterwort	*Pinguicula ionantha*	Threatened
Both	Yadon's piperia	*Piperia yadonii*	Endangered
Range	Ruth's golden aster	*Pityopsis ruthii*	Endangered
Range	White fringeless orchid	*Platanthera integrilabia*	Threatened
Range	Eastern prairie fringed orchid	*Platanthera leucophaea*	Threatened
Range	Western prairie fringed Orchid	*Platanthera praeclara*	Threatened
Range	Lewton's polygala	*Polygala lewtonii*	Endangered
Range	Tiny polygala	*Polygala smallii*	Endangered
Range	Sandlace	*Polygonella myriophylla*	Endangered
Range	Scotts Valley Polygonum	*Polygonum hickmanii*	Endangered
Range	Hickman's potentilla	*Potentilla hickmanii*	Endangered
Range	Maguire primrose	*Primula maguirei*	Threatened
Range	Hartweg's golden sunburst	*Pseudobahia bahiifolia*	Endangered
Range	San Joaquin adobe sunburst	*Pseudobahia peirsonii*	Threatened
Range	Harperella	*Ptilimnium nodosum*	Endangered
Range	Arizona Cliffrose	*Purshia (=Cowania) subintegra*	Endangered
Range	Autumn Buttercup	*Ranunculus aestivalis (=acriformis)*	Endangered
Range	Leedy's roseroot	*Rhodiola integrifolia ssp. leedyi*	Threatened
Range	Chapman rhododendron	*Rhododendron chapmanii*	Endangered
Range	Michaux's sumac	*Rhus michauxii*	Endangered
Range	Knieskern's Beaked-rush	*Rhynchospora knieskernii*	Threatened
Range	Miccosukee gooseberry	*Ribes echinellum*	Threatened
Range	Bunched arrowhead	*Sagittaria fasciculata*	Endangered
Range	Kral's water-plantain	*Sagittaria secundifolia*	Threatened
Range	Green pitcher-plant	*Sarracenia oreophila*	Endangered

Range	Alabama canebrake pitcher-plant	*Sarracenia rubra ssp. alabamensis*	Endangered
Range	Mountain sweet pitcher-plant	*Sarracenia rubra ssp. jonesii*	Endangered
Range	Clay reed-mustard	*Schoenocrambe argillacea*	Threatened
Range	Barneby reed-mustard	*Schoenocrambe barnebyi*	Endangered
Range	Shrubby reed-mustard	*Schoenocrambe suffrutescens*	Endangered
Range	American chaffseed	*Schwalbea americana*	Endangered
Range	Northeastern bulrush	*Scirpus ancistrochaetus*	Endangered
Range	Tobusch fishhook cactus	*Sclerocactus brevihamatus ssp. tobuschii*	Threatened
Range	Pariette cactus	*Sclerocactus brevispinus*	Threatened
Range	Colorado hookless Cactus	*Sclerocactus glaucus*	Threatened
Range	Mesa Verde cactus	*Sclerocactus mesae-verdae*	Threatened
Range	Uinta Basin hookless cactus	*Sclerocactus wetlandicus*	Threatened
Range	Florida skullcap	*Scutellaria floridana*	Threatened
Range	Large-flowered skullcap	*Scutellaria montana*	Threatened
Range	Keck's Checker-mallow	*Sidalcea keckii*	Endangered
Range	Nelson's checker-mallow	*Sidalcea nelsoniana*	Threatened
Range	Wenatchee Mountains checkermallow	*Sidalcea oregana var. calva*	Endangered
Range	Fringed campion	*Silene polypetala*	Endangered
Range	Spalding's Catchfly	*Silene spaldingii*	Threatened
Range	White irisette	*Sisyrinchium dichotomum*	Endangered
Range	Houghton's goldenrod	*Solidago houghtonii*	Threatened
Range	Short's goldenrod	*Solidago shortii*	Endangered
Range	Blue Ridge goldenrod	*Solidago spithamaea*	Threatened
Both	Gierisch mallow	*Sphaeralcea gierischii*	Endangered
Range	Gentian pinkroot	*Spigelia gentianoides*	Endangered
Range	Virginia spiraea	*Spiraea virginiana*	Threatened
Range	Ute ladies'-tresses	*Spiranthes diluvialis*	Threatened
Range	Navasota ladies-tresses	*Spiranthes parksii*	Endangered
Both	Bracted twistflower	*Streptanthus bracteatus*	Proposed Threatened
Range	Tiburon jewelflower	*Streptanthus niger*	Endangered
Range	California seablite	*Suaeda californica*	Endangered
Range	Cooley's meadowrue	*Thalictrum cooleyi*	Endangered
Range	Howell"s spectacular thelypody	*Thelypodium howellii ssp. spectabilis*	Threatened
Range	Ashy dogweed	*Thymophylla tephroleuca*	Endangered
Range	Last Chance townsendia	*Townsendia aprica*	Threatened
Range	Showy Indian clover	*Trifolium amoenum*	Endangered

Range	Monterey clover	*Trifolium trichocalyx*	Endangered
Range	Persistent trillium	*Trillium persistens*	Endangered
Range	Relict trillium	*Trillium reliquum*	Endangered
Both	Greene's tuctoria	*Tuctoria greenei*	Endangered
Both	Solano grass	*Tuctoria mucronata*	Endangered
Range	Carter's mustard	*Warea carteri*	Endangered
Range	Tennessee yellow-eyed grass	*Xyris tennesseensis*	Endangered
Both	Texas wild-rice	*Zizania texana*	Endangered
Range	Large-fruited sand-verbena	*Abronia macrocarpa*	Endangered
Both	San Mateo thornmint	*Acanthomintha obovata ssp. duttonii*	Endangered
Range	Northern wild monkshood	*Aconitum noveboracense*	Threatened
Range	Sensitive joint-vetch	*Aeschynomene virginica*	Threatened
Range	Sandplain gerardia	*Agalinis acuta*	Endangered
Range	Sonoma alopecurus	*Alopecurus aequalis var. sonomensis*	Endangered
Range	Seabeach amaranth	*Amaranthus pumilus*	Threatened
Range	South Texas ambrosia	*Ambrosia cheiranthifolia*	Endangered
Range	Little amphianthus	*Amphianthus pusillus*	Threatened
Range	Large-flowered fiddleneck	*Amsinckia grandiflora*	Endangered
Range	Price''s potato-bean	*Apios priceana*	Threatened
Range	Georgia rockcress	*Arabis georgiana*	Threatened
Both	McDonald's rock-cress	*Arabis macdonaldiana*	Endangered
Range	Braun's rock-cress	*Arabis perstellata*	Endangered
Range	Dwarf Bear-poppy	*Arctomecon humilis*	Endangered
Range	Franciscan manzanita	*Arctostaphylos franciscana*	Endangered
Range	Presidio Manzanita	*Arctostaphylos hookeri var. ravenii*	Endangered
Range	Pallid manzanita	*Arctostaphylos pallida*	Threatened
Range	Marsh Sandwort	*Arenaria paludicola*	Endangered
Range	Sacramento prickly poppy	*Argemone pleiacantha ssp. pinnatisecta*	Endangered
Range	Mead's milkweed	*Asclepias meadii*	Threatened
Range	Prostrate milkweed	*Asclepias prostrata*	Proposed Endangered
Both	Welsh's milkweed	*Asclepias welshii*	Threatened
Range	Shivwits milk-vetch	*Astragalus ampullarioides*	Endangered
Range	Guthrie's (=Pyne's) ground-plum	*Astragalus bibullatus*	Endangered
Range	Sentry milk-vetch	*Astragalus cremnophylax var. cremnophylax*	Endangered
Both	Holmgren milk-vetch	*Astragalus holmgreniorum*	Endangered
Range	Mancos milk-vetch	*Astragalus humillimus*	Endangered

Range	Peirson's milk-vetch	*Astragalus magdalenae var. peirsonii*	Threatened
Range	Jesup"s milk-vetch	*Astragalus robbinsii var. jesupii*	Endangered
Range	Coastal dunes milk-vetch	*Astragalus tener var. titi*	Endangered
Range	Star cactus	*Astrophytum asterias*	Endangered
Range	Texas ayenia	*Ayenia limitaris*	Endangered
Range	Hairy rattleweed	*Baptisia arachnifera*	Endangered
Range	Virginia round-leaf birch	*Betula uber*	Threatened
Range	Sonoma sunshine	*Blennosperma bakeri*	Endangered
Range	Shale barren rock cress	*Boechera serotina*	Endangered
Range	Decurrent false aster	*Boltonia decurrens*	Threatened
Range	Texas poppy-mallow	*Callirhoe scabriuscula*	Endangered
Range	Tiburon mariposa lily	*Calochortus tiburonensis*	Threatened
Range	Small-anthered bittercress	*Cardamine micranthera*	Endangered
Range	Golden sedge	*Carex lutea*	Endangered
Both	Navajo sedge	*Carex specuicola*	Threatened
Range	Tiburon paintbrush	*Castilleja affinis ssp. neglecta*	Endangered
Range	Fleshy owl's-clover	*Castilleja campestris ssp. succulenta*	Threatened
Both	golden paintbrush	*Castilleja levisecta*	Threatened
Range	California jewelflower	*Caulanthus californicus*	Endangered
Range	Fragrant prickly-apple	*Cereus eriophorus var. fragrans*	Endangered
Both	Hoover's spurge	*Chamaesyce hooveri*	Threatened
Both	Pygmy fringe-tree	*Chionanthus pygmaeus*	Endangered
Range	Ben Lomond spineflower	*Chorizanthe pungens var. hartwegiana*	Endangered
Both	Monterey spineflower	*Chorizanthe pungens var. pungens*	Threatened
Range	Scotts Valley spineflower	*Chorizanthe robusta var. hartwegii*	Endangered
Range	Robust spineflower	*Chorizanthe robusta var. robusta*	Endangered
Range	Sonoma spineflower	*Chorizanthe valida*	Endangered
Range	Florida golden aster	*Chrysopsis floridana*	Endangered
Range	Fountain thistle	*Cirsium fontinale var. fontinale*	Endangered
Range	Pitcher's thistle	*Cirsium pitcheri*	Threatened
Range	Sacramento Mountains thistle	*Cirsium vinaceum*	Threatened
Range	Wright's marsh thistle	*Cirsium wrightii*	Proposed Threatened
Range	Presidio clarkia	*Clarkia franciscana*	Endangered
Range	Springville clarkia	*Clarkia springvillensis*	Threatened
Range	Morefield"s leather flower	*Clematis morefieldii*	Endangered
Range	Alabama leather flower	*Clematis socialis*	Endangered

Range	Pigeon wings	*Clitoria fragrans*	Threatened
Range	Etonia rosemary	*Conradina etonia*	Endangered
Range	Apalachicola rosemary	*Conradina glabra*	Endangered
Range	Cumberland rosemary	*Conradina verticillata*	Threatened
Range	Salt marsh bird's-beak	*Cordylanthus maritimus ssp. maritimus*	Endangered
Range	Soft bird's-beak	*Cordylanthus mollis ssp. mollis*	Endangered
Range	Palmate-bracted bird's beak	*Cordylanthus palmatus*	Endangered
Range	Lee pincushion cactus	*Coryphantha sneedii var. leei*	Threatened
Range	Sneed pincushion cactus	*Coryphantha sneedii var. sneedii*	Endangered
Range	Okeechobee gourd	*Cucurbita okeechobeensis ssp. okeechobeensis*	Endangered
Range	Jones Cycladenia	*Cycladenia humilis var. jonesii*	Threatened
Range	Siler pincushion cactus	*Pediocactus (=Echinocactus,=Utahia) sileri*	Threatened
Both	Ocmulgee skullcap	*Scutellaria ocmulgee*	Proposed Threatened

Fishes, Clams, and Crustaceans

We found 104 fishes, 129 clams, and 21 crustaceans in the action area (Table IX.B-3, IX.B-4, IX.B-5). The Slender chub, Topeka shiner, St. Francis River crayfish, Texas fawnsfoot, Slackwater darter, Big Creek crayfish, Neosho madtom, False spike, and Neosho mucket were some species within these three taxonomic groups that saw the relatively larger percentage overlap results from the potential land use impact analyses (Tables VII.D-1 to VII.D-4).

The PBFs for many fish include creeks and streams with low turbidity, well oxygenated and moderately clean water, and riffles, pools, and runs with differing substrates of gravel, pebble, sand, and silt. Other essential features may include riparian cover and cooler temperature of waters, an abundant source of food, absence of invasive species, geomorphically stable river channels and banks, and sufficient water depth.

Clams have very similar PBFs, but also rely on the occurrence of certain fish assemblages and community compositions. For many clams, like the Neosho mucket, the presence of specific fish hosts is also necessary. In the case of the Neosho mucket, hosts include smallmouth bass, largemouth bass, and spotted bass (US FWS Region 3, n.d.).

Finally, crustaceans have similar PBFs as well; many require small rocks or shallow burrows in gravel for shelter in small to medium flowing streams with boulder and pebble substrates. For the fish, clam, and crustacean taxonomic groups combined, the RFS Set Rule could alter habitats and their essential features by contributing to water quality impairments. Species could also be exposed to pesticide runoff. However, EPA anticipates that potential effects of the RFS Set Rule would be insignificant or discountable for fish, clam, and crustacean populations as well as their critical habitats due to the uncertainties associated with the location of potential localized effects and due to the limited nature of changes that may be attributable to the RFS Set Rule.

Table IX.B-3. The 104 FWS fish populations and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects.

CH, Range, or Both	Common Name	Scientific Name	DPS (if applicable)	Listing Status
Range	Laurel dace	*Chrosomus saylori*		Endangered
Range	Pygmy Sculpin	*Cottus paulus (=pygmaeus)*		Threatened
Range	Grotto Sculpin	*Cottus specus*		Endangered
Range	diamond Darter	*Crystallaria cincotta*		Endangered
Range	Blue shiner	*Cyprinella caerulea*		Threatened
Range	Desert pupfish	*Cyprinodon macularius*		Endangered
Range	Lost River sucker	*Deltistes luxatus*		Endangered
Range	Devils River minnow	*Dionda diaboli*		Threatened
Range	Spring pygmy sunfish	*Elassoma alabamae*		Threatened
Both	Spotfin Chub	*Erimonax monachus*	Wherever found; Except where listed as Experimental Populations	Threatened
Range	Spotfin Chub	*Erimonax monachus*	U.S.A. (TN-specified portions of the Tellico River	Experimental Population, Non-Essential
Range	Spotfin Chub	*Erimonax monachus*	U.S.A. (AL, TN-specified portions of Shoal Creek	Experimental Population, Non-Essential
Range	Spotfin Chub	*Erimonax monachus*	U.S.A. (TN-specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Range	Slender chub	*Erimystax cahni*		Threatened
Range	bluemask darter	*Etheostoma akatulo*		Endangered
Range	Slackwater darter	*Etheostoma boschungi*		Threatened
Range	Vermilion darter	*Etheostoma chermocki*		Endangered
Range	Relict darter	*Etheostoma chienense*		Endangered
Range	Etowah darter	*Etheostoma etowahae*		Endangered
Range	Fountain darter	*Etheostoma fonticola*		Endangered
Both	Yellowcheek Darter	*Etheostoma moorei*		Endangered
Range	Niangua darter	*Etheostoma nianguae*		Threatened
Range	Candy darter	*Etheostoma osburni*		Endangered
Range	Duskytail darter	*Etheostoma percnurum*	Wherever found	Endangered
Range	Duskytail darter	*Etheostoma percnurum*	The Tellico River, between the backwaters of the Tellico Reservoir (approximately Tellico	Experimental Population, Non-Essential

