

Roaring Fork Transportation Authority *Rio Grande Trail Restoration Seeding Plan*

Mile Post 360 -382

Glenwood Springs to Emma

**GARFIELD AND EAGLE COUNTY
COLORADO**

**JANUARY
2022**

DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING



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EXECUTIVE SUMMARY

This comprehensive restoration seeding plan was developed for the Roaring Fork Transportation Authority (RFTA) by DHM Design Ecological Services for the entirety of RFTA's management jurisdiction of the trail corridor, from Glenwood Springs to Emma. This includes 22 linear miles of trail, from mile marker 360 – 382 (Historic Railroad Mile Marker Posts). DHM Design was contracted to complete this restoration seeding plan utilizing a three (3) year phased approach, separating the assessments into yearly phases from 2019 -2021, as described below and depicted in *Figure a*. This report is the culmination of the effort, comprised of all three phases of the completed restoration seeding plans.

- **Phase 1 (2019):** *Cattle Creek Road to Catherine Store Road Bridge (Mile Post 367-376)*
- **Phase 2 (2020):** *Glenwood Springs to Cattle Creek Road (Mile Post 360-376)*
- **Phase 3 (2021):** *Catherine Store Road Bridge to Emma Road (Mile Post 376-382)*

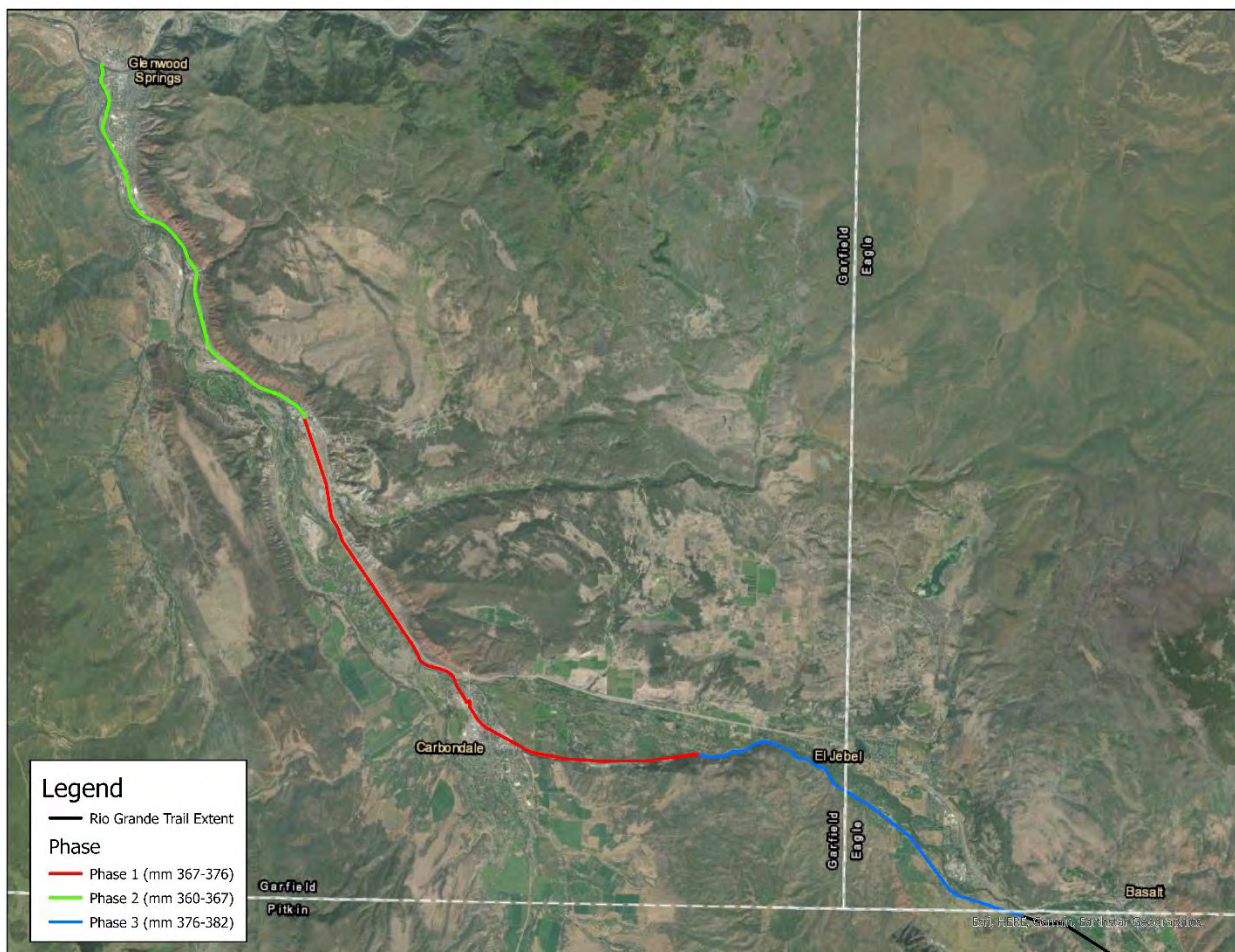


Figure a: Overview of the three (3) phased segments of the Rio Grande Trail for the restoration seeding assessments.

Traversing the Roaring Fork Valley, the Rio Grande Trail passes through a diversity of vegetative communities, with developing land uses strongly influencing the composition and integrity of vegetation throughout the trail corridor. Along with the diversity of vegetive communities, the condition of the vegetation varies significantly, with expanses of intact sagebrush shrublands, montane-mixed

shrublands, scrub-shrub wetlands, herbaceous grasslands, and forested riparian communities being observed along with large extents of significantly impacted and ruderal vegetation consisting primarily of noxious and nuisance vegetation. These vegetative conditions are the foundation for developing the restoration seeding recommendations found within this report, with priority restoration areas being identified for each section of trail. This report is intended to be utilized as a planning tool for RFTA staff to budget for, conduct, and track the success of restoration seeding efforts throughout this section of the Rio Grande Trail corridor.

