



NATIONAL SEED STRATEGY  
**BUSINESS  
 PLAN**  
 2015-2020



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## Table of Contents

<b>Introduction</b>	<b>1</b>
<b>The National Seed Strategy Goals, Objectives, and Actions with Costs</b>	<b>2</b>
<i>Goal One: Identify Seed Needs and Ensure the Reliable Availability of Genetically Appropriate Seed</i>	<i>2</i>
<i>Goal Two: Identify research needs and conduct research to provide genetically appropriate seed, and to improve technology for native seed production and ecosystem restoration</i>	<i>5</i>
<i>Goal Three: Develop Tools that Enable Managers to Make Timely, Informed Seeding Decisions for Ecological Restoration</i>	<i>10</i>
<i>Goal Four: Develop Strategies for Internal and External Communications</i>	<i>14</i>
<b>Conclusion</b>	<b>16</b>
<b>Addendum: Action Cost Estimate Table</b>	<b>17</b>

## Introduction

The “National Seed Strategy for Rehabilitation and Restoration 2015-2020” (Strategy) was launched on August 17, 2015 in Boise, ID. The Strategy was written to address seed needs across the country. A broad coalition of Federal agencies and non-Federal organizations developed the Strategy to provide guidance on increasing the supply of genetically-appropriate seed and improving the use of native plant species for stabilization, rehabilitation, and restoration treatments on Federal and privately-owned land. The Strategy also presents specific seed research actions that can rely on public-private partnerships to improve the seed supply for rehabilitation and restoration. While the Strategy will be renewed in 5-year cycles, its actions will affect landscapes and habitats far into the future.

The National Seed Strategy Draft Business Plan (Business Plan) is a working document that demonstrates the Strategy’s implementation costs to top policymakers, Plant Conservation Alliance (PCA) partners, and the public. It was developed through consultation with staff and researchers at the Agricultural Research Service, Bureau of Land Management, U.S. Forest Service, National Park Service, Natural Resource Conservation Service, U.S. Fish and Wildlife Service, U.S. Geological Survey, Non-Government organizations, and Universities, together with experts at Botanic Gardens and private seed companies. The plan’s intent is to help agencies and partners better direct existing financial resources – and work to secure additional funding – to implement the Strategy. The Business Plan is a companion document to the Strategy and must be viewed alongside the Strategy. The Business Plan is not a plan to develop a seed business run by the Federal government, but a plan to encourage private sector cooperation and participation.

The Strategy has four broad goals covering (1) the assessment of current seed resources and needs; (2) research to improve seed availability and restoration success; (3) the development of restoration and seeding tools for land managers; and (4) strategies for internal and external communication of seed and restoration issues. Layered within these four goals are a series of 14 objectives with 50 discreet actions. The Business Plan follows the Strategy’s format, breaking cost estimates down by goals and objectives and explaining individual actions in detail.

The Business Plan’s cost estimates for specific actions were formulated with the assumption that, as a national initiative, the Strategy would require implementation across the whole U.S. The final cost of the Strategy will depend on the scope and scale of implementation for each action. For many actions, the Business Plan provides a breakdown of cost drivers so that managers can understand the price of up-scaling or down-scaling implementation.

As of this draft’s printing, no agency or organization has committed to implementing a specific Strategy action; therefore this document is not an implementation plan. A series of facilitated workshops with all PCA Federal partners (under Objective 4.2) will be a critical step towards coordinating implementation and securing agency commitments to the Strategy. The agreements and information that results from those workshops will be incorporated into the final business plan.

## The National Seed Strategy Goals, Objectives, and Actions with Costs

This section lists costs for implementation of the Strategy over a five-year period and provides detail on the major investments necessary for plant materials development and research. Cost estimates are presented by goal, by objective, and by action. The addendum provides a summary table of all cost estimates.

### **Goal One: Identify Seed Needs and Ensure the Reliable Availability of Genetically Appropriate Seed**

**Cost Estimate: \$131.85 million**

Goal One has three objectives that encompass a total of 13 separate actions; all of these actions start in the first two years of Strategy implementation. While collaboration with the private sector and state and local governments will be necessary, most Goal One actions should be funded and led by Federal agencies.

The major cost associated with this goal is increasing the availability of genetically appropriate seed, through seed collections and grow-outs. Agencies do have funds for seed procurement now, but expanding the list of available (species and quantities) will be costly, especially when bringing new species into production. Many forbs will require more than one year of growth before any seed is produced, thus their costs will always be relatively more expensive when compared to the cost of many exotic and native grasses.

**Objective 1.1: Assess the Seed Needs of Federal Agencies and the Capacity of Private and Federal Producers**

**Cost Estimate: \$1.85 million**

Action 1.1.1 will assess the seed needs of the 12 PCA-member Federal agencies, including the need for pollinator-friendly plant materials and the need for seeds on a bioregional basis.

Action 1.1.2. is an inventory of Federal and private seed collections, production, and storage capacity as well as identification of all Federal guidance for seed collection and production. This will include a review of Federal databases and reporting systems used to track seed inventory and use.

Action 1.1.3 is to identify existing Federal seed and restoration policies and guidance. Action 1.1.4 and 1.1.5 include analyses of the needs and capacity assessments resulting from actions 1.1.1 and 1.2.1.

Since all Objective 1.1 actions focus on an assessment of seed need, seed collections, and seed storage and production capacity, the business plan recommends addressing these actions with a single contract or agreement with an independent third-party. Entrusting these assessments and analyses to a single, independent entity with experience in this type of data collection will provide an unbiased, comprehensive view of all information related to seed supply and use. Moreover, it will lend credibility to the effort and will likely result in a higher quality product than an effort led in-house by one of the PCA agencies.

