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Current and Innovative Solutions to Roadside Revegetation Using Native Plants

A DOMESTIC SCAN REPORT

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16. Abstract

The use of native plants in roadside revegetation has evolved as more and more resource management agencies prescribe the practice as a much better approach for ecosystem. However, this practice is not widely used by state and local agencies that are responsible for building majority of the roads. The goals and priorities of those responsible to successfully complete roadside revegetation projects are as diverse as the methods used to accomplish them. Even for the most seasoned revegetation professional, achieving success is not guaranteed. A domestic scan was initiated by the Federal Highway Administration to facilitate understanding about the processes and techniques used in successful and innovative projects that used native plants for roadside revegetation.

This report summarizes the observations, discussions and broad conclusions of nationally-recognized revegetation specialists during the 2009 scan tour. A key finding was that there are many interconnected elements involved in both the technical and non-technical aspects of the revegetation process – all of which should be addressed in a project revegetation plan. Notably, the non-technical aspects—planning, design, implementation, monitoring, and maintenance—were found to be just as critical to the success of revegetation projects as the technical aspects.

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A DOMESTIC SCAN REPORT
JANUARY 2011

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LIST OF ACRONYMS

APA	Adirondack Park Agency
BMP	Best Management Practice
DEC	Department of Environmental Conservation
ITD	Idaho Transportation Department
MSE	Mechanically Stabilized Earth
NYSDOT	New York State Department of Transportation
ROW	Right-of-Way
US	United States
USFS	United States Forest Service
VTrans	Vermont Agency of Transportation

EXECUTIVE SUMMARY

Native roadside revegetation involves establishing or re-establishing appropriate plant material on areas disturbed by road construction projects. The process has gained increased attention as agencies realize the many benefits it provides, including soil and slope stabilization, improved water quality, aesthetics, carbon sequestration, weed suppression, and enhanced wildlife habitat. However, when revegetation efforts fail, the costs and consequences can be equally significant, resulting in erosion and slope failures, water contamination, weed infestations, decreased landscape aesthetics, and costly redesign and implementation efforts.

One of the main challenges in achieving successful roadside revegetation is that there is no one-size-fits-all technique or approach that can be applied to every project. A domestic scan was initiated by the Federal Highway Administration to facilitate understanding about the processes and techniques used in successful and innovative projects that used native plants for roadside revegetation.

The scan included eight project sites observed by an expert panel of six, nationally-recognized experts with relevant expertise in roadside revegetation using native plants. The participants included revegetation specialists representing the Federal Highway Administration, the US Forest Service, the National Parks Service, the US Fish and Wildlife Service, and the Colorado Department of Transportation. The end result of the scan was a detailed report, which documents practices at each project site, summarizes the observations and conclusions of the expert panel, and provides a discussion of common themes and practices about roadside revegetation using native plants.

A comprehensive online questionnaire (distributed to over 500 key Federal, state, and county agencies and Metropolitan Planning Organizations in all 50 states) was used to identify in-progress roadside revegetation using native plants projects with innovative practices and/or success stories. Host project sites for the scan were selected based on (a) diversity in geography and project sponsor, type, and size, and project details as described in the survey response; and (b) a telephone discussion to clarify survey responses. The survey results are included as an appendix and summarized in the report.

Four initial project sites were selected and included:

- **Route 9 Reconstruction Project –** Searsburg to Wilmington, Vermont; Vermont Agency of Transportation
- **Cascade Lakes Pass Revegetation Project –** Keene to Lake Placid, New York; New York State Department of Transportation
- **Blaine Road Reconstruction –** Blaine, Oregon; US Forest Service and Federal Highway Administration
- **US-95 Road Reconstruction –** Electrical Substation to Smith Creek, Idaho; Idaho Transportation Department

In addition, three of the four host agencies invited the expert panel to visit additional revegetation projects located within driving distance from the originally-identified project sites (no more than one hour):

- **Route 9 Reconstruction Wetland Mitigation –** Wilmington, Vermont; Vermont Agency of Transportation
- **Sandlake Road Reconstruction –** Hemlock, Oregon; Federal Highway Administration
- **Setters Road Construction –** Worley, Idaho; Idaho Transportation Department
- **Native Revegetation Experimental Survey Station –** Worley, Idaho; University of Idaho and the Idaho Transportation Department

For most projects observed during the scan, several key characteristics were noted by the host agency and expert panel as contributing factors in achieving overall success (i.e., early planning, clear project objectives, collaboration among stakeholders, contractor commitment to revegetation, monitoring/maintenance). The results of the scan survey, a precursor to the scan tour, also confirmed the importance of these characteristics in revegetation process success.

The final report summarizes the observations, discussions and broad conclusions of the expert panel during the 2009 roadside revegetation using native plants scan. A key understanding is that there are many interconnected elements involved in both the technical and non-technical aspects of the revegetation process – all of which should be addressed in a project revegetation plan. Notably, the non-technical aspects—planning, design, implementation, monitoring, and maintenance—have been found to be just as critical to the success of revegetation projects as the technical aspects, such as knowledge of the plantings, seeding, and soils.

INTRODUCTION

Native roadside revegetation involves establishing or re-establishing appropriate plant material on areas disturbed by road construction projects. It has gained increased attention as people realize the many benefits it provides, including soil and slope stabilization, improved water quality, aesthetics, carbon sequestration, weed suppression, and enhanced wildlife habitat. Furthermore, given the sheer number of road and highway improvement projects conducted annually by local, state, and federal agencies, these benefits are realized on a very large scale. However, when revegetation efforts fail, the costs and consequences can be equally significant, resulting in erosion and slope failures, water contamination, weed infestations, decreased landscape aesthetics, and costly redesign and implementation efforts.

One of the main challenges in achieving successful roadside revegetation using native plants is that there is no one-size-fits-all technique or approach that can be applied to every project. Designers and contractors must have specific knowledge of local conditions and techniques; however, this may not be sufficient to ensure a successful revegetation effort. Oftentimes, the non-technical aspects of the process are equally important, such as good planning, communication, oversight, and monitoring.

Sharing information about the processes and techniques used in successful and innovative projects is one way to improve and advance the field of roadside revegetation. To contribute to the concept of sharing information and advancing the field, a domestic scan for roadside revegetation using native plants was initiated by Federal Highway Administration (scan). The objective was to assemble a group of revegetation specialists and review innovative and successful projects from across the United States.

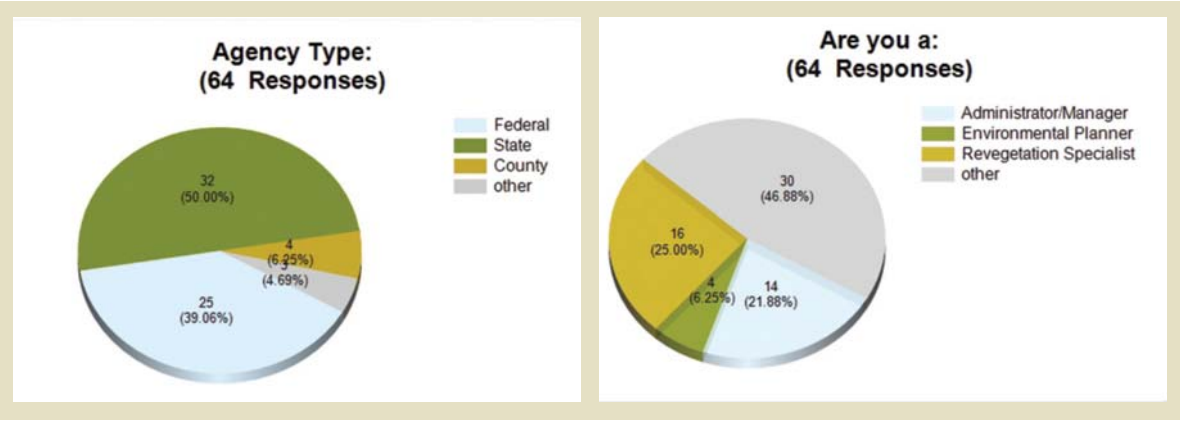
For the scan, an expert panel of six revegetation specialists was convened to travel to eight individual project sites located in Vermont, New York, Oregon, and Idaho. The expert panel was comprised of experts representing the Federal Highway Administration, the US Forest Service, the National Parks Service, the US Fish and Wildlife Service, and the Colorado Department of Transportation.

This report summarizes the observations and conclusions of the expert panel from the roadside revegetation scan and offer insight to assist other agencies with revegetation efforts.

SCAN PROCESS

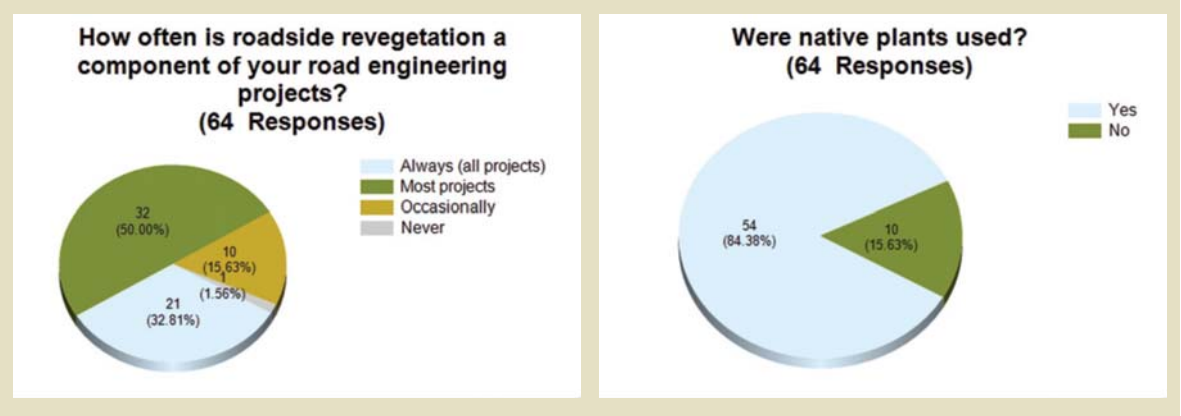
The planning and coordination of the scan first began with identification of qualified revegetation experts willing to participate on the expert panel. The expert panel was comprised of nationally-recognized experts with relevant expertise and experience in roadside revegetation, who could provide insight and feedback about the projects observed during the scan (Appendix A). The expert panel consisted of both Federal and state employee representatives.

Next, an online questionnaire was distributed to over 500 key Federal, state, and county agencies and Metropolitan Planning Organizations in all 50 states to identify in-progress native roadside revegetation projects; agencies included Departments of Transportation, the National Park Service, the National Forest Service, the US Fish and Wildlife Service, and others. A total of 64 responses were received (approximately 13% response rate).



The survey questions were designed to identify agencies with active revegetation projects and elicit innovative practices, lessons learned and/or success stories with their roadside revegetation using native plants. Survey respondents included engineers, environmental planners, landscape architects, botanists, revegetation specialists, ecologists, weed specialists, and project administrators.

Due to schedule and budget constraints, comprehensive geographic coverage and project diversity was not feasible; the scan included two, one-week trips within a one month period. Each trip visited a single geographic location for which multiple project sites were within driving distance. Host project sites for the scan were selected based on (a) diversity in geography and project sponsor, type, and size, and project details as described in the survey response; and (b) a telephone discussion to clarify survey responses, and confirm both host site interest in participating and appropriateness of project to the scan.



Appendix B includes the complete online questionnaire template and responses received, including detailed project descriptions of native revegetation projects and comments/feedback on native revegetation processes.

HOST SITE LOCATIONS

Four initial project sites were selected after a preliminary and included the following locations:

- **Route 9 Reconstruction Project –** Searsburg to Wilmington, Vermont; Vermont Agency of Transportation
- **Cascade Lakes Pass Revegetation Project –** Keene to Lake Placid, New York; New York State Department of Transportation
- **Blaine Road Reconstruction –** Blaine, Oregon; US Forest Service and Federal Highway Administration
- **US-95 Road Reconstruction –** Electrical Substation to Smith Creek, Idaho; Idaho Transportation Department

In addition to these four locations, three of the four host agencies invited the expert panel to visit additional revegetation projects located within driving distance from the originally-identified project sites (no more than one hour). The expert panel included these additional project sites in their observation and discussion for the roadside revegetation scan. The additional sites included the following locations:

- **Route 9 Reconstruction Wetland Mitigation –** Wilmington, Vermont; Vermont Agency of Transportation
- **Sandlake Road Reconstruction –** Hemlock, Oregon; Federal Highway Administration
- **Setters Road Construction –** Worley, Idaho; Idaho Transportation Department
- **Native Revegetation Experimental Survey Station –** Worley, Idaho; University of Idaho and the Idaho Transportation Department

In total, the expert panel observed eight individual revegetation sites in areas with distinctly different conditions. Although the scan did not include travel to the desert southwest, a Midwest prairie community, or a sub-tropical zone such as Florida, the observations at the eight project sites generated significant discussion on the subject of revegetation, which could potentially be extrapolated to revegetation sites nationwide.

SCAN PARTICIPANTS

Six individuals were selected for participation on the expert panel, and included representation from Federal and State agencies (Appendix A). These individuals were selected for their expertise in the field of revegetation, botany, and/or biology and their ability to share insight and expertise regarding roadside revegetation in a meaningful and constructive manner during the scan site visits.

PROJECT SITE TRIPS

Two one-week trips were scheduled in Fall 2009. The first trip, which included site visits to Vermont and upstate New York, was conducted September 15 -18, 2009. The second trip, which included site visits to Oregon and Idaho, was conducted October 5-9, 2009.

REVEGETATION PROJECT SITES

The site locations for the scan included one trip each to the Northeast United States and Northwest United States. Figure 1 illustrates the scan site locations across the United States (US) visited by the scan expert panel.

Figure 1. *Unites States Scan Site Locations*

ROUTE 9 RECONSTRUCTION PROJECT – SEARSBURG TO WILMINGTON, VERMONT

Figure 2. *US Route 9 from Searsburg to Wilmington*

PROJECT SUMMARY

The first roadside revegetation project observed by the expert panel was located along 3.67 miles of US Route 9 from Searsburg to Wilmington, Vermont (Figure 2). This site was a two-year highway reconstruction project that impacted many acres of roadside landscape and wildlife habitat corridors. The main purpose of the road reconstruction project was to widen the highway, upgrade conditions, and improve safety. As a designated National Highway System road, US Route 9 is held to a high standard of design to accommodate interstate transportation; US Route 9 was accepted for designation as a Vermont Scenic Highway.

The sinuous alignment of US Route 9 and the existing topography presented difficult design challenges for engineers and landscape architects. The roadway is wedged between steep, wooded slopes and the edge of the Deerfield River and Harriman Reservoir, and in some sections where slopes needed to be cleared to the water's edge, stone riprap was placed on steep 1:1.5 and 1:2 slopes for stability. Native topsoil was used to cover these slopes to promote revegetation, and then the use of innovative landscape measures was implemented to help restore native plant species despite unfavorable growing conditions.

The difficult task of replanting steep slopes in minimal soil over stone fill was the primary challenge for this roadside revegetation project. Innovative slope planting methods were developed by the Vermont Agency of Transportation (VTrans) and used successfully throughout the project to revegetate the extreme slopes adjacent to the water bodies.

DECISION MAKING PROCESS

The revegetation design of this project began after road construction had begun; therefore, the designers did not work collaboratively with the engineers as they designed the roadway. In this case, the revegetation plans were developed solely as a response to the final road construction plans. The landscape architects had to work closely with the VTrans road project manager and the state and federal regulatory agencies to develop three unique revegetation solutions that used plants native to the area. These methods were approved by the Vermont Agency of Natural Resources staff, including their wildlife and aquatic biologists, and the Army Corps of Engineers, for integration into the final design and construction schedule.

There was a lengthy road design process that included input from local officials and residents, as well as state and federal regulatory agencies, and environmental groups. During this process, the Vtrans roadway engineers were able to make significant changes to the overall roadway design that were intended to minimize the impact to the Deerfield River in response to environmental concerns. Large segments of riparian and wooded vegetation ended up being left untouched with these changes in the roadway design.

In addition to the landscape architect, the VTrans project manager was very influential in the decision making process. Although now retired and not present on the scan, his effort and commitment to the revegetation on the project, as cited by the landscape architect, was critical in the successful outcome. He understood that revegetation was an important component of road design and he was very adamant that it was done correctly.

REVEGETATION APPROACH

The landscape architect's office was located in Montpelier, which is over a three-hour drive from the Wilmington, so it was impractical to have her on site regularly during the construction phase. Therefore, a full-time field representative was specifically hired to work with the contractors during the installation of the landscape revegetation. The field representative was trained by the landscape architect to ensure that the design intent would be realized in the field during her absence, work collaboratively with the contractor, and provide daily oversight. This approach was invaluable to the success of the project, as answers to questions and field decisions could be made immediately by a qualified individual, which prevented costly delays and mistakes.

One of the revegetation objectives was to establish healthy stands of native grasses and forbs on the steep slopes for the purpose of providing erosion control, water quality, wildlife habitat, and improved aesthetics. This objective was accomplished, in part, by seeding a conservation mix over the disturbed and newly constructed areas. This seed mix was quite successful due to the appropriate selection of species in the mix itself, and the added benefit of ample precipitation throughout the first growing season. In order to prevent erosion while the seed became established, jute netting was installed on the slopes.

Topsoil was salvaged prior to construction activities and stockpiled, and later spread over the disturbed and riprap areas to a depth of 12 inches. This technique is a standard practice in Vermont and they refer to it as using "soil grubbings", which is another term for using buried riprap with native, salvaged soils that come from the project site.

A second revegetation objective was to establish woody plantings in selected locations among the seeded areas. In order to determine the appropriate native species in the planting plan, the designers inventoried the site prior to construction and used these same trees and shrubs in the design. The following paragraphs describe the techniques that were developed by the landscape architect to get these woody plants established on the steep slopes.

Planting Pockets – It was determined that the 12-inches of topsoil above the riprap on the slopes would not be adequate for long term survival of the trees and shrubs. Their roots would require a greater depth, so a design was developed where eight-foot long by eight-foot wide "planting pockets" were excavated out of the riprap to a depth of approximately three feet to provide additional planting depth (Figure 3). The size of the planting pockets were kept small—so as to not impact the integrity of the slope protection gained from using the riprap—and they were placed throughout the project site.

Figure 3. *Planting pocket showing tree planting, with Harriman Reservoir in background*

Embankment Plantings – Not all slopes required riprap protection as described above. Much of the roadside area did require planting on steep slopes; however, much of this landscape required only additional topsoil over the sub-soil (Figure 4). This technique facilitated planting of trees and shrubs in larger groups rather than the limitations imposed by planting pockets.

Although embankment plantings are not an innovative technique, these areas established quite successfully and provide large masses of native vegetation that contribute to the overall project objectives. The vegetation in these areas also includes the same native grasses, forbs, shrubs, and trees that were installed in the planting pockets, but the vegetation was installed in areas exceeding 100 feet in length and twenty feet in width.

Figure 4. *Embankment planting on Route 9 near Wilmington, VT*

Geogrid Sub-Base Stabilization Plantings – A third planting technique was required for steep slopes created during road construction, when the sub-base of the road was built up in lifts of approximately 18". Instead of using riprap to stabilize the slopes, the engineers developed a method where the soil lifts were wrapped and contained in a geogrid material (Figure 5). However, the geogrid not only created a stabilizing structure for the embankment soil, but also created a barrier for root growth. Therefore, the landscape architect developed a specialized planting plan for these areas that only included grasses, forbs, and shrubs. Trees were not used because of the potential damage to both the geogrid material and to the tree roots themselves.

Figure 5. *Geogrid sub-base stabilization planting near Wilmington, VT*

Wetland Mitigation – Another component to this project observed by the expert panel included a wetland mitigation site (Figure 6). This site was constructed under requirements set forth by the US Army Corps of Engineers for impacts to existing wetlands that occurred during construction of the road. Due to the lack of adequate on-site mitigation, all of the wetland mitigation was conducted at an off-site location that was approximately 15-miles from the town of Wilmington. The site was approximately 10-acres and located in abandoned gravel mine.