Roaring Fork Transportation Authority

Rio Grande Trail Restoration Seeding Plan

Mile Post 367-376

Cattle Creek Road to Catherine Store Bridge

GARFIELD COUNTY, COLORADO

Prepared By : DHM DESIGN



January 2020

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Appendix 1 – Existing Corridor Conditions Map

Appendix 2 – 2020 Restoration Priority Areas

Appendix 3 – Corridor Panel Maps and Site Photos

Appendix 4 – Seeding, Soil Preparation and Erosion Control Specifications

Appendix 5 – NRCS Soil Survey Report

Appendix 6 – RFTA Haney Soil Test Data

1. Executive Summary

This comprehensive restoration-seeding plan was developed for the Roaring Fork Transportation Authority (RFTA) by DHM Design Ecological Services for the Cattle Creek to Catherine Store Road Bridge (historic railroad mm posts 367 to 376) section of the Rio Grande Trail Corridor. The purpose of this plan is to provide the following:

- A detailed analysis of current existing conditions
- Recommendations for restoration for short-term and long-term management and budgeting.
- Project specific specifications and methods for seeding, soils management, and erosion control best management practices
- Restoration requirements and monitoring protocol for contractors and RFTA employees

Restoration of vegetative plant communities throughout an extensive, linear right-of-way corridor that dissects numerous land use types and ecological communities poses many unique challenges. It also provides valuable opportunities to connect and restore fragmented habitats through establishment of native vegetation communities, improve soil health, reduce the potential for erosion, and improve overall aesthetic quality. This plan recognizes the importance of healthy plant communities as an essential foundation for ecosystem integrity, aesthetic value, functional management and diversity. Healthy plant communities create habitat for animals, provide ecosystem services that sustain people, their communities, and have intrinsic and irreplaceable biotic value. This report is intended to be utilized as a planning tool for RFTA staff to budget for, conduct, and track the success of restoration seeding efforts throughout this section of the Rio Grande Trail corridor.