			River mile 19 (30.4 kilometers) and Tellico River mile 33 (52.8 kilometers), near the Tellico Ranger Station, Monroe County, Tennessee.	
Range	Duskytail darter	*Etheostoma percnurum*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Both	Rush Darter	*Etheostoma phytophilum*		Endangered
Range	Bayou darter	*Etheostoma rubrum*		Threatened
Range	Cherokee darter	*Etheostoma scotti*		Threatened
Both	Maryland darter	*Etheostoma sellare*		Endangered
Range	Kentucky arrow darter	*Etheostoma spilotum*		Threatened
Range	Cumberland darter	*Etheostoma susanae*		Endangered
Both	Trispot darter	*Etheostoma trisella*		Threatened
Range	Boulder darter	*Etheostoma wapiti*	Wherever found	Endangered
Range	Boulder darter	*Etheostoma wapiti*	Shoal Creek (from Shoal Creek mile 41.7 (66.7 km)) at the mouth of Long Branch, Lawrence County, TN, downstream to the backwaters of Wilson Reservoir (Shoal Creek mile 14 (22 km)) at Goose Shoals, Lauderdale County, AL, including the lower 5 miles (8 km) of all tributaries that enter this reach	Experimental Population, Non-Essential
Both	Tidewater goby	*Eucyclogobius newberryi*		Endangered
Both	San Marcos gambusia	*Gambusia georgei*		Endangered
Range	Pecos gambusia	*Gambusia nobilis*		Endangered
Both	Humpback chub	*Gila cypha*		Threatened
Both	Bonytail	*Gila elegans*		Endangered
Range	Gila chub	*Gila intermedia*		Endangered
Range	Chihuahua chub	*Gila nigrescens*		Threatened
Range	Yaqui chub	*Gila purpurea*		Endangered
Both	Virgin River Chub	*Gila seminuda (=robusta)*		Endangered
Both	Rio Grande Silvery Minnow	*Hybognathus amarus*	Wherever found; Except where listed as Experimental Populations	Endangered

Range	Rio Grande Silvery Minnow	*Hybognathus amarus*	Rio Grande, from Little Box Canyon (approximately 10.4 river miles downstream of Fort Quitman, TX) to Amistad Dam; and on the Pecos River, from its confluence with Independence Creek to its confluence with the Rio Grande	Experimental Population, Non-Essential
Both	Delta smelt	*Hypomesus transpacificus*		Threatened
Range	Yaqui catfish	*Ictalurus pricei*		Threatened
Both	Peppered chub	*Macrhybopsis tetranema*		Endangered
Range	Spikedace	*Meda fulgida*		Endangered
Both	Waccamaw silverside	*Menidia extensa*		Threatened
Range	Palezone shiner	*Notropis albizonatus*		Endangered
Range	Smalleye Shiner	*Notropis buccula*		Endangered
Range	Cahaba shiner	*Notropis cahabae*		Endangered
Both	Arkansas River shiner	*Notropis girardi*		Threatened
Both	Cape Fear shiner	*Notropis mekistocholas*		Endangered
Range	Sharpnose Shiner	*Notropis oxyrhynchus*		Endangered
Both	Pecos bluntnose shiner	*Notropis simus pecosensis*		Threatened
Both	Topeka shiner	*Notropis topeka (=tristis)*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Topeka shiner	*Notropis topeka (=tristis)*	U.S.A. (MO-specified portions of Little Creek, Big Muddy Creek, and Spring Creek watersheds in Adair, Gentry, Harrison, Putnam, Sullivan, and Worth Counties	Experimental Population, Non-Essential
Both	Smoky madtom	*Noturus baileyi*	Wherever found	Endangered
Range	Smoky madtom	*Noturus baileyi*	The Tellico River, between the backwaters of the Tellico Reservoir (approximately Tellico River mile 19 (30.4 kilometers) and Tellico River mile 33 (52.8 kilometers), near the Tellico Ranger Station, Monroe County, Tennessee	Experimental Population, Non-Essential
Range	Chucky Madtom	*Noturus crypticus*		Endangered

Both	Yellowfin madtom	*Noturus flavipinnis*	Wherever found; Except where listed as Experimental Populations	Threatened
Range	Yellowfin madtom	*Noturus flavipinnis*	U.S.A. (TN-specified portions of the Tellico River	Experimental Population, Non-Essential
Range	Yellowfin madtom	*Noturus flavipinnis*	U.S.A. (TN, VA-specified portions of the Holston River and watershed	Experimental Population, Non-Essential
Range	Yellowfin madtom	*Noturus flavipinnis*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Both	Carolina madtom	*Noturus furiosus*		Endangered
Both	Frecklebelly madtom	*Noturus munitus*		Proposed Threatened
Range	Neosho madtom	*Noturus placidus*		Threatened
Range	Pygmy madtom	*Noturus stanauli*	Wherever found	Endangered
Range	Pygmy madtom	*Noturus stanauli*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers)	Experimental Population, Non-Essential
Range	Scioto madtom	*Noturus trautmani*		Endangered
Range	Apache trout	*Oncorhynchus apache*		Threatened
Range	Lahontan cutthroat trout	*Oncorhynchus clarkii henshawi*		Threatened
Range	Greenback Cutthroat trout	*Oncorhynchus clarkii stomias*		Threatened
Range	Gila trout	*Oncorhynchus gilae*		Threatened
Both	Amber darter	*Percina antesella*		Endangered
Range	Goldline darter	*Percina aurolineata*		Threatened
Range	Pearl darter	*Percina aurora*		Threatened
Both	Conasauga logperch	*Percina jenkinsi*		Endangered
Range	Leopard darter	*Percina pantherina*		Threatened
Range	Roanoke logperch	*Percina rex*		Endangered
Range	Blackside dace	*Phoxinus cumberlandensis*		Threatened
Both	Woundfin	*Plagopterus argentissimus*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Woundfin	*Plagopterus argentissimus*	Gila R. drainage, AZ, NM	Experimental Population, Non-Essential
Range	Gila topminnow (incl. Yaqui)	*Poeciliopsis occidentalis*		Endangered
Both	Colorado pikeminnow	*Ptychocheilus lucius*	Wherever found; Except where listed as Experimental Populations	Endangered

Range	Colorado pikeminnow	*Ptychocheilus lucius*	Salt and Verde R. drainages, AZ	Experimental Population, Non-Essential
Both	Atlantic salmon	*Salmo salar*		Endangered
Both	Bull Trout	*Salvelinus confluentus*		Threatened
Range	Pallid sturgeon	*Scaphirhynchus albus*		Endangered
Range	Alabama sturgeon	*Scaphirhynchus suttkusi*		Endangered
Both	Alabama cavefish	*Speoplatyrhinus poulsoni*		Endangered
Range	Loach minnow	*Tiaroga cobitis*		Endangered
Both	Razorback sucker	*Xyrauchen texanus*		Endangered
Range	Gulf sturgeon	*Acipenser oxyrinchus (=oxyrhynchus) desotoi*		Threatened
Range	White sturgeon	*Acipenser transmontanus*		Endangered
Both	Ozark cavefish	*Amblyopsis rosae*		Threatened
Range	Shortnose Sucker	*Chasmistes brevirostris*		Endangered
Range	June sucker	*Chasmistes liorus*		Threatened
Range	Rio Grande cutthroat trout	*Oncorhynchus clarkii virginalis*		Candidate
Range	Mexican blindcat (catfish)	*Prietella phreatophila*		Endangered
Range	Longfin Smelt	*Spirinchus thaleichthys*		Candidate

Table IX.B-4. The 129 FWS clam populations and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects.

CH, Range, or Both	Common Name	Scientific Name	DPS (if applicable)	Listing Status
Range	Spectaclecase (mussel)	*Cumberlandia monodonta*		Endangered
Range	Fanshell	*Cyprogenia stegaria*		Endangered
Range	Dromedary pearlymussel	*Dromus dromas*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Dromedary pearlymussel	*Dromus dromas*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential

Range	Dromedary pearlymussel	*Dromus dromas*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Both	Chipola slabshell	*Elliptio chipolaensis*		Threatened
Range	Yellow lance	*Elliptio lanceolata*		Threatened
Range	Altamaha Spinymussel	*Elliptio spinosa*		Endangered
Range	Purple bankclimber (mussel)	*Elliptoideus sloatianus*		Threatened
Both	Cumberlandian combshell	*Epioblasma brevidens*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Cumberlandian combshell	*Epioblasma brevidens*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Cumberlandian combshell	*Epioblasma brevidens*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Both	Oyster mussel	*Epioblasma capsaeformis*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Oyster mussel	*Epioblasma capsaeformis*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Oyster mussel	*Epioblasma capsaeformis*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential

Range	Curtis pearlymussel	*Epioblasma florentina curtisii*		Endangered
Range	Yellow blossom (pearlymussel)	*Epioblasma florentina florentina*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Yellow blossom (pearlymussel)	*Epioblasma florentina florentina*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Tan riffleshell	*Epioblasma florentina walkeri (=E. walkeri)*		Endangered
Range	Upland combshell	*Epioblasma metastriata*		Endangered
Range	Purple Cat"s paw (=Purple Cat"s paw pearlymussel)	*Epioblasma obliquata*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Purple Cat"s paw (=Purple Cat"s paw pearlymussel)	*Epioblasma obliquata*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Southern acornshell	*Epioblasma othcaloogensis*		Endangered
Range	Southern combshell	*Epioblasma penita*		Endangered
Range	White catspaw (pearlymussel)	*Epioblasma perobliqua*		Endangered
Range	Northern riffleshell	*Epioblasma rangiana*		Endangered
Range	Green blossom (pearlymussel)	*Epioblasma torulosa gubernaculum*		Endangered
Range	Tubercled blossom (pearlymussel)	*Epioblasma torulosa torulosa*	Wherever found; Except where listed as Experimental Populations	Endangered

Range	Tubercled blossom (pearlymussel)	*Epioblasma torulosa torulosa*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Both	Snuffbox mussel	*Epioblasma triquetra*		Endangered
Range	Turgid blossom (pearlymussel)	*Epioblasma turgidula*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Turgid blossom (pearlymussel)	*Epioblasma turgidula*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Tapered pigtoe	*Fusconaia burkei*		Threatened
Range	Shiny pigtoe	*Fusconaia cor*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Shiny pigtoe	*Fusconaia cor*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Shiny pigtoe	*Fusconaia cor*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Range	Finerayed pigtoe	*Fusconaia cuneolus*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Finerayed pigtoe	*Fusconaia cuneolus*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam	Experimental Population,

			downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Non-Essential
Range	Finerayed pigtoe	*Fusconaia cuneolus*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Both	Narrow pigtoe	*Fusconaia escambia*		Threatened
Range	Atlantic pigtoe	*Fusconaia masoni*		Threatened
Range	Longsolid	*Fusconaia subrotunda*		Proposed Threatened
Both	Finelined pocketbook	*Hamiota altilis*		Threatened
Range	Southern Sandshell	*Hamiota australis*		Threatened
Range	Orangenacre mucket	*Hamiota perovalis*		Threatened
Range	Shinyrayed pocketbook	*Hamiota subangulata*		Endangered
Range	Cracking pearlymussel	*Hemistena lata*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Cracking pearlymussel	*Hemistena lata*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Cracking pearlymussel	*Hemistena lata*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Range	Pink mucket (pearlymussel)	*Lampsilis abrupta*		Endangered
Range	Higgins eye (pearlymussel)	*Lampsilis higginsii*		Endangered
Range	Arkansas fatmucket	*Lampsilis powellii*		Threatened

Range	Neosho Mucket	*Lampsilis rafinesqueana*		Endangered
Range	Speckled pocketbook	*Lampsilis streckeri*		Endangered
Range	Alabama lampmussel	*Lampsilis virescens*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Alabama lampmussel	*Lampsilis virescens*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Both	Carolina heelsplitter	*Lasmigona decorata*		Endangered
Range	Birdwing pearlymussel	*Lemiox rimosus*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Birdwing pearlymussel	*Lemiox rimosus*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Birdwing pearlymussel	*Lemiox rimosus*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Range	Scaleshell mussel	*Leptodea leptodon*		Endangered
Range	Louisiana pearlshell	*Margaritifera hembeli*		Threatened
Range	Alabama pearlshell	*Margaritifera marrianae*		Endangered
Range	Alabama moccasinshell	*Medionidus acutissimus*		Threatened
Range	Coosa moccasinshell	*Medionidus parvulus*		Endangered
Range	Gulf moccasinshell	*Medionidus penicillatus*		Endangered

Range	Ochlockonee moccasinshell	*Medionidus simpsonianus*		Endangered
Range	Suwannee moccasinshell	*Medionidus walkeri*		Threatened
Range	Choctaw bean	*Obovaria choctawensis*		Endangered
Range	Ring pink (mussel)	*Obovaria retusa*		Endangered
Range	Round hickorynut	*Obovaria subrotunda*		Proposed Threatened
Range	James spinymussel	*Parvaspina collina*		Endangered
Range	Tar River spinymussel	*Parvaspina steinstansana*		Endangered
Range	Littlewing pearlymussel	*Pegias fabula*		Endangered
Range	White wartyback (pearlymussel)	*Plethobasus cicatricosus*		Endangered
Range	Orangefoot pimpleback (pearlymussel)	*Plethobasus cooperianus*	Wherever found	Endangered
Range	Orangefoot pimpleback (pearlymussel)	*Plethobasus cooperianus*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Range	Sheepnose Mussel	*Plethobasus cyphyus*		Endangered
Both	Canoe Creek Clubshell	*Pleurobema athearni*		Endangered
Range	Clubshell	*Pleurobema clava*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Clubshell	*Pleurobema clava*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Black clubshell	*Pleurobema curtum*		Endangered
Range	Southern clubshell	*Pleurobema decisum*		Endangered

Range	Dark pigtoe	*Pleurobema furvum*		Endangered
Range	Southern pigtoe	*Pleurobema georgianum*		Endangered
Range	Georgia pigtoe	*Pleurobema hanleyianum*		Endangered
Range	Flat pigtoe	*Pleurobema marshalli*		Endangered
Range	Ovate clubshell	*Pleurobema perovatum*		Endangered
Range	Rough pigtoe	*Pleurobema plenum*		Endangered
Range	Oval pigtoe	*Pleurobema pyriforme*		Endangered
Range	Fuzzy pigtoe	*Pleurobema strodeanum*		Threatened
Range	Heavy pigtoe	*Pleurobema taitianum*		Endangered
Range	Slabside Pearlymussel	*Pleuronaia dolabelloides*		Endangered
Range	Cumberland pigtoe	*Pleuronaia gibber*		Endangered
Both	Texas Hornshell	*Popenaias popeii*		Endangered
Range	Fat pocketbook	*Potamilus capax*		Endangered
Range	Inflated heelsplitter	*Potamilus inflatus*		Threatened
Range	Triangular Kidneyshell	*Ptychobranchus greenii*		Endangered
Range	Southern kidneyshell	*Ptychobranchus jonesi*		Endangered
Range	Fluted kidneyshell	*Ptychobranchus subtentus*		Endangered
Range	Rabbitsfoot	*Quadrula cylindrica cylindrica*		Threatened
Both	Rough rabbitsfoot	*Quadrula cylindrica strigillata*		Endangered
Range	Winged Mapleleaf	*Quadrula fragosa*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Winged Mapleleaf	*Quadrula fragosa*	U.S.A. (AL-specified portions of the Tennessee River	Experimental Population, Non-Essential
Range	Stirrupshell	*Quadrula stapes*		Endangered
Range	Round Ebonyshell	*Reginaia rotulata*		Endangered

Range	Cumberland monkeyface (pearlymussel)	*Theliderma intermedia*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Cumberland monkeyface (pearlymussel)	*Theliderma intermedia*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Range	Cumberland monkeyface (pearlymussel)	*Theliderma intermedia*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Appalachian monkeyface (pearlymussel)	*Theliderma sparsa*	Wherever found	Endangered
Range	Appalachian monkeyface (pearlymussel)	*Theliderma sparsa*	USA (TN - specified portions of the French Broad and Holston Rivers)	Experimental Population, Non-Essential
Range	Pale lilliput (pearlymussel)	*Toxolasma cylindrellus*		Endangered
Range	Rayed Bean	*Villosa fabalis*		Endangered
Both	Purple bean	*Villosa perpurpurea*		Endangered
Range	Cumberland bean (pearlymussel)	*Villosa trabalis*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Cumberland bean (pearlymussel)	*Villosa trabalis*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Cumberland bean (pearlymussel)	*Villosa trabalis*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential

Both	Cumberland elktoe	*Alasmidonta atropurpurea*		Endangered
Range	Dwarf wedgemussel	*Alasmidonta heterodon*		Endangered
Range	Appalachian elktoe	*Alasmidonta raveneliana*		Endangered
Range	Fat threeridge (mussel)	*Amblema neislerii*		Endangered
Both	Ouachita rock pocketbook	*Arcidens wheeleri*		Endangered
Range	Guadalupe Orb	*Cyclonaias necki*		Proposed Endangered
Range	Texas pimpleback	*Cyclonaias petrina*		Proposed Endangered
Range	Western fanshell	*Cyprogenia aberti*		Proposed Threatened
Both	false spike	*Fusconaia mitchelli*		Proposed Endangered
Range	Guadalupe Fatmucket	*Lampsilis bergmanni*		Proposed Endangered
Both	Texas fatmucket	*Lampsilis bracteata*		Proposed Endangered
Both	Texas fawnsfoot	*Truncilla macrodon*		Proposed Threatened

Table IX.B-5. The 21 FWS crustacean species and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects. None of these species have separate DPSs.