(Additionally, the business plan recommends including action 2.1.1 in the contract with whatever third-party is hired. See below for more detail).

The cost estimate for this objective, \$1.85 million over two years, will cover a team of experts and data collectors developing and administering the assessment of all 12 Federal PCA agencies over a two-year period. It also encompasses some Federal staff costs for working with the third-party contractor to develop the assessment and manage the contract.

**Objective 1.2:** Assess Capacity and Needs of More than 20 tribes, 50 states, more than 300 Private Sector Seed Producers, Nurseries, and Other Partners

**Cost Estimate: \$1.30 million**

Action 1.2.1 is the assessment of state, local, tribal, private and non-profit seed storage and distribution facilities. As recommended under Objective 1.1, one method of carrying out projects such as the needs and capacity assessments would be to engage a third-party to conduct an assessment. The assessment under this action could be included with the assessment called for under Objective 1.1 and run by an independent third-party. The business plan estimates this action will cost \$400,000 in year one and \$300,000 in year two.

Action 1.2.2 is to work collaboratively with private seed producers and other partners to improve the distribution of native seed. This action will occur after the assessment is completed for action 1.2.1. The cost for this action (\$200,000 in year one and \$150,000 year two) will cover expenses for meetings among Federal land managers, non-profit partners, and private seed industry leaders to discuss ways to transform the Federal seed purchasing to address challenges identified in the assessments. This discussion could explore how to expand seed production funding through advance contracting and how to encourage speculative seed production. This funding estimate will also cover the cost of a graduate student exploring the seed industry market and economics, which will help inform the discussion of how to improve availability of native seed.

Action 1.2.3 is to analyze results of non-Federal needs and capacity assessment to determine if current seed collections, as well as storage and production facilities, meet restoration needs. The business plan estimates this will cost \$250,000 in year two. This action could also be included under a contract with a third-party

**Objective 1.3:** Increase the supply and availability of genetically appropriate seed

**Cost Estimate: \$128.70 million**

The result of the assessments (from Objectives 1.1. and 1.2) will greatly impact the estimated costs of the actions within 1.3.

Action 1.3.1 is to expand and improve facilities and plant production capacity. This action presumes a need that may or may not be confirmed by the assessments mentioned above. In year one, agencies could invest in increasing seed for 100 grass species and 100 forb species. The seeds produced in these grow-outs will be stored in government seed

warehouses. At \$10,000 per acre for grasses with five-acre plots per species and \$12,000 per acre for forbs with two-acre plot per forb species, the total annual cost will come to \$7.4 million.

If the need for additional or improved seed storage is necessary, the business plan estimates the minimum capital cost for a new, large facility at \$10 million, as indicated in years two, through five. Should the assessment indicate that current storage space is sufficient or that a network of smaller seed storage facilities is needed, these costs could be adjusted accordingly. This is an area where collaboration with state and local governments that store seed would be beneficial. The total estimate as it stands now is \$77 million over five years.

Action 1.3.2 will improve agency and partner capability to plan for seed needs by seed zone. An annual cost of \$150,000 will pay for a graduate student, as well as plant ecologists and procurement staff, to work with existing seed banking networks to find ways to coordinate multiagency seed sharing and, perhaps, create a national online database for source-identified seed. The total two-year cost is \$300,000.

Action 1.3.3 aims to increase the supply of shrub seed through alternative methods. This action will include a review of regulations that control establishment of shrub seed reserves or planted shrub seed orchards on wildland sites (permitting, contracting, etc). Such reserves and orchards could also be established by private land owners and seed growers. The business plan estimates \$100,000 in year one to pay for a review of existing research and regulations on alternative production methods. In year two and onward, the plan predicts a \$250,000 annual cost to test alternative production methods in the field. The total cost over five years is \$1.1 million.

In order to increase the supply of native seed, agencies need to expand wildland seed collection and conservation. Action 1.3.4 makes an investment in seed collection programs and would be spread among multiple agencies and non-Federal partners. For \$10 million annually, the business plan estimates that agencies and partners would be able to make more than 5500 native seed collections a year. (In order to perform some of the research actions in the Strategy, scientists may need as many as 100 collections of the same taxa). This cost also covers intern training and employment, seed cleaning, seed collection management, herbarium management, and seed storage.

Action 1.3.5 is to engage Federal procurement specialists to assess current contracting regulations and practices so that agencies can identify strengths and address challenges. The aim is to improve Federal agencies ability to purchase the appropriate seed so it can be available when needed. The cost estimated under this action (\$150,000 in years two and three) is to pay for meetings with Federal procurement staff, field staff who need to buy seed, and seed industry representatives.

**Goal Two: Identify research needs and conduct research to provide genetically appropriate seed, and to improve technology for native seed production and ecosystem restoration**

**Cost Estimate: \$197.21 million**

The goal has four objectives with a total of 12 separate actions that require substantial investment in field and laboratory research. All actions commence in year one and will advance the science and practice of restoration and land management.

**Objective 2.1: Characterize Genetic Variation of Restoration Species to Delineate Seed Zones, and Provide Seed Transfer Guidelines for Current and Projected Future Environmental Conditions**

**Cost Estimate: \$72.50 million**

The two actions under this goal will help land managers select genetically appropriate seed and plant materials for restoration and predict climate change effects on plant distributions.