2. Introduction

The Rio Grande Trail Corridor was built on the historic foundation of the old Denver and Rio Grande Western Railroad corridor that ran from Glenwood Springs to Aspen, Colorado and is approximately 33 miles in length. The trail corridor passes through three counties, including Garfield, Eagle, and Pitkin County. Over the extent of the trail, it gains 1,800 ft of elevation from Glenwood Springs to Aspen and dissects the Roaring Fork Valley, occupying the biologically diverse habitats associated with the Roaring Fork River and vegetation communities found throughout the valley. The section of trail analyzed for this plan extends from railroad milepost # 367 -376, and is referred to as the Cattle Creek Road to Catherine Store Road Bridge Section, see Figure 1 on the following page and *Appendix 1 – Restoration Seeding Plan Graphic*.

This restoration seeding plan is intended to be utilized in conjunction with the current weed management plan and activities to provide the basis for establishing self-sustaining plant communities and to restore degraded areas that are susceptible to erosional activity and continued invasion by noxious vegetation. This plan also provides a uniform framework for future restoration needs following future man-made or natural disturbances occurring throughout the corridor and provides detailed restoration guidelines for contractors and RFTA employees working within the Rio Grande Corridor.

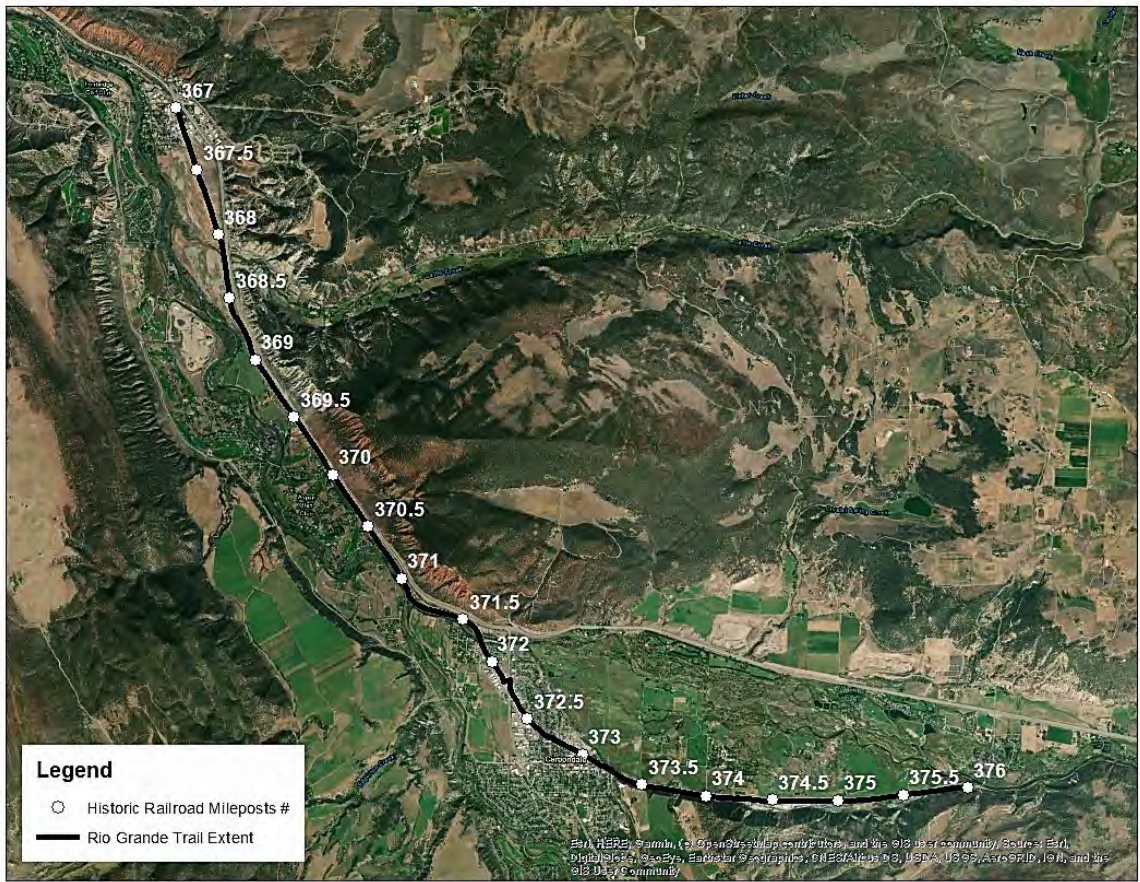


Figure 1- Project Extent

3. Methods

A. Desktop Analysis

To initiate the plan development, DHM conducted a comprehensive and thorough desktop analysis of existing natural resource management data and reports provided by RFTA including:

- Roaring Fork Transportation Authority Integrated Weed Management Policy and Plan (2003)
- Soil test analysis (5 sample sites provided within Survey extent)
- RFTA Railroad Right-of-Way Ownership Atlas

In addition to the documents provided by RFTA, the following documents were identified and reviewed for the report:

- NRCS Soil Report
- Google Earth and ESRI Aerial Imagery
- CNHP Ecological Systems Definitions

B. Field Survey Methods

DHM Design conducted field surveys on September 19, 20 and October 18, 2019 to evaluate the planning area which includes a 10-mile section of the corridor extending from County Road 154 to the Catherine Store Road Bridge. The purpose of the survey was to evaluate the existing conditions, identify dominant vegetation types, and locate and prioritize individual restoration zones. Impairment ratings were established and used to evaluate the corridor conditions and prioritize restoration zones. For the purpose of this plan, the entire corridor was assigned an impairment rating of:

- **Significant** – Highly disturbed areas affected by surrounding land use generally lacking vegetation, or areas with lacking healthy native vegetation structure, or areas influenced by erosional issues.