CH, Range, or Both	Common Name	Scientific Name	Listing Status
Both	Big Creek Crayfish	*Faxonius peruncus*	Proposed Threatened
Both	St. Francis River Crayfish	*Faxonius quadruncus*	Proposed Threatened
Range	Illinois cave amphipod	*Gammarus acherondytes*	Endangered
Both	Noel's Amphipod	*Gammarus desperatus*	Endangered
Both	Vernal pool tadpole shrimp	*Lepidurus packardi*	Endangered
Range	Lee County cave isopod	*Lirceus usdagalun*	Endangered
Range	Nashville crayfish	*Orconectes shoupi*	Endangered
Range	Squirrel Chimney Cave shrimp	*Palaemonetes cummingi*	Threatened
Range	Alabama cave shrimp	*Palaemonias alabamae*	Endangered

Both	Kentucky cave shrimp	*Palaemonias ganteri*	Endangered
Both	Peck's cave amphipod	*Stygobromus (=Stygonectes) pecki*	Endangered
Range	California freshwater shrimp	*Syncaris pacifica*	Endangered
Range	Socorro isopod	*Thermosphaeroma thermophilus*	Endangered
Range	Madison Cave isopod	*Antrolana lira*	Threatened
Both	Conservancy fairy shrimp	*Branchinecta conservatio*	Endangered
Range	Longhorn fairy shrimp	*Branchinecta longiantenna*	Endangered
Range	Vernal pool fairy shrimp	*Branchinecta lynchi*	Threatened
Range	Benton County cave crayfish	*Cambarus aculabrum*	Endangered
Both	Big Sandy crayfish	*Cambarus callainus*	Threatened
Range	Slenderclaw crayfish	*Cambarus cracens*	Endangered
Range	Hell Creek Cave crayfish	*Cambarus zophonastes*	Endangered

Mammals

Fifty-five mammals were found to be present in the action area (Table XI.A-6). Among the mammals, potential effects to most carnivores are very unlikely to occur. Many listed mammalian carnivores are nocturnal or crepuscular for most or part of the year and are also found within larger ranges. Depending on the species and its mobility, we anticipate that potential impacts would be discountable or insignificant as many carnivores are able to move to another region of their range if they experience some sort of localized disturbance. It is also unlikely that their prey base would be reduced to a degree that would harm the carnivorous species; again, they could move to another part of their range if there were any impacts to localized prey populations. Further, many carnivores such as the Canada lynx depend on certain types of vegetative cover such as dense understories and forests. As discussed previously, it is unlikely that forests would be converted to agriculture to meet biofuel demand attributable to the RFS Set Rule.

For other types of mammals, such as rodents, bats, and ungulates, potential effects are also likely to be insignificant or discountable. Habitat types for many, but not all, of these species within these groups are unlikely to be affected by agriculture. Many ungulates, for example, are found in steep, high elevation, and rocky habitat; many squirrel and chipmunk populations occur in mature forest stands in protected areas; and bats are typically shelter in trees, under bark, or inside caves. Many of these mammal groups are also mobile and able to travel to other areas to forage if their food sources are impacted.

Other mammals may be more likely to be impacted by agricultural practices. For example, rodents that rely on more riparian areas (e.g., the New Mexico meadow jumping mouse) or grassland ecosystems for PBFs such as insects for food. As another example, the West Indian Manatee could be affected by water pollution from agricultural runoff. However, we anticipate that potential effects to these species would also be insignificant and discountable for the same reasons previously stated for flowering plants and other taxa (due to the limited nature and uncertainty of changes attributed to the RFS Set Rule).

Table IX.B-6. The 55 FWS mammal populations and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects.

CH, Range, or Both	Common Name	Scientific Name	DPS (if applicable)	Listing Status
Range	Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*		Endangered
Range	Ocelot	*Leopardus (=Felis) pardalis*		Endangered
Range	Mexican long-nosed bat	*Leptonycteris nivalis*		Endangered
Both	Canada Lynx	*Lynx canadensis*		Threatened
Both	Pacific Marten, Coastal Distinct Population Segment	*Martes caurina*		Threatened
Range	Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*		Endangered
Range	Black-footed ferret	*Mustela nigripes*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Black-footed ferret	*Mustela nigripes*	U.S.A. (WY and specified portions of AZ, CO, MT, SD, and UT,	Experimental Population, Non-Essential
Range	Gray bat	*Myotis grisescens*		Endangered
Range	Northern Long-Eared Bat	*Myotis septentrionalis*		Endangered
Both	Indiana bat	*Myotis sodalis*		Endangered
Range	Riparian woodrat (=San Joaquin Valley)	*Neotoma fuscipes riparia*		Endangered
Range	Columbian white-tailed deer	*Odocoileus virginianus leucurus*		Threatened
Range	Jaguar	*Panthera onca*		Endangered
Range	Fisher	*Pekania pennanti*		Endangered
Both	Choctawhatchee beach mouse	*Peromyscus polionotus allophrys*		Endangered
Both	Alabama beach mouse	*Peromyscus polionotus ammobates*		Endangered
Range	Southeastern beach mouse	*Peromyscus polionotus niveiventris*		Threatened
Both	St. Andrew beach mouse	*Peromyscus polionotus peninsularis*		Endangered
Both	Perdido Key beach mouse	*Peromyscus polionotus trissyllepsis*		Endangered
Range	Florida panther	*Puma (=Felis) concolor coryi*		Endangered
Range	Gulf Coast jaguarundi	*Puma yagouaroundi cacomitli*		Endangered
Range	Southern Mountain Caribou DPS	*Rangifer tarandus ssp. caribou*		Endangered

Range	Salt marsh harvest mouse	*Reithrodontomys raviventris*		Endangered
Both	Buena Vista Lake ornate Shrew	*Sorex ornatus relictus*		Endangered
Range	Riparian brush rabbit	*Sylvilagus bachmani riparius*		Endangered
Both	Olympia pocket gopher	*Thomomys mazama pugetensis*		Threatened
Both	Tenino pocket gopher	*Thomomys mazama tumuli*		Threatened
Range	Yelm pocket gopher	*Thomomys mazama yelmensis*		Threatened
Both	West Indian Manatee	*Trichechus manatus*		Threatened
Range	Grizzly bear	*Ursus arctos horribilis*		Threatened
Range	San Joaquin kit fox	*Vulpes macrotis mutica*		Endangered
Both	New Mexico meadow jumping mouse	*Zapus hudsonius luteus*		Endangered
Both	Preble's meadow jumping mouse	*Zapus hudsonius preblei*		Threatened
Range	Sonoran pronghorn	*Antilocapra americana sonoriensis*		Endangered
Range	Point Arena mountain beaver	*Aplodontia rufa nigra*		Endangered
Range	red tree vole	*Arborimus longicaudus*		Candidate
Both	Columbia Basin Pygmy Rabbit	*Brachylagus idahoensis*		Endangered
Range	Gray wolf	*Canis lupus*	U.S. – multiple states	Endangered
Both	Gray wolf	*Canis lupus*	Minnesota	Threatened
Range	Mexican wolf	*Canis lupus baileyi*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Mexican wolf	*Canis lupus baileyi*	U.S.A. (portions of AZ and NM)	Experimental Population, Non-Essential
Range	Red wolf	*Canis rufus*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Red wolf	*Canis rufus*	U.S.A. (portions of NC and TN)	Experimental Population, Non-Essential
Range	Ozark big-eared bat	*Corynorhinus (=Plecotus) townsendii ingens*		Endangered
Range	Virginia big-eared bat	*Corynorhinus (=Plecotus) townsendii virginianus*		Endangered
Range	Utah prairie dog	*Cynomys parvidens*		Threatened
Range	Giant kangaroo rat	*Dipodomys ingens*		Endangered
Range	Fresno kangaroo rat	*Dipodomys nitratoides exilis*		Endangered
Range	Tipton kangaroo rat	*Dipodomys nitratoides nitratoides*		Endangered
Range	Southern sea otter	*Enhydra lutris nereis*		Threatened

Both	Florida bonneted bat	*Eumops floridanus*		Endangered
Range	North American wolverine	*Gulo gulo luscus*		Proposed Threatened
Range	Tricolored bat	*Perimyotis subflavus*		Proposed Endangered
Range	Penasco least chipmunk	*Tamias minimus atristriatus*		Proposed Endangered

Birds

Among the 41 birds found within the action area (Table XI.A-7), the Piping plover was one species that saw relatively higher potential impacts based on the land use impacts alone (Tables VII.D-1 to VII.D-4). The Piping plover Great Lakes breeding population have PBFs that include shorelines and islands of the Great Lakes with sparsely vegetated and sandy landscapes dunes and wetlands. This population also relies on the complex and dynamic ecology of the Great Lakes shoreline, which is in a constant change with natural disturbances from storms and sediment transportation (US FWS Region 3, n.d.).

The Norther Great Plains Piping plover population also depends on dynamic ecological processes and landscape features including permanently flooded wetlands, and sparsely vegetated sandbars, islands, and peninsulas on rivers, reservoirs, and inland lakes (US FWS Region 3, n.d.). These features could be potentially affected by erosion and runoff from agricultural fields. However, for reasons stated in IX.A, we anticipate discountable or insignificant effects.

This is the case for other listed birds as well. PBFs for many birds include access to forest and/or riparian areas with certain tree and understory species and diversity for roosting, nesting, and shelter. They also rely on such ecosystems for foraging of insects and other food sources. Birds typically have high mobility and are able to forage widely if they encounter localized threats or disturbances. As such, potential impacts from the RFS Rule, if any, are expected to be insignificant or discountable.

Table IX.B-7. The 41 FWS bird populations found within the action area that receive a NLAA finding due to insignificant or discountable effects.

CH, Range, or Both	Common Name	Scientific Name	DPS (if applicable)	Listing Status
Range	Florida scrub-jay	*Aphelocoma coerulescens*		Threatened
Both	Marbled murrelet	*Brachyramphus marmoratus*		Threatened
Range	Red knot	*Calidris canutus rufa*		Threatened
Range	Ivory-billed woodpecker	*Campephilus principalis*		Endangered
Range	Gunnison sage-grouse	*Centrocercus minimus*		Threatened
Both	Piping Plover	*Charadrius melodus*	Great Lakes Watershed	Endangered
Both	Piping Plover	*Charadrius melodus*	Atlantic Coast and Northern Great Plains	Threatened
Both	Western snowy plover	*Charadrius nivosus nivosus*		Threatened
Range	Yellow-billed Cuckoo	*Coccyzus americanus*		Threatened

Range	Southwestern willow flycatcher	*Empidonax traillii extimus*		Endangered
Both	Streaked Horned lark	*Eremophila alpestris strigata*		Threatened
Range	Northern Aplomado Falcon	*Falco femoralis septentrionalis*		Endangered
Both	Whooping crane	*Grus americana*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Whooping crane	*Grus americana*	U.S.A. (CO, ID, FL, NM, UT, and the western half of Wyoming)	Experimental Population, Non-Essential
Range	Whooping crane	*Grus americana*	U.S.A. (AL, AR, CO, FL, GA, ID, IL, IN, IA, KY, LA, MI, MN, MS, MO, NC, NM, OH, SC, TN, UT, VA, WI, WV, western half of WY)	Experimental Population, Non-Essential
Range	Whooping crane	*Grus americana*	U.S.A (Southwestern Louisiana)	Experimental Population, Non-Essential
Both	Mississippi sandhill crane	*Grus canadensis pulla*		Endangered
Both	California condor	*Gymnogyps californianus*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	California condor	*Gymnogyps californianus*	U.S.A. (specific portions of Arizona, Nevada, and Utah)	Experimental Population, Non-Essential
Range	Eastern Black rail	*Laterallus jamaicensis ssp. jamaicensis*		Threatened
Range	Wood stork	*Mycteria americana*		Threatened
Range	Eskimo curlew	*Numenius borealis*		Endangered
Range	Short-tailed albatross	*Phoebastria (=Diomedea) albatrus*		Endangered
Range	Red-cockaded woodpecker	*Picoides borealis*		Endangered
Range	Audubon's crested caracara	*Polyborus plancus audubonii*		Threatened
Range	Hawaiian petrel	*Pterodroma sandwichensis*		Endangered
Range	California clapper rail	*Rallus longirostris obsoletus*		Endangered
Range	Yuma Ridgway"s rail	*Rallus obsoletus yumanensis*		Endangered
Both	Everglade snail kite	*Rostrhamus sociabilis plumbeus*		Endangered
Range	golden-cheeked warbler	*Setophaga chrysoparia*		Endangered
Range	California least tern	*Sterna antillarum browni*		Endangered
Range	Roseate tern	*Sterna dougallii dougallii*	Atlantic Coast south to NC, Canada, Bermuda	Endangered

Range	Roseate tern	*Sterna dougallii dougallii*	Western Hemisphere and adjacent oceans, including USA (FL, PR, VI), where not listed as endangered	Endangered
Both	Northern spotted owl	*Strix occidentalis caurina*		Threatened
Both	Mexican spotted owl	*Strix occidentalis lucida*		Threatened
Range	Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*		Endangered
Range	Bachman's warbler (=wood)	*Vermivora bachmanii*		Endangered
Range	Least Bell's vireo	*Vireo bellii pusillus*		Endangered
Range	Florida grasshopper sparrow	*Ammodramus savannarum floridanus*		Endangered
Range	Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*		Proposed Threatened
Range	Black-capped petrel	*Pterodroma hasitata*		Proposed Threatened

Snails

Twenty-nine snails were present in the action area for the RFS Set Rule (Table IX.A-8). Snails are found on a variety of terrestrial and aquatic ecosystems. The PBFs for snails that live in aquatic environments are very similar to the PBFs for fish, clams, and crustaceans described previously (e.g., clean, well-oxygenated water with gravely beds and riffles). One with critical habitat found within the action area includes the Koster's springsnail which is found in New Mexico. The Roswell springsnail also has critical habitat in New Mexico, but in it lives in wetland sinkholes and spring-fed caves (US FWS, n.d.-d). It is unlikely that any effects of the RFS Rule would be detrimental to Roswell springsnail in particular because of where it lives. Nonetheless, EPA anticipates insignificant or discountable effects for all snails and their critical habitats due to the limited and uncertain nature of changes from the RFS Set Rule.

Table IX.B-8. The 27 FWS snail populations and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects.