Action 2.1.1 is to conduct genetic research to develop species-specific seed zones for native seeds. Species required for restoration will be identified on an eco-regional basis during the assessment under Goal One. Common widespread “workhorse” species will be selected from this list for development of species-specific seed zones. Prioritization will be based on restoration need as well as genetic, breeding system and range characteristics. This seed zone research would require common garden to identify adaptive plant traits for development of climate-based empirical seed zones. Forest Service researchers as well as university and NGO research centers estimate that such studies will cost \$150,000 per taxa. Government and non-government researchers may be able to study 50 taxa in year one and ramp up to studying 100 taxa in years two through five. At current estimates, the cost for this action over five years is \$67.5 million.

Research for other species, particularly forbs, may require refinement of species distributions, identification of ploidy levels within species, examination of genetic diversity, or other research required to guide seed supply development and deployment. If further research is necessary, this could increase the cost of this action.

Modeling for climate change effects on target restoration species (2.1.2) will help land managers and restoration practitioners better target and prioritize species and populations for restoration projects. Climate change researchers estimate this would cost \$1 million annually to predict effects on 100 taxa a year. Modeling will require data from common garden studies collected using standardized protocols and conducted by a cohesive group of researchers. Thus the data available for immediate use is quite limited (maybe 10 species), though presence/absence data might enable some modeling. The total action cost is \$5 million.



**Objective 2.2:** Conduct Species-Specific Research to Provide Seed Technology, Storage, and Production Protocols for Restoration Species

**Cost Estimate: \$42.35 million**

If a native seed is to become a commercially-produced and available product, seed producers must be able to evaluate seed quality; they must determine how to produce the seed as a commercial crop; and, they must learn under what conditions to store a seed (temperature, duration, humidity). To develop this information, plant research organizations must conduct seed germination studies and develop seed testing protocols for key restoration species. They must also develop seed storage guidelines and develop species-specific protocols for seed and seedling production. Objective 2.2 has three actions to address these research issues.

The first action (2.2.1) is to conduct seed germination studies and develop seed testing protocols for key restoration species. Botanical scientists from the public and private sector estimated that this action will cost on average \$2500 per species. Five hundred species studied per year would cost \$1.25 million annually and yield 2500 taxa studied after five years. The total for five years is \$6.25 million.

Seed handling and storage protocols are lacking for most restoration seed species. Developing storage guidelines for these species (2.2.2) is necessary to preserve seed viability during the handling and banking of seeds. It requires a steady flow of seed, which makes the increased seed collection under Goal One imperative. In year one of this action, \$100,000 would cover the cost of two graduate students doing a literature review to prioritize seeds for research. The total cost for seed storage studies over years three through five will be \$1.2 million.

The Association of Official Seed Analysts and the Society of Commercial Seed Technologists are responsible for official testing rule development for commercially-traded species. These organizations will need \$450,000 annually to cover the costs of testing for formal rule formation for 500 species every year. Work during the first two years will include review of assessment lists developed in Goal One to identify existing rules and germination research literature previously developed for any of those species. Total for 4 years will be \$1.8 million which brings the total cost for Action 2.2.2 to \$3.1 million over five years.

Since this goal is foundational to most other activities in this business plan, it needs to be initiated as early as possible. An established native plant laboratory (e.g. USFS National Seed Laboratory in Macon, GA) with sufficient germination capacity to conduct hundreds of tests simultaneously at numerous temperatures will be best suited to carry out the actions of this goal. This will minimize start up time and provide the highest output of results.

Action 2.2.3 is to develop species-specific protocols for seed and seedling production practices to provide high quality, genetically-diverse products. Experts at NRCS Plant Materials Centers and at private seed companies shared their costs for field tests for seed production which led to an estimated cost of \$10,000 per acre plot for production of grasses and \$12,000 per acre plot for forbs. Seeds for 1000 grass species and 1500 forb

species could be production-tested in field plots over a five-year period, bringing the annual cost of seed production to \$5.6 million.

Experts from University of Iowa predict that protocols for seedling production could be developed for approximately 25 species per year at a cost of \$40,000 each. This information is needed to provide users and nurserymen with specifications for producing high quality seedlings to fit specific planting needs. Specifications are currently lacking for most native species. Seedling production is a \$1 million annual cost. Both seed and seedling production together will cost \$6.6 million annually bringing the five-year cost of action 2.2.3 to \$33 million.

**Note:** *A very important issue related to seedling production is registration of herbicides for use on wildflowers/forbs. Right now, none are registered for use on wildflowers or forbs, so growers are forced to do hand weeding – a very expensive process that keeps some growers from attempting wildflowers and forbs. Registering herbicides for use on these species requires testing and permitting by EPA. This should be investigated.*

**Objective 2.3:** Conduct Research on Plant Establishment, Species Interactions, and Ecological Restoration

**Cost Estimate: \$54.85 million**

If land managers are going to plant native seed successfully in large landscape restoration projects, they will need more information on how to establish seed in the wild; how native plants interact with already-established non-natives; and how to select the appropriate restoration strategy for specific sites.

One part of this objective is to develop site preparation, seeding, and transplanting strategies (2.3.1) that improve plant establishment. Forest Service researchers estimated that a site preparation, seeding, and transplanting study would cost between \$80,000 to \$100,000. If agencies were to undertake 50 studies per year, the cost would be \$4 million to \$5 million annually.

Another essential piece of this objective is determining which native plant populations can compete with non-native annual and perennial species within seed zones. Action 2.3.2 will first include a survey of researchers to identify potential native species and non-native combinations that may require more study. It will cost approximately \$100,000 in year one. Then, in year two, field studies will commence. Researchers estimate that a single study could cost \$175,000. If 25 studies start annually from years two through five the total cost for action 2.3.2 would be \$12.6 million.

