The Scotts Company and Monsanto Company Petition (15-300-01p) for Determination of Nonregulated Status for ASR368 Creeping Bentgrass

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Draft Environmental Impact Statement

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Executive Summary

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) received a request (APHIS Petition 15-300-01p) from the Scotts Company LLC of Marysville, OH and Monsanto Company of St. Louis, MO (Scotts and Monsanto) seeking a determination of nonregulated status for ASR368 creeping bentgrass that has been engineered to be resistant to the herbicide glyphosate (Scotts and Monsanto, 2015a). When APHIS receives a petition for nonregulated status of an article currently regulated under its PPA authority codified in 7 CFR part 340, the Agency is required to make a decision. As a Federal agency, APHIS must also comply with applicable U.S. environmental laws and regulations because a decision on a petition for nonregulated status, whether positive or negative, is a final Agency action that might cause environmental impacts.

The petition stated that APHIS should not regulate ASR368 creeping bentgrass because it does not present a plant pest risk. In the event of a determination of nonregulated status, the nonregulated status would include ASR368 creeping bentgrass and any progeny derived from crosses between ASR368 creeping bentgrass and conventional creeping bentgrass, including crosses of ASR368 creeping bentgrass with other biotechnology-derived creeping bentgrass varieties that are no longer subject to the regulatory requirements of 7 CFR part 340.

Regulatory Authority

The Plant Protection Act of 2000 (PPA), as amended (7 U.S.C. §§ 7701-7772), provides the legal authorization for the APHIS plant protection mission. It authorizes the Agency to regulate the introduction of potential plant pests into the territorial boundaries of the United States, and their interstate movement within U.S. boundaries by establishing quarantine, eradication and control programs. Implementing rules, regulations and guidelines for this enabling legislation (PPA) are codified in Title 7 of the U.S. Code of Federal Regulations (CFR). Rules that implement this authority specific to GE organisms have been published in 7 CFR part 340.

Under the current regulations, a GE organism is considered to be a regulated article if the donor organism, recipient organism, vector, or vector agent is a plant pest or if the Administrator has reason to believe the GE organism is a plant pest. A plant pest is defined in § 340.1 as "Any living stage (including active and dormant forms) of insects, mites, nematodes, slugs, snails, protozoa, or other invertebrate animals, bacteria, fungi, other parasitic plants or reproductive parts thereof; viruses; or any organisms similar to or allied with any of the foregoing; or any infectious agents or substances, which can directly or indirectly injure or cause disease or damage in or to any plants or parts thereof, or any processed, manufactured, or other products of plants." The regulations also provide a process to petition APHIS to determine that a GE organism is nonregulated. A determination of nonregulated status means that the regulated article is no longer subject to the regulations in 7 CFR part 340 and, therefore, there is no longer any authority for APHIS to require a permit or notification for the importation, interstate movement, or environmental release of the regulated article pursuant to 7 CFR part 340.

Two other agencies, the Federal Drug Administration (FDA) and the Environmental Protection Agency (EPA), are involved in regulating GE organisms. The regulatory roles of USDA-APHIS, the FDA, and the EPA are described by the "Coordinated Framework," a 1986 policy statement from the Office of Science and Technology Policy that describes the comprehensive Federal policy for ensuring the safety of biotechnology research and products.

The FDA regulates GE organisms under the authority of the Federal Food, Drug, and Cosmetic Act (FFDCA) (21 U.S.C. 301 *et seq.*). The FDA implements a voluntary consultation process to ensure that human food and animal feed safety issues or other regulatory issues, such as labeling, are resolved before commercial distribution of food derived from GE products.

The EPA is responsible for regulating the sale, distribution, and use of pesticides, including pesticides that are produced by an organism through techniques of biotechnology. The EPA regulates plant incorporated protectants (PIPs) and microorganisms used as pesticides, e.g. bacteria, fungi, viruses, bacteriophages; both naturally occurring and genetically engineered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. 136 *et seq.*) and certain microorganisms under the Toxic Substances Control Act (15 U.S.C. 53 *et seq*.).

Under FIFRA (7 U.S.C. 136 *et seq.*), the EPA regulates the use of pesticides (requiring registration of a pesticide for a specific use prior to distribution or sale of the pesticide for a proposed use pattern). The EPA examines the ingredients of the pesticide; the particular site or crop on which it is to be used; the amount, frequency, and timing of its use; and storage and disposal practices. Prior to registration of a new pesticide or a new use for a previously registered pesticide, the EPA must determine that the pesticide will not cause unreasonable adverse effects on the environment and a reasonable certainty of no harm to humans when used in accordance with label instructions. The EPA reevaluates all pesticides every fifteen years (or shorter) to ensure they meet current standards for continued safe use (7 U.S.C. 136a(g)(1)(A)(iv)).

The EPA also sets tolerances for residues of pesticides on and in food and animal feed, or establishes an exemption from the requirement for a tolerance, under the FFDCA. The EPA is required, before establishing pesticide tolerance, to reach a safety determination based on a finding of reasonable certainty of no harm under the FFDCA, as amended by the Food Quality Protection Act (FQPA). The FDA enforces the pesticide tolerances set by the EPA.

Purpose and Need for Agency Action

Under the authority of the plant pest provisions of the PPA and 7 CFR part 340, APHIS regulates the safe development and use of GE organisms. Any party can petition APHIS to seek a determination of nonregulated status for a GE organism that is regulated under 7 CFR part 340. As required by 7 CFR part 340.6, APHIS must respond to petitioners that request a determination of the regulated status of GE organisms, including GE plants such as ASR368 creeping bentgrass. When a petition for nonregulated status is submitted, APHIS must make a determination if the GE organism is unlikely to pose a plant pest risk. The petitioner is required to provide information under § 340.6(c)(4) related to plant pest risk that the agency may use to compare the plant pest risk of the regulated article to that of the unmodified organism. A GE organism is no longer subject to the regulatory requirements of 7 CFR part 340 when APHIS determines that it is unlikely to pose a plant pest risk. In October 2015, APHIS received a petition from Scotts and Monsanto requesting a determination of the regulated status of ASR368 creeping bentgrass. The purpose of the petition was to request nonregulated status for ASR368 creeping bentgrass because it is not a plant pest. APHIS prepared a PPRA and this EIS to respond to the request and avoid the inappropriate use of public resources regulating a genetically engineered product if the agency determines that it has no authority to do so; the need for this action.

Consistent with the Council of Environmental Quality's National Environmental Policy Act (NEPA) regulations and the USDA and APHIS NEPA implementing regulations and procedures (40 CFR parts 1500-1508, 7 CFR part 1b, and 7 CFR part 372), APHIS has prepared this draft Environmental Impact Statement (EIS) to consider the potential environmental impacts of an agency determination of nonregulated status. Specifically, this draft EIS has been prepared in order to evaluate the impacts on the quality of the human environment[1] that may result from a determination of nonregulated status of ASR368 creeping bentgrass.

Public Involvement

APHIS sought comments for the petition that is the subject of this EIS in a *Federal Register* notice dated January 8, 2016. The docket received a total of 169 public submissions. Some of the submissions to the docket contained multiple attached comments gathered by organizations from their members. Contained within the 169 submissions were a total of 5,852 public comments. The issues that were raised in the public comments that were related to the ASR368 creeping bentgrass petition included:

- Gene flow of the glyphosate-resistant trait from cultivated plants to wild/weedy/feral relatives may occur
- The economic impacts associated with ASR368 creeping bentgrass currently in the environment, including control costs
- Increased glyphosate use
- Impacts of ASR368 creeping bentgrass on biodiversity including the impacts on natural habitats and grasslands
- Increased weediness or invasiveness of ASR368 creeping bentgrass

As part of its scoping process to identify issues to address in this EIS, APHIS also published a Notice of Intent (NOI) to prepare an EIS and sought public input during a 30 day comment period (August 3 to September 2, 2016). Comments were submitted by individuals, academic researchers, non-government organizations, state departments of agriculture, and industry representatives. The majority of comments submitted were opposed to determinations of nonregulated status for ASR368 creeping bentgrass.

Alternatives Analyzed

[1] Under NEPA regulations, the "human environment" includes "the natural and physical environment and the relationship of people with that environment" (40 CFR §1508.14).

In this EIS, APHIS considered two alternatives for its response to the Scotts and Monsanto petition for nonregulated status. The two alternatives are: 1) continue to regulate ASR368 creeping bentgrass (No Action Alternative) and 2) approve the petition for nonregulated status of ASR368 creeping bentgrass (Preferred Alternative). These alternatives are further described here and in Chapter 2.

Alternative 1: No Action Alternative—Continuation as a Regulated Article

Under the No Action Alternative, APHIS would deny the petition because it was found to pose a plant pest risk. ASR368 creeping bentgrass and progeny derived from ASR368 creeping bentgrass would continue to be regulated articles under the regulations at 7 CFR part 340. Any introduction of ASR368 creeping bentgrass would still require authorization by APHIS. In addition, measures to ensure physical and reproductive confinement of ASR368 creeping bentgrass would continue to be implemented for any existing or new authorization. APHIS might choose this alternative if there were insufficient evidence to demonstrate the lack of plant pest risk from the unconfined cultivation of ASR368 creeping bentgrass.

This alternative is not the Preferred Alternative because APHIS has concluded through a preliminary PPRA that ASR368 creeping bentgrass is unlikely to pose a plant pest risk (USDA-APHIS, 2016b). Choosing this alternative would not satisfy the purpose and need of making a determination of plant pest risk status and responding to the petition for nonregulated status.

Alternative 2: Preferred Alternative – Determination that ASR368 Creeping Bentgrass is No Longer a Regulated Article

Under this alternative, ASR368 creeping bentgrass and progeny derived from it would no longer be regulated articles under the regulations at 7 CFR part 340. APHIS would no longer require authorizations for introductions of ASR368 creeping bentgrass and progeny derived from this event. This alternative best meets the purpose and need to respond appropriately to a petition for nonregulated status based on the requirements in 7 CFR part 340 and the agency’s authority under the plant pest provisions of the PPA. Because the agency has concluded that ASR368 creeping bentgrass is unlikely to pose a plant pest risk (USDA-APHIS, 2016b), a determination of nonregulated status of ASR368 creeping bentgrass is a response that is consistent with the plant pest provisions of the PPA, the regulations codified in 7 CFR part 340, and the biotechnology regulatory policies in the Coordinated Framework. A determination of nonregulated status and this EIS would not necessarily apply to other glyphosate resistant creeping bentgrass events as APHIS’ regulatory practice is to review requests on a case-by-case basis.

Although this petition seeks nonregulated status for ASR368 creeping bentgrass, Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate such plants in the future. Further, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b; 2015a; Scotts, 2016).

Affected Environment

Although Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass now or in the future and that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b; Scotts, 2016) the Preferred Alternative would allow for new plantings of ASR368 creeping bentgrass to occur anywhere in the United States. For this reason, APHIS considered the affected environment to include areas where creeping bentgrass is currently known to exist, predominately conventional creeping bentgrass production, mostly for commercial use in the golf industry. For the purposes of this EIS, those aspects of the human environment are: creeping bentgrass production practices, the physical environment, biological resources, public health, animal feed, and socioeconomic issues.

Potential Environmental Consequences of Alternatives

Environmental issues are assessed individually in Chapter 4 (Environmental Consequences). The scope of this EIS analyzes the potential for direct and indirect impacts that might result from a determination of nonregulated status of ASR368 creeping bentgrass where new plantings may occur.

APHIS emphasizes that its decision to prepare an EIS in this case was discretionary. The agency's decision was based on a perceived need for the level of thoroughness afforded by the EIS process because of the complexity of issues that needed to be addressed.

APHIS determined that the direct impacts on the environment from the potential cultivation of ASR368 creeping bentgrass would not differ from those caused by the cultivation of conventional creeping bentgrass varieties, because ASR368 creeping bentgrass is not agronomically different from conventional creeping bentgrass. Potential impacts would be the same under the No Action and Preferred Alternatives with respect to agricultural production, the physical environment (e.g., soil, water, air), biological resources (e.g., animal, plant, biodiversity), human health, animal feed, and socioeconomics. APHIS previously assessed the weed risk potentials of herbicide resistant and non-herbicide resistant types of creeping bentgrass, using PPQ's weed risk assessment guidelines and found the two types to be the same in terms of weed risk potential (USDA-APHIS-PPQ, 2014). As a result, APHIS did not add glyphosate-resistant creeping bentgrass to the federal list of noxious weeds. More detailed descriptions and analyses of the potential environmental consequences can be found in Chapter 4.

Potential Cumulative Impacts

Chapter 5 of this EIS includes an environmental analysis of potential cumulative impacts, focusing on the incremental impacts of the Preferred Alternative taken in consideration with related activities including past, present, and reasonably foreseeable future actions. APHIS considered the potential for ASR368 creeping bentgrass to extend the range of creeping bentgrass production and cultivation. If APHIS approves the petition for nonregulated status for ASR368 creeping bentgrass, Scotts and Monsanto have stated in their petition that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). ASR368 creeping bentgrass was originally developed in the 1990s to address a market need for a product that would simplify golf course weed management (Scotts and Monsanto, 2015b). During field testing in 2003 and 2004 creeping bentgrass escaped from authorized field trial sites. As a result of this escape, Scotts was fined and required to conduct workshops on their efforts to monitor and destroy ASR368 creeping bentgrass (USDA, 2007). Since this time, market conditions have changed and ASR368 no longer has commercial value (Scotts and Monsanto, 2015b; Scotts, 2016). Scotts has since destroyed all commercial ASR368 creeping bentgrass seed stock and withdrew their EPA label amendment application for any glyphosate-based product for use on ASR368 creeping bentgrass (Scotts and Monsanto, 2015b). Therefore, as part of the cumulative impacts analysis, APHIS will assume that ASR368 creeping bentgrass will not be commercially produced and that Scotts and Monsanto will continue their management efforts to control ASR368 creeping bentgrass currently in the environment as a result of escapes that happened in the early 2000's and are no longer subject to USDA's jurisdiction as agreed upon in the MOA (USDA-APHIS, 2015b; 2015a). The potential for impacts of new plantings of ASR368 creeping bentgrass would not result in any changes to the resource areas when compared to the No Action Alternative. No cumulative impacts are expected from approving the petition for nonregulated status for ASR368 creeping bentgrass, when taken in consideration with related activities, including past, present, and reasonably foreseeable future actions.

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ACRONYMS AND ABBREVIATIONS

AIA	advanced informed agreement
AOSCA	Association of Official Seed Certifying Agencies
APHIS	Animal and Plant Health Inspection Service
CAA	Clean Air Act
CBD	Convention on Biological Diversity
CFR	Code of Federal Regulations (United States)
CH_4	methane
CO_2	carbon dioxide
DNA	deoxyribonucleic acid
EA	environmental assessment
EIS	environmental impact statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973
FDA	U.S. Food and Drug Administration
FFDCA	Federal Food, Drug, and Cosmetic Act
FFP	food, feed, or processing
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GE	genetically engineered
GHG	greenhouse gas
IPPC	International Plant Protection Convention
LMO	living modified organisms
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAPPO	North American Plant Protection Organization
NEPA	National Environmental Policy Act of 1969 and subsequent amendments
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPS	Agricultural non-point source
OECD	Organization for Economic Cooperation and Development
PIP	plant incorporated protectants
PPRA	Plant Pest Risk Assessment
PPA	Plant Protection Act
T&E	threatened and endangered

ACRONYMS AND ABBREVIATIONS

USDA	U.S. Department of Agriculture
USDA-NASS	U.S. Department of Agriculture-National Agricultural Statistics Service
USC	United States Code
USFWS	U.S. Fish & Wildlife Service
WPS	Worker Protection Standard for Agricultural Pesticides

1 PURPOSE AND NEED

This document is intended to ensure compliance with the National Environmental Policy Act (NEPA). NEPA requires agencies to prepare an environmental impact statement (EIS) to be included in “every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment” (42 U.S.C. §4332(2)(C)).

The United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) is currently engaged in decisionmaking relevant to its statutory authority to regulate ASR368 creeping bentgrass as a potential plant pest. The Agency has determined that there are possible environmental impacts, as described in chapter 4, associated with whatever regulatory decision it renders. Therefore, this document has been prepared as part of this APHIS decisionmaking process.

In October 2015, APHIS received a petition from Scotts and Monsanto requesting a determination of the regulated status of ASR368 creeping bentgrass. The purpose of the petition was to request nonregulated status for ASR368 creeping bentgrass because it is not a plant pest. APHIS prepared a plant pest risk assessment (PPRA) and this EIS to respond to the request and avoid the inappropriate use of public resources regulating a genetically engineered product if the agency determines that it has no authority to do so; the need for this action.

1.1 Introduction

Summarized as “Protecting American Agriculture,” the mission of USDA APHIS[2] is: “To protect the health and value of American agriculture and natural resources.” To achieve its mission, APHIS regulates plant and animal health. It integrates these regulatory functions to protect and promote U.S. domestic agricultural production, commodities, and trade in agricultural products in a manner that prevents or minimizes impacts on the environment.

To implement its plant protection mission, the Agency establishes policies and measures to prevent the introduction of plant pests into the United States. It also promotes management of those plants, animals, and microorganisms that currently occur within the United States and cause economic losses to U.S. agriculture, including commercial and non-commercial production of crops and ornamental plants. Its mission encompasses all practices and technologies that have the potential to impact plant pest risks.

One practice overseen by the APHIS plant protection mission is the use of genetic engineering to modify plant agronomic properties. The Agency has regulatory authority to ensure that applications of genetic engineering technology are unlikely to pose a plant pest risk

Principles of biochemistry and molecular biology underlie the current understanding of genetic inheritance. The mechanisms involved provide the theoretical framework for biotechnology.

[2] For more details about the APHIS mission, visit http://www.aphis.usda.gov/about_aphis/

Genetic engineering is one application of biotechnology. It enables the precise manipulation (insertion, modification, or deletion) of one or more selected genetic traits (genes) into the genome of an organism without sole dependence on the sexual compatibility of traditional breeding (cross-breeding principles of classical Mendelian genetics of inheritance). As a result, genetic engineering makes possible the transfer of highly specific, individual, beneficial genetic traits between unrelated species.

APHIS regulates those genetically engineered (GE) organisms that have the potential to be plant pests or to increase plant pest risks. The Agency performs extensive, science-based analyses to evaluate the plant pest potential of a GE organism for which a petition for nonregulated status has been submitted. Results are documented in a plant pest risk assessment (PPRA). If the conclusion of the PPRA is that a GE organism is unlikely to pose a plant pest risk, the Agency must determine that it does not regulate that organism as a plant pest.

Regardless of its decision (either not to regulate or continue regulating) for a particular article (i.e., organism) that has not been released previously into the environment, the Agency also assesses whether or not its decision is likely to cause an environmental impact(s), and if so, examines the environmental impacts of its determination to comply with regulations codified under NEPA. The results of the examination APHIS has performed, relevant to ASR368 creeping bentgrass, is the subject of this document.

1.2 APHIS Regulatory Authority

The Plant Protection Act of 2000 (PPA), as amended (7 U.S.C. §§ 7701-7772), provides the legal authorization for the APHIS plant protection mission. It authorizes the Agency to regulate the introduction of potential plant pests into the territorial boundaries of the United States, and their interstate movement within U.S. boundaries by establishing quarantine, eradication and control programs. Implementing rules, regulations and guidelines for this enabling legislation (PPA) are codified in Title 7 of the U.S. Code of Federal Regulations (CFR). Rules that implement this authority specific to GE organisms have been published in 7 CFR part 340.

1.3 Requirement for this Document

When APHIS receives a petition for nonregulated status of an article currently regulated under its PPA authority codified in 7 CFR part 340, the Agency is required to make a decision. As a Federal agency, APHIS must also comply with applicable U.S. environmental laws and regulations because a decision on a petition for nonregulated status, whether positive or negative, is a final Agency action that might cause environmental impact(s).

This document addresses both of these requirements relevant to decisionmaking for a petition submitted by the Scotts Company LLC of Marysville, OH and Monsanto Company of St. Louis, MO (henceforth referred to as “Scotts” and “Monsanto”), APHIS Petition 15-300-01p for ASR368 creeping bentgrass that has resistance to glyphosate (Scotts and Monsanto, 2015a). Scotts and Monsanto have presented data in their petition to support its claims that ASR368 creeping bentgrass is not a plant pest risk, so should not be regulated by APHIS under the PPA and 7 CFR part 340.

ASR368 creeping bentgrass is currently regulated under 7 CFR part 340. Interstate movements and field trials of ASR368 creeping bentgrass have been conducted under authorizations by APHIS since 1999. These field trials were conducted in diverse growing regions throughout the United States including:

- Alabama (Baldwin County, Shelby County),
- Arizona (Maricopa County),
- California (San Diego County),
- Colorado (Jefferson County, Larimer County),
- Connecticut (New Haven County, Tolland County),
- Delaware (New Castle County),
- Georgia (Richmond County),
- Idaho (Canyon County, Owyhee County),
- Illinois (Clinton County, Champaign County, Cook County, DuPage County),
- Indiana (Hamilton County, Tippecanoe County),
- Iowa (Polk County, Story County),
- Kansas (Johnson County),
- Kentucky (Boone County, Fayette County, Jefferson County),
- Massachusetts (Bristol County, Franklin County, Hampshire County),
- Maryland (Baltimore County, Montgomery County, Prince George's County),
- Michigan (Ingham County, Ottawa County),
- Montana (Ravalli County),
- Missouri (St. Louis County),
- Nebraska (Saunders County),
- New Jersey (East Brunswick County, Middlesex County, Union County),
- New York (Broome County, Tompkins County),
- North Carolina (Wake County),
- Ohio (Cuyahoga County, Delaware County, Fairfield County, Franklin County, Geauga County, Lucas County, Union County),
- Oregon (Marion County, Jefferson County, Linn County, Umatilla County),
- Pennsylvania (Allegheny County, Delaware County),
- South Carolina (Pickens County),
- Virginia (Montgomery County, City of Richmond, City of Virginia Beach),
- Washington (Franklin County, Whitman County), and
- Wisconsin (Dane County, Sheboygan County)

With the exception of the plantings for seed production in Jefferson County, Oregon and Canyon and Owyhee Counties in Idaho, field releases were mostly less than one quarter acre in size with only a few approaching one acre. The purpose of these individual field tests were to generate data to support a petition to request nonregulated status. Details regarding and data resulting from these field trials are described in the ASR368 petition (Scotts and Monsanto, 2015a) and have been analyzed for plant pest risk in the APHIS preliminary Plant Pest Risk Assessment (PPRA) (USDA-APHIS, 2016b).

The petition stated that APHIS should not regulate ASR368 creeping bentgrass because it does not present a plant pest risk, the purpose of this petition request. In the event of a determination of nonregulated status, the nonregulated status would include ASR368 creeping bentgrass and any progeny derived from crosses between ASR368 creeping bentgrass and conventional creeping bentgrass, including crosses of ASR368 creeping bentgrass with other biotechnology-derived creeping bentgrass varieties that are no longer subject to the regulatory requirements of 7 CFR part 340. A determination of nonregulated status and this EIS would not necessarily apply to other glyphosate-resistant creeping bentgrass events as APHIS' regulatory practice is to review requests on a case-by-case basis.

1.4 Purpose of Product

ASR368 creeping bentgrass is genetically engineered to exhibit resistance to the herbicide glyphosate. Glyphosate-resistant ASR368 creeping bentgrass was developed by the insertion of a 5-enolpyruvylshikimate-3-phosphate synthase (*epsps*) gene from *Agrobacterium* sp. strain CP4 (*cp4 epsps*) into the creeping bentgrass genome. When creeping bentgrass plants containing the inserted gene are treated with glyphosate herbicide, the plants are unaffected (Scotts and Monsanto, 2015a). ASR368 creeping bentgrass was originally developed in the 1990s to address a market need for a product that would simplify golf course weed management (Scotts and Monsanto, 2015b). Since this time, market conditions have changed and ASR368 no longer has commercial value (Scotts and Monsanto, 2015b; Scotts, 2016). During field testing in 2003 and 2004 creeping bentgrass escaped from authorized field trial sites. As a result of this escape, Scotts was fined and required to conduct workshops on their efforts to monitor and destroy ASR368 creeping bentgrass (USDA, 2007). Scotts and Monsanto stated that they have no intention to and will not commercialize or further propagate such plants in the future (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b; Scotts, 2016). Scotts and Monsanto have also stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a). Scotts has destroyed all commercial ASR368 creeping bentgrass seed stock and withdrew their EPA label amendment application for any glyphosate-based product for use on ASR368 creeping bentgrass (Scotts and Monsanto, 2015b). Therefore, as part of the environmental impacts analysis, APHIS will assume that ASR368 creeping bentgrass will not be commercially produced and that Scotts and Monsanto will continue their management efforts to control ASR368 creeping bentgrass currently in the environment as a result of escapes that happened in the early 2000's and are no longer subject to USDA's jurisdiction as agreed upon in the MOA (USDA-APHIS, 2015b; 2015a).

1.5 Coordinated Framework Review and Regulatory Review

In 1986, the Office of Science and Technology Policy (OSTP) issued the Coordinated Framework for the Regulation of Biotechnology (CF), which describes the comprehensive Federal regulatory policy for ensuring the safety of biotechnology products. The CF sought to achieve a balance between regulation adequate to ensure the protection of health and the environment while maintaining sufficient regulatory flexibility to avoid impeding innovation. In 1992, OSTP issued an update to the CF that sets forth a risk-based, scientifically sound basis for the oversight of activities that introduce biotechnology products into the environment. The update affirmed that Federal oversight should focus on the characteristics of the product and the environment into which it is being introduced, rather than the process by which the product is created (51 FR 23302, 1986; 57 FR 22984, 1992).

The Coordinated Framework explains the regulatory roles and authorities for the three major agencies involved in regulating GE organisms: USDA-APHIS, the U.S. Environmental Protection Agency (EPA), and the U.S. Food and Drug Administration (FDA). A summary of each role follows.

1.5.1 USDA-APHIS

APHIS administers regulations in 7 CFR part 340, "Introduction of Organisms and Products Altered or Produced Through Genetic Engineering Which are Plant Pests or Which There is Reason to Believe are Plant Pests" (referred to below as the regulations). The current regulations govern the introduction (importation, interstate movement, or release into the environment) of certain genetically engineered (GE) organisms that are considered “regulated articles.”

Under the current regulations, a GE organism is considered to be a regulated article if the donor organism, recipient organism, vector, or vector agent is a plant pest or if the Administrator has reason to believe the GE organism is a plant pest. A plant pest is defined in § 340.1 as “Any living stage (including active and dormant forms) of insects, mites, nematodes, slugs, snails, protozoa, or other invertebrate animals, bacteria, fungi, other parasitic plants or reproductive parts thereof; viruses; or any organisms similar to or allied with any of the foregoing; or any infectious agents or substances, which can directly or indirectly injure or cause disease or damage in or to any plants or parts thereof, or any processed, manufactured, or other products of plants.” The regulations also provide a process to petition APHIS to determine that a GE organism is nonregulated. A determination of nonregulated status means that the regulated article is no longer subject to the regulations in 7 CFR part 340 and, therefore, there is no longer any authority for APHIS to require a permit or notification for the importation, interstate movement, or environmental release of the regulated article pursuant to 7 CFR part 340.

1.5.2 Environmental Protection Agency

The EPA is responsible for regulating the sale, distribution, and use of pesticides, including pesticides that are produced by an organism through techniques of biotechnology. The EPA regulates plant incorporated protectants (PIPs) and microorganisms used as pesticides, e.g. bacteria, fungi, viruses, bacteriophages; both naturally occurring and genetically engineered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. 136 *et seq.*) and certain microorganisms under the Toxic Substances Control Act (15 U.S.C. 53 *et seq*.). Before planting a crop containing a PIP, a company must seek whether an experimental use permit will be needed from the EPA. Commercial production of crops containing PIPs for purposes of seed increases and sale requires a FIFRA Section 3 registration with the EPA. When assessing the potential risks of genetically engineered PIPs, EPA requires extensive studies examining numerous factors, such as risks to human health, nontarget organisms, and the environment; potential for gene flow; and the need for insect resistance management plans.

Under FIFRA (7 U.S.C. 136 *et seq.*), the EPA regulates the use of pesticides (requiring registration of a pesticide for a specific use prior to distribution or sale of the pesticide for a proposed use pattern). The EPA examines the ingredients of the pesticide; the particular site or crop on which it is to be used; the amount, frequency, and timing of its use; and storage and disposal practices. Prior to registration of a new pesticide or a new use for a previously registered pesticide, the EPA must determine that the pesticide will not cause unreasonable adverse effects on the environment and a reasonable certainty of no harm to humans when used in accordance with label instructions. The EPA must also approve the language used on the pesticide label in accordance with 40 CFR part 158. Once registered, a pesticide may not legally be used unless the use is consistent with the approved directions for use on the pesticide's label. The overall intent of the label is to provide clear directions for effective product performance while minimizing risks to human health and the environment. Under FIFRA the EPA has a standard of reviewing pesticide registrations every 15 years (US-EPA, 2011c). The Food Quality Protection Act (FQPA) of 1996 amended FIFRA, and set a standard to reassess, over a 10-year period, all pesticide tolerances that were in place when the FQPA was signed, make a safety finding when setting tolerances that the pesticide can be used with "a reasonable certainty of no harm," take into consideration aggregate and cumulative effects/risks in assessing human health, and emphasize risks to special sub-populations such as infants and children (US-EPA, 2015e).

The EPA also sets tolerances for residues of pesticides on and in food and animal feed, or establishes an exemption from the requirement for a tolerance, under the Federal Food, Drug, and Cosmetic Act (FFDCA). The EPA is required, before establishing pesticide tolerance, to reach a safety determination based on a finding of reasonable certainty of no harm under the FFDCA, as amended by the FQPA. The FDA enforces the pesticide tolerances set by the EPA.

1.5.3 Food and Drug Administration

The FDA regulates GE organisms under the authority of the FFDCA (21 U.S.C. 301 *et seq.*). The FDA published its policy statement concerning regulation of products derived from new plant varieties, including those derived from genetic engineering, in the *Federal Register* on May 29, 1992 (57 FR 22984). Under this policy, the FDA implements a voluntary consultation process to ensure that human food and animal feed safety issues or other regulatory issues, such as labeling, are resolved before commercial distribution of GE food. This voluntary consultation process provides a way for developers to receive assistance from the FDA in complying with their obligations under Federal food safety laws prior to marketing.

More recently, in June 2006, the FDA published recommendations in "Guidance for Industry: Recommendations for the Early Food Safety Evaluation of New Non-Pesticidal Proteins Produced by New Plant Varieties Intended for Food Use" (US-FDA, 2006) for establishing voluntary food safety evaluations for new non-pesticidal proteins produced by new plant varieties intended to be used as food, including GE plants. Early food safety evaluations help make sure that potential food safety issues related to a new protein in a new plant variety are addressed early in development. These evaluations are not intended as a replacement for a biotechnology consultation with the FDA, but the information may be used later in the biotechnology consultation.

1.6 Purpose and Need for APHIS Action

Under the authority of the plant pest provisions of the PPA and 7 CFR part 340, APHIS regulates the safe development and use of GE organisms. Any party can petition APHIS to seek a determination of nonregulated status for a GE organism that is regulated under 7 CFR part 340. As required by 7 CFR part 340.6, APHIS must respond to petitioners that request a determination of the regulated status of GE organisms, including GE plants such as ASR368 creeping bentgrass. When a petition for nonregulated status is submitted, APHIS must make a determination if the GE organism is unlikely to pose a plant pest risk. The petitioner is required to provide information under § 340.6(c)(4) related to plant pest risk that the agency may use to compare the plant pest risk of the regulated article to that of the unmodified organism. A GE organism is no longer subject to the regulatory requirements of 7 CFR part 340 when APHIS determines that it is unlikely to pose a plant pest risk. In October 2015, APHIS received a petition from Scotts and Monsanto requesting a determination of the regulated status of ASR368 creeping bentgrass.

Consistent with the Council of Environmental Quality's National Environmental Policy Act (NEPA) regulations and the USDA and APHIS NEPA implementing regulations and procedures (40 CFR parts 1500-1508, 7 CFR part 1b, and 7 CFR part 372), APHIS has prepared this draft Environmental Impact Statement (EIS) to consider the potential environmental impacts of an agency determination of nonregulated status. Specifically, this draft EIS has been prepared in order to evaluate the impacts on the quality of the human environment[3] that may result from a determination of nonregulated status of ASR368 creeping bentgrass.

1.7 Public Involvement

APHIS seeks public comment on petitions it receives that request a decision of nonregulated status for GE organisms. APHIS does this through a notice published in the *Federal Register*. When the Agency decides to prepare an EIS as part of its decisionmaking process for a petition, prior to preparation, it also seeks public comments as part of its advance scoping process. Details about the public involvement process for the petition that is the subject of this document follows.

1.7.1 Public Comments for the Petition

Once APHIS deems a petition complete, APHIS publishes a notice in the *Federal Register* making the petition available for public comment for 60 days. This provides the public an opportunity to raise issues regarding the petition itself as well as provide input for consideration by the Agency as it develops its EA or EIS and PPRA.

On October 27, 2015, APHIS received a new petition for nonregulated status from Scotts and Monsanto following withdrawal of its 2003 petition (03-104-01p). On January 8, 2016, APHIS published the new petition for a 60-day public comment period, closing March 8, 2016 (81 FR 902-903). The docket received a total of 169 public submissions. Some of the submissions to the

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[3] Under NEPA regulations, the "human environment" includes "the natural and physical environment and the relationship of people with that environment" (40 CFR §1508.14).

docket contained multiple attached comments gathered by organizations from their members. Contained within the 169 submissions were a total of 5,852 public comments. The issues that were raised in the public comments that were related to the ASR368 creeping bentgrass petition included:

- Gene flow of the glyphosate-resistant trait from cultivated plants to wild/weedy/feral relatives may occur
- The economic impacts associated with ASR368 creeping bentgrass currently in the environment, including control costs
- Increased glyphosate use
- Impacts of ASR368 creeping bentgrass on biodiversity including the impacts on natural habitats and grasslands
- Increased weediness or invasiveness of ASR368 creeping bentgrass

APHIS evaluated these issues and has included a discussion of these issues in the relevant sections of this draft EIS.

1.7.2 Public Scoping for this draft EIS

As part of its scoping process to identify issues to address in this EIS, APHIS also published a Notice of Intent (NOI) to prepare the EIS and sought public input during a 30 day comment period (August 3, 2016 to September 2, 2016). The docket received a total of 18 public comments. Issues most frequently cited in public comments on the NOI included:

- the potential for gene flow from ASR368 creeping bentgrass to wild or weedy relatives
- impacts to irrigation, including reducing water flow and potential to spread ASR368 creeping bentgrass to other areas
- the invasiveness of ASR368 creeping bentgrass and limited herbicide options for control,
- threatened and endangered species impacts including impacts to critical habitat
- the costs associated with the management of escaped ASR368 creeping bentgrass
- the use of alternative herbicides or more invasive methods to control ASR368 creeping bentgrass
- the economic impacts, including impacts on trade
- defining the scope of the EIS
- identifying additional alternatives for analysis

The issues discussed in this EIS were developed by considering the public input, including public comment received from the *Federal Register* notice announcing the availability of the petition (81 FR 902-903), the NOI, as well as issues raised in public comments submitted for other NEPA documents of GE organisms, issues raised in lawsuits, and other issues raised by various stakeholders. These issues, including those regarding the agricultural production of creeping bentgrass using various production methods and the environmental and food/feed safety of GE plants, were addressed to analyze the potential environmental impacts of ASR368 creeping bentgrass.

1.8 Issues Considered

The list of resource areas considered in this draft EIS was developed by APHIS through experience in considering issues raised by the public, with specific attention to the issues raised in public comments submitted for this petition and EAs and EISs of other GE organisms. The resource areas considered also address issues raised in previous and unrelated lawsuits, and issues that have been raised by various stakeholders for this and prior petitions. The resource areas considered in this draft EIS can be categorized as follows:

Agricultural Production Considerations:

- Acreage and Range of Creeping Bentgrass
- Agronomic Practices
- Creeping Bentgrass Seed Production

Environmental Considerations:

- Soil Quality
- Water Resources
- Air Quality
- Climate Change
- Animal Communities
- Plant Communities
- Gene Flow and Weediness
- Microorganisms
- Biodiversity

Human Health Considerations:

- Consumer Health
- Worker Safety

Livestock Health Considerations:

- Animal Feed/Livestock Health

Socioeconomic Considerations:

- Domestic Economic Environment
- Trade Economic Environment

2 ALTERNATIVES

This document analyzes the potential environmental consequences of a determination of nonregulated status of ASR368 creeping bentgrass. To respond favorably to a petition for nonregulated status, APHIS must determine that ASR368 creeping bentgrass is unlikely to pose a plant pest risk. Based on its preliminary PPRA (USDA-APHIS, 2016b), APHIS has concluded that ASR368 creeping bentgrass is unlikely to pose a plant pest risk. Therefore in the absence of any new information, APHIS must determine that ASR368 creeping bentgrass is no longer subject to 7 CFR part 340.

Two alternatives are evaluated in this draft EIS: (1) No Action: Continuation as a Regulated Article and (2) Preferred Alternative: Determination of Nonregulated Status of ASR368 Creeping Bentgrass. APHIS has assessed the potential for environmental impacts for each alternative in the Environmental Consequences chapter.

2.1 No Action Alternative: Continuation as a Regulated Article

Under the No Action Alternative, APHIS would deny the petition. ASR368 creeping bentgrass and progeny derived from ASR368 creeping bentgrass would continue to be regulated articles under the regulations at 7 CFR part 340. Any introduction of ASR368 creeping bentgrass would still require authorization by APHIS. In addition, measures to ensure physical and reproductive confinement of ASR368 creeping bentgrass would continue to be implemented. APHIS might choose this alternative if there were insufficient evidence to demonstrate the lack of plant pest risk from the unconfined cultivation of ASR368 creeping bentgrass.

This alternative is not the Preferred Alternative because APHIS has concluded through a preliminary PPRA that ASR368 creeping bentgrass is unlikely to pose a plant pest risk (USDA-APHIS, 2016b). Choosing this alternative would not satisfy the purpose and need of making a determination of plant pest risk status and responding to the petition for nonregulated status.