Figure 6. *Wetland mitigation site near Wilmington, VT*

Wildlife Underpass Crossings – There are many incidents involving wildlife and traffic encounters in this area, so designers worked closely with staff from the Vermont Department of Fish and Wildlife to provide for animal passage under the bridges. These pathways were called "Critter Crossings" and were specially designed to allow animals, both large and small, the opportunity to pass under the bridges on stable footing (Figure 7). While this technique didn't have a significant impact on the revegetation process, it is worth noting as a technique to improve safety for both humans and wildlife along State and Federal highways.

Figure 7. *Critter crossing underpass near Wilmington, VT*

RESULTS OF THE REVEGETATION

Although the revegetation plans were designed after roadway construction had begun, the project was successful. After approximately five years from plant and seed installation, the positive results of the revegetation efforts are evident; healthy stands of grasses and forbs have present with nearly 100% coverage in the seeded areas. The trees and shrubs have established and are continuing to thrive.

The methods used by the Vermont Agency of Transportation in this revegetation project were somewhat experimental, but with their success, their methods have formed a model for statewide use in similar conditions. Further, the plant installations and seed did exceptionally well despite difficult growing conditions.

LESSONS LEARNED

Planting pockets demonstrated that trees and shrubs can be established on a buried riprap slope if they are given additional room to expand their root systems. Since this project is less than five years old, the long term success of these plants remains to be seen; however, at the time of observation, there is no indication that they will fail. The decision to use this particular method will roadway engineer review to confirm that excavating from embankment riprap will not compromise the integrity of the erosion protection.

Project success may also be partially attributed to the fact that the agency was able to hire a full-time field supervisor who was given authority to act as an owner's representative. This arrangement was beneficial for the project in that it increased the amount of daily contact with the contractors. Questions regarding the plans could be answered immediately and field adjustments could be made without delay, since this person was onsite during the entire revegetation process.

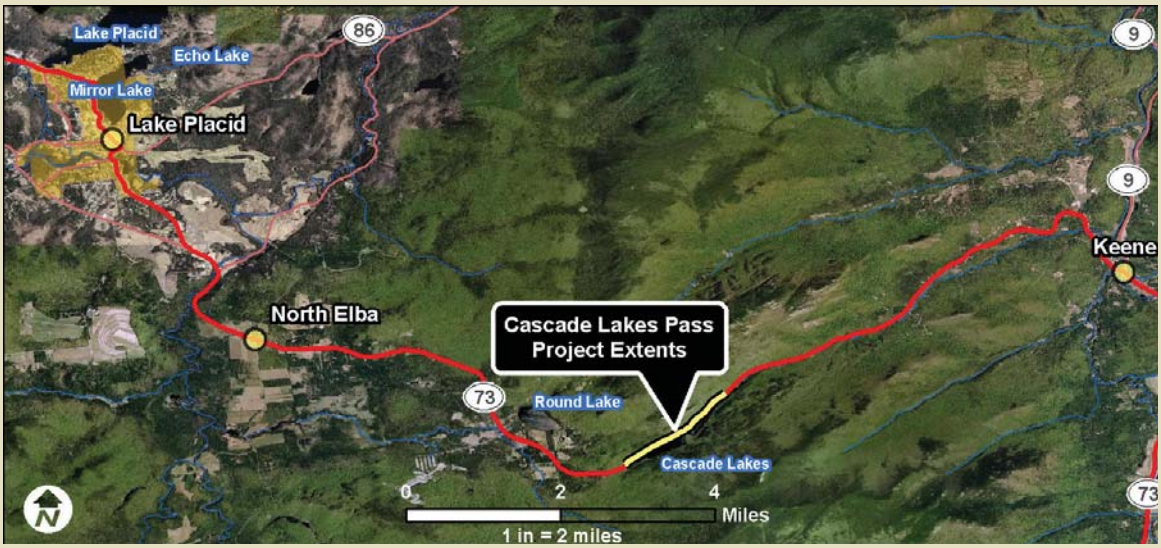
The various treatments devised for vegetating the slopes demonstrate that revegetation is not a "once-size-fits-all" practice. Identifying site conditions prior to developing a design revealed that several different techniques would be necessary to establish plants.

The VTrans landscape architect emphasized the importance and benefit of having pre-construction conversations with the construction contractor to ensure they understood the importance of revegetation in the overall success of the road project; this communication does not always happen when working with contractors. In this project, the construction contractor approached the task with a commitment to working with the designers and project liaison to ensure the revegetation was approached properly and following the intent of the design. Having this level of dedication from a contractor on a project is invaluable to achieving the objectives. Additionally, the experience and imagination of the designers cannot be overlooked when discussing why this project was successful, as it was critical to their successful interaction and collaboration with the contractors.

Another project-specific lesson was regarding the use of irrigation during the vegetation establishment period. The design specified that hand watering each plant was to be completed four times per month. This level of watering seemed excessive and the line item cost was entered as a lump sum of $30,000 for one season. The rainfall during this first growing season was above normal and the plants did not require much, if any, supplemental watering. This high cost could have been revised and funds applied elsewhere on the project if a revegetation plan was provided that analyzed the average precipitation rates for the area.

CASCADE LAKES PASS, NEW YORK

Figure 8. *Cascade Lakes Pass*



PROJECT SUMMARY

The New York project was located in the Adirondacks in an area called Cascade Lakes, which is on a mountain pass between Keene, NH and Lake Placid, NY (Figure 8). A two-lane highway runs adjacent to the Cascade Lakes at an elevation of approximately 2,200 feet above sea level. Winters in this area are notoriously cold, windy, and wet, creating dangerous driving conditions with drifting snow and ice build up on the roads that require frequent maintenance activities to keep them clear. Sand has not been used in this area for snow and ice control for a number of years; rather, control now consists of salt and other anti-icing and de-icing products. Historically, sand was used in larger quantities and contributed to vegetation die-back.

The landscape that lies between the roadway and the lakeshore is very narrow and steep with poor topsoil (Figure 9). There is evidence of soil erosion caused by stormwater runoff that flowed off of the road and into the lake. Additionally, the sand and salt used to control the ice have washed off the road, smothering the bases of trees, shrubs, and grasses at this site. One species in particular was noticed to be experiencing a higher than normal (and unexplained) mortality rate - the white birch (Betula papyrifera).

Figure 9. *Route 73 at Cascades Lakes Pass showing steep slopes with rocky soils*

In 2003, the New York State Department of Transportation (NYSDOT) initiated a transportation research project to analyze the environmental impacts of snow and ice removal efforts (a) on the water quality of regional lakes; and (b) as a potential cause of the white birch dieback. It was hypothesized that the trees were dying off due to their age, environmental stressors, soil erosion around their roots, and possibly from the salts used for ice control. The study was funded with Federal Statewide Planning and Research money.

The study was conducted by engineering, biology, and natural resources professors from Clarkson University in Potsdam, NY, and Paul Smiths College near Saranac Lake, NY. From the study, the professors submitted a variety of conclusions and one recommendation pertaining to revegetation. They suggested that NYSDOT should revegetate the roadside shoulder between Route 73 and the lake to limit shoulder runoff and protect water quality and aquatic fauna, including the endangered round whitefish that inhabits the Cascade Lakes.

To accomplish the revegetation tasks based on study recommendations, NYSDOT decided to tap into their own resources to not only fund the entire project, but also provide the design and implementation. The designers developed a revegetation plan that included native plant species that were salt resistant, sustainable, and would minimize maintenance to the greatest extent possible. The NYSDOT provided the labor and machinery necessary for the installation of these plants.

DECISION MAKING PROCESS

Since all of the funding, design, and construction of the project were completed with resources within the NYSDOT through a special grant program, the project team encountered unique circumstances pertaining to decision making. While the project was most self-contained, there were a few regulatory agencies with jurisdiction over the project that had to be consulted prior to initiating the work. The NYSDOT staff shared their revegetation plan with the Adirondack Park Agency (APA), a State agency that regulates development in the Adirondacks, and the New York State Department of Environmental Conservation (DEC), which manages Forest Preserve lands adjoining Route 73, and the Ausable River Association, which is a citizen's group that also wished to contribute to the improvement of the Pass.

This project was funded with money from a New York State program called the Green and Blue Highways Initiative. This is an environmental initiative where maintenance staff identify activities with environmental significance and then implement them with their own staff. The Office of Transportation Maintenance started Green and Blue Highways in 2005 as a grassroots effort within the NYSDOT to capitalize on field staff insights and capabilities. The initiative encourages a stewardship/operations/maintenance synergy. When staff or managers address an issue that could potentially result in conflicts among operations, safety, and environmental concerns, Green and Blue Highways offers a process and resources to develop a solution that minimizes the conflict and leads to a mutually beneficial outcome.

When the recommendation to revegetate between the shoulder and the lake was made, the staff thought this approach would be a good candidate for Green and Blue Highways funding. In all, the program provided $20,000 in funding for materials and construction.

REVEGETATION APPROACH

The designers established a plant and seed palette that consisted of native species, which would tolerate the harsh roadside conditions and the elevation of the Pass. In addition, these plants had to be able to withstand the saline from salt and sand treatments used by the maintenance crews and washed off the road and onto plants. With budget limited and a large project area, the agency had to prioritize individual sites to maximize the benefits from the revegetation efforts.

The following paragraphs describe the two revegetation techniques used at the project.

Coir Log Planting Bench – Several of the planting locations were on very steep grades with extremely poor topsoil. Revegetation would have been nearly impossible without the use of a method to create more favorable planting conditions on these extreme slopes. Additionally, the area was located in a narrow area that was wedged between the highway and the lakeshore. Working the site with heavy equipment and attempting to install plants on near vertical slopes would have been impractical; therefore, coir logs were installed by hand and then topsoil was placed behind them to create a planting bench (Figure 10). This method created a stable planting area with good water holding capacity on an otherwise harsh site.

Coir logs were constructed of rolled coconut fiber that were approximately 20 inches in diameter and 20 foot in length. The coir logs were staked into the slopes using metal rebar and wood stakes, and then the topsoil was imported from an offsite source and placed behind the coir logs.

Figure 10. *Coir log planting along Route 73 with Cascade Lakes in the background*

Living Snow Fence – The snow and ice that accumulates on the road in winter creates a very dangerous situation for drivers and presents a constant challenge for the maintenance crews. Wind blows through the valley and across the frozen lake, depositing drifting snow and ice across the roads. One of the study recommendations was to install a living snow fence created by planting native evergreen trees (Figure 11). Although the plants that were installed are only approximately 3' in height, it is anticipated that eventually the plants will reach sufficient height to provide a barrier and prevent excess snow and ice from accumulating on the roads.

White spruce (Picea glauca) trees were planted due to their ability to withstand wind, heat, cold, drought, and crowding. In addition, these species are salt tolerant and are native to the Adirondacks.

Figure 11. *Living snow fence area at Cascade Lakes Pass; small spruce trees planted for the eventual snow fence*

RESULTS OF THE REVEGETATION

After two complete growing seasons the results are mostly successful. The coir logs have created hospitable conditions for plant materials on the upslope side and along with the imported topsoil have effectively held water. The planting benches also support good growth of the trees, shrubs, grasses, and forbs that were installed by the crew. Following is a list of species that were planted from container plantings:

- White spruce *Picea Glauca*
- Tamarack *Larix laricina*
- White birch *Betula papyrifera*
- Grey birch *Betula populifolia*
- Red osier dogwood *Cornus sericea*
- Dwarf sand cherry *Prunus pumila*
- False sunflower *Heliopsis helianthoides*
- Wild bergamot *Monarda fistulosa*
- Grey goldenrod *Solidago nemoralis*
- Little bluestem *Schizachyrium scoparium*
- Freshwater cordgrass *Spartina pectinata*

One documented problem is that three of the white spruce did not survive or appear to be extremely stressed. The NYSDOT replaced these species with additional tamarack (Larix laricina), which will function similarly to the white spruce. Subsequent to the site visit, NYSDOT determined that most of the white spruce did not survive—likely a result of the wet planting conditions near the lake—and they have been replaced with tamarack.

LESSONS LEARNED

Occasionally, roadside revegetation projects are initiated and funded by means other than a road reconstruction project. In this case, the revegetation was conducted at the suggestion of participants in the transportation research study and the work was completed by NYSDOT maintenance workers and community volunteers. The ability to hold a contractor accountable for any failures was not possible.

Although this project presented a unique staffing situation, in that citizen groups aren't often involved in roadside revegetation when the funding is coming from a governmental agency, the volunteer groups were found to be a valuable resource that contributed to project success. Local citizens are often very interested in pitching in their time and effort to improve the aesthetics, ecology, and safety of their communities.

Due to the steep slopes and inaccessibility for heavy equipment on the site, the coir logs were installed by hand by the work crews. However, although the logs were manageable by hand when the materials were dry, they were almost unmovable when they became wet.

NYSDOT reported that using imported topsoil can pose risks with weed infestations if the soil is not properly selected and/or treated. In this case, topsoil was brought in that contained farm weed seed and for many years following installation, NYSDOT has provided hand weeding to preserve the native plantings. The ability to screen topsoil and guarantee that it is weed-free presents a challenge.

BLAINE ROAD, OREGON

Figure 12. *Blaine Road*

PROJECT SUMMARY

This road improvement project for Blain Road begins near the town of Blaine, OR and travels approximately four miles through lands owned by the US Forest Service, the Bureau of Land Management, and lands that are held by private land owners (Figure 12). These lands border the Nestucca River, which is designated as an Oregon State Scenic Waterway and plays a significant role in the revegetation efforts. The first 1.5 miles of the road project traverse a broad valley of private land and then enters a steep canyon of federal land.

The planning of this project lasted more than ten years because of several design revisions resulting from budgetary changes and adjustments to project objectives. The initial objectives were to widen the road and improve the road surface for improved safety. The roadway quality had degraded over the years with heavy use by logging trucks transporting timber from nearby harvest sites.

The road reconstruction was built in two phases. Phase one was constructed in the upper reaches of the project site, which was located in a steep canyon area. The intent of this phase was to widen the road, which would have significant impacts to the steep slopes of the canyon walls. Since the soils in the canyon were typically gravelly loams over fractured volcanic bedrock ranging from three to six feet deep, it made the slopes very unstable in certain areas.

The result was a wider and straighter road that did meet engineering objectives, and didn't minimize impacts to the adjacent landscape. Additionally, the cut slopes were even more unstable after construction, especially during periods after heavy rains, which led to several large landslide events that shut down the road altogether.

One local resident, who was upset by the impacts to the existing landscape, became very vocal after the first phase of construction was completed and strongly suggested that the FHWA reconsider the road improvement plans for Phase 2 if they were similar in approach to Phase 1. The design and planning teams agreed and Phase 2 of the road reconstruction was redesigned to better incorporate lower impact solutions. In general, Phase 2 became more of a road rehabilitation effort that minimized the disturbance to existing vegetation rather than a total road reconstruction. Although the adjacent landscape impacts were minimized, slope revegetation was required where retaining walls and culverts were located.

DECISION MAKING PROCESS

The Forest Service begin planning for the revegetation project during site assessments and information gathering that took place several years before construction. During the initial planning stage, they were able to obtain important information regarding site conditions such as soil types and chemistry, existing vegetation, solar aspect, slopes, average precipitation data, as well as any limiting factors that would inhibit plant establishment.

This information was used to develop the site Revegetation Plan, which documents the existing conditions and also states the revegetation objectives for the project. This plan represents the culmination of the extensive planning process and included the following information:

- Revegetation objectives
- Description and map of each revegetation unit
- Desired future conditions for each revegetation unit
- Analysis of site attributes (limiting factors and resources) and type of vegetation
- Description of mitigating measures
- Description of the revegetation strategy, including plant materials/stock types and application methods for each unit
- Key contacts and responsibilities

- Budget and timelines
- Strategies for monitoring achievement of desired future conditions
- Strategies for correcting shortcomings based on monitoring information

There were several regulatory agencies that had jurisdiction over this project and all played a role in the revegetation decision making process; their collective input had a significant impact on revegetation planning. For example, the US Fish and Wildlife Service addressed revegetation concerns that would impact two endangered species that inhabit the area (Western Spotted Owl, Marbled Murrelet). The US Army Corps of Engineers enforced 404 Permit terms for impacts incurred within the floodplain of the Nestucca River, including the installation of drainage culverts and riprap protection at approximately sixty-four individual locations. In turn, the Army Corps of Engineers mandated these areas be vegetated at a rate of 12 individual plants per 100 square feet of riprap.

The Wild and Scenic River designation for the adjacent Nestucca River was also a driver for portions of the revegetation efforts. The National Wild and Scenic Rivers System was created by Congress in 1968 to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Act is notable for safeguarding the special character of these rivers, while also recognizing the potential for their appropriate use and development. It encourages river management that crosses political boundaries and promotes public participation in developing goals for river protection (www.rivers.gov). Therefore, providing a consistent vegetative cover over areas of disturbance was critical in determining the extent of revegetation.

During the design portion of Phase 1, engineers with the State of Washington were consulted to provide bioengineering design plans for the steep slopes. The intent was for revegetation to occur with the use of "soft" soil stabilization techniques such as the installation of a coir blanket and coir logs on steep slopes. The project team also decided that a revision to the Revegetation Plan was necessary before Phase One completion, to address the growing cost of the original plan. During the time period spent on design, volunteer vegetation established on the slopes and the project team decided that the installation of the coir logs and blankets would most likely cause more damage than good, and a redesign was necessary to accommodate changed conditions.

REVEGETATION APPROACH

During the visit to Blaine Road, the expert panel observed three aspects of the revegetation efforts on this project, which included the vegetated mechanically stabilized earth (MSE) retaining walls, vegetated riprap areas, and compost berms. The first two techniques were developed in response to policies mandated by the state and federal agencies with jurisdiction over this project. The compost berm was developed to create a low-impact water quality best management practice (BMP) that addressed the difficulty of installing a regular silt fence into rocky soils.

For these revegetation techniques, seed and plant material had to be obtained from local sources for proper propagation. During the summer and fall of 2007, seed was gathered by a local botanist from nearby plant populations and sent to the United States Forest Service (USFS) Bend Seed Extractory for cleaning. USFS Dorena Genetic Resource Center sowed seed the following winter into RL 10 containers and grew the plants until the fall of 2008. The sword fern was the only species on the plant list not grown from seed; rather, it was transplanted from wildings into half-gallon round containers.

Vegetated Mechanically Stabilized Earth (MSE) Retaining Walls – As the road project required several areas where cuts were made into the existing slopes, the visual impact of any type of retaining wall was a major concern due to the proximity of the Nestucca River and its status as a Wild and Scenic River. Therefore, special regulations were enacted regarding the treatments to the surrounding landscape aesthetics, and included the requirement to provide permanent vegetative screening of the walls. The project team determined that providing a vegetated retaining wall would be the best option to blend into the existing landscape.

Figure 13. *Mechanically Stabilized Earth Retaining Wall planting*

The MSE wall is a modular wall that uses welded wire material and geogrid fabrics in combination with both structural soils and topsoil to create a modular system (Figure 13). The topsoil is placed on the inside face of the walls to a depth of approximately 12 inches to ensure the face of the wall and the stepped ledges are capable of supporting plant materials. Container plants and grasses were installed by hand to create the vegetative screening along the wall structure.

Figure 14. *Vegetated mechanically stabilized earth wall on Blaine Road*

Vegetated Riprap Areas – Because of the strict revegetation standards set forth by the regulatory agencies pertaining to riprap areas around the culverts, an innovative approach had to be developed that would allow plants the opportunity to properly establish (Figure 14). Riprap was installed to prevent soil erosion in steep areas and along drainage culverts, but the shortage of adequate topsoil for cover over the riprap was a constraint. Further, some of the sites that were on very steep slopes would have present complications in the installation of topsoil, even if adequate topsoil were available.