Action 2.3.3 is to advance investigations to diversify depleted native communities and improve the ecological structure and function of grass monocultures. To calculate an estimate for this action, we used two separate examples:

Example one is Diversifying Monotypic Stands of Non-Native Perennial Grasses. Researchers will develop effective site preparation practices, including timelines, for the grass species and site conditions. This involves examination of treatments for reduction of plant residue, removal of existing vegetation while minimizing erosion risk, reduction of

weed seed banks, and seed bed preparation. This process may require two to three years. Staged planting approaches may be evaluated by first seeding native grasses, followed by addition of forb and shrub seed or seedlings to islands or selected spots following establishment of the seeded grasses. Post-seeding weed control techniques will be applied as required. Monitoring will document weed control throughout the site preparation and seeding/stand establishment period, establishment of the seeded and planted species, and long-term data collection to document community development including reproduction of seeded species, shrub canopy development, use by wildlife, and other factors of concern at specific sites. The overall cost per study will range from \$100,000 to \$150,000. It is anticipated that 25 studies will be initiated over the 5-year period. The annual cost for example one is \$750,000.

Example two is Diversifying Monotypic or Species-Poor Stands of Native Grasses. Adding shrubs, forbs and additional grass species to such sites is essential to improve community functioning, provide habitat for additional species, and increase connectivity. The general procedures outlined in example one will be followed, but with diversity added to openings in the native grass stand. Treatments will include any required preliminary weed control, native grass control and site preparation in patches, spots or trips to facilitate seeding or planting, and follow-up weed control and monitoring. Overall costs per study will range from \$50,000 to \$75,000. Twenty studies could be initiated over the 5-year period. The annual cost for example two is \$300,000.

The total five-year cost for action 2.3.3 is \$5.25 million. This assumes collaboration with local land managers and completed NEPA.

The foundation of success for all restoration is having the appropriate growth medium for the appropriate plant material. Action 2.3.4 would assess soil degradation and develop soil treatments (e.g., amendments) to enhance germination, establishment, and development of healthy native plant communities. Under this action, government, university and private researchers, could initiate new work focused on this need and complement existing related research. Given the infinite number of possible plant and soil organism interactions, researchers would apply a strategic approach to key vegetation zones across the U.S. based on soil and climate characteristics. Studies can range between \$250,000 to more than \$1 million for 3-5 years. Funds will also be necessary to synthesize and model data and results to predict belowground interactions, and responses to treatments across larger spatial areas. Projects will be developed in an adaptive management context with managers so future costs would include continued treatments such as weed control, and monitoring for long term analysis. If one to two studies start in year one and then researchers increase the number of studies annually, the total estimate for five years is \$12 million.

**Objective 2.4: Develop or Modify Monitoring Techniques, and Investigate Long-Term Restoration Impacts and Outcomes**

**Cost Estimate: \$27.51 million**

Among Federal and non-Federal land managers, there is no common monitoring protocol or technique for judging the success of restoration projects. Oftentimes, land managers modify standard ecological monitoring techniques used on existing, natural sites to measure the efficacy of restoration treatments on damaged or degraded sites. Additionally, there is little objective comparison of the costs and benefits of using genetically appropriate seed measured versus cultivars and non-natives plant material.

Action 2.4.1 will examine current monitoring techniques for their success of restoration projects. In part one of this action, two graduate restoration students would perform a literature review and survey of restoration ecologists to determine strengths and deficiencies of current restoration monitoring methodologies. We estimate that cost at \$100,000 per year. In the second, but simultaneous step for this action, teams of interns led by botanists would test different monitoring techniques at restoration sites in various regions. A team of four interns managed by one botanist could monitor five sites in one region per year. If all five land management agencies each employed five teams annually, the total cost of this action is \$25.5 million over five years.

In Action 2.4.2, agencies would contract with an environmental economist to quantify the short and long-term ecological and economic costs and benefits of planting native or nonnative plants on public lands. A well-regarded ecological economics firm estimated that scoping the project would cost \$10,000. Performing a three-year study will cost approximately \$500,000 year for a \$1.5 million total cost.

For Action 2.4.3, two graduate students would conduct retrospective studies of selected native plant restoration projects to evaluate the effectiveness of different restoration treatments and the impact of weather conditions on restoration success. This would be an ongoing study costing approximately \$100,000 annually. The total five-year cost is \$500,000.

### **Goal Three: Develop Tools that Enable Managers to Make Timely, Informed Seeding Decisions for Ecological Restoration**

**Cost Estimate: \$26.20 million**

Ecological restoration is a growing discipline that needs new tools to help managers assess the risks, guide the scope, and predict the efficacy of restoration treatments. Goal Three has four objectives with 17 actions that cover training for restoration practitioners on the use of genetically appropriate seed; creating new channels for sharing seed information; developing data tools, including GIS databases, to inform restoration site and seed selection; and developing guides and reports on seed and restoration strategies.

**Objective 3.1:** Develop Training Programs for Practitioners, Producers, and Stakeholders on the Use of Genetically Appropriate Seed

**Cost Estimate: \$17.29 million**

Land managers who oversee rehabilitation and restoration projects need to be aware of the current research, methodologies, and technologies. There is a great need for more training on restoration and more information sharing, especially related to seed selection and use. Developing a series of restoration trainings could lead to the creation of a professional restoration certification program that would help ensure a common level of knowledge across the land management and restoration community.

Action 3.1.1 envisions developing a cadre of restoration experts who can offer trainings to practitioners. This will require funds to support restoration training programs around the country targeted at different types of landscapes and restoration challenges. The business plan budgets \$1 million annually to support these trainings.