2.2 Preferred Alternative: Determination that ASR368 Creeping Bentgrass is No Longer a Regulated Article

Under this alternative, ASR368 creeping bentgrass and progeny derived from it would no longer be regulated articles under the regulations at 7 CFR part 340. APHIS would no longer require authorizations for introductions of ASR368 creeping bentgrass and progeny derived from this event. This alternative best meets the purpose and need to respond appropriately to a petition for nonregulated status based on the requirements in 7 CFR part 340 and the agency's authority under the plant pest provisions of the PPA. Because the agency has concluded that ASR368 creeping bentgrass is unlikely to pose a plant pest risk (USDA-APHIS, 2016b), a determination of nonregulated status of ASR368 creeping bentgrass is a response that is consistent with the plant pest provisions of the PPA, the regulations codified in 7 CFR part 340, and the biotechnology regulatory policies in the Coordinated Framework.

Under this alternative, growers may have future access to ASR368 creeping bentgrass and progeny derived from this event if the developer decides to commercialize ASR368 creeping bentgrass. Although this petition seeks nonregulated status for ASR368 creeping bentgrass, Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate such plants in the future. Further, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b; 2015a; Scotts, 2016).

2.3 Alternatives Considered But Rejected from Further Consideration

APHIS assembled a list of alternatives that might be considered for ASR368 creeping bentgrass. The agency evaluated these alternatives, in light of the agency's regulations at 7 CFR part 340 to identify which alternatives would be further considered for ASR368 creeping bentgrass. Based on this evaluation, APHIS rejected several alternatives. These alternatives are discussed briefly below along with the specific reasons for rejecting each.

2.3.1 Prohibit Any ASR368 Creeping Bentgrass from Being Released

In response to public comments that stated a preference that no GE organisms enter the marketplace, APHIS considered prohibiting the release of ASR368 creeping bentgrass, including denying any permits associated with field testing. APHIS determined that this alternative is not appropriate given that APHIS has concluded that ASR368 creeping bentgrass is unlikely to pose a plant pest risk (USDA-APHIS, 2016b).

In enacting the PPA, Congress found that

> [D]ecisions affecting imports, exports, and interstate movement of products regulated under [the Plant Protection Act] shall be based on sound science…§ 402(4).

On March 11, 2011, in a Memorandum for the Heads of Executive Departments and Agencies, the White House Emerging Technologies Interagency Policy Coordination Committee developed broad principles, consistent with Executive Order 13563, to guide the development and implementation of policies for oversight of emerging technologies (such as genetic engineering) at the agency level. In accordance with this memorandum, agencies should adhere to Executive Order 13563 and, consistent with that Executive Order, the following principle, among others, to the extent permitted by law, when regulating emerging technologies:

> [D]ecisions should be based on the best reasonably obtainable scientific, technical, economic, and other information, within the boundaries of the authorities and mandates of each agency.

Based on the preliminary PPRA (USDA-APHIS, 2016b) and the scientific data evaluated therein, APHIS concluded that ASR368 creeping bentgrass is unlikely to pose a plant pest risk. Accordingly, there is no basis in science for prohibiting the release of ASR368 creeping bentgrass.

2.3.2 Approve the Petition in Part

The regulations at 7 CFR 340.6(d)(3)(i) state that APHIS may "approve the petition in whole or in part." For example, a determination of nonregulated status in part may be appropriate if there is a plant pest risk associated with some, but not all lines described in a petition. Because APHIS has concluded that ASR368 creeping bentgrass is unlikely to pose a plant pest risk (USDA-APHIS, 2016b), it would be inconsistent with the statutory authority under the plant pest provisions of the PPA and regulations in 7 CFR part 340 to consider approval of the petition only in part.

2.3.3 Isolation Distance between ASR368 creeping bentgrass and Non-GE Creeping Bentgrass Production and Geographical Restrictions

In response to public concerns of gene movement between GE and non-GE plants, APHIS considered requiring an isolation distance separating ASR368 creeping bentgrass from non-GE creeping bentgrass production. However, because APHIS has concluded that ASR368 creeping bentgrass is unlikely to pose a plant pest risk (USDA-APHIS, 2016b), an alternative based on requiring isolation distances would be inconsistent with the statutory authority under the plant pest provisions of the PPA and regulations in 7 CFR part 340.

APHIS also considered geographically restricting the production of ASR368 creeping bentgrass based on the location of production of non-GE grass seed, organic grass seed production systems, or production systems for GE-sensitive markets in response to public concerns regarding possible gene movement between GE and non-GE plants. However, as presented in APHIS' preliminary PPRA for ASR368 creeping bentgrass, there are no geographic differences associated with any identifiable plant pest risks for ASR368 creeping bentgrass (USDA-APHIS, 2016b). This alternative was rejected and not analyzed in detail because APHIS has concluded that ASR368 creeping bentgrass does not pose a plant pest risk, and will not exhibit a greater plant pest risk in any geographically restricted area. Therefore, such an alternative would not be consistent with APHIS' statutory authority under the plant pest provisions of the PPA and regulations in 7 CFR part 340.

Based on the foregoing, the imposition of isolation distances or geographic restrictions would not meet APHIS' purpose and need to respond appropriately to a petition for nonregulated status based on the requirements in 7 CFR part 340 and the agency's authority under the plant pest provisions of the PPA.

2.3.4 Requirements of Testing for ASR368 Creeping Bentgrass

During the comment periods for other petitions for nonregulated status, some commenters requested that USDA require and provide testing for GE products in non-GE production systems. APHIS notes there are no nationally-established regulations involving testing, criteria, or limits of GE material in non-GE systems. Such a requirement would be extremely difficult to implement and maintain. Additionally, because ASR368 creeping bentgrass does not pose a plant pest risk (USDA-APHIS, 2016b), the imposition of any type of testing requirements is inconsistent with the plant pest provisions of the PPA and the regulations at 7 CFR part 340.

Therefore, imposing such a requirement for ASR368 creeping bentgrass would not meet APHIS' purpose and need to respond appropriately to the petition.

2.4 Comparison of Alternatives

Table 1 presents a summary of the potential impacts associated with selection of either of the alternatives evaluated in this EIS. The impact assessment is presented in Chapter 4 of this EIS.

Table 1. Summary of Issues of Potential Impacts and Consequences of Alternatives.

Attribute/Measure	Alternative A: No Action	Alternative B: Determination of Nonregulated Status
Meets Purpose and Need and Objectives	No	Yes
Unlikely to pose a plant pest risk	Satisfied through use of regulated field trials.	Satisfied—risk assessment (USDA-APHIS, 2016b)
Management Practices		
Acreage and Areas of Creeping Bentgrass Production	Nearly all of the bentgrass seed grown in the United States is produced as certified seed in Oregon's Willamette Valley. Oregon growers produce essentially all of the U.S. bentgrass (*Agrostis* spp.) commercial seed stock. Bentgrass production ranges from around 4,000 to 6,000 acres, relative to market demand.	Unchanged from No Action Alternative
Acreage and Areas of Herbicide-Resistant Creeping Bentgrass	Glyphosate-resistant creeping bentgrass escaped from authorized field trial sites leading to established populations in Jefferson County and Malheur County, Oregon and Canyon County, Idaho. The primary means of spread of glyphosate-resistant creeping bentgrass outside of test sites was due to seed dispersal. While the efforts to date have not been successful in eradicating ASR368 creeping bentgrass, they have significantly reduced both the number of ASR368 plants and the areas	Unchanged from No Action Alternative. After deregulation, control efforts will continue as part of normal maintenance of irrigation canals by landowners, with technical support from Scotts.

Attribute/Measure	Alternative A: No Action	Alternative B: Determination of Nonregulated Status
	where they may be found.	
Agronomic Practices	General agronomic practices such as seed bed preparation, planting, irrigation, nutrient inputs, pesticide use, disease management, harvest, and post-harvest residue management are expected to remain the same as current practices for creeping bentgrass production. ASR368 creeping bentgrass that is already present in the environment is expected to continue to be managed in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass.	Unchanged from No Action Alternative
Physical Environment		
Soil Quality	Agronomic practices associated with conventional creeping bentgrass seed production and management of conventional creeping bentgrass on golf courses, including seed bed preparation, post-harvest residue management, agronomic inputs, mowing, core aeration, and sand topdressing, can affect soil quality.	Unchanged from No Action Alternative
Water Resources	The primary cause of agricultural non-point source pollution is increased sedimentation from soil erosion, which can introduce sediments, fertilizers, and pesticides to nearby lakes and streams. Agronomic practices associated with creeping bentgrass seed production and	Unchanged from No Action Alternative

Attribute/Measure	Alternative A: No Action	Alternative B: Determination of Nonregulated Status
	maintenance of grass on golf courses, including fertilizer and pesticide use, has the potential to impact water quality. Growers will continue to choose certain pesticides based on weed, insect and disease pressures, cost of seed and other inputs, human safety, potential for crop injury, and ease and flexibility of the production system. Growers and landowners would continue to manage ASR368 creeping bentgrass as part of their routine weed management program using registered herbicides and/or physical and mechanical techniques	
Air Quality	Agricultural practices have the potential to cause negative impacts to air quality. These management practices may include vehicle exhaust associated with mowing and harvesting, field burning, and emissions from the use of nitrogen fertilizer and pesticide use.	Unchanged from No Action Alternative
Climate Change	Agriculture, including land-use changes associated with farming, is responsible for an estimated 6.9 percent of all human-induced GHG emissions in the United States. Current agronomic practices associated with conventional creeping bentgrass seed production and management of grass on golf courses which contribute to GHG emissions, including vehicle exhaust associated with mowing and	Unchanged from No Action Alternative

Attribute/Measure	Alternative A: No Action	Alternative B: Determination of Nonregulated Status
	harvesting, field burning, and emissions from the use of nitrogen fertilizer.	
Biological Resources		
Animal Communities	A wide array of animal and insect species occupy or use habitats that are within or adjacent to creeping bentgrass seed production fields, golf courses, or other areas where creeping bentgrass currently exists. Mammals and birds may use creeping bentgrass for food or shelter. Invertebrates can feed on creeping bentgrass plants or prey upon other insects living on creeping bentgrass plants as well as in the vegetation surrounding creeping bentgrass seed production fields and areas where creeping bentgrass presently exists. Common agronomic practices used for creeping bentgrass, including the application of agricultural inputs, could potentially impact animal communities.	Unchanged from No Action Alternative
Plant Communities	Plants communities adjacent to creeping bentgrass seed fields or golf courses are highly variable and range from urban to rural, and commonly include other cultivated fields, fence rows and hedge rows, meadows, fallow fields, grasslands, woodlands, riparian habitats and other uncultivated areas. Weeds are important pests in creeping bentgrass seed production and on golf courses and weed control is important for seed purity and golf	Unchanged from No Action Alternative

Attribute/Measure	Alternative A: No Action	Alternative B: Determination of Nonregulated Status
	course greens maintenance. Management of ASR368 creeping bentgrass would continue in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass.	
Gene Flow and Weediness	Creeping bentgrass is wind pollinated and capable of hybridizing with other bentgrass species and some other grasses. Although creeping bentgrass can hybridize with other species, most offspring are sterile or will have low fertility. Intergeneric gene flow has also been documented between glyphosate-resistant creeping bentgrass and rabbitfoot grass. While creeping bentgrass has some weedy characteristics, it is rarely considered a problem that warrants management and so is generally not managed as a weed. While there is potential for glyphosate-resistant hybrids between ASR368 creeping bentgrass and relatives to form the glyphosate-resistant hybrids are unlikely to be any weedier than non-GR hybrids because of the low frequency of hybridization, the availability of alternative herbicides, and other methods for management, and the very low level of hybrid fertility. ASR368 creeping bentgrass will continue to be managed in accordance with the agreed	Unchanged from No Action Alternative

Attribute/Measure	Alternative A: No Action	Alternative B: Determination of Nonregulated Status
	management plan to minimize further distribution of ASR368 creeping bentgrass.	
Microorganisms	Management practices used in creeping bentgrass seed production and on golf courses can affect soil microorganisms by altering microbial populations and activity through modification of the soil environment.	Unchanged from No Action Alternative
Biodiversity	In turfgrass production, farmers will intensively manage plant and animal communities through chemical and cultural controls to protect the crop from damage. Golf course managers take similar actions to protect greens and fairways from weeds and animal damage. Therefore, the biological diversity in turfgrass production systems and on golf courses is highly managed and may be lower than in the surrounding habitats.	Unchanged from No Action Alternative
Human and Animal Health		
Risk to Human Health	Creeping bentgrass is not a food and not consumed directly by humans, but consumers could be exposed to food products derived indirectly from creeping bentgrass due to animals consuming creeping bentgrass. The EPA's WPS; (40 CFR part 170.1, *Scope and Purpose*) requires employers to take actions to reduce the risk of pesticide poisonings and injuries among agricultural workers and pesticide handlers. The WPS contains requirements for pesticide safety	Unchanged from No Action Alternative. A compositional analysis concluded that ASR368 creeping bentgrass is compositionally equivalent to conventional creeping bentgrass varieties with the exception of the glyphosate-resistance trait. The management of ASR368 creeping bentgrass would not increase worker exposure to herbicides or any other weed management practice that would

Attribute/Measure	Alternative A: No Action	Alternative B: Determination of Nonregulated Status
	training, notification of pesticide applications, use of personal protective equipment, restricted entry intervals following pesticide application, decontamination supplies, and emergency medical assistance.	create a worker health risk.
Risk to Animal Feed	Creeping bentgrass has limited use as animal feed. It is the responsibility of food and feed manufacturers to ensure that the products they market are safe and labeled properly.	Unchanged from No Action Alternative. A compositional analysis concluded that ASR368 creeping bentgrass is compositionally equivalent to conventional creeping bentgrass varieties with the exception of the glyphosate-resistance trait.
Socioeconomic		
Domestic Economic Environment	Turfgrass is an important market in the United States and makes a significant contribution to the U.S. economy with a market size around $40 billion. The vast majority of creeping bentgrass seed is produced in Oregon. In 2013, bentgrass in Oregon was grown on 4,710 acres and produced approximately 2.2 million pounds of bentgrass seed, at a value of $5,567,000 (ODA, 2014). No market impacts are expected due to ASR368 creeping bentgrass already present in the environment because of the differences in flowering timing with other turf grasses, seed size differences, and weed control measures already in place.	Unchanged from No Action Alternative. Scotts and Monsanto have stated that they have no intention to and will not commercialize ASR368 creeping bentgrass (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b).
Trade Economic Environment	In 2013, the United States exported approximately $379 million in turf grass seed. Around	The trade economic impacts associated with a determination of nonregulated status of ASR368

Attribute/Measure	Alternative A: No Action	Alternative B: Determination of Nonregulated Status
	12-15% of turf grass seed grown in Oregon is exported. The United States will continue to be a supplier in the international market. No impacts on trade are anticipated from the presence of ASR368 creeping bentgrass where it currently exists.	creeping bentgrass are anticipated to be similar to the No Action Alternative because Scotts and Monsanto have stated that they do not intend to commercialize ASR368 creeping bentgrass (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b).
Other Regulatory Approvals		
U.S.	Scotts and Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002 (Scotts and Monsanto, 2015a). The FDA completed consultation on September 23, 2003 (US-FDA, 2003c).	Scotts and Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002 (Scotts and Monsanto, 2015a). The FDA completed consultation on September 23, 2003 (US-FDA, 2003c).
Compliance with Other Laws		
CWA, CAA, EOs	Fully compliant	Fully compliant

3 AFFECTED ENVIRONMENT

The Affected Environment Section provides a discussion of the current conditions of those aspects of the human environment potentially impacted by a determination of nonregulated status of ASR368 creeping bentgrass. For the purposes of this EIS, those aspects of the human environment are: agricultural production practices, the physical environment, biological resources, public health, animal feed, and socioeconomic issues.

3.1 Distribution of Creeping Bentgrass in the United States

Among the bentgrasses (*Agrostis* genus) there are around 150 to 200 species of both annual and perennial grasses, which are found in nearly all countries of the world; distributed across temperate and cool regions, and in subtropical and tropical areas. Approximately 35 species are found in the United States (Watson and Dallwitz, 1992; MacBryde, 2006).

The geographical origin of creeping bentgrass (*Agrostis stolonifera*) is not entirely certain. However, it primarily occurs and probably originated evolutionarily in the Northern Hemisphere in western Eurasia, with some species having evolved in the Southern Hemisphere and temperate to cold-temperate areas of tropical mountains. Creeping bentgrass is considered native to Portugal, Africa, temperate and tropical Asia, Europe, and Greenland (USDA-ARS, 2016). Areas to which it has been introduced and is naturalized include Canada, Australia, New Zealand, Southern South America, and the United States (USDA-ARS, 2016). In the United States, creeping bentgrass is entirely naturalized and probably arrived well before the 1750s, inadvertently introduced with seed or hay as forage for cattle, sheep, and horses (MacBryde, 2006).

In the 1890s seeds of a few *Agrostis* species gathered from pasture populations in central Europe (present-day Austria and Hungary), likely including small amounts of *A. stolonifera*, were first imported into the United States to establish golf courses (MacBryde, 2006). Trade in various species of bentgrass seed expanded in the 1900s, largely among the countries of Germany, New Zealand, Canada, and United States, due to an emerging demand for use of *Agrostis* species for sports turf and lawns, as well for municipal parks, playgrounds, and fine lawns (MacBryde, 2006).[4]

Responding to increasing demand for bentgrass, production in the United States began in the early 1900s utilizing free-living (naturalized) U.S. populations of *Agrostis* in Rhode Island, Massachusetts, Connecticut, Oregon, Washington, and northern California (MacBryde, 2006). As a result of importation of *Agrostis* species from areas such as Europe, New Zealand, and Canada, utilization of naturalized species from the United States for commercial purposes, and outcrossing of naturalized species, there are around 35 species of *Agrostis* widely distributed across the United States (e.g., *A. capillaris, A. canina, A. castellana, A. stolinifera, A. gigantea*). Creeping bentgrass is believed to occur in all 50 states, although as a temperate to cool climate

[4] Bentgrass is used as a turf grass due to its desired traits: it can be mowed to a very short height (centimeters); can tolerate a high degree of wear such as foot traffic; grows in thick, dense mats; seeds rather easily; and its color and texture are aesthetically pleasing.

grass, to a lesser extent in southern states with more subtropical climates (Figure 1) (MacBryde, 2006).

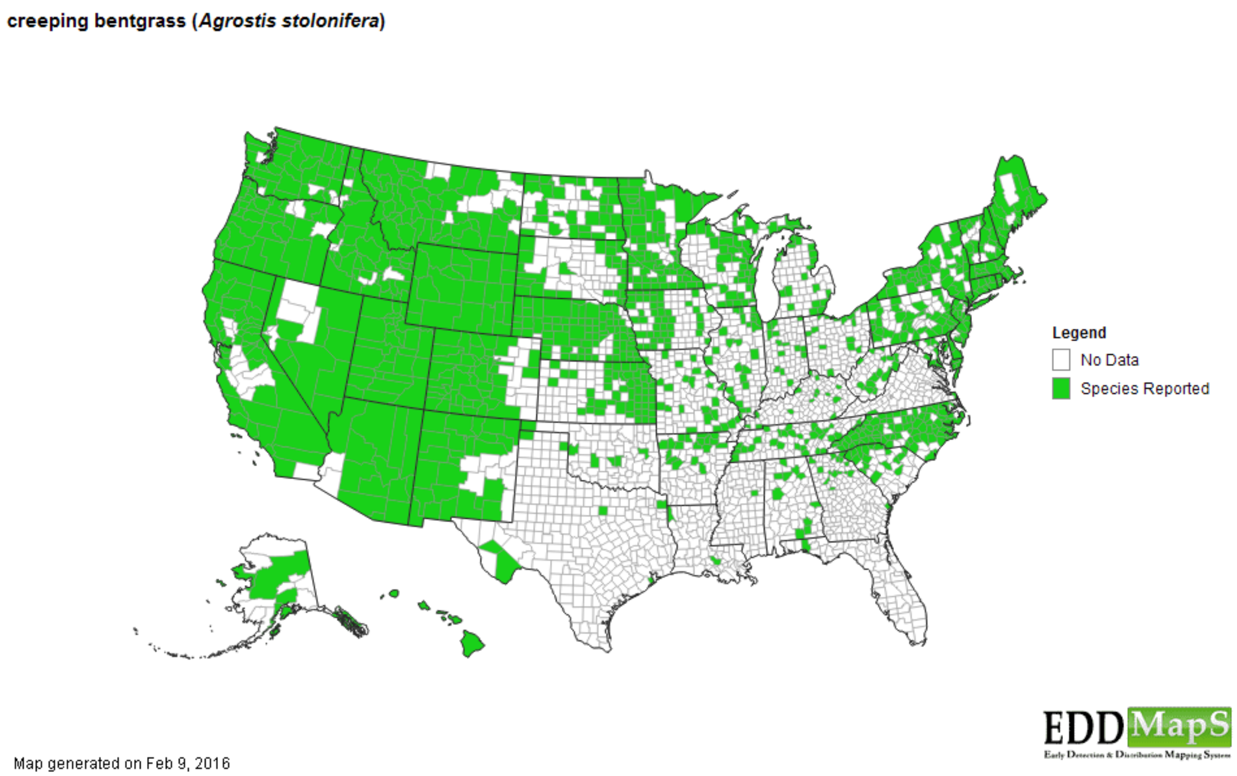


Figure 1. Distribution of Naturalized Creeping Bentgrass in the United States, 2014
Source: (University of Georgia, 2016)

3.1.1 Acreage and Area of Commercially Produced Bentgrass in the United States

Commercial Bentgrass Uses

Through the 1900s creeping bentgrass emerged as one of the most popular and successful grasses for putting greens and now is grown extensively for use on U.S. golf greens, tees, and fairways (MacBryde, 2006). Currently, golf courses are the primary market for creeping bentgrass. Colonial bentgrass and creeping bentgrass are particularly desired by the golf industry due to their tolerance to short mowing heights and durability. Due to the high level of maintenance required to sustain its aesthetic character there is limited home lawn or institutional use of creeping bentgrass. Occasionally, creeping bentgrass is also used for playing surfaces such as croquet, lawn bowling, home lawn putting greens, and very rarely as an ornamental lawn. Creeping bentgrass is additionally used, to a limited degree, as a forage for pasture raised livestock (Fransen and Chaney, 2002). For these reasons, in regard to the areas and acreage of creeping bentgrass in the United States, this draft EIS focuses predominately on the commercial use of creeping bentgrass in the golf industry.

Commercial Bentgrass Production

Oregon emerged as the primary locale for the production of grass seed on a commercial scale due to favorable growing conditions; namely, a temperate climate, wet winters, and arid summers. Oregon produces more cool-season forage and turf grass than anywhere else in the world. Nearly all of the bentgrass seed grown in the United States is produced as certified seed in Oregon's Willamette Valley (Alderman *et al*., 2012), located between the Coastal Range and Cascade Range (Figure 2). Currently, around 950 varieties from eight grass species are grown on over 390,000 acres in Oregon. Of these, approximately 360,000 acres are located in the Willamette Valley. The remaining acres are mostly made up of Kentucky bluegrass and ryegrass east of the Cascades (USDA-NASS, 2014b). Oregon growers produce essentially all of the U.S. commercial seed stock of annual ryegrass (*Lolium multiflorum* Lam.), perennial ryegrass (*L. perenne* L.), bentgrass (*Agrostis* spp.), and fine fescue (*Festuca* spp.). Smaller amounts, but significant stocks of Kentucky bluegrass (*Poa pratensis* L.), orchardgrass (*Dactylis glomerata* L.), and tall fescue *(Festuca arundinacea* Schreb.) are also produced. Bentgrass production ranges from around 4,000 to 6,000 acres, relative to market demand (USDA-NASS, 2011; 2014b).

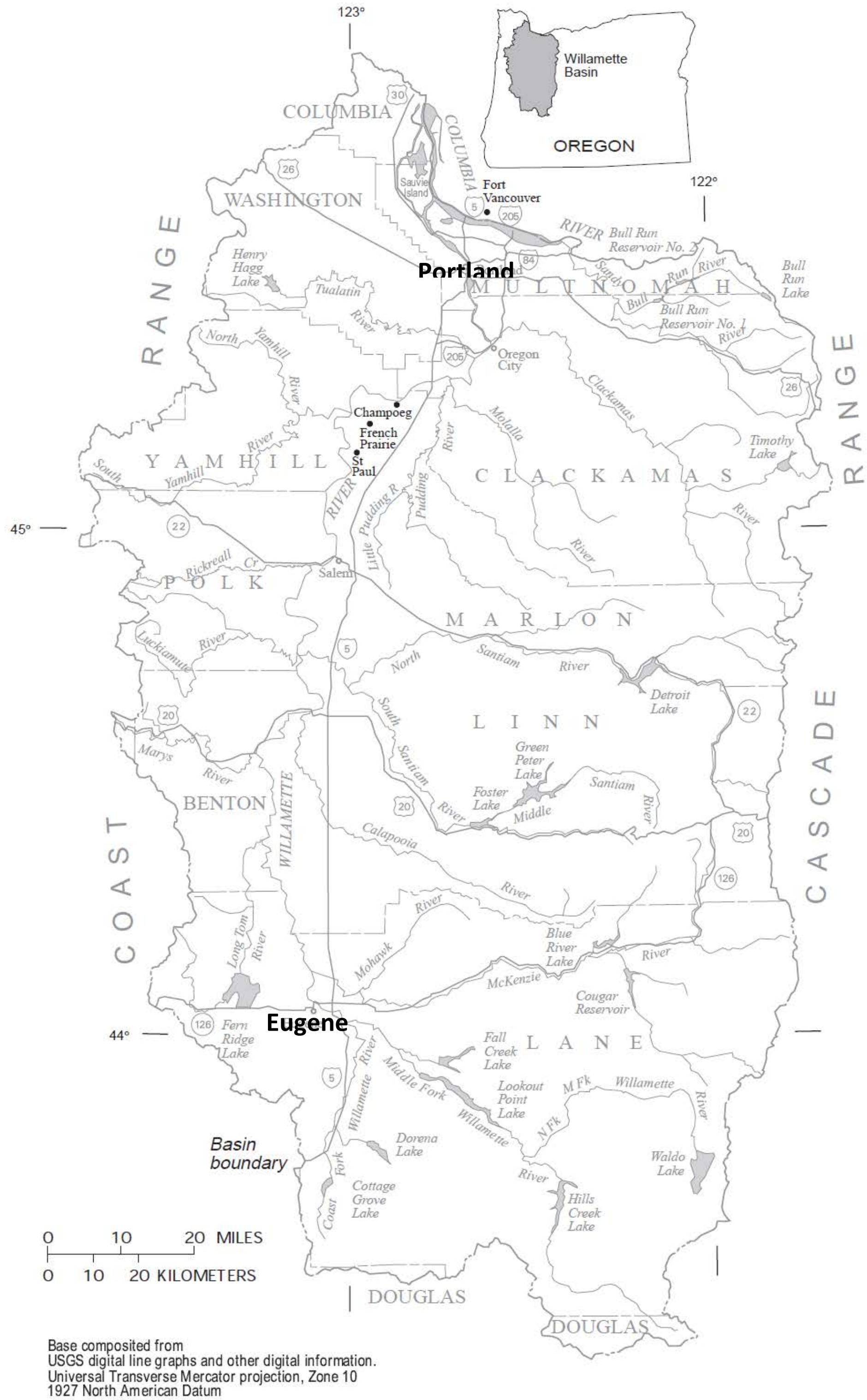
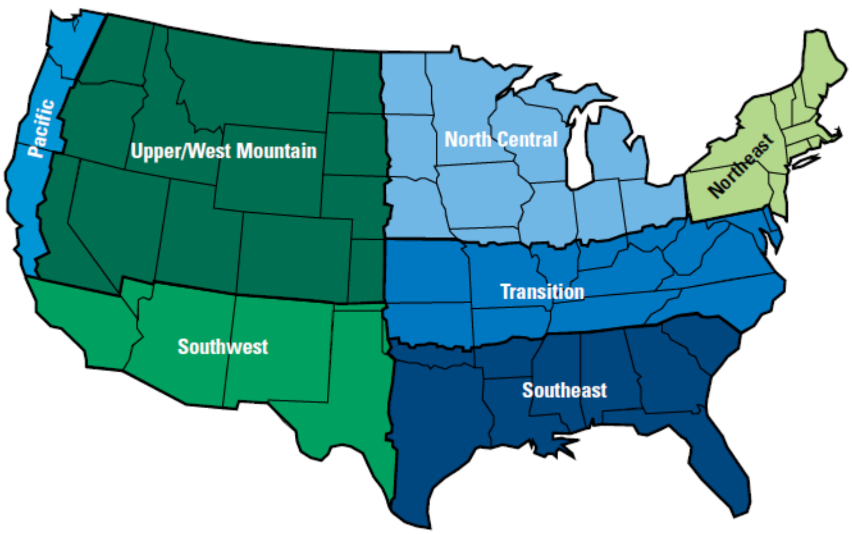


Figure 2. Location and features of the Willamette Basin, Oregon

The Willamette Valley extends from Portland in the North to Eugene in the South. Around 347, 000 acres are utilized for commercial grass seed production, and around 6,000 acres for production of *Agrostis* spp. seed (MacBryde, 2006).

Distribution and Acreage of Golf Courses in the United States

Over the last decade the number of golf courses in the United States has ranged from around 15,000 to 16,000, depending on the year. The total number of traditional golf facilities contracted slightly from 16,052 in 2005 to 15,372 in 2015, but remains at a higher level than in 2000 (SRI, 2011; NGF, 2016). The approximate regional distribution of golf courses across the United States is summarized in (Figure 3). Golf courses are found in every state.



Approximate Number of Golf Courses by Region

North Central	3,900
Northeast	2,600
Pacific	630
Southeast	3,040
Southwest	1,200
Transition	2,790
Upper West/Mountain	1,100
Hawaii	108
Alaska	26

Figure 3. Regional Distribution and Number of U.S. Golf Courses: 2014
Source: (GCSAA, 2015)

Bearing in mind annual fluctuations in the number of courses, there are an estimated 2.24 million acres of land in golf courses in the United States. Of this, around 1.5 million acres is managed turf grass, and approximately 740,300 acres is non-turf grass area such as water bodies, buildings, bunkers, or parking lots (GCSAA, 2007). An 18-hole golf facility averages around 150-200 acres, including water bodies, hard structures, and out-of-play areas. A typical urban golf course averages around 110-120 acres, and courses in resort areas may be 170-190 acres (GCSAA, 2007). For an average18-hole golf course comprising 150 acres; approximately 100 acres are maintained turf grass. Average land uses for golf courses are summarized in Figure 4.

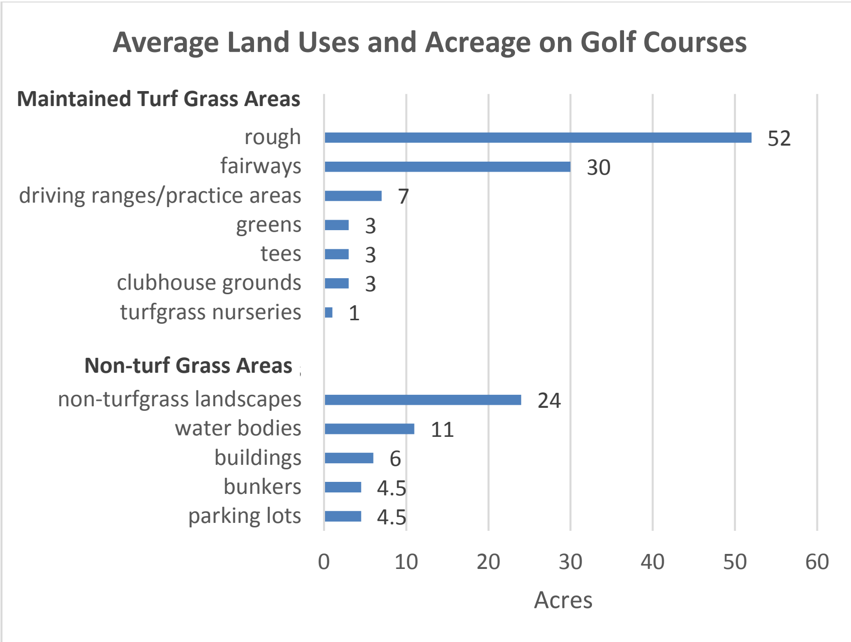


Figure 4. Land use on an average 150 acre, 18-hole golf course
Source: (GCSAA, 2007)

The average acreage for all turf grass species on U.S. golf courses is summarized in Figure 5 (GCSAA, 2007). The two most common turf grass species planted on golf course putting greens are creeping bentgrass and hybrid Bermuda grass (*Cynodon dactylon* × *C. transvaalensis*). For the year 2007, creeping bentgrass[5] was used on approximately 140,757 acres of U.S. golf courses (Figure 6), most of which comprised putting green and tee acreage, especially in the Northeast, North Central, and Transition regions (Figure 6) (GCSAA, 2007). Other grasses such as Bermuda or zoysia are better adapted for use on fairways and tees, especially in the South and transition zone (GCSAA, 2007). The 2007 data, while several years old, is the latest report from the Golf Course Superintendents Association of America (GCSAA), and provides a good approximation of turf grass uses on U.S. golf courses. These figures will fluctuate somewhat from year to year relative to new courses being developed, and other courses being closed.

[5] The turf grass industry in the United States frequently equates creeping bentgrass with *Agrostis palustris* or sometimes *A. stolonifera* var. palustris MacBryde (2006).

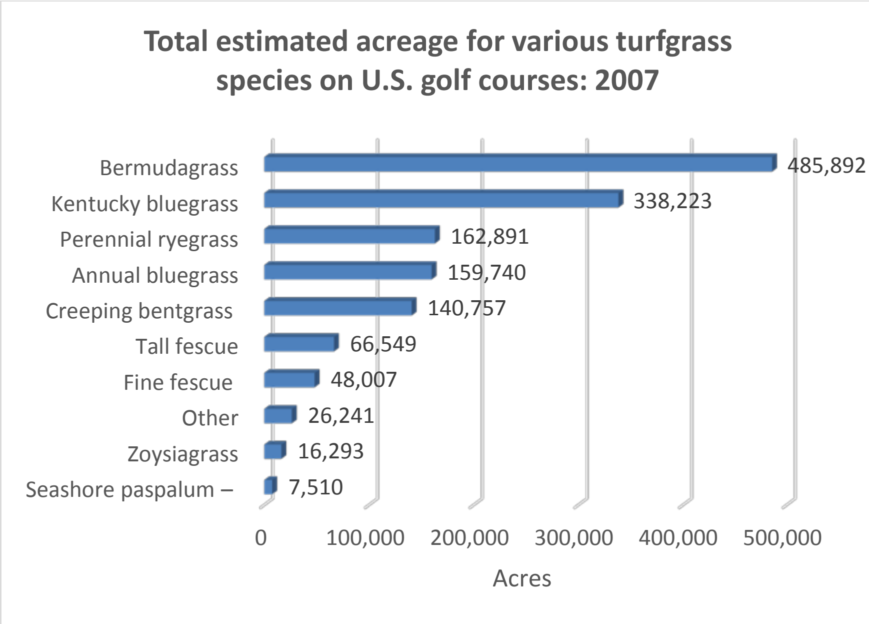


Figure 5. Managed Turf Grass Species on U.S. Golf Courses
Source: (GCSAA, 2007)

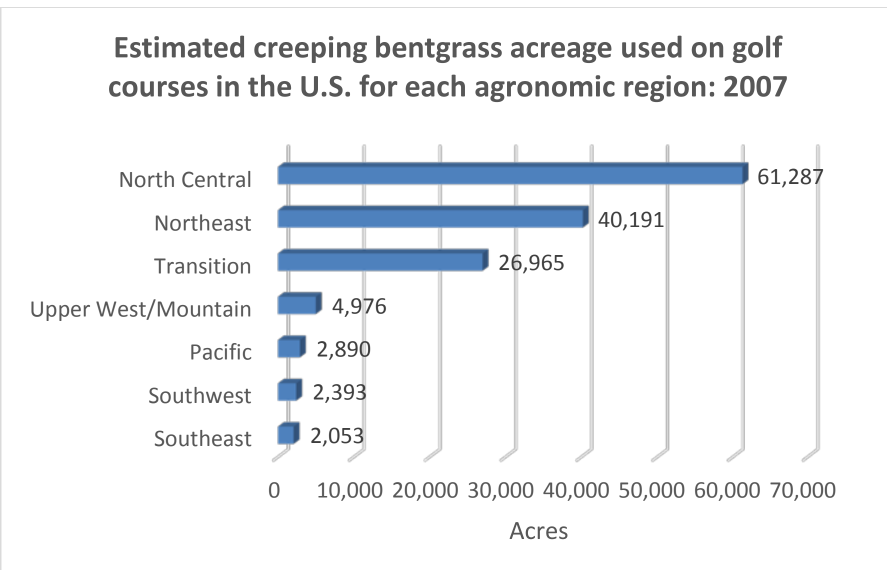


Figure 6. Regional Distribution of Creeping Bentgrass use on U.S. Golf Courses
Source: (GCSAA, 2007)

3.1.2 Acreage and Area of Herbicide-Resistant Creeping Bentgrass

In addition to naturalized populations of various bentgrass species throughout the United States, commercially produced cultivars of creeping bentgrass in Oregon and Idaho, and cultivated varieties of creeping bentgrass on many, if not most, of the golf courses in the United States, there are isolated populations of ASR368 creeping bentgrass in Oregon and Idaho.

Background

The use of plant biotechnologies has led to the production and adoption of several major transgenic crops such as maize, soybean, cotton and canola (Wang and Brummer, 2012). These varieties have been widely adopted, worldwide, to facilitate the management of weeds, pests, and diseases during crop production. As a result of the benefits that have derived from these crops, there has been interest in using biotechnology to introduce desired traits into species such as bentgrass and zoysia.

Turf grasses managed for putting greens are subjected to a considerable amount of both biotic and abiotic stress (Brosnan *et al.*, 2014). Putting green turf is often mowed daily at heights less than 0.15 inch (3.81 millimeters) and subjected to heavy traffic from both golfers and maintenance equipment (Brosnan *et al.*, 2014). Weeds such as Crabgrass (*Digitaria* spp.), goosegrass (*Eleusine indica*), Sedge (*Cyperus* spp.), and kyllinga (*Kyllinga* spp.) can invade putting greens when the turf grass lacks sufficient density and vigor due to wear (Brosnan *et al.*, 2014). Bentgrass species are susceptible to a number of fungal diseases, which include: dollar spot (*Sclerotinia homoeocarpa*), copper spot (*Gleocercospora sorghi*); anthracnose (*Colletotrichum cereale*) and brown patch (*Rhizoctonia solani Kühn*).