CH, Range, or Both	Common Name	Scientific Name	DPS (if applicable)	Listing Status
Both	Koster's springsnail	*Juturnia kosteri*		Endangered
Range	Round rocksnail	*Leptoxis ampla*		Threatened
Range	Interrupted (=Georgia) Rocksnail	*Leptoxis foremani*		Endangered
Range	Plicate rocksnail	*Leptoxis plicata*		Endangered
Range	Painted rocksnail	*Leptoxis taeniata*		Threatened
Range	Cylindrical lioplax (snail)	*Lioplax cyclostomaformis*		Endangered
Range	Royal marstonia (snail)	*Marstonia ogmorhaphe*		Endangered
Range	Armored snail	*Marstonia pachyta*		Endangered

Range	Chittenango ovate amber snail	*Novisuccinea chittenangoensis*		Threatened
Range	Rough hornsnail	*Pleurocera foremani*		Endangered
Range	Virginia fringed mountain snail	*Polygyriscus virginianus*		Endangered
Range	Bruneau Hot springsnail	*Pyrgulopsis bruneauensis*		Endangered
Range	Chupadera springsnail	*Pyrgulopsis chupaderae*		Endangered
Range	Socorro springsnail	*Pyrgulopsis neomexicana*		Endangered
Both	Roswell springsnail	*Pyrgulopsis roswellensis*		Endangered
Range	Bliss Rapids snail	*Taylorconcha serpenticola*		Threatened
Range	Flat-spired three-toothed Snail	*Triodopsis platysayoides*		Threatened
Range	Tulotoma snail	*Tulotoma magnifica*		Threatened
Range	Painted snake coiled forest snail	*Anguispira picta*		Threatened
Range	Pecos assiminea snail	*Assiminea pecos*		Endangered
Range	Anthony's riversnail	*Athearnia anthonyi*	Wherever found; Except where listed as Experimental Populations	Endangered
Range	Anthony's riversnail	*Athearnia anthonyi*	U.S.A. (AL;The free-flowing reach of the Tennessee R. from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir [about 12 RM (19 km)] and the lower 5 RM [8 km] of all tributaries to this reach in Colbert and Lauderdale Cos.	Experimental Population, Non-Essential
Range	Anthony's riversnail	*Athearnia anthonyi*	U.S.A. (TN - specified portions of the French Broad and Holston Rivers	Experimental Population, Non-Essential
Range	Slender campeloma	*Campeloma decampi*		Endangered
Range	Iowa Pleistocene snail	*Discus macclintocki*		Endangered
Range	Lacy elimia (snail)	*Elimia crenatella*		Threatened
Range	Banbury Springs limpet	*Lanx sp.*		Endangered
Range	Snake River physa snail	*Physa natricina*		Endangered
Both	Magnificent ramshorn	*Planorbella magnifica*		Proposed Endangered

Arachnids

Many of the 10 arachnids in the action area (Table IX.A-8) are spiders that occur in cave and forest habitats. It is not very likely that such areas would be affected by the RFS Set Rule as they are areas that not favorable for agriculture conversion. PBFs for arachnids may be particular to the caves or other environments in which they are found, but in general PBFs would be similar to those described under the insects section previously (e.g., vegetation and other features needed for refugia and foraging). As is the case with the insects taxonomic group, EPA anticipates discountable and insignificant effects for arachnids. Agriculture conversion or intensification caused by the Set Rule, if any, would likely occur in areas that are already impacted and not suitable for habitat or in areas that meet criteria for arachnids' PBFs/PCEs.

Table IX.B-9. The 10 FWS arachnid populations and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects. None of these species have separate DPSs.

CH, Range, or Both	Common Name	Scientific Name	Listing Status
Both	Robber Baron Cave Meshweaver	*Cicurina baronia*	Endangered
Both	Madla Cave Meshweaver	*Cicurina madla*	Endangered
Range	Government Canyon Bat Cave meshweaver	*Cicurina vespera*	Endangered
Range	Spruce-fir moss spider	*Microhexura montivaga*	Endangered
Range	Tooth Cave pseudoscorpion	*Tartarocreagris texana*	Endangered
Both	Government Canyon Bat Cave spider	*Tayshaneta microps*	Endangered
Range	Tooth Cave spider	*Tayshaneta myopica*	Endangered
Range	Cokendolpher Cave Harvestman	*Texella cokendolpheri*	Endangered
Range	Bee Creek Cave harvestman	*Texella reddelli*	Endangered
Range	Bone Cave harvestman	*Texella reyesi*	Endangered

Reptiles

Twenty-nine reptiles were found within the action area (Table IX.A-10). Many reptiles can be found in a variety of habitats, including but not limited to forests, open fields, and near water. Some reptiles are fossorial and spend time underground, such as the Blunt-nose leopard lizard and narrow-headed garter snake. Habitat for shelter and protection, hibernation, thermoregulation, foraging, and gestation are important, as is the absence of invasive species and access to prey and other food sources. Critical habitat PBFs may include woody debris and riparian vegetation, streams and ponds, and presence of small mammal burrows. It is possible that RFS rule may impact some of these features and habitats through conversion of lands and increases in sediment and pollution from agricultural runoff. EPA determines, however, that potential effects are discountable or insignificant because of the limited nature and uncertainty of changes especially at the local level.

Runoff from agriculture attributed to the RFS Rule may also affect other reptiles such as sea turtles that occur in marine and coastal regions. Some of these FWS marine reptiles are also managed by NMFS and, as discussed in Section V, EPA anticipates discountable and insignificant potential effects to these species. Further analyses in Section VIII affirm that potential effects in downstream areas would be limited relative to baseline conditions, and therefore would not contribute to any measurable adverse effects.

Table IX.B-10. The 29 FWS reptile populations and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects. None of these species have separate DPSs.

CH, Range, or Both	**Common Name**	**Scientific Name**	**Listing Status**
Range	bog turtle	*Glyptemys muhlenbergii*	Threatened
Both	Desert tortoise	*Gopherus agassizii*	Threatened
Range	Gopher tortoise	*Gopherus polyphemus*	Threatened
Range	Yellow-blotched map turtle	*Graptemys flavimaculata*	Threatened
Range	Ringed map turtle	*Graptemys oculifera*	Threatened
Range	Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Range	Olive ridley sea turtle	*Lepidochelys olivacea*	Threatened
Range	Alameda whipsnake (=striped racer)	*Masticophis lateralis euryxanthus*	Threatened
Range	Sand skink	*Neoseps reynoldsi*	Threatened
Range	Atlantic salt marsh snake	*Nerodia clarkii taeniata*	Threatened
Range	Copperbelly water snake	*Nerodia erythrogaster neglecta*	Threatened
Both	Black pinesnake	*Pituophis melanoleucus lodingi*	Threatened
Both	Louisiana pinesnake	*Pituophis ruthveni*	Threatened
Range	Alabama red-bellied turtle	*Pseudemys alabamensis*	Endangered
Range	Plymouth Redbelly Turtle	*Pseudemys rubriventris bangsi*	Endangered
Range	Eastern Massasauga (=rattlesnake)	*Sistrurus catenatus*	Threatened
Range	Flattened musk turtle	*Sternotherus depressus*	Threatened
Both	Northern Mexican gartersnake	*Thamnophis eques megalops*	Threatened
Range	Giant garter snake	*Thamnophis gigas*	Threatened
Both	Narrow-headed gartersnake	*Thamnophis rufipunctatus*	Threatened
Range	San Francisco garter snake	*Thamnophis sirtalis tetrataenia*	Endangered
Both	Loggerhead sea turtle	*Caretta caretta*	Threatened
Range	Green sea turtle	*Chelonia mydas*	Threatened
Range	Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Range	Eastern indigo snake	*Drymarchon couperi*	Threatened
Range	Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Range	Blunt-nosed leopard lizard	*Gambelia silus*	Endangered
Range	Suwannee alligator snapping turtle	*Macrochelys suwanniensis*	Proposed Threatened

Range	Alligator snapping turtle	*Macrochelys temminckii*	Proposed Threatened

Amphibians

This Biological Evaluation identified 25 amphibians that may be impacted by the action (Table IX.A-11). As is the case for reptiles, many amphibians are fossorial and remain in underground burrows for long periods at a time. Others are semi or fully aquatic. Amphibians rely on food such as insects, crayfish, snails, and earthworms. Some essential features found in critical habitat may include the following: depressions in land that create ephemeral bodies of fresh water; tree and plant communities encompassing specific plant species or types; large shelter rocks in rivers and other habitat for refugia; wetlands with herbaceous vegetation. While it is possible that such features may be affected by agricultural conversion or runoff, EPA anticipates that potential effects would be discountable or insignificant for amphibians as well.

Table IX.B-11. The 25 FWS amphibian populations and those with designated critical habitat found within the action area that receive a NLAA finding due to insignificant or discountable effects.

CH, Range, or Both	Common Name	Scientific Name	DPS (if applicable)	Listing Status
Range	Reticulated flatwoods salamander	*Ambystoma bishopi*		Endangered
Both	California tiger salamander	*Ambystoma californiense*	Central California	Threatened
Both	California tiger salamander	*Ambystoma californiense*	Santa Barbara County	Endangered
Both	California tiger salamander	*Ambystoma californiense*	Sonoma County	Endangered
Range	Frosted Flatwoods salamander	*Ambystoma cingulatum*		Threatened
Range	Santa Cruz long-toed salamander	*Ambystoma macrodactylum croceum*		Endangered
Range	Dixie Valley Toad	*Anaxyrus williamsi*		Endangered
Range	Houston toad	*Bufo houstonensis*		Endangered
Range	Ozark Hellbender	*Cryptobranchus alleganiensis bishopi*		Endangered
Both	Salado Salamander	*Eurycea chisholmensis*		Threatened
Both	San Marcos salamander	*Eurycea nana*		Threatened
Both	Georgetown Salamander	*Eurycea naufragia*		Threatened
Range	Texas blind salamander	*Eurycea rathbuni*		Endangered
Range	Barton Springs salamander	*Eurycea sosorum*		Endangered
Both	Jollyville Plateau Salamander	*Eurycea tonkawae*		Threatened
Both	Austin blind Salamander	*Eurycea waterlooensis*		Endangered
Range	Black warrior (=Sipsey Fork) Waterdog	*Necturus alabamensis*		Endangered
Both	Neuse River waterdog	*Necturus lewisi*		Threatened
Range	Red Hills salamander	*Phaeognathus hubrichti*		Threatened
Range	Cheat Mountain salamander	*Plethodon nettingi*		Threatened
Range	Shenandoah salamander	*Plethodon shenandoah*		Endangered

Range	Chiricahua leopard frog	*Rana chiricahuensis*		Threatened
Both	California red-legged frog	*Rana draytonii*		Threatened
Both	Oregon spotted frog	*Rana pretiosa*		Threatened
Both	dusky gopher frog	*Rana sevosa*		Endangered

Ferns and Allies; Conifers and Cycads; Lichens

Five ferns and allies, four conifers and cycads, and two lichens are present within the action area. The species within these three taxonomic groups are found within a variety of habitats, including forests of varying tree densities and species, ephemeral pools and aquatic ecosystems, vertical rock faces (in the case of the Rock Gnome lichen), and landscapes with particular soil types and/or moisture levels that are suitable for the species. Like flowering plants, some species rely on pollinators for reproduction. None of the species within the three groups have critical habitat. EPA anticipates that potential effects would be discountable or insignificant.

Table IX.B-12. The 5 FWS ferns and allies found within the action area that receive a NLAA finding due to insignificant or discountable effects. None of these species have separate DPSs.

CH, Range, or Both	Common Name	Scientific Name	Listing Status
Range	Louisiana quillwort	*Isoetes louisianensis*	Endangered
Range	Black spored quillwort	*Isoetes melanospora*	Endangered
Range	Mat-forming quillwort	*Isoetes tegetiformans*	Endangered
Range	Alabama streak-sorus fern	*Thelypteris pilosa var. alabamensis*	Threatened
Range	American hart's-tongue fern	*Asplenium scolopendrium var. americanum*	Threatened

Table IX.B-13. The 4 FWS conifers and cycads found within the action area that receive a NLAA finding due to insignificant or discountable effects. None of these species have separate DPSs.

CH, Range, or Both	Common Name	Scientific Name	Listing Status
Range	Santa Cruz cypress	*Cupressus abramsiana*	Threatened
Range	Gowen cypress	*Cupressus goveniana ssp. goveniana*	Threatened
Range	Whitebark pine	*Pinus albicaulis*	Threatened
Range	Florida torreya	*Torreya taxifolia*	Endangered

Table IX.B-14. The 2 FWS lichens found within the action area that receive a NLAA finding due to insignificant or discountable effects. Neither of these species have separate DPss.

CH, Range, or Both	Common Name	Scientific Name	Listing Status
Range	Rock gnome lichen	*Gymnoderma lineare*	Endangered
Range	Florida perforate cladonia	*Cladonia perforata*	Endangered

C. NMFS Species and Critical Habitats

Seventy-three NMFS populations were found in the action area. Out of the 73 populations, four are corals; 44 are fishes; 14 are mammals; nine are reptiles; one is a snail; and one is an echinoderm (Table IX.C-1).

Table IX.C-1. The 73 NMFS populations found within the action area and their associated taxonomic group.

CH, Range, or Both	Common Name	Scientific Name	DPS or ESU (if applicable)	Listing Status	Taxonomic Group
Range	Shortnose sturgeon	*Acipenser brevirostrum*		Endangered	Fishes
Both	Sturgeon, Green	*Acipenser medirostris*	Southern	Threatened	Fishes
Both	Sturgeon, Atlantic (Gulf subspecies)	*Acipenser oxyrinchus (=oxyrhynchus) desotoi*		Threatened	Fishes
Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	Carolina	Endangered	Fishes
Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	Chesapeake Bay	Endangered	Fishes
Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	Gulf of Maine	Threatened	Fishes
Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	New York Bight	Endangered	Fishes
Both	Sturgeon, Atlantic	*Acipenser oxyrinchus oxyrinchus*	South Atlantic	Endangered	Fishes
Both	Elkhorn coral	*Acropora palmata*		Threatened	Corals
Range	Guadalupe fur seal	*Arctocephalus townsendi*		Threatened	Mammals
Range	Sei Whale	*Balaenoptera borealis*		Endangered	Mammals
Range	Blue Whale	*Balaenoptera musculus*		Endangered	Mammals
Range	Fin Whale	*Balaenoptera physalus*		Endangered	Mammals
Range	Rice's Whale	*Balaenoptera ricei*	Gulf of Mexico	Endangered	Mammals
Range	Oceanic Whitetip Shark	*Carcharhinus longimanus*		Threatened	Fishes
Both	Loggerhead Sea Turtle	*Caretta caretta*	Northwest Atlantic Ocean	Endangered	Reptiles
Range	Loggerhead Sea Turtle	*Caretta caretta*	North Pacific Ocean	Endangered	Reptiles
Range	Green Sea Turtle	*Chelonia mydas*	North Atlantic	Threatened	Reptiles
Range	Green Sea Turtle	*Chelonia mydas*	East Pacific	Threatened	Reptiles

Both	Leatherback Sea Turtle	*Dermochelys coriacea*		Endangered	Reptiles
Range	Hawskbill Sea Turtle	*Eretmochelys imbricata*		Endangered	Reptiles
Both	North Atlantic Right Whale	*Eubalaena glacialis*		Endangered	Mammals
Range	North Pacific Right Whale	*Eubalaena japonica*		Endangered	Mammals
Both	Steller Sea Lion	*Eumetopias jubatus*	Western	Endangered	Mammals
Both	Abalone, black	*Haliotis cracherodii*		Endangered	Snails
Range	Kemp's Ridley Sea Turtle	*Lepidochelys kempii*		Endangered	Reptiles
Range	Olive Ridley Sea Turtle	*Lepidochelys olivacea*	All other areas	Threatened	Reptiles
Range	Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Mexico's Pacific coast breeding colonies	Endangered	Reptiles
Range	Giant Manta Ray	*Manta birostris*		Threatened	Fishes
Both	Humpback Whale	*Megaptera novaeangliae*	Central America	Endangered	Mammals
Both	Humpback Whale	*Megaptera novaeangliae*	Mexico	Threatened	Mammals
Range	Humpback Whale	*Megaptera novaeangliae*	Western North Pacific	Endangered	Mammals
Both	Coho Salmon	*Oncorhynchus (=Salmo) kisutch*	Central California coast	Endangered	Fishes
Both	Coho Salmon	*Oncorhynchus (=Salmo) kisutch*	Lower Columbia River	Threatened	Fishes
Both	Coho Salmon	*Oncorhynchus (=Salmo) kisutch*	Oregon coast	Threatened	Fishes
Both	Coho Salmon	*Oncorhynchus (=Salmo) kisutch*	Southern Oregon & Northern California coasts (SONCC)	Threatened	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	California Central Valley	Threatened	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Central California coast	Threatened	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Lower Columbia River	Threatened	Fishes

Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Middle Columbia River	Threatened	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Northern California	Threatened	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Puget Sound	Threatened	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Snake River Basin	Threatened	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	South-Central California coast	Threatened	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Southern California	Endangered	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Upper Columbia River	Threatened	Fishes
Both	Steelhead	*Oncorhynchus (=Salmo) mykiss*	Upper Willamette River	Threatened	Fishes
Both	Salmon, sockeye	*Oncorhynchus (=Salmo) nerka*	Ozette Lake	Threatened	Fishes
Both	Salmon, sockeye	*Oncorhynchus (=Salmo) nerka*	Snake River	Endangered	Fishes
Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	California coastal	Threatened	Fishes
Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Central Valley spring-run	Threatened	Fishes
Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Lower Columbia River	Threatened	Fishes
Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Puget Sound	Threatened	Fishes
Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Sacramento River winter-run	Endangered	Fishes
Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Snake River fall-run	Threatened	Fishes
Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Snake River spring/summer-run	Threatened	Fishes
Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Upper Columbia River spring-run	Endangered	Fishes

Both	Chinook Salmon	*Oncorhynchus (=Salmo) tshawytscha*	Upper Willamette River	Threatened	Fishes
Both	Chum Salmon	*Oncorhynchus keta*	Columbia River	Threatened	Fishes
Both	Chum Salmon	*Oncorhynchus keta*	Hood Canal summer-run	Threatened	Fishes
Both	Coral, lobed star	*Orbicella annularis*		Threatened	Corals
Both	Coral, mountainous star	*Orbicella faveolata*		Threatened	Corals
Both	Boulder star coral	*Orbicella franksi*		Threatened	Corals
Both	Whale, killer	*Orcinus orca*	Southern Resident	Endangered	Mammals
Range	Sperm Whale	*Physeter macrocephalus (= catodon)*		Endangered	Mammals
Range	Smalltooth sawfish	*Pristis pectinata*	U.S. portion of range	Endangered	Fishes
Range	False Killer Whale	*Pseudorca crassidens*	Main Hawaiian Islands Insular	Endangered	Mammals
Range	Sunflower sea star	*Pycnopodia helianthoides*		Proposed Threatened	Echinoderms
Both	Salmon, Atlantic	*Salmo salar*	Gulf of Maine	Endangered	Fishes
Both	Bocaccio	*Sebastes paucispinis*	Puget Sound/ Georgia Basin	Endangered	Fishes
Both	Rockfish, yelloweye	*Sebastes ruberrimus*	Puget Sound/ Georgia Basin	Threatened	Fishes
Range	Scalloped Hammerhead	*Sphyrna lewini*	Central & Southwest Atlantic	Threatened	Fishes
Both	Eulachon	*Thaleichthys pacificus*	Southern	Threatened	Fishes

Another way to group species is by type of aquatic ecosystem(s) in which they reside. NMFS populations can be found in one or more of the following: offshore marine ecosystems, coastal ecosystems, and inland aquatic ecosystems (e.g., in the case of migratory salmonid species that spawn in headwaters of rivers and streams). As discussed in Section V of this Biological Evaluation, EPA concludes that potential effects would be insignificant or discountable for most of the offshore and/or coastal NMFS populations which include the following: Sei Whale, Rice's Whale Gulf of Mexico population, Blue Whale, Finback Whale, all listed Humpback Whale DPSs, Sperm Whale, the North Atlantic Right Whale, North Pacific Right Whale, False Killer Whale Main Hawaiian Islands Insular population). Olive Ridley Sea Turtle (Mexico's Pacific coast breeding colonies and all other areas populations), Leatherback Sea Turtle, Loggerhead Sea Turtle (Northwest Atlantic Ocean and North Pacific Ocean populations), Green Sea Turtle (North Atlantic and East Pacific populations), Hawksbill Sea Turtle, Kemp's Ridley Sea Turtle, Elkhorn Coral, Lobed Star Coral, Mountainous Star Coral, Boulder Star Coral, Steller Sea lion (Western population), Guadalupe Fur Seal, Oceanic Whitetip Shark, Scalloped Hammerhead Shark (Central & Southwest Atlantic population), and Giant Manta Ray. These species were not assessed in the worst-case scenario potential land use impacts analyses described in Section VII. The Southern Resident Killer Whale was also not included in those analyses but must be considered separately as it depends on Chinook and other salmon populations that may be affected by the action. We discuss this in more detail in later paragraphs.

After making these conclusions for the above 40 populations, in Sections VII.A and VII.B of this Biological Evaluation we evaluated the potential land use impacts that could occur within ranges and critical habitats of the remaining 43 NMFS populations. These assessments represented a worst-case scenario due to a variety of conservative assumptions we made in attributing potential land use impacts to the RFS Set Rule alone. In the same sections, we provided detailed information on many of these listed NMFS populations, including information on where they are found, what they are threatened by, and life history traits.

38 of the 40 populations belong to the fish taxonomic group. The remaining two species are an echinoderm (Sunflower sea star) and a snail (Black Abalone). The mechanism through which the RFS Rule may impact these species is through water quality effects from intensification and extensification of agriculture. Pesticide exposure can lead to toxicity effects in species and increases in nutrient and sediment deposition can alter their ecosystems and habitat as well as PBFs. PBFs for these aquatic species would be similar to the PBFs for FWS fish, clams, and crustaceans as discussed previously including clean and well-oxygenated water; creeks and streams with low turbidity and riffles, pools, and runs; riparian tree cover to provide shade and protect species from the heat; an abundant source of food and absence of invasive species; in addition to other essential physical, geomorphological, and biological features. Additionally, as discussed in the water quality section (Section VIII), potential concentrations of pollutants would be highest nearest to edge of field. While it is not feasible to determine the magnitude of localized pollutant concentrations associated with potential land use changes resulting from the RFS Set Rule, it is important to assess the potential impacts on these populations which may occur in areas that are near or within watersheds where agricultural impacts could occur.

Recognizing that these 40 NMFS populations are already exposed to pollution from existing cropland within their critical habitat and/or range, EPA worked with NMFS on an additional analysis to better understand the potential effects. Using the conservative 90% percentile acreage increase results from the probabilistic analysis described in Section VII.A, in addition to the number of acres of corn already existing within species' critical habitats and ranges, we calculated the potential percent increase in corn acreage within species' critical habitat or range. It is important to note that there are several assumptions in this analysis. First, the corn acreage numbers that were used as the existing baseline for comparison came from a Biological Opinion (BiOP) that NMFS developed for another federal action; the corn acreage numbers were acquired from CDL data from years 2013-2017 which likely do not accurately represent current conditions as they were from 6+ years ago. In addition, since the release of the BiOp, the critical habitat and range GIS layers for many NMFS species may have been updated and therefore it is likely that the total corn acreage numbers changed as well with the change of those boundaries. Nonetheless, we believe that the BiOp corn acreage numbers can serve as a ballpark estimate for the purposes of this analysis. Another assumption is that the acreage increases from the probabilistic analysis would represent corn cropland only, when in reality as discussed in Section VII.A they could represent other crops. Finally, it is important to recognize that the baseline corn acreage numbers came from CDL data which, as was also discussed previously in this Biological Evaluation, does not always accurately capture land cover data. The overall accuracy for CDL cropland classification is around 90% for corn (USDA-NASS, 2021). The results of this additional analysis help to provide some understanding of potential impacts, but due to such assumptions and uncertainties they they are used qualitatively. For example, to assess the extent to which the range of a species will see expansion of corn. This informs how 1) the potential for an individual to be in close proximity to new corn cropland and 2) the potential magnitude of changes in pollutant concentrations at a larger scale (e.g. away from the converted cropland).

The results from this additional analysis are shown in Table IX.C-2 and Table IX.C-3. Table IX.C-2 shows the results for critical habitat without a buffer (S1 or scenario 1) and critical habitat with a buffer (S2 or scenario 2). Table IX.C-3 shows the results based on the probabilistic analysis for range without a buffer (S3 or scenario 3) and with a buffer (S4 or scenario 4). Overall, across all scenarios, the increase in percentage of corn cropland was very small relative to the baseline, ranging from an increase of 0.001 to 0.04 percent. On average, the change in percentage before and after the land use probabilistic analysis was 0.016 percent.

Table IX.C-2. Critical habitat results from the additional qualitative analysis. For each NMFS population with critical habitat, the percent increase in corn acreage was calculated for scenario 1 (without a buffer) and scenario 2 (with a buffer) based on total acres of critical habitat, an estimate number for existing corn acres in critical habitat, and 90th percentile acreage impact results from the corn ethanol probabilistic analysis.

Common Name	Population	Scientific Name	Total CH Acres	Corn Acres in CH	Scenario 1 Acres Impacted (90th percentile)	Scenario 2 Acres Impacted (90th percentile)	Scenario 1 Percent Increase	Scenario 2 Percent Increase
Atlantic sturgeon (Gulf subspecies)	None	Acipenser oxyrinchus (=oxyrhynchus) desotoi	7843992.54	106034	1620	1950	0.021	0.025
Chum salmon	Hood Canal summer-run	Oncorhynchus keta	610912.59	578	60	60	0.010	0.010
Chinook salmon	Central Valley spring-run	Oncorhynchus (=Salmo) tshawytscha	3486524.67	136407	420	420	0.012	0.012

Steelhead	Upper Columbia River	Oncorhynchus (=Salmo) mykiss	7051473.74	180157	2490	2700	0.035	0.038
Chinook salmon	Snake River spring/ summer-run	Oncorhynchus (=Salmo) tshawytscha	13821589.59	20923	1920	2010	0.014	0.015
green sturgeon	Southern	Acipenser medirostris	13042187.39	271003	630	660	0.005	0.005
Steelhead	Upper Willamette River	Oncorhynchus (=Salmo) mykiss	3301904.46	46196	930	1020	0.028	0.031
Steelhead	California Central Valley	Oncorhynchus (=Salmo) mykiss	5837579.79	388644	660	750	0.011	0.013
Chinook salmon	Snake River fall-run	Oncorhynchus (=Salmo) tshawytscha	5653843.90	144469	2160	2280	0.038	0.040
Chinook salmon	Puget Sound	Oncorhynchus (=Salmo) tshawytscha	4328340.70	56470	540	570	0.012	0.013
Chum salmon	Columbia River	Oncorhynchus keta	1954501.64	11773	300	330	0.015	0.017
Coho salmon	Oregon coast	Oncorhynchus (=Salmo) kisutch	6213617.80	2644	150	150	0.002	0.002
Steelhead	Middle Columbia River	Oncorhynchus (=Salmo) mykiss	14566302.72	210326	2130	2280	0.015	0.016
Steelhead	Lower Columbia River	Oncorhynchus (=Salmo) mykiss	4158668.06	11796	330	330	0.008	0.008
Chinook salmon	Upper Columbia River spring-run	Oncorhynchus (=Salmo) tshawytscha	5976906.82	163153	1800	1920	0.030	0.032
Chinook salmon	Lower Columbia River	Oncorhynchus (=Salmo) tshawytscha	3642262.09	11898	330	330	0.009	0.009
Chinook salmon	Sacramento River winter-run	Oncorhynchus (=Salmo) tshawytscha	1551693.99	106009	240	300	0.015	0.019
Steelhead	Snake River Basin	Oncorhynchus (=Salmo) mykiss	20160639.13	145663	3300	3450	0.016	0.017
Chinook salmon	Upper Willamette River	Oncorhynchus (=Salmo) tshawytscha	4581901.04	46092	1050	1110	0.023	0.024
Sockeye salmon	Snake River	Oncorhynchus (=Salmo) nerka	6528151.82	26006	1680	1710	0.026	0.026
Coho salmon	Lower Columbia River	Oncorhynchus (=Salmo) kisutch	4574604.36	12067	360	330	0.008	0.007
Steelhead	Puget Sound	Oncorhynchus (=Salmo) mykiss	6010259.79	70182	690	720	0.011	0.012
Atlantic salmon	Gulf of Maine	Salmo salar	513271.64	1059	30	30	0.006	0.006
Bocaccio	Puget Sound/ Georgia Basin	Sebastes paucispinis	1373482.37	10615	180	240	0.013	0.017
Eulachon	Southern	Thaleichthys pacificus	1555543.65	10922	240	240	0.015	0.015
yelloweye rockfish	Puget Sound/ Georgia Basin	Sebastes ruberrimus	1242811.97	10584	210	240	0.017	0.019
Atlantic sturgeon	Gulf of Maine	Acipenser oxyrinchus oxyrinchus	925163.49	5785	210	240	0.023	0.026

Atlantic sturgeon	New York Bight	Acipenser oxyrinchus oxyrinchus	2639906.10	108053	450	510	0.017	0.019
Atlantic sturgeon	Chesapeake Bay	Acipenser oxyrinchus oxyrinchus	2925765.34	288926	480	540	0.016	0.018
Atlantic sturgeon	Carolina	Acipenser oxyrinchus oxyrinchus	5892363.45	534326	1200	1350	0.020	0.023
Atlantic sturgeon	South Atlantic	Acipenser oxyrinchus oxyrinchus	9789946.26	312303	2640	2910	0.027	0.030

Table IX.C-3. Range results from the additional qualitative analysis. For each NMFS population with range, the percent increase in corn acreage was calculated for scenario 3 (without a buffer) and scenario 4 (with a buffer) based on total acres of range, an estimate number for existing corn acres in critical habitat, and 90th percentile acreage impact results from the corn ethanol probabilistic analysis.