Additionally, 3.1.1 calls for the founding of a professional restoration certification program (or programs) that Federal and non-Federal land managers and restoration practitioners could take to gain advanced ecological restoration knowledge. This program will be modeled on the successful USDA Forest Service's silviculture certification program and could take the form of a certificate offered by one or a few universities. Alternatively, it could be full certification credential developed by an independent non-profit or a consortium of restoration agencies and organizations. Approximately \$250,000 is necessary to support a survey that would gauge consumer demand for a certification program. If the survey finds that demand is sufficient to support a self-sustaining certification program, the next step would be to scope the requirements of a program. Agencies could then post a *Request for Proposals* for certification programs that meet the scoped requirements and contract with an organization to develop and deliver the credentialing program. This would be a multi-year task requiring roughly a roughly \$1 million annual investment over two years for research and development of a certification program. The support for the certification program would taper off over the latter years as user fees grow to maintain the program. The total cost for action 3.1.1 over five years is \$8.5 million.

Action 3.1.2 would promote the sharing of information on restoration by expanding the use of restoration demonstration areas. Establishing a demonstration site costs approximately \$25,000. This would cover NEPA and other mandates, the cost of fencing, seed,

maintenance, and monitoring. Agencies could implement 20 new demonstration sites a year on Federal land across the nation (three per year for each of four agencies). Additionally, it could fund demonstration sites on non-Federal land managed by states or NGOs. The total cost for this effort would be \$500,000 in year one but would increase as new sites are established annually and existing sites are maintained. The total five year cost is \$7.5 million.

Action 3.1.3 will ensure that land managers can visit and learn from demonstration sites, as well as other restoration projects. This action funds travel to sites, which could range in cost from \$50,000 to \$200,000 annually if implemented nationally. It could also support online tools that publicize restoration lessons and resources for land managers. A restoration resource website and webinars on restoration sites could be produced and operated by a non-profit science organization. Website design, including curating of restoration resources, would cost no more than \$50,000 in year one. Webinar production (12 per year at \$5,000 per webinar) would cost approximately \$60,000 annually. The total cost for this action over five years is \$1.29 million.

**Objective 3.2:** Develop Native Seed Source Availability Data and Tools for Accessing the Data

**Cost Estimate: \$1.62 million**

In order for land managers and restoration practitioners to find the genetically-appropriate seed they need for projects, there needs to be publicly available data showing seed availability and seed sources. The first three actions under this objective are all focused on creating better internet-based tools. The final one targets improvements in Federal seed procurement processes.

Action 3.2.1 recognizes that regional native seed networks are vital tools that provide land managers with links to native seed growers and information describing available native seed supplies.. Agencies should support the expansion and improvement of these regional networks so that their databases can track information on seed transfer zones and other relevant data that helps land managers select the appropriate seed. The cost in this action is for supporting improvements to databases and maintaining non-profit operated websites on seed availability and source. The five-year cost for this action is \$400,000.

Action 3.2.2 is to maintain an existing website with seed zone maps and a tool to match seed sources to appropriate planting sites. This could be a Federal or non-profit project and is relatively low cost, except for the \$200,000 portion, in year five, where it is necessary to develop the seed source tool that will match seed source to planting site. The five-year cost of this action is \$250,000.

The creation of an interagency seed inventory system will help meet the goals of many resource management initiatives (Action 3.2.3). Building such a system, that gathers data on seed availability from each seed storage facility and every agency, would require an extraordinary amount of cooperation and coordination among different departments and agencies. The cost of \$200,000 annually in years one and two is for scoping and investigation to determine the design of the seed inventory system. That would likely be a task handled by a contractor with an expertise in inventory management systems. In years

three through five, the cost is for maintenance of the website and training seed storage managers on the use of the system. The total five-year cost is estimated at \$700,000.

After agencies have engaged Federal procurement specialists to assess current contracting regulations regarding seed purchasing (Action 1.3.5), agencies would seek to improve existing procurement agreements or develop new tools that would facilitate seed acquisition across agencies (Action 3.2.4). Much of this can be accomplished by coordinating an on-going dialogue between seed growers, land managers, and procurement specialists so the cost is to fund eight meetings for these groups at \$25,000 per meeting over years one and two; and then fund one meeting per year in years three through five. This item's budget will cover travel costs for small seed growers to ensure their participation in the meetings. The total cost for action 3.2.4 is \$275,000.

**Objective 3.3: Integrate and Develop Science Delivery Tools to Support Restoration Project Development and Implementation**

**Cost Estimate: \$3.17 million**

The techniques and knowledge needed for ecological restoration can vary from region to region. The three actions under this objective focus on providing ecoregional guides and protocols and sharing information on a regional basis.

Action 3.3.1 identifies available restoration guides and protocols by ecoregion. (There are more than 100 identified eco-regions in the U.S.) For regions that lack protocols and/or guides, this action would see the development of new guides and protocols. The first step of identifying what exists would require one graduate student working for four to six months. Creating new guides and distributing them could cost as much as \$250,000 per year for a total five-year cost of \$1,250,000.

Action 3.3.2 is to write and distribute native plant project reports by ecoregion. Similar reports have been done covering all restoration research in the Great Basin. New reports would cover ecoregions such as the Colorado Plateau, the Pacific Northwest, and Longleaf Pine area, to name a few. In year one, the plan budgets \$20,000 to develop a template for the report and, in the following years, the plan estimates \$50,000 annually to print up to five eco-regional project reports a year. The total action cost estimate is \$220,000.