Weed control on putting greens can be difficult given the relatively small number of herbicides labeled for use on putting greens by the EPA. Additionally, putting green turf is the most valuable acreage on the golf course, and expensive to repair if injured; whether by foot or machine traffic, or herbicides (Brosnan *et al.*, 2014). Consequently, many companies do not register herbicides for use (with EPA) on greens to avoid being liable for potential chemical injury to turf grass, as well as the fact that putting greens, collectively, comprise an infinitesimally small area of land. Currently, no herbicides are labeled for selective post-emergence control of grass weeds such as crabgrass, goosegrass, or annual bluegrass on creeping bentgrass putting greens (Brosnan *et al.*, 2014). Although the products are not labeled for use on putting greens, some turfgrass managers have successfully reduced annual bluegrass populations with the herbicides Velocity SG (bispyribac-sodium) and Xonerate (amicarbazone) (Brosnan *et al.*, 2014). Additionally, interest exists among golf course managers in the experimental herbicide PoaCure (methiozolin) for controlling annual bluegrass in creeping bentgrass putting greens (Brosnan *et al.*, 2014). Turfgrass managers have also found that sequential applications of plant growth regulators, such as paclobutrazol and flurprimidol, often reduce annual bluegrass populations in creeping bentgrass putting greens and/or control seedhead production (Brosnan *et al.*, 2014). Fungicides, such as propiconazole, triadimefon, and vinclozolin can be used to treat fungal infestations.

Consequently, conventional breeding for improved pest and disease resistance is major goal of many of the turf grass breeding programs in the United States. Breeding programs are also trying to improve bentgrass durability and resistance to wear, drought and salinity tolerance, and overall plant quality under reduced pesticide, fertilizer, and water input (Bonos *et al.*, 2013). In addition to conventional breeding, there has been interest in using biotechnology to introduce these types of desired traits into species such as bentgrass and Zoysia, to include resistance to particular herbicides.

ASR368 creeping bentgrass was developed for resistance to the herbicide glyphosate. Glyphosate-resistant creeping bentgrass was chosen as a commercial target for use on golf courses because the herbicide-resistance trait was expected to enable better weed control, and glyphosate is of relatively low toxicity.[6]

Distribution of Herbicide-Resistant Creeping Bentgrass

From 2002 to 2004, field trials were conducted in Jefferson County, Oregon and Canyon County, Idaho for glyphosate-resistant creeping bentgrass, the subject of this EIS. Due to an unforeseen wind event glyphosate-resistant creeping bentgrass escaped from authorized field trial sites in Jefferson County, OR at a time postharvest of the seed, when the residual materials including seeds and perhaps viable plants, in piles/windrows, were blown outside the field trial confines and established. In Canyon County, ID glyphosate-resistant creeping bentgrass also escaped authorized field trial sites leading to established populations in Canyon County, ID and Malheur County, OR, however, the ultimate factor in the escapes was never confirmed. ASR368 creeping bentgrass is now found growing outside the field sites at both locations (Figure 7). This section describes the current area and acreage of glyphosate-resistant creeping bentgrass. It is part of the baseline affected environment upon which the analysis of the incremental impacts of a determination of nonregulated status is added; APHIS has no jurisdiction over the escaped populations of glyphosate-resistant creeping bentgrass. A decision to grant or not nonregulated status to ASR368 creeping bentgrass will have no effect on the status of these escaped populations, therefore, the environmental impacts will not change as a result of the APHIS decision.

[6] http://www.epa.gov/ingredients-used-pesticide-products/glyphosate; http://archive.epa.gov/pesticides/reregistration/web/pdf/0178fact.pdf

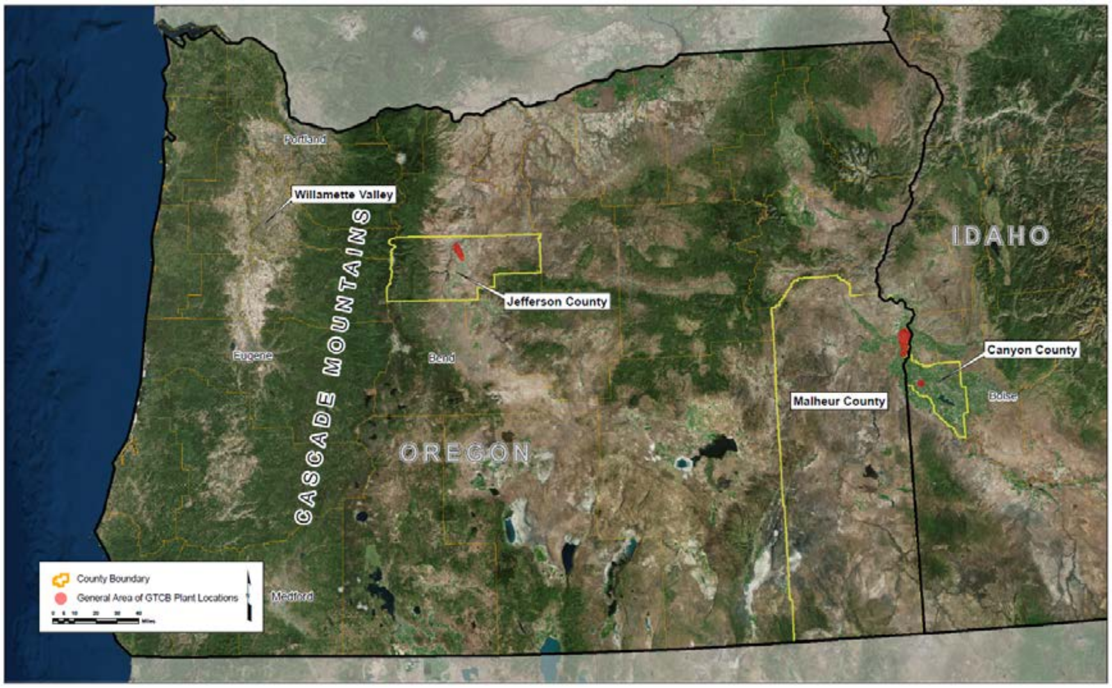


Figure 7. Oregon and Idaho locations where ASR368 creeping bentgrass is known to exist
Source: (Scotts and Monsanto, 2015b)

Area 1: Jefferson County, OR

In 2002, the Oregon Department of Agriculture established a seed production control area in Jefferson County, several miles north of Madras, OR (ODA, 2002; Zapiola and Mallory-Smith, 2012). From 2002 to 2004, field trials for glyphosate-resistant creeping bentgrass were conducted under APHIS authorizations within the 64-square mile (11,569 acre) Jefferson County control area. A total of 421 acres of glyphosate-resistant creeping bentgrass was planted. The trials flowered in June 2003 and were taken out of production in 2004 (Scotts and Monsanto, 2015b).

In mid-August 2003, two wind storms disturbed windrows of harvested glyphosate-resistant creeping bentgrass material causing seed to scatter south and east to locations inside and outside of the Control Area. Following the 2003 wind event, surveys conducted from 2004 to 2006 found glyphosate-resistant creeping bentgrass both inside and outside the authorized control area, at several sites (Figure 8) (Watrud *et al.*, 2004; Mallory-Smith and Zapiola, 2008; Zapiola *et al.*, 2008; Kausch *et al.*, 2010; Scotts and Monsanto, 2015b). In addition to the wind mediated distribution of seed, Watrud *et al.* (2004) found that the herbicide-resistance transgene spread via pollen to sentinel plants located up to 13 miles beyond the control area perimeter. Most of these plants were found within a 1.3 mile area outside and downwind of the control area. For the 124 miles of irrigation canals, ditches, pond banks, roadsides and pipeline sides surveyed in 2006, glyphosate-resistant creeping bentgrass plant abundance was approximately 1.8 plants/mile (Zapiola *et al.*, 2008). Figure 8 illustrates the areas where glyphosate-resistant creeping bentgrass has been found over the past 11 years.

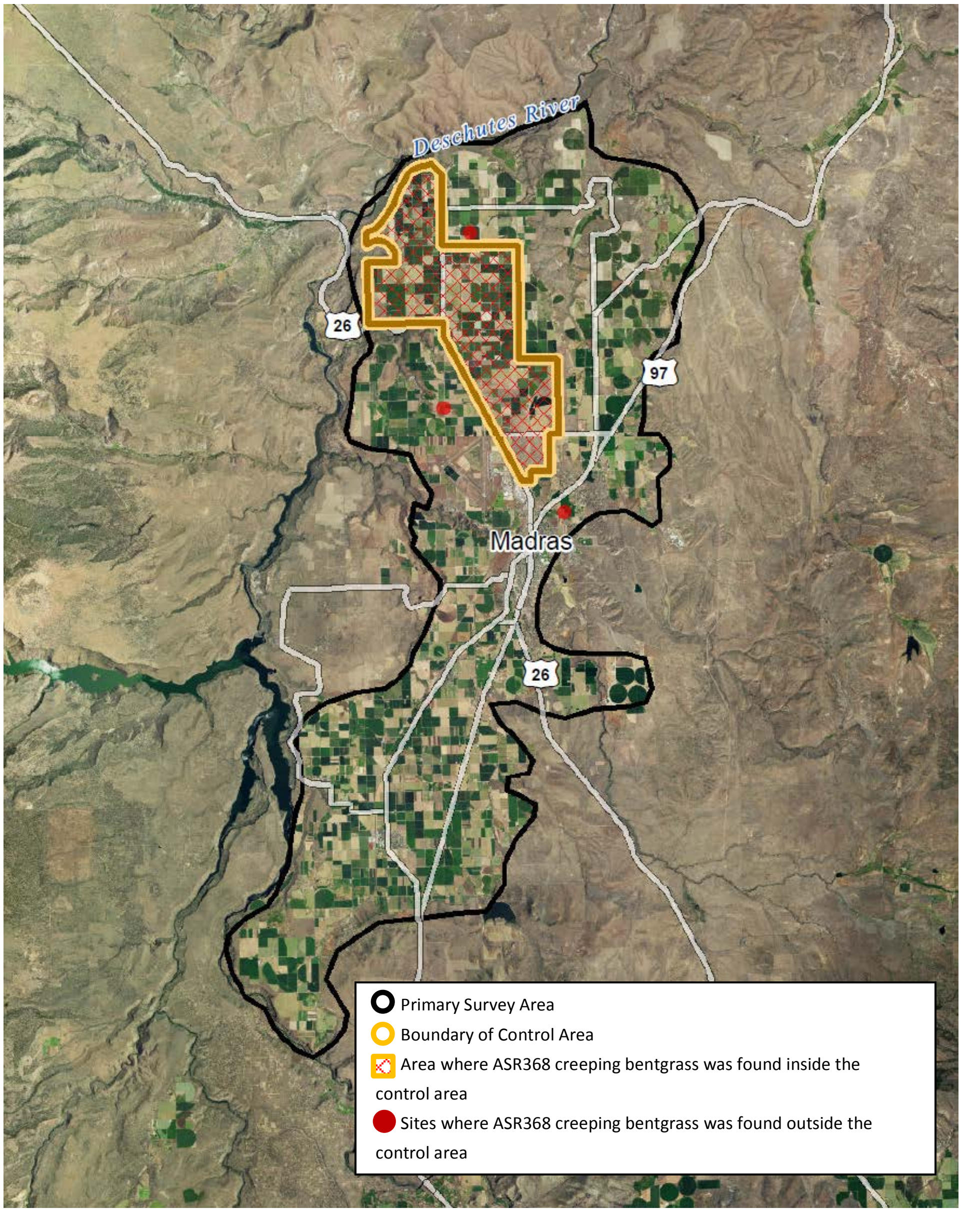


Figure 8. Locations Where ASR368 Creeping Bentgrass has Been Found in Jefferson County, Oregon

The general areas where ASR368 creeping bentgrass has been found in Jefferson County, OR over the past 11 years. ASR368 creeping bentgrass has been found to the north, south and east of the Control Area (red dots).
Source: (Scotts and Monsanto, 2015b)

Area 2: Canyon County, ID

From 2002 to 2004 authorized field tests were also conducted at two sites in Canyon County, ID. The Canyon County North site near Parma, ID consisted of two fields totaling 83 acres that produced seed (Scotts and Monsanto, 2015b). The Canyon County South site near Wilder consisted of one 40-acre field that was destroyed before seed was produced. The test sites in Idaho were discontinued in 2006, and the plants were destroyed. All of the field trial sites were devitalized in 2006 (Scotts and Monsanto, 2015b). Following devitalization, surveys found glyphosate-resistant creeping bentgrass primarily along irrigation and drainage ditches, generally within one mile of the former Canyon County field trial sites (Figure 9) (Scotts and Monsanto, 2015b).

No field trials were conducted in Malheur County, Oregon. However, a 2010 survey found glyphosate-resistant creeping bentgrass volunteers along irrigation and drainage ditches between Nyssa and Ontario, Oregon (Figure 9) (Scotts and Monsanto, 2015b). Malheur County is located in southeastern Oregon, immediately west of Canyon County, Idaho. The two former glyphosate-resistant creeping bentgrass field trial sites located in neighboring Canyon County, Idaho were suspected to be the source of the infestation. Starting in the spring of 2011, a mitigation program was initiated to further control and eradicate the glyphosate-resistant creeping bentgrass plants (Scotts and Monsanto, 2015b).

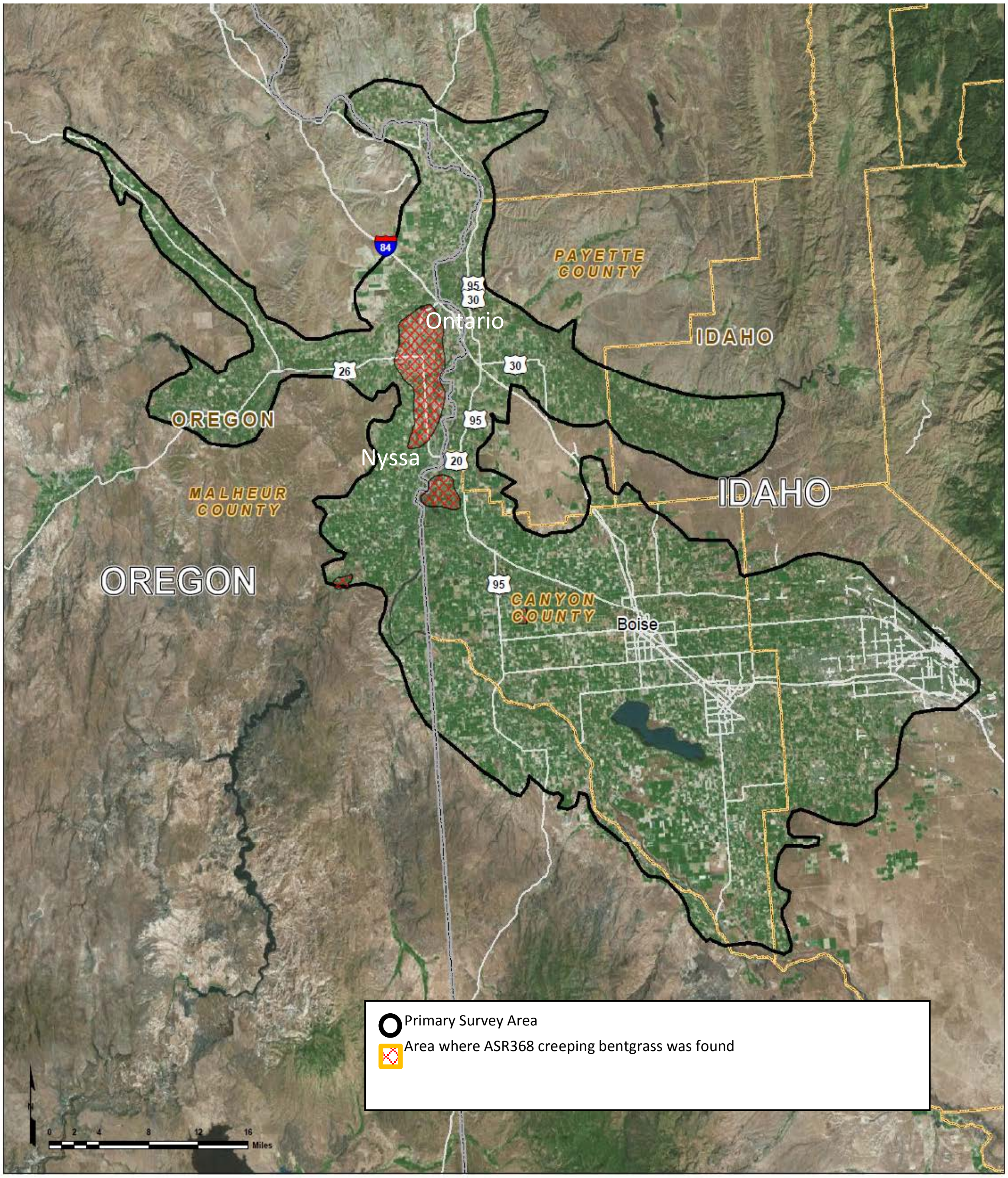


Figure 9. Locations Where ASR368 Creeping Bentgrass has Been Found in Malheur and Canyon Counties

Isolated plants have been found in Malheur and Canyon counties. No field trials were conducted in Malheur County, Oregon. However, in 2010, glyphosate-resistant creeping bentgrass volunteers were found along irrigation and drainage ditches between Nyssa and Ontario, Oregon. Glyphosate-resistant creeping bentgrass plants have also been found in Canyon County, generally within one mile of the former Canyon County field trial sites. Active mitigation efforts have been underway to effectively manage glyphosate-resistant creeping bentgrass.
Source: (Scotts and Monsanto, 2015b)

Surveys have been conducted since 2004 in Jefferson County and Canyon County and since 2010 in Malheur County. Beginning in 2014, the boundaries of the survey areas were extended to include all of the irrigated areas where ASR368 creeping bentgrass may establish. This encompassed 86,263 acres in Jefferson County; 82,182 acres in Malheur County, and 10,743 acres in Canyon County. Surveys have also been conducted along the Deschutes and Snake Rivers, where no ASR368 creeping bentgrass has been found (Scotts and Monsanto, 2015b).

Surveys conducted by Oregon State University and the EPA of areas in and around Madras, Oregon suggest that the primary means of spread of glyphosate-resistant creeping bentgrass outside of test sites was due to seed dispersal associated with the wind event, and to a lesser extent pollen flow (Watrud *et al.*, 2004; Mallory-Smith and Zapiola, 2008; Zapiola *et al.*, 2008; Kausch *et al.*, 2010). Hybridization with other bentgrass species, specifically, *A. capillaris* and *A. gigantea*, has been demonstrated (Watrud *et al.*, 2004; Zapiola *et al.*, 2008). The Oregon State University group also studied the potential hybridization of glyphosate-resistant creeping bentgrass to a related species (rabbitsfoot (*Polypogon monspeliensis*)) (Zapiola and Mallory-Smith, 2012). Out of 123,226 rabbitsfoot grass seedlings evaluated, hybridization between rabbitsfoot grass as the maternal parent and glyphosate-resistant creeping bentgrass as the pollen donor was not observed. However, the study found a single hybrid between glyphosate-resistant creeping bentgrass as the maternal parent and rabbitsfoot as the pollen donor (Zapiola and Mallory-Smith, 2012). After extended surveys and mitigation efforts, that have been conducted since 2004, and are still underway, the eradication of escaped glyphosate-resistant creeping bentgrass has proven elusive (Reichman *et al.*, 2006; Kausch *et al.*, 2010; Zapiola and Mallory-Smith, 2012).

While the efforts to date have not been successful in eradicating ASR368 creeping bentgrass, they have significantly reduced both the number of ASR368 plants and the areas where they may be found. During the spring 2015, of the 86,263 acres Scotts surveyed in Jefferson County 116 plants were found (0.001 plants/acre); 82,182 acres were surveyed in Malheur County and 478 plants were found (0.006 plants/acre); and 10,743 acres were surveyed in Canyon County and 30 plants were found (0.003 plants/acre) (Scotts and Monsanto, 2015b). Scotts has been committed to the control efforts of ASR368 creeping bentgrass and entered a Memorandum of Agreement (MOA) with the USDA that describes their commitment to control regulated feral glyphosate-resistant creeping bentgrass in Jefferson County and Malheur County, Oregon and Canyon County, Idaho over the next ten years (USDA-APHIS, 2015a). Scotts has pledged to continue their commitment if APHIS were to reach a determination that ASR368 creeping bentgrass is no longer a regulated article (USDA-APHIS, 2015a; Scotts, 2016). After deregulation, control efforts will continue as part of normal maintenance of irrigation canals by landowners, with technical support from Scotts (USDA-APHIS, 2015a).

ASR368 creeping bentgrass can be managed using a variety of currently available methods, including mechanical and cultural methods and alternative herbicides (Scotts and Monsanto, 2015a; 2015b). Examples include glufosinate, diuron, imazapyr, fluridone, diquat, endothall, and ACCase inhibitors (clethodim, sethoxydim, fluazifop-p-butyl) (Scotts and Monsanto, 2015a; 2015b). These vary in number and strength depending on the specific situation. Further analysis of the alternative herbicides that can be used in different environments can be found in the accompanying PPRA (USDA-APHIS, 2016b). Plants can also be removed by mechanical methods such as double disking, hand hoeing, and hand pulling (Chastain, 2003; Butler *et al.*, 2005). On ditch banks, mowers, scythes, or string trimmers can reduce stands of emergent plants; searing or burning plants with a propane torch may also be used to slow growth (Patten *et al.*, 2016).

3.1.3 Agronomic Practices: Commercial Production - Tillage, Crop Rotation, and Agronomic Inputs

Grass seed production is an important agricultural market. As described, much of the world's supply of grass seed comes from Oregon. Seed producers, which number around 1,500, harvest around 400,000 acres of grass seed valued at more than $300 million, depending on market demand, which can significantly affect the grass-seed market. In 2008, over 450,000 acres in the Willamette Valley were in grass-seed production. By 2010, the number had declined to 375,665 acres. In the Southern Plains, grass seed production is on a much smaller scale and primarily involves warm-season species such as buffalograss, Old World bluestem, bermudagrass, and crabgrass (Hopkins, 2001).

For 2013 (latest data), the USDA National Agricultural Statistics estimated farmers harvested 4,710 acres of bentgrass (ODA, 2014). Other grasses include 105,690 acres of perennial ryegrass, 127,040 acres of annual ryegrass, and 114,690 acres of turf type tall fescue (ODA, 2014).

Turf Production Practices

Turf is established by sodding, sprigging, or seeding. Once established, the turf must be maintained. More intensively maintained turf, such as golf-course greens, requires the most management input, whereas highway roadsides require minimal maintenance. Maintenance inputs include pest-control products, fertilizer, irrigation water, plant growth regulators, seed, mowing, trimming, aeration, dethatching, etc.

Seed Crop Production Practices

Optimum yields of high-quality turf grass seed require practices somewhat different than row crops. Standard grass seed production involves practices including seedbed preparation; planting methods - seeding depth, row spacing, and type of equipment such as double-disk furrow openers; irrigation; fertilizers; weed control including pesticide use; and post-harvest residue control including residue burning (Hopkins, 2001).

Seed production fields are prepared by removing weeds, volunteer plants from previous crops, and other plants. Field inspections are conducted throughout the production process to ensure that these procedures for seed certification are followed, especially before flowering. Mature seed is harvested with combines outfitted specifically for grass-seed harvesting, or by swathing (mowing and leaving in rows), and then threshing the seed after it has dried in the row. Seed is then taken to an on-site or locally owned processing plant for further cleaning.

Once cleaned, seed is tested for purity, the percentage of presence of other crops and weeds, germination rate, and other information required for marketing. Pursuant to the Federal Seed Act, a label with testing data is attached to the bag or box for sale. This label in itself does not guarantee the variety of seed present, nor imply certification per the Association of Official Seed Certifying Agencies (AOSCA) or Organization for Economic Co-operation and Development (OECD) requirements (AOSCA, 2015; OECD, 2016). If procedures for certification are followed, the seed lot can be certified by the state seed certification agency and can be sold as such. Certified seed is the primary class of quality seed produced and sold in the United States. Not all turf grass seed sold is certified.

<u>Weed Control</u>

As in crop production, pesticides are used to protect turf grasses from weeds, diseases, and insects. For treatment of bentgrass seed crops, herbicides currently registered for application include those in Table 2.

Table 2. Herbicides Registered for Use on Bentgrass Seed Crops

Herbicide	**Rate (lbs/ai/acre)***	**Mode of Action**	**Chemical family**
Grass Weeds			
Dimethenamid-P	0.66 to 0.98	Inhibition of cell division	Chloroacetamide
Ethofumesate	0.75 to 1.5	Inhibition of lipid synthesis	Benzofuran
Metribuzin	0.285 to 0.375	Photosystem II inhibitors	Triazinone
Oxyfluorfen	0.125 to 0.375	Inhibition of protoporphyrinogen oxidase (PPO)	Diphenylether
Pendimethalin	2 to 3	Microtubule assembly inhibition	Dinitroaniline
S-metolachlor	0.95 to 1.27	Inhibition of cell division	Chloroacetamide
Broadleaf Weeds			
Glyphosate	0.75 to 2.25	EPSP synthase inhibitors	Glycine
Bromoxynil:	0.25 to 0.50	PSII inhibitors	Nitriles
Dicamba:	0.25 to 1.0	Synthetic Auxins	Benzoic acids
2,4-D:	0.36 to 0.75	Synthetic Auxins	Phenoxy-acetic-acids

*ai = active ingredient
Source: (Hulting, 2015)

<u>Fertilizers</u>

Nitrogen, phosphorus, potassium and trace elements must be available for rapid establishment and maximum seed production (Hulting, 2015). Hence, fertilizers are commonly used on most seed crops, including for bentgrass seed production.

<u>Irrigation</u>

Irrigation is considered as supplemental to natural precipitation. Timing of rainfall and irrigation, if needed, is critical to seed crop production. Development of the flower of the seed crop, not vegetative growth, is the primary factor determining when and how much water is required. Seed production is influenced by a variety of environmental and management conditions. Irrigation in the fall after seed harvest is critical in maintaining maximum production of cool-season grasses (Majerus, no date). Creeping bentgrass prefers deep, well drained soils and requires late season irrigation for maximum seed production (Edminster, no date).

Harvest

Swathing followed by combining is the most commonly accepted practice for harvesting grass seed. Swathing involves cutting the crop and forming it into rows or "windrows". In most cases, a conventional grain combine is used to harvest either a standing or swathed grass crop (Horton *et al.*, 1990).

Post-harvest Residue Management

Crop residues are managed to minimize pests, stimulate the yield of grasses, remove large volumes of straw and stubble that can interfere with crop management operations, and to recycle nutrients to fields (Hart *et al.*, 2012). Three primary residue management methods are used by Oregon grass seed growers; open-field burning (or thermal management); full straw load; and clean non-thermal.

Open-field burning includes fire-based straw and stubble removal, or propane burning, typically involving burning the full straw load on the field (Hart *et al.*, 2012). In some instances, straw is removed from the field and burned in stacks.

Full straw load management involves no straw removal. The straw is allowed to decompose in the field, which may be facilitated with mowing and/or use of a combine straw chopper. The straw decomposes in place, allowing for nutrient recycling (Hart *et al.*, 2012).

The clean non-thermal method involves a swather cutting the crop, the seed is removed with a combine, and the straw is then raked and baled. The straw removed from grass seed fields is used for animal feed as well as for other products. It also has potential for use as a feedstock for the production of biofuels (Hart *et al.*, 2012).

Field burning has been an effective and economical method of crop residue removal and pest control in grass seed crops for more than 50 years (Hart *et al.*, 2012). However, field burning has proven unsustainable. At its peak, Willamette Valley farmers burned around 250,000 acres of grass seed stubble annually (Hart *et al.*, 2012). In 2009, the Oregon House and Senate considered a bill mandating the phase-out of field burning in nine counties.[7] Field burning was banned except for a limited area in the northeastern area of the Willamette Valley, primarily in Marion County, on highly-erodible lands (Hart *et al.*, 2012). The ban was instituted in large part due to atmospheric pollution. State law currently limits field burning of seed crop residue to 15,000 acres in the northern Willamette Valley. Currently, it is not allowed in western Oregon for perennial ryegrass, annual ryegrass, orchardgrass, or tall fescue seed production. Field burning

[7] Willamette Valley Field Burning Rule Revisions, http://www.deq.state.or.us/aq/burning/willamette.htm

can be used in western Oregon for fine fescue and bentgrass production and in the Columbia Basin, central, and eastern Oregon for Kentucky bluegrass and other species.

Some farmers prefer field burning as part of their crop management system as it facilitates good yields. Oregon's fine fescue grass seed production relies on field burning, or thermal sanitation of crop residue, to stimulate the plants to produce seed and rid fields of disease, weeds, and pests (OSC, 2016b). Farmers who cultivate crops on steep ground also rely on burning to help reduce erosion, though other methods may be available. Farmers also prefer field burning to help maintain the purity of seed lots (OSC, 2016b), which is important to seed certification and trade in Pacific Rim markets, including China and Japan.

3.2 Physical Environment

3.2.1 Soil Quality

Soil consists of solids (minerals and organic matter), liquids, and gases. This body of inorganic and organic matter is home to a wide variety of fungi, bacteria, and arthropods, as well as the growth medium for terrestrial plant life (USDA-NRCS, 2004). Soil is characterized by its layers that can be distinguished from the initial parent material due to additions, losses, transfers, and transformations of energy and matter (USDA-NRCS, 1999). It is further distinguished by its ability to support rooted plants in a natural environment. Soil plays a key role in determining the capacity of a site for biomass vigor and production in terms of physical support, air, water, temperature moderation, protection from toxins, and nutrient availability. Soils also determine a site's susceptibility to erosion by wind and water, and a site's flood attenuation capacity. Soil health may be monitored as an indicator of overall environmental health. Natural conditions and anthropogenic actions, such as soil preparation, planting, cultivating and irrigation, continuously affect and determine soil health, which in turn can alter the global environment (Lal, 2008).

Soil properties including temperature, pH, soluble salts, the amount of organic matter, the carbon nitrogen ratio, the numbers of microorganisms, and soil fauna all vary seasonally, as well as over extended periods of time (USDA-NRCS, 1999). Soil texture and organic matter levels directly influence its shear strength, nutrient holding capacity, and permeability. Soil taxonomy was established to classify soils according to the relationship between soils and the factors responsible for their character (USDA-NRCS, 1999). Soils are organized into four levels of classification, the highest being the soil order. Soils are differentiated based on characteristics such as particle size, texture, and color, and classified taxonomically into soil orders based on observable properties such as organic matter content and degree of soil profile development (USDA-NRCS, 2010). The Natural Resources Conservation Service (NRCS) maintains soil maps on a county level for the entire United States and its territories (Palm *et al.*, 2007; USDA-NRCS, 2010).

Creeping bentgrass prefers a slightly acidic soil pH between 5.5 and 6.5 (Scotts and Monsanto, 2015a). Creeping bentgrass grows best in moist to semi-wet soils, but can also tolerate poorly drained conditions, submergence, and frequent flooding (Esser, 1994). While creeping bentgrass grows best on loam, clay-loam, and sandy soils, it can also be found growing on gravelly and rocky substrates (Esser, 1994). Creeping bentgrass readily colonizes areas disturbed by logging, plowing, burning, or excessive grazing (Esser, 1994). Creeping bentgrass can be used for erosion control and occasionally used to stabilize stream banks, ditch banks, and irrigation canals due to its typically dense network of intertwining roots and rhizomes (Esser, 1994; MacBryde, 2006).

The cultivation of creeping bentgrass can impact the qualitative and quantitative attributes of soil. In particular soil quality can be affected by agronomic inputs and turf management practices. When cultivated for use on golf courses or for seed production creeping bentgrass requires nutrient inputs. Mature fairway plantings require between 80 and 160 pounds of nitrogen per acre per season and greens are generally fertilized at 1.5 times the fairway recommendation (Scotts and Monsanto, 2015a). Newly established stands are fertilized more intensively and frequently than mature stands to hasten root growth, plant development and to establish a tight closed plant stand (Scotts and Monsanto, 2015a). Creeping bentgrass has the potential to accumulate excess organic matter in the upper soil profile, potentially having a negative effect on the long term performance of the putting green. Core aeration is a traditional agronomic practice conducted twice per year by golf course managers in order to relieve surface compaction of organic matter (Bigelow and Tudor, 2012). Additionally, sand topdressing is applied to offset and dilute surface organic matter and promote firm, smooth surfaces that allow for low cutting heights (Bigelow and Tudor, 2012).

3.2.2 Water Resources

The principal law governing the nation’s water resources is the Federal Water Pollution Control Act of 1972, better known as the Clean Water Act. The Clean Water Act establishes water quality standards, permitting requirements, and monitoring to protect water quality. The EPA sets the standards for water pollution abatement for all waters of the United States under the programs contained in the Clean Water Act, but, in most cases, gives qualified states the authority to issue and enforce permits. Drinking water is protected under the Safe Drinking Water Act of 1974 (Public Law 93-523, 42 U.S.C. 300 *et seq*.) (US-EPA, 2012).

Surface water in rivers, streams, creeks, lakes, and reservoirs support everyday life through the provision of water for drinking and other public uses, irrigation, and industry (USGS, 2011). In 2005, about 77 percent of the freshwater used in the United States came from surface water sources, whereas the other 23 percent originated from groundwater (USGS, 2011). Groundwater is water that flows underground and is stored in natural geologic formations called aquifers (USGS, 2011). In the United States, approximately 47 percent of the population depends on groundwater for its drinking water supply (NGWA, 2010). Currently, the largest use of groundwater in the United States is irrigation, representing approximately 67 percent of all the groundwater pumped each day (McCray, 2012).

Creeping bentgrass cultivation may directly affect water resources through the use of local water sources or indirectly through associated management practices, including: mowing, core aeration sand topdressing, cultivation, and the use of agricultural inputs. Creeping bentgrass can be used to stabilize stream banks, ditch banks, and irrigation canals due to its dense network of roots and rhizomes (Esser, 1994; MacBryde, 2006). In summer months, environmental stressors from high temperatures make frequent irrigation necessary for creeping bentgrass to meet its moisture requirements (Strunk, 2006; Bigelow and Tudor, 2012).

Non-point source (NPS) pollution is the leading source of impacts on surveyed rivers and lakes and the second largest source of impairment to wetlands, as well as a major source of impairment to groundwater and estuaries (US-EPA, 2005). NPS pollutants generally include agricultural pollutants released by soil erosion including sediments, fertilizers, and pesticides (US-EPA, 2005). Management practices that contribute to NPS pollution include the type of crop cultivated; plowing and tillage; and the application of pesticides, herbicides, and fertilizers. The primary source of NPS pollution is increased sedimentation following soil erosion by surface runoff. Increases in sediment loads to surface waters can directly affect fish, aquatic invertebrates, and other wildlife maintenance and survival. It also reduces the amount of light penetration in water, which directly affects aquatic plants. Indirectly, soil erosion can increase fertilizer runoff, facilitating higher water turbidity, algal blooms, and oxygen depletion (US-EPA, 2005).

Pesticides associated with the turfgrass industry have been detected in stormwater runoff and surface waters of urban watersheds. In the EPA's Pesticide Industry Usage and Sales report, in 2006-2007 an estimated 1/5 of the pesticides used in the United States are from nonagricultural pest control, including applications on golf courses, in lawns and gardens, for protection of structures, control of roadsides and right of ways, and to repel and control nuisance and disease-carrying pests for humans and animals (US-EPA, 2011b). Highly managed systems, such as golf course turf, often require multiple applications of pesticides at rates that exceed those typically found in agricultural or home environments (Gianessi and Marcelli, 2000; Rice et al., 2012), but still within the label restrictions set by the EPA. Water quality impacts on surface and groundwater associated pesticide use on golf courses are infrequently observed (Cohen *et al.*, 1999; Baris *et al.*, 2010). Herbicides are used mostly on fairways and roughs, fungicides are applied more intensively to greens and tees, and insecticides are often used throughout the course (Baris *et al.*, 2010). Management practices on golf courses, especially those that enhance infiltration rates, can reduce runoff volume, the amounts of pesticides found in runoff, and minimize environmental contamination (Kohler *et al.*, 2004; Rice *et al.*, 2010; Rice *et al.*, 2011; 2012). Turfgrass itself acts as a living filter that is often used as part of phytoremediation and as a best management practice to treat stormwater runoff. This filtration efficacy is likely due partly to its extensive shoot and root density (Baris *et al.*, 2010). On many golf courses storm water and irrigation runoff is captured, filtered, and re-used to reduce irrigation costs and to minimize environmental contamination (Schwecke *et al.*, 2007).

3.2.3 Air Quality

The Clean Air Act (CAA) requires the maintenance of National Ambient Air Quality Standards (NAAQS). The NAAQS, developed by the EPA to protect public health, establishes limits for six criteria pollutants: ozone, nitrogen dioxide, carbon monoxide (CO), sulfur dioxide, lead, and Particulate Matter (US-EPA, 2014b). The CAA requires states to achieve and maintain the NAAQS within their borders. Each state may adopt requirements stricter than those of the national standard and each is required by the EPA to develop a State Implementation Plan that contains strategies to achieve and maintain the national standard of air quality within the state. Areas that violate air quality standards are designated as non-attainment areas for the relevant pollutants, whereas areas that comply with air quality standards are designated as attainment areas (US-EPA, 2014a).

Management practices carried out on golf courses and seed production fields can affect air quality by releasing particulates, gases, and other chemicals into the air. These management practices may include vehicle exhaust associated with mowing and harvesting, field burning, pesticide drift and volatiles from spraying, and emissions from the use of nitrogen fertilizer (Aneja *et al.*, 2009; US-EPA, 2015c). While still within label requirements set by the EPA, golf courses often require multiple applications of pesticides at rates beyond the average agricultural or home environment (Rice *et al.*, 2012). Pesticide spraying may impact air quality through both drift and diffusion. Drift is defined by EPA as "the movement of pesticide through air at the time of application or soon thereafter, to any site other than that intended for application" (US-EPA, 2015b). Pesticides may volatilize after application to soil or plant surfaces and move following wind erosion (Vogel *et al.*, 2008). Proper fertilization is vital in protecting creeping bentgrass health from environmental and pest stresses. In combination with other nutrients to maintain the vigor of creeping bentgrass, nitrogen is the main nutrient that promotes greening and growth (Bigelow and Tudor, 2012).