The project team determined that a blown-in-place compost material could be applied that would provide plants with a favorable growing medium over the riprap. The consistency and relative ease of application made this a good choice to fill the voids and to build up a five- to ten-inch layer above the rock material. Not only was the ease of application a plus for the project, but the material itself is a very nutrient-rich compost that is made out of recycled organics containing beneficial bacteria, mycorrhizal fungi, and a binding agent to prevent wind and water erosion. The compost was blown in place through a low impact, pneumatic method and was mixed with the native grass seed mix in one application process.

Figure 15. *Application of compost over rip rap*

In January of 2009, approximately 2,800 tree and shrub materials were planted by hand to meet the desired future condition of twelve native shrub or tree species per 100 square feet (Figure 15). This plant material was able to survive even during the drier summer months because the compost held an ideal moisture level throughout the year (Figures 16 and 17).

Figure 16. *Compost over riprap at culvert prior to plantings*

Figure 17. *Compost over riprap at culvert after planting*

Compost Berm. As an alternative to using a silt fence, project managers decided to install a compost berm between the construction zone and the adjacent Nestucca River as a means to prevent sediment runoff. Due to the rocky soils, the use of a silt fence would have caused unnecessary damage to the landscape during installation (Figure 18). However, the compost berm was a reliable option without causing harm to the riparian zone. In addition, the berm itself was planted with a native seed mix that ultimately provided visual screening of the BMP when the grasses began to establish.

Figure 18. *Compost berm*

RESULTS OF THE REVEGETATION

Each of the planting techniques was successful and provided an innovative method to establish vegetation in extremely difficult growing conditions. While there were some areas that did not establish as intended, the overall success rate on the seeding and planting areas was over 80%.

The Vegetated Mechanically Stabilized Earth Retaining Walls exhibited mostly favorable results. One of the three walls was installed with native grass seeding with the intent of having both grasses and shrub plantings, while the other two walls contained only shrubs for vegetative cover. Approximately 80% of the wall face was covered by grass species. The shrubs were in the early stages of establishment during observation.

The Vegetated Riprap Areas have produced favorable results with both the success of the seeding and the high survival rates of the planted container materials.

The Compost Berms provided an erosion control measure that was very low impact compared to what would have occurred had a silt fence been installed in the rocky soils. The success of these berms can be measured by the fact that they perform their function of keeping sediment out of the river by providing a stable vegetated barrier. The grasses established on these berms blend well into the existing landscape.

LESSONS LEARNED

The early planning process and development of a revegetation plan allowed project managers to make informed decisions regarding the best methods to revegetate the site. Acknowledgement of the importance of the revegetation by the project engineer also facilitated revegetation implementation.

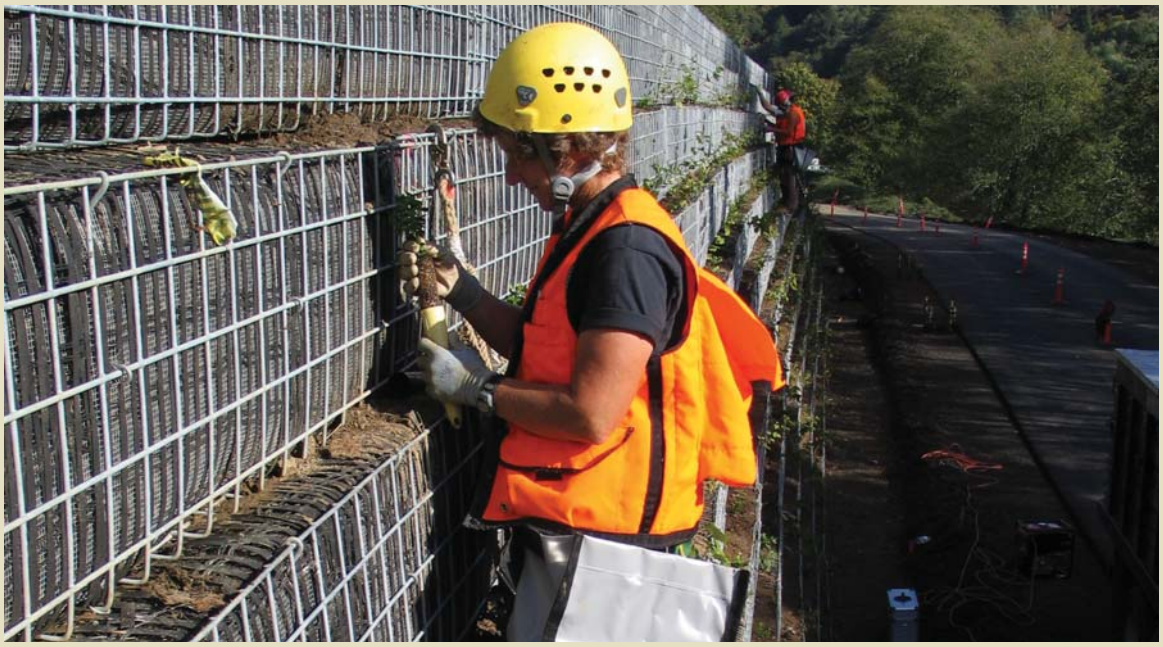
Given the complexity of the project and the number of regulatory agencies involved with oversight, good communication between all parties was a critical factor in the success of this project. Whether communication between the contractor and the designer or with all of the regulatory agencies involved, good communication was key in keeping everyone apprised of relevant issues.

A preliminary stakeholders meeting was held to gather the referral agencies in one room along with the designers and contractors. This meeting allowed each of the agencies to discuss their interest in the project in front of the others, where they could coordinate efforts and understand the different levels of complexity involved with the project.

The compost used on the riprap was a very effective, although costly material for the establishment of plants and seed. The cost of the compost to install was approximately five-times the cost of a traditional hydroseeding application. Hydroseeding typically costs $0.03/s.f. while the compost costs roughly $0.15/sf. The cost may not outweigh the benefits in all revegetation situations, but for this project, where the need to establish plants directly on riprap and steep slopes was required, the cost was considered justified.

The compost with tackifier was stable through several very intense rainstorms and held the soil even without the use of a surface erosion fabric. Moisture in compost remained relatively high during August without supplemental irrigation.

Figure 19. Plant installation on Mechanically Stabilized Earth Wall



When ledges on which people can stand are built into the MSE wall, it is much easier to install plants. Oftentimes, these walls are designed and constructed without any ledge and it makes it extremely difficult to install plants. Further, plants must be installed at an angle, which makes establishment difficult (Figure 19).

The compost met the original specifications; however, the soils appeared to require more coarse organic matter because existing soils did not drain well after a rainstorm. In fact, some of the dibble holes filled up with water and did not drain overnight, which can be detrimental to seedling survival and growth.

Finally, a critical lesson learned was that originally-proposed "soft" engineering techniques (bioengineering) can actually cause more damage during installation than would be expected. Some of these original bioengineering plans were redesigned once the extent of adverse impact was realized.

SANDLAKE ROAD RECONSTRUCTION, OREGON

Figure 20. *Sandlake Road reconstruction*

PROJECT SUMMARY

The Sandlake Road Reconstruction was conducted by the FHWA near the town of Hemlock, Oregon and consisted of several miles of roadway construction efforts that included widening and resurfacing (Figure 20). There were many revegetation locations along its route, but the scan only stopped at one location, where two cut slopes on opposite sides of the road could be observed.

This particular site provided the expert panel an excellent contrast between two different revegetation techniques on roadside cuts that were located directly across the four-lane road from each other. Sandlake Road runs in a northwest to southeast direction, giving the two cut slopes a northeast and southwest exposure on the opposite sides of the road. For reasons unknown to the host site engineer at the time of the visit, the side of the road with the northeast exposure was revegetated only with a hydroseed application directly on native soils. The opposite side of the road with the southwest exposure was revegetated with seed mixed in with a two-inch layer of blown-in-place compost.

REVEGETATION APPROACH

A two-inch layer of compost (tackifier) and seed was blown onto the north side of the road to provide a better substrate than soil for the seed to establish. This method was similar to the blown-in-place compost that was used on the Blaine Road project, except that the depth on the Blaine Road sites was eight inches. In contrast, the south side of the road was revegetated with a hydroseed application directly on topsoil and without any blown-in-place compost (Figure 21). The exact same seed mix was used for each application, so the only differences were in the solar aspect of the cut slope and the presence or absence of the compost.

Figure 21. *Example of hydroseeding without using blown in place mulch on Sandlake Road*

RESULTS OF THE REVEGETATION

The success rates of the seeding efforts are striking. The north side of the road (south facing slope) exhibited a more dense and consistent cover of grasses than the opposite side of the road. While the hydroseeded side of the road did not necessarily demonstrate a poor success rate, it paled in comparison to the success of the blown-in-place compost application (Figure 22).

The lower quarter of the slope with the compost demonstrated a very dense stand of grasses that was very different than the top three quarters of the slope. It had the appearance of seed that may have washed down the slope and settled in the lower regions, but upon further exploration, it was determined that there is most likely a seep in the cut slope that provides additional moisture to the bottom quarter of the slope.

Figure 22. *Example of seeding on steep slope and using blow-in-place compost on Sandlake Road*

LESSONS LEARNED

The revegetation methods used to revegetate the two opposite sides of the road revealed significant contrasts in establishment. The compost provided a beneficial growing medium for the grasses to establish and, in fact, led to a healthier and denser stand of vegetation on a southwest-facing slope than on the northeast-facing slope. This results was surprising given the similar seeding applications.

The cost of the compost and seeding is at least 2 to 3 times that of a basic hydroseeding application, but in this project, led to a highly successful result.

SETTERS ROAD CONSTRUCTION, WORLEY, IDAHO

Figure 23. *Setters Road construction*

PROJECT SUMMARY

Roadside revegetation at the Setters Road site was located approximately 5 miles north of the town of Worley, Idaho (Figure 23). This effort was part of the on-going statewide reconstruction of US-95. Setters Road is approximately 1,000 linear feet of new roadway constructed to extend and connect the existing portion of Setters Road to US-95. The revegetation within the observed area covered both sides of the newly constructed roadway, which is oriented in an east/west direction, giving the new cut slopes a north and south aspect.

DECISION MAKING PROCESS

The roadside revegetation approach on this stretch of highway was conducted in this unique manner due to a sedimentation event and project failure on an Idaho Transportation Department (ITD) roadside project located within this region, north of the city of Coeur D'Alene. The other project resulted in a large amount of sediment entering into Lake Pend Oreille. The revegetation did not provide adequate slope stabilization. The slopes were seeded and mulched, but for unexplained reasons did not stabilize the slopes. ITD determined that the contractor was at fault for lack of adequate performance.

Several multi-million dollar court settlements were paid out by both the ITD and the contractor involved in the project to land owners in the Mica Bay area of Lake Pend Oreille. The lawsuits were not yet completed at the time of the scan. However, a consent decree with the Environmental Protection Agency to cease activities alleged by the government to be illegal in return for an end to the charges.

With the lawsuits resulting from the unwanted sedimentation and the need for roadside revegetation on other highway construction efforts, an alternative method of roadside revegetation was developed by ITD. This method was employed at the Setter's Road site and observed by the scan.

Figure 24. *North facing slope with rock mulch and vegetation on Setter's Road*

REVEGETATION APPROACH

Due to the prior and pending lawsuits, the main goal of this roadside revegetation application was to ensure sediment wouldn't run off into the roadside ditches where it could make its way to a body of water. To achieve this objective, a rock-armoring base was applied to the entire slope, much the same way topsoil would be spread. The rock came from a local source that was not specified to be clean rock and was approximately 4 to 6 inches diameter or smaller. The rock was spread to approximately 12 inches in depth. The load of rock was dumped at the base of the slopes and then pushed up into place by using loaders and dozers (Figure 24).

After the rock was pushed into place, the area was seeded with a hydroseed mixture that contained twelve species of woody shrubs and was applied at 30lbs per acre. Additionally, two annual grasses were applied at 8lbs per acre over the rock mulch. A bonded-fiber matrix was then sprayed on the rock to secure the seed in place. While the majority of the surface area was covered by rock mulch, approximately 15% of the surface was covered by gaps in the rock and soil. This soil eventually filtered down into the rock after several rain storms. In fact, the runoff after the first several precipitation events was running clear and little to no sediment was running into the roadside ditches. The goal of stabilizing the slopes and preventing any sediment was achieved almost immediately.

As dirt washed away and/or settled into the voids in the rock mulch, the shrub seeds also settled into pockets between the rocks. Eventually, the seeds with ideal conditions began to germinate.

Figure 25. *Cut slope on Setter's Road three years after revegetation efforts*

At the time of the site visit, the project was a little over three years old and there were many specimens of shrubs that were at least 4 feet in height and many more that were beginning to emerge (Figure 25). In addition, there were volunteer species of shrubs and perennial grasses that had begun to establish.

RESULTS OF THE REVEGETATION

This revegetation technique has been used on other areas of the US-95 reconstruction project and also produced successful results. According to the ITD designers, the vegetation at this site is filling in at a rate similar to other ITD sites, and the area is expected to demonstrate similarly successful results.

Currently, the majority of the cut slopes on this project are comprised of rock mulch with perennial grasses and shrubs covering less than 10% of the area. As the shrub material continues to grow and fill in, it is anticipated that the majority of the site will contain full aerial coverage of shrub material and grasses (Figure 26). The project has fulfilled its two objectives, which were to prevent soil erosion and provide revegetation. As an aesthetic element to the roadside, the rock will eventually become less visually prominent, but still remain functional in preventing erosion.

Figure 26. *Setters Road rock mulch and revegetation*

LESSONS LEARNED

The addition of the annual grass seed mixture was likely unnecessary due to the success of the rock mulch in stabilizing the slopes. The annual grasses did grow, but they did not significantly contribute to slope stabilization. In hindsight, a perennial grass seed mixture should have been applied to the slopes in place of the annuals; the grasses would have grown just as well and would have returned year after year. In fact, perennial grasses from volunteer species are now beginning to appear, which indicates that the conditions are favorable for at least some of these species.

The host site agency indicated the shrub seed was beginning to establish in rock areas and not so much in areas where the ground cover was mostly soil. This indicates that as the rock is "cleaned" by precipitation and the loose soil settles into the voids between the rock mulch, the areas where more dirt has accumulated has likely buried seeds too deep for germination. The area where the rock mulch is not entirely covered with soil indicates these are the ideal conditions for the seed to begin to establish. In hindsight, it would have been more beneficial to flush the slopes and rock mulch with a water truck to help settle some of the loose soils and then apply the seed via hydroseeding methods.

I-95 RECONSTRUCTION AND REVEGETATION – SMITH CREEK, IDAHO

Figure 27. *Smith Creek reconstruction and revegetation*

PROJECT SUMMARY

The project consisted of alignment improvements to 6.6 miles of US 95 in Benewah and Latah Counties (Figure 27). The project area extends through the Palouse Prairie consisting of Palouse Prairie vegetation and organic soils, as well as mixed pine and Douglas fir. Most of the project is within rolling terrain, while mountainous terrain exists for approximately 1.8 miles of the project as the roadway passes over the Marsh Hill summit at the county line. Significant improvements were made to the horizontal and vertical alignments of the roadway to improve safety for travelers and maintenance crews. Some of the project

features included adding shoulders, incorporating right-turn lanes at road intersections, constructing climbing lanes on both sides of the summit, and incorporating a left-turn lane at one.

The existing narrow, winding, two-lane roadway was reconstructed and realigned with a new two-lane roadway with shoulders that meet current highway design standards. Safety improvements were made primarily by improving sight distances, adding width to the lanes and right-of-way (ROW), eliminating substandard horizontal curves, and improving the existing "roller coaster" vertical profile. The largest cut was approximately 75 feet and the largest fill was approximately 90 feet.

Much of the revegetation process entailed standard Idaho Transportation Department (IDT) specifications and design standards. This design work was completed by an outside engineering consulting firm, but the plans and specifications were reviewed and approved by IDT. The roadside revegetation was quite extensive and included stabilizing and seeding over 55-acres of both cut and fill slopes along US-95 (Figure 28). A variety of stabilization techniques were employed, but for the most part, this was a typical revegetation project for ITD.

Figure 28. *An example of a successful revegetated cut slope along US-95*

DECISION MAKING PROCESS

The project was funded by the Federal Highway Administration and was a design-bid-build project mostly performed by outside design consultants and construction contractors. In-house oversight, inspection, surveying, and monitoring were conducted by ITD staff; typical of how this agency conducts roadside projects.

The recommendations for stabilization techniques to apply at each area were first suggested by the design consultant and reviewed by ITD staff. During the course of the project, there were several areas of slope that continuously demonstrated problems with instability and alternative applications were employed. This project was a collaborative effort between the design consultant and ITD.

REVEGETATION APPROACH

Approximately 35-acres of seeding were originally planned for the roadway project design within the right-of-way limits of which, approximately 25-acres required seed bed preparation. An additional 20 acres of seeding were also included at two sites within the project's immediate vicinity.

Two different seeding mixes were used for seeding within the right-of-way. One of the mixes was used exclusively for the slopes and ditches.

Hydroseeding was applied to all areas of the roadway right-of-way and the majority of the waste sites. However, a small amount of drill seeding was applied to one of the waste sites due to equipment availability and the site configuration. Most of the project slopes were 1:3 or greater.

The seed application was scheduled between September 15th and May 15th to take advantage of optimal moisture conditions for establishing the seed. This is standard ITD specification for seeding and followed whenever possible.

RESULTS OF THE REVEGETATION

The seeded areas were mostly successful in that healthy stands of grass were able to establish in areas where the soils were stable. However, in several areas the seeding wasn't able to establish due to excessive soil moisture and the movement of the soils. After several of these events, it was determined that applying rock mulch similar to that described earlier at the US-95 Setter's Road project was needed. The 6-inch rock was spread over these problem areas with a dozer and loader to a depth of approximately 12 inches. These areas were then seeded via hydroseeding methods directly over the rock and the seed with the expectation that the soils would fill the gaps between the rocks and the seed would begin to germinate within these areas. Again, this technique has proven to be very successful for soil stabilization and revegetation (Figure 29). The voids between the rocks provide ideal conditions for the seed to establish.

Figure 29. *Revegetated cut slope on US-95*

LESSONS LEARNED

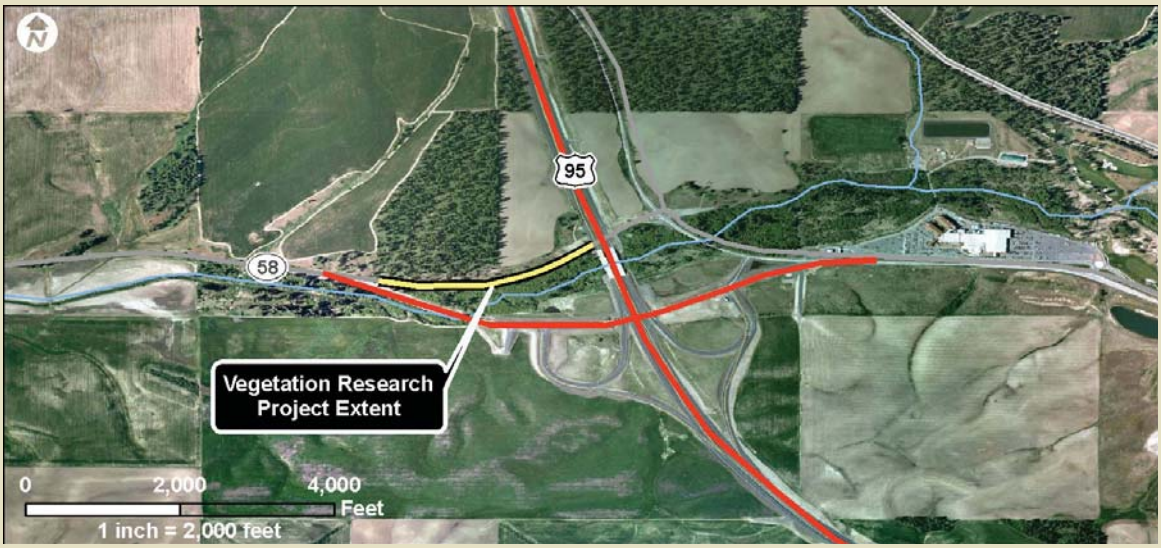
Twelve inches of topsoil placed on top of heavy clay soils is very susceptible to saturation that produces slope slides. According to the ITD staff on site, better soils information and an enhanced method of anchoring the topsoil would have improved revegetation. Many of the stabilization techniques, such as the use of straw wattles, did not prevent soil movement in many of the slide sites, which required continuous effort to stabilize, a result of subsurface water movement.