Action 3.3.3 supports field implementation of restoration tools. This entails field workshops for seed growers and researchers to demonstrate seed production methods to other growers or for restoration researchers and practitioners to teach new techniques to other restoration practitioners. This may include support for regional conferences that would host such workshops. The business plan estimates \$200,000 in year one to develop workshops and cover travel costs; the increased cost in year two is to fund a national seed conference and its workshops. In the final three years, \$300,000 annually would cover ongoing workshops. The five-year cost is \$1.7 million.

**Objective 3.4: Build on Ecological Assessments and Disturbance Data, and provide Training that Will Allow Managers to Anticipate Needs and Establish Spatially-Explicit Contingency Strategies**

**Cost Estimate: \$4.12 million**

The actions under this objective will inventory and assess GIS tools, climate models and remote sensing capabilities with regard to seeding and restoration and develop new tools for prioritizing seed needs.

To build an understanding of the current state of climate-based GIS tools, action 3.4.1 calls for an inventory and assessment of these tools applicability. The funding would pay for a pair of graduate students, or one GS-11, to inventory and assess GIS tools, as well as provide web access to all the tools available in years one and two. In years three onward, the funding supports ongoing web access and updates. The total estimate over five years is \$210,000.

For action 3.4.2, agencies will develop a “crosswalk” that lists and connects existing agency habitat restoration priorities and tools by provisional seed zone. This will lead to the development of geodatabases that include information on past and current restoration activities. Since this is a multi-agency effort, the \$500,000 in years two, three, and four covers staff time to build the “crosswalk” and technical development of new geodatabases. The total estimate is \$1.5 million over three years.

Action 3.4.3 will assess climate modeling and soil/water remote sensing for their ability to forecast seedling establishment. This will lead to new tools that relate soil condition to probability of restoration success. This assessment would begin in year two and involve mainly research and then tool development. The total cost over four years is \$1 million.

For budgeting purposes, the business plan combines actions 3.4.4 and 3.4.5. Developing web tools that help prioritize seed needs by analyzing disturbance and climate change and that use wildfire risk-based assessments to prioritize seed treatment locations will cost \$100,000 in year one, \$300,000 in year two, \$400,000 in year three, and then \$50,000 annually for maintenance of the tools. The total cost over five years is \$900,000.

Action 3.4.6 is to develop a decision tool of belowground assessment and treatment. This action will utilize research identified in Goal Two to improve understanding of belowground ecological drivers and interactions. The National Park Service estimated that such a tool will cost \$250,000 to develop over a three to four-year period.

Action 3.4.7, developing information tools and guidelines on appropriate use of cultivars, hybrids and noninvasive nonnative species will require one GS-13 botanist working for two years at \$130,000 per year. This includes travel, research tools, and equipment. The Strategy’s preference is restoration with native species, but it recognizes non-natives are sometimes used to stabilize sites, create wildfire breaks, and control invasive species. The total cost for this action is \$260,000.



## Goal Four: Develop Strategies for Internal and External Communications

**Cost Estimate: \$2.93 million**

Multiple agencies and non-Federal partners must engage in the Strategy if it is to be successful. To ensure engagement, participating agencies must proactively communicate their Strategy roles to their own employees, to other agencies, and to external partners. External partners can help communicate the Strategy's goals and objectives to their constituencies and the public.

**Objective 4.1** Conduct Education and Outreach through the Plant Conservation Alliance Network

**Cost Estimate: \$1.01 million**

To coordinate Strategy messages and actions, partners must collaborate on both internal and external communication strategies and tactics.

To implement action 4.1.1, the business plan budgets \$250,000 in year one to hire an external communications firm to develop a communications plan with participation from partner agencies program and communication staff. In years two through five, the \$75,000 annual cost covers staff time for partner agencies communications and plant program teams to implement the communications plan. The total for five years is \$550,000.

Action 4.1.2 involves the Plant Conservation Alliance in communications for the Strategy. The \$150,000 cost for this action in year one would fund PCA members' participation in communications planning meetings. In years, two through five, the funding would help support partners' engagement in Strategy communications' events as well as press visits to restoration sites. The total for five years is \$460,000.

**Objective 4.2:** Distribute and Implement the Strategy Across Agencies, and Provide Feedback Mechanisms.

**Cost Estimate: \$1.49 million**

Agencies must foster awareness of the Strategy among their staff to enhance collaboration and facilitate the coordination of Strategy actions with parallel initiatives, such as those promoting greater sage grouse and pollinator habitat.

The funding for action 4.2.1 in year one supports the salaries of agencies' communication and program staff who will be developing internal communications plans for the Strategy. Funding in years two through five cover staff time to implement the internal communications plans. The total five-year cost is \$400,000.

For action 4.2.2, agencies will utilize the appropriate communications mechanisms for implementing the Strategy, as indicated by the communications' plans. This could include the development of instruction memoranda, guidelines, policy directives, and handbooks.

Funding in years two through five would cover agencies' staff time to develop these information tools and for printed materials, when necessary. The total five-year cost is \$1 million.

Action 4.2.3 uses the policy information gathered in Action 1.1.3 then make it more accessible to the public through agency and partner web sites. The \$20,000 cost in year one is to pay a graduate student to publish existing restoration policies on the internet. The ongoing costs pay to maintain the websites. The total cost is \$40,000 over five years.

Action 4.2.4 is to incorporate the Strategy's goals and messages into appropriate existing landscape-scale restoration initiatives. Agencies can achieve this integration through the ongoing work of the PCA and by organizing annual facilitated workshops that include key managers from agencies directing large-scale restoration projects. The estimated cost here of \$10,000 annually is to pay for convening and facilitation of the workshops each year. The five-year cost would be \$50,000.