3.2.4 Climate Change

Climate change represents a statistical change in global climate conditions, including shifts in the frequency of extreme weather (Rosenzweig *et al.*, 2001). The EPA has identified carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) as the key greenhouse gases (GHG) contributing to climate change. Greenhouse gases, including CO_2, CH_4, and N_2O, function as retainers of solar radiation (Aneja *et al.*, 2009). While each of these gases occurs naturally in the atmosphere, human activity has significantly increased the concentrations of these gases since the beginning of the industrial revolution. Since the beginning of the industrial age, there has been a 36 percent increase in the concentration of CO_2, a 148 percent increase in CH_4, and a 18 percent increase in N_2O (US-EPA, 2011a).

Although agriculture may influence climate change, climate change, in turn, may also affect agriculture (CCSP, 2008). These potential impacts on the agro-environment and individual crops may be direct, including changing patterns in precipitation, temperature, and duration of growing season, or may cause indirect impacts influencing weed and pest pressure (Rosenzweig *et al.*, 2001; Schmidhuber and Tubiello, 2007). According to a study by Burgess and Huang (Burgess and Huang, 2014), increased CO_2 levels lead to increased growth potential in creeping bentgrass plants. Creeping bentgrass plants grown under elevated CO_2 conditions displayed changes in growth rate, leaf and root morphology, and water use that are favorable for turfgrass growth and highly desirable for turfgrass management. The increased CO_2 levels stimulated growth of smaller and thicker leaves, increased root growth, and improved water use efficiency which could potentially lead to changes to irrigation management of turfgrasses (Burgess and Huang, 2014).

3.3 Biological Resources

Biological resources include animal, plant, and microbial organisms, and the ecological communities these species form as they interact with the physical environment. Habitats where they may encounter creeping bentgrass grass include golf courses and certain kinds of farm sites, such as irrigated pastures and those for seed and turf production, as well as areas where creeping bentgrass has naturalized, and other habitats as discussed in Section 3.3.2 below. Individual species and the biological communities they form in or near golf courses are emphasized here because this is where most creeping bentgrass is grown in the United States (MacBryde, 2006).

This section provides a summary of the biological environment and includes an overview of animals, plants, gene transfer, weeds and weediness, microorganisms, and biodiversity. This summary provides the foundation to assess the potential impact to plant and animal communities and the potential for gene movement.

3.3.1 Animal Communities

Animal communities include wildlife species and their habitats. Wildlife refers to both native and introduced species of mammals, birds, amphibians, reptiles, invertebrates, fish and shellfish. Animals that might be exposed to creeping bentgrass would be individuals of species that typically inhabit seed fields or golf courses, inhabit areas where creeping bentgrass has naturalized, or feed on creeping bentgrass. Animal species may also be exposed to pesticide and fertilizer application and runoff (e.g., soil microbes, amphibians, and aquatic organisms) that result from creeping bentgrass production and management. Wildlife abundance and composition in creeping bentgrass seed fields and on golf courses depends on geographic location.

While creeping bentgrass is not highly productive, and is less palatable to animals after flowering, it stays green throughout summer, and is considered good forage crop for wildlife. Furthermore, it provides cover for small mammals and some birds. Many species of insects can be found in creeping bentgrass seed fields and on golf courses, which are preyed upon by several species of birds (e.g., songbirds, swallows, waterfowl, game species [ring-necked pheasants, quail, and wild turkey], and migratory species) and bats (Order *Chiroptera*). Species that feed directly on creeping bentgrass include, among others, small nongame birds, upland game birds, waterfowl (including American widgeon (*Anas americana*), mallard duck, (*A. platyrhynchos*), and Canada goose (*Branta canadensis*), rabbits (Family *Leporidae*), deer mice (*Peromyscus maniculatus*), pocket gophers (*Thomomys* spp.), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), and elk (*Cervus canadensis*) (Esser, 1994; IPF, 2000; Merola-Zwartjes and DeLong, 2005; MacBryde, 2006; USFWS, 2016a). Many raptors may seek prey on or near golf courses and have a range that includes all or most of the United States, two of the most widespread species are the red-tailed hawk (*Buteo jamaicensis*) and peregrine falcon (*Falco peregrinus*) (IPF, 2000; Merola-Zwartjes and DeLong, 2005; USFWS, 2016a).

Creeping bentgrass is rated good in nutritional value for elk and mule deer, poor for pronghorn, and fair for white-tailed deer, small mammals, small nongame birds, upland game birds, and waterfowl (Esser, 1994). Cover value of creeping bentgrass is rated good for upland game birds and waterfowl and fair for small mammals and small nongame birds (Esser, 1994).

Some vertebrate species can cause damage to turfgrass by feeding on plants and roots, foraging for insects, and by tunneling. Armadillos, opossums, raccoons, skunks, foxes, wild pigs are known to damage turf by digging in search of webworms, cutworms, white grubs, earthworms or other insect prey. Several species of birds including starlings, grackles, red-winged blackbirds, and crows can leave holes in the turf or even rip up patches of turf when searching for insects. Waterfowl species, especially Canada geese, can cause significant damage to turf from over grazing and defecation (Gosser *et al.*, 1997). Goose populations have increased in the Willamette Valley, leading to significant damage to grass seed crops. A 2010 report by USDA APHIS estimated that 300,000 migratory geese winter in the lower Columbia/Willamette Valley each year. The report estimated that damage to Oregon's grass seed industry is about $9.4 million per year (ODA, 2016). Other pests, such as moles, and pocket gophers damage turfgrasses by burrowing and pushing up ridges and mounds of soil as they burrow (Potter, 1998).

Numerous insects and related arthropods may perform valuable functions: they pollinate plants, contribute to the decay and processing of organic matter, reduce weed populations, and cycle soil nutrients. Arthropods may also feed upon insects and mites that are considered to be pests (van der Geest, 2010) . Some of these beneficial predatory species include the convergent lady beetle (*Hippodamia convergens*), carabid beetles (Family Carabidae), parasitoids, and the predatory mite (*Phytoseiulus persimilis*).

Insect species that may occur in habitats that support creeping bentgrass have been reviewed by (Vittum *et al.*, 1999). Destructive insect pests found in habitats that support bentgrass, including those that attack bentgrass, have been reviewed by (Potter, 1998). The most common insects that feed on creeping bentgrass are generalist feeders that attack a wide spectrum of turf grasses. These pests include sod webworms (*Crambus* spp. and other species in the family Pyralidae), armyworms (*Spodoptera* spp.), cut worms (Family: Noctuidae), billbugs (*Sphenophorus* spp.), mole crickets (*Scapteriscus* spp.*)*, many thrips species (Order: Thysanoptera), and white grubs (*Ataenius spretulus*, *Popillia japonica*, *Cyclocephala* spp., *Phyllophaga* spp.) (Georgis *et al.*, 2006; Duble; University of Illinois, 2016). Many of these turf pests are controlled by parasitic nematodes occurring naturally in the soil or by augmentation of their populations using nematode-based biopesticides as an alternative to chemical insecticide applications, but despite progress with these non-chemical approaches, these nematode-based products have limited market share (Georgis *et al.*, 2006). However, plant parasitic nematodes represent one important cause of turf grass diseases (Crow, 2005).

As noted is Section 3.1.2 Acreage and Area of Herbicide Resistant Creeping Bentgrass, isolated populations of ASR368 creeping bentgrass have been found along irrigation and drainage ditches in Jefferson and Malheur Counties in Oregon, and Canyon County in Idaho. The animals most likely to be found in the irrigated agricultural areas where ASR368 creeping bentgrass currently exists would be the same as those listed above as feeding on and causing damage to turfgrass. The most common include gophers, squirrels, other rodents, and chipmunks. Birds that are associated with the sagebrush communities include bald eagle (*Haliaeetus leucocephalus*), Brewer’s sparrow (*Spizella breweri*), calliope hummingbird (*Selasphorus calliope*), Cassin’s finch (*Haemorhous cassinii*), eared grebe (*Podiceps nigricollis*), ferruginous hawk (*Buteo regalis*), flammulated owl (*Psiloscops flammeolus*), fox sparrow (*Passerella iliaca*), greater sage-grouse (*Centrocercus urophasianus*), green-tailed towhee (*Pipilo chlorurus*), Lewis’s woodpecker (*Melanerpes lewis*), loggerhead shrike (*Lanius ludovicianus*), long-billed curlew (*Numenius americanus*), olive-sided flycatcher (*Contopus cooperi*), peregrine falcon (*Falco peregrinus*), pinyon jay (*Gymnorhinus cyanocephalus*), rufous hummingbird (*Selasphorus* *rufus*), sage thrasher (*Oreoscoptes montanus*), short-eared owl (*Asio flammeus*), Swainson's hawk (*Buteo swainsoni*), white headed woodpecker (Picoides albolarvatus), Williamson's sapsucker (*Sphyrapicus thyroideus*) and willow flycatcher (*Empidonax traillii*).

3.3.2 Plant Communities

As noted in Section 3.1 – Distribution of Creeping Bentgrass in the United States, creeping bentgrass can be found in naturalized populations in all 50 states. CBG is generally found in moist, often disturbed areas with low environmental stress, including moist meadows, pastures, hayfields, and forest edges, coastal scrub and beaches, the banks and edges of lakes, ponds, marshes, rivers, streams, creeks, canals and ditches, in home lawns and recreation areas, and along roadsides, railroad rights-of-way and in waste lands (Widen, 1971; Hunt *et al.*, 1987; Kik *et al.*, 1990; Edgar and Forde, 1991; Banks *et al.*, 2005; Harvey, 2007; Ahrens *et al.*, 2011a; Bollman *et al.*, 2012).

Commercially produced creeping bentgrass occurs predominantly on golf courses in the United States, as such, it can be found in a wide range of ecosystems and climatic zones. The types of vegetation, including the variety of weeds within and adjacent to golf courses and creeping bentgrass seed production fields vary according to geographic region. Landscapes surrounding these areas are also highly variable and range from urban to rural, and may include cultivated fields, fence rows and hedge rows, meadows, fallow fields, grasslands, woodlands, riparian habitats and other uncultivated areas. The adjacent plant communities may be natural or managed for agricultural production, forests or wildlife.

Plant associations with creeping bentgrass include within-field and outside-of-field communities. Within-field communities include creeping bentgrass as well as other turfgrasses on golf courses and any weeds that may be found on golf courses and those found in seed production fields. Out-of-field communities include plants in the surrounding landscape, including wetland and riparian areas, roadsides, meadows, wasteland, and edge forest and include native or naturalized species (Ahrens *et al.*, 2011b; Bollman *et al.*, 2012). Some of the out-of-field plant communities can serve as sources of weeds.

The ecological community dynamics for predicting where creeping bentgrass can establish and survive in the United States are complex. The most important factors influencing where feral populations can establish are related to human disturbances (e.g., logging, cattle grazing, controlled burning, crop production practices such as tillage and the application chemical fertilizers and pesticides) (Esser, 1994). The limiting factor for survival of creeping bentgrass in any landscape is moisture, being most commonly found in moist areas such as recently exposed sand and gravel bars, wet meadows, along streams, in ditches, along roadsides, and in pastures and hayfields (Esser, 1994; Ahrens *et al.*, 2011a; Scotts and Monsanto, 2015b).

As noted in Section 3.1.2 Acreage and Area of Herbicide Resistant Creeping Bentgrass, isolated populations of ASR368 creeping bentgrass have been found along irrigation and drainage ditches in Jefferson and Malheur Counties in Oregon, and Canyon County in Idaho. These areas are considered high desert region and consist largely of sagebrush grasslands and western juniper woodlands. Although generally semi-arid, sagebrush habitats may be traversed by natural water channels (e.g., streams, creeks or rivers) or man-made irrigation channels that create riparian areas capable of supporting grass species, such as creeping bentgrass, that require more moisture than those adapted to the prevailing semi-arid environment. The sagebrush grasslands have an over story of sagebrush and other shrubs such as bitterbrush and rabbit brush, and an understory of perennial bunch grasses (e.g., Idaho fescue, bluebunch wheatgrass), and forbs (Scotts and Monsanto, 2015b). Western juniper is a long-lived conifer that can survive with as little as eight inches of annual rainfall. Young juniper can occur intermixed with sagebrush and other shrubs and grasses. However, as a stand matures, the juniper outcompetes other vegetation for the limited water available resulting in a loss of understory vegetation (ODSL, 2011; Scotts and Monsanto, 2015b).

<u>Weeds</u>

Weeds are plants growing in areas where their presence is undesired by humans (Baucom and Holt, 2009). Typical traits include early germination and rapid growth from seedling to sexual maturity. Most weeds also have the ability to reproduce both sexually and asexually. Many weeds are plants that frequently colonize disturbed environments, so have evolved characteristics or mechanisms that allow them to survive and rapidly adapt to conditions in a variety of shifting unstable environments.

Weeds are classified as annuals or perennials. An annual is a plant that completes its lifecycle in one year or less and reproduces only by seed. Perennials are plants that live for more than two years. Weeds are also classified as broadleaf (dicots) or grass (monocots). Weeds can reproduce by seeds, rhizomes (underground creeping stems), or other vegetative parts (e.g., above ground runners).

Weeds can compromise both aesthetic and functional turf quality on golf courses and can reduce yields in seed production by competing for light, nutrients, and moisture (Alderman *et al.*, 2012; Brosnan *et al.*, 2014). In addition, weeds can introduce weed seed or plant material into the harvested seed crop. Weeds can also harbor insects and diseases, and can interfere with equipment used to manage crops and ornamental plants (Loux *et al.*, 2012).

The most common weeds of creeping bentgrass putting greens include: Crabgrass (*Digitaria* species), goosegrass (*Eleusine indica*), annual bluegrass (*Poa annua*), Sedge (*Cyperus* species), kyllinga (*Kyllinga* species), white clover (*Trifolium repens*), mouse-ear chickweed (*Cerastium vulgatum*), dandelion (*Taraxacum officinale*), cudweed (*Gnaphalium* or *Gamochaeta* species) and prostrate spurge (*Euphorbia humistrata*) (Brosnan *et al.*, 2014). The most common weeds in creeping bentgrass seed fields include: shepherd's purse (*Capsella bursapastoris* (L.) Medik.), willowherb (*Epilobium* spp.), and annual bluegrass *(Poa annua*) (Alderman *et al.*, 2012).

Where ASR368 creeping bentgrass is currently found common broad leaf weeds that may be found in the agricultural areas include: prickly lettuce (*Lactuca serriola*), common groundsel (*Senecio vulgaris*), kochia (*kochia scoparia*), annual sowthistle (*Sonchus oleraceus*), black nightshade (*Solanum nigrum*), Canada thistle (*Cirsium arvense*), catchweed bedstraw (*Galium aparine*), common chickweed (*Stellaria media*), common salsify (*Tragopogon porrifolius*), field bindweed (*Convolvulus arvensis*), flixweed (*Descurainia sophia*), hairy nightshade (*Solanum* *sarrachoides*), horseweed (*Conyza canadensis*), lambsquarters (*Chenopodium album*), little bittercress (*Cardamine oligosperma*), pineappleweed (*Matricaria matricarioides*), powell amaranth (*Amaranthus powellii*), prostrate knotweed (*Polygonum arenastrum*), puncturevine (*Tribulus terrestris*), red sorrel (*Rumex acetosella*), redroot pigweed (*Amaranthus retroflexus*), redstem filaree (*Erodium cicutarium*), Russian thistle (*Salsola iberica*), shephard's purse (*Capsella bursapastoris*), tumble mustard (*Sisymbrium altissimum*), and yellow nutsedge (*Cyperus esculentus*) (Scotts and Monsanto, 2015b; ODA, No Date). Common grass weeds include: rattail fescue (*Vulpia myuros*), green foxtail (*Setaria viridis*), Italian ryegrass (*Lolium multiflorum*), annual bluegrass (*Poa annua*), barnyardgrass (*Echinochloa crus-galli*), downy brome (*Bromus teetorum*), quackgrass (*Elymus repens*), and witchgrass (*Panicum capillare*) (Scotts and Monsanto, 2015b; ODA, No Date).

Weed control is an important aspect of golf course maintenance. Weed control typically involves an integrated approach that includes mowing, timely applications of herbicide, mechanical removal, and weed surveillance and monitoring (Brosnan *et al.*, 2014; Hulting, 2015). Weed control in established perennial grass seed fields depends on effective management of crop residues (Hulting, 2015). Removing crop residues either through burning or bailing hay prior to the application of herbicides helps reduce the potential weed populations prior to planting (Hulting, 2015). The most common source of weeds in seed fields is from weed populations currently growing in individual fields (i.e., the soil seed bank), but can also include sources from outside the production fields, including windborne seed or introduction of contaminants during transport, storage, or conditioning of seed lots (Alderman *et al.*, 2012).

3.3.3 Gene Flow and Weediness

Gene flow is a biological process that facilitates the production of hybrid plants, introgression of novel alleles, and evolution of new plant genotypes. Gene flow to and from an agro-ecosystem can occur on both spatial and temporal scales. In general, plant pollen tends to represent the major reproductive method for moving across areas, while both seed and vegetative propagation tend to promote the movement of genes across time and space.

The rate and success of gene flow is dependent on numerous factors. General factors related to pollen-mediated gene flow include the presence, abundance, and distance of sexually-compatible plant species; overlap of flowering phenology between populations; the method of pollination; the biology and amount of pollen produced; and weather conditions, including temperature, wind, and humidity (Zapiola *et al.*, 2008). Seed-mediated gene flow also depends on many factors, including the absence, presence, and magnitude of seed dormancy; contribution and participation in various dispersal pathways; and environmental conditions and events (Zapiola *et al.*, 2008).

Creeping bentgrass, like other grass species, is wind-pollinated. Creeping bentgrass pollen has been shown to remain viable for 1.5 to 2.5 hours (Fei and Nelson). Hybridization has been shown to occur between creeping bentgrass and other bentgrass species such as redtop bentgrass (*Agrostis gigantea*), colonial bentgrass (*Agrostis capillaris*), and velvet bentgrass (*Agrostis canina*). It has also been shown to hybridize with some species of another genus, such as rabbitsfoot grass (*Polypogon monspeliensis*) (MacBryde, 2006). The hybrids are for the most part sterile or with very low fertility, but can reproduce vegetatively and be vegetatively vigorous, allowing them to persist in the environment even if they are sterile (Bradshaw, 1958; MacBryde, 2006; Zhao *et al.*, 2007).

The possibility of long-distance, pollen-mediated transgene flow has also been confirmed for glyphosate-resistant creeping bentgrass fields in Oregon. Watrud *et al.* (2004) detected wind-dispersed creeping bentgrass pollen carrying glyphosate-resistance transgenes in florets of naturalized creeping bentgrass and a related bentgrass species (*A. gigantea*) 14 km from the source population, and in sentinel plants placed 21 km from the source. More recently, intergeneric gene flow has been documented between glyphosate-resistant creeping bentgrass and rabbitfoot grass (*Polypogon monospeliensis*) (Zapiola and Mallory-Smith, 2012). The hybrid was a perennial, unlike rabbitfoot grass which is an annual, and produced stolons. These traits can increase the likelihood of the spread of transgenes (Zapiola and Mallory-Smith, 2012).

Dispersal of creeping bentgrass can also occur through the spread of seeds, roots, and stolons. Creeping bentgrass spreads vegetatively by stolons, forming new plants where stolon fragments are deposited (Banks et al., 2005). Stolons can be transported by water, vehicles, and shoes to new areas of establishment (Banks *et al.*, 2005; MacBryde, 2006; Zapiola and Mallory-Smith, 2010). Creeping bentgrass also produces numerous tiny seeds that are easily dispersed by the wind, water (Wolters *et al.*, 2005; Zapiola and Mallory-Smith, 2010), and sometimes by cattle, sheep, deer, and waterfowl (Welch, 1985; Gill and Beardall, 2001; Myers *et al.*, 2004; Chang *et al.*, 2005; MacBryde, 2006). Creeping bentgrass plants can establish outside of cultivation, contributing to gene flow, especially close to water sources such as creeks, rivers, and irrigation canals (Zapiola and Mallory-Smith, 2010). Seeds of creeping bentgrass can germinate soon after dispersal or can remain dormant in seedbanks for up to at least four years (MacBryde, 2006; Zapiola and Mallory-Smith, 2010).

<u>Weediness of Creeping Bentgrass</u>

Although creeping bentgrass is grown extensively as a turf crop for golf courses, and to a lesser extent as a forage crop for livestock and for hay, it also has some weedy characteristics (MacBryde, 2006). These characteristic include its ability to successfully colonize and proliferate in disturbed areas, its prolific seed production, its ability to disperse both short and long distances, and its ability to reproduce both sexually by seed and vegetatively by creeping stolons (MacBryde, 2006). The primary agriculture-related impacts of creeping bentgrass are likely to occur in grass seed crops, with some marginal impacts in fruit and nut orchards (USDA-APHIS-PPQ, 2014). While creeping bentgrass has some weedy characteristics, because it is relatively non-aggressive, it is rarely considered a problem that warrants management and so is generally not managed as a weed (Banks *et al.*, 2005). APHIS previously assessed the weed risk potentials of herbicide resistant and non-herbicide resistant types of creeping bentgrass, using PPQ's weed risk assessment guidelines, as a result of a petition requesting that the Agency list herbicide-resistant creeping bentgrass in its Federal noxious weed regulations. The results of the assessment found the two types of creeping bentgrass to be the same in terms of weed risk potential (USDA-APHIS-PPQ, 2014). As a result, APHIS did not add glyphosate-resistant creeping bentgrass to the federal list of noxious weeds. Creeping bentgrass is not listed in the United States as a noxious weed species by the Federal government (USDA-NRCS, 2015), nor is it listed as an invasive species by major invasive plant databases.

Although conventional creeping bentgrass is rarely considered a problem weed, the Malheur County Court, at the request of the Malheur County Weed Advisory Board, added glyphosate-resistant creeping bentgrass to the high-priority Class A list of noxious weeds (Malheur County Court, 2016). This action requires the grass to be removed or controlled when found, and provides penalties for failure to do so. Listing glyphosate-resistant creeping bentgrass as a Class A noxious weed makes it unlikely that ASR368 creeping bentgrass will spread beyond the areas where it currently exists as there will be more incentive to control the grass where it currently exists.

3.3.4 Microorganisms

Soil microorganisms are critical for structure formation, decomposition of organic matter, toxin removal, nutrient cycling, and most biochemical soil processes (Young and Ritz, 2000; Garbeva *et al.*, 2004). They suppress soil-borne plant diseases and promote plant growth (Doran *et al.*, 1996). The main factors affecting microbial population size and diversity include soil type (texture, structure, organic matter, aggregate stability, pH, and nutrient content), plant type (providers of specific carbon and energy sources into the soil), and management practices (e.g., herbicide and fertilizer applications, and irrigation) (Young and Ritz, 2000; Garbeva *et al.*, 2004). Plant roots release a large variety of compounds into the soil, creating a unique environment for microorganisms in the rhizosphere[8] (Bais *et al.*, 2006). Microbial diversity in the rhizosphere is extensive and differs from the microbial community in the bulk soil (Garbeva *et al.*, 2004).

Microorganisms in the field may mediate both negative and positive outcomes. Diseases that afflict creeping bentgrass with significant potential for economic loss include dollar spot and brownpatch in addition to other diseases (Duble, 2016). Management to control disease outbreaks varies by region and pathogen, but preventive applications of fungicides are typically used to control outbreaks (Duble, 2016).

Some of the effects of these factors on soil microbial populations, species composition, colonization, and associated biochemical processes have been studied by Buckley and Schmidt (Buckley and Schmidt, 2001; 2003). Agronomic practices in particular contribute to a broad range of variation in the structure of microbial populations in managed habitats. Most of the studies of soil microbial communities underlying bentgrass are related to golf course management (e.g., (Feng *et al.*, 2002; Mueller and Kussow, 2005). Management practices for pathogens that infect creeping bentgrass have been thoroughly reviewed by Dernoeden (2013).

[8] The rhizosphere is defined as subsoil area in the root zone of plants in which plant roots compete with the invading root systems of neighboring plants for space, water, and mineral nutrients, and interact with soil-borne microorganisms, including bacteria, fungi, and insects feeding on the organic material in the soil Walker et al. (2003).

3.3.5 Biodiversity

Biodiversity refers to all plants, animals, and microorganisms interacting in an ecosystem (Wilson, 1988). Biodiversity provides valuable genetic resources for crop improvement and also provides other functions beyond food, fiber, fuel, and income (Harlan, 1975). These include pollination, genetic introgression, biological control, nutrient recycling, competition against natural enemies, soil structure, soil and water conservation, disease suppression, control of local microclimate, control of local hydrological processes, and detoxification of noxious chemicals (Altieri, 1999). Beneficial insects, birds, and mammals are natural predators of many crop pests that have an important role in pest management (USDA-NRCS, 2002). The loss of biodiversity results in a need for costly management practices in order to provide these functions to the crop (Altieri, 1999).

The degree of biodiversity in an agroecosystem depends on four primary characteristics: 1) diversity of vegetation within and around the agroecosystem; 2) permanence of various crops within the system; 3) intensity of management; and 4) extent of isolation of the agroecosystem from natural areas and native vegetation (Southwood and Way, 1970). Relative to any natural ecosystem, species abundance and richness will generally be less in intensively managed agroecosystems. Tillage, seed bed preparation, planting of a monoculture crop, pesticide use, fertilizer use, and harvesting limit the diversity of plants and animals (Lovett *et al.*, 2003). Biodiversity can be maintained or reintroduced into agroecosystems through the use of woodlots, fencerows, hedgerows, and wetlands. Agronomic practices that may be employed to support biodiversity include intercropping (the planting of two or more crops simultaneously to occupy the same field), agroforestry, crop rotations, cover crops, no-tillage, composting, green manuring (growing a crop specifically for the purpose of incorporating it into the soil in order to provide nutrients and organic matter), addition of organic matter (compost, green manure, animal manure, etc.), and hedgerows and windbreaks (Altieri, 1999).

Studies of the effects of golf courses on bird biodiversity have indicated conflicting results. Blair (1996) considered moderately disturbed sites in California, a category that included golf courses. Results from this study indicated that species richness and diversity peaked in such sites. However, the structure of the bird community in these sites shifted to predominantly invasive and exotic species compared to a predominance of native species in undisturbed sites. Similar findings were reported by Merola-Zwartjes and DeLong (2005) for bird populations on golf courses in the semi-arid Southwest. However, rather than a predominance of exotic and invasive species, their findings indicated that in semi-arid environments, golf courses were especially important as alternative sites supporting riparian bird species. Cristol and Rodewald (2005) reviewed studies regarding the role golf courses in conserving bird populations, and found that golf courses in urban landscapes may be important to bird conservation where open naturalized spaces are lacking.

3.4 Human Health

Human health considerations associated with GE crops are those related to (1) the safety and nutritional value of GE crops and their products to consumers, and (2) the potential health effects of pesticides that may be used in association with GE crops. As for food safety, consumer health concerns are in regard to the potential toxicity or allergenicity of the introduced genes/proteins, the potential for altered levels of existing allergens in plants, or the expression of new antigenic proteins. Consumers may also be concerned about the potential consumption of pesticides on foods derived from GE crops. In the case of creeping bentgrass; it is not a food crop. The only potential risk posed by GE creeping bentgrass would be inadvertent mixing of GE creeping bentgrass seed with a food crop during processing and marketing. This is unlikely as food and seed crops are processed through two different production systems (i.e, certified seed processes).

In the United States, GE plants and other organisms are regulated and evaluated for public health and environmental safety under the Coordinated Framework for the Regulation of Biotechnology, described in Section 1.3. The safety assessment of crop plants derived through biotechnology includes characterization of the DNA insert or other genetic material, characterization of the biochemical and functional properties of the expressed protein(s), and compositional analysis of the GE plant.

Food Safety

Under the FFDCA and the Food Safety Modernization Act (FSMA), it is the responsibility of food and feed manufacturers to ensure that the products they introduce into commerce are safe and in compliance with applicable laws and regulations. GE organisms for food and feed may undergo a voluntary consultation process with the FDA prior to release onto the market (US-FDA, 2006). Although a voluntary process, thus far all applicants who wish to commercialize a GE variety that will be included in the food supply have completed a consultation with the FDA. APHIS considers the voluntary FDA assessment in evaluating the potential impacts of a determination on nonregulated status of GE plants or other organisms.

Food safety reviews frequently compare the compositional characteristics of the GE crop with non-GE, conventional varieties of that crop. Compositional characteristics evaluated in these comparative tests typically include plant components such as protein, fat, carbohydrates, ash, minerals, dietary fiber, essential and non-essential amino acids, fatty acids, vitamins, and anti-nutrients. Various developers have performed characterization analyses of trait genes and proteins, safety assessments of the genes and proteins, compositional analyses of food and feed, and safety and nutritional assessments of food and feed products derived from GE plants containing these traits (i.e., those submissions listed at (US-FDA, 2015; USDA-APHIS, 2016a)). The FDA evaluates the submission and responds to the developer by letter with any concerns it may have or additional information it may require.

While creeping bentgrass is not consumed directly by humans, there has been some interest in using creeping bentgrass as a feed crop, and creeping bentgrass may also be fed upon by wildlife. Monsanto and Scotts have consulted with the FDA on the safety of glyphosate-resistant creeping bentgrass pursuant to the voluntary consultation process for GE crops (21 C.F.R. Parts 192 and 592). The consultation identified and discussed relevant safety, nutritional, and other regulatory issues regarding the potential ingestion of glyphosate-resistant creeping bentgrass (US-FDA, 2003b). The FDA completed its consultation on September 23, 2003 with no further questions (US-FDA, 2003a; 2003b).

In addition, foods derived from GE plants typically undergo a safety evaluation among international agencies before entering foreign markets, including reviews under Codex Alimentarius guidelines, the European Food Safety Agency (EFSA), and Australia and New Zealand Food Standards Agency (ANZFS) (e.g., see (WHO, 2005; FAO, 2009; EFSA, 2015)).

In general, based on over 15 years of peer reviewed research and regulatory review, rather broad agreement among the scientific and regulatory communities has emerged that food products derived from GE plants currently on the market are as safe as and nutritionally equivalent to their non-GE counterparts, and pose no more risks than foods derived from conventional crop varieties (e.g., see (CAST, 2005; WHO, 2005; Batista and Oliveira, 2009; Ronald, 2011; AAAS, 2012; AMA, 2012; DeFrancesco, 2013; Goldstein, 2014; Nicolia *et al.*, 2014), and reviews by FDA (US-FDA, 2015), EFSA (EFSA, 2015), and ANZFS (ANZFS, 2015)).

While the safety of foods derived from current GE crops has been established through peer reviewed research and regulatory agency reviews (e.g., (Batista and Oliveira, 2009; AAAS, 2012; AMA, 2012; DeFrancesco, 2013; Goldstein, 2014; WHO, 2015), and others), some consumers may worry about potential negative health effects from food derived from GE plants; such as through the consumption of introduced DNA, or changes in nutritional quality or allergenicity. Consequently, consumer preferences can tend towards avoidance of food derived from GE plants unless such food contains perceptible benefits (Lucht, 2015).

Pesticide Safety

The risk of potential adverse health effects from pesticides depends on the toxicity of the ingredients, and dose, duration, and frequency of exposure to a pesticide. Certain people, such as children, pregnant women, and elderly populations may be more sensitive to the effects of pesticides than others.

Before a pesticide can be used on a food or feed crop, to include creeping bentgrass, the EPA, pursuant to the FFDCA, and FQPA, establishes tolerance limits, which is the amount of pesticide residue allowed to remain in or on each treated food commodity (21 U.S. Code § 346a - Tolerances and exemptions for pesticide chemical residues). Pesticide tolerance limits established by the EPA are to ensure the safety of foods and feed for human and animal consumption (US-EPA, 2015d). Currently there is no label for use of glyphosate on glyphosate-resistant creeping bentgrass, therefore no tolerance limit exists. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have withdrawn the application for label use of glyphosate on ASR368 creeping bentgrass (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b).

Worker Safety

Agriculture is considered one of the most hazardous industries in the United States. Worker hazards common to all types of agricultural production include those associated with the operation of farm machinery, vehicles, and pesticide application. Pesticide application represents the primary exposure route to pesticides for farm workers (USDA-NASS, 2007). The EPA pesticide registration process, however, involves the design of use restrictions that if followed have been determined to be protective of worker health.

EPA's Worker Protection Standard (WPS) (40 CFR Part170) was published in 1992 to require actions to reduce the risk of pesticide poisonings and injuries among agricultural workers and pesticide handlers. The WPS (40 CFR Part 170) provides occupational protections to over 2 million agricultural workers and pesticide applicators at more than 600,000 agricultural establishments (farms, forests, nurseries and greenhouses) (US-EPA, 2015a). The WPS contains requirements on pesticide safety training, notification of pesticide applications, use of personal protective equipment, restricted entry intervals following pesticide application, decontamination supplies, and emergency medical assistance. Under the WPS, the EPA requires the pesticide label to specify personal protective equipment and restricted entry intervals that will provide an appropriate level of protection, based on the properties of the product. Furthermore, the Occupational Safety and Health Administration (OSHA) require all employers to protect their employees from hazards associated with pesticides and herbicides.

On February 20, 2014, the US-EPA announced proposed changes to the agricultural WPS to increase protections from pesticide exposure for agricultural workers and their families[9]. The changes will strengthen the protections provided to agricultural workers and handlers under the WPS by improving elements of the existing regulation, such as training, notification, communication materials, use of personal protective equipment, and decontamination supplies.

The changes to the WPS requirements, specifically improved training on reducing pesticide residues brought from the treated area to the home on workers and handlers' clothing and bodies and establishing a minimum age for handlers and early entry workers, other than those covered by the immediate family exemption, mitigate the potential for children to be exposed to pesticides directly and indirectly. The EPA expects the revisions to prevent unreasonable adverse effects from exposure to pesticides among agricultural workers and pesticide handlers; vulnerable groups, such as minority and low-income populations, child farmworkers, and farmworker families; and the general public.

All pesticides labeled for use on crops in the United States must be evaluated for safety and registered by the EPA. Worker safety precautions and use restrictions are clearly noted on pesticide registration labels. Growers are required to use pesticides consistent with the application instructions provided on the EPA-approved pesticide labels. These restrictions provide instructions as to the appropriate levels of personal protection required for agricultural workers to use pesticides. These may include instructions on personal protective equipment, specific handling requirements, and field reentry procedures. These label restrictions carry the weight of law and are enforced by the EPA and the states (FIFRA 7 U.S.C. 136j (a)(2)(G) Unlawful Acts); therefore, it is expected that herbicide use would be consistent with the EPA-approved labels.

[9] For the changes to the WPS see: http://www.epa.gov/oppfead1/safety/workers/proposed/index.html

3.4.1 Management of ASR368 Creeping Bentgrass Escapes

As previously described in Section 3.1 - Distribution of Creeping Bentgrass in the United States, surveys conducted over the last 11 years have detected glyphosate-resistant creeping bentgrass outside of authorized testing areas. To mitigate the spread of glyphosate-resistant creeping bentgrass, and manage existing glyphosate-resistant creeping bentgrass plants, herbicides have been used where appropriate, to remove those glyphosate-resistant creeping bentgrass plants found. Both glufosinate (Finale®) and sethoxydim (Poast®) have been tested for use on glyphosate-resistant creeping bentgrass and herbicide efficacy was determined 40 and 90 days after the last treatment application (Scotts and Monsanto, 2015b). Other herbicides effective on glyphosate-resistant creeping bentgrass include imazapyr, fluridone, diquat, diuron, mesotrione, and pendimethalin (Scotts and Monsanto, 2015b). Control of glyphosate-resistant creeping bentgrass is unlikely to be more difficult in rights of way and waste areas, turf, or fruit crops. However, control in riparian areas and grass seed production fields may be more difficult due to limited herbicide options (USDA-APHIS, 2016b). A more detailed discussion of herbicide options for use on ASR368 creeping bentgrass and their effectiveness in different environments can be found in the PPRA (USDA-APHIS, 2016b). These herbicides, when used according to EPA label requirements would not be expected to present a risk to public health or worker safety.

3.5 Animal Feed

Creeping bentgrass is found naturalized throughout the United States (MacBryde, 2006). Creeping bentgrass is most commonly used on golf course putting greens, tees, and fairways (MacBryde, 2006). While mainly grown for golf courses, the straw and screenings left over from seed production can be used as animal feed (Scotts and Monsanto, 2015a). Creeping bentgrass can be found in pastures and natural environments throughout the United States. It can be an important forage for cattle, sheep, and horses because it stays green and palatable throughout the summer (MacBryde, 2006). While creeping bentgrass produces good forage, it is less productive and less palatable than many introduced perennial grasses in pastures (Esser, 1994). As well as being grazed by cattle, creeping bentgrass is also used by rabbits and hares, elk, mule deer, pronghorn sheep, white-tailed deer, small mammals, small nongame birds, upland game birds, waterfowl, and grebes (Esser, 1994; MacBryde, 2006). While creeping bentgrass provides some value it is not the preferred grass species for forage (Frame, 1991). Some evidence shows that creeping bentgrass may not be the preferred grass species for wildlife such as geese and wigeon when other more palatable grasses are present (Owen, 1971). Overall creeping bentgrass has limited use as animal feed.

It is the responsibility of feed manufacturers to ensure that the products they market are safe and properly labeled. Feed derived from GE creeping bentgrass must comply with all applicable legal and regulatory requirements, which are designed to protect human health. To help ensure compliance, a voluntary consultation process with the FDA may be implemented before release of commodity products with origins from GE plants as animal feed into the market.

3.6 Socioeconomics

3.6.1 Domestic Economic Environment

Market Overview

Turfgrass has emerged as an important market in the United States over the last 50 years and makes a significant contribution to the U.S. economy, especially in large urban and suburban areas (Breuninger *et al.*, 2013). Turfgrass commodities provide three primary socioeconomic benefits to consumers; these are functional, recreational, and aesthetic (Beard and Green, 1994). While the latter two are more obvious, functional benefits include erosion and dust control; urban heat dissipation and temperature moderation; and reduced noise, glare, and visual pollution (Beard and Green, 1994). Consumption of turfgrass products and services can be classified into two primary uses (a) integral turf-based use that relies heavily on turfgrass as a major driver of business, such as for golf courses and athletic fields, and (b) ancillary use, such as on home lawns, businesses, and public roads and highways (Haydu *et al.*, 2006).

The market size of the industry is not well quantified on an annual basis, so data is rather sparse.[10] However, a commonly cited estimate for market size is around $40 billion (NTF, 2016) and encompasses demand arising for use in home lawns, commercial properties, golf courses, public parks, athletic fields, and federal and state roadsides (Breuninger *et al.*, 2013). Consequently, the turfgrass industry consists of diverse groups of individuals that includes seed and sod producers, homeowners, athletic field managers, lawn care operators, golf course superintendents, architects, commercial real estate developers and owners, landscape designers and contractors, parks and grounds superintendents, and roadside and vegetation managers, and cemetery managers (Breuninger *et al.*, 2013).