This project was another example of how a combination of rock mulch and hydroseeding techniques is successful. The areas where this method was used have provided a stabilizing effect with the added benefit of vegetation within the rock. During the time of the site visit, it did not appear that the grasses had established well, however, the representative from the host agency indicated that during the growing season, forbs covered approximately 80% of the slope. Eventually, the vegetation is expected to provide more dense aerial cover over the rock mulch, but ITD is presently satisfied with the results of this effort.

The project was in progress for three winter seasons and various methods were used to prevent the loss of top soil and erosion during construction. One technique included covering large areas of topsoil with black plastic during the winter months. These areas required quite a bit of maintenance due to wind and weather, but the topsoil protected the surface and had the additional benefit of creating a greenhouse effect, which promoted growth even during the colder months.

NATIVE PLANT RESEARCH PROJECT, WORLEY, IDAHO

Figure 30. *Native Plant Research Project at Worley, Idaho*



PROJECT SUMMARY

The Native Plant Research Project is located 0.5-mile west of the US-95 / SH-58 interchange in Worley, ID (Figure 30). This native revegetation site consists of an approximate 2-acre area that was the location of the former SH-58 prior to its realignment. During the project, the contractor was responsible for the installation of the native seeding, live plantings, mulch, tackifer, and fertilizer.

The scan was invited to join members of ITD on a site visit that was led by a professor with the University of Idaho. This project allowed the scan to observe the effects of revegetation on an obliterated road site.

In September 2008, ITD met with the University of Idaho on the proposed project site to evaluate site conditions and discuss potential native plants suitable for revegetation. The native species mix and rates were developed by the University of Idaho and the ITD, which included native grasses, forbs, and shrubs that were applied via hydroseeding methods (Figure 31). The site characteristics include flat areas with gradual slopes (4:1) or flatter, and a few steeper slopes (2.5:1). A portion of the site contained an established riparian area created from creek drainage.

The goal of this project was to evaluate success rates of certain native plant species that can be used in roadside revegetation. The species in this study were selected from an undisturbed reference site located adjacent to the project. In addition to studying the native plants that were seeded on the project site, the study also included monitoring of non-native, invasive weed species that began to establish.

Figure 31. *Native Plant Research Project transects*

DECISION MAKING PROCESS

The revegetation plan was developed in conjunction with the University of Idaho study and implemented with help from an outside contractor. The objectives were to establish a healthy stand of native grasses, forbs, and shrubs on the project site that matched the adjacent reference site. The goal of the study was to scientifically monitor and evaluate the success rates of individual species and the overall success of the site in general. This included documenting the weed species and any other problems such as erosion.

REVEGETATION APPROACH

The first step in seed bed preparation was to apply the stripped and stockpiled topsoil to a depth of six inches and then anchor it by tracking up and down the slopes with heavy equipment. The seed mix and rates of application were developed after an inventory of the species present on the reference site.

The monitoring and study of the site involved setting up twenty equally-spaced transects that spanned the entire length of the sampling areas. The first transect was located randomly and then the subsequent transects were laid out at equal intervals from the projected line, perpendicular to the former road edge. A diagonal orientation was implemented to account for the differences in width of the study areas and to create a more balanced representation. Each transect contained five, individually-spaced quadrates that were outlined using a four square-foot measurement square.

RESULTS OF THE REVEGETATION

The seeded areas are beginning to establish native grasses, although, these areas are not comparable yet to the reference sites (Figure 32). The current site coverage for native species is approximately 13%. The current site coverage for non-seeded species is approximately 14%. This demonstrates an overall coverage of approximately 27% after one year of monitoring.

Figure 32. *Native Plant Research Project reference site*

LESSONS LEARNED

Lessons learned are on-going with the numerous University of Idaho studies that are underway at this site. Often, even with a monitoring plan, the results of a revegetation project are not studied in depth like as is occurring at this site. For most revegetation projects, simply having visible aerial coverage of plant material is sufficient to determine project success. For this project, there will be the added benefit of sustained monitoring with a compilation of several years of closely monitored revegetation data.

A great deal of emphasis was placed on matching the species and conditions of the adjacent reference site for this project. This does not always happen when determining a plant and seed palette for many roadside revegetation projects, but would be beneficial when feasible.

DISCUSSION

The scan provided the expert panel with an opportunity to travel to several states and view and discuss specific native revegetation projects that were located in different geographic regions of the United States. Throughout this process, the expert panel not only observed the individual revegetation techniques applied on the projects, but also discussed first-hand the planning, design, implementation, and monitoring processes for each project. Additionally, multiple site visits allowed the panel to identify trends in revegetation processes that largely contributed to the success of the revegetation project.

For most projects included in the scan, the following characteristics were documented for each project and were specifically mentioned by the host agency as a contributing factor in achieving overall success. However, although many of these characteristics are considered standard practice in the revegetation process, both the expert panel and host agencies cited other projects where these characteristics were absent, which resulted in complications or project failure.

- **Early Planning –** Each of the host agencies stressed the importance of early planning in the revegetation process. Although not always possible, as exhibited with the Vermont project, it is invaluable to begin revegetation planning early in the construction project so the different project components are attuned to each other and conflicts can be avoided. Too often, revegetation is an afterthought or given insufficient attention, and a poorly-organized effort ensues; failure can often be avoided with early involvement and planning by the revegetation designers.
- **Defining Clear Project Objectives –** This is one of the most critical aspects when undertaking any type of project, not just revegetation. Formulating and writing out clearly-defined objectives allows the revegetation designers to work toward a common goal and to communicate these objectives to the contractor who will ultimately build the project. Having established objectives from the project start provides a benchmark for measuring the success of the project during and after the construction process.
- **Collaboration Among Stakeholders –** Project stakeholders include project owners, designers, contractors, regulatory agencies, and/or the public. Collaborative effort between the designers and contractors is especially important for maximizing the chances of success for revegetation projects. Collaboration fosters a team attitude about achieving project objectives and helps each side understand the perspectives and concerns of other parties. Further, potential or actual problems can be addressed more efficiently in a collaborative environment.
- **Contractor Commitment to the Importance of Revegetation –** Each of the host agencies strongly emphasized that one of the most critical factors contributing to project success was having contractors who understand the importance of, and who embrace, revegetation.
- **Construction Oversight and/or Designer Availability –** This is a very critical element to ensuring that the design intent is realized in the field. If there is no revegetation representative who can make decisions and/or immediately answer questions for the contractor, then the project runs the risk of moving in the wrong direction. Most contractors, understandably, don't have time to stop working for any length of time if there is a question or discrepancy regarding the plans and the designer isn't available. While it is understood that having a designer on site for the entire construction phase is not practical, having an open line of communication and flexibility in designer availability is critical.
- **Monitoring and Maintenance –** Given how long it takes for vegetation to germinate and/or establish from container plantings, success of a revegetation project cannot be measured immediately after installation. While this is no revelation, it emphasizes the point that consistent and on-going monitoring and maintenance efforts are critical to identify and mitigate problems throughout the post-construction period. Oftentimes, this means monitoring for up to five years or more.

To further illustrate the importance of these characteristics in revegetation process success, and to document that these characteristics were not specific to the scan projects, following are a sampling of results from other revegetation professionals in response to the roadside revegetation scan survey (Appendix A).

In response to the question "To which of the following would you attribute to your roadside revegetation success?" the top three answers were (Figure 32):

a) Sufficient Funding 57.8%

b) Revegetation Specialist Consultation 43.8%

c) Early Planning 42.2%

In response to the question "To which of the following would you attribute to unsuccessful roadside revegetation project?" the top three answers were (Figure 33):

a) Inadequate Planning 48.4%

b) Insufficient Funding 45.3%

c) Lack of Revegetation Specialist Consultation 39.1

In response to the question "What are your parameters for defining successful revegetation?" the top three answers were (Figure 34):

a) Plant survival after 5 years 50%

b) Coverage meets or exceeds your success criteria after 1 year 43.8%

c) Plant coverage meets or exceeds your success criteria 37.5%

Figure 33. *Survey results: successful roadside revegetation attributes*

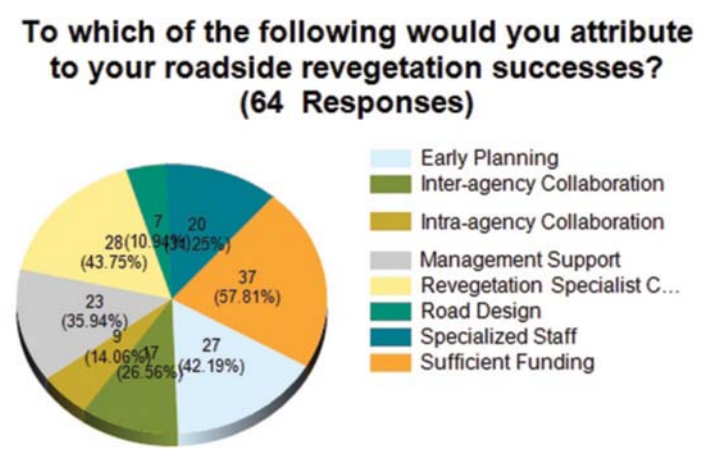


Figure 34. *Survey results: unsuccessful roadside revegetation attributes*

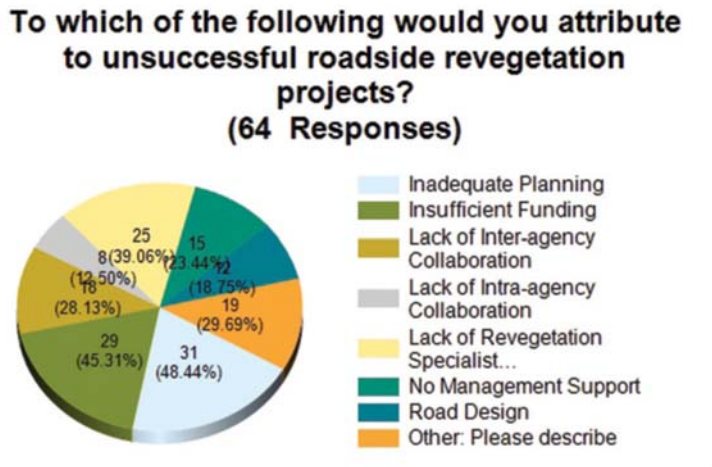
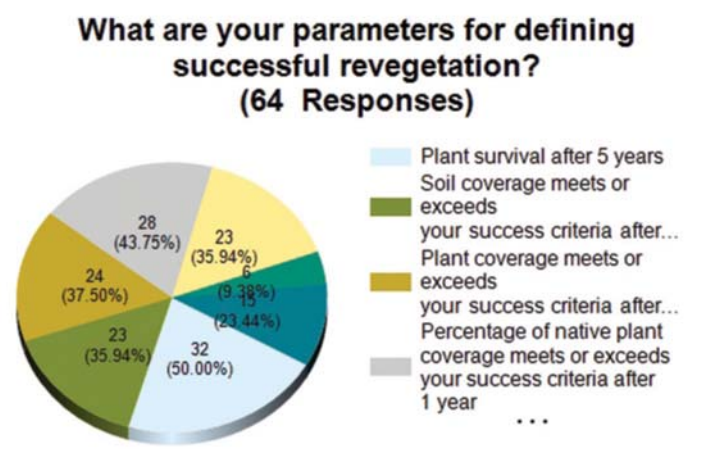


Figure 35. *Survey results: parameters of successful roadside revegetation*



During the scan, the expert panel engaged in many broad discussions amongst themselves and with site hosts about roadside revegetation practices that were not necessarily related to any specific project viewed during the scan. The discussions built upon the collective experiences and perspectives of the expert panel, and covered common problems in successful roadside revegetation implementation and possible solutions. Following is a synopsis of these discussions.

Revegetation Plans – Developing a revegetation plan is much more than providing a set of planting and seeding plans for a contractor. A revegetation plan begins with the process of identifying and gathering critical information pertaining to the site, and then documenting the desired outcome of the revegetation effort. Oftentimes, the construction documents are the first—and final—plans that are produced related to revegetation, but they represent design decisions that are not based on solid information about the project. The revegetation plan should be developed prior to the construction documents, when information about existing and desired future conditions can be gathered to make informed decisions that will maximize project success.

Revegetation plans must map out how project goals will be fulfilled and describe a comprehensive approach to goal fulfillment. The revegetation plan should include the following elements, as at minimum:

- Project background
- Roles, Responsibilities, and Contacts
- Revegetation Objectives
- Project Constraints
- Laws, Regulations, and Policies
- Noxious Weeds
- Soils
- Revegetation Schedule
- Monitoring
- Revegetation Units

Documenting this level of detail prior to developing a construction plan will provide the designer with a comprehensive understanding of the existing site conditions and how to get to the desired future conditions. While it isn't always practical or feasible to obtain this level of detail for every project, the goal should be to find the most cost effective manner to maximize success and to minimize the risk of failure.

Why Contractors Don't Always Follow the Plans and Specifications – A common frustration among revegetation designers and project managers is that contractors don't always follow plans and specifications as provided in the contract. There are many theories as to why this occurs, but two main ideas emerged from the discussions.

- **Cost cutting on the part of the contractor –** This does not pertain to all contractors, but there has been documented occasions where contractors have deliberately cut corners on the project plan in order to gain profit on the project. This can happen purposefully because the contractor may decide their approach is comparable to the proposed design or better when, in fact, it is detrimental to the project. Another instance may be due to an unscrupulous contractor who doesn't find value in following the intent of the design and will deliberately not follow the specifications, but then does not provide alternative substitution.
- **Not seeing the value in revegetation –** Although they made the effort to provide a bid for the project and may have experience doing this very kind of work, not all contactors place a high priority on revegetation. This may be due to a lack of understanding of the many benefits provided by a healthy stand of desired vegetation along the road project. Oftentimes, revegetation is an afterthought for many contractors.

The discussions of the expert panel led to consensus that even if the contractor is cutting corners and/or doesn't see value in the revegetation process, it is the responsibility of the designers to ultimately ensure the project is built to its original intent. This will mean better communication of the project objective and why these are critical to the success of the project. Whether these objectives are communicated through meetings, written statements, and/or in the plans and specifications, it is up to the designers to educate the contractors if they don't already understand the importance of revegetation. However, this doesn't mean that the contractors shouldn't be given the opportunity to make suggestions about a better alternative or method of achieving the project goals.

Consequences of Poor Performance – Departments of Transportation must often contend with poor attempts at cost-benefit analysis by contractors. Poor revegetation planning often results in little or no consequences for a designer or contractor, as it is difficult to take action if the revegetation fails after the project is closed. Financially, there is little incentive to spend money on successful revegetation when unsuccessful revegetation costs less and is perceived to work "well enough". Control of noxious weeds, for example, is usually not considered in this process because even though it is expensive, it is paid for separately and often not until years later.

Reinventing the Wheel – There are pockets of experience and sophistication in the practice of revegetation and restoration, but practice is inconsistent within the agency because staff frequently change positions, thus the agency tends to reinvent the wheel time and time again. Staff are properly trained, but when they leave, new practitioners come in who must learn all the same processes. Increasingly, information is now available via the Internet and will hopefully end this undesirable cycle.

Deficiencies in the Revegetation Process – Following is a list of items that were noted as deficiencies often found in the process of roadside revegetation.

- Internal agency inertia that is resistant to change, including altering the amount of time or money spent on something like revegetation that is considered "peripheral' to road building.
- Lack of respect between engineers/contractors and revegetation specialists.
- Failure to recognize that all projects will have different, unique challenges such as soils, appropriate vegetative species, precipitation, goals, etc., and that a close relationship with a revegetation specialist will work much better than reliance on a few standard specifications.
- Poor cost-benefit analysis of the long term costs of successful revegetation versus invasive species control.
- Highways, even when successfully vegetated, traverse so many property lines that invasive species frequently border the rights-of-way, resulting in regular introductions of weeds and a path for the weeds to invade other areas.
- There are serious deficiencies in the overall understanding of amending soils on revegetation projects. Greater knowledge about soils would improve revegetation success.
- Contractors are rarely held accountable for planting failures beyond one year and often, not even that long.
- Engineers and contractors already have numerous environmental commitments to track on their projects, so vegetation is rarely a project priority, let alone native vegetation.
- Revegetation is rarely a public priority.

CONCLUSIONS

This report provides insight into the observations and discussions during the 2009 roadside revegetation using native plants scan. As noted by the expert panel, there are many interconnected elements involved in both the technical and non-technical aspects of the revegetation process – all of which should be addressed in a project revegetation plan. The non-technical aspects—planning, design, implementation, monitoring, and maintenance—have been found to be just as critical to the success of revegetation projects as the technical aspects, such as knowledge of the plantings, seeding, and soils.

While there were no new revelations on issues such as the benefits of early planning, sufficient funding, or proper expertise, the scan did confirm that most practitioners agree that these are critical elements to achieving revegetation success, regardless of geographic location or local conditions. Further, the scan documented that without these factors in place, the chances of revegetation success are considerably lowered.

The scan and associated discussions of the native revegetation projects provided firsthand insight into the revegetation process applied at each individual site. The expert panel had the opportunity to both listen to the hosts describe their projects while simultaneously observing results in the field. As the group visited successive project sites, trends emerged that clearly demonstrated why each of these projects was successful: good planning, adequate funding, and open communication between the designers and contractors. In addition, the innovative revegetation techniques used at each site provided examples of methods that could potentially be employed by other agencies in different parts of the country.

The roadside revegetation scan report offers insight into a variety of roadside revegetation techniques and processes, and the observations of a panel of roadside revegetation experts. The expert panel conclusions may facilitate better practices for individuals who are in a position to positively influence the outcomes of their own revegetation projects.

ADDITIONAL INFORMATION

Additional information about the technical aspects of roadside revegetation can be found at www.nativerevegetation.org, which includes a technical handbook titled roadside revegetation: An Integrated Approach to Establishing Native Plants (available for download from the website), interactive training modules on roadside revegetation process, and an interactive visualization tool illustrating the impact of multiple criteria on roadside revegetation.

APPENDIX A: SCAN PANEL BIOGRAPHIES

SCAN EXPERT PANEL

David Steinfeld

Revegetation Specialist

US Forest Service

David Steinfeld has been with USFS for more than 30 years. He has worked as a field soil scientist and geomorphologist in Oregon and Utah, as an assistant nursery manager and nursery culturist at the J. Herbert Stone Nursery in Oregon, and as a revegetation specialist for Region 6 in Oregon. For the past 11 years, David has worked with FHWA on revegetating road construction disturbances with native plants. He holds a bachelor's degree in agriculture (soil science) from Oregon State University.

Bryan Roeder

Wildlife Biologist

Colorado Department of Transportation

Bryan Roeder has a bachelor's degree in biology and a M.S. in Wildlife Sciences. He has worked in the natural resources for over 15 years in a diversity of settings including fisheries biology in Alaska, and tropical reforestation in northeastern Australia. Bryan's primary interest now involves reducing the introduction and spread of invasive species along highway corridors by implementing weed control efforts in multiple phases of transportation planning, analysis, design, construction and maintenance. Since 2004, he has worked as Noxious Weed Specialist and Threatened & Endangered Species Biologist for the Colorado Department of Transportation, providing statewide support for transportation projects.