- **Moderate** – evidence of disturbance, but functioning vegetation communities exist with lack of species diversity or presence of non-native or nuisance vegetation. Potential for erosion.
- **Minimal** - Well established ground cover and species diversity consistent with areas vegetation community. Stable soils with no presence of erosion.

Impairment ratings were determined by analysis of the following metrics observed in the field: vegetation conditions, soil conditions and slope, aesthetics, and surrounding land use. Existing conditions metrics are included in Table 1 on Page 3 of this plan. These five (5) evaluation metrics are critical for understanding the restoration need, type of restoration required, implementation strategies and recommended monitoring throughout the corridor. Each metric should be considered and reviewed to assess and prioritize projects into the future.



Figure 2 - Significant impairment conditions (MP 372.5) Figure 3 - Moderate impairment conditions (MP 369) Figure 4 - Low impairment conditions (MP 371)

Table 1. Existing Conditions Metrics, Impairment Levels and Evaluation Criteria

<i>Existing Condition Metric</i>	<i>Impairment Level/Evaluation Criteria</i>
<i>Vegetation Conditions</i>	<ul style="list-style-type: none"> • Significant: dominated by non-native or nuisance vegetation, minimal existing ground cover • Moderate: Moderate ground cover/non-native vegetation • Low: Well established ground cover and species diversity consistent with areas vegetation community
<i>Soil Conditions and Erosion</i>	<ul style="list-style-type: none"> • Significant: Gravel/coble covering topsoil or soil compaction present. Steep slopes, 3-1 with bare soils • Moderate: Moderately compacted soils with sparse gravel/cobble cover • Low: No compaction or erosion evident, no gravel/cobble
<i>Surrounding Land</i>	<ul style="list-style-type: none"> • Significant: High level of disturbance cause by surrounding land use • Moderate: Moderate level of disturbance caused by surrounding land use • Low: Low level of disturbance caused by surrounding land use
<i>Aesthetics/Visual Impact</i>	<ul style="list-style-type: none"> • Significant: Highly visible areas in proximity to high traffic areas • Moderate: Moderately visible areas in proximity to moderate traffic areas • Low: Low visibility areas in proximity to low-moderate traffic areas

In addition to the impairment conditions, dominant vegetation types were observed and recorded and broad vegetation communities were identified. Representative photos of each impairment area were taken and are provided in *Appendix 3, Corridor Panel Maps and Site Photos*. A Trimble handheld GPS device was used to map the existing conditions of the trail corridor and impairment rating conditions were digitized using ArcMap to display and provide area calculations. Establishment of 2019 restoration priority areas were identified based upon observed conditions and input from RFTA staff.