Bentgrass comprises a small subset of the turfgrass industry. Currently, golf courses are the primary market for creeping bentgrasses. Colonial bentgrass and creeping bentgrass are particularly desired by the golf industry due to their tolerance to short mowing heights and durability (Alderman *et al.*, 2012). Because of the high level of maintenance required to sustain the aesthetic character of creeping bentgrass, there is limited home lawn or institutional use. Occasionally, creeping bentgrass is also used for playing surfaces such as croquet, lawn bowling, and home lawn putting greens. Rarely is it used as an ornamental lawn.

National

In 2012, the USDA National Agricultural Statistics Service survey reported that 41 farms comprising 4,590 acres produced approximately 1.6 million pounds of bentgrass seed (USDA-NASS, 2014a). As evident in Table 3, the vast majority of bentgrass seed is produced in Oregon. Other commercially important grasses in the United States include 245,146 acres of ryegrass, 216,518 acres of fescue, and 61,860 acres of Kentucky blue grass (USDA-NASS, 2014a).

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[10] Published economic information is relatively scarce. Unlike more traditional agricultural commodities, such as corn, soybeans, wheat, and cotton that have been quantified for decades few resources have been directed toward quantifying production and financial data in the turfgrass industry Haydu et al. (2008).

Table 3. Bentgrass Seed Production in the United States: 2012

	Farms	Harvested Acres	Quantity (pounds)
Idaho	2	(D)	(D)
Missouri	2	(D)	(D)
Oregon	37	4,366	1,615,391
United States	41	4,590	1,640,751

*(D) – Information withheld during surveys to avoid disclosing data for individual farms
Source: (USDA-NASS, 2014a)

<u>Oregon</u>

Oregon is the world's major producer of cool-season turf grass seed and is widely recognized as a center of expertise in seed production (OSU, 2016). Most of the acreage is located in the Willamette Valley, often referred to as the "grass seed capital of the world." Collectively, Oregon's Willamette Valley produces almost two-thirds of the total production of cool-season grasses in the United States. By acreage, roughly 25 percent of the Willamette Valley consists of grass seed farms (OSC, 2016a; 2016c).

Turfgrass seed producers in Oregon, which number approximately 1,500, harvest around 400,000 acres of grass seed with a market value of more than $300 million, depending on market demand (OSC, 2016c). Oregon growers produce essentially all of the U.S. harvest of annual ryegrass, perennial ryegrass, bentgrass, and fine fescue. Smaller amounts, but significant portions of Kentucky bluegrass, orchardgrass, and tall fescue are also grown in Oregon. Today, seed crops of over 950 varieties from eight grass species are grown on over 530,000 acres statewide (Breuninger *et al.*, 2013). Of these, 347, 000 acres, over 90 percent, are located in the Willamette Valley. The Willamette Valley has more acreage in grass seed than all other agricultural uses combined. Bentgrass seed production by county in Oregon for the years 2007 and 2012 is summarized in Table 4. As evidenced, seed production is highly sensitive to market demand and fluctuation, and the industry responds accordingly relative to the number of farms in operation.

Table 4. Bentgrass Seed Production in Oregon: 2012

	2012			2007		
County	**Farms**	**Acres**	**Harvest (pounds)**	**Farms**	**Acres**	**Harvest (pounds)**
Benton	1	ND	ND	1	(D)	(D)
Clackamas	-			2	(D)	(D)
Jackson	-			1	(D)	(D)
Jefferson	1	ND	ND	-	-	-
Lane	2	ND	ND	3	258	147,900
Linn	6	423	171,740	10	1,055	630,622
Marion	25	3,593	1,339,138	45	5,061	2,870,729
Polk	-			1	(D)	(D)

Washington	2	ND	ND	-	-	-
Total	37	4,366	1,615,391	63	6,809	3,921,751

(D) – Information withheld during surveys to avoid disclosing data for individual farms
(-) – Represents zero
Source: (USDA-NASS, 2014b)

For 2013 (most recent economic data), bentgrass in Oregon was grown on 4,710 acres and 2,177,000 pounds was harvested with a value of $5,567,000 (ODA, 2014). This is down from the high years of 2007- 2009, when bentgrass seed production was around 6,700 to 6,800 harvested acres, 3.8 to 4.0 million pounds (USDA-NASS, 2014a; 2014b). Since this time volume of seed production has been reduced by almost half.

Creeping Bentgrass Cultivar Development

Turf grass cultivar development is a cornerstone of the turf grass industry; developers strive to reduce the cost of inputs required for plant maintenance and improve overall quality (Breuninger *et al.*, 2013). As part of an integrated pest management program, selection of grass species/subspecies resistant or tolerant to disease, insects, and weeds is the primary defense against biotic stresses. Abiotic stresses, such as drought, heat, cold, and salinity, are more effectively minimized by utilizing grasses resistant, or at least tolerant, to such stresses. Foot traffic, maintenance equipment, and sports events cause less damage to turf grasses that have been developed to withstand soil compaction, leaf abrasion, and plant shearing. Hence, continued improvement/development of cultivars that reduce the damage from stresses, reduces the reliance on inputs to manage biotic and abiotic stresses, and allows increased use of the turf, is fundamental to competing in the industry (Breuninger *et al.*, 2013).

Developers of turf grass cultivars can protect their commodity through several legal means. A plant breeder can obtain protections via (1) the Plant Variety Protection Act (PVPA) of 1970 (7 U.S.C. §§ 2321-2582), (2) a plant patent, or (3) a utility patent. The PVPA is administered by the USDA's Agricultural Marketing Service, Plant Variety Protection Office. Plant and utility patents are issued by the U.S. Patent and Trademark Office (USPTO). Cultivars that receive a PVP certificate or a patent are protected from illegal production and sale for 20 years (Breuninger *et al.*, 2013). Establishment of the PVPA in 1970 has brought more recent growth to the industry. The PVPA provides private and commercial plant breeders a protection program granting exclusive rights to produce and market their proprietary seed (Young and Silberstein, 2012). This has encouraged a sharp increase in the number of breeding programs focused on cool-season grasses, particularly cultivars used for turf. As a result, the demand for turf-type proprietary varieties has increased markedly over the past 25 years (Young and Silberstein, 2012).

There are well over 20 conventionally bred bentgrass cultivars available with single or combined traits conferring characteristics of color, density, and durability to wear, as well resistance to certain diseases and insects (Bonos and Murphy, 2009). While there are numerous bentgrass varieties that can be found in the marketplace, with trait characteristics encompassing resistance to various pests and stresses, colors from light to dark green, and fine to coarse leaf textures, there are always new needs in the marketplace responsive to various environmental, pest, and consumer preference forces. Plant breeders work to incorporate desired traits into new cultivars to meet market demand (Breuninger *et al.*, 2013). Traits such as salt and drought tolerance, and ability to sustain high traffic, are examples of traits currently in demand, but are not easily detected in single-plant selections or readily transferred from existing germplasm (Breuninger *et al.*, 2013). Further, the marketplace demands cultivars exhibiting these newly desired traits must also possess an acceptable level of quality, color, density, and disease resistance (Breuninger *et al.*, 2013).

Adding new seeds or tissue (germplasm) to a breeding program allows the incorporation of a new or foreign gene(s) into desirable plants. Today, however, it is more difficult to make significant improvements by traditional breeding techniques such as natural plant selection, unconscious selection, methodical selection, and introduction of new germplasm sources (Breuninger *et al.*, 2013). Accordingly, there has been interest in the turfgrass industry for the infusion of biotechnology into breeding programs, considering the size of the market, the market segmentation and distribution streams already in place, and market demand for high quality turf grass with multiple desired traits (Breuninger *et al.*, 2013).

The first attempt to commercialize genetically engineered turfgrass was of herbicide (glyphosate)-resistant creeping bentgrass, the subject of this EIS. Glyphosate-resistant creeping bentgrass was developed to facilitate control of perennial and annual weeds in creeping bentgrass putting greens, fairways, and tees with a nonselective herbicide (Guo *et al.*, 2009; Breuninger *et al.*, 2013), thereby providing benefits to golf-course superintendents in managing problem weeds. As a result of seed and pollen dispersal during field testing of glyphosate-resistant creeping bentgrass, described herein, and concerns regarding the impacts of glyphosate-resistant creeping bentgrass on the environment (e.g., pest and weed resistance), potential contamination of conventionally raised and organic plants, and issues of liability, progress on commercialization of glyphosate-resistant creeping bentgrass stalled (Reichman *et al.*, 2006; Mallory-Smith and Zapiola, 2008; Cowan, 2011).

In the interim other herbicide-resistant turf grass varieties have been developed and eligible for adoption by the industry. Examples include GE glyphosate-resistant tall fescue and Kentucky bluegrass (Wang and Brummer, 2012; Reitman, 2014), and non-GE glyphosate-resistant ryegrass. Two glyphosate-resistant perennial ryegrass (*Lolium perenne*) cultivars, JS501 and Replay, have recently been released for commercial use. These cultivars were produced through conventional plant breeding, not with methods utilizing genetic engineering (Flessner and McElroy, 2013; Flessner *et al.*, 2014).

As breeders strive to meet market demand for turf grasses with various qualities, plant biotechnologies are continuing to be employed for development of turf varieties valuable to the turf industry (Wang and Brummer, 2012), and considered a useful approach to introduce traits that can facilitate sustainable cropping or landscape systems (Ronald, 2011). The current challenge is how to apply the technology to generate new turf grass varieties that present negligible environmental and regulatory concerns (Wang and Brummer, 2012). For grasses, the development of intragenic or cisgenic lines are emerging as a viable approach to achieve such ends (Wang and Brummer, 2012).

3.6.2 Trade Economic Environment

Around 12 to 15 percent of turf grass seed grown in Oregon is exported to nearly 60 countries worldwide (OSC, 2016a). In 2013, Oregon seeds exports where valued at $378,800,000. There is no data on bentgrass exports, specifically (ODA, 2014). Asian countries make up a large percentage of Oregon grass seed exports with China and Korea being the primary consumers (ODA, 2012).

Trade of seed requires producers to certify their seed through regulatory agencies. The purpose of seed certification is to preserve genetic purity and identity, and facilitate the distribution and trade of new and improved seed varieties on the open market. Certification is widely used for seed destined for international trade. The variety and origin of certified seed can be traced back to the producer through the information on the shipping label. Certified seed accounts for 86 percent of the creeping bentgrass and 85 percent of the colonial bentgrass crop produced in Oregon, but much lower percentages of the other grass seed produced in Oregon is certified (Edminster, no date).

Certification programs are administered by state agencies, state universities, and/or state departments of agriculture, following criteria established by the Association of Official Seed Certifying Agencies (AOSCA) (AOSCA, 2015) and the Organization for Economic Co-operation and Development (OECD) (OECD, 2016). The OECD Seed Schemes Program for seed moving in International trade is administered by the USDA Agriculture Marketing Service, Seed Regulatory and Testing Branch.

4 Environmental Consequences

This analysis of potential environmental consequences addresses the potential impact to the human environment from the alternatives analyzed in this EIS: the No Action Alternative and the Preferred Alternative, a determination of nonregulated status of ASR368 creeping bentgrass. Potential environmental impacts from the No Action Alternative and the Preferred Alternative for ASR368 creeping bentgrass are described in detail throughout this section. A cumulative impact analysis is presented for each potentially affected environmental concern in Section 5. Certain aspects of ASR368 creeping bentgrass would be no different between the alternatives as described below.

ASR368 creeping bentgrass was originally developed in the 1990s to address a market need for a product that would simplify golf course weed management (Scotts and Monsanto, 2015b). During field testing in 2003 and 2004 creeping bentgrass escaped from authorized field trial sites. As a result of this escape, Scotts was fined and required to conduct workshops on their efforts to monitor and destroy ASR368 creeping bentgrass (USDA, 2007). Since this time, market conditions have changed and ASR368 creeping bentgrass no longer has commercial value (Scotts and Monsanto, 2015b; Scotts, 2016). Scotts and Monsanto have stated in their petition that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Additionally, Scotts has destroyed all commercial ASR368 creeping bentgrass seed stock and withdrew their EPA label amendment application for any glyphosate-based product for use on ASR368 creeping bentgrass (Scotts and Monsanto, 2015b). In addition Scotts has agreed to a management plan and reiterated their companies commitment to the management of ASR368 creeping bentgrass in the three affected counties where it currently exists (USDA-APHIS, 2015a; Scotts, 2016). Therefore, as part of the environmental impacts analysis, APHIS will assume that ASR368 creeping bentgrass will not be commercially produced and that Scotts will continue their management efforts as agreed upon in the MOA (USDA-APHIS, 2015b; 2015a).

4.1 Scope of Analysis

Potential environmental impacts from the No Action Alternative and the Preferred Alternative for ASR368 creeping bentgrass are described in detail throughout this section. An impact would be any change, positive or negative, from the existing (baseline) conditions of the affected environment (described for each resource area in Section 3.0); the baseline conditions would be those as they exist today. Impacts may be categorized as direct, indirect, or cumulative. A direct impact is an effect that results solely from a proposed action without intermediate steps or processes. Examples include soil disturbance, air emissions, and water use. An indirect impact may be an effect that is related to but removed from a proposed action by an intermediate step or process. Examples include surface water quality changes resulting from soil erosion due to increased tillage, and worker safety impacts resulting from an increase in herbicide use.

A cumulative impacts analysis is also included for each environmental issue and are discussed fully in Section 5. A cumulative impact may be an effect on the environment which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. If there are no direct or indirect impacts identified for a resource area, then there can be no cumulative impacts.

Where it is not possible to quantify impacts, APHIS provides a qualitative assessment of potential impacts. Certain aspects of this product may be no different between the alternatives. In addition, when referring to all cultivars of creeping bentgrass (ASR368 and conventional cultivars) this analysis will use the general term “creeping bentgrass.” Otherwise, this analysis will use ASR368 for genetically engineered glyphosate-resistant creeping bentgrass and conventional creeping bentgrass for all other cultivars, as appropriate.

Although Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass now or in the future and that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b; Scotts, 2016) the Preferred Alternative would allow for new plantings of ASR368 creeping bentgrass to occur anywhere in the United States. For this reason, APHIS considered potential impacts to the affected environment in areas where creeping bentgrass is currently known to exist. This includes naturalized populations of creeping bentgrass throughout the United States, commercially produced cultivars of conventional creeping bentgrass in Oregon and Idaho, and cultivated varieties of conventional creeping bentgrass on many, if not most, of the golf courses in the United States. In addition, as noted in Section 3.1.2, there are isolated escaped populations of creeping bentgrass genetically engineered for glyphosate-resistance from past regulated field trials in Oregon and Idaho (ASR368).

4.2 Agricultural Production of Creeping Bentgrass

Best management practices (BMP) are commonly accepted, practical ways to grow creeping bentgrass. These management practices consider crop-specific planting dates, seeding rates, and harvest times, among others, regardless of whether it is conventional or genetically engineered. Over the years, conventional creeping bentgrass production has resulted in well-established management practices that are available through local Cooperative Extension offices and their respective websites. The National Information System for the Regional Integrated Pest Management Centers publishes crop profiles for major crops on a state-by-state basis. These crop profiles provide production guidance for local growers, including recommended practices for specific pest control. Crop profiles for some conventional creeping bentgrass production states can be reviewed at www.ipmcenters.org/cropprofiles/index.cfm.

Scotts and Monsanto’s studies demonstrate that agronomic characteristics and cultivation practices required for ASR368 creeping bentgrass are unlikely to change from current practices for conventional creeping bentgrass cultivation and management, with the exception of the glyphosate-resistance trait (Scotts and Monsanto, 2015a) which allows its use to control unwanted weeds in established creeping bentgrass. BMPs currently employed for conventional creeping bentgrass production are not expected to change if ASR368 creeping bentgrass is no longer subject to the regulatory requirements of 7 CFR Part 340 or the plant pest provisions of the PPA. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Accordingly, the potential impacts on agricultural production resulting from management practices associated with ASR368 creeping bentgrass are the same under the No Action and Preferred Alternative.

4.2.1 Acreage and Area of Creeping Bentgrass Production

No Action Alternative: Acreage and Area of Creeping Bentgrass Production

Under the No Action Alternative, existing trends related to area and acreage of creeping bentgrass seed production is expected to remain the same. Creeping bentgrass is expected to continue being commercially cultivated in the United States, with the majority of seed production centered in Oregon's Willamette Valley (Alderman *et al.*, 2012). As discussed in Section 3.1.1 – Acreage and Area of Commercially Produced Bentgrass in the United States, bentgrass seed production ranges from around 4,000 to 6,000 acres, relative to market demand (USDA-NASS, 2011; 2014b).

Conventional creeping bentgrass seed was planted on approximately 140,757 acres of U.S. golf courses in 2007, mostly on putting greens and tees (GCSAA, 2007). This analysis assumes that this trend will continue for the foreseeable future, neither materially increasing nor decreasing.

As described in Section 3.1.2 – Acreage and Area of Herbicide-Resistant Creeping Bentgrass, in addition to naturalized populations of conventional creeping bentgrass species found throughout the United States, commercially produced conventional creeping bentgrass in Oregon and Idaho, and cultivated conventional creeping bentgrass on many, if not most, of the golf courses in the United States, there are known isolated populations of ASR368 creeping bentgrass in a total of three counties in Oregon and Idaho. Under the No Action Alternative growers and other affected landowners would to be encouraged to manage ASR368 creeping bentgrass as part of their routine weed management programs, with Scotts serving as a resource (USDA-APHIS, 2015a). Because the area where ASR368 creeping bentgrass is currently known to exist, irrigation and drainage ditches, is surrounded by a native desert landscape that is not conducive to ASR368 creeping bentgrass establishment and persistence, ASR368 creeping bentgrass is geographically isolated and likely contained in the area where it is currently known to exist.

Preferred Alternative: Acreage and Area of Creeping Bentgrass Production

The Preferred Alternative is not expected to extend the area of U.S. creeping bentgrass production or cause an increase in overall creeping bentgrass acreage, relative to the No Action Alternative. Scotts and Monsanto studies have demonstrated that with the exception of the glyphosate-resistance trait, ASR368 creeping bentgrass is phenotypically and agronomically equivalent to other conventional commercially cultivated creeping bentgrass (Scotts and Monsanto, 2015a).

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and

Monsanto, 2015a; USDA-APHIS, 2015b). As under the No Action Alternative, growers and other affected landowners would continue to be encouraged to manage ASR368 creeping bentgrass as part of their routine weed management programs, with Scotts serving as a resource (USDA-APHIS, 2015a). As noted above, ASR368 creeping bentgrass is geographically isolated and likely contained in the area where it is currently known to exist. Therefore, deregulation of ASR368 creeping bentgrass would not be expected to affect the total acreage and range of U.S. creeping bentgrass nor the acreage and range of ASR368 creeping bentgrass known to exist in the environment.

The Preferred Alternative, a determination of nonregulated status of ASR368 creeping bentgrass, is therefore not expected to increase creeping bentgrass production or result in an increase in overall acreage of creeping bentgrass relative to the No Action Alternative. Potential impacts would be similar to the No Action Alternative.

4.2.2 Agronomic Practices

<u>No Acton Alternative: Agronomic Practices</u>

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be regulated by APHIS. Current availability and usage of commercially cultivated conventional creeping bentgrass are expected to remain the same under the No Action Alternative. Agronomic practices such as seed bed preparation, harvest, post-harvest residue management, pest and disease management, and other agronomic practices described in Section 3.1.3 – Agronomic Practices, are expected to continue as practiced today for the production of conventional creeping bentgrass.

ASR368 creeping bentgrass that is already present in the environment is expected to continue to be managed in accordance with the agreed management plan (USDA-APHIS, 2015b; 2015a; Scotts, 2016) to minimize further distribution of ASR368 creeping bentgrass, under which growers and landowners are encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs. ASR368 creeping bentgrass is unlikely to be more difficult to control than conventional creeping bentgrass in rights of way and waste areas, turf, or fruit crops, but may be more difficult to control in riparian areas and grass seed production fields due to more limited herbicide options in these areas (USDA-APHIS, 2016b). Further analysis of the alternative herbicides that can be used to control ASR368 creeping bentgrass in different environments can be found in the accompanying PPRA (USDA-APHIS, 2016b). Surveys have shown ASR368 creeping bentgrass is primarily limited to the general vicinity of the production fields, mainly in irrigation channels. No reports have been received that the environment or agriculture has been negatively impacted by the presence of ASR368 creeping bentgrass (Scotts and Monsanto, 2015a). Under the No Action Alternative, ASR368 creeping bentgrass found along irrigation ditches or canals will continue to be managed using a variety of currently available methods, including mechanical and cultural methods and spot treatment using registered herbicides.

<u>Preferred Alternative: Agronomic Practices</u>

Similar to the No Action Alternative, a determination of nonregulated status of ASR368 creeping bentgrass is unlikely to substantially change current agronomic practices for creeping bentgrass cultivation. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Thus, a determination of nonregulated status of ASR368 creeping bentgrass is not anticipated to facilitate production of ASR368 creeping bentgrass in areas where it is not currently known to exist nor to impact total creeping bentgrass production acres. In addition, with the exception of the glyphosate-resistant trait, ASR368 creeping bentgrass is phenotypically and agronomically comparable to other conventional commercially cultivated creeping bentgrass (Scotts and Monsanto, 2015a). Agronomic practices such as seed bed preparation, post-harvest residue management, and the application of agricultural chemicals would not change from those currently used for production and management of conventional creeping bentgrass seed producing fields. Additionally, practices such as core aeration, use of agricultural chemicals, and sand topdressing would not change from those currently used for management of areas where conventional creeping bentgrass is grown (e.g., golf courses).

Herbicide use under the Preferred Alternative would be the same as under the No Action Alternative. Growers would continue to manage ASR368 creeping bentgrass, as necessary, as part of their routine weed management program using the same registered herbicides used under the No Action Alternative. Further analysis of the alternative herbicides that can be used to control ASR368 creeping bentgrass in different environments can be found in the accompanying PPRA (USDA-APHIS, 2016b). Plants can also be removed by mechanical methods such as double disking, hand hoeing, and hand pulling (Chastain, 2003; Butler *et al.*, 2005). On ditch banks, mowers, scythes, or string trimmers can reduce stands of emergent plants; searing or burning plants with a propane torch may also be used to slow growth (Patten *et al.*, 2016). The potential impacts to agronomic practices associated with the Preferred Alternative would be the same as the No Action Alternative.

4.3 Physical Environment

4.3.1 Soil Quality

<u>No Action Alternative: Soil Quality</u>

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be regulated by APHIS and current land acreage and agronomic practices associated with conventional creeping bentgrass production would be expected to be unchanged. Agronomic practices associated with conventional creeping bentgrass seed production, such seed bed preparation, post-harvest residue management, and the application of agronomic inputs would not change from those currently used for production and management. In addition, management of conventional creeping bentgrass on golf courses, including, mowing, core aeration, use of agricultural chemicals, and sand topdressing would continue unchanged.

Herbicide use for the management of ASR368 creeping bentgrass will remain as it is currently practiced under the agreed management plan to minimize further distribution of ASR368 creeping bentgrass, with growers and landowners being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management practices and with Scotts serving as a resource for ASR368 creeping bentgrass management.

Current availability and usage of commercially cultivated conventional creeping bentgrass are expected to remain the same under the No Action Alternative. Impacts on soil quality are not expected to change.

Preferred Alternative: Soil Quality

A determination of nonregulated status of ASR368 creeping bentgrass would not affect soil quality differently than conventional creeping bentgrass. ASR368 creeping bentgrass is agronomically and compositionally equivalent to other conventional creeping bentgrass varieties currently in commercial production with the exception of the glyphosate-resistance trait (Scotts and Monsanto, 2015a; USDA-APHIS, 2016b). Furthermore, Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate such plants in the future. Additionally, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, agronomic practices associated with conventional creeping bentgrass seed production, such seed bed preparation, post-harvest residue management, and the application of agronomic inputs that could impact soil quality or its community structure and function would not change from those currently used for production of conventional creeping bentgrass seed. Additionally, mowing, core aeration, use of agricultural chemicals, and sand topdressing used in the management of conventional creeping bentgrass on golf courses that could have impacts on soils would not change from those currently used on conventional creeping bentgrass.

Herbicide use under the Preferred Alternative would be similar to that under the No Action Alternative as growers and landowners would continue to manage ASR368 creeping bentgrass, as necessary, as part of their routine weed management program using the same registered herbicides or other mechanical or physical control techniques (burning or pulling plants) used under the No Action Alternative. Scotts will continue to serve as a resource for ASR368 creeping bentgrass management. Based on these considerations, APHIS has concluded there would be no changes in the direct or indirect impacts on soil quality from the Preferred Alternative.

4.3.2 Water Resources

No Action Alternative: Water Resources

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be regulated by APHIS. Land acreage and agronomic practices associated with conventional creeping bentgrass seed production and management of grass on golf courses would continue unchanged. As discussed in Section 3.2.2, Water Resources, current agronomic practices associated with conventional creeping bentgrass seed production, including irrigation and fertilizer and pesticide use, has the potential to impact water quality. Seed producers will continue to choose certain pesticides based on weed, insect and disease pressures, cost of seed and other inputs, human safety, potential for crop injury, and ease and flexibility of the production system.

Maintenance of creeping bentgrass on golf courses that could impact water resources, including irrigation and fertilizer and pesticide application would remain unchanged with golf course managers continuing to choose certain pesticides based on weed, insect and disease pressures, cost, human safety, potential for crop injury, and ease and flexibility of use.

The EPA's reregistration and registration review process ensures that registered pesticides continue to meet the FIFRA registration standard, that pesticides will not cause unreasonable adverse effects when used as directed on product labels. Therefore, when used consistent with registered uses and EPA-approved labels, pesticides presents an acceptable level of impacts to surface and groundwater.

Herbicides used to manage ASR368 creeping bentgrass would continue in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass, with growers and landowners being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs where appropriate, most likely by using a combination of herbicides and/or physical and mechanical techniques. To the extent that ASR368 creeping bentgrass is managed within irrigation ditches or canals when water is present, only herbicides labeled for aquatic use or registered by the State under FIFRA section 24(c) are used. Scotts will serve as a resource for ASR368 creeping bentgrass management. Hand pulling and raking to remove weeds on ditchbanks or irrigation ditches may result in turbid or murky water (Patten *et al.*, 2016). However, this effect should be temporary.

Under the No Action Alternative, water resources associated with conventional creeping bentgrass seed production and management of grass on golf courses would not be expected to change. Current availability and usage of commercially cultivated conventional creeping bentgrass are expected to remain the same under the No Action Alternative. Existing water use and water quality conditions would be expected to be unchanged.

<u>Preferred Alternative: Water Resources</u>

Under the Preferred Alternative, impacts to water resources are expected to be similar to those of the No Action Alternative. ASR368 creeping bentgrass has been shown to be compositionally, agronomically, and phenotypically equivalent to commercially cultivated conventional creeping bentgrass with the exception of the glyphosate-resistance trait and is therefore unlikely to have any additional impact on surface water quality different from that of conventional creeping bentgrass (Scotts and Monsanto, 2015a).

Since Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b) deregulation of ASR368 creeping bentgrass would not be expected to affect the total acres and range of U.S. creeping bentgrass nor the cultivation and management practices for creeping bentgrass.

Herbicide use under the Preferred Alternative would be similar to that under the No Action Alternative as the herbicides used to control ASR368 creeping bentgrass in and near the canals and irrigation ditches in the three counties of the escapes would be unchanged. Growers and landowners would continue to manage ASR368 creeping bentgrass as part of their routine weed management program using registered herbicides and/or physical and mechanical techniques. Scotts will continue to serve as a resource for ASR368 management.

Based on these considerations, APHIS has concluded that the potential impacts to water resources are expected to be the same under the Preferred Alternative as under the No Action Alternative.

4.3.3 Air Quality

No Action: Air Quality

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be regulated by APHIS and current impacts to air quality associated with conventional creeping bentgrass management practices would be expected to be unchanged. Agricultural practices have the potential to cause negative impacts to air quality. These management practices may include vehicle exhaust associated with mowing and harvesting, field burning, and emissions from the use of nitrogen fertilizer (Aneja et al., 2009; US-EPA, 2015c).

Preferred Alternative: Air Quality

Under the Preferred Alternative, a determination of nonregulated status of ASR368 creeping bentgrass is unlikely to impact air quality more so when compared to the No Action Alternative.

A determination of nonregulated status of ASR368 creeping bentgrass is not expected to change agricultural practices that may affect air quality. ASR368 creeping bentgrass has been shown to be compositionally, agronomically, and phenotypically equivalent to conventional creeping bentgrass with the exception of the glyphosate-resistance trait (Scotts and Monsanto, 2015a). Furthermore, Scotts and Monsanto have stated that they will not commercialize or further propagate ASR368 creeping bentgrass and will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a) so deregulation of ASR368 creeping bentgrass would not be expected to affect the total acres and range of conventional creeping bentgrass nor the cultivation and management practices for conventional creeping bentgrass. Herbicides used to manage ASR368 creeping bentgrass would continue in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass, with growers and affected landowners being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs. The potential impacts to air quality under the Preferred Alternative are, therefore, similar to the No Action Alternative.

4.3.4 Climate Change

No Action Alternative: Climate Change

Agriculture, including land-use changes associated with farming, is responsible for an estimated 6.9 percent of all human-induced GHG emissions in the United States (US-EPA, 2013). Agriculture-related GHG emissions include CO_2, N_2O, and CH_4, produced through the combustion of fossil fuels to run farm equipment; the use of fertilizers; or the decomposition of agricultural waste products, including crop residues, animal wastes, and enteric emissions from livestock.

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be regulated by APHIS. Current agronomic practices associated with conventional creeping bentgrass seed production which contribute to GHG emissions, including vehicle exhaust associated with mowing and harvesting, field burning, and emissions from the use of nitrogen fertilizer, are not expected to change under the No Action Alternative. In addition, GHG emissions from the management of creeping bentgrass on golf courses including vehicle exhaust associated with mowing and emissions from the use of nitrogen fertilizer, are not expected to change under the No Action Alternative. Impacts of agriculture on climate change are expected to be unchanged.

Growers and affected landowners are encouraged to manage ASR368 creeping bentgrass as a weed during current weed management practices. This may include the use of additional herbicides and would likely be incorporated in the form of a tank mix with herbicides currently used. Herbicide applications for ASR368 creeping bentgrass management under the No Action Alternative is not expected to result in increased greenhouse emissions because the area where ASR368 creeping bentgrass is currently known to exist is relatively small and plant densities are low (fewer than 700 plants over approximately 180,000 acres surveyed in spring of 2015 as described in Section 3.1.2) and any incremental increase in GHG emissions from additional tillage, vehicle use, emissions from spraying, or from burning to control this creeping bentgrass as a weed would likely not be detectable.

Preferred Alternative: Climate Change

A determination of nonregulated status of ASR368 is not expected to result in climate change impacts any more so than the No Action Alternative. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to affect the total acreage and range of creeping bentgrass nor the cultivation and management practices for conventional creeping bentgrass.

As under the No Action Alternative, should growers choose to manage ASR368 creeping bentgrass as a weed in the areas where it is known to exist today, additional herbicides may be used and would likely be incorporated into growers’ current weed management practices, most likely in the form of a tank mix with herbicides currently used. Thus, herbicide application for

ASR368 creeping bentgrass management is not expected to result in increased greenhouse emissions. Since the total contribution of agricultural practices to global climate change is 6.9% of all emissions (US-EPA, 2015c) and the area where ASR368 creeping bentgrass is currently known to exist is relatively small and plant densities are low (fewer than 700 plants over approximately 180,000 acres surveyed in spring of 2015 as described in Section 3.1.2) any incremental increase in GHG emissions from additional tillage, vehicle use, emissions from spraying, or from burning to control this creeping bentgrass as a weed would likely not be detectable. Collectively, because the range, area, and agronomic practices of conventional creeping bentgrass are unlikely to change from the No Action Alternative following a determination of nonregulated status of ASR368 creeping bentgrass, the potential impacts to climate change are also unlikely to change under the Preferred Alternative.

4.4 Biological Resources

4.4.1 Animal Communities

No Action Alternative: Animal Communities

Under the No Action Alternative, conventional creeping bentgrass seed production would continue and conventional creeping bentgrass would continue to be widely used on golf courses while ASR368 creeping bentgrass would remain regulated by APHIS. As discussed in Section 3.3.1 a wide array of animal and insect species occupy or use habitats that are within or adjacent to conventional creeping bentgrass seed production fields, golf courses, or other areas where creeping bentgrass currently exists. Mammals and birds may use conventional creeping bentgrass seed production fields or areas where conventional creeping bentgrass is grown (e.g., golf courses) and the surrounding vegetation for food and habitat throughout the year. Invertebrates can feed on creeping bentgrass plants or prey upon other insects living on creeping bentgrass plants as well as in the vegetation surrounding conventional creeping bentgrass seed production fields and areas where conventional creeping bentgrass presently exists (e.g., golf courses).

The creeping bentgrass agronomic practices potentially impacting animal communities includes the application of agricultural inputs, such as fertilizer, herbicides, and pesticides. Both fertilizer and pesticides are applied to conventional creeping bentgrass seed production fields and golf courses in the United States and potentially impact non-target wildlife from exposures during application and for a period after application.

Herbicides used to manage ASR368 creeping bentgrass would continue in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass, with growers and landowners being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs. When used consistent with the EPA-registered uses and labels, pesticide applications to creeping bentgrass present an acceptable level of risk to non-target animals.

Potential impacts to animal communities associated with conventional creeping bentgrass seed production and in areas where conventional creeping bentgrass currently exists (e.g., golf courses) are not expected to change in the No Action Alternative.

Preferred Alternative: Animal Communities

Under the Preferred Alternative, potential impacts to animal communities are not anticipated to be different compared to the No Action Alternative. Potential impacts to animal communities arise from any changes in agronomic practices associated with the crop modification and direct exposure to the GE crop and its products.

Scotts and Monsanto have presented the results of field trials which demonstrate ASR368 creeping bentgrass is compositionally and agronomically equivalent to conventional creeping bentgrass with the exception of the glyphosate-resistance trait and does not require any changes to agronomic practices (Scotts and Monsanto, 2015a). Agricultural production of conventional creeping bentgrass under the Preferred Alternative is likely to continue as currently practiced. The use and maintenance of conventional creeping bentgrass on golf courses is also likely to continue as currently practiced under the Preferred Alternative.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to affect the total acreage and range of creeping bentgrass. The cultivation and management practices for creeping bentgrass that may affect animal communities are expected to remain the same as under the No Action Alternative.

Growers would continue to choose certain pesticides based on weed, insect and disease pressures, human safety, potential for crop injury, and ease and flexibility of use. Should growers choose to manage ASR368 creeping bentgrass as a weed, herbicides used to manage ASR368 creeping bentgrass would continue in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass, with growers being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs, most likely using a combination of registered herbicides. Scotts will continue to serve as a resource for ASR368 creeping bentgrass management. When used consistent with the EPA-registered uses and labels, pesticide applications to ASR368 creeping bentgrass present an acceptable level of risk to non-target animals. There would be no greater impact to the animal communities discussed in Section 3.3.1 – Animal Communities, from ASR368 creeping bentgrass control methods under the Preferred Alternative.

Compositional analysis were conducted on leaf forage samples from ASR368 creeping bentgrass, the non-transformed parent, B99061R and three conventional varieties produced from four replicated field sites across the U.S. during 2000-2001 (Scotts and Monsanto, 2015a). Leaf forage samples were analyzed for levels of nutrients including proximates (protein, fat, ash and moisture), acid detergent fiber, neutral detergent fiber, crude fiber, minerals (calcium, copper, iron, magnesium, manganese, phosphorous, potassium, sodium and zinc) and carbohydrates by calculation (Scotts and Monsanto, 2015a).

In a combined-site analysis in which the data were pooled among the sites, there were no statistically significant differences observed between ASR368 creeping bentgrass and the conventional controls for any of the analytical components (Scotts and Monsanto, 2015a). In an individual-site analysis of the data, four statistically significant differences were observed between ASR368 creeping bentgrass and B99061R among three different analytical components. Statistically significant differences were detected for the content of moisture (1 site), phosphorus (1 site), and neutral detergent fiber (2 sites). Of the four comparisons observed to be statistically different between ASR368 creeping bentgrass and B99061R, all values of ASR368 creeping bentgrass were within the range and 99 percent tolerance interval of the conventional, commercial varieties (Scotts and Monsanto, 2015a). The statistically significant differences were only observed at one or two sites, not in the combination of all the field sites, and were not considered to be biologically meaningful from a food and feed safety or nutritional perspective. Therefore, ASR368 creeping bentgrass would pose no greater risk to animal communities that conventional bentgrass species. Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002 (Scotts and Monsanto, 2015a). The FDA consultation completed on September 23, 2003 (US-FDA, 2003a).

Based on the above, the impacts of a determination of nonregulated status for ASR368 creeping bentgrass to animal communities would be similar to those of the No Action Alternative.

4.4.2 Plant Communities

<u>No Action Alternative: Plant Communities</u>

As described in Section 3.1.1 Acreage and Area of Commercially Produced Bentgrass, conventional creeping bentgrass is one of the most popular grasses grown on most golf courses in a wide range of environments throughout the United States (MacBryde, 2006). However, nearly all of the conventional bentgrass seed grown in the United States is produced as certified seed in Oregon's Willamette Valley (Alderman *et al.*, 2012). As noted in Section 3.1.2 Acreage and Area of Herbicide Resistant Creeping Bentgrass, isolated populations of ASR368 creeping bentgrass have been found along canals and irrigation ditches in Jefferson and Malheur Counties in Oregon, and Canyon County in Idaho.

Non-turfgrass vegetation in conventional creeping bentgrass seed fields or on golf courses is limited by weed control practices. Plants communities adjacent to conventional creeping bentgrass seed fields or golf courses are highly variable and range from urban to rural, and commonly include other cultivated fields, fence rows and hedge rows, meadows, fallow fields, grasslands, woodlands, riparian habitats and other uncultivated areas. Weeds are important pests in conventional creeping bentgrass seed production and weed control is important for seed purity. Additionally, weed management is an important aspect of golf course and greens maintenance. Existing weed management methods would continue even if ASR368 creeping bentgrass continues to remain a regulated article.

Herbicides used to manage ASR368 creeping bentgrass would continue in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass, with growers and landowners being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs, most likely using a combination of registered herbicides and physical and mechanical techniques (e.g., pulling or burning the grass). Scotts will serve as a resource for ASR368 creeping bentgrass management.