**Objective 4.3: Report Progress, Recognize Achievements, and Revise Strategy**

**Cost Estimate: \$425,000**

The actions for this objective will publicize the Strategy's progress and achievements.

Action 4.3.1 will fund an annual report on Strategy progress that can be shared with the PCA partners at annual PCA meetings and with the public at conferences and events. Funding of \$25,000 in year one will pay for the development of an annual report template. The continuing funding will pay for annual writing, editing, and printing of the report. The total five-year cost is \$185,000.

Action 4.3.2 is meant to recognize and promote the Strategy's achievements through new or existing award programs (e.g., Most successful native restoration project), journal articles, and press events. The business plan budgets \$35,000 annually in years two through five for this action. The total five-year cost is \$140,000.

Action 4.3.3 is to review and revise the Strategy every five years, or as needed. The business plan estimates a \$100,000 cost in year five to convene a large meeting of Strategy partners to assess the Strategy's progress and discuss potential revisions and directions for the next five years.

## Conclusion

If the United States is to be prepared to restore ecosystems following extreme weather events, such as wildfires, hurricanes and floods, it will need a reliable supply of genetically appropriate seed. Full implementation of the Strategy will provide that seed, however, it will require high-level executive leadership, regular staff coordination among agencies and non-Federal partners, and financial support. To achieve this, Federal PCA partners will engage in a series of facilitated workshops to secure funding commitments by agencies for each action. The PCA Federal Committee will create a Strategy implementation team that includes staff level experts who can inform the implementation of Strategy actions.

While the total cost of the Strategy may appear large at nearly \$360 million over five years, its average annual cost is approximately \$72 million. If the cost burden is shared across multiple PCA agencies, the funds required become more manageable.

Regardless of how the Strategy's cost is shared, agency leaders and policymakers could consider a number of options to fund its implementation. The Business Plan offers a few ideas below for discussion:

- **Create National Seed Strategy Fund at National Fish and Wildlife Foundation**  
The National Fish and Wildlife Foundation (NFWF) helps create public-private partnerships to protect and restore public lands and waters; it matches Federal dollars with private sector donations to fund important conservation projects across the nation. Congress could appropriate funds to NFWF to support the implementation of Strategy and private sector companies could provide matching funds. NFWF would then distribute grants to agencies and NGOs to advance Strategy goals.
- **Seek additional appropriations to implement the Seed Strategy**  
The PCA Federal partners could organize a joint-proposal to Congress for a National Seed Strategy appropriation that would cover Strategy costs over the next five years. The proposal would link the Seed Strategy's goals to other national priorities such as conserving greater sage-grouse and pollinator habitat, preventing wildfires, and combating the spread of invasive species.
- **Build links to National Seed Strategy in Regional Mitigation Strategies**  
Mitigation rarely covers the loss of native plant communities. BLM develops Regional Mitigation Strategies (RMS) to use a landscape approach towards mitigation actions in certain regions. Future RMS could incorporate the Seed Strategy's goals and objectives into landscape restoration activities.
- **Direct Funds for Major Conservation Priorities to Seed Strategy Actions**  
Federal land management agencies are pursuing a number of high priority conservation efforts that would benefit from Strategy actions. The greater sage-grouse conservation plans, the National Strategy to Promote Pollinator Health, the DOI Secretarial Order 3336 on Rangeland Fire Prevention all include goals that overlap with Seed Strategy goals and objectives. Leaders of these efforts should consider investing in Seed Strategy actions to advance their conservation goals.

## Addendum: Action Cost Estimate Table

Action Obj	Year 1	Year 2	Year 3	Year 4	Year 5	Action/Obj subtotals	
1.1.1	250,000	250,000	0	0	0	500,000	
1.1.2	250,000	250,000	0	0	0	500,000	
1.1.3	75,000	75,000	0	0	0	150,000	
1.1.4		200,000	0	0	0	200,000	
1.1.5		500,000	0	0	0	500,000	
<b>1.1 st</b>	<b>575,000</b>	<b>1,275,000</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1,850,000</b>	Obj 1.1 st
1.2.1	400,000	300,000		0	0	700,000	
1.2.2		200,000	150,000	0	0	350,000	
1.2.3		250,000		0	0	250,000	
<b>1.2 st</b>	<b>400,000</b>	<b>750,000</b>	<b>150,000</b>	<b>0</b>	<b>0</b>	<b>1,300,000</b>	Obj 1.2 st
1.3.1	7,400,000	17,400,000	17,400,000	17,400,000	17,400,000	77,000,000	
1.3.2	150,000	150,000	0	0	0	300,000	
1.3.3	100,000	250,000	250,000	250,000	250,000	1,100,000	
1.3.4	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	50,000,000	
1.3.5		150,000	150,000	0	0	300,000	
<b>1.3 st</b>	<b>17,650,000</b>	<b>27,950,000</b>	<b>27,800,000</b>	<b>27,650,000</b>	<b>27,650,000</b>	<b>128,700,000</b>	Obj 1.3 st
<b>Goal 1</b>	<b>18,625,000</b>	<b>29,975,000</b>	<b>27,950,000</b>	<b>27,650,000</b>	<b>27,650,000</b>	<b>131,850,000</b>	<b>Goal 1 st</b>
2.1.1	7,500,000	15,000,000	15,000,000	15,000,000	15,000,000	67,500,000	
2.1.2	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	5,000,000	
<b>2.1 st</b>	<b>8,500,000</b>	<b>16,000,000</b>	<b>16,000,000</b>	<b>16,000,000</b>	<b>16,000,000</b>	<b>72,500,000</b>	Obj 2.1 st
2.2.1	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000	6,250,000	
2.2.2	100,000	450,000	850,000	850,000	850,000	3,100,000	
2.2.3	6,600,000	6,600,000	6,600,000	6,600,000	6,600,000	33,000,000	
<b>2.2 st</b>	<b>7,950,000</b>	<b>8,300,000</b>	<b>8,700,000</b>	<b>8,700,000</b>	<b>8,700,000</b>	<b>42,350,000</b>	Obj 2.2 st
2.3.1	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	25,000,000	
2.3.2	100,000	3,125,000	3,125,000	3,125,000	3,125,000	12,600,000	
2.3.3	1,050,000	1,050,000	1,050,000	1,050,000	1,050,000	5,250,000	
2.3.4	1,000,000	2,500,000	2,500,000	3,000,000	3,000,000	12,000,000	
<b>2.3 st</b>	<b>7,150,000</b>	<b>11,675,000</b>	<b>11,675,000</b>	<b>12,175,000</b>	<b>12,175,000</b>	<b>54,850,000</b>	Obj 2.3 st
2.4.1	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	25,500,000	
2.4.2	510,000	500,000	500,000	0	0	1,510,000	
2.4.3	100,000	100,000	100,000	100,000	100,000	500,000	
<b>2.4 st</b>	<b>5,710,000</b>	<b>5,700,000</b>	<b>5,700,000</b>	<b>5,200,000</b>	<b>5,200,000</b>	<b>27,510,000</b>	Obj 2.4 st
<b>Goal 2</b>	<b>29,310,000</b>	<b>41,675,000</b>	<b>42,075,000</b>	<b>42,075,000</b>	<b>42,075,000</b>	<b>197,210,000</b>	<b>Goal 2 st</b>