Common Name	Population	Scientific Name	Total Range Acres	Corn Acres in Range	Scenario 3 Acres Impacted (90th percentile)	Scenario 4 Acres Impacted (90th percentile)	Scenario 3 Percent Increase	Scenario 4 Percent Increase
Atlantic sturgeon (Gulf subspecies)	None	Acipenser oxyrinchus (=oxyrhynchus) desotoi	8562606.84	31018	300	360	0.004	0.004
Chum salmon	Hood Canal summer-run	Oncorhynchus keta	687019.44	580	90	90	0.013	0.013
Chinook salmon	Central Valley spring-run	Oncorhynchus (=Salmo) tshawytscha	12522233.53	664302	1440	1470	0.011	0.012
Steelhead	Upper Columbia River	Oncorhynchus (=Salmo) mykiss	7514261.89	187957	2550	2820	0.034	0.038
Chinook salmon	Snake River spring/ summer-run	Oncorhynchus (=Salmo) tshawytscha	16568922.70	139960	2640	2790	0.016	0.017
Steelhead	Central California coast	Oncorhynchus (=Salmo) mykiss	3806847.33	1502	30	30	0.001	0.001
green sturgeon	Southern	Acipenser medirostris	18132188.78	299167	870	930	0.005	0.005
Steelhead	Upper Willamette River	Oncorhynchus (=Salmo) mykiss	4294283.77	54429	1230	1320	0.029	0.031
Steelhead	California Central Valley	Oncorhynchus (=Salmo) mykiss	14686561.35	711933	1770	1770	0.012	0.012
Chinook salmon	Snake River fall-run	Oncorhynchus (=Salmo) tshawytscha	6388833.65	144474	2340	2550	0.037	0.040
Shortnose sturgeon	None	Acipenser brevirostrum	32552627.77	1598998	4290	4830	0.013	0.015
Chinook salmon	Puget Sound	Oncorhynchus (=Salmo) tshawytscha	6024710.96	76940	660	690	0.011	0.011
Smalltooth sawfish	U.S. portion of range	Pristis pectinata	13284212.53	4295	90	90	0.001	0.001
Chum salmon	Columbia River	Oncorhynchus keta	3079569.86	12002	330	330	0.011	0.011
Coho salmon	Oregon coast	Oncorhynchus (=Salmo) kisutch	6464676.43	2645	150	150	0.002	0.002
Steelhead	Middle Columbia River	Oncorhynchus (=Salmo) mykiss	17284614.97	247425	2760	2850	0.016	0.016
Steelhead	Lower Columbia River	Oncorhynchus (=Salmo) mykiss	4412124.01	12051	330	360	0.007	0.008

Coho salmon	Southern Oregon & Northern California coasts (SONCC)	Oncorhynchus (=Salmo) kisutch	11816475.29	1803	120	120	0.001	0.001
Chinook salmon	Upper Columbia River spring-run	Oncorhynchus (=Salmo) tshawytscha	6941669.66	165202	2460	2640	0.035	0.038
Chinook salmon	Lower Columbia River	Oncorhynchus (=Salmo) tshawytscha	4764245.77	12074	360	330	0.008	0.007
Chinook salmon	Sacramento River winter-run	Oncorhynchus (=Salmo) tshawytscha	3489726.96	144686	480	480	0.014	0.014
Steelhead	Snake River Basin	Oncorhynchus (=Salmo) mykiss	20970139.13	145729	3510	3630	0.017	0.017
Chinook salmon	Upper Willamette River	Oncorhynchus (=Salmo) tshawytscha	5669747.42	51384	1230	1320	0.022	0.023
Sockeye salmon	Snake River	Oncorhynchus (=Salmo) nerka	6561935.30	144671	1890	2070	0.029	0.032
Coho salmon	Lower Columbia River	Oncorhynchus (=Salmo) kisutch	4666311.14	12073	360	360	0.008	0.008
Steelhead	Puget Sound	Oncorhynchus (=Salmo) mykiss	6834219.44	77558	720	720	0.011	0.011
Atlantic salmon	Gulf of Maine	Salmo salar	11295748.00	2090	60	330	0.002	0.003
Bocaccio	Puget Sound/ Georgia Basin	Sebastes paucispinis	3162389.10	33648	300	60	0.020	0.002
Eulachon	Southern	Thaleichthys pacificus	1512022.74	10922	240	330	0.015	0.022
yelloweye rockfish	Puget Sound/ Georgia Basin	Sebastes ruberrimus	1555543.65	33648	270	270	0.018	0.017
Atlantic sturgeon	Gulf of Maine	Acipenser oxyrinchus oxyrinchus	1512022.74	12199	300	330	0.004	0.022
Atlantic sturgeon	New York Bight	Acipenser oxyrinchus oxyrinchus	8353481.66	292589	1080	330	0.010	0.004
Atlantic sturgeon	Chesapeake Bay	Acipenser oxyrinchus oxyrinchus	10926367.48	1067249	1380	1170	0.014	0.011
Atlantic sturgeon	Carolina	Acipenser oxyrinchus oxyrinchus	10171166.55	851265	1710	1470	0.015	0.014
Atlantic sturgeon	South Atlantic	Acipenser oxyrinchus oxyrinchus	11511799.75	321427	2850	1890	0.023	0.016
Sunflower sea star		Pychnopodia helianthoides	12323258.02	39189	300	3030	0.003	0.025

Because these numbers are very small, and they represent potential land use effects of the action based on a worst-case scenario, EPA anticipates that potential effects of the RFS Set Rule on all these species are discountable. Since this list of species includes the salmon that the Southern resident killer whale depends on, we also conclude that the Southern resident killer whale would experience discountable effects in regards to prey availability and otherwise insignificant effects as described in Section X for some marine species that reside in coastal regions.

X. Conclusions

Based on the analyses presented in this Biological Evaluation, we find that the Renewable Fuel Standard (RFS) Program: Standards for 2023–2025 and Other Changes, or the "Set Rule," is not likely to adversely affect listed species or critical habitat. The primary mechanism through which this rule is expected to impact listed species is through establishing volume requirements for the use of various types of renewable fuels, thus increasing demand for these renewable fuels. For non-crop-based biofuels, such as CNG/LNG derived from biogas and biodiesel and renewable diesel produced from waste fats, oils and greases, we determined there would be no effect on listed species and critical habitat. In addition, this action implements regulatory changes that will not impact the volumes of renewable fuel and will also not impact listed species or critical habitat because they are administrative in nature.

For crop-based biofuels such as corn ethanol, soybean biodiesel, and canola biodiesel, we determined that the increased consumption and production may affect listed species. Ultimately, the increase in demand for feedstocks used to produce renewable fuels could potentially lead to an increase in the amount of land used to produce these crops. Listed species could potentially be impacted by loss of PBFs in critical habitat or loss of range to cropland, or by water quality impacts from increased loads of fertilizers and pesticides. In this Biological Evaluation, we identified the action area where these impacts could occur and found that 810 unique populations may be impacted by the action.

However, our analyses conclude that impacts from the RFS Set Rule, if any, would be insignificant and/or discountable. First and foremost, we reach this conclusion because of various uncertainties and complex causal chain of steps that occur in-between EPA setting the RFS volume requirements to potential on-the-ground land use changes (Figure 1 in Appendix A).

In this Biological Evaluation, we first projected the degree to which the Set Rule might increase the consumption of renewable fuels in 2023–2025 relative to a scenario where there were no RFS volume requirements for these three years.[42] We assumed (conservatively) that the entire increase in renewable fuel consumption attributable to the Set Rule would result in a corresponding increase in domestic biofuel production.

After projecting the potential increase in biofuel production, we next projected the potential impact of the increased demand for feedstocks used to produce these biofuels on crop production. Where possible, we relied upon the best available science and data (e.g., published literature or assessments completed in the context of other RFS actions) to inform our estimates.

The changes in land use potentially attributable to the Set Rule, briefly described above and presented in more detail in Section VI, represent our best estimates using the available data. There is, however, a considerable degree of uncertainty associated with these estimates. For example, there is uncertainty associated with estimating the volume biofuel consumption that can be attributed to the RFS program generally, and to the Set Rule in particular. We cannot predict

[42] While the analysis was initially performed based on the proposed applicable volumes, for the reasons described in Section IV.A.2, the analysis is still appropriate.

with certainty which biofuels will be used to meet the broad RFS volume requirements in 2023–2025, and it is even more difficult to project the quantity of these fuels that would be used in the absence of the RFS program. The use of compliance flexibilities under the RFS program, in particular carryover RINs and deficit carryovers, also introduce uncertainty into the volume of renewable fuel that will be consumed in the future.

There is also considerable uncertainty in the relationship between biofuel consumption and biofuel production in the U.S. The RFS program is designed to ensure a minimum volume of biofuel consumption, but it does not directly regulate domestic biofuel production or limit it to U.S. production. For example, ethanol producers can, and typically do, produce higher volumes than can be consumed domestically, with the excess ethanol being exported. While we have estimated the volume of biofuel consumption that can potentially be attributed to the Set Rule, it is considerably more difficult to determine how this volume of biofuel consumption influences domestic biofuel production since an increase in biofuel consumption can also be met with a decrease in biofuel exports and/or an increase in biofuel imports. For the purposes of our analyses, we have made the conservative assumption that every gallon of biofuel consumption attributable to the Set Rule corresponds to one gallon of additional domestic production of biofuel, but in fact the actual impact on biofuel production is likely to be smaller, and could in fact be zero, as the market adjusts import and export volumes in response to changes in domestic biofuel demand.

A similar dynamic is at play in the relationship between domestic biofuel production and domestic production of the crops used to produce biofuels, adding even more uncertainty to the analyses. The corn, soybean oil, and canola oil used to produce the volumes of renewable fuel that we estimate are potentially attributable to the Set Rule can come from several sources. If the necessary feedstocks result in increased corn, soybean, and canola plantings, this could have direct implications for listed species or critical habitat. However, the necessary feedstocks could also derive from a reduction in exports or a diversion of these feedstocks away from food and feed markets. In both cases, there may be no change in crop plantings and thus no direct impact on species or habitat, though there might still be some indirect effects on total cropland as markets shift to accommodate the change in the use of these feedstocks.

In general, we have made conservative assumptions in our projection of the amount of land use change potentially attributable to the Set Rule (e.g., assumptions that would lead to higher projections of land use change). We believe this is appropriate in the context of this Biological Evaluation, as we consider the potential impacts of this rule on listed species. However, we note that the consistent use of these conservative assumptions in the many steps of this analysis compound on each other to likely result in an over-projection of land use change potentially attributable to the Set Rule.

In order to assess the potential impacts on listed species and critical habitat, it is important to know geographically where land use changes from the RFS Set Rule, if any, could occur. Potential land use changes from the RFS Set rule can affect the PBFs of listed species found within their critical habitat (e.g., by affecting their prey or pollinators). Land use changes can also contribute to species' exposure to pollution from nutrient, sediment, and pesticide runoff. However, any potential land use changes from the Set Rule would occur at a very small scale and local level across a very large geographical area that represents available land for conversion within the action area. As there are many factors that drive agricultural growth, the location of such changes attributable to the RFS Set Rule alone is very challenging to assess and determine with any certainty.

Nevertheless, we attempted to identify potential locations of land use change. To assess potential impacts from soybean biodiesel, a contractor to EPA developed a soybean-specific land selection model. We used the two scenarios closest to the maximum projected acreage changes from increases in soybean biodiesel from the RFS Set Rule (1.9 million acres). Interestingly, the contractor found the biofuel demand for these two scenarios could be met by projected soybean yields on existing soybean acres, highlighting again the complexity of various factors that influence biofuel production, and that the RFS Set Rule could in fact lead to zero acres being converted for agricultural purposes. Still, we conservatively assumed that demands would be met by newly converted soybean acres and used their modeled expansion areas to assess potential impacts to species.

We used a different approach to assess impacts from increases in corn ethanol and canola biodiesel. Unlike the case for soybean oil which is expected to result in increased soybean plantings, the increase in demand for corn and canola oil suggest that the new cropland will not be limited to these crops. We developed a probabilistic approach to select available lands for conversion within the action area and repeated the process 100 to 500 times to generate an estimated probability that any given acre of land would be converted. For corn ethanol this was applied to the area of potential land use change within the action area and for canola biodiesel we limited the analysis to North Dakota since previous modeling work suggests that most changes could occur in that state.

Although we separately assessed impacts on listed species and designated critical habitat from potential increases in corn ethanol (Section VII.A), soybean biodiesel (Section VII.B), and canola biodiesel (Section VII.C), in Section VII.D we show the total potential impacts from all three analyses combined. In no particular order, the following FWS species were found to experience higher potential acreage impacts to their critical habitat and/or range relative to all other species: the Salt Creek Tiger beetle, Kentuck glade cress, Poweshiek skipperling, Dakota Skipper, Slender chub, Braun’s rock-cress, Topeka shiner, St. Francis River Crayfish, Big Creek Crayfish, Piping Plover, Fleshy-fruit gladecress, Slenderclaw crayfish, Devils River minnow, Slackwater darter, Roswell springsnail, False spike, Texas fawnsfoot, Guadalupe Orb, Neosho madtom, White catspaw, Neosho mucket, Illinois cave amphipod, Mead’s milkweed, Virginia round-leaf birch, and Rabbitsfoot.

With regard to critical habitat alone (i.e., no buffer), the maximum potential impacts occurred to the Salt Creek Tiger beetle at 4.62% overlap between the critical habitat and land potentially converted due to the Set Rule. With regard to range alone (i.e., no buffer), the maximum potential impacts occurred to the Neosho madtom at 13.67% overlap. We estimated that only 7 species would have greater than 1% of their critical habitat converted to cropland (38 species had greater than 1% of critical habitat plus buffer converted) and 15 species would have greater than 1% of their range converted (14 species had greater than 1% of their range plus buffer converted).

Additionally, we considered essential PBFs/PCEs of critical habitat and species taxa information such as feeding, survival, and reproduction needs and strategies in Section IX. In the case of the Salt Creek Tiger beetle's critical habitat as an example, the species is found in a very small area (1,100 acres) north of Lincoln, Nebraska. It includes saline wetlands and streams that are fed by groundwater discharge originating from Pennsylvanian and/or Permian formations as it passes through a salt source (*79 FR 26014*, 2014). Although this area is classified as available land in our analyses, we cannot determine with reasonable certainty that agricultural growth attributable to the Set Rule would occur in or near this critical habitat. Again, there are many other factors, beyond the RFS program, that influence biofuel production and land use change. Therefore, it is possible that the RFS Set Rule alone won't contribute to any future land use or water quality changes in or around Lincoln, Nebraska, or indeed anywhere at all. We therefore determine that effects, if any, would not likely adversely affect listed species or critical habitat.

We also assessed the potential water quality impacts that may occur at larger regional scales due to smaller cumulative water quality impacts across the action area. We primarily relied on published literature that used the SWAT to estimate the water quality impacts from observed increases in cropland in the Missouri River basin from 2008–2016 (Chen et al., 2021). We found that modeled increases in total nitrogen and phosphorus would represent increases of approximately 0.8% and 2.1% respectively at the Mississippi River outlet if we conservatively assume that the modeled increase in nitrogen and phosphorus at the mouth of the Missouri River is equal to the increase in nitrogen and phosphorus at the Mississippi River outlet. We expect that the increases in nitrogen and phosphorus from new cropland potentially attributable to the Set Rule would be similar to these SWAT results. We also estimated that any increase in pesticides in aquatic environments would be approximately equal to the potential increases in nitrogen and phosphorus projected using SWAT.

With regard to coastal and marine species, such as the NMFS species identified in the action area, the potential water quality impacts from the RFS Set Rule would be either discountable (for offshore species) or undetectable and not measurable relative to baseline conditions and would not rise to the level of take. The latter would likely be the case for potential effects in estuarine and coastal regions found in the action area, though we expect that downstream impacts, if they were to occur, would mostly take place in the Gulf of Mexico region. Potential effects from the action would be discountable or insignificant for species that live offshore as well as species that occur along the coast in more shallow waters. Potential effects on NMFS species that migrate to headwaters of streams and rivers for spawning (e.g., salmonids) would also be discountable, as supported by an additional analysis EPA completed that demonstrated very small percentage increases in total corn acreage within those species' critical habitats and ranges.