Under the No Action Alternative, conventional creeping bentgrass production and management on golf courses and other areas of cultivation would continue while ASR368 creeping bentgrass remains a regulated article. Potential impacts to plant communities associated with conventional creeping bentgrass production and management are not expected to change in the No Action Alternative.

Preferred Alternative: Plant Communities

Under the Preferred Alternative, potential impacts to plant communities are not anticipated to be different compared to the No Action Alternative.

ASR368 creeping bentgrass has been shown to be compositionally, agronomically, and phenotypically equivalent to conventional creeping bentgrass with the exception of the glyphosate-resistant trait (Scotts and Monsanto, 2015a). Growers and landowners will continue to manage ASR368 creeping bentgrass, as necessary, in the same way as under the No Action Alternative. Should growers choose to manage ASR368 creeping bentgrass as a weed, herbicides may be used in accordance with their approved labels. However, it is expected that ASR368 creeping bentgrass management will be incorporated into growers' current weed management practices, most likely using a combination of registered herbicides and physical and mechanical techniques. Scotts will continue to serve as a resource for ASR368 creeping bentgrass management. Therefore, impacts to plant communities would be unchanged by the deregulation of ASR368 creeping bentgrass when compared to the No Action Alternative.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). However, conventional seed production and use of conventional creeping bentgrass on golf courses is likely to continue as currently practiced. A determination of nonregulated status for ASR368 creeping bentgrass would not be expected to affect the total acreage and range of creeping bentgrass nor the cultivation and management practices used for conventional creeping bentgrass. Consequently, any impact to plant communities as a result of creeping bentgrass production and management practices under the Preferred Alternative is the same as the No Action Alternative.

4.4.3 Gene Flow and Weediness

No Action Alternative: Gene Flow and Weediness

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be regulated by APHIS. Conventional creeping bentgrass seed production would continue and conventional creeping bentgrass would continue to be widely used on golf courses. ASR368 creeping bentgrass would continue to be present in the environment where it exists today and be managed in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass, with growers and landowners being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs. Scotts will serve as a resource for ASR368 creeping bentgrass management.

As described in Section 3.3.3 – Gene Flow and Weediness, creeping bentgrass, like other grasses is wind pollinated and capable of hybridizing with other bentgrass species and some other grasses (MacBryde, 2006). Although creeping bentgrass can hybridize with other species, most offspring are sterile or will have low fertility (Bradshaw, 1958; MacBryde, 2006; Zhao *et al.*, 2007). Intergeneric gene flow has also been documented between glyphosate-resistant creeping bentgrass and rabbitfoot grass (*Polypogon monospeliensis*) (Zapiola and Mallory-Smith, 2012).

There is potential for glyphosate-resistant hybrids resulting from gene flow to form. The glyphosate-resistant hybrids could have a fitness advantage when exposed to glyphosate. However, the glyphosate-resistant hybrids are unlikely to be any weedier than non-GR hybrids because of the low frequency of hybridization, the availability of alternative herbicides, and other methods for management, and the very low level of hybrid fertility (USDA-APHIS, 2016b). Therefore, adverse consequences of gene flow under the No Action Alternative are extremely unlikely.

Creeping bentgrass readily colonizes areas disturbed by logging, plowing, burning, or excessive grazing (Esser, 1994). Once a suitable site is disturbed, the extensive stolon system of creeping bentgrass allows it to rapidly spread and establish. It also withstands high levels of grazing (Esser, 1994). The limiting factor for survival of creeping bentgrass in any landscape is moisture. As discussed in Section 3.3.2, the landscape surrounding the irrigated areas where ASR368 creeping bentgrass is known to exist is typical of the high desert region and consists largely of sagebrush grasslands and western juniper woodlands. These areas are not conducive to ASR368 creeping bentgrass establishment and would likely contain ASR368 creeping bentgrass to those areas where it is currently exists.

APHIS previously assessed the weed risk potentials of herbicide resistant and non-herbicide resistant types of creeping bentgrass, using PPQ's weed risk assessment guidelines, as a result of a petition requesting that the Agency list herbicide-resistant creeping bentgrass in its Federal noxious weed regulations. The results of the assessment found the two types of creeping bentgrass to be the same in terms of weed risk potential (USDA-APHIS-PPQ, 2014). As a result, APHIS did not add glyphosate-resistant creeping bentgrass to the Federal list of noxious weeds.

<u>Preferred Alternative: Gene Flow and Weediness</u>

Gene flow could be affected by changes in pollen or flower characteristics, or timing of flowering. The results from the phenotypic and agronomic evaluations support a conclusion that ASR368 creeping bentgrass, compared to its conventional control variety, did not exhibit any changes in reproductive characteristics that would increase likelihood of gene flow, such as fecundity, seed dispersal, increased persistence, pollen viability, or differences in general pollen or flower morphology (Scotts and Monsanto, 2015a; USDA-APHIS, 2016b). Thus, under the Preferred Alternative, the likelihood of gene flow from ASR368 creeping bentgrass is not substantially different than the levels of ASR368 creeping bentgrass gene flow that currently exists.

Weediness potential could be affected if seed dormancy and germination characteristics change. Scotts and Monsanto have presented data from field trials showing seed dormancy and germination characterization indicating that ASR368 creeping bentgrass seed had no changes in the dormancy or germination characteristics that could be indicative of increased plant weediness or pest potential compared to the conventional creeping bentgrass control (Scotts and Monsanto, 2015a). Scotts and Monsanto presented data from field trials on the establishment and persistence of seedlings showing that ASR368 creeping bentgrass would not be expected to germinate, establish or persist in unmanaged competitive and non-competitive ecosystems differently from conventional creeping bentgrasses (Scotts and Monsanto, 2015a). They also conducted field trials on the vegetative establishment and persistence of ASR368 creeping bentgrass and found that ASR368 creeping bentgrass plants are not different from conventional creeping bentgrass cultivars in their ability to produce new tillers from viable stolon nodes (Scotts and Monsanto, 2015a). Collectively, these findings support the conclusion that ASR368 creeping bentgrass is no more likely to be a weed compared to conventional creeping bentgrass.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to change the levels of ASR368 creeping bentgrass gene flow that currently exists. Growers and landowners will likely continue to manage ASR368 creeping bentgrass as part of their routine weed management programs to minimize further distribution. ASR368 creeping bentgrass' presence in the environment will likely stay localized to mesic habitats such as the canals and irrigation ditches.

4.4.4 Microorganisms

<u>No Action Alternative: Microorganisms</u>

The soil microbial community is an integral ecosystem component that may provide and sustain critical ecological processes. Soil microorganisms play a key role in soil structure formation, decomposition of organic matter, toxin removal, nutrient cycling, and most biochemical soil processes (Garbeva *et al.*, 2004). They also suppress soil-borne plant diseases and promote plant growth (Doran *et al.*, 1996). As described in Section 3.3.4, Microorganisms, the main factors affecting microbial population size and diversity include soil and plant type, and agricultural management practices (tillage, herbicide and fertilizer application, and irrigation) (Garbeva *et al.*, 2004). Plant roots, including those of creeping bentgrass, release a variety of compounds into the soil creating a unique environment for microorganisms in the rhizosphere.

Management practices used in conventional creeping bentgrass seed production and on golf courses can affect soil microorganisms by altering microbial populations and activity through modification of the soil environment. Some management practices may be beneficial for one microorganism but detrimental to another. As presented in Section 3.3.4, Microorganisms, management practices affect microbial community structure and functions such as nutrient cycling, disease promotion or suppression, and presence in soil. Conventional creeping bentgrass seed production and management practices are expected to continue as currently practiced and conventional creeping bentgrass would continue to be widely used on golf courses under the No Action Alternative.

Herbicides used to manage ASR368 creeping bentgrass would continue in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass, with growers and landowners being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs, most likely using a combination of registered herbicides and physical and mechanical techniques. Registered herbicides used for ASR368 creeping bentgrass management have the potential to impact soil microbes. However, the EPA has evaluated the potential impacts of those herbicides to soil microbes as part of its FIFRA registration and registration review process.

Preferred Alternative: Microorganisms

A determination of nonregulated status of ASR368 creeping bentgrass is not expected to result in any new impacts to microbial communities. ASR368 creeping bentgrass is agronomically and compositionally equivalent to conventional creeping bentgrass varieties currently in commercial production with the exception of the glyphosate-resistance trait (Scotts and Monsanto, 2015a). No known adverse effects on soil microorganisms are associated with ASR368 creeping bentgrass or its cultivation.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to affect the total acreage and range of creeping bentgrass nor the cultivation and management practices for conventional creeping bentgrass.

Herbicides used to manage ASR368 creeping bentgrass would continue in the same way as under the No Action Alternative, with growers integrating ASR368 creeping bentgrass management, as necessary, into their routine weed management programs to minimize further distribution. Scotts will continue to serve as a resource for ASR368 creeping bentgrass management. As under the No Action Alternative the herbicides used for ASR368 creeping bentgrass management have been evaluated by the EPA for the potential impacts to soil microbes as part of its FIFRA registration and registration review process.

Because the acreage and range as well as the agronomic practices of creeping bentgrass are unlikely to change following a determination of nonregulated status of ASR368 creeping bentgrass, the impacts of creeping bentgrass production and management on microorganisms are likely to be the same as the No Action Alternative.

4.4.5 Biodiversity

No Action Alternative: Biodiversity

Biological diversity, or the variation in species or life forms in an area, is highly managed in turfgrass production systems as well as on golf courses. Farmers typically plant crops that are genetically adapted to grow well in a specific area of cultivation and have been bred for a specific market. In turfgrass production, farmers want to encourage high yields from their crop, and will intensively manage plant and animal communities through chemical and cultural controls to protect the crop from damage. Golf course managers take similar actions to protect greens and fairways from weeds and animal damage. Therefore, the biological diversity in turfgrass production systems and on golf courses is highly managed and may be lower than in the surrounding habitats.

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be a regulated article. Growers, landowners, and golf course managers would continue to have access to conventional creeping bentgrass varieties. Agronomic practices associated with conventional creeping bentgrass seed production and management, such as cultivation, irrigation, pesticide application, and fertilizer applications, would continue unchanged. Animal and plant species that typically inhabit conventional creeping bentgrass seed production fields will continue to be affected by currently utilized management plans and systems, which include the use of mechanical, cultural, and chemical control methods. The consequences of current agronomic practices associated with conventional creeping bentgrass seed production and management on the biodiversity of plant and animal communities is unlikely to be altered.

Similarly, golf course maintenance of conventional creeping bentgrass would continue unchanged. Animal and plant species that typically inhabit golf courses and their surrounding areas will continue to be affected by currently utilized management plans and systems, which include the use of mechanical, cultural, and chemical control methods. The consequences of current management practices associated with golf course maintenance on the biodiversity of plant and animal communities is unlikely to be altered.

Herbicides used to manage ASR368 creeping bentgrass would continue in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass, with growers and landowners being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs. Scotts and Monsanto have presented compositional data comparing the phenotypic, morphological and compositional characteristics of ASR368 creeping bentgrass with conventional creeping bentgrass, including bioinformatics analysis of allergenicity, toxicity, nutrients and anti-nutrients, and amino acid homology, among others. Compositional analysis of ASR368 creeping bentgrass has shown no statistically significant differences between ASR368 creeping bentgrass and conventional creeping bentgrass (Scotts and Monsanto, 2015a).

Impacts to biodiversity associated with agronomic practices in cultivating conventional creeping bentgrass or managing the presence of ASR368 creeping bentgrass are not expected to change under the No Action Alternative. The presence of ASR368 creeping bentgrass is not anticipated to have any impacts on biodiversity.

Preferred Alternative: Biodiversity

Scotts and Monsanto have presented results of agronomic field trials comparing ASR368 creeping bentgrass to conventional creeping bentgrass varieties. The results show that except for the glyphosate-resistance trait, ASR368 creeping bentgrass is phenotypically and agronomically the same as conventional creeping bentgrass (Scotts and Monsanto, 2015a). Therefore, ASR368 creeping bentgrass would not be expected to change agronomic practices with the exception of glyphosate use to control unwanted weeds, and therefore would not likely impact biodiversity any differently than conventional creeping bentgrass.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to affect the total acreage and range of creeping bentgrass nor the cultivation and management practices for creeping bentgrass.

Herbicides used to manage ASR368 creeping bentgrass would continue in the same way as under the No Action Alternative, with growers integrating ASR368 creeping bentgrass management, as necessary, into their routine weed management programs to minimize further distribution. Scotts will continue to serve as a resource for ASR368 creeping bentgrass management. The potential impacts to the environment from herbicides are evaluated by the EPA under its FIFRA registration and registration review process.

As noted in Section 4.4.1 – Animal Communities, Scotts and Monsanto have presented compositional data comparing the phenotypic, morphological and compositional characteristics of ASR368 creeping bentgrass with conventional creeping bentgrass, including bioinformatics analysis of allergenicity, toxicity, nutrients and anti-nutrients, and amino acid homology, among others. Compositional analysis of ASR368 creeping bentgrass has shown no statistically significant differences between ASR368 creeping bentgrass and conventional creeping bentgrass (Scotts and Monsanto, 2015a).

Based on the above information, APHIS has determined that approval of a petition for nonregulated status of ASR368 creeping bentgrass will have the same impact on biodiversity as the No Action Alternative.

4.5 Human Health

No Action Alternative: Human Health

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be regulated by APHIS. Current availability and usage of commercially cultivated conventional creeping bentgrass are expected to remain the same under the No Action Alternative. As noted in Section 3.4 – Human Health, creeping bentgrass is not a food and not consumed directly by humans, but consumers could be exposed to food products derived indirectly from creeping bentgrass due to animals consuming creeping bentgrass. Feed derived from GE creeping bentgrass must be in compliance with all applicable legal and regulatory requirements. GE organisms for feed may undergo a voluntary consultation process with the FDA prior to release onto the market. Scotts and Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002 (Scotts and Monsanto, 2015a). The FDA evaluated the submission and as of September 23, 2003 the consultation was complete with no further questions (US-FDA, 2003a; 2003b).

Exposure to pesticides used on conventional and ASR368 creeping bentgrass would continue under the No Action Alternative. Human exposure to ASR368 creeping bentgrass that is already present in the environment would continue at current levels for the foreseeable future. Management practices of conventional creeping bentgrass, and the associated human health effects, are expected to continue under the No Action Alternative.

As discussed in Section 3.4 – Human Health, agriculture, including conventional creeping bentgrass production, is a relatively high-hazard industry, with machinery-related injuries being the primary hazard. A common agricultural practice, pesticide application, represents the primary exposure route to pesticides for farm workers. Growers will continue to choose agronomic practices based on weed, insect and disease pressures, cost of seed and other inputs, technology fees, human safety, potential for crop injury, and ease and flexibility of the production system. Herbicides used to manage ASR368 creeping bentgrass already present in the environment would remain unchanged as it is not expected to increase beyond areas where it currently exists. Growers and landowners are encouraged to manage ASR368 creeping bentgrass as necessary in accordance with the agreed management plan to minimize further distribution of ASR368 creeping bentgrass. It is anticipated that growers will integrate ASR368 creeping bentgrass management into their routine weed management programs using registered herbicides. The management of ASR368 creeping bentgrass would not increase worker exposure to herbicides or any other weed management practice. Worker safety is taken into consideration by the EPA in the pesticide registration and registration review processes. When use is consistent with the label, pesticides present minimal risk to the worker.

Human exposure to conventional creeping bentgrass crops and products, and the agronomic inputs associated with their production, are not expected to change from the current condition under the No Action Alternative.

<u>Preferred Alternative: Human Health</u>

Under the Preferred Alternative, potential impacts to human health are not anticipated to be different from those under the No Action Alternative. As discussed above, creeping bentgrass is not consumed directly by humans, but could be used as a forage/feed crop, and creeping bentgrass may also be fed upon by wildlife. ASR368 creeping bentgrass has been shown to be compositionally equivalent to conventional creeping bentgrass with the exception of the glyphosate-resistance trait (Scotts and Monsanto, 2015a) and is not expected to result in adverse human health effects from direct or indirect human contact.

Feed derived from GE creeping bentgrass must be in compliance with all applicable legal and regulatory requirements. GE organisms for feed may undergo a voluntary consultation process with the FDA prior to release onto the market. Scotts and Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in

September 2002 (Scotts and Monsanto, 2015a). The FDA evaluated the submission and as of September 23, 2003 the consultation was complete with no further questions (US-FDA, 2003a; 2003b).

The potential human health impacts associated with herbicide use to control ASR368 creeping bentgrass under the Preferred Alternative would be similar to that under the No Action Alternative, with growers integrating ASR368 creeping bentgrass management, as necessary, into their routine weed management programs using registered herbicides to minimize further distribution. The management of ASR368 creeping bentgrass would not increase worker exposure to herbicides or any other weed management practice that would create a worker health risk. The EPA WPS will continue to provide the same level of protection as is currently available under the No-Action Alternative. Accordingly, impacts to worker health under the preferred Alternative are expected to be the same as the No Action Alternative.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to affect human health differently than the No Action Alternative since it would be unlikely for people to come in contact with ASR368 creeping bentgrass other than where it currently exists.

Based on these findings, APHIS has determined that approval of a petition for nonregulated status of ASR368 creeping bentgrass will have the same impact human health as the No Action Alternative.

4.6 Animal Feed

No Action Alternative: Animal Feed

As described in Section 3.5, Animal Feed, conventional creeping bentgrass has limited use as animal feed, but the straw and plant residues (screenings) left over from conventional seed production can be used as animal feed (Scotts and Monsanto, 2015a). In addition, conventional creeping bentgrass can be found in pastures and natural environments throughout the United States, where it can be grazed on by cattle, sheep, and horses because it stays green and palatable throughout the summer (MacBryde, 2006).

Exposure to ASR368 creeping bentgrass that is already present in the environment would likely continue for some time. While unlikely, ASR368 creeping bentgrass may be forage for livestock in the three counties where it is growing if it were present where livestock graze. Management practices, and the associated impacts to livestock health, are not likely to change under the No Action Alternative. Exposure to pesticides used on ASR368 creeping bentgrass would continue under the No Action Alternative.

Preferred Alternative: Animal Feed

Under the Preferred Alternative, a determination of nonregulated status of ASR368 creeping bentgrass is not expected to result in any changes in animal exposure to ASR368 creeping bentgrass compared to the No Action Alternative. ASR368 creeping bentgrass is already present in the environment in the three counties described earlier and is not expected to increase beyond its current distribution. To the extent that livestock currently forage on ASR368 creeping bentgrass, deregulation of ASR368 creeping bentgrass would not change that forage behavior.

Under FFDCA, it is the responsibility of feed manufacturers to ensure that the products they market are safe and properly labeled. Feed derived from ASR368 creeping bentgrass must be in compliance with all applicable legal and regulatory requirements. GE organisms for feed may undergo a voluntary consultation process with the FDA prior to release onto the market. Scotts and Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002, identified under BNF No. 079 (Scotts and Monsanto, 2015a). The FDA evaluated the submission and as of September 23, 2003 the consultation was completed with no further questions (US-FDA, 2003a; 2003b).

Under Section 408 of the FFDCA, the EPA regulates the levels of pesticide residues that can remain on food or food commodities from pesticide applications (US-FDA, 2002). Before allowing the use of a pesticide on food crops, the EPA sets a tolerance, or maximum residue limit, which is the amount of pesticide residue allowed to remain in or on each treated food or feed commodity to ensure a reasonable certainty that no harm will result from aggregate exposure to the pesticide residue on food or animal feed. Actual residues are unlikely to exceed this level when a pesticide is applied according to label directions (US-EPA, 2015d). With regard to pesticides and pesticide residues, management practices for ASR368 creeping bentgrass must adhere to the EPA label use restrictions for pesticides, making it unlikely that any ASR368 creeping bentgrass used for animal feed would exceed tolerance levels.

Compositional analysis were conducted on leaf forage samples from ASR368 creeping bentgrass, the non-transformed parent, B99061R and three conventional varieties produced from four replicated field sites across the U.S. during 2000-2001 (Scotts and Monsanto, 2015a). Leaf forage samples were analyzed for levels of nutrients including proximates (protein, fat, ash and moisture), acid detergent fiber, neutral detergent fiber, crude fiber, minerals (calcium, copper, iron, magnesium, manganese, phosphorous, potassium, sodium and zinc) and carbohydrates by calculation (Scotts and Monsanto, 2015a).

In a combined-site analysis in which the data were pooled among the sites, there were no statistically significant differences observed between ASR368 creeping bentgrass and the conventional controls for any of the analytical components (Scotts and Monsanto, 2015a). In an individual-site analysis of the data, four statistically significant differences were observed between ASR368 creeping bentgrass and B99061R among three different analytical components. Statistically significant differences were detected for the content of moisture (1 site), phosphorus (1 site), and neutral detergent fiber (2 sites). Of the four comparisons observed to be statistically different between ASR368 creeping bentgrass and B99061R, all values of ASR368 creeping bentgrass were within the range and 99 percent tolerance interval of the conventional, commercial varieties (Scotts and Monsanto, 2015a). The statistically significant differences were only observed at one or two sites, not in the combination of all the field sites, and were not considered to be biologically meaningful from a food and feed safety or nutritional perspective. Consequently, the quality of animal feed derived from ASR368 creeping bentgrass is unlikely to be different than animal feed produced from current conventional creeping bentgrass varieties.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to affect animal feed differently than the No Action Alternative since it would be unlikely for ASR368 creeping bentgrass to be used for animal forage.

Based on these findings, approval of a petition for nonregulated status of ASR368 creeping bentgrass will have the same impact on animal feed as the No Action alternative.

4.7 Socioeconomic Impacts

The analysis of potential socioeconomic impacts typically addresses the potential impacts to the domestic trade environment, foreign trade environment, and social and economic environment from the deregulation of a particular crop. However, Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, our analysis will focus on areas where ASR368 creeping bentgrass currently exists and its potential socioeconomic impacts.

4.7.1 Domestic Economic Environment

No Action Alternative: Domestic Economic Environment

As described in Section 3.6.1 – Domestic Economic Environment, turfgrass products are primarily used for golf courses and athletic fields, and on home lawns, businesses, and public roads and highways to a lesser extent (Haydu *et al.*, 2006). The market size of the industry is not well quantified on an annual basis, but an estimate for market size is around $40 billion (NTF, 2016). Conventional creeping bentgrass comprises a small subset of the turfgrass industry. Currently, golf courses are the primary market for conventional creeping bentgrass. Due to the high level of maintenance required to sustain the aesthetic character of conventional creeping bentgrass, there is limited home lawn or institutional use.

The vast majority of conventional creeping bentgrass seed is produced in Oregon. In 2013, the Oregon Department of Agriculture reported 4,710 acres produced approximately 2.2 million pounds of bentgrass seed, at a value of $5,567,000 (ODA, 2014). Most of the acreage is located in the Willamette Valley, which produces almost two-thirds of the total cool-season grass seed in the United States (OSC, 2016a; 2016c).

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be regulated by APHIS. Growers and other parties who are involved in production, handling, processing, or use of conventional creeping bentgrass would not have access to ASR368 creeping bentgrass and its progeny, but would continue to have access to conventional creeping bentgrass varieties. Creeping bentgrass production and use would be expected to continue much as it is currently.

Growers and landowners will be encouraged to incorporate ASR368 creeping bentgrass management into their current weed management practices, most likely in the form of a tank mix with herbicides currently used and physical and mechanical techniques. Growers and landowners controlling ASR368 creeping bentgrass as a weed may experience a marginal incremental cost associated with this herbicide use.

Currently, ASR368 creeping bentgrass occurs in regions where Kentucky bluegrass, fine fescue, and perennial ryegrass are grown for seed production. There could be potential economic impacts from ASR368 creeping bentgrass seed intermixing with these other grass seeds. One example of this happening is an incident in 2003 where ASR368 creeping bentgrass was identified in Kentucky bluegrass seed production fields in Jefferson County, Oregon. If ASR368 creeping bentgrass seeds were to become intermixed with Kentucky bluegrass seeds, it could potentially impact sales, including sales to foreign markets. In the Jefferson County discovery, all seed lots from Kentucky bluegrass fields where ASR368 creeping bentgrass plants were discovered, were quarantined, cleaned at The Scotts Company’s expense, and evaluated for the presence of ASR368 creeping bentgrass seeds for a period of four years. After four years of testing, no ASR368 creeping bentgrass seeds were identified in a total of 102 seed lots analyzed by a registered, independent seed lab. Kentucky bluegrass seed production, has not been impacted even when ASR368 creeping bentgrass was present in Kentucky bluegrass seed production fields. The lack of ASR368 creeping bentgrass seeds in Kentucky bluegrass seed lots is attributed to the differences in flowering timing, seed size differences, and efforts to remove ASR368 creeping bentgrass and conventional creeping bentgrass from the affected fields (Scotts and Monsanto, 2015b).

Preferred Alternative: Domestic Economic Environment

A determination of nonregulated status of ASR368 creeping bentgrass is not expected to adversely impact domestic commerce any differently than the No Action Alternative. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would be expected to have the same effects on the domestic economic environment as the No Action Alternative since ASR368 creeping bentgrass will not be introduced into domestic commerce.

Under the management plan, growers and landowners will be encouraged to incorporate ASR368 creeping bentgrass management into their current weed management practices, most likely in the form of a tank mix with herbicides currently used or physical or mechanical techniques. To the extent growers choose to manage ASR368 creeping bentgrass, they may experience a marginal incremental increased cost associated with herbicide use, but that cost would be the same under the No Action and Preferred Alternatives.

As noted above, even when ASR368 creeping bentgrass has been found in Kentucky bluegrass seed lots, no market impacts are expected because of the differences in flowering timing, seed size differences, and weed control measures already in place. Therefore, a determination of nonregulated status of ASR368 creeping bentgrass will not impact production of other turfgrasses grown in the area where ASR368 creeping bentgrass is currently known to exist and therefore would not be expected to impact markets for those crops.

Due to the assumption that ASR368 creeping bentgrass will not be grown, and the range and abundance of ASR368 creeping bentgrass is not expected to increased compared to the No Action Alternative potential impacts to the domestic economic environment associated with the Preferred Alternative are expected to be no different than those currently observed under the No Action Alternative.

4.7.2 Trade Economic Environment

No Action Alternative: Trade Economic Environment

As noted in Section 3.6.2 – Trade Economic Environment, around 12 to 15 percent of turf grass seed grown in Oregon is exported to nearly 60 countries worldwide with China, Japan, and Korea being the primary consumers (OSC, 2016a). In 2013, Oregon seeds exports where valued at $378,800,000 (ODA, 2014).

Under the No Action Alternative, ASR368 creeping bentgrass would continue to be regulated by APHIS. There is unlikely to be any change to the current creeping bentgrass market. Current availability and usage of commercially cultivated conventional creeping bentgrass is expected to remain the same under the No Action Alternative. Asia is likely to continue as a major export destination for conventional creeping bentgrass products.

Preferred Alternative: Trade Economic Environment

A determination of nonregulated status of ASR368 creeping bentgrass is not expected to adversely impact international creeping bentgrass markets differently than the No Action Alternative. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to affect the trade economic environment differently than the No Action Alternative since ASR368 creeping bentgrass will not be cultivated.

Trade of seed requires producers to certify their seed through regulatory agencies. Certification is widely used for seed destined for international trade. Certification programs, administered by state agencies, state universities, and/or state departments of agriculture, would continue to ensure that turfgrass seeds destined for international trade would continue to meet established criteria set by the Association of Official Seed Certifying Agencies (AOSCA) (AOSCA, 2015) and the Organization for Economic Co-operation and Development (OECD) (OECD, 2016) and would not include ASR368 creeping bentgrass seeds.

The trade economic impacts associated with a determination of nonregulated status of ASR368 creeping bentgrass would be no different than those currently expected under the No Action Alternative.

5 CUMULATIVE IMPACTS

A cumulative impact may be an effect on the environment which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. For example, the potential impacts associated with a determination of nonregulated status for a GE crop in combination with the future production of crop seeds with multiple deregulated traits (i.e., “stacked” traits), including drought tolerance, herbicide resistance, and pest resistance, would be considered a cumulative impact.

5.1 Assumptions Used for Cumulative Impacts Analysis

Cumulative impacts have been analyzed for each environmental issue assessed in Section 4, Environmental Consequences. In this EIS, the cumulative impacts analysis is focused on the incremental impacts of the Preferred Alternative taken in consideration with related activities including past, present, and reasonably foreseeable future actions. In this analysis, if there are no direct or indirect impacts identified for a resource area, then APHIS assumes there can be no cumulative impacts. Where it is not possible to quantify impacts, APHIS provides a qualitative assessment of potential cumulative impacts.

APHIS considered the potential for ASR368 creeping bentgrass to extend the range of creeping bentgrass production and cultivation. ASR368 creeping bentgrass was originally developed in the 1990s to address a market need for a product that would simplify golf course weed management (Scotts and Monsanto, 2015b). During field testing in 2003 and 2004 creeping bentgrass escaped from authorized field trial sites. As a result of this escape, Scotts was fined and required to conduct workshops on their efforts to monitor and destroy ASR368 creeping bentgrass (USDA, 2007). Since this time, market conditions have changed and ASR368 no longer has commercial value (Scotts and Monsanto, 2015b; Scotts, 2016). Scotts and Monsanto have stated in their petition that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Scotts has since destroyed all commercial ASR368 creeping bentgrass seed stock and withdrew their EPA label amendment application for any glyphosate-based product for use on ASR368 creeping bentgrass (Scotts and Monsanto, 2015b). In addition Scotts has agreed to a management plan and reiterated their companies commitment to the management of ASR368 creeping bentgrass in the three affected counties where it currently exists (USDA-APHIS, 2015a; Scotts, 2016). Therefore, as part of the cumulative impacts analysis, APHIS will assume that ASR368 creeping bentgrass will not be commercially produced and that Scotts and Monsanto will continue their management efforts as agreed upon in the MOA (USDA-APHIS, 2015b; 2015a).

5.2 Cumulative Impacts: Acreage and Area of Creeping Bentgrass Production

Neither the No Action nor the Preferred Alternative are expected to directly cause a measurable change in agricultural acreage or area devoted to creeping bentgrass cultivation in the United States (see Section 4.2.1, Acreage and Range of Creeping Bentgrass Production). Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, deregulation of ASR368 creeping bentgrass would not be expected to affect the total acres and range of U.S. conventional creeping bentgrass nor the acreage and range of ASR368 creeping bentgrass currently in the environment.

Growers would continue to be encouraged to manage ASR368 creeping bentgrass as part of their routine weed management programs, with Scotts serving as a resource. Because the area where ASR368 creeping bentgrass is found, irrigation and drainage ditches, is surrounded by a native desert landscape that is not conducive to ASR368 creeping bentgrass establishment and persistence, ASR368 creeping bentgrass is geographically isolated and likely contained in the area where it is currently found. While it is possible for ASR368 creeping bentgrass to move beyond the areas where it currently exists, evidence from the over 10 years of management have shown that this is unlikely. Scotts has reaffirmed that they are committed to continuing the management plan after deregulation (Scotts, 2016). Any impacts from ASR368 creeping bentgrass movement from areas where it currently exists would be the same under the No Action and Preferred Alternatives. Because ASR368 creeping bentgrass us unlikely to become established beyond the areas where it currently exists, the Preferred Alternative would have no impacts to acreage or area of creeping bentgrass production different than the No Action Alternative.

5.3 Cumulative Impacts: Agronomic Practices

In the preceding analysis, the potential impacts from a determination of nonregulated status of ASR368 creeping bentgrass were assessed. With the exception of the glyphosate-resistant trait, ASR368 creeping bentgrass is phenotypically and agronomically comparable to conventional commercially cultivated creeping bentgrass (Scotts and Monsanto, 2015a). Agronomic practices such as seed bed preparation, post-harvest residue management, the application of agricultural chemicals, core aeration, and sand topdressing would not change from those currently used for production and management of conventional creeping bentgrass. ASR368 creeping bentgrass would not alter agronomic requirements for cultivation.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Herbicide use would also be unchanged from the No Action Alternative. Growers and landowners would continue to manage ASR368 creeping bentgrass, as necessary, as part of their routine weed management program using the same registered herbicides used under the No Action Alternative. ASR368 creeping bentgrass is unlikely to be more difficult to control than conventional creeping bentgrass in rights of way and waste areas, turf, or fruit crops, but may be more difficult to control in riparian areas and grass seed production fields due to more limited herbicide options in these areas (USDA-APHIS, 2016b). Detailed analysis of the alternative herbicides that can be used to control ASR368 creeping bentgrass in different environments can be found in the accompanying PPRA (USDA-APHIS, 2016b). In addition to spot treatment with herbicides, ASR368 creeping bentgrass found along irrigation ditches or canals can be removed by mechanical methods such as double disking, hand hoeing, and hand pulling (Chastain, 2003; Butler *et al.*, 2005). Mowers, scythes, or string trimmers can reduce stands of emergent plants and searing or burning plants with a propane torch may also be used to slow growth (Patten *et al.*, 2016). Scotts will continue to serve as a resource for ASR368 creeping bentgrass management (USDA-APHIS, 2015a). Consequently, no changes to agronomic practices are expected from a determination of nonregulated status of ASR368 creeping bentgrass.

5.4 Cumulative Impacts: Physical Environment

As discussed in Section 4.3, Physical Environment, approving the petition for nonregulated status of ASR368 creeping bentgrass under the Preferred Alternative would have the same potential impacts to water, soil, air quality, and climate change as that of conventional creeping bentgrass varieties currently available. Agronomic practices that have the potential to impact soil, water and air quality, and climate change such as tillage, agricultural inputs (fertilizers and pesticides), and irrigation would not change because ASR368 creeping bentgrass will not be commercialized. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). In addition, ASR368 creeping bentgrass has been determined to be agronomically similar to conventional creeping bentgrass varieties (Scotts and Monsanto, 2015a). No difference in impacts to these resources would occur between the Preferred and No Action Alternatives. Therefore, no cumulative impacts to the physical environment would be expected.

5.5 Cumulative Impacts: Biological Resources

The impacts of the Preferred Alternative to animal and plants communities, microorganisms, and biodiversity as discussed in Section 4.4, Biological Resources would be no different than that experienced under the No Action Alternative. Animal communities would not be affected by direct contact or consumption of ASR368 creeping bentgrass. This assessment is based on the lack of toxicity or allergenicity from the CP4 EPSPS protein and due to its nutritional and compositional equivalence to conventional creeping bentgrass varieties (Scotts and Monsanto, 2015a). Compositional analysis of ASR368 creeping bentgrass has shown no statistically significant differences between ASR368 creeping bentgrass and conventional creeping bentgrass (Scotts and Monsanto, 2015a) and therefore would pose no greater risk to animal communities that conventional bentgrass species. Scotts and Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002 (Scotts and Monsanto, 2015a). The FDA completed its consultation with no further questions on September 23, 2003 (US-FDA, 2003a).

ASR368 creeping bentgrass is unlikely to have a cumulative impact on soil microorganisms or biodiversity relative to conventional creeping bentgrass varieties. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Growers would continue to choose certain pesticides based on weed, insect and disease pressures, human safety, potential for crop injury, and ease and flexibility of use. Should growers choose to manage ASR368 creeping bentgrass as a weed, herbicides used to manage ASR368 creeping bentgrass would continue in accordance with the agreed management plan, with growers being encouraged to integrate ASR368 creeping bentgrass management into their routine weed management programs, most likely using a combination of registered herbicides. Scotts will continue to serve as a resource for ASR368 creeping bentgrass management (USDA-APHIS, 2015a). Application of herbicides will continue to be dictated by both individual farm need and EPA label use restrictions. As a consequence of its herbicide registration program, EPA has effectively determined that there is no unreasonable environmental risk if the end user adheres to the directions and restrictions on the EPA registration label when applying herbicide formulations.

ASR368 creeping bentgrass is both agronomically and compositionally similar to conventional creeping bentgrass varieties with the exception of the glyphosate-resistance trait. The results from the phenotypic and agronomic evaluations support a conclusion that ASR368 creeping bentgrass, compared to its conventional control variety, did not exhibit any changes in reproductive characteristics that would increase likelihood of gene flow, such as fecundity, seed dispersal, increased persistence, pollen viability, or differences in general pollen or flower morphology (Scotts and Monsanto, 2015a; USDA-APHIS, 2016b). Thus, under the Preferred Alternative, the likelihood of gene flow from ASR368 creeping bentgrass is not substantially different than the levels of ASR368 creeping bentgrass gene flow that currently exists. Scotts and Monsanto have also presented data from field trials showing seed dormancy and germination characterization indicating that ASR368 creeping bentgrass seed had no changes in the dormancy or germination characteristics that could be indicative of increased plant weediness or pest potential compared to the conventional creeping bentgrass control (Scotts and Monsanto, 2015a). Collectively, these findings support the conclusion that ASR368 creeping bentgrass is no more likely to be a weed compared to conventional creeping bentgrass.

There are no differences in the potential for gene flow and weediness between the Preferred Action and No Action alternatives. Therefore, no cumulative impacts to the biological resources analyzed in this draft EIS are expected.

5.6 Cumulative Impacts: Public Health and Animal Feed

Food and feed derived from GE creeping bentgrass must be in compliance with all applicable legal and regulatory requirements and may undergo a voluntary consultation process with the FDA prior to release onto the market to identify and discuss relevant safety, nutritional, or other regulatory issues regarding the bioengineered food. As discussed in Sections 4.5, Public Health and 4.6, Animal Feed, creeping bentgrass is not consumed directly by humans, but could be used as a feed crop, and creeping bentgrass may also be fed upon by wildlife. ASR368 creeping bentgrass has been shown to be compositionally equivalent to conventional creeping bentgrass with the exception of the glyphosate-resistance trait (Scotts and Monsanto, 2015a) and is not expected to create any adverse human health effects from direct or indirect human contact. Scotts and Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002 (Scotts and Monsanto, 2015a). The FDA evaluated the submission and as of September 23, 2003 the consultation was complete with no further questions (US-FDA, 2003a). No change in food and feed safety is expected to occur under the Preferred Alternative.

The potential human health impacts associated with herbicide use to control ASR368 creeping bentgrass would be unchanged from the No Action Alternative, with growers integrating ASR368 creeping bentgrass management, as necessary, into their routine weed management programs using registered herbicides. The management of ASR368 creeping bentgrass would not increase worker exposure to herbicides or any other weed management practice that would create a worker health risk. The EPA WPS will continue to provide the same level of protection as is currently available under the No-Action Alternative. Accordingly, impacts to worker health under the preferred Alternative are expected to be the same as the No Action Alternative.