Sarah Wynn

Revegetation Specialist

National Park Service

Sarah has a BS in History, a joint Master's degrees in Botany and Landscape Architecture, and a PhD in Environmental Monitoring with an emphasis on plant ecology and Geographic Information Systems, all from the University of Wisconsin-Madison. She has worked as a contractor for the Bureau of Land Management, followed by 9 years at the Bureau of Reclamation and, to date, 14 years for the National Park Service. Her positions have included building Geographic Information Systems databases for the Bureau of Land Management and the National Park Service, building a Geographic Information Systems program for the National Park Service, coordinating the research program as well as carrying out invasive plant research, and leading the native revegetation-restoration program in the Transportation Division of the Denver Service Center at NPS.

Bonnie Harper-Lore

Restoration Ecologist

Federal Highway Administration

Bonnie has recently retired as a restoration ecologist from the Federal Highway Administration where she was a vegetation management technical resource for all state departments of transportation. She also acted as a liaison to Federal Interagency Committees regarding invasive and native vegetation.

Mara Alexander

Botanist

US Fish and Wildlife Service

Mara has a PhD in Botany and works with the US Fish and Wildlife Service at the San Marcos National Fish Hatchery and Technology Center located in San Marco, Texas. Her work includes the study and management of invasive aquatic plant species.

HOST SITE PARTICIPANTS

The scan could not have been successful without the participation and commitment from the staff representing the host sites. These folks were extremely generous with their time and resources during the site visits. It should be noted that many of these individuals traveled a great distance from their offices and took time out of their busy schedules to show us their projects and participate in the discussions with the expert panel. We greatly appreciate all of their time and effort.

VERMONT

Jane Brown
Landscape Architect
Vermont Agency of Transportation

Charlotte Brodie
Field Naturalist
DuBois and King (project consultant)

Craig Dusablon
Landscape Technician / Operations Division
Vermont Agency of Transportation

NEW YORK STATE

John Rowen
Vegetation/Environmental Manager
NYS Department of Transportation

Peter Howard
Maintenance Environmental Specialist
NYS Department of Transportation

Mike Fayette
Resident Engineer
NYS Department of Transportation

George Paye
Maintenance Operations
NYS Department of Transportation

OREGON

Lee Riley
Revegetation Specialist
US Forest Service

Chuck Mikkola
Project Engineer
Federal Highway Administration DOT

Diane Spencer
Revegetation Specialist
Federal Highway Administration

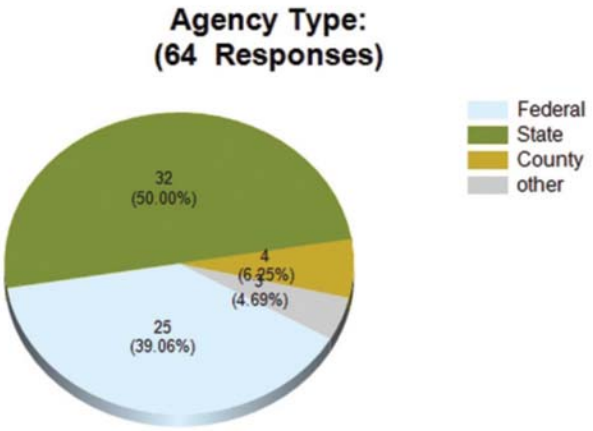
IDAHO

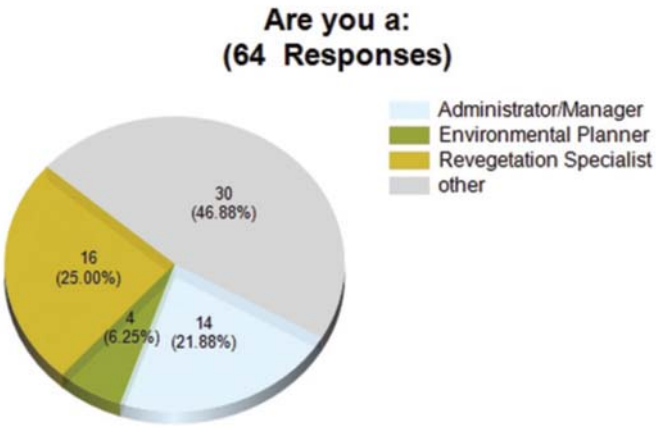
Cathy Ford
Roadside Programs Administrator
Idaho Transportation Department

Manny Todhunter
Environmental Compliance Manager
Idaho Transportation Department

APPENDIX B: SCAN SURVEY QUESTIONNAIRE

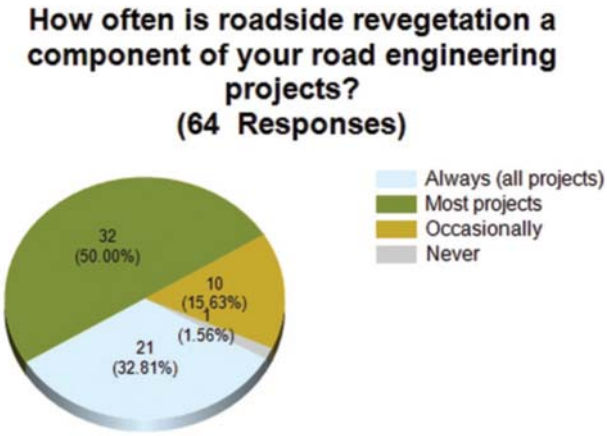
State: (64 Responses)		
State	**Response Count**	**Percent**
Alabama	1	1.6
Alaska	2	3.1
Arizona	1	1.6
California	5	7.8
Colorado	4	6.3
Florida	2	3.1
Georgia	2	3.1
Hawaii	2	3.1
Idaho	1	1.6
Illinois	1	1.6
Indiana	1	1.6
Iowa	4	6.3
Louisiana	1	1.6
Maine	1	1.6
Maryland	1	1.6
Minnesota	2	3.1
Mississippi	1	1.6
Missouri	1	1.6
Montana	3	4.7
Nebraska	1	1.6
Nevada	3	4.7
New Hampshire	1	1.6
New Jersey	1	1.6
New York	1	1.6
North Carolina	1	1.6
North Dakota	1	1.6
Ohio	1	1.6
Oregon	1	1.6
Pennsylvania	1	1.6
Texas	4	6.3
Utah	1	1.6
Vermont	1	1.6
Washington	5	7.8
Wisconsin	4	6.3
Wyoming	1	1.6
Total:	**64**	**100%**





HOW OFTEN IS ROADSIDE REVEGETATION A COMPONENT OF YOUR ROAD ENGINEERING PROJECTS?

Option	Count	Percent
Always	21	32.8
Most Projects	32	50.0
Occasionally	10	15.6
Never	1	1.6
Total	**64**	**100**



FOR YOUR MOST SUCCESSFUL (OR TYPICAL) ROADSIDE REVEGETATION PROJECT, WHO:

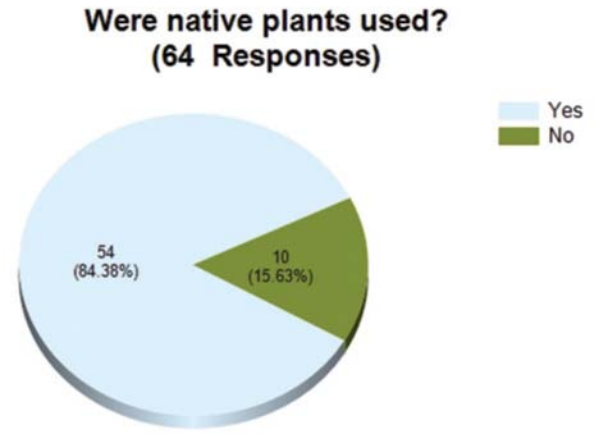
	Project Team	Project Manager	Road Designer	Reveg. Specialist	Envir. Specialist	Design Consultant	Don't Know	N/A
Initiates the revegetation effort?	11 (17.19%)	14 (21.88%)	9 (14.06%)	16 (25.00%)	4 (6.25%)	3 (4.69%)	5 (7.81%)	2 (3.13%)
Allocates project funding for revegetation?	3 (4.69%)	35 (54.69%)	7 (10.94%)	5 (7.81%)	3 (4.69%)	0 (0.00%)	7 (10.94%)	4 (6.25%)
Sets revegetation goals (performance based results)?	6 (9.38%)	4 (6.25%)	2 (3.13%)	30 (46.88%)	9 (14.06%)	2 (3.13%)	5 (7.81%)	6 (9.38%)
Develops the revegetation plan?	1 (1.56%)	2 (3.13%)	10 (15.63%)	37 (57.81%)	2 (3.13%)	6 (9.36%)	4 (6.25%)	2 (3.13%)
Implements the revegetation plan?	9 (14.06%)	16 (25.00%)	5 (7.81%)	27 (42.19%)	2 (3.13%)	0 (0.00%)	2 (3.13%)	3 (4.69%)
Selects the vegetation used?	1 (1.56%)	3 (4.69%)	4 (6.25%)	41 (64.06%)	4 (6.25%)	5 (7.81%)	4 (6.25%)	2 (3.13%)
Monitors revegetation progress over time?	9 (14.06%)	10 (15.63%)	0 (0.00%)	31 (48.44%)	5 (7.81%)	0 (0.00%)	5 (7.81%)	4 (6.25%)
Determines criteria for success?	9 (14.06%)	7 (10.94%)	2 (3.13%)	26 (40.63%)	9 (14.06%)	1 (1.56%)	5 (7.81%)	5 (7.81%)

FOR YOUR MOST SUCCESSFUL (OR TYPICAL) ROADSIDE REVEGETATION PROJECT, WHEN DURING THE ROAD ENGINEERING PROCESS:

	Planning	Develop. Design	Construction	Maintenance/ Post Constr.	Varies	Does not apply/ unknown
Was Revegetation suggested/ conceived?	22 (34.38%)	27 (42.19%)	3 (4.69%)	1 (1.56%)	5 (7.81%)	6 (9.38%)
Was revegetation initiated?	3 (4.69%)	26 (40.63%)	15 (23.44%)	9 (14.06%)	5 (7.81%)	6 (9.38%)
Was revegetation implemented?	0 (0.00%)	2 (3.13%)	36 (56.25%)	16 (25.00%)	4 (6.25%)	6 (9.38%)
Was revegetation monitored for success?	0 (0.00%)	1 (1/56%)	5 (7.81%)	40 (62.50%)	11 (17.19%)	7 (10.94%)
Were revegetation objectives set?	17 (26.56%)	23 (35.94%)	3 (4.69%)	3 (4.69%)	9 (14.06%)	9 (14.06%)

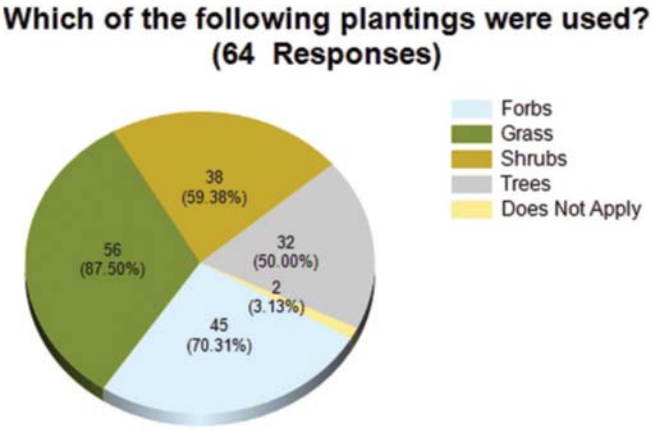
WERE NATIVE PLANTS USED?

Option	Count	Percent
Yes	54	84.4
No	10	15.6
Total:	**64**	**100.0**



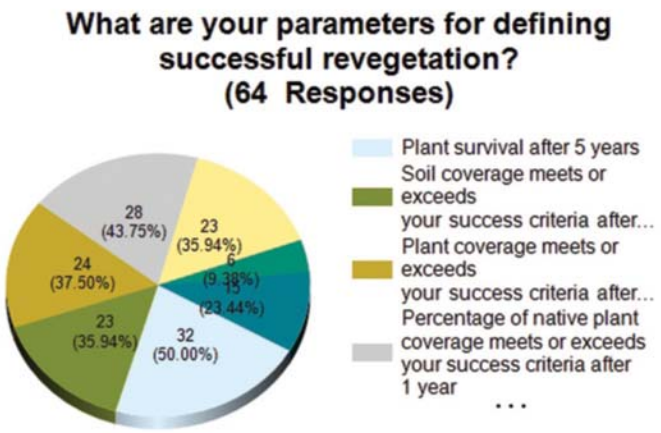
WHICH OF THE FOLLOWING PLANTS WERE USED?

Option	Count	Percent
Grass	56	87.5
Shrubs	38	59.4
Trees	32	50.0
Does Not Apply	2	3.1
Total:	**173**	**100.0**



WHAT ARE YOUR PARAMETERS FOR DEFINING SUCCESSFUL REVEGETATION?

Option	Count	Percent
Plant survival after 5 years	32	50.0
Soil coverage meets or exceeds your success criteria after 1 year	23	35.9
Plant coverage meets or exceeds your success criteria after 1 year	24	37.5
Percentage of native plant coverage meets or exceeds your success criteria after 1 year	28	43.8
Weed control meets or exceeds your success criteria after 1 year	23	35.9
No citations for non-compliance with permit conditions	6	9.4
Other	15	23.4
Total:	**151**	**100.0**

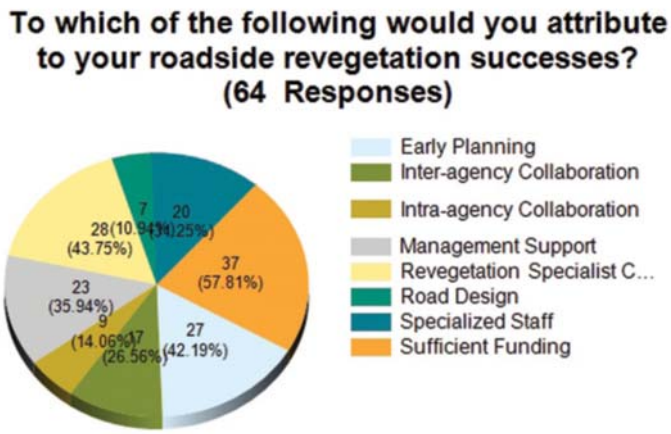


FOR YOUR MOST SUCCESSFUL (OR TYPICAL) ROADSIDE REVEGETATION PROJECT, WHAT MITIGATING MEASURES DID YOU USE?

Option	Count	Percent
Biostimulants	5	7.8
Erosion mats	27	42.2
Fertilization	28	43.8
Hydroseed	26	40.6
Incorporation of organic matter	25	39.1
Liming	6	9.4
Mulching	40	62.5
Mycorrhizae	10	15.6
Reapply topsoil	27	42.2
Till compacted soil	29	45.3
Other:	17	26.6
Total:	**240**	**100.0**

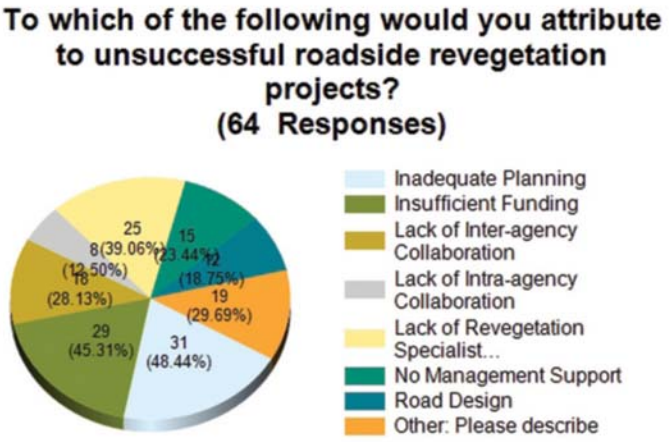
TO WHICH OF THE FOLLOWING WOULD YOU ATTRIBUTE TO YOUR ROADSIDE REVEGETATION SUCCESSES?

Option	Count	Percent
Early planning	27	42.2
Inter-agency collaboration	17	26.6
Intra-agency collaboration	9	14.1
Management support	23	35.9
Revegetation specialist consultation	28	43.8
Road design	7	10.9
Specialized staff	20	31.3
Sufficient funding	37	57.8
Total:	**168**	**100.0**



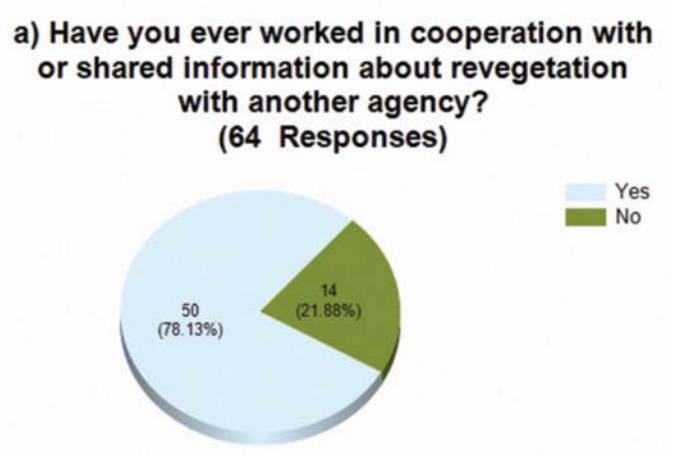
TO WHICH OF THE FOLLOWING WOULD YOU ATTRIBUTE TO UNSUCCESSFUL ROADSIDE REVEGETATION PROJECTS?

Option	Count	Percent
Inadequate Planning	31	48.4
Insufficient Funding	29	45.3
Lack of Inter-agency collaboration	18	28.1
Lack of intra-agency collaboration	8	12.5
Lack of revegetation specialist consultation	25	39.1
No management support	15	23.4
Road design	12	18.8
Other: please describe	19	29.7
Total:	**157**	**100.0**



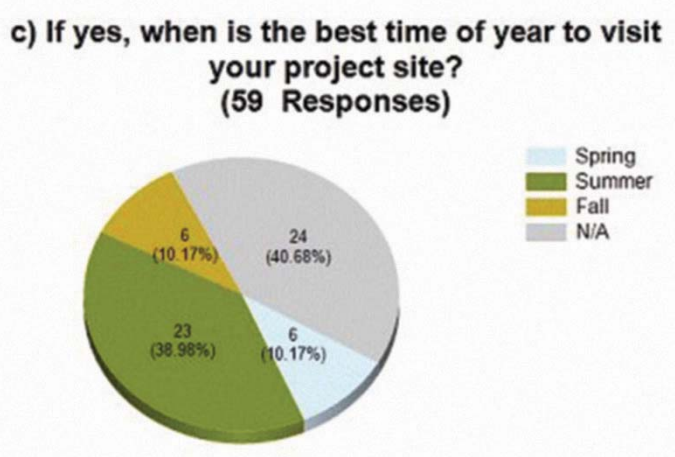
HAVE YOU EVER WORKED IN COOPERATION WITH OR SHARED INFORMATION ABOUT REVEGETATION WITH ANOTHER AGENCY?

Option	Count	Percent
Yes	50	78.1
No	14	21.9
Total:	**64**	**100.0**



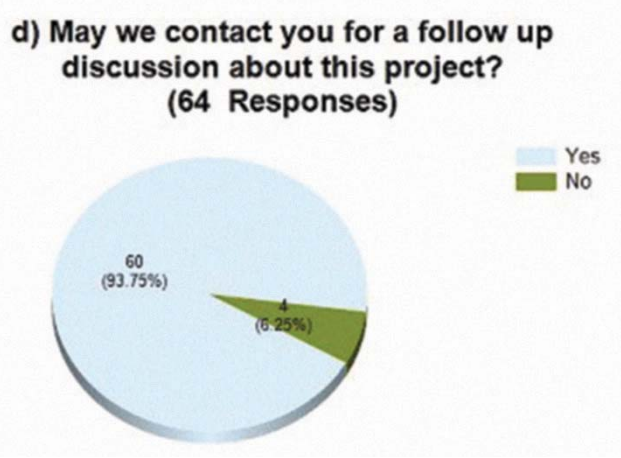
WOULD YOU LIKE US TO VISIT YOUR SITE AS PART OF OUR SCAN?