4.Existing Conditions Analysis

A matrix of well-established vegetation communities and stressed native plant communities exist throughout the Rio Grande Trail Corridor. Many areas have been severely degraded and consist of primarily non-native annual grasses and forbs and state-listed noxious vegetation. These degraded conditions persist primarily from two causes; 1.) The corridor exists on and within the historic railroad corridor; and 2.) There is a significant mix of land use types that occur today that fragment habitat. The transition of the old railroad corridor to a multi-use trail corridor with a commitment to preserving, maintaining and enhancing the corridor to provide natural and scenic open space areas offers the

ability restore these struggling plant communities and create well established native plant communities.

A. Vegetation Communities

To understand the existing conditions, vegetation communities were evaluated in the field. A total of five (5) vegetation communities were identified and they include:

1. Sagebrush shrublands
2. Mixed mountain shrublands
3. Pinyon-Juniper woodlands
4. Scrub-shrub wetlands
5. Lower-Montane Riparian forest

Sagebrush shrublands

This vegetation community occupies the majority of the upland areas of the Rio Grande Trail corridor, with the section north of Carbondale consisting primarily of sagebrush shrubland communities. These shrublands are dominated by *Artemisia tridentata* (mountain big sagebrush), with areas of co-dominance to dominance by *Chrysothamnus nauseosus* (rubber rabbitbrush). The dominance of *C. nauseosus* is indicative of the historical and current disturbances throughout the corridor, as *C. nauseosus* is a pioneer species with the ability to establish following disturbances. The shrub overstory is typically the dominant layer, with an absence of tree species and sparse understory vegetation of forbs and graminoids. The composition of the understory vegetation for sagebrush communities varies throughout the corridor, but generally the healthier, more intact communities are dominated by graminoids: *Elymus trachycaulus* (slender wheatgrass), *Pascopyrum smithii* (western wheatgrass) *Festuca idahoensis* (Idaho fescue) with sparse forbs *Artemisia ludoviciana* (white sage), *Heterotheca villosa* (hairy goldenaster), *Salidago altissima* (goldenrod), *Phlox hoodii* (spiny phlox) and *Ritibida columnifera* (prairie coneflower).



Figure 5 - View looking at well-established sagebrush shrubland community

Mixed Mountain Shrublands

The mixed mountain shrubland community is distinguished by the presence of a dominant shrub layer consisting of *Amelanchier alnifolia* (Serviceberry), *Quercus gambelii* (Gamble oak), and *Rhus trilobata* (skunkbush shumac). The presence of a dense canopy cover from the shrub matrix restricts the understory to sparse populations of shade tolerant graminoids and forbs. The mixed mountain shrub land



Figure 6 - View looking at well-established mixed mountain shrubland community

communities have relatively intact native vegetation establishment with the presence of noxious vegetation scattered throughout. *Clematis orientalis* (oriental clematis) is well established throughout the lower-to mid-shrub species canopy. The mixed mountain shrublands are found in a matrix along the Catherine Store Road section with sagebrush and pinyon-juniper vegetation communities. They can also be found NW of the town of Carbondale from milepost 371-372.

Pinyon pine-juniper woodland

The pinyon pine-juniper woodland community is situated on the north facing slope of the hillside of the Catherine Store Road section, east out of Carbondale. This vegetation community is distinguished by the dominance of *Juniperus monosperma* (one-seeded juniper) and *Pinus edulis* (pinon pine). Other shrub species found include *Amelanchier alnifolia* (serviceberry), *Artemisia tridentate* (mountain big sagebrush), *Chrysothamnus nauseosus* (rubber rabbitbrush), and *Symphoricarpos rotundifolius* (roundleaf snowberry).



Figure 7 - View looking at well-established pinyon-juniper woodland