In the preceding analysis, the potential impacts from approving the petition for nonregulated status to ASR368 creeping bentgrass were assessed. The compositional analysis proximates (protein, fat, ash and moisture), acid detergent fiber, neutral detergent fiber, crude fiber, minerals (calcium, copper, iron, magnesium, manganese, phosphorous, potassium, sodium and zinc) and carbohydrates by calculation. None of the components showed a significant difference between ASR368 creeping bentgrass and the conventional control (Scotts and Monsanto, 2015a). As a result, the potential impacts under the Preferred Alternative for animal feed are the same as those described for the No Action Alternative.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Therefore, a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to have any significant negative impacts on human health or animal feed analyzed in this EIS.

5.7 Cumulative Impacts: Socioeconomics

Based on the information described in Section 4.7.1 – Domestic Economic Environment and 4.7.2 – Trade Economic Environment, APHIS concludes that a determination of nonregulated status of ASR368 creeping bentgrass will have no foreseeable adverse cumulative impacts on domestic commerce or trade. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass and they have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Scotts and Monsanto have also stated in their petition that they do not intend to make any submissions for approval of ASR368 creeping bentgrass to foreign governments (Scotts and Monsanto, 2015a).

Under the management plan, growers will be encouraged to incorporate ASR368 creeping bentgrass management into their current weed management practices, most likely in the form of a tank mix with herbicides currently used. To the extent growers choose to manage ASR368 creeping bentgrass, they may experience a marginal incremental cost associated with herbicide use, but that cost would be the same under the No Action and Preferred Alternatives.

If ASR368 creeping bentgrass seeds were to become intermixed with other grass seeds, it could potentially impact sales. However, it is unlikely that ASR368 creeping bentgrass seeds would become intermixed with other grass seeds because of differences in flowering timing and seed size (Scotts and Monsanto, 2015b). Certification programs, administered by state agencies, state universities, and/or state departments of agriculture, would continue to ensure that turfgrass seeds destined for international trade would continue to meet established criteria set by the Association of Official Seed Certifying Agencies (AOSCA) (AOSCA, 2015) and the Organization for Economic Co-operation and Development (OECD) (OECD, 2016) and would not include ASR368 creeping bentgrass seeds. A determination of nonregulated status of ASR368 creeping bentgrass is not expected to adversely impact international creeping bentgrass markets.

Based on these factors, APHIS has determined that a determination of nonregulated status for ASR368 creeping bentgrass would not be expected to have any cumulative impacts on domestic commerce or international trade as analyzed in this EIS.

5.8 Cumulative Impacts Summary

In summary, the potential for impacts of ASR368 creeping bentgrass would not result in any changes to the resource areas when compared to the No Action Alternative. No cumulative impacts are expected from approving the petition for nonregulated status for ASR368 creeping bentgrass, when taken in consideration with related activities, including past, present, and reasonably foreseeable future actions.

6 Threatened and Endangered Species

The Endangered Species Act (ESA) of 1973, as amended, is one of the most far-reaching wildlife conservation laws ever enacted by any nation. Congress passed the ESA to prevent extinctions facing many species of fish, wildlife and plants. The purpose of the ESA is to conserve endangered and threatened species, and the ecosystems on which they depend, as key components of America's heritage. To implement the ESA, the U.S. Fish & Wildlife Service (USFWS) works in cooperation with the National Marine Fisheries Service (NMFS), other Federal, State, and local agencies, Tribes, non-governmental organizations, and private citizens. Before a plant or animal species can receive the protection provided by the ESA, one of the Services must first add it to the Federal list of threatened and endangered wildlife and plants. Threatened and endangered (T&E) species are plants and animals at risk of becoming extinct throughout all or part of their geographic range (endangered species) or species likely to become endangered in the foreseeable future throughout all or a significant portion of their ranges (threatened species).

The Services add a species to the list when they determine it is endangered or threatened because of any of the following factors or a combination thereof:

- The present or threatened destruction, modification, or curtailment of its habitat or range;
- Overutilization for commercial, recreational, scientific, or educational purposes;
- Disease or predation;
- The inadequacy of existing regulatory mechanisms; or
- The natural or manmade factors affecting its survival.

Once an animal or plant is added to the list, in accordance with the ESA, protective measures apply to the species and its habitat. These measures include protection from adverse effects of Federal activities.

6.1 Requirements for Federal Agencies

Section 7 (a)(2) of the ESA requires that federal agencies, in consultation with USFWS and/or the NMFS, ensure that any action they authorize, fund, or carry out is "not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat." It is the responsibility of the federal agency taking the action to assess the effects of their action and to consult with the USFWS and NMFS if it is determined that the action "may affect" listed species or designated critical habitat. To facilitate their ESA consultation requirements, APHIS met with the USFWS from 1999 to 2003 to discuss factors relevant to APHIS' regulatory authority and effects analysis for petitions for nonregulated status and developed a process for conducting an effects determination consistent with the PPA (Title IV of Public Law 106-224). APHIS uses this process to help fulfill its obligations and responsibilities under Section 7 of the ESA for biotechnology regulatory actions.

The APHIS regulatory authority over GE organisms is limited to those GE organisms for which it has reason to believe might be a plant pest or those for which APHIS does not have sufficient information to determine that the GE organism is unlikely to pose a plant pest risk (7 CFR

§340.1). In this case, Scotts and Monsanto requests that the USDA APHIS consider that ASR368 creeping bentgrass is not a plant pest as defined by Plant Protection Act (PPA). After completing a Plant Pest Risk Assessment, if APHIS determines that ASR368 creeping bentgrass seeds, plants, or parts thereof do not pose a plant pest risk, then this article would no longer be subject to the plant pest provisions of the PPA or to the regulatory requirements of 7 CFR Part 340, and therefore, APHIS must reach a determination that this article is no longer regulated. As part of its EIS analysis, APHIS analyzed the potential effects of ASR368 creeping bentgrass on the environment, including any potential effects to threatened and endangered (T&E) species and critical habitat. As part of this process, APHIS thoroughly reviews GE product information and data related to the GE organism to inform the ESA effects analysis and, if necessary, the biological assessment. For each transgene/transgenic plant the following information, data, and questions are considered by APHIS:

- A review of the biology, taxonomy, and weediness potential of the crop plant and its sexually compatible relatives;
- Characterization of each transgene with respect to its structure and function and the nature of the organism from which it was obtained;
- A determination of where the new transgene and its products (if any) are produced in the plant and their quantity;
- A review of the agronomic performance of the plant including disease and pest susceptibilities, weediness potential, and agronomic and environmental impact;
- Determination of the concentrations of known plant toxicants (if any are known in the plant);
- Analysis to determine if the transgenic plant is sexually compatible with any T&E species of plants or a host of any T&E species; and
- Any other information that may inform the potential for an organism to pose a plant pest risk.

APHIS met with USFWS officials on June 15, 2011, to discuss and clarify whether APHIS has any obligations under the ESA regarding analyzing the effects on T&E species that may occur from use of pesticides associated with GE crops. As a result of these joint discussions, USFWS and APHIS have agreed that it is not necessary for APHIS to perform an ESA effects analysis on pesticide use associated with GE crops because EPA has both regulatory authority over the labeling of pesticides under FIFRA, and the necessary technical expertise to assess pesticide effects on the environment. APHIS has no statutory authority to authorize or regulate the use of pesticides by growers. Under APHIS' Part 340 regulations, APHIS only has the authority to regulate ASR368 creeping bentgrass or any GE organism as long as APHIS believes they may pose a plant pest risk (7 CFR § 340.1). APHIS has no regulatory jurisdiction over any other risks associated with GE organisms including risks resulting from the use of pesticides on those organisms.

In following this review process, APHIS, as described below, has evaluated the potential effects that a determination of nonregulated status of ASR368 creeping bentgrass may have, if any, on federally-listed T&E species and species proposed for listing, as well as designated critical habitat and habitat proposed for designation.

6.2 Potential Effects of ASR368 Creeping Bentgrass on T&E Species

Although Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass now or in the future and that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b; Scotts, 2016) the Preferred Alternative would have otherwise allow for new plantings of ASR368 creeping bentgrass to occur anywhere in the United States. Based on this information, APHIS assessed potential impacts to species and habitat within areas where creeping bentgrass is adapted and used as a turfgrass.

Based on the information submitted by the applicant and reviewed by APHIS, ASR368 creeping bentgrass with the exception of resistance to glyphosate, is agronomically, phenotypically, and biochemically comparable to conventional bentgrass with the exception of the glyphosate-resistance trait (Scotts and Monsanto, 2015a). Scotts and Monsanto have presented results of agronomic field trials for ASR368 creeping bentgrass. The results of these field trials demonstrate that there are no differences in agronomic practices between ASR368 creeping bentgrass and conventional creeping bentgrass (Scotts and Monsanto, 2015a). The common agricultural practices that would be carried out in the cultivation of ASR368 creeping bentgrass are not expected to deviate from current practices, including the use of EPA-registered pesticides. ASR368 creeping bentgrass is not expected to directly cause a measurable change in agricultural acreage or area devoted to creeping bentgrass in the United States (see Section 4.2.1, Acreage and Area of Creeping Bentgrass Production).

Creeping bentgrass is believed to occur in all 50 states, although as a temperate to cool climate grass, to a lesser extent in southern states with more subtropical climates (MacBryde, 2006). Accordingly, the issues discussed herein focus on the potential environmental consequences of approval of the petition for nonregulated status of ASR368 creeping bentgrass on T&E species and critical habitat in the areas where creeping bentgrass can occur. APHIS obtained and reviewed the USFWS list of T&E species (listed and proposed) for all 50 states from the USFWS Environmental Conservation Online System (USFWS, 2016b).

APHIS has determined that no T&E species will be exposed to ASR368 creeping bentgrass as a result of a determination of nonregulated status. As stated previously Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass. Further, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b; Scotts, 2016). In addition, all commercial seed stocks developed for marketing ASR368 creeping bentgrass have been destroyed (Scotts, 2016). Furthermore, the herbicide glyphosate is not labeled for use on ASR368 creeping bentgrass, and the EPA has informed APHIS that all pesticide registration applications for use of glyphosate on ASR368 creeping bentgrass have been withdrawn. Based on these facts, as outlined in the petition and obtained from EPA, APHIS has concluded that no exposures will occur to T&E species as a result of a determination of nonregulated status for ASR368 creeping bentgrass. This conclusion is based on these facts and for this event. Should USDA receive information otherwise or a new glyphosate resistant creeping bentgrass event come before the USDA for a determination of nonregulated status, USDA will supplement this EIS and publish for comment consistent with NEPA regulations.

ASR368 creeping bentgrass is confined to certain areas within Malhuer and Jefferson Counties, Oregon and Canyon County, Idaho, and with the control efforts in place for more than 10 year and underway, no known expansion is occurring within these counties or into other counties bordering these three. Geographic features of the areas where ASR368 creeping bentgrass currently exists make spread to other areas unlikely. The region is very arid and the only locations where ASR368 creeping bentgrass has been found are in irrigation canals, ditches, and riparian areas. Following a public hearing, on May 4, 2016 the Malheur County Court added glyphosate-resistant creeping bentgrass to the high-priority Class A list of noxious weeds at the request of the county Weed Advisory Board. This action requires the grass to be removed or controlled when found, and provides penalties for failure to do so. This regulatory action makes it much less likely that ASR368 creeping bentgrass will spread, and makes it more likely that its extent would decrease over time.

For its analysis on T&E plants and critical habitat, APHIS focused on the agronomic differences between ASR368 creeping bentgrass and conventional creeping bentgrass varieties currently grown; the potential for increased weediness; and the potential for gene movement to native plants, listed species, and species proposed for listing.

For its analysis of effects on T&E animals, APHIS focused on the implications of exposure to the modified 5-enol pyruvylshikimate-3-phosphate synthase (EPSPS) protein expressed in ASR368 creeping bentgrass as a result of the transformation (Scotts and Monsanto, 2015a), and the ability of the plants to serve as a host for a T&E Species.

6.2.1 Threatened and Endangered Plant Species and Critical Habitat

The agronomic data provided by Scotts and Monsanto were used in the APHIS analysis of the weediness potential for ASR368 creeping bentgrass, and further evaluated for the potential to impact T&E species and critical habitat. Agronomic studies conducted by Scotts and Monsanto tested the hypothesis that the weediness potential of ASR368 creeping bentgrass is unchanged with respect to conventional bentgrass (Scotts and Monsanto, 2015a). No differences were detected between ASR368 creeping bentgrass and conventional creeping bentgrass in growth, reproduction, or interactions with pests and diseases, other than the intended effect of resistance to glyphosate (Scotts and Monsanto, 2015a). APHIS has concluded that the determination of nonregulated status of ASR368 creeping bentgrass does not present a plant pest risk, does not present an increased risk of weediness, and does not present an increased risk of gene flow when compared to other currently cultivated conventional creeping bentgrass varieties (USDA-APHIS, 2016b).

APHIS BRS commissioned and funded a report by the Weed Science Society of America (WSSA) to assess if *Agrostis* species and sexually compatible *Polypogon* species in the United States currently occur as weeds in any natural or managed ecosystems, whether glyphosate herbicides were important in the management of these species, and to document alternatives to these herbicides for the management of these species and the presence or absence of herbicide resistance in these species (Banks *et al.*, 2005). Results from the WSSA study reveal that while *Agrostis* and *Polypogon* species are widespread throughout the United States, they are not typically aggressive and rarely managed as a weed (Banks *et al.*, 2005). The study also found that there is nothing about glyphosate-resistant creeping bentgrass that will make it inherently more weedy than the existing non-resistant varieties (Banks *et al.*, 2005). If herbicides are used to control these species or to control other weeds in environments where these species can grow, glyphosate is preferred in many of these environments and is typically applied as spot treatments. However, glyphosate is sometimes used broadly to control all vegetation in an area. For example, glyphosate is commonly used on public lands and rights of way because of the lack of residual activity in the soil making it possible to reseed immediately. Several alternative herbicides were identified that can be used to control *Agrostis* and related species in non-crop areas, public lands, forests, etc. where T&E species are most likely to occur (Banks *et al.*, 2005). In addition APHIS Plant Protection and Quarantine (PPQ) assessed the weed risk potentials of herbicide resistant and non-herbicide resistant types of creeping bentgrass (*Agrostis stolonifera)* using the PPQ weed risk assessment guidelines (USDA-APHIS-PPQ, 2014). The assessment found glyphosate-resistant creeping bentgrass to be no different than conventional creeping bentgrass in terms of weed risk potential (USDA-APHIS-PPQ, 2014).

APHIS evaluated the potential of ASR368 creeping bentgrass to cross with a listed species. There are at least 11 well characterized species of *Agrostis* and 2 species of *Polypogon* in the United States with which it is known that *A. stolonifera* can directly hybridize (see Tables 1 & 2 in (MacBryde, 2006)). Natural hybrids have been described with all except *A. pallens* and *A. idahoensis*. There is some question about whether natural hybrids with *A. scabra* were formed with *A. stolonifera* or with *A. gigantea* (see Table 2 in (MacBryde, 2006)). The various hybrids are for the most part sterile or with very low fertility, but can be vegetatively vigorous (Table 2 in (MacBryde, 2006)). None of the relatives of creeping bentgrass are Federally listed (or proposed) as endangered or threatened species (http://www.fws.gov/endangered/). Accordingly, the presence of ASR368 creeping bentgrass in the environment will not result in movement of the inserted genetic material to any endangered or threatened species.

Scotts and Monsanto have stated in a Memorandum of Understanding with USDA that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass in the future. Further, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate ASR368 creeping bentgrass (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b; Scotts, 2016). While the efforts to date have not eradicated ASR368 creeping bentgrass, it has been well contained, and it has not spread further from the areas of release in over a decade. The Scotts Company LLC has been committed to the control efforts of ASR368 creeping bentgrass and entered a Memorandum of Agreement (MOA) with the USDA that describes their commitment to control feral glyphosate-resistant creeping bentgrass in Jefferson County and Malheur County, Oregon and Canyon County, Idaho over at least the next ten years (USDA-APHIS, 2015a).

After reviewing the list of threatened and endangered plant species, APHIS determined, based on agronomic field data, literature surveyed on creeping bentgrass weediness potential, no sexual compatibility of any T&E species with creeping bentgrass, and the reasonable conclusion that there will be no exposure of T&E species to ASR368 creeping bentgrass, APHIS determined that

ASR368 creeping bentgrass will have no effect on threatened or endangered plant species or on critical habitat.

6.2.2 Threatened and Endangered Animal Species

Threatened and endangered animal species that may be exposed to the gene products from ASR368 creeping bentgrass would be those T&E species that inhabit areas where creeping bentgrass is found and/or may feed on creeping bentgrass.

APHIS considered the risks to threatened and endangered animals from consuming ASR368 creeping bentgrass. Scotts and Monsanto have presented information on the food and feed safety of ASR368 creeping bentgrass, comparing the ASR368 creeping bentgrass variety with conventional varieties currently grown. There are no toxins or allergens associated with this plant (Scotts and Monsanto, 2015a). Compositionally, ASR368 creeping bentgrass was determined to be the same as conventional varieties. Results presented by Scotts and Monsanto show that the introduced genetic material in ASR368 creeping bentgrass does not result in any compositional differences between ASR368 creeping bentgrass and the non-transgenic hybrid (Scotts and Monsanto, 2015a). A history of safe use demonstrate that the EPSPS protein present in ASR368 creeping bentgrass presents no risk of harm to humans or livestock that consume creeping bentgrass products or to wildlife potentially exposed to ASR368 creeping bentgrass. The EPSPS proteins is exempt by EPA from the requirement for food or feed tolerances in all crops and have a history of safe use in numerous transgenic crop varieties that have been deregulated by the USDA APHIS and reviewed through the biotechnology consultation process with the U.S. Food and Drug Administration. Therefore, there is no expectation that exposure to the protein or the plant will have any effect on T&E animal species that may be exposed to ASR368 creeping bentgrass.

An assessment of the allergenic potential of the protein supports the conclusion that the CP4 EPSPS protein does not pose an allergenic risk to humans or animals (Scotts and Monsanto, 2015a). The donor organisms for the CP4 EPSPS coding sequence, *Agrobacterium* sp. strain CP4, is ubiquitous in the environment and not commonly known for human or animal pathogenicity or allergenicity. The CP4 EPSPS protein lacks structural similarity to allergens, toxins or other proteins known to have adverse effects on mammals. The CP4 EPSPS protein is rapidly digested in simulated digestive fluid and demonstrates no oral toxicity in mice at the level tested (Scotts and Monsanto, 2015a). Based on the above information, the consumption of the CP4 EPSPS protein from ASR368 or its progeny is considered safe for humans and animals.

Compositional analyses were conducted on leaf forage samples from ASR368 creeping bentgrass, the non-transformed parent, B99061R and three conventional varieties produced from four replicated field sites across the United States. Single samples of four additional conventional, commercial varieties were also included to establish commercial ranges and 99 percent tolerance intervals to provide additional information on the range of natural variability for each component. Comparative analyses of proximates (protein, fat, ash and moisture), acid detergent fiber (ADF), neutral detergent fiber (NDF), crude fiber, minerals (calcium, copper, iron, magnesium, manganese, phosphorous, potassium, sodium and zinc) and carbohydrates by calculation were performed. In all, 17 different components were analyzed to assess the composition of ASR368 creeping bentgrass.

In a combined-site analysis in which the data were pooled among the sites, there were no statistically significant differences observed between ASR368 creeping bentgrass and the control B99061R for any of the analytical components (Scotts and Monsanto, 2015a). In an individual-site analysis of the data, four statistically significant differences were observed between ASR368 creeping bentgrass and B99061R among three different analytical components. Statistically significant differences were detected for the content of moisture (1 site), phosphorus (1 site), and NDF (2 sites). Of the four comparisons observed to be statistically different between ASR368 and B99061R, all values of ASR368 creeping bentgrass were within the range and 99 percent tolerance interval of the conventional, commercial varieties (Scotts and Monsanto, 2015a). The statistically significant differences were only observed at one or two sites, not in the combination of all the field sites, and were not considered to be biologically meaningful from a food and feed safety or nutritional perspective. Therefore, it is concluded that ASR368 creeping bentgrass is compositionally equivalent to and as safe and nutritious as the forage produced from other conventional creeping bentgrass varieties (Scotts and Monsanto, 2015a).

Scotts and Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002 to permit the use of straw and chaff from this creeping bentgrass as animal feed. Supplementary information was submitted to the FDA on August 18, 2003. All materials relevant to this notification were placed in an FDA file designated BNF 0079. On September 23, 2003, the FDA responded to this submission and indicated that “Monsanto and Scotts have concluded that glyphosate-tolerant creeping bentgrass forage derived from the new variety is not materially different in composition, safety, and other relevant parameters from creeping bentgrass forage currently on the market and that the GE creeping bentgrass does not raise new issues that would require premarket review or approval by FDA” (US-FDA, 2003a; 2003b).The FDA letter further states that they “have no further questions concerning forage from glyphosate-tolerant creeping bentgrass line ASR368 at this time” (US-FDA, 2003a; 2003b).

APHIS considered the possibility that ASR368 creeping bentgrass could serve as a host plant for a threatened or endangered species (i.e., a listed insect or other organism that may use the creeping bentgrass plant to complete its lifecycle). APHIS reviewed the complete T&E species database available on the FWS website (USFWS, 2016b) and found no listed or proposed animal that would use creeping bentgrass or any of its relatives as a host plant necessary to complete its lifecycle.

6.3 Summary of Effects and Determination

After reviewing the possible effects of determining nonregulated status of ASR368 creeping bentgrass, APHIS has not identified any stressor that could affect the reproduction, numbers, or distribution of a listed T&E species or species proposed for listing. Further, other than the three counties of the escapes which are no longer under APHIS regulatory authority, there is no reasonable expectation that T&E species will be exposed. In the three counties of the release, APHIS has concluded no effects to T&E species should exposure occur. APHIS also considered the potential effect of a determination of nonregulated status of ASR368 creeping bentgrass on designated critical habitat or habitat proposed for designation, and could identify no differences from effects that would occur from the production of other conventional creeping bentgrass varieties. In addition, as ASR368 creeping bentgrass will not be commercialized, there is no exposure to critical habitats. Consumption of ASR368 creeping bentgrass by any listed species or species proposed for listing will not result in a toxic or allergic reaction. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass in the future. Further, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b; Scotts, 2016). No effects are expected to listed and proposed T&E species and critical habitat where creeping bentgrass currently exists because it is reasonable to conclude that there will be no exposure to these habitats or species within them.

Based on these factors, APHIS has concluded that a determination of nonregulated status of ASR368 creeping bentgrass, will have no effect on listed species or species proposed for listing, and would not affect designated habitat or habitat proposed for designation because there is no direct or indirect exposure to listed or proposed species or critical habitat as a result of this determination. Because of this no-effect determination, consultation under Section 7(a)(2) of the Act or the concurrences of the USFWS or NMFS is not required.

7 CONSIDERATION OF EXECUTIVE ORDERS, STANDARDS, AND TREATIES RELATING TO ENVIRONMENTAL IMPACTS

7.1 Executive Orders Related to Domestic Issues

The following executive orders require consideration of the potential impacts of the Federal action to various segments of the population.

> ***Executive Order (EO) 12898 (US-NARA, 2010), "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,"*** requires Federal agencies to conduct their programs, policies, and activities that substantially affect human health or the environment in a manner so as not to exclude persons and populations from participation in or benefiting from such programs. It also enforces existing statutes to prevent minority and low-income communities from being subjected to disproportionately high and adverse human health or environmental effects.
>
> ***EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks,"*** acknowledges that children may suffer disproportionately from environmental health and safety risks because of their developmental stage, greater metabolic activity levels, and behavior patterns, as compared to adults. The EO (to the extent permitted by law and consistent with the agency's mission) requires each Federal agency to identify, assess, and address environmental health risks and safety risks that may disproportionately affect children.

The No Action and Preferred Alternatives were analyzed with respect to EO 12898 and EO 13045. Neither alternative is expected to have a disproportionate adverse impact on minorities, low-income populations, or children.

Based on the information submitted by the applicant and reviewed by APHIS, ASR368 creeping bentgrass is agronomically, phenotypically, and biochemically comparable to conventional creeping bentgrass except for the glyphosate-resistant trait expressed in ASR368 creeping bentgrass. Although humans do not consume creeping bentgrass, straw and screenings may be used in animal feed. Comparative compositional analysis were conducted on leaf forage samples from ASR368 and conventional controls. Analysis found no statistically significant difference between ASR368 creeping bentgrass and the conventional controls. The lack of any statistically significant differences between ASR368 creeping bentgrass and the conventional controls demonstrated that event ASR368 is compositionally equivalent to and as safe and nutritious as the forage produced from other conventional creeping bentgrass varieties (Scotts and Monsanto, 2015a).

Scotts and Monsanto initiated the consultation process with the FDA and submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002 (Scotts and Monsanto, 2015a). The FDA completed their consultation on September 23, 2003 (US-FDA, 2003c).

Scotts and Monsanto indicated in their submission that the CP4 EPSPS proteins in ASR368 creeping bentgrass were shown to be equivalent to that produced in other transgenic crops and previous assessments have shown it is non-toxic to mammals and does not exhibit any potential to be allergenic to humans. Acute oral toxicity studies conducted by Scotts and Monsanto indicated that the CP4 EPSPS protein is rapidly digested in simulated digestive fluid and demonstrate no oral toxicity in mice (Scotts and Monsanto, 2015a). Given the assessed protein safety data, the identical nature of the CP4 EPSPS protein in ASR368 to CP4 EPSPS contained in other products that have been deregulated by USDA-APHIS, CP4 EPSPS contained in ASR368 is also considered as safe for humans, animals, and the environment as conventional creeping bentgrass (Scotts and Monsanto, 2015a). Since Scotts and Monsanto have stated that they will not commercialize ASR368 (Scotts and Monsanto, 2015a), exposure to humans, who do not consume creeping bentgrass, and animals is expected to be negligible.

Based on these factors, a determination of nonregulated status of ASR368 creeping bentgrass is not expected to have a disproportionate adverse impact on minorities, low-income populations, or children.

The following executive order requires consideration of the potential impacts of the Federal action on tribal lands.

> ***EO 13175 (US-NARA, 2010)***, ***"Consultation and Coordination with Indian Tribal Governments"***, pledges agency communication and collaboration with tribal officials when proposed Federal actions have potential tribal implications.

Consistent with EO 13175, APHIS sent a letter of notification and request for comment and consultation on the proposed action to tribes in areas where ASR368 creeping bentgrass could be grown on January 8th, 2016. This letter contained information regarding the Scotts and Monsanto petition and the ASR368 creeping bentgrass variety. Additionally, this same notification also asked tribal leaders to contact APHIS if they believed that there were potentially significant impacts to tribal lands or resources that should be considered. APHIS will continue to consult and collaborate with tribal officials to ensure that they are well-informed and represented in policy and program decisions that may impact their agricultural interests, in accordance with EO 13175.

A determination of nonregulated status of ASR368 creeping bentgrass will not adversely impact cultural resources on tribal properties. Scotts and Monsanto have stated that they will not commercialize or further propagate ASR368 creeping bentgrass and will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a).

The No Action and Preferred Alternatives were analyzed with respect to EO 12898, EO 13045, and EO 13175. Neither alternative is expected to have a disproportionate adverse impact on minorities, low-income populations, or children. Nor is any alternative expected to have potential Tribal implications.

The following executive order addresses Federal responsibilities regarding the introduction and effects of invasive species:

> ***EO 1311 (US-NARA, 2010), "Invasive Species,"*** states that Federal agencies take action to prevent the introduction of invasive species, to provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

Creeping bentgrass is not listed in the United States as a noxious weed species by the Federal government (USDA-NRCS, 2015), nor is it listed as an invasive species by major invasive plant data bases. Scotts and Monsanto have stated that they will not commercialize or further propagate ASR368 creeping bentgrass and will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a). As a result the presence of ASR368 creeping bentgrass is likely to stay localized in mesic habitats, such as irrigation ditches, where it is already located. Any ASR368 creeping bentgrass plants that may become established can be easily managed using standard weed control practices.

Based on the data submitted by the applicant and reviewed by APHIS, ASR368 creeping bentgrass plants are sufficiently similar in fitness characteristics to other creeping bentgrass varieties currently grown and are not expected to become more weedy or invasive than conventional creeping bentgrass.

The following executive order requires the protection of migratory bird populations:

> ***EO 13186 (US-NARA, 2010), "Responsibilities of Federal Agencies to Protect Migratory Birds,"*** states that federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations are directed to develop and implement, within two years, a Memorandum of Understanding (MOU) with the Fish and Wildlife Service that shall promote the conservation of migratory bird populations.

Migratory birds may be found on golf courses where creeping bentgrass is grown. As noted in Section 3.3.1 Animal Communities, a variety of birds including small nongame birds, upland game birds, waterfowl, and grebes are known to feed directly on creeping bentgrass (Esser, 1994; MacBryde, 2006). Data submitted by the applicant has shown no difference in compositional and nutritional quality of ASR368 creeping bentgrass compared with other creeping bentgrass (Scotts and Monsanto, 2015a). As discussed in Section 4.6 Animal Feed, Monsanto submitted a safety and nutritional assessment of food and feed derived from ASR368 creeping bentgrass to the FDA in September 2002 (Scotts and Monsanto, 2015a). The FDA completed consultation on September 23, 2003 (US-FDA, 2003a; 2003b). ASR368 creeping bentgrass was determined not to be allergenic, toxic, or pathogenic in mammals. Based on APHIS' assessment of ASR368 creeping bentgrass, it is unlikely that a determination of nonregulated status of ASR368 creeping bentgrass would have a negative impact on migratory bird populations.

7.2 Executive Orders related to International Issues

EO 12114 (US-NARA, 2010), "Environmental Effects Abroad of Major Federal Actions" requires federal officials to take into consideration any potential environmental effects outside the United States, its territories, and possessions that result from actions being taken.

APHIS has given this EO careful consideration and does not expect a significant environmental impact outside the United States in the event of a determination of nonregulated status of ASR368 creeping bentgrass. All existing national and international regulatory authorities and phytosanitary regimes that currently apply to introductions of new creeping bentgrass varieties internationally apply equally to those covered by an APHIS determination of nonregulated status under 7 CFR part 340.

Any international trade of ASR368 creeping bentgrass subsequent to a determination of nonregulated status of the product would be fully subject to national phytosanitary requirements and be in accordance with phytosanitary standards developed under the International Plant Protection Convention (IPPC) (IPPC, 2010). The purpose of the IPPC "is to secure a common and effective action to prevent the spread and introduction of pests of plants and plant products and to promote appropriate measures for their control" (IPPC, 2010). The protection it affords extends to natural flora and plant products and includes both direct and indirect damage by pests, including weeds.

The IPPC establishes a standard for the reciprocal acceptance of phytosanitary certification among the nations that have signed or acceded to the Convention (172 countries as of March 2010). In April 2004, a standard for pest risk analysis of living modified organisms (LMOs) was adopted at a meeting of the governing body of the IPPC as a supplement to an existing standard, International Standard for Phytosanitary Measure No. 11 (ISPM-11, Pest Risk Analysis for Quarantine Pests). The standard acknowledges that all LMOs will not present a pest risk and that a determination needs to be made early in the pest risk analysis for importation as to whether the LMO poses a potential pest risk resulting from the genetic modification. APHIS pest risk assessment procedures for genetically engineered organisms are consistent with the guidance developed under the IPPC. In addition, issues that may relate to commercialization and transboundary movement of particular agricultural commodities produced through biotechnology are being addressed in other international forums and through national regulations.

The *Cartagena Protocol on Biosafety* is a treaty under the United Nations Convention on Biological Diversity (CBD) that established a framework for the safe transboundary movement, with respect to the environment and biodiversity, of LMOs, which include those modified through biotechnology. The Protocol came into force on September 11, 2003, and 160 countries are Parties to it as of December 2010 (CBD, 2010). Although the United States is not a party to the CBD, and thus not a party to the Cartagena Protocol on Biosafety, U.S. exporters will still need to comply with those regulations that importing countries which are Parties to the Protocol have promulgated to comply with their obligations. The first intentional transboundary movement of LMOs intended for environmental release (field trials or commercial planting) will require consent from the importing country under an advanced informed agreement (AIA) provision, which includes a requirement for a risk assessment consistent with Annex III of the

Protocol and the required documentation. LMOs imported for food, feed, or processing (FFP) are exempt from the AIA procedure, and are covered under Article 11 and Annex II of the Protocol. Under Article 11, Parties must post decisions to the Biosafety Clearinghouse database on domestic use of LMOs for FFP that may be subject to transboundary movement.

APHIS continues to work toward harmonization of biosafety and biotechnology consensus documents, guidelines, and regulations, including within the North American Plant Protection Organization (NAPPO), which includes Mexico, Canada, and the United States, and within the OECD. NAPPO has completed three modules of the Regional Standards for Phytosanitary Measures No. 14, *Importation and Release into the Environment of Transgenic Plants in NAPPO Member Countries* (NAPPO, 2015).

APHIS also participates in the *North American Biotechnology Initiative*, a forum for information exchange and cooperation on agricultural biotechnology issues for the United States, Mexico, and Canada. In addition, bilateral discussions on biotechnology regulatory issues are held regularly with other countries including Argentina, Brazil, Japan, China, and Korea.

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate such plants in the future. Further, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Scotts and Monsanto have stated that they do not intend to make any submissions for approval of ASR368 creeping bentgrass to foreign governments (Scotts and Monsanto, 2015a).

7.3 Compliance with Clean Water Act and Clean Air Act

Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate such plants in the future. Further, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). Since ASR368 creeping bentgrass will not be commercialized impacts to water resources or air quality would be no different than from currently cultivated creeping bentgrass varieties. As discussed in Sections 4.3.2 and 4.3.3, there are no expected significant negative impacts to water resources or air quality associated with ASR368 creeping bentgrass. Based on these analyses, APHIS concludes that a determination of nonregulated status of ASR368 creeping bentgrass would comply with the CWA and the CAA.

7.4 Impacts on Unique Characteristics of Geographic Areas

A determination of nonregulated status of ASR368 creeping bentgrass is not expected to impact unique characteristics of geographic areas such as park lands, prime farmlands, wetlands, wild and scenic areas, or ecologically critical areas.

Monsanto and Scotts have presented results of agronomic field trials for ASR368 creeping bentgrass. The results of these field trials demonstrate that there are no differences in agronomic practices between ASR368 creeping bentgrass and conventional creeping bentgrass. The common agricultural practices that would be carried out in the cultivation of ASR368 creeping bentgrass are not expected to deviate substantially from current practices, including the use of EPA-registered pesticides. Scotts and Monsanto have stated that they do not intend to seek a label amendment for the use of any glyphosate-based product on ASR368 creeping bentgrass since they do not intend to commercialize it (Scotts and Monsanto, 2015a).

There are no proposed major ground disturbances; no new physical destruction or damage to property; no alterations of property, wildlife habitat, or landscapes; and no prescribed sale, lease, or transfer of ownership of any property. This action is limited to a determination of nonregulated status of ASR368 creeping bentgrass. This action would not convert land use to nonagricultural use and, therefore, would have no adverse impact on prime farmland. Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate such plants in the future. Further, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b).

Based on these findings, including the assumption that EPA label use instructions are in place to protect unique geographic areas and that those label use instructions are adhered to, a determination of nonregulated status of ASR368 creeping bentgrass is not expected to impact unique characteristics of geographic areas such as park lands, prime farm lands, wetlands, wild and scenic areas, or ecologically critical areas.

7.5 National Historic Preservation Act of 1966 as Amended

The National Historic Preservation Act (NHPA) of 1966 and its implementing regulations (36 CFR 800) require Federal agencies to: 1) determine whether activities they propose constitute "undertakings" that have the potential to cause effects on historic properties and 2) if so, to evaluate the effects of such undertakings on such historic resources and consult with the Advisory Council on Historic Preservation (i.e., State Historic Preservation Office, Tribal Historic Preservation Officers), as appropriate.

APHIS' proposed action, a determination of nonregulated status of ASR368 creeping bentgrass is not expected to adversely impact cultural resources on tribal properties. Any farming activity that may be taken by farmers on tribal lands would only be conducted at the tribe's request; thus, the tribes would have control over any potential conflict with cultural resources on tribal properties. In addition, Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass. Further, Scotts and Monsanto have stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b).

APHIS' Preferred Alternative would have no impact on districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, nor would it likely cause any loss or destruction of scientific, cultural, or historical resources. This action is limited to a determination of nonregulated status of ASR368 creeping bentgrass.

APHIS' proposed action is not an undertaking that may directly or indirectly cause alteration in the character or use of historic properties protected under the NHPA. In general, common agricultural activities conducted under this action do not have the potential to introduce visual, atmospheric, or noise elements to areas in which they are used that could result in effects on the character or use of historic properties. For example, there is potential for increased noise on the use and enjoyment of a historic property during the operation of tractors and other mechanical equipment close to such sites. A built-in mitigating factor for this issue is that virtually all of the methods involved would only have temporary effects on the audible nature of a site and can be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects. Additionally, Scotts and Monsanto have stated that they have no intention to and will not commercialize or further propagate ASR368 creeping bentgrass. Further, Scotts and Monsanto has stated that they will not grant a license to or otherwise allow other entities to obtain, use, or propagate such plants (Scotts and Monsanto, 2015a; USDA-APHIS, 2015b). The cultivation of ASR368 creeping bentgrass is not expected to change any agronomic practices that would result in an adverse impact under the NHPA.

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No additional parties requested physical copies of the EIS. In addition to this distribution list APHIS notified all of its stakeholders of the availability of the EIS for review and comment.

10 REFERENCES

Coordinated Framework for Regulation of Biotechnology 1986. Pub. L. Stat. June 26.

Statement of Policy: Foods Derived from New Plant Varieties 1992. Pub. L. Stat. May 29.

AAAS (2012) "Statement by the AAAS Board of Directors On Labeling of Genetically Modified Foods. American Association for the Advancement of Science (AAAS)." http://www.aaas.org/news/statement-aaas-board-directors-labeling-genetically-modified-foods.

Ahrens, C; Chung, J; Meyer, T; and Auer, C (2011a) "Bentgrass Distribution Surveys and Habitat Suitability Maps Support Ecological Risk Assessment in Cultural Landscapes." *Weed Science.* 59 (2): p 145-54. Last Accessed: 2016/01/07 http://www.wssajournals.org/doi/abs/10.1614/WS-D-10-00094.1.

Ahrens, C; Ecker, G; and Auer, C (2011b) "The intersection of ecological risk assessment and plant communities: an analysis of Agrostis and Panicum species in the northeastern U.S." *Plant Ecology.* 212 (10): p 1629-42.