Option	Count	Percent
Yes	38	59.4
No	26	40.6
Total:	**64**	**100.0**



IF YES, WHEN IS THE BEST TIME OF YEAR TO VISIT YOUR PROJECT SITE?

Option	Count	Percent
Spring	6	10.2
Summer	23	39.0
Fall	6	10.2
NA	24	40.7
Total:	**59**	**100.0**



MAY WE CONTACT YOU FOR A FOLLOW UP DISCUSSION ABOUT THIS PROJECT?

Option	Count	Percent
Yes	60	93.8
No	4	6.3
Total:	**64**	**100.0**

Project Name: Blaine Road

Project Location: Blaine, Oregon

Start Date (project planning): 01/01/2001

End Date (post-construction monitoring): 01/01/2009

Short Description: Planted containerized native plant seedlings on three retaining walls. Covered over 30 rip rapped culvert outlets with a deep compost and planted with over 10 native species

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? A long planning period. Good communications with the design engineer and the environmental specialist. Adequate funding.

Project Name: Brockway Summit

Project Location: Rt. 267, Tahoe area, California

Start Date (project planning): 01-01-2002

End Date (post-construction monitoring): 01-01-2005

Short Description: Over steepened cut slope was tilled 2-feet deep with compost and planted. Great success.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? New technology and practice that applies new research findings on a typical highway construction project.

Project Name: Pequawket Wetland Conway NH

Project Location: Conway, NH

Start Date (project planning): 06-08-2009

End Date (post-construction monitoring): 06-08-2009

Short Description: A restoration of a wetland area using native plant material.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? A very good cooperation between all agencies. Good cooperation with the contractor also helped.

Project Name: Ringling N & S

Project Location: West, central Montana

Start Date (project planning): 09-06-2008

End Date (post-construction monitoring): 10-06-2008

Short Description: Large reconstruction project. Approximately 200 acres reseeded. Dirt contractor salvaged and replaced adequate amounts of topsoil. Revegetation specifications were followed by seeding contractor. Timely precipitation.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The availability and handling of topsoil is the most important variable in achieving revegetation success. The project area was fall-dormant seeded and the department construction staff monitored all aspects of the seeding to make sure the seeding contractor followed the specifications.

Project Name: Sutter-Yuba 70

Project Location: State Route 70, Sutter and Yuba Counties

Start Date (project planning): 03-01-2002

End Date (post-construction monitoring): 06-30-2010

Short Description: 15-mile widening project with long stretches of exposed new slopes adjacent to sensitive vernal pools and agriculture lands. Slopes were treated with varying types of seed mixes and treatments as part of a research project for best practices guidance on revegetating. Worked with UC Davis to establish parameters and monitor success of the different types of treatment.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Landscape architect liaison was also a biologist and was very innovative in coming up with solutions.

Project Name: Gateway Landscaping Project

Project Location: statewide (Ohio)

Start Date (project planning): 06-25-2004

End Date (post-construction monitoring): 03-03-2009

Short Description: The project provides a partnership between ODOT and Local Public Agencies. ODOT provides the funding for the projects and the Local Public Agencies provide the installation labor and after care. The after care is the most important part of the project.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Partner between two different agencies.

Project Name: Four Land RTE 13

Project Location: Bolivar to Collins, MO

Start Date (project planning): 06-01-2004

End Date (post-construction monitoring): 05-02-2007

Short Description: MO RTE 13 was upgraded to 4 lane, new grade and alignment, seeded with most recent seed mix and additional coreopsis.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Rocky soils, deep roadcuts, dry conditions during establishment, and high seeding success.

Project Name: Dismal River South of Mullen

Project Location: Mullen, NE

Start Date (project planning): 03-13-2007

End Date (post-construction monitoring): 03-01-2009

Short Description: Restoration of an erosion hole. Project is currently in post construction monitoring

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? With the unique character of the landscape, restoring the erosion in a manner to blend with the surrounding landscape while using native plants.

Project Name: US 2

Project Location: White Earth, ND

Start Date (project planning): 11-01-2002

End Date (post-construction monitoring): 10-31-2008

Short Description: 93 mile grading project with the ditches seeded to native grasses.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The length of this project was quite large (93 miles). The disturbed areas were revegetated with native grasses.

Project Name: Legacy Roads Project

Project Location: Ocala, FL

Start Date (project planning): 10-2007

End Date (post-construction monitoring): 07-2008

Short Description: Project requirements were to restore watershed, reduce resource damage from roads/trails. User made roads were decommissioned; planted with native grasses that were collected locally. Work included mechanical earthwork, seeding and planting Florida ecotypes of indigenous vegetation, blocking roads and signing.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Benefits of the project include: restoration of 40 miles of roads; seeded 90 acres to restore ground cover, create hunting enhancements; planted 6,000 trees and shrubs, reduced sediment to streams and wetlands, restored T&E habitat, reduced fragmentation that impacted 43,000 acres of wetlands.

Project Name: Hwy 1 Reconstruction

Project Location: Ely, MN

Start Date (project planning): 01-01-2005

End Date (post-construction monitoring): 01-01-2011

Short Description: Reconstruct, straighten and safety improvements on a five mile stretch in the Superior Natl. Forest

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Establishing native species in difficult terrain without introducing non-natives to the region species.

Project Name: Rte 9 Searsburg to Wilmington

Project Location: Searsburg to Wilmington, VT

Start Date (project planning): 04-15-2004

End Date (post-construction monitoring): 07-01-2006

Short Description: Rte 9 was a 3 mile road reconstruction parallel to the Deerfield River. Revegetation of lopes along the river included one foot of native topsoil "grubbings" from stockpile over deep stone fill. We created deeper "pockets" where needed and planted hundreds of native shrubs and small trees at 4-5' height on south facing slopes. We paid for maintenance and watering separately so the plants were well watered during the establishment period. We had excellent success rate and won a VT Public Space Award.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The south facing slopes, the dry conditions with soil over stone and the steep slopes 1:1:75 were difficult. Mature oaks had been removed and the regulators wanted oaks replanted. We planted hundreds of small native trees and shrubs and the contractor did a good job watering all summer on a very dry site.

Project Name: Replacement of Bridge 186B

Project Location: Franklin County, MS

Start Date (project planning): 06-01-2007

End Date (post-construction monitoring): 09-15-2008

Short Description: Replacement of a precast concrete bridge on a low volume forest road. We have fertile soil, plenty of rain, warm humid weather, and a long growing season, so our revegetation projects consist of seeding and mulching disturbed ground to hold the soil the first season until native vegetation takes over.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Successful – project's geographical location Challenging – nothing

Project Name: Cascades Lake Pass

Project Location: Essex County, NY

Start Date (project planning): 05-14-2008

End Date (post-construction monitoring): 08-28-2008

Short Description: Maintenance forces revegetated a segment of Route 73, a scenic Adirondack Highway that passes through the Cascades Pass. The revegetation was to replace vegetation that had died, to provide a living snow fence, and to limit run-off going into the Cascade Lakes

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Good coordination within the region and with regulatory agencies. Project work generally matched equipment, schedule, and competencies of the maintenance staff at the location, Essex Residency. Maintenance staff brought a strong work ethic to planting and maintaining vegetation.

Project Name: McDonald's

Project Location: Stillwater, NV

Start Date (project planning): 09-28-1993

End Date (post-construction monitoring): 04-20-1994

Short Description: Re-establishing native bunchgrass & native shrubs to dewatered farm fields.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Use of irrigation.

Project Name: Exeter Duck Club

Project Location: Los Banos, CA

Start Date (project planning): 06-01-2004

End Date (post-construction monitoring): 12-31-2034

Short Description: Wetland habitat restoration in the San Joaquin Valley's Grasslands Wildlife management Area (GWMA) includes native shrub and tree plantings on the sides of dikes adjacent roads to – among other reasons- reduce disturbance to wildlife.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? This project was very successful due in large part to land owner interest and participation; the native shrubs and trees established very successfully.

Project Name: NA

Project Location: NA

Start Date (project planning): NA

End Date (post-construction monitoring): NA

Short Description: You have some severe errors in your questions. First of all, define "roadside revegetation". Is it just erosion control? Or is it replanting? Or is it revegetating with native plants. You never define it, so thus we cannot accurately answer your questions. Also, there is more to "road design" than just the road – slopes are the biggest factor affecting revegetation, followed by the lack of topsoil… Sorry for such crappy answers, but I cannot answer your questions.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? [Agency] does not use enough native plants. [Agency] is forced to go with low bidders that do not care about the quality and long-range goals of the project. Roadside revegetation can be anything from chipping green waste over existing soil that has seeds in it to that of full-blown landscape and irrigation plans – sometimes using water-hungry, non-native 'foo-foo' plant species. There is no mention of landscape architectural services – a 'road designer' isn't a good description either.

Project Name: La. Ave. Interchange

Project Location: Lafayette, LA

Start Date (project planning): 02-28-2002

End Date (post-construction monitoring): 09-22-2004

Short Description: Interstate 10 interchange construction at Louisiana Avenue consisting of clearing and grubbing, drainage, seeding Bermuda grass 70 acres.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? This area in the project had major drainage problems with swamp section on the south side of I-10.

Project Name: Los Velas

Project Location: Rio Grande City, TX

Start Date (project planning): 06-2007

End Date (post-construction monitoring): 03-2008

Short Description: Conversion of 3 adjacent crop fields to native vegetation (~160 acres). Planning began by selecting a mix of native tree and shrub species for the site along with desired density of planting. Plants were grown in local nurseries under contract. Site preparation included pre-plant glyphosate application followed by irrigation. Planting was done using a mechanical transplanter. Monitoring includes periodic spot checks of seeding survival and weed pressure and quantitative sampling after one year post-planting.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? All of our revegetation efforts are challenging as we never know when we are going to have optimal soil moisture for planting. In this case, we were able to flood irrigate the fields prior to planting. But this is not always an option. Non-native grass invasion is a constant threat, as the grass suppresses growth and prevents recruitment of new plants from seeds of the transplanted trees/ shrubs.

Project Name: Prescribed Fire

Project Location: Laguna Atascosa NWR, Texas

Start Date (project planning): 10-01-2008

End Date (post-construction monitoring): 09-01-2009

Short Description: Prescribed fire that meets Objectives: 1. Maintain coastal prairie habitat 2. Improve nesting, feeding cover and brood rearing habitat for a variety of waterfowl, wading, shorebird and numerous other avian species. 3. Improve overall habitat for mammalian species including white-tailed deer and javalinas. 4. Rejuvenate 90 % of cordgrass by removing decadent vegetation and facilitate the recycling of nutrients. 5. Open up stands of vegetation suppressed by invasive grasses. 6. Reduce fuel loadings in the burn units by 80-95%. 7. Establish burn rotation to maintain optimal fuel loads within the unit. 8. Prevent succession in cordgrass units. 9. 50-80% kill of invasive trees and brush (not including the larger Thornscrub Forest). 10. Reduce fuel loadings in the burn units by 75-100%.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? It was challenging on several different levels; physical and bureaucratic: 1: Finish all the paperwork necessary for a burn. 2: Staffing issues. 3: Funding issues. It was successful on one very important issue – dedicated staff.

Project Name: Chugach ROW

Project Location: Girdwood, Alaska

Start Date (project planning): 05-01-1994

End Date (post-construction monitoring): 09-15-1999

Short Description: Revegetation of coastal wetland with native sedge and other species.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The species used

Project Name: US 60 Florence Jct. to Superior

Project Location: Superior, AZ

Start Date (project planning): 03-15-2004

End Date (post-construction monitoring): 12-31-2008

Short Description: The US 60 "Gonzo" project completed the reconstruction of a 2 lane highway into a 4 lane highway for 9 miles through mostly Tonto National Forest lands. Plant salvage of thousands of native plants. Large Sonoran Desert plants included Saguaro, Barrel, Hedgehog, Cholla Cacti, as well as Ocotillo, Palo Verde, Mesquite and Ironwood trees. Native forbs and grasses were used in the seed mix. The total area revegetated on this project was 168 acres. A new Arizona Department of Transportation special provision was included in the contract that required the contractor to remove noxious weeds known to be along the corridor alignment. Drainage issues were addressed with basins, sediment logs and riprap in the SWPPP that kept contaminated stormwater out of Queen Creek. A full time registered Landscape architect and erosion control coordinator was employed on this project. Vegetation establishment, aesthetics and the reduction of noxious weeds were all addressed in this successful project.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The magnitude of constructing a 4 lane highway through previously undisturbed lands was tremendous. Interagency cooperation was at the highest level. The design team understood the importance of sustaining the Sonoran Desert ecosystem and making the highway construction fit the land. Large rainfall events taxed the competence of the construction team and many revisions of the SWPPP were required. Landslides in the cut areas that went through previously undisturbed schist formations required the Landscape Architect and construction team to waste 100,000+ of cubic yards of materials along the roadway and make them blend into the natural geography. Every element of cooperation between the Forest Service, Arizona Dept. of Transportation, and the contractor were stressed to the max and successfully addressed in this project.

Project Name: US 64 ByPass

Project Location: Knightdale ByPass, North Carolina

Start Date (project planning): 10-2006

End Date (post-construction monitoring): 11-2007

Short Description: To mitigate for the removal of trees during the construction phase, NCDOT agreed to reforest several areas along this 13 mile corridor. Revegetation included an assortment of native trees comprised of evergreens and deciduous varieties as well as low-growing shrubs. They were not planted in traditional 'bed' areas therefore future maintenance will be kept to a minimum.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Adjoining neighborhoods were at first concerned about the aesthetic component of this project after construction. But after the trees and other plant materials were installed most of these inquires ceased.

Project Name: Camino Real

Project Location: Laredo, TX

Start Date (project planning): 02-01-2009

End Date (post-construction monitoring): 03-01-2009

Short Description: Quick erosion control project utilizing some locally grown natives along with our standard seed mix.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The ability to use some locally grown seeds.

Project Name: NJ Meadows

Project Location: Southern part of I-295 and lower part of NJ 55

Start Date (project planning): 05-01-1998

End Date (post-construction monitoring): 05-01-2007

Short Description: At the request of my daughter and I in about 1997 to the NJDOT Operations Director, a program was started that stopped mowing on these portions of the noted highways except what was absolutely required by FHWA safety standards. It worked will until about 2 years ago when mowing started again on non-safety areas. The signs demarking the project areas are still present. It was never expanded to other portion of NJ highways.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Mowing in non-safety required areas, and planting of non-indigenous vegetation are greatest problems for successful roadside vegetation management, in my opinion. Second to these two factors are the non-control/management of invasives.

Project Name: Confidential

Project Location: Confidential

Start Date (project planning): 01-01-1993

End Date (post-construction monitoring): 01-01-2000

Short Description: Great basin habitat, prior to project set up, test plots using locally collected native seeds and make them work in a matrix of cheat grass and other weeds. 99% native cover and a low amount of weed cover that had not been accomplished by 1993 when the first test plots were done. Test plots must be successful at least two year prior to the planned project, and it requires a ton of money to get them right the first time. However, getting the test plots right, saves hundreds of millions of dollars in failure after failure, that has been happening in the West for decades now, like you can see at http://www.ecoseeds.com/road.test.html. Without test plots in the planning stage, and without obtaining or inventing licensed ecological restoration technologies, using natives in un-irrigated western roadsides will only be a dream or doomed to extremely expensive failures in the future, especially in California that is 100% covered by 1,000 species of weeds. Also, there was no part of your survey, that talked about another important aspect, is before the test plots, to go out and measure the existing ecosystems, to get an idea of its structure, so that you can copy and paste that pattern into your project. Also, no mention of the roadsides that still contain native, to be conserved for later use as seed sources. In the west, roadsides are sometimes the only source of local native seeds for projects, like you can see at http://www.ecoseeds.com/megatransect.html. I would suggest that there is a mile-by-mile survey every 10 years for native stands across the county and that the best stands are intentionally protected as future seed sources.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Successful doing test plots in the planning stage, and not proceeding until they were 99% successful, and using licensed ecological restoration technologies, because the restoration technologies in journals or for free have been failures for decades in the West for non-riparian roadsides. Challenging, where there was very little local seed sources to draw on, and the soil was poor volcanic infested with cheat grass and tumble mustard.

Project Name: STH 133

Project Location: Boscobel, WI

Start Date (project planning): 01-01-2003

End Date (post-construction monitoring): 10-01-2008

Short Description: Road widening with a degraded prairie adjacent to the road. The remnant also contained some listed plants. As part of the road widening mitigation the prairie was identified for restoration and special provisions were made to move plants or collect seed of the listed species and use local native prairie seed in any disturbed areas. The site is now a very nice prairie that blossomed after restoration.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Success was in knowing what native plants were out there that helped direct appropriate restoration efforts. Challenging was trying to work with the locals to not run ATV's along the roadside and through the prairie. In the winter this is a snowmobile trail, so the 'trail' is present and therefore the locals use it year round. It is not authorized for ATV's, only snowmobiles when snow is present.

Project Name: STH 35 (Webster – Danbury)

Project Location: Danbury, WI

Start Date (project planning): 01-01-2003

End Date (post-construction monitoring): 12-30-2006

Short Description: Reconstruction of state trunk highway. DOT used native seed mix to revegetate large backslope area of highway.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Challenging: due to the low numbers of projects that have documented successful use of native seed mixes we did not have a lot of guidance to use. This was somewhat of an 'experiment' for us. Successful: due to the willingness of DOT staff to incorporate the native seed mix into their design plans, and due to the County's willingness to practice maintenance procedures.

Project Name: Bridge

Project Location: North of Dewitt, IA

Start Date (project planning): 06-12-2007

End Date (post-construction monitoring): 09-19-2007

Short Description: Reseeded a bridge movement with a regrade. Seeded to natives, the seeds went dormant and had to reseed the following season, also had to mow throughout the growing seasons to keep week pressures down

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Limited topsoil found on site. Everything was packed hard for good rooting.

Project Name: Badger Highway

Project Location: P-59 Webster County, Iowa

Start Date (project planning): 03-06-2009

End Date (post-construction monitoring): 06-15-2009

Short Description: This is a 6 mile stretch of highway that was bare ground post construction. I have broadcasted and hydroseeded native grass and forb mixes with mixed results. Unfortunately, the weather has been an issue with flash flooding making this project difficult.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Weather and poor soil fill.

Project Name: R Avenue Clean Out

Project Location: Woodward, IA

Start Date (project planning): 08-01-2001

End Date (post-construction monitoring): 08-01-2008

Short Description: 1000-foot cleanout was hydroseeded with native tallgrass prairie grass and forbs on 08-21-2001 with oats, annual rye and timothy grass added as nurse crops. It is now a highly diverse, showy and functional roadside prairie planting.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The right equipment (hydroseeder) was essential for success, which would not have been possible to acquire without the help of the Iowa Living Roadway Trust Fund.

Project Name: ?

Project Location: ?

Start Date (project planning):

End Date (post-construction monitoring):

Short Description: I am new to this position and do not have a specific project to utilize at this time.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? In my limited experience MDT does a very good job of planning and setting specification for contracts. I do believe that we could improve with our follow up and adhering to those specifications. I hope to educate our workers and show them that importance and cost effectiveness of good revegetation.

Project Name: Contract R-27141

Project Location: US 37 & SR 46, Indiana

Start Date (project planning): 03-23-2004

End Date (post-construction monitoring): 12-01-2008

Short Description: Landscaping contract to remove Tall Fescue replace with Warm season grass, forbs, and trees, maintain for two years for invasive plants. Two seasons for removing and planting, plus two years of maintenance on site

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The success of the project support was plant/seed specifications. The contractor was knowledgeable. The challenging parts were the steep slopes and poor sub-soils. Still it is one of the best, if not the best in the entire site.

Project Name: Tripod Fire Rehab

Project Location: Okanogan, WA

Start Date (project planning): 10-2006

End Date (post-construction monitoring): 09-2009

Short Description: hydroseed/hydromulch forest roadside areas burned over in tripod fire.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Lack of local revegetation experience meant specs for seeding work could have been better.