st = subtotal; Obj = Objective

Action/ Obj	Year 1	Year 2	Year 3	Year 4	Year 5	Action/Obj subtotals	
3.1.1	1,250,000	2,000,000	2,000,000	1,750,000	1,500,000	8,500,000	
3.1.2	500,000	1,000,000	1,500,000	2,000,000	2,500,000	7,500,000	
3.1.3	250,000	260,000	260,000	260,000	260,000	1,290,000	
3.1 st	2,000,000	3,260,000	3,760,000	4,010,000	4,260,000	17,290,000	Obj 3.1 st
3.2.1	100,000	75,000	75,000	75,000	75,000	400,000	
3.2.2	10,000	10,000	10,000	10,000	210,000	250,000	
3.2.3	200,000	200,000	100,000	100,000	100,000	700,000	
3.2.4	100,000	100,000	25,000	25,000	25,000	275,000	
3.2 st	410,000	385,000	210,000	210,000	410,000	1,625,000	Obj 3.2 st
3.3.1	250,000	250,000	250,000	250,000	250,000	1,250,000	
3.3.2	20,000	50,000	50,000	50,000	50,000	220,000	
3.3.3	200,000	600,000	300,000	300,000	300,000	1,700,000	
3.3 st	470,000	900,000	600,000	600,000	600,000	3,170,000	Obj 3.3 st
3.4.1	90,000	90,000	10,000	10,000	10,000	210,000	
3.4.2		500,000	500,000	500,000	0	1,500,000	
3.4.3		200,000	400,000	200,000	200,000	1,000,000	
3.4.4 & 3.4.5	100,000	300,000	400,000	50,000	50,000	900,000	
3.4.6		70,000	70,000	70,000	40,000	250,000	
3.4.7	130,000	130,000	0	0	0	260,000	
3.4 st	320,000	1,290,000	1,380,000	830,000	300,000	4,120,000	Obj 3.4 st
<b>Goal 3</b>	<b>3,200,000</b>	<b>5,835,000</b>	<b>5,950,000</b>	<b>5,650,000</b>	<b>5,570,000</b>	<b>26,205,000</b>	<b>Goal 3 st</b>
4.1.1	250,000	75,000	75,000	75,000	75,000	550,000	
4.1.2	150,000	77,500	77,500	77,500	77,500	460,000	
4.1 st	<b>400,000</b>	<b>152,500</b>	<b>152,500</b>	<b>152,500</b>	<b>152,500</b>	<b>1,010,000</b>	Obj 4.1 st
4.2.1	200,000	50,000	50,000	50,000	50,000	400,000	
4.2.2		300,000	300,000	200,000	200,000	1,000,000	
4.2.3	20,000	5,000	5,000	5,000	5,000	40,000	
4.2.4	10,000	10,000	10,000	10,000	10,000	50,000	
4.2 st	<b>230,000</b>	<b>365,000</b>	<b>365,000</b>	<b>265,000</b>	<b>265,000</b>	<b>1,490,000</b>	Obj 4.2 st
4.3.1	25,000	40,000	40,000	40,000	40,000	185,000	
4.3.2	0	35,000	35,000	35,000	35,000	140,000	
4.3.3	0	0	0	0	100,000	100,000	
4.3 st	25,000	75,000	75,000	75,000	175,000	425,000	Obj 4.3 st
<b>Goal 4</b>	<b>655,000</b>	<b>592,500</b>	<b>592,500</b>	<b>492,500</b>	<b>592,500</b>	<b>2,925,000</b>	<b>Goal 4 st</b>
<b>Yearly Totals</b>	<b>51,790,000</b>	<b>78,077,500</b>	<b>76,567,500</b>	<b>75,867,500</b>	<b>75,887,500</b>	<b>358,190,000</b>	<b>Grand Total</b>