Alderman, SC; Elias, S; and Hulting, AG (2012) "Occurrence and Trends of Weed Seed and Pathogen Contaminants in Bentgrass Seed Lots in Oregon." *Seed Technology.* 34 (2): p 203-15. http://www.jstor.org/stable/23433399.

Altieri, MA (1999) "The Ecological Role of Biodiversity in Agroecosystems." *Agriculture, Ecosystems and Environment.* 74 (1-3): p 19-31. Last Accessed: July 2012 http://www.sciencedirect.com/science/article/pii/S0167880999000286.

AMA (2012) "American Medical Association: Report 2 of the Council on Science and Public Health (A-12), Labeling of Bioengineered Foods (Resolutions 508 and 509-A-11)." http://www.ama-assn.org/ama/pub/about-ama/our-people/ama-councils/council-science-public-health/reports/2012-reports.page?

Aneja, VP; Schlesinger, WH; and Erisman, JW (2009) "Effects of Agriculture upon the Air Quality and Climate: Research, Policy, and Regulations." *Environmental Science & Technology.* 43 p 4234-40.

ANZFS (2015) "Australia and New Zealand Food Standards Agency: Current GM applications and approvals " http://www.foodstandards.gov.au/consumer/gmfood/applications/Pages/default.aspx.

AOSCA (2015) "Association of Official Seed Certifying Agencies (AOSCA)." http://www.aosca.org/.

Bais, HP; Weir, TL; Perry, LG; Gilroy, S; and Vivanco, JM (2006) "The role of root exudates in rhizosphere interactions with plants and other organisms." *Annu. Rev. Plant Biol.* 57 (233-266). http://www.annualreviews.org/doi/full/10.1146/annurev.arplant.57.032905.105159?url_v er=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed.

Banks, PA; Branham, B; Harrison, K; Whitson, T; and Heap, I (2005) "Determination of the Potential Impact from the Release of Glyphosate- and Glufosinate-Resistant Agrostis stolonifera L. in Various Crop and Non-Crop Ecosystems." Weed Science Society of America.

Baris, RD; Cohen, SZ; Barnes, NL; Lam, J; and Ma, Q (2010) "Quantitative analysis of over 20 years of golf course monitoring studies." *Environmental Toxicology and Chemistry.* 29 (6): p 1224-36. http://dx.doi.org/10.1002/etc.185.

Batista, R and Oliveira, MM (2009) "Facts and fiction of genetically engineered food." *Trends in Biotechnology.* 27 (5): p 277-86. http://www.sciencedirect.com/science/article/pii/S0167779909000511.

Baucom, RS and Holt, JS (2009) "Weeds of agricultural importance: bridging the gap between evolutionary ecology and crop and weed science." *New Phytologist.* 184 (4): p 741-43.

Beard, JB and Green, RL (1994) "The Role of Turfgrasses in Environmental Protection and Their Benefits to Humans." *Journal of Environmental Quality.* 23 (3). http://dx.doi.org/10.2134/jeq1994.00472425002300030007x

https://dl.sciencesocieties.org/publications/jeq/abstracts/23/3/JEQ0230030452.

Bigelow, CA and Tudor, WT "Economic analysis of creeping bentgrass and annual bluegrass greens maintenance." *Golf Course Superintendents Association Of America (GCSAA).* Last Accessed: 2/9/16 https://www.gcsaa.org/gcm-magazine/2012/october/gcm-october-

2012-economic-analysis-of-creeping-bentgrass-and-annual-bluegrass-greens-maintenance.

Blair, R (1996) "Land Use and Avian Species Diversity Along an Urban Gradient." *Ecological Applications.* 6 (2): p 506-19.

Bollman, MA; Storm, MJ; King, GA; and Watrud, LS (2012) "Wetland and riparian plant communities at risk of invasion by transgenic herbicide-resistant Agrostis spp. in central Oregon." *Plant Ecology.* 213 (3): p 355-70.

Bonos, SA and Murphy, JA (2009) "Bentgrass Cultivars for Golf Course Turf (Bulletin E324). Rutgers, The State University of New Jersey, Cooperative Extension." http://www.sroseed.com/resources/pdfs/articles/bent_cultivars_rutgers2010.pdf.

Bonos, SA; Weibel, EN; Koch, E; Meyer, WA; Sosa, Sa; Cortese, L; and Department of Plant Biology and Pathology, RU (2013) "Breeding Perennial Grasses for a Sustainable Future." http://turf.rutgers.edu/research/abstracts/symposium2013.pdf.

Bradshaw, AD (1958) "Natural hybridization of Agrostis tenuis Sibth. and A. stolonifera L." *New Phytologist* 57 p 66-84. http://onlinelibrary.wiley.com/doi/10.1111/j.1469-8137.1958.tb05917.x/full.

Breuninger, JM; Welterlen, MS; Augustin, BJ; Cline, V; and Morris, K (2013) "The Turfgrass Industry." *Turfgrass: Biology, Use, and Management*. Madison, WI: American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. http://dx.doi.org/10.2134/agronmonogr56.c2.

Brosnan, JT; Breeden, GK; and Patton, AJ (2014) "Weed management options on golf course putting greens." http://www.gcsaa.org/gcm-magazine/2014/august/weed-management-options-on-golf-course-putting-greens.

Buckley, DH and Schmidt, TM (2001) "The structure of microbial communities in soil and the lasting impact of cultivation." *Microbial Ecology.* 42 (1): p 11-21.

Buckley, DH and Schmidt, TM (2003) "Diversity and dynamics of microbial communities in soils from agro-ecosystems." *Environmental Microbiology.* 5 (6): p 441-52.

Burgess, P and Huang, B (2014) "Growth and physiological responses of creeping bentgrass (Agrostis stolonifera) to elevated carbon dioxide concentrations." *Horticultural Research* 1(14021): p 1-8.

Butler, M; Crockett, R; Campbell, C; and Fine, L (2005) "Use of herbicided and tillage to remove commercial plantings of Roundup Ready® creeping bentgrass in central Oregon 2004 ".

CAST (2005) "Crop Biotechnology and the Future of Food: A Scientific Assessment. CAST Commentary QTA 2005, 2 October 2005. ." The Council for Agricultural Science and Technology (CAST). http://www.cast-science.org/download.cfm?PublicationID=2922&File=1030246b70caa799d92cd626634e451d14e4TR.

CBD (2010) "The Cartegena Protocol on Biosafety " Convention on Biological Diversity. Last Accessed: July 2012 http://www.cbd.int/biosafety/.

CCSP (2008) "The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States (U.S. Climate Change Science Program Synthesis and Assessment Product 4.3)." The U.S. Climate Change Science Program. Last Accessed: July 2012 http://www.climatescience.gov/Library/sap/sap4-3/final-report/Synthesis_SAP_4.3.pdf.

Chang, E; Zozaya, E; Kuijper, D; and Bakker, J (2005) "Seed dispersal by small herbivores and tidal water: are they important filters in the assembly of salt-marsh communities?" *Functional Ecology.* 19 p 665-73.

Chastain, T (2003) "Grass Seed Crops: Pest Management, Lodging Control, and Harvest Practices." *The art and science of seed production in the Pacific Northwest*. http://cropandsoil.oregonstate.edu/system/files/u1473/Chapter_5.pdf

Cohen, S; Svrjcek, A; Durborow, T; and Barnes, NL (1999) "Water Quality Impacts by Golf Courses." *Journal of Environmental Quality* 28 (3): p 12.

Cowan, T (2011) "Agricultural Biotechnology: Background and Recent Issues. CRS Report for Congress (7-5700)." Congressional Research Service. http://www.justlabelit.org/wp-content/uploads/2011/09/CRS%20Agricultural_Biotechnology2011.pdf.

Cristol, D and Rodewald, A (2005) "Introduction: Can golf courses play a role in bird conservation?" *Wildlife Society Bulletin.* 33 (2): p 407-10.

Crow, WT (2005) "Plant-parasitic nematodes on golf course turf." *Outlooks on Pest Management.* 16 (1): p 10-15.

DeFrancesco, L (2013) "How safe does transgenic food need to be?" *Nat Biotech.* 31 (9): p 794-802. http://dx.doi.org/10.1038/nbt.2686

http://www.nature.com/nbt/journal/v31/n9/pdf/nbt.2686.pdf.

Dernoeden, PH (2013) *Creeping Bentgrass Management*. CRC Press, Taylor and Francis Group.

Doran, JW; Sarrantonio, M; and Liebig, MA (1996) "Soil Health and Sustainability." *Advances in Agronomy*. p 1-54.

Duble, RL (2016) "Bentgrass." Aggie Horticulture. http://aggie-horticulture.tamu.edu/archives/parsons/turf/publications/Bent.html.

Edgar, E and Forde, MB (1991) "AgrostisL. in New Zealand." *New Zealand Journal of Botany.* 29 (2): p 139-61.

Edminster, CW (no date) "Seed production in the pacific northwest." http://www.intlseed.com/documents/info_NW_seed_production.htm.

EFSA (2015) "European Food Safety Authority: GMO." http://www.efsa.europa.eu/en/science/gmo.

Esser, LL (1994) "Agrostis stolonifera. In: Fire Effects Information System." U.S. Department of Agriculture, Forest Service. http://www.fs.fed.us/database/feis/plants/graminoid/agrsto/all.html#21.

FAO (2009) "Codex Alimentarius, Foods Derived from Modern Biotechnology, 2nd Edition. World Health Organization, Food and Agriculture Organization of the United Nations." ftp://ftp.fao.org/docrep/fao/011/a1554e/a1554e00.pdf.

Fei, S and Nelson, E (2004) "Greenhouse evaluation of fitness-related reproductive traits in roundup®-tolerant transgenic creeping bentgrass (Agrostis Stolonifera L.)." *In Vitro Cellular & Developmental Biology - Plant.* 40 (3): p 266-73. http://dx.doi.org/10.1079/IVP2003522.

Feng, Y; Stoeckel, DM; van Santen, E; and Walker, RH (2002) "Effects of subsurface aeration and trinexapac-ethyl application on soil microbial communities in a creeping bentgrass putting green." *Biology and Fertility of Soils.* 36 (6): p 456-60. http://download.springer.com/static/pdf/353/art%253A10.1007%252Fs00374-002-0558-1.pdf?originUrl=http%3A%2F%2Flink.springer.com%2Farticle%2F10.1007%2Fs00374-002-0558-1&token2=exp=1460399334~acl=%2Fstatic%2Fpdf%2F353%2Fart%25253A10.1007%25252Fs00374-002-0558-1.pdf%3ForiginUrl%3Dhttp%253A%252F%252Flink.springer.com%252Farticle%252F10.1007%252Fs00374-002-0558-1*~hmac=913fe2c59ba40458ba1f4f36d54d3b8a2cd2539bbe93d96c7297f77e8b39154c.

Flessner, ML and McElroy, JS (2013) "Glyphosate-tolerant perennial ryegrass and Poa annua control." https://www.gcsaa.org/gcm-magazine/2013/october/gcm-october-2013-glyphosate-tolerant-perennial-ryegrass-and-poa-annua-control.

Flessner, ML; McElroy, JS; and Wehtje, GR (2014) "Annual Bluegrass (Poa annua) Control in Glyphosate-Resistant Perennial Ryegrass Overseeding." *Weed Technology.* 28 (1): p 213-24.

Frame, J (1991) "Herbage production and quality of a range of secondary grass species at five rates of fertilizer nitrogen application." *Grass and Forage Science.* 46 (2): p 139-51. http://dx.doi.org/10.1111/j.1365-2494.1991.tb02216.x.

Fransen, SC and Chaney, M (2002) "Pasture and Hayland Renovation [EB1870]. Farming West of the Cascades series." Washington State University Cooperative Extension, Oregon State University Extension Service, University of Idaho Cooperative Extension System, and the U. S. Department of Agriculture. http://cru.cahe.wsu.edu/CEPublications/eb1870/eb1870.pdf.

Garbeva, P; van Veen, JA; and van Elsas, JD (2004) "Microbial diversity in soil: Selection of microbial populations by plant and soil type and implications for disease suppressiveness." *Annual Review of Phytopathology*. 42 (1): p 243-70. http://www.ncbi.nlm.nih.gov/pubmed/15283667.

GCSAA (2007) "Golf Course Environmental Profile: Property Profile and Environmental Stewardship of Golf Courses, Volume I." Golf Course Superintendents Association of America. https://www.gcsaa.org/Uploadedfiles/Environment/Environmental-Profile/Property-Profile/Golf-Course-Environmental-Profile--Property-Report.pdf.

GCSAA (2015) "Golf Course Environmental Profile. Phase II, Volume I. 2014 Water Use and Conservation Practices on U.S. Golf Courses." Golf Course Superintendents Association of America. http://www.gcsaa.org/docs/default-source/Environment/phase-2-water-use-survey-full-report.pdf?sfvrsn=4.

Georgis, R; Koppenhöferb, AM; Lacey, LA; Bélaird, G; Duncane, LW; Grewalf, PS; Samishg, M; Tanh, L; Torri, P; and van Tolj, RWHM (2006) "Successes and failures in the use of parasitic nematodes for pest control." *Biological Control.* 38 (1): p 103-23.

Gianessi, LP and Marcelli, MB (2000) "PESTICIDE USE IN U.S. CROP PRODUCTION: 1997." National Center for Food and Agricultural Policy

Gill, R and Beardall, V (2001) "The impact of deer on woodlands: the effects of browsing and seed dispersal on vegetation structure and composition." *Forestry, Vol. 74, No. 3, 2001*. 74 (3): p 209-18.

Goldstein, DA (2014) "Tempest in a Tea Pot: How did the Public Conversation on Genetically Modified Crops Drift so far from the Facts?" *Journal of Medical Toxicology.* 10 (2): p 194-201. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4057531/.

Gosser, AL; Conover, MR; and Messmer, TA (1997) "Managing problems caused by urban Canada geese.

."

Guo, SX; Harriman, RW; Lee, L; and E.K., N 2009) "Bentgrass event ASR-368 and compositions and methods for detection thereof. U.S. Patent 7 569 747. Date issued: 4 August." US Patent: http://www.google.com/patents/US7569747.

Harlan, JR (1975) "Our Vanishing Genetic Resources." *Science.* 188 (4188): p 617-21. Last Accessed: July 2012 http://www.sciencemag.org/content/188/4188/617.short.

Hart, JM; Anderson, NP; Hulting, AG; Chastain, TG; Mellbye, ME; Young , WC; and Silberstein, TB (2012) "Postharvest Residue Management for Grass Seed Production in Western Oregon [EM 9051]." Oregon State University. http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/33454/em9051.pdf.

Harvey, M (2007) "Agrostis L." *Flora of North America, volume 24*. Last Accessed: July 12, 2016 http://herbarium.usu.edu/webmanual/.

Haydu, JJ; Hodges, AW; and Hall, CR (2006) "Economic Impacts of the Turfgrass and Lawncare Industry in the United States (FE632)." University of Florida, Institute of Food and Agricultural Sciences (IFAS). https://edis.ifas.ufl.edu/pdffiles/FE/FE63200.pdf.

Haydu, JJ; Hodges, AW; and Hall, CR (2008) "Estimating the Economic Impact of the U.S. Golf Course Industry: Challenges and Solutions." *HortScience.* 43 (3): p 759-63. http://hortsci.ashspublications.org/content/43/3/759.abstract.

Hopkins, A (2001) "Grass Seed Production " http://www.noble.org/ag/pasture/grassseedproduction/.

Horton, H; Asay, KH; Glover, TF; Young, SA; Haws, BA; Dewey, SA; and Evans, JO (1990) "Grass Seed Production Guide for Utah. Utah State University Cooperative Extension, AG 437." Utah State University Cooperative Extension. https://extension.usu.edu/files/publications/publication/AG_437.pdf.

Hulting, A (2015) "Section E. Grass Seed Crops." *Pacific Northwest Weed Management Handbook.* http://pnwhandbooks.org/weed/sites/default/files/chapters/pdf/e-grassseed.pdf.

Hunt, R; Nicholls, A; and Fathy, S (1987) "Growth and root-shoot partitioning in eighteen British grasses." *OIKOS* 50 p 53-59. Last Accessed: 8/5/16 http://www.jstor.org/stable/3565401?seq=1#page_scan_tab_contents.

IPF (2000) "Idaho Bird Conservation Plan."

IPPC (2010) "International Plant Protection Convention: Protecting the World's Plant Resources from Pests." International Plant Protection Convention. Last Accessed: July 2012 https://www.ippc.int/en/.

Kausch, AP; Hague, J; Oliver, M; Watrud, LS; Mallory-Smith, C; Meier, V; and Stewart, CN (2010) "Gene Flow in Genetically Engineered Perennial Grasses: Lessons for Modification of Dedicated Bioenergy Crops." *Plant Biotechnology for Sustainable Production of Energy and Co-products*. Berlin, Heidelberg: Springer Berlin Heidelberg. p 285-97. http://dx.doi.org/10.1007/978-3-642-13440-1_10

http://link.springer.com/chapter/10.1007%2F978-3-642-13440-1_10.

Kik, C; Van Andel, J; and Joenje, W (1990) "Life-history variation in ecologically contrasting populations of Agrostis stolonifera." *Journal of Ecology.* 78 p 962-73. Last Accessed: 8/5/16 https://www.jstor.org/stable/2260946?seq=1#page_scan_tab_contents.

Kohler, EA; Poole, VL; Reicher, ZJ; and Turco, RF (2004) "Nutrient, metal, and pesticide removal during storm and nonstorm events by a constructed wetland on an urban golf course." *Ecological Engineering.* 23 (4–5): p 285-98. http://www.sciencedirect.com/science/article/pii/S0925857404001442.

Lal, R. "Soil plays an important role in Earth's health." *National Public Radio:Talk of the Nation interview on July 11, 2008*2008.

Loux, M; Doohan, D; Dobbels, A; and Johnson, W (2012) "Weed Control Guide for Ohio and Indiana." Last Accessed: 8 April 2016 http://farmanddairy.lyleprintingandp.netdna-cdn.com/wp-content/uploads/2012/02/2010-Weed-Control-Guide.pdf

Lovett, S; Price, P; and Lovett, J (2003) "Managing Riparian Lands in the Cotton Industry." Cotton Research and Development Corporation. Last Accessed: July 2012 http://www.cottoncrc.org.au/catchments/Publications/Rivers/Managing_Riparian_Lands.

Lucht, JM (2015) "Public Acceptance of Plant Biotechnology and GM Crops." *Viruses.* 7 (8): p 4254-81. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4576180/

http://www.mdpi.com/1999-4915/7/8/2819/pdf.

MacBryde, B (2006) "White Paper: Perspective on Creeping Bentgrass, Agrostis stolonifera L." USDA-APHIS-BRS.

Majerus, ME (no date) "Stimulating Existing Grass Stands For Seed Production." USDA-SCS Plant Materials Center. http://plants.usda.gov/pmpubs/pdf/mtpmcsygrstnd.pdf.

Malheur County Court (2016) "Malheur County Court Minutes." Malheur County Court. http://malheurco.org/sites/malheurco.org/files/File/clerk/05-May%204,%202016.pdf.

Mallory-Smith, C and Zapiola, M (2008) "Gene flow from glyphosate-resistant crops." *Pest Manag Sci.* 64 (4): p 428-40. http://onlinelibrary.wiley.com/doi/10.1002/ps.1517/abstract.

Merola-Zwartjes, M and DeLong, JP (2005) "Avian species assemblages on New Mexico golf courses: surrogate riparian habitat for birds?" *Wildlife Society Bulletin.* 33 (2): p 435-37.

Mueller, SR and Kussow, WR (2005) "Biostimulant influences on turfgrass microbial communities and creeping bentgrass putting green quality." *HortScience.* 40 (6): p 1904-10. http://hortsci.ashspublications.org/content/40/6/1904.full.pdf+html.

Myers, J; Vellend, M; Gardescu, S; and Marks, P (2004) "Seed dispersal by white-tailed deer: implications for long-distance dispersal, invasion, and migration of plants in eastern North America." *Oecologia* 139 p 35-44.

NAPPO (2015) "NAPPO approved standards." Last Accessed: November 2015 http://www.nappo.org/english/standards-and-protocols/regional-phytosanitary-standards-rspms/.

NGF (2016) "National Golf Foundation - Courses/Clubs." http://www.ngf.org/pages/courses-clubs.

NGWA (2010) "Groundwater Facts." http://www.ngwa.org/Fundamentals/use/Documents/gwfactsheet.pdf.

Nicolia, A; Manzo, A; Veronesi, F; and Rosellini, D (2014) "An overview of the last 10 years of genetically engineered crop safety research." *Critical Reviews in Biotechnology*. 34 (1): p 77-88. http://informahealthcare.com/doi/abs/10.3109/07388551.2013.823595.

NTF (2016) "The National Turfgrass Research Initiative " http://www.turfresearch.org/initiative.htm.

"Bentgrass Control Area in Jefferson County." ODA. 2002. http://arcweb.sos.state.or.us/pages/rules/oars_600/oar_603/603_052.html.

ODA (2012) "Oregon grass seed business resurrected by exports." Natural Resource Report. http://naturalresourcereport.com/2012/05/oregon-grass-seed-business-resurrected-by-exports/.

ODA (2014) "Oregon Agricultural: Facts and Figures." Oregon Department of Agriculture. http://www.nass.usda.gov/Statistics_by_State/Oregon/Publications/facts_and_figures/facts_and_figures.pdf.

ODA (2016) "State of Oregon Agriculture: Industry Report from the State Board of Agriculture, January 2015." Oregon Dept. of Agriculture. http://www.oregon.gov/ODA/shared/Documents/Publications/Administration/BoardReport.pdf.

ODA (No Date) "Oregon Noxious Weed Profiles." Oregon Department of Agriculture. http://www.oregon.gov/oda/programs/weeds/oregonnoxiousweeds/pages/aboutoregonweeds.aspx.

ODSL (2011) "Central Oregon Area Management Plan." Last Accessed: 8 April 2016 https://services.oregon.gov/DSL/LW/pages/coamp.aspx.

OECD (2016) "About the OECD Seed Schemes. Organization for Economic Co-operation and Development (OECD)." http://www.oecd.org/tad/code/abouttheoecdseedschemes.htm.

OSC (2016a) "Economy." http://www.oregonseedcouncil.org/economy/.

OSC (2016b) "Farming Practices." http://www.oregonseedcouncil.org/farming-practices/.

OSC (2016c) "Overview." http://www.oregonseedcouncil.org/faqs/.

OSU (2016) "Willamette Valley Field Crops: Grass Seed. Oregon State University." http://oregonstate.edu/valleyfieldcrops/grass-seed.

Owen, M (1971) "The Selection of Feeding Site by White-Fronted Geese in Winter." *Journal of Applied Ecology*. 8 (3): p 905-17. http://www.jstor.org/stable/2402690.

Palm, C; Sanchez, P; Ahamed, S; and Awiti, A (2007) "Soils a Contemporary Perspective."

Patten, K; Madsen, J; and Morgan, VH (2016) "Aquatic Weed Control." *Pacific Northwest Weed Management Handbook*. Oregon State University.

Potter, D (1998) *Destructive Turfgrass Insects: Biology, Diagnosis, and Control*. Chelsea, Michigan: Ann Arbor Press. https://books.google.com/books?id=zMJ4MSKG9-AC&pg=PA276&lpg=PA276&dq=nuisance+wildlife+turfgrass&source=bl&ots=ZsOt9WEXS8&sig=5ZR8Md_TFMFZC76E6ZaebtbTDKE&hl=en&sa=X&ved=0ahUKEwjZlfn0v_rLAhWG7iYKHU3oAZAQ6AEILjAA#v=onepage&q=nuisance%20wildlife%20turfgrass&f=false.

Reichman, JR; Watrud, LS; Lee, EH; Burdick, CA; Bollman, MA; Storm, MJ; King, GA; and Mallory-Smith, C (2006) "Establishment of transgenic herbicide-resistant creeping bentgrass (Agrostis stolonifera L.) in nonagronomic habitats." *Mol Ecol*. 15 (13): p 4243-55. http://www.ncbi.nlm.nih.gov/pubmed/17054516

http://onlinelibrary.wiley.com/store/10.1111/j.1365-294X.2006.03072.x/asset/j.1365-294X.2006.03072.x.pdf?v=1&t=ill0edut&s=603433e6f39f8c97ffd7b09aa799fd117c2baf41.

Reitman, J (2014) "USDA paves way for glyphosate-resistant fescue " Turnstile Media Group. http://www.turfnet.com/news.html/_/usda-paves-way-for-glyphosate-resistant-fescue-r432.

Rice, PJ; Horgan, BP; and Rittenhouse, JL (2010) "Evaluation of core cultivation practices to reduce ecological risk of pesticides in runoff from Agrostis palustris." *Environmental Toxicology and Chemistry*. 29 (6): p 1215-23. http://dx.doi.org/10.1002/etc.179.

Rice, PJ; Horgan, BP; and Rittenhouse, JL (2011) "Effectiveness of Cultivation Practices To Minimize the Off-Site Transport of Pesticides in Runoff from Managed Turf." Web 2011. Society, American Chemical.

Rice, PJ; Horgan, BP; and Rittenhouse, JL (2012) "Evaluation of Core Cultivation Practices to Reduce Ecological Risk of Pesticides in Runoff from Turf." *USGA Turfgrass and Environmental Research Online.* 11 (8): p 12.

Ronald, P (2011) "Plant Genetics, Sustainable Agriculture and Global Food Security." *Genetics.* 188 (1): p 11-20. http://www.genetics.org/content/188/1/11.abstract

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3120150/pdf/11.pdf.

Rosenzweig, C; Iglesius, A; Yang, XB; Epstein, PR; and Chivian, E (2001) "Climate change and extreme weather events -Implications for food production, plant diseases, and pests." *Global Change and Human Health.* 2 (2): p 90-104.

Schmidhuber, J and Tubiello, FN (2007) "Global food security under climate change." *PNAS.* 104 (50): p 19703–08.

Schwecke, M; Simmons, B; and Maheshwari, B (2007) "Sustainable use of stormwater for irrigation case study: Manly Golf Course." *The Environmentalist.* 27 (1): p 51-61. http://dx.doi.org/10.1007/s10669-007-9013-z.

Scotts (2016) "Scotts letter to Malheur County Court."

Scotts and Monsanto (2015a) "Petition for the Determination of Nonregulated Status for Glyphosate Tolerant Creeping Bentgrass Event ASR368." Monsanto Company, Scotts Company LLC.

Scotts and Monsanto (2015b) "Petitioner's Environmental Report for Glyphosate Tolerant Creeping Bentgrass Event ASR368 " Monsanto Company, Scotts Company LLC.

Southwood, T and Way, M (1970) "Ecological Background to Pest Management." p 7-28. Raleigh, NC.

SRI (2011) "The 2011 Golf Economy Report." SRI International, commissioned by the World Golf Foundation and GOLF 20/20, with support from the Allied Associations of Golf. http://www.golf2020.com/research/economic-impact-reports.aspx.

Strunk, WD (2006) "Mowing and Light-weight Rolling of Creeping Bentgrass (Agrostis stolinifera L.) Putting Greens during summer heat stress periods in the Transition Zone." University of Tennessee-Knoxville. *Dissertations and Theses*. Last Accessed: 2/9/16 http://trace.tennessee.edu/cgi/viewcontent.cgi?article=3162&context=utk_gradthes.

University of Georgia (2016) "Invasive.org: Center for Invasive Species and Ecosystem Health. creeping bentgrass *Agrostis stolonifera* L." http://www.invasive.org/browse/subinfo.cfm?sub=5052.

University of Illinois (2016) "University of Illinois Extension Hot Answers." University of Illinois at Urbana. Last Accessed: March 31, 2016 http://extension.illinois.edu/hortanswers/plantdetail.cfm?PlantID=23&PlantTypeID=12.

US-EPA (2005) "Protecting Water Quality from Agricultural Runoff."

US-EPA (2011a) "Inventory of U.S. Greehouse Gas Emissions And Sinks: 1990- 2009."

US-EPA (2011b) "Pesticide Industry Sales and Usage 2006 and 2007 Market Estimates " U.S. Environmental Protection Agency

US-EPA (2011c) "Pesticides: Registration Review." U.S. Environmental Protection Agency. http://www2.epa.gov/pesticide-reevaluation/registration-review-process.

US-EPA (2012) "Ag 101." http://www.epa.gov/agriculture/ag101/.

US-EPA (2013) "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2012."

US-EPA (2014a) "Clean Air Act Requirements and History " Last Accessed: November 2014 http://www.epa.gov/air/caa/requirements.html.

US-EPA (2014b) "National Ambient Air Quality Standards (NAAQS)." Last Accessed: November 2014 http://www.epa.gov/air/criteria.html.

US-EPA (2015a) "40 CFR Part 170 - Worker Protection Standard." http://www.ecfr.gov/cgi-bin/text-idx?SID=9c977dceaf9c753cb49aa3cd453ae7a6&mc=true&node=pt40.24.170&rgn=div5.

US-EPA (2015b) "Introduction to Pesticide Drift." http://www.epa.gov/reducing-pesticide-drift/introduction-pesticide-drift.

US-EPA (2015c) "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013."

US-EPA (2015d) "Pesticide Tolerances. U.S. Environmental Protection Agency " http://www.epa.gov/opp00001/regulating/tolerances.htm.

US-EPA (2015e) "Summary of the Food Quality Protection Act." https://www.epa.gov/laws-regulations/summary-food-quality-protection-act.

Federal Food, Drug, and Cosmetic Act 2002. Pub. L. Stat. https://www.epa.gov/laws-regulations/summary-federal-food-drug-and-cosmetic-act.

US-FDA (2003a) "Biotechnology Consultation Agency Response Letter BNF No. 000079." http://www.fda.gov/Food/FoodScienceResearch/GEPlants/Submissions/ucm155757.htm.

US-FDA (2003b) "Biotechnology Consultation Note to the File BNF No. 000079: Roundup Ready® Creeping Bentgrass Event ASR368." http://www.fda.gov/Food/FoodScienceResearch/GEPlants/Submissions/ucm155781.htm.

US-FDA (2003c) "Completed Consultations on Food from GE Plant Varieties BNF No. 79." US-FDA. http://www.accessdata.fda.gov/scripts/fdcc/index.cfm?set=Biocon&id=SMG-36800-2.

US-FDA (2006) "Guidance for Industry: Recommendations for the Early Food Safety Evaluation of New Non-Pesticidal Proteins Produced by New Plant Varieties Intended for Food Use." U.S. Food and Drug

Administration. http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/Biotechnology/ucm096156.htm.

US-FDA (2015) "Biotechnology Consultations on Food from GE Plant Varieties. U.S. Food and Drug Administration." http://www.accessdata.fda.gov/scripts/fdcc/?set=Biocon.

US-NARA (2010) "Executive Orders disposition tables index." United States National Archives and Records Administration. Last Accessed: March 2010 http://www.archives.gov/federal-register/executive-orders/disposition.html.

USDA-APHIS-PPQ (2014) "Weed Risk Assessments for nonherbicide resistant and herbicide resistant types of Agrostis stolonifera L." Plant Epidemiology and Risk Analysis Laboratory Center for Plant Health Science and Technology.

USDA-APHIS (2015a) "Memorandum of Agreement Between the United States Department of Agricluture, Animal and Plant Health Inspection Service and the Scotts Company LLC."

USDA-APHIS (2015b) "Memorandum of Understanding Between the United States Department of Agricluture, Animal and Plant Health Inspection Service and the Scotts Company LLC."

USDA-APHIS (2016a) "Biotechnology: Petitions for Determination of Nonregulated Status " http://www.aphis.usda.gov/biotechnology/petitions_table_pending.shtml.

USDA-APHIS (2016b) "Draft Plant Pest Risk Assessment "

USDA-ARS (2016) "National Plant Germplasm System: Taxon: Agrostis stolonifera L. United States Department of Agriculture, Agricultural Research Service." https://npgsweb.ars-grin.gov/gringlobal/taxonomydetail.aspx?400060.

USDA-NASS (2007) "Agricultural Chemical Usage - 2006 Field Crops Summary." United States Department of Agriculture - National Agricultural Statistics Service.

USDA-NASS (2011) "2010 Agripedia: Oregon Agricultural & Fisheries Statistics 2009-2010." U.S. Department of Agriculture, National Agricultural Statistics Service; Oregon Department of Agriculture. http://library.state.or.us/repository/2008/200802261548322/2010.pdf.

USDA-NASS (2014a) "2012 Census of Agriculture, Summary and State Data, Volume 1, Geographic Area Series. U.S. Department of Agriculture, National Agricultural Statistics Service." http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf.

USDA-NASS (2014b) "2012 Census of Agriculture: Oregon State and County Data, Volume 1, Geographic Area Series, Part 37 [AC-12-A-37]." U.S. Department of Agriculture, National Agricultural Statistics Service (NASS). http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Oregon/orv1.pdf.

USDA-NRCS (1999) "CONSERVATION TILLAGE AND TERRESTRIAL WILDLIFE."

USDA-NRCS (2002) "Integrated Pest Management (IPM) and Wildlife." Institute, Wildlife Habitat Management.

USDA-NRCS (2004) "Soil Biology and Land Management."

USDA-NRCS (2010) "From the Surface Down: An Introduction to Soil Surveys for Agronomic Use."

USDA-NRCS (2015) "Introduced, Invasive, and Noxious Plants." http://plants.usda.gov/java/noxious?rptType=Federal.

USDA (2007) "Consent Decision and Order."

USFWS "Environmental Conservation Online System." http://ecos.fws.gov/tess_public/pub/SpeciesReport.do?groups=Q&listingType=L&mapstatus=1.

USFWS (2016b) "Environmental Conservation Online System." Last Accessed: August 25, 2016 https://www.fws.gov/endangered/.

USGS (2011) "Surface Water Use in the United States, 2005." http://water.usgs.gov/edu/wusw.html.

van der Geest, LPS (2010) "IPM Potentials of Microbial Pathogens and Diseases of Mites." *Integrated Management of Arthropod Pests and Insect Borne Diseases*. New York, NY: Springer Science & Business Media. p 249-309.

Vittum, PJ; Villani, MG; and Tashiro, H (1999) *Turfgrass insects of the United States and Canada*. Cornell Univ. Press: Ithaca, NY.

Vogel, JR; Majewski, MS; and Capel, PD (2008) "Pesticides in Rain in Four Agricultural Watersheds in the United States." *Journal of Enviromental Quality.* 37 (3): p 1101-15. Last Accessed: July 2012 https://www.agronomy.org/publications/jeq/abstracts/37/3/1101.

Wang, Z and Brummer, EC (2012) "Is genetic engineering ever going to take off in forage, turf and bioenergy crop breeding?" *Annals of Botany.* http://aob.oxfordjournals.org/content/early/2012/02/28/aob.mcs027.abstract

http://aob.oxfordjournals.org/content/110/6/1317.full.pdf.

Watrud, LS; Lee, EH; Fairbrother, A; Burdick, C; Reichman, JR; Bollman, M; Storm, M; King, G; and Van de Water, PK (2004) "Evidence for landscape-level, pollen-mediated gene flow from genetically modified creeping bentgrass with CP4 EPSPS as a marker." *PNAS.* 101 (40): p 14533-38.

Watson, L and Dallwitz, MJ (1992) "Grass genera of the world: descriptions, illustrations, identification, and information retrieval; including synonyms, morphology, anatomy, physiology, phytochemistry, cytology, classification, pathogens, world and local distribution, and references." http://delta-intkey.com/grass/www/agrostis.htm.

Welch, D (1985) "Studies in the Grazing of Heather Moorland in North-East Scotland; IV Seed dispersal and Plant Establishment in Dung " *Journal of Applied Ecology* 22 p 461-72.

WHO (2005) "Modern food biotechnology, human health and development: an evidence-based study. World Health Organization (WHO), Department of Food Safety, Zoonoses and Foodborne Diseases. ISBN 92 4 159305 9." http://www.who.int/foodsafety/publications/biotech/biotech_en.pdf.

WHO (2015) "Food Safety: Frequently asked questions on genetically modified foods. World Health Organization (WHO)." http://www.who.int/foodsafety/areas_work/food-technology/faq-genetically-modified-food/en/.

Widen, KG (1971) *The genus Agrostis L. in eastern Fennoscandia: Taxonomy and distribution*. Societas pro Fauna et Flora Fennica. https://helda.helsinki.fi/handle/10138/36219.

Wilson, EO (1988) "Biodiversity." Washington DC: The National Academy Press. The National Academies Press, The National Academies. Last Accessed: July 2012 http://www.nap.edu/catalog.php?record_id=989.

Wolters, M; Garbutt, A; and Bakker, J (2005) "Plant colonization after managed realignment: the relative importance of diaspore dispersal." *Journal of Applied Ecology.* 42 p 770-77.

Young, IM and Ritz, K (2000) "Tillage, habitat space and function of soil microbes." *Soil & Tillage Research.* 53 p 201-12. http://www.sciencedirect.com/science/article/pii/S0167198799001063.

Young, WC and Silberstein, TB (2012) "2.4: The Oregon grass seed industry." *Epichloae, endophytes of cool season grasses: Implications, utilization and biology*. Ardmore Oklahoma, USA: The Samuel Roberts Noble Foundation. http://www.noble.org/plant-symbionts/isfeg7.

Zapiola, ML; Campbell, CK; Butler, MD; and Mallory-Smith, CA (2008) "Escape and establishment of transgenic glyphosate-resistant creeping bentgrass Agrostis stolonifera in Oregon, USA: a 4-year study." *Journal of Applied Ecology.* 45 (2): p 9. http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2007.01430.x/pdf.

Zapiola, ML and Mallory-Smith, CA (2010) "Soaking Time and Water Temperature Impact on Creeping Bentgrass Seed Germination." *Weed Science.* 58 (3): p 223-28. http://www.jstor.org/stable/40891090.

Zapiola, ML and Mallory-Smith, CA (2012) "Crossing the divide: gene flow produces intergeneric hybrid in feral transgenic creeping bentgrass population." *Mol Ecol.* 21 (19): p 4672-80. http://onlinelibrary.wiley.com/store/10.1111/j.1365-294X.2012.05627.x/asset/mec5627.pdf?v=1&t=ill0cpzh&s=b6a077c3ddfb93d8abd2c000cd853facdda9aa84.

Zhao, H; Bughrara, SS; and Wang, Y (2007) "Cytology and pollen grain fertility in creeping bentgrass interspecific and intergeneric hybrids." *Euphytica.* 156 (1): p 227-35. http://dx.doi.org/10.1007/s10681-007-9369-7.

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