Project Name: 79, A23 Missing Ramps

Project Location: Pittsburgh, PA

Start Date (project planning): 01-01-2001

End Date (post-construction monitoring): 11-01-2008

Short Description: Construction of two missing ramps at interchange west of Pittsburgh. Slope work and wetland mitigation construction.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Significant earth disturbance with steep slopes – erosion concerns. Needed grasses that revegetated quickly and gave complete coverage.

Project Name: Carolina Sandhills love grass removal

Project Location: McBee, South Carolina

Start Date (project planning): 03-09-2009

End Date (post-construction monitoring): 09-30-2010

Short Description: Removal of love grass, re-establishment of native wire grass

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Removal of currently entrenched invasive bunch grass.

Project Name: None

Project Location: None

Start Date (project planning): NA

End Date (post-construction monitoring): NA

Short Description: The projects that have taken place here at IDOT were past projects. Presently, there are not any major revegetation projects taking place.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? As stated earlier, most of our success has been done in the past. Presently, there is interest in getting more involved with roadside revegetation, but the State and National economies are not favoring that idea. With rising cost and loss of personal, it may be wise for IDOT to investigate and consider a vegetation management approach to the landscape verse the present mowing and spraying regimen.

Project Name: Cody – Yellowstone NP

Project Location: Cody, WY

Start Date (project planning): 01-16-1990

End Date (post-construction monitoring): 11-01-2001

Short Description: US Highway 14/16/20 reconstruction from East Gate YNP to Shoshone NF boundary (MP 0.0 – 27.6). Use of tested cultivars of native grasses, wildflowers (forbs) and wild collected tree and shrub seed (untested) along with extensive tree and shrub transplants. Semi-arid Foothills & Montane climate along with large game predation including grizzly bear. Extensive use of erosion prevention BMP's in volcanic parent materials along with sediment control BMP's during construction, all along a major river. Interagency collaboration with Shoshone NF Ecologist and Landscape Architect, etc., which won the USFS Region 2 Cooperative

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Use of "tested" native grass cultivars versus use of untested wild collections earlier requested by YNP staff, which caused only stand failures within first 3-miles of Park Boundary. Extensive use of erosion control blankets (w/bio-degradable nets) and slow-release organic fertilizer on erosion-prone volcanic soils (breccia) cuts. Limited the use of surface hydroseeding under semi-arid climate restrictions.

Project Name: Death Valley

Project Location: Death Valley, CA

Start Date (project planning): 01-01-2001

End Date (post-construction monitoring): 12-31-2001

Short Description: Park Service used a Reveg Specialist who, with her team, salvaged and transplanted cacti successfully

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Maintaining plant survival during construction

Project Name: Culvert Replacements to Enhance Fish Passage

Project Location: Methow Valley Ranger District – Winthrop, Washington

Start Date (project planning): 06-01-2004

End Date (post-construction monitoring): 09-30-2009

Short Description: The first wave of flat bottom culverts was replaced to improve fish passage starting in 2004. Since this time, over 20 culverts have been replaced. In the fall following project completion, revegetation planting of native trees & shrubs occurs. Weeding and watering of these plantings is on going for 2 seasons. Grass seeding has been part of the operation to stabilize soils and reduce weed establishment. By end of the 3rd growing season, we have averaged between 50% and 75% survival on these dry harsh sites.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Internal cooperation and funding provided for optimizing the success of the project. These first waves of culverts were particularly challenging since it was the first attempt at this type of revegetation. Given the support we had, we learned what worked and didn't and have become more efficient and successful at our current efforts. Post-project site conditions for planting are tough sites for plants. This combined with the dry summer conditions in our area make planting success a challenge. So lack of good soil for planting and dry summer months are the biggest obstacles, followed by cattle trampling & browsing.

Project Name: Young - North

Project Location: Young, Arizona

Start Date (project planning): 01-01-2000

End Date (post-construction monitoring): 01-01-2005

Short Description: Seed mix included native plants and shrubs. Although they are slow growers, shrubs offer much more in terms of root anchorage on steep slopes. By contract modification, also required the addition of amendments at particular location to improve growth.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The situation was challenging in that we had a number of very steep, largely sterile slopes with a tendency to ravel. With the selection of native shrubs and the addition of targeted amendments during the planting stage, the results were much improved.

Project Name: Guanella Pass Road Phase 1

Project Location: Georgetown, Colorado

Start Date (project planning): 01-01-2004

End Date (post-construction monitoring): 10-01-2007

Short Description: The overall project was $21 million and reveg items made up about $1.5 million. Project located in the Rocky Mountains of Colorado between 10,000 ft and 11,667 feet. Successfully transplanted high altitude tundra at 11,667 ft.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Extreme working conditions at high elevation made for a challenging project. Multiple applications of native seed made for success. Salvage and transplanting of high altitude tundra was challenging. Protection of container stock plants from native animals was a challenge.

Project Name: HWY 59 (resurfacing between Palmyra and Eagle

Project Location: Southeast Wisconsin

Start Date (project planning): 10-01-2003

End Date (post-construction monitoring): 10-01-2005

Short Description: Resurfacing of a two lane highway adjacent to a state forest. Native planting was incorporated.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? It was successful because of specialized staff work on the project.

Project Name: Flowery Trail

Project Location: Chewelah, Washington

Start Date (project planning): 01-01-1998

End Date (post-construction monitoring): 07-30-2008

Short Description: 13 miles of road reconstruction through forested mountains

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Revegetation success due to hands on approach and interest of a Colville National Forest engineer.

Project Name: Lakeshore Road Reconstruction Phase 1

Project Location: Lake Mead NRA

Start Date (project planning): 01-01-1990

End Date (post-construction monitoring): 03-01-1998

Short Description: Dates above are approximate. Re-route road, collect seeds from native plants, salvage cacti, and topsoil. Topsoil replaced, cacti replaced, plants grown from seeds collected installed in replaced topsoil. Installed plants were watered for two summer seasons, plants that germinated out of the topsoil were not watered or protected. Here in the Mojave, large-scale success depends a great deal on environmental conditions post-construction.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? It was challenging in that the park had never done this before and neither had FHWA in the Mojave. The NPS had conducted topsoil salvage and deveg/reveg operations in a few places (like Glacier NP for the Going to the Sun Road) but not on this scale. There were many misunderstandings between the FHWA, the contractor, and the park reveg rep that made for some difficulties, but

we worked it all out in the end. One thing that made this particular project very successful was that we laid topsoil and planted during an El Nino year, which meant we had soil at field capacity in many places. Our park reveg rep was also very focused on her work, and was very adamant that the contractor do everything they had bid on.

Project Name: SR 240 Causeway Wetland Mitigation Site

Project Location: Richland, Washington

Start Date (project planning): 08-01-1999

End Date (post-construction monitoring): 11-15-2016

Short Description: This was a wetland mitigation site for a roadway widening at the confluence of the Columbia and Yakima Rivers. I was able to help pick the mitigation site, design the grading and planting plans, and have been consulting with our South Central Region on site management to meet our mitigation standards of success. This was a site that multiple disciplines worked together on.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The multidisciplinary team, project team support for compost incorporation, and excellent hydrology data.

Project Name: Travel Plan

Project Location: SMNRA, Nevada

Start Date (project planning): 01-01-2002

End Date (post-construction monitoring): 01-10-2007

Short Description: Restoring routes, or along routes designated in the travel management effort

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Lack of management direction, lack of restoration planning, lack of available resources.

Project Name: Rice Road Tallow Eradication

Project Location: Demi John, Texas

Start Date (project planning): 06-01-2007

End Date (post-construction monitoring): 06-01-2008

Short Description: Chinese tallow trees were bulldozed and buried to clear sides of rice field road. Labor shortage could not follow up with chemical treatment. Tallow returned in force.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The tallow tree was easy to remove from the surface.

Project Name: PG4135172 MD 5 from Auth Way to South of I-95/495, Phase 1 of Metro Access Improvements

Project Location: Temple Hills, Maryland

Start Date (project planning): 04-01-2003

End Date (post-construction monitoring): 12-15-2009

Short Description: Major Interchange Reconstruction

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? This project has been successful in large part through the cooperation and communication between all of the stakeholders involved in the implementation of a fairly well planned integrated planting plan. The size and scope of the project was a challenge.

Project Name: US-95 Electrical Substation

Project Location: CM-NH-STP-4110 (110)

Start Date (project planning): 01-01-2002

End Date (post-construction monitoring): 02-02-2006

Short Description: Highway Relocation. Timber areas with steep hillsides. Used many different erosion control and revegetation applications

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Achieved desirable plant establishment and coverage, as well as erosion control after 3 years. Native plant establishment. Challenges were very tall steep fill and cut slopes and lack of precipitation during initial establishment period.

Project Name: Meheffey Bridge

Project Location: Solon, IA

Start Date (project planning): 01-01-2003

End Date (post-construction monitoring): 11-30-2008

Short Description: Regrade and pave project – except for lawn areas, nearly all planted into native grasses and wildflowers. High traffic and visibility areas.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Quality seed mixes and timing for planting, along with regular maintenance for establishment afterwards (burning, mowing, spot spraying, etc.)

Project Name: WA st hwy 31

Project Location: Metaline Fall, Washington

Start Date (project planning): 02-2006

End Date (post-construction monitoring): 10-2007

Short Description: Widening of road and ROW on Hwy 31. Reveg of section that pass through USFS land.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? This project with the state of WA had poor success compared to other projects done with FHA. Primary reason for poor success attributed to how seeding was applied.

Project Name: Post Fire Road Rehab

Project Location: Okefenokee Refuge

Start Date (project planning): 08-01-2007

End Date (post-construction monitoring): 09-01-2008

Short Description: Rehab of roads used to control 2007 fires

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The size of the project – 125 miles of road to be rehabbed.

Project Name: Cedar Creek

Project Location: Superior, Montana

Start Date (project planning): 10-01-2007

End Date (post-construction monitoring): 09-01-2009

Short Description: In April of 2008 the Lolo National Forest partnered with Trout Unlimited on a demonstration project involving the revegetation of riparian roads in the Cedar Creek watershed. Cedar Creek is a tributary of the Clark Fork River approximately 40 miles west of Missoula, Montana. It is one of four primary bull trout spawning tributaries in the Middle Clark Fork River and also maintains a strong native west slope cutthroat population. Implementation involved hiring the Salish and Kootenai Environmental Restoration firm who holds the patent on a unique piece of restoration technology called the stinger. The stinger is a long needlelike attachment mounted on an excavator which can penetrate riprap and plant container stock up to 3-4 feet below the surface. For the demonstration project, willow cuttings were collected from local sources in February of the same year and other plants were grown at the tribal nursery into 14"long containers that are designed for use with the stinger. In total, the project team planted 553 plants (355 willow cuttings, 24 willow containers, 128 wild rose containers, 46 cottonwood containers) at 3 foot linear spacing in 3 rows moving up the riprapped bank. Generally, willow cuttings and containers were planted at the toe of the slope, cottonwoods midslope, and wild rose on the top of the bank. With the excavator and 2 field crew, the project team tallied 5 hours of total planting time for 465 feet of road length at 4 different sites. The stinger averaged about 110 plants per hour. In conclusion, the stinger can plant one row, at 1 foot spacing, about 100 feet of riprapped road per hour.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The demonstration project should have both long term resource benefits and provide information for future use of the stinger technology. The addition of riparian vegetation in the riprap should improve bank stability and decrease maintenance over

time. As the vegetation grows, it should help lower stream temperatures, reduce the amount of sediment input from the roads, increase the amount of leaf litter and debris, and increase the complexity of salmonid habitat. The project team has photo points and is monitoring the success of the project through vegetation survival counts. Therefore, this demonstration project should yield important information for to improve the success of future efforts, including information on planting space, plant species, riprap type and size, bank height, bank slope and other measurements.

Project Name: Federal Highways Administration Park road upgrade

Project Location: Denali National Park

Start Date (project planning): 07-15-1985

End Date (post-construction monitoring): 08-15-2003

Short Description: A variety of native plant species were tested for revegetation potential. A mixture of native grasses and legumes were selected for direct seeding on roadside fill slopes and cut slopes. Native grass seed supply was increased at Alaska State facilities and legume seeds were hand collected. After construction, cut and fill slopes were fertilized with slow release fertilizer, and the native grass/legume mix was dormant seeded in the fall or at the beginning of the growing season.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Planning and adequate funding that made it possible to test and select native plants suitable for well-drained gravelly sites. This naïve plant revegetation project is still growing and providing a seed source for other projects.

Project Name: Houston Co. Erosion Control

Project Location: Various Houston Co. Twp. Roads, Minnesota

Start Date (project planning): 06-01-2008

End Date (post-construction monitoring): 06-01-2009

Short Description: In June of 2008, Houston County, MN was hit with torrential rains that caused many steep hillsides to slump down and block roads. After clearing and resloping, the County Hwy dept. and MN DNR Roadsides for Wildlife worked together to hydroseed these hills with native prairie seed. It is hoped that the deep roots of the prairie plants will better stabilize the hills than the previous non-native grasses.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Houston County lies in the Driftless area of MN and had very steep slopes. We do not typically hydroseed, but in this location it was the only option. Our program focus is primarily grassland habitat, but in this case erosion control was the main goal.

Project Name: Logan Canyon

Project Location: Cache Co., Utah

Start Date (project planning): 01-01-2000

End Date (post-construction monitoring): 08-01-2006

Short Description: Roadway widening project through a sensitive canyon environment. Use of native grasses, forbs, and wildflowers. Project emphasized blending slopes to fit the natural terrain. A few years after installation there is no evidence of construction.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? Roadway project being constructed in a sensitive environment with much environmental opposition to the project.

Project Name: Interstate H1 Middle Street to Ola Lane

Project Location: Honolulu, Hawaii

Start Date (project planning): 01-01-2001

End Date (post-construction monitoring): 01-01-2007

Short Description: Revegetation of roadside with 3 native Hawaiian plants, Naio papa (Myoporum sandwicense), Pohinahina (Vitex rotundifolia), and Prince Kuhio Vine (Ipomoea horsfalliae). It met our internal criteria of durability, sustainability and sense of place (or CSS), Durability projected to last 10+ years, sustainable with existing maintenance resources, and reflects the Hawaii sense of place.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? It met our criteria of durable, sustainable and a Hawaii sense of place.

Project Name: Camden Route 1

Project Location: Camden, Maine

Start Date (project planning): 01-01-1990

End Date (post-construction monitoring): 07-30-2006

Short Description: Route 1 in Camden Maine is a highly visible and tourist oriented 2-lane rural in town section of US Route 1 fronted by high-end bed and breakfasts, historic homes, and providing a walking route to a popular coastal state park. The project was successful through very conscientious context sensitive design, featuring sidewalks, esplanade, numerous plantings, and new walking path to the Camden Hills State Park.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The project landscape architect used a wide range of plant materials and methods, including trees and shrubs, perennials, vines, native seed, and native trees and shrubs to replicate and enhance a full range of planting experiences.

Project Name: Hawaii Native Revegetation

Project Location: Oahu

Start Date (project planning): 03-15-2009

End Date (post-construction monitoring): 03-05-2011

Short Description: Self contained project

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? First attempt to do native reveg.

Project Name: Carlsbad Caverns

Project Location: Carlsbad, New Mexico

Start Date (project planning): 07-04-2004

End Date (post-construction monitoring): 10-12-2012

Short Description: Seven miles of park road will be resurfaced. Two-thirds of the Bat Cave parking lot will be taken up and the area revegetated as it drained into the caverns. Introducing automobile fluids into the caves. Native plants salvaged from several disturbance-causing projects are being held in a shade structure and will be planted out into the Bat Cave parking lot this fall. This has allowed a number of large succulents to be moved from their original site, when they are planted out they will provide some mature vegetation at the site.

In your opinion, what made this particular roadside revegetation successful and/or especially challenging? The native vegetation of Carlsbad is Chihuahuan Desert Scrub, characterized by many prickly succulents of varying sizes. Getting around in this vegetation is challenging as is recreating it. We will be transplanting salvaged materials into the Bat Cave site and over planting it with native grasses grown out by the NRCS Plant Materials Center at Los Lunas.

ADDITIONAL SURVEY COMMENTS:

- Success can be achieved if the needs of revegetation are treated equally as important as the engineering design elements. In a semi-arid environment, no other practice is more important than salvaging adequate amounts of topsoil.
- Native plants have been a part of our roadside program since the early 70s. over th past three years we have been redefining the program and furthering our use of natives.
- For this particular project we used our own employees to accomplish work – we had a tight time frame. We also utilized partnerships with Florida Fish & Wildlife Conservation Commission, National Turkey Federation and the Sierra Club. White hat project definitely.
- As a landscape architect, it was important to get support of the project manager, the Resident Engineer & the contractor to create innovative and sustainable solutions. The team approach worked. We tested the stockpile of "grubbings" before they were spread & added compost to raise the % of organic material. This was a critical factor in the success of the project.
- You can't stop vegetation from growing in this climate, and our reveg projects are very simple (spreading seed and mulch), so we may not be the intended typical survey participant.
- This questionnaire appears to be focused on the design and construction, rather than maintenance. Maintenance staff in our 61 Residencies, the front line unit for undertaking maintenance work, do a varying amount of revegetation work, based on demands, equipment and staffing. In addition to the Cascades Lake work, several of our Residencies, including Broome, Chenango, and Allegany, have undertaken activities, in partnership with local agencies, to use vegetation to help stabilize stream banks and bridges. Other examples of maintenance successes with revegetation may be found on the NYSDOT website, under the heading for Green and Blue Highways or our trees webpage.
- If available irrigation is critical in desert environments
- This revegetation project receives heavy use by pheasants, quail, migratory passerines, and small mammals; it is not advised for close proximity to roads with heavy vehicle traffic.
- This is now a practice that can be accomplished by any agency willing to do the preplanning and with the desire to do the work.
- Soils play a very big role in the success of these projects. During construction typically a lot of soil is displaced during the initial grading phases of these projects. We rarely have top-soil on the surface during the planting phase of a project.
- There is not enough seed sources for many desirable seed species since the ag community drive the seed industry.
- Implement a policy that is promoted for adopting by state DOTs that contains the following: 1. Only mow to meet FHWA safety standards. This will save funds, reduce pollutions, and reduce green house gas emission. 2. Allow native vegetation to grow in n-mow areas versus planting. This will save funds and effort. Outreach and education of the public will be necessary, but can be accomplished in large part by willing partners. 3. Control invasives. Using partners to assist along the lines of adopt a highway could assist with long-term, low cost management. 4. It is understood that during new highway construction or renovation, soil erosion prevention procedures must be implemented. The focus here should be on using native indigenous species or short lived species that hold the soil until natives can quickly out-compete them.
- In any part of the country you want to be successful with natives along roadsides, you must set up test plots, and get them to achieve 99% success within 90 days or less, with less than 5% weed cover, using locally genetic native seeds. In order to do that, you will either have to invent or license the proper ecological restoration technologies to accomplish that. (See ECOLOGICAL RESTORATION. (2001) 19:(2) 70-71.about licensed ecological restoration technologies).
- WI is developing best management practices for preventing the spread of invasives on ROWs. They will cover planning, design, construction, maintenance and monitoring. We have a team of stakeholders (ROW mgrs) working on this and should have a draft by Sept. Could send you more details sooner. Let us know who needs it.
- Sometimes it is hard to get the state DOT to allocate funds for native plant restoration projects. Even though the money has been authorized by FHWA for purposes such as that, the state does not always support the use of those funds for those purposes.
- It appears that DOT staff could use more training on this issue.
- A special thank you. Seed used for this project was purchased with TEA-21 enhancement funds.
- FHWA need to push native plants more on projects and also more field inspections for compliances on all revegetation projects.
- I just responded to indicate a recommendation for roadside habitat management. Grassland/old-field birds (e.g., Bobwhite Quail), and likely other wildlife associated with this habitat type, have been disappearing most rapidly of any bird group. It is easier to manage this habitat type along roadsides than mowing them several times a year, thus providing a cost savings. In addition to providing habitat, it provides connections (corridors) to other existing habitat

on private and public lands adjacent to the roadside. This could be critical to survival of these species. In addition, the monarch butterfly has been losing resting and feeding habitat along its long migration route. Mixing in native milkweeds would provide habitat for this species and provide long corridors of habitat, perhaps stretching along most of its migratory pathways. Thus, roadsides are critical for conservation of species by providing feeding, resting, and breeding sites along with travel lanes/corridors for migration and linkages of habitats. This should be emphasized (in my estimation required) when monies are earmarked for new roads and maintenance of existing roadsides.