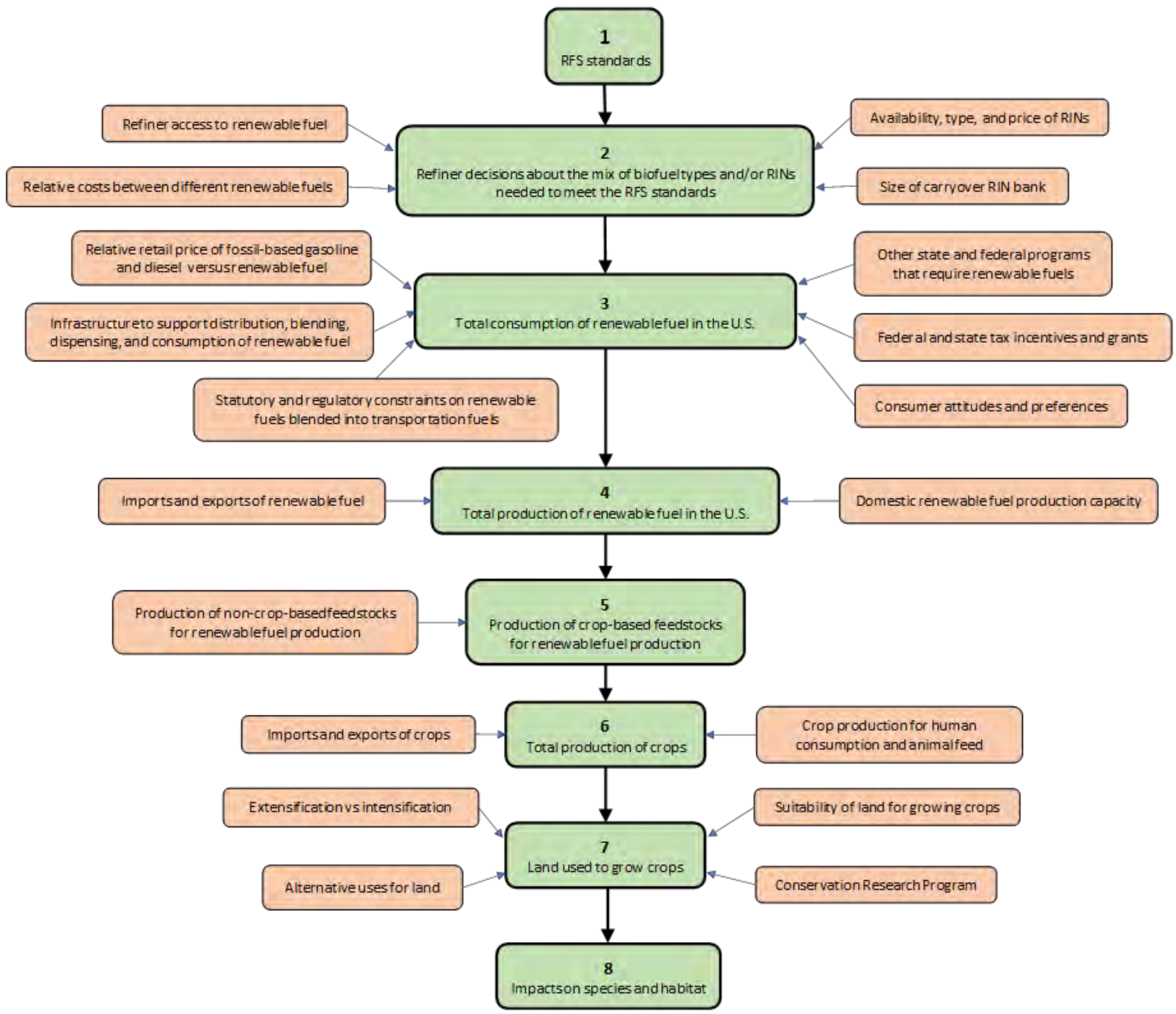
Furthermore, we note that EPA currently has several programs and funding opportunities designed to improve water quality. We would therefore expect that these ongoing efforts, discussed further in Section VIII.B, would reduce any water quality impacts of increased cropland potentially attributable to the Set Rule.

In summary, our Biological Evaluation finds that the 810 populations with critical habitats and/or ranges within the action area may be affected. The potential impacts, however, would be insignificant or discountable and therefore we determine that the effects from the RFS Set Rule are not likely to adversely affect species and critical habitats.

Appendix A. Overview of how the RFS program could affect listed species and critical habitat via land use change

The RFS program does not directly affect land use, listed species, or critical habitat. Instead, there is a multi-step causal chain between the standards and potential land use changes resulting from production of crops that involves several layers of third parties who are not subject to the RFS standards. The diagram below shows this causal chain.

Figure A-1: Causal chain between RFS standards and impacts on species and habitat



Stage 1: RFS standards

Stage 1: RFS standards

The applicable percentage standards under the RFS program provide the means through which each individual refiner determines its Renewable Volume Obligations (RVO). The RVOs represent the unique volume of renewable fuel that each refiner is responsible for ensuring is blended into gasoline and diesel. There are four separate RVOs as shown in Table II.A-1. Refiners can either blend renewable fuel into the gasoline and diesel they produce, or can purchase credits (Renewable Identification Numbers or RINs) from other parties who have done such blending.

Stage 2: Refiner decisions

While refiners must ensure that the renewable fuel volumes identified by their individual RVOs are used as transportation fuel, they are not required to use any particular type of renewable fuel. Insofar as a refiner is blending renewable fuel into its own gasoline and diesel, it can choose the mix of renewable fuel types it uses. Generally, refiners would be expected to do so in a way that minimizes overall costs, and this in turn is a function of the renewable fuels available to it and their relative costs, the relative amounts of gasoline and diesel that it produces, the equipment it has available to manage the production, storage, and blending of renewable fuel, and the demand for (or tolerance of) renewable fuels in the refiner's marketing area.

To the degree that a refiner chooses to purchase RINs instead of blending renewable fuel into its own gasoline and diesel (many refiners are in this position, as some or even all of the fuel they produce is sold to others for subsequent blending), however, the refiner has little control over the mix of renewable fuels used as transportation fuel. RINs are not specific to fuel type and feedstock, but instead are designated only as qualifying for one (or more) of the four categories shown in Table II.A-1. Renewable fuel producers decide what renewable fuels to produce and from what feedstocks based on market demand. Parties downstream of the refiner make decisions about what specific types of renewable fuels are blended into gasoline or diesel or are otherwise used as transportation fuel, and make the RINs associated with that renewable fuel available for sale to refiners. Consumers ultimately make the fuel purchase decisions for the fuels and the renewable fuels they contain. As for refiners, all parties would be expected to make decisions that maximize profit potential and/or minimize cost.

Stage 3: Total consumption of renewable fuel

While the RFS program requires minimum volumes of renewable fuel to be used in the transportation sector, actual total consumption of renewable fuel can and in some cases has been higher under appropriate economic circumstances. The total volume of renewable fuel consumed in the U.S. includes some that is used outside of the transportation sector and which, as a result, does not qualify under the RFS program. Finally, the total volume of renewable fuel produced in the U.S. includes volumes that are exported and consumed outside of the U.S., which again does not qualify under the RFS program.

There are a number of other state and federal programs that also require or incentivize the use of renewable fuel confounding attempts to assess the impacts of the RFS program alone. For instance, Minnesota requires that diesel fuel contain an average of 11% biodiesel, while California's Low Carbon Fuel Standard (LCFS) creates a demand for various advanced biofuels. Other states have similar requirements. The federal reformulated gasoline program does not require the use of an oxygenate, but the applicable emission standards are generally more difficult (i.e., more costly) to meet without the use of ethanol. A biodiesel tax credit of $1 per gallon was originally established by the Energy Policy Act of 2005 and has temporarily expired and been retroactively reinstated multiple times since then. A number of states offer tax subsidies that offset the production costs of renewable fuels, making them more attractive to consumers. And some vehicle fleets owned by state or federal agencies are required to refuel on renewable fuel when it is available.

At the retail level, the consumption of renewable fuel is driven primarily by their price in comparison to petroleum-based gasoline and diesel. Retail prices are a function of the cost of production which in the case of both renewable fuels and petroleum-based gasoline and diesel is in turn driven primarily by the costs of the feedstocks. Thus, to a large degree the economic attractiveness of renewable fuel to consumers is a function of crude oil prices and crop prices. Consumer choices about whether, how much, and what type of renewable fuel to consume can also be influenced by other factors such as perceptions of the impacts that renewable fuels may have on vehicles or engines, the impact that renewable fuels have on the environment, or the benefits of renewable fuels to rural economic development and farmers.

Certain constraints on renewable fuel use can also affect the mix of fuel types that are consumed. For instance, gasoline that can be used in all vehicles can contain no more than 10% ethanol (E10). While higher ethanol blends such as E15 and E85 are also possible, they can only be used in certain vehicles and the fraction of retail service stations offering such blends is very small. As a result, most ethanol blending occurs as E10 with limited volumes of higher level ethanol blends. Higher volumes of renewable fuel consumption typically comes in the form of non-ethanol renewable fuels such as biodiesel, renewable diesel, and biogas. For biogas used in CNG vehicles, the number of CNG vehicles in the current fleet places an upper bound on the total volume of biogas that can be consumed.

Thus, in addition to the RFS program standards, there are a wide variety of factors that can influence the actual consumption of renewable fuel, both in terms of total volumes as well as the mix of types of renewable fuel. These consumption-side factors strongly influence the choices that upstream parties make in terms of which renewable fuels to produce and blend into gasoline and diesel.

Stage 4: Total production of renewable fuel

While domestic production of renewable fuel is largely a function of domestic demand, other factors also influence what is produced and how much. Domestic renewable fuel production capacity places a limit on how much of each type of renewable fuel can be produced. As the production of one type of renewable fuel approaches its production capacity limit, additional volumes must come from other types of renewable fuel. For instance, the production capacity of liquid cellulosic biofuels remains very low, and cellulosic biogas for use in CNG engines has proliferated.

Imports and exports of renewable fuel also influence domestic production volumes. In recent years, the primary fuel types that have been imported are biodiesel, renewable diesel, and ethanol, in total representing about 5% of domestic consumption. Smaller amounts of biogas have also been imported. Greater import volumes generally mean that there is less need for domestic production in order to meet the RFS standards. Exports of renewable fuel, in contrast, generally mean that domestic production is higher than what is needed to meet the RFS standards. However, volumes that are produced domestically and then exported cannot be attributed to the RFS program since they are being used to meet foreign demand. Over the last several years, the primary type of renewable fuel exported has been ethanol, though not insignificant volumes of biodiesel have also been exported. In total, these exports represent about 10% of domestic consumption over the last several years.

Stage 5: Production of crop-based feedstocks

The fraction of total renewable fuel production that is derived from crop-based feedstocks is a function of their cost, availability, and ease with which they can be converted into renewable fuel in comparison to non-crop-based feedstocks. Each renewable fuel producer decides which feedstocks they will use to produce renewable fuel, and those decisions determine the renewable fuel category into which that renewable fuel falls. The choice of feedstock also likely impacts the selling price of that fuel. Downstream parties such as blenders and distributors will make their own choices about which biofuels to purchase, and can be expected to make choices based primarily on price. Few downstream parties have an incentive to make fuel purchasing choices based directly on feedstock, and more importantly they rarely have sufficient access to information about feedstocks to enable them to do so.

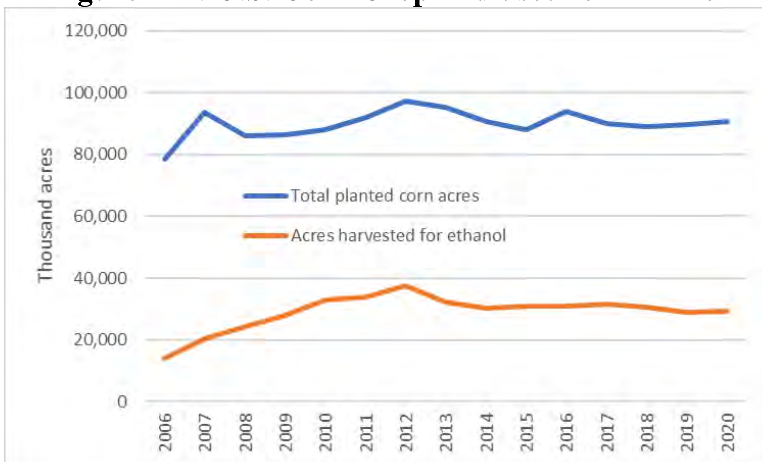
The driving factors for competing feedstocks have different outcomes for each of the renewable fuel categories shown in Figure II.A-1. As described previously, essentially all cellulosic biofuel has been derived from the non-crop feedstock biogas, while essentially all conventional renewable fuel has been derived from the crop-based feedstock corn. For non-cellulosic advanced biofuel, composed predominately of biodiesel, crop-based feedstocks have represented on average 56% of total domestic production over the last several years.

Stage 6: Total production of crops

Individual farmers choose what crops they will grow based primarily on projected grain and oilseed market prices, but their choices also depend on the land available to them and its suitability for growing certain crops. They do not grow particular crops for the purposes of meeting demand for renewable fuel or any other particular end use. Moreover, their choices can and often do change from year to year. Actual crop production is also-affected by climate, the availability of irrigation water, and a host of other factors.

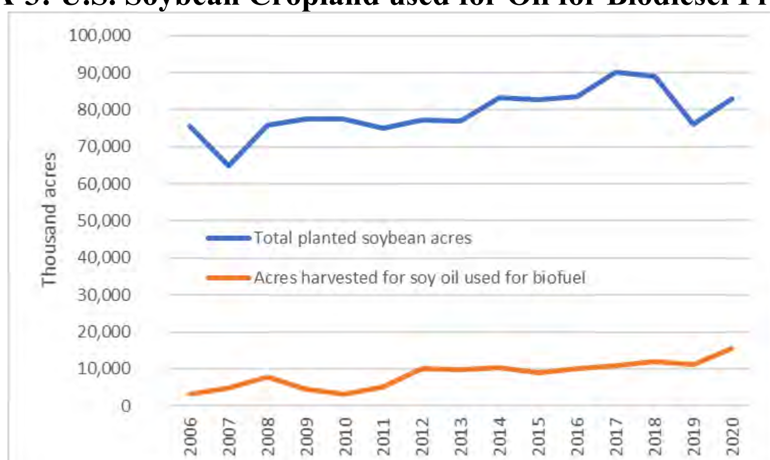
Crops are grown for a variety of purposes in addition to renewable fuel. These include food, animal feed, and various industrial and manufacturing processes. Between 2016 and 2020, an average of about 37% of domestic corn production was used for fuel ethanol, while an average of about 29% of domestic soybean oil (representing about 14% of domestic soybean production) was used for biodiesel (USDA Economic Research Reserve, 2022). Figures III.B.4-2 and III.B.4-3 show the yearly corn and soybean acreage used for biofuel production relative to total corn and soybean planted acreage in the United States.

Figure A-2: U.S. Corn Cropland used for Ethanol



Source: USDA's Economic Research Service

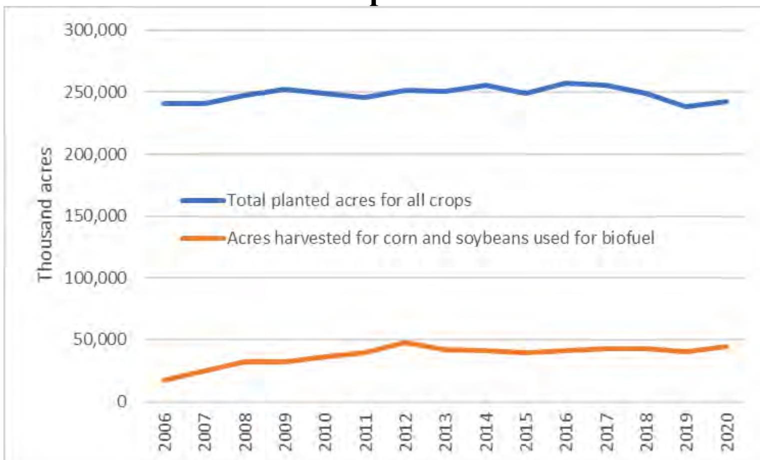
Figure A-3: U.S. Soybean Cropland used for Oil for Biodiesel Production



Source: USDA's Economic Research Service

Taken together, soybeans and corn used for biofuel production represent a small but not insignificant portion of total cropland as shown below.

Figure A-4: U.S. Soybean and Corn Cropland used for Biofuel Production versus Total Cropland[a]



[a] For purposes of this assessment, "total cropland" includes corn, soybeans, wheat, cotton, sorghum, barley, and oats

As for domestic renewable fuel production, domestic crop production is affected by imports and exports of crops for their many other uses including food and feed. Imported crops reduce the need for domestic production, while exported crops cannot be attributed to the RFS program since they meet foreign demand. Between 2016 and 2020, almost no corn has been imported, but 15% of corn grown in the U.S. has been exported. Similarly, almost no soybeans have been imported, but on average 49% of domestically grown soybeans have been exported.

Attempts to model where biofuel feedstocks might be grown in the future, even at a coarse level, rely on a range of assumptions that result in widely different conclusions. One analysis used two types of models—GTAP-BIO and GLOBIOM—to predict land use change effects that may occur in the United States from increased biofuel production from soy oil. While the GTAP-BIO model predicted that crop switching (i.e., a decrease in the use of cropland for non-biofuel crops accompanied by an increase in the use of cropland for soybeans for biofuel) on existing croplands would be the dominant change to supply the additional soy oil feedstock, the GLOBIOM model predicted crop-switching to be low and instead showed major changes to natural and abandoned lands (CORSIA, 2019). Another study by Zhao et al. (2021) used GTAP-BIO to estimate the land use impacts from increasing jet fuel and renewable diesel production from soy oil in the U.S. by about two billion gallons. They projected a fair amount of crop switching in the U.S. and small increases in total cropland (Zhao et al., 2021).