- Lack of planning and funding are the biggest hurdles to overcome in establishing roadside vegetation for forest projects.
- Some of the options on previous questions were not complete. Regulatory agencies set the criteria for coverage on design projects (Soil Conservation Districts). Sometimes native plants do not always give the best coverage and quickest growth on long steep slopes.
- Adequate funding is essential for success.
- Reveg specialist involvement
- Having native planting materials available when you need them is problematic. A 3 year lead time is often needed for collection and propagation of the appropriate materials. We have been lucky in having a local Native Plants Nursery that provides us with a ready supply of genetically suited material for use in these projects. Most areas are not as lucky.
- We have too many projects with just grasses in the seed mixes. Need to expand to include shrubs and, possibly, forbs as applicable. We should be performing soil testing during construction so that amendments can be added to the mix during application. These changes would greatly improve SWPPP compliance and long term slope stability--especially in arid areas.
- Contractor won an award from the Colorado Contractor's Association for Environmental Excellence for their salvage and transplant of the high altitude tundra.
- I don't quite know why, but for several years it seemed like the contractors were always underestimating the amount of time it took to properly harvest topsoil. They bid like it was straight grubbing, when in reality, it is much more refined and complex. They could not believe we really wanted to treat "dirt" like gold, and would want to take shortcuts to save them money. I honestly believe that this topsoil salvage operation would not have been successful if we didn't have a park reveg rep out there watching them like a hawk. And quite frankly, I don't think FHWA took the park too seriously on this issue either. After many years, and seeing the results, they do now.
- The project was graded correctly so that we had so many native volunteer plants that we could have planted far fewer plants ourselves. This is one project that demonstrates the validity of ordering plants after a 1-2 year period after grading to see what the site will do by itself with the correct grading and good weed control.
- Don't commit if you can't follow through.
- We have had several successful and unsuccessful revegetation projects. This is the only one that comes to mind readily. We achieve successful revegetation projects when we have good precipitation during the first and second years of establishment. Where we have limited or lacking precipitation in the first 3 years we have failures.
- Results of this and other native revegetation projects were published as a manual "Native plant revegetation manual for Denali National Park and Preserve", Information and Technology Report USGS/BRD/ITR-2000-0006, online at http://alaska.usgs.gov/science/biology/restoration
- 1. Native plants are best for roadsides and the environment. Avoid cultivars or non-native varieties. 2. Species diversity is important to our native insects, birds and wildlife. Try for 20-50 different grasses and wildflowers. 3. Invasive species should be monitored vigilantly and controlled with spot spraying or spot mowing.
- Hawaii is embarking on an aggressive approach to revegetate our roadsides with as much natives as practical considering the climate and soil changes over time. We have two current native hydroseed research projects to develop native hydroseed mixes since none exist in Hawaii currently. This year we will began our first native restoration project in a 12 acre parcel of a 150 acre interchange. This year we awarded a three year contract to develop the first statewide noxious invasive plant program in Hawaii or SNIPP.
- Local FHWA officials repeatedly voice approval and appreciation for the successful efforts on this project
- This project has taken close coordination with Design and Construction and park staff within NPS as well as with Federal Highways staff and reveg contractors. It has taken intense involvement and commitment by individuals from all of these groups or we would not be headed toward successful completion of this project.

APPENDIX C: EXAMPLE REVEGETATION PLAN FROM THE NATIONAL PARK SERVICE

NATIONAL PARK SERVICE REVEGETATION PLAN OUTLINES – BRIEF AND ANNOTATED FORMS

Brief Revegetation Project Plan Outline

(Park Name)

Date

I. Project Information

- A. Project and Package Number
- B. Project Manager
- C. Estimated acres to be revegetated
- D. Vegetation types to be re-established
- E. Revegetation Goals
- F. Plan Authors

II. Project Location

- A. Need for the Project
- B. Site analysis - soils topography, climate, vegetation, hydrology and wetlands, wildlife, cultural landscape features, and visual resources.
- C. Special considerations

III. Project Specifications

- A. Revegetation Goals, Objectives and Measures of Success
- B. Alternatives considered
- C. Implementation plan
  1. Plant Materials Acquisition
  2. Seeding and Planting
  3. Establishment Care
  4. Monitoring
- D. Revegetation Specifications for Road Contractor

IV. Administrative Requirements

- A. Cost estimate

Budget	FY-08	FY-09	FY-10	FY-11	FY-12	TOTAL
Original						
Revised						
Actual Costs						

- B. Funding source
- C. Prepared by
- D. Reviewed by
  1. DSC
  2. Park
  3. Region

V. Approvals

VI. Reference cited or consulted

VII. Attachments/map/photos/etc.

ANNOTATED VERSION

Revegetation Project Plan Outline

I. Project Information

A. Project and Package Number

B. Project Manager

C. Estimated acres to be revegetated

D. Vegetation types to be re-established

For example: Oak Woodland, Chaparral, and Riparian

E. Revegetation Goals

F. Plan Authors

II. Project Location

A. Need for the Project

B. Site analysis - soils topography, climate, vegetation, hydrology and wetlands, wildlife, cultural landscape features, and visual resources.

Note: This section is intended to identify factors which influence or limit revegetation. It should be concise and focused on the relationship between the environmental element and revegetation. This is not a place for a summary description such as appears in an environmental document.

C. Special considerations

Briefly highlight special issues or problems, particularly if they will increase the project cost. For example, wetland enhancement may be required in order to receive a 404 permit. Access may be particularly difficult. Topsoil may be critical for meeting the objectives but may be in short supply.

III. Project Specifications

A. Revegetation Goals, Objectives and Measures of Success

What is the revegetation project intended to achieve?

What measures or indicators will tell us whether or not we have been successful?

B. Plant Materials Strategies Considered

Plant materials strategies which are commonly used are: collecting native material and reseeding it, collecting native material and increasing it through field propagation, salvaging plants and replanting them after construction, collecting native seed and/or cuttings and propagating them to produce transplants, purchasing native seed, purchasing plant, and applying temporary erosion measures to stabilize the site and control erosion until natural regeneration occurs. Normally a combination of strategies is used. In this section, identify the chosen strategy as well as others that were considered and rejected.

C. Implementation plan

1. Plant Materials - Identify the species, quantities, form (seed, container, bareroot), size etc. Where and how will each be obtained?
2. Seeding and planting - Who will do each of these tasks? What techniques will be used?
3. Establishment Care – What is needed. Whose responsibility will it be? If there is watering, the irrigation plan including the design of applications and rates, etc. should be included here.
4. Monitoring – what do we hope to learn by monitoring? What methods will be used?

D. Revegetation Specifications for road contractor

Normally the National Park Service provides input to the "specials, "special specification material that differs from the FHWA standard specifications (FP-03). Any special items that will be submitted to FHWA should be recorded here. In the past, revegetation specials have addressed topics like the following: directions for conserving and handling topsoil, recipes for manufactured topsoil, special grading, applying the initial erosion control seed mix, special equipment needed to apply native grass seed, and lists of acceptable erosion control products and their sources. See Supplemental Specifications for PNW/DSC National Park Projects: http://www.wfl.fha.dot.gov/design/specs/NPS_PNW_specs.pdf

E. Revegetation Project Schedule/ Responsibilities Checklist

REVEGETATION PROJECT SCHEDULE/ RESPONSIBILITIES CHECKLIST

TASKS	RESPONSIBLE PARTY	START DATE	COMPLETION DATE
PLANNING/DESIGN			
Identify Revegetation Type			
Identify Revegetation Species			
Prepare Revegetation Plan			
Prepare Cost Estimate			
Prepare NRCS Interagency Agreement			
Prepare Task Order or Contract with Private Sector Revegetation Company			
Input prepared for FHWA plans and specifications			
Participate in project reviews			
Locate and inspect topsoil sources			
PLANT MATERIALS DEVELOPMENT			
Select revegetation species and collection areas			
Collect seed/cuttings etc.			
Start seed fields			
Start container plants (size, number?)			
Salvage plants on site			
Storage and care of salvaged plants			
Monitor Contract or NRCS growing			
Pre Construction weed/pest control			
DELIVERIES			
Native Seed Mix			
Plants			
PLANTING/SEEDING			
Post Construction weed/pest control			
Seeding (hydro, hand, mechanical?)			

TASKS	RESPONSIBLE PARTY	START DATE	COMPLETION DATE
Mulching			
Erosion Control (logs, blanket, tackifier?)			
Plant Protection			
Soil Amendments (fertilizer, Biosol?			
Monitor topsoil application and grading			
Supplemental Watering			
ESTABLISHMENT/CARE			
Post Construction weed/pest control			
Supplemental Watering			
MONITORING			
Follow-up inspections to record results of revegetation project			

IV. Administrative Requirements

A. Cost estimate

Budget	FY-08	FY-09	FY-10	FY-11	FY-12	TOTAL
Original						
Revised						
Actual Costs						

B. A multiyear estimate and breakdown is required with the full revegetation plan.

C. Funding source

D. Reviewed by

a. DSC

b. Park

c. Region

V. Approvals

VI. References cited or consulted

STATEMENT OF WORK/SPECIFICATIONS-REVEGETATION SERVICES IDIQ – WESTERN AND EASTERN STATES

STATEMENT OF WORK/SPECIFICATIONS: WESTERN REVEGETATION IDIQ

The Federal Government Department of Interior (DOI), United States Forest Service (USFS), and Central Federal Land Highway Division (CFLHD) is seeking one or more revegetation/reclamation/ecological restoration organizations to perform the following tasks: provide technical assistance in the field of native plant revegetation, and ecological restoration including bioengineering; prepare revegetation plans; prepare project sites for seed and plant installation; install seed and plants; collect seed and cuttings; propagate native plants from ordering agency genetic stocks; control exotic plants; salvage plants from designated areas; construct or apply plant protective devices or substances; provide plant establishment care; locate and provide plants when genetic considerations are not applicable; hold and care for plants in the contractor nursery if project delays require; and monitor revegetation/restoration success. Work will be performed for units of the DOI, USFS, and CFLHD in Alaska, Arizona, California, Colorado, Kansas, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Utah, South Dakota, Texas, Washington and Wyoming.

The scope of work includes but is not limited to the following areas. They are listed in order of most frequently used to least frequently used.

1. Revegetation Consulting: Utilizing ordering agency regulations and policies, provide technical assistance to ordering agency staff. Technical assistance may include services such as analysis of soils as well as advice, recommendations or education regarding analysis of soil resources, recommendations for soil salvage, topsoil storage, and soil amendments; seeding and planting prescriptions; installation techniques including soil amendments and erosion control materials; plant protection including temporary holding options, supplemental watering and establishment care; work scheduling and cost estimating. Potential deliverables may include but be limited to reports and drawings or sketches regarding specific questions or projects; written summaries of site conditions and/or work completed; or preparation of revegetation plans or sections of plans for requested projects.
2. Site Preparation: Prepare soil as needed, including scarification and addition of appropriate soil amendments. Install erosion control measures as needed. If task order is for this task only provide written summary of the site conditions and the work completed.
3. Installation: Deliver and install seed and plant materials. As directed, mulch and perform other associated planting practices. Provide a one-year guarantee for plants installed by the offeror. If task order is for this task only provide written summary of the site conditions and the work completed.
4. Seed and Cutting Collection: Collect seed, cuttings and native soil for mycorrhizal inoculum from within designated areas. Provide all labor, materials, equipment, supplies, and transportation needed to collect seed, cuttings and soils for plant propagation. Records must be maintained regarding collection and provided to the ordering agency.
5. Plant Propagation: Provide a permanent greenhouse/nursery facility with heat, water, fertilizer, insecticides, fungicides, and photo periods as needed to ensure the propagation of healthy seedlings. Stock under production must not interbreed with other ecotypes of the same species and potting mix must not be contaminated with weed or species alien to the designated area. Provide appropriate measures of hardening and site adaptation to prepare stock for successful transplanting into the project site. Records must be maintained throughout production and provided to the ordering agency.
6. Exotic Plant Control: As appropriate and acceptable in the designated area, utilize hand pulling, clearing, tilling and chemical application practices to control exotic species as directed by the task order. If task order is for this task only provide written summary of the site conditions and the work completed.
7. Plant salvage and direct transplant: Dig native plants mechanically or by hand from designated areas only. Plant where directed. Plants will range in size from seedlings to 2-inch caliper or larger. Hold in storage areas if necessary. Provide care during storage. If task order is for this task only provide written summary of the site conditions and the work completed.
8. Protection: Provide protection from human trampling, and surface and underground predators as needed. Methods may include protective netting, photo-degrading protector tubes and repellents, and temporary fencing. If task order is for this task only provide written summary of the site conditions and the work completed.
9. Follow Up Care: Provide, upon request, care for revegetation installations until the plants are established (approximately 2-3 years). Care to include exotic plant control, weeding and irrigation as needed. Provide written progress reports as specified by ordering agency.
10. Plant Provision: Provide native seed and plants in sizes ranging from seedlings to 4″ caliper trees that are native to the designated area and adapted to the environmental conditions at the project site, but not necessarily from local genetic stocks.
11. Holding: Provide holding for plant materials which will ensure healthy stock if there are changes in the delivery date. Include repotting when necessary.

12. Monitoring: Establish baseline conditions and monitor revegetation success following installation for a period of 1- 5 years, depending on the situation. Provide reports as requested.

NPS genetic conservation policy: The National Park Service policy calls for the preservation of native plant communities and their genetic resources wherever possible in natural zones. Accordingly, road slopes and other large areas intended to support self-sustaining native plant communities will usually be restored with local genetic stocks of native species. Most propagation requested under this IDIQ will require use of seed or cuttings native to areas which the NPS will designate as appropriate for a particular project. Genetic policy is less stringently applied for landscaping around developed areas. Depending on the site, the project time frame, and the importance of genetic issues there, large landscape plants may be custom-grown or they may be provided from sources other than park gene pools. Preferably, provided plants will be site-adapted (i.e., from genetic stocks likely to survive at the project site).

Materials to be produced or supplied: The types of materials to be produced include, but are not limited to: trees and shrubs in seedling, 1 gallon and 5 gallon sizes; and grasses, sedges, rushes and forbs in plugs, tubelings and other small containers. For areas where a more mature landscape is desired and genetic integrity is not crucial, the contractor may be requested to provide the same sizes of materials from sources that are likely to survive well at the project site.

STATEMENT OF WORK/SPECIFICATIONS: EASTERN REVEGETATION IDIQ

The Federal Government Department of Interior (DOI), and United States Forest Service (USFS), is seeking one or more revegetation/ecological restoration/exotics control organizations to perform the following tasks: provide technical assistance in the fields of native plant revegetation, ecological restoration, and exotics control, provide invasives control services, and prepare revegetation plans. Other desired services include: prepare planting sites; provide local plant provision when genetic considerations are not applicable; salvage plants from designated areas; deliver and install seeds and plants, and collect seed and cuttings; propagate native plants from DOI genetic stocks; hold and care for plants if project delays require; provide establishment care; and monitor revegetation/restoration success. Work will be performed for DOI and USFS units in Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, and West Virginia, and Wisconsin.

The scope of work includes but is not limited to the following:

1. Revegetation Consulting: Utilizing ordering agency regulations and policies, provide technical assistance to ordering agency staff. Prepare invasives control-revegetation plans or sections of plans for ordering agency projects. Technical assistance may include services such as recommendations for invasives control, analyses of soil resources, soil salvage, topsoil storage, and soil amendments; seeding and planting prescriptions; installation techniques including soil amendments and tackifiers; plant protection including temporary holding options, supplemental watering and establishment care; work scheduling, and cost estimating. Potential deliverables may include but not be limited to reports and drawings or sketches regarding specific questions or projects; written summaries of site conditions and/or work completed; or preparation of revegetation plans or sections of plans for requested projects
2. Exotics Control: As appropriate and acceptable in the designated area, utilize hand pulling, clearing, tilling, chemical applications and other practices to control exotic species. If performed at a revegetation site, perform exotics control before and after installation. If task order is for this task only, provide written summary of the site conditions and the work completed.
3. Plant Provision: Provide native seed and plants in sizes ranging from seedlings to 2 1/2" caliper trees that are native to the designated project site and adapted to the environmental conditions at the project site, but not necessarily from local genetic stocks The types of materials to be produced include, but are not limited to: trees and shrubs in seedling, 1 gallon and 5 gallon sizes; and grasses and forbs in plugs, tubelings and other small containers. For areas where a more mature landscape is desired and genetic integrity is not crucial, the contractor may be requested to provide the same sizes of materials from sources that are likely to survive well at the project site. Larger plants may be specified on a task order basis. If task order is for this task only, provide written summary of the site conditions and the work completed.
4. Site Preparation and Erosion Control: Prepare soil as needed, including scarification and addition of appropriate soil amendments. Provide and install a full range of erosion control measures as required. If task order is for this task only, provide written summary of the site conditions and the work completed.
5. Installation and Establishment: Deliver and install seed and plant material. As directed, mulch and perform other associated planting practices. Provide a minimum one-year guarantee for plants installed by the offeror if grown by the offeror. Specific task orders may require longer periods of establishment and extended guarantees based on industry practices and site specific requirements. If task order is for this task only, provide written summary of the site conditions and the work completed.
6. Plant Propagation and Holding: Provide a permanent greenhouse/nursery facility with heat, water, fertilizer, insecticides, fungicides, and photo periods as needed to ensure the propagation of healthy seedlings. Stock under production must not interbreed with other ecotypes of the same species and potting mix must not be contaminated

with weed or species alien to the designated project site. Provide appropriate measures of hardening and site adaptation to prepare stock for successful transplanting into the project site. Records must be maintained throughout production and provided to the ordering agency. Provide holding for plant materials which will ensure healthy stock if there are changes in the delivery date. Include repotting as necessary.

7. Seed and Cutting Collection and Plant Salvage: Collect seed, cuttings and native soil for mycorrhizal inoculums from within designated project site. Provide all labor, materials, equipment, supplies, and transportation needed to collect seed, cuttings, and soil for plant propagation. Dig native plants mechanically or by hand from designated areas only. Plants will range in size from seedlings to no more than 2-inch caliper. Hold in storage areas. Provide care during storage. If task order is for this task only, provide written summary of collections made, their locations, the site conditions and the work completed.

8. Protection, Follow-Up Care, and Monitoring: Provide protection from human trampling, and surface and underground predators as needed. Methods may include protective netting, photo-degrading protector tubes and repellents, and temporary fencing. Provide, upon request, care for revegetation installations until the plants are established (approximately 2-3 years). Care to include exotics control, weeding and irrigation as needed. Contractor maybe required to provide instructions for long-term care and maintenance of installation or a maintenance pla for installed items. Provide written progress reports as needed. Establish baseline conditions and monitor revegetation success following installation for a period of 1- 5 years, depending on the situation. If task order is for this task only, provide a written summary of the site conditions and the work completed.

NPS genetic conservation policy: The National Park Service policy calls for the preservation of native plant communities and their genetic resources wherever possible in natural zones. Accordingly, road slopes and other large areas intended to support self-sustaining native plant communities will usually be restored with local genetic stocks of native species. Most propagation requested under this contract will require use of seed or cuttings native to areas which the NPS will designate as appropriate for a particular project. Genetic policy is less stringently applied for landscaping around developed areas. Depending on the site, the project time frame, and the importance of genetic issues at the site, large landscape plants may be custom-grown or they may be provided from sources other than park gene pools. Preferably provided plants will be site-adapted (i.e., from genetic stocks likely to survive at the project site).