In the vast majority of cases, farmers do not know which bushels they produce will be used to produce renewable fuel. Instead, farmers sell their crops to distributors (e.g., grain elevators) who meet the regional demand for the crops they collect. Bushels can change hands multiple times before they reach their final destination, and as fungible commodities those bushels are often mixed together without regard for their farm of origin. Nevertheless, in very general terms it is likely that crops used to produce renewable fuel are more likely to be grown near a renewable fuel production facility than further away. A study by Wright et al. (2017) assessed land use changes from 2008 to 2012 and found that the rate of grassland conversion to cropland increased with proximity to a biorefinery location. Other studies that quantitatively correlate crop production with distance to a production facility have shown similar results (Austin et al., 2022).

Stage 7: Land used to grow crops

Not only do individual farmers choose what crops they will grow, they also choose what land they will use to grow those crops based upon the availability of land, their rights to grow crops on that land, and its suitability for particular crop types. If a farmer chooses to increase production of a particular crop, he can do so through conversion of non-cropland to crop production if there is suitable land available to him to do so ("extensification"). But he can also increase production of a particular crop without increasing total land used through one of several different "intensification" methods:

- Increase the density of rows, plants, or plant closer to the edges of fields.
    - This is one of the most common forms of intensification.
- Reduce production of one crop type and increase production of another crop type.
- Increase the yield of an existing crop through increased use of fertilizer, herbicides, pesticides, and/or fungicides.
- Harvest two crops in a single year from the same plot of land (so-called double-cropping or multi-cropping).
    - This is not common in the U.S.

In these intensification cases, total land used to produce crops remains unchanged, but farming activities may change (e.g. application rates for fertilizer or pesticides, frequency of equipment use, irrigation needs). Since farmers make decisions about extensification versus intensification based on their particular circumstances, there is no straightforward way to predict what those choices will be for total cropland writ large.

Stage 8: Impacts on species and habitat

Changes in the way that land is used to grow crops can impact species and habitat in several ways. Non-cropland that is converted to cropland can result in adverse effects to habitats within the range of listed species, and nearby habitats can indirectly be affected by the noise, dust, or runoff created during the land conversion. After conversion, the new cropland can also affect listed species or habitat on both the land in question and nearby areas through sediment, pesticide, herbicide, or fertilizer runoff. Similarly, in cases where additional crops are grown on existing cropland through various intensification measures such as double-cropping or increased fertilizer or pesticide use, there can be impacts on flora and fauna for that land and nearby areas.

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Phillips, Tuana (she/her/hers)

From: Phillips, Tuana (she/her/hers)
Sent: Wednesday, May 31, 2023 1:55 PM
To: David Baldwin - NOAA Federal; Miller, Meredith; Michaels, Lauren (she/her/hers); Lisamarie Carrubba - NOAA Federal; jennifer.douglas
Subject: RE: One piece of new analysis/info needed for RFS consultation
Attachments: Soybean Analysis Comment _with EPA response.docx

Hi David,

As we discussed yesterday, see attached for our response to your comment for recordkeeping purposes. We decided to just add to the document you provided. You can find our response towards the bottom of page 3.

Thank you and let us know if you have any questions,
Tuana

From: David Baldwin - NOAA Federal <david.baldwin@noaa.gov>
Sent: Friday, May 26, 2023 3:44 PM
To: Phillips, Tuana (she/her/hers) <phillips.tuana@epa.gov>; Miller, Meredith <Miller.Meredith@epa.gov>; Michaels, Lauren (she/her/hers) <Michaels.Lauren@epa.gov>; Lisamarie Carrubba - NOAA Federal <lisamarie.carrubba@noaa.gov>; jennifer.douglas <jennifer.douglas@noaa.gov>
Subject: One piece of new analysis/info needed for RFS consultation

I've finished reviewing the BE. I identified just one piece of analyses/info that is lacking in the BE. Basically, we want to adequately capture the risks posed by soybean expansion to all of NMFS species. Based on the info in the BE, the potential for soybean expansion in several Atlantic states does appear to be a concern that is not addressed. I've attached a file with more details and options for addressing this assessment need.

EPA does not need to provide a new BE or redo the ICF model. Instead, EPA can provide the additional analysis or info as a separate file.

Let me know if there are any questions.

David

--
David H. Baldwin, Ph.D.
Biologist (Endangered Species)
NOAA Fisheries
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phone: (301) 427-8412

<u>Exchange between EPA and NMFS</u>

NMFS's request for addressing potential soybean expansion in states such as NY and PA

Comment #27 (NMFS): The potential for soybean expansion outside the modelled area should be addressed qualitatively, at least. Based on Figure VII.B-2 that would include PA, NY, and VA.

EPA Response (05/19/23): We added the following text to Section VII.B.1, page 154:

To assess where soybeans are currently grown, we accessed the most recent NASS data for soybean acres harvested annually from 2018 – 2022. During this time approximately 94% of all acres of soybeans harvested were from the geographic region identified by ICF. This percentage we very consistent, ranging from a low of 93.81% in 2021 to a high of 94.44% in 2018. In 2022, the most recent year for which data are available, these states accounted for 94.23% of the total acres of soybeans harvested. Only one state outside of the geographic scope identified by ICF (North Carolina) accounted for more than 1% of the total acres of soybeans harvested in any year from 2018 – 2022. North Carolina accounted for a high of 2.03% of all soybeans harvested in the U.S. in 2019 and a low of 1.79% of all soybeans harvested in the U.S. in 2018. This analysis supports the geographic scope selected by ICF, as the vast majority of soybeans harvested annually within the U.S. (as well as nearly all the states that saw increasing soybean acreage, as shown in Figure VII.B-2) are within this geographic scope. The results of this state-by-state assessment are shown in Tables VII.B-1 and VII.B-2.

NMFS Reply (05/26/2023):

The BE excludes consideration of any effects due to soybean expansion to species located in states outside the modelled region. While LA and MS were included in the modelled region, NY and PA were excluded despite showing greater changes in soybean acres than LA with PA showing almost as much increase as MS (Figure VII.B.2). Both LA and MS were the basis of the ICF overlap analyses for NMFS species. However, NMFS species will overlap with Atlantic coast states such as NY, PA, and NC. Although soybean acres in a state may represent a small percent of the national total, the state should not be excluded from the overall assessment of soybean expansion. For example, the 169,0000 acres grown in NC or 510,000 acres grown in MD (Table VII.B.1) indicate that soybean expansion might pose a risk to species located in those states. Excluding states such as NC and MD effectively assumes no expansion will occur there and, therefore, no risk to NMFS species located in those areas. The available data doesn't appear to support that conclusion. Importantly, we want to adequately capture the risks posed by soybean expansion to all NMFS species.

To that end, while redoing the ICF is not necessary, some assessment of the potential extent of soybean expansion in other states is needed. While the existing ICF modeling won't provide quantitative info, could it provide qualitative extrapolations to states not included in the model? Or are other sources of info available for this assessment? One option is that EPA provide some additional analyses for these states. Alternatively, NMFS is willing to perform analyses similar to those being done for corn expansion provided EPA provides some additional info.
That info should be readily available and consists of:
1) the GIS raster data for Figure VII.B-4,
2) which categories of non-soybean pixels were considered suitable for soybean expansion, and
3) the average probability of a non-soybean pixel being converted to soybean (this might be able to come from the ICF modeling).

Figure VII.B-2: Average Year-Over-Year Change in Soybean Planting Acreage

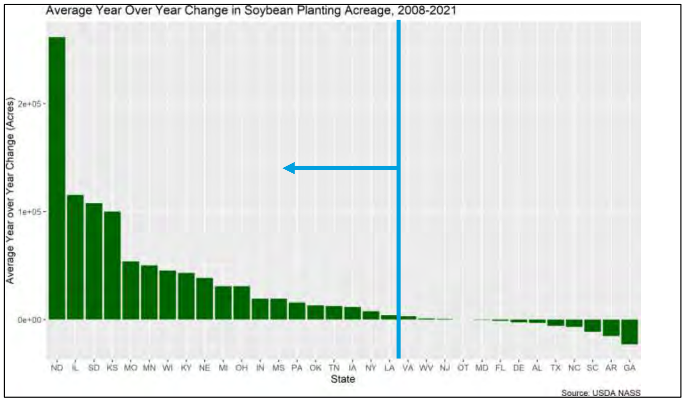

Figure VII.B-3: Map Showing Potential Soy Expansion Areas in Green

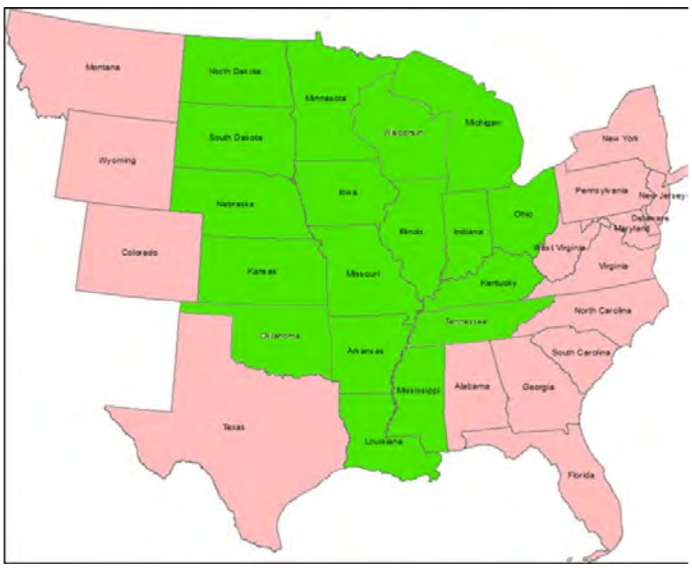

Figure VII.B-4: Modeled Soybean Expansion Areas (Red Color) for 250-Million-Gallon Scenario [37]

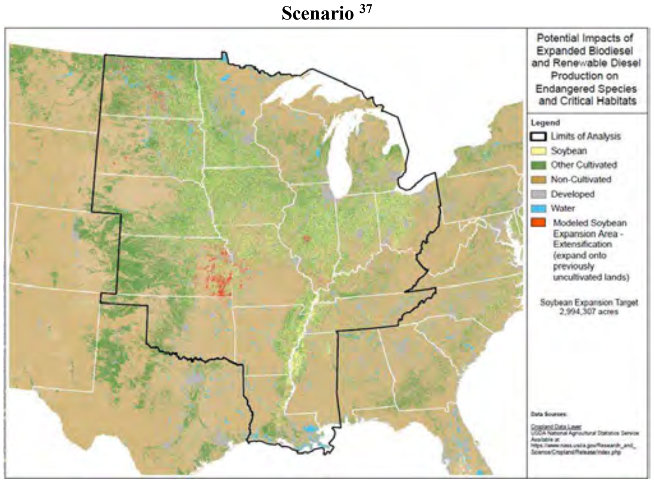

Table VII.B-1: Soybean Acres Harvested Acres by State

State(s)	2018	2019	2020	2021	2022
All States in the Geographic Scope	82,720,000	74,939,000	78,050,000	80,970,000	81,355,000
NORTH CAROLINA	1,570,000	1,520,000	1,570,000	1,640,000	1,690,000
PENNSYLVANIA	630,000	610,000	630,000	595,000	590,000
VIRGINIA	590,000	560,000	560,000	590,000	610,000
MARYLAND	515,000	475,000	465,000	485,000	510,000
ALABAMA	335,000	315,000	275,000	305,000	355,000
SOUTH CAROLINA	330,000	260,000	295,000	385,000	390,000
NEW YORK	325,000	225,000	312,000	320,000	325,000
DELAWARE	168,000	153,000	148,000	153,000	158,000
TEXAS	135,000	73,000	110,000	100,000	85,000
GEORGIA	130,000	86,000	95,000	135,000	160,000
NEW JERSEY	107,000	92,000	93,000	99,000	108,000
WEST VIRGINIA	27,000	0	0	0	N/A*
FLORIDA	12,000	0	0	0	N/A*
OTHER STATES	0	0	0	0	N/A*

*For 2022 the NASS database did not list a total for "Other States"
All data in Table VII.B-1 from USDA NASS database

Table VII.B-2: Percent of U.S. Soybean Acres Harvested Acres by State

State(s)	2018	2019	2020	2021	2022
All States in the Geographic Scope	94.44%	94.17%	93.83%	93.81%	94.23%
NORTH CAROLINA	1.79%	2.03%	1.90%	1.90%	1.96%
PENNSYLVANIA	0.72%	0.81%	0.76%	0.69%	0.68%
VIRGINIA	0.67%	0.75%	0.68%	0.68%	0.71%
MARYLAND	0.59%	0.63%	0.56%	0.56%	0.59%
ALABAMA	0.38%	0.35%	0.33%	0.35%	0.41%
SOUTH CAROLINA	0.38%	0.42%	0.36%	0.45%	0.45%
NEW YORK	0.37%	0.30%	0.38%	0.37%	0.38%
DELAWARE	0.19%	0.20%	0.18%	0.18%	0.18%
TEXAS	0.15%	0.10%	0.13%	0.12%	0.10%
GEORGIA	0.15%	0.11%	0.12%	0.16%	0.19%
NEW JERSEY	0.12%	0.12%	0.11%	0.11%	0.13%
WEST VIRGINIA	0.03%	0.00%	0.00%	0.00%	N/A*
FLORIDA	0.01%	0.00%	0.00%	0.00%	N/A*
OTHER STATES	0.00%	0.00%	0.00%	0.00%	N/A*

*For 2022 the NASS database did not list a total for "Other States"
All data in Table VII.B-2 from USDA NASS database

EPA Response (5/31/2023)

In response to NMFS' comments, we have provided the GIS raster file for Figure VII.B-4 in the BE's SharePoint folder that is shared by EPA and the Services. To complete the qualitative extrapolation that NMFS describes above, we think it would be appropriate to use the information presented in Table VII.B-1 which shows the ICF land selection results by land cover type. For example, the table shows that for the 250-million-gallon scenario approximately 3.7 million acres or 2.6% of grassland may be converted within the potential soy expansion area shown in Figure VII.B-3 of the BE. These same numbers could be used to make conservative assumptions about potential land use changes in states like North Carolina (e.g., 2.6% of grasslands may be impacted there as well). We believe using these numbers to extrapolate in the additional Atlantic coast states would be conservative because it assumes the same percentage of conversion from non-cropland to soybean planting in states outside of the ICF study without consideration of the other weighting factors such as proximity to existing soybean planting. Most of the soybean is grown in the Midwest, and expansion would largely occur in that region for reasons discussed in more detail in the BE.

EPA discussed the above plan with NMFS during the May 30, 2023 EPA-Services ESA call and NMFS agreed this would be appropriate. NMFS agreed to do some more analysis and thinking to assess potential increases in soybean growth within NMFS species' critical habitat or range in these Atlantic coast states. EPA is available to support and discuss more as needed.

NMFS Reply (06/04/2023)

NMFS appreciates EPA's response and subsequent feedback. A summary of the current state of the specific information needs identified by NMFS follows.

1) In a subsequent email, EPA recognized that the GIS raster data provided via the SharePoint folder did not extend to areas outside the ICF modelled states as needed for NMFS additional analyses. However, NMFS identified GIS data from previous NMFS assessments that can be applied to the RFS analysis. These include Soybean and Rangeland raster data.
2) The Rangeland and Soybean GIS raster data were provided by EPA as part of their recent carbaryl and methomyl BEs. While they are not identical to that used in the ICF modelling, they are suitable for the purposes of assessing the potential for soybean expansion due to the RFS Rule. In particular, the Rangeland GIS raster encompasses the majority of land uses considered suitable by the ICF modelling.
3) EPA has identified the ICF model results as the best available information on the extent of soybean expansion in states outside the modeled region (e.g. North Carolina). NMFS agrees that these estimates are conservative and the actual extent is likely less due to a variety of factors. For example, NMFS will consider proximity to existing soybean acres similar to that done for corn expansion (i.e. 15 mile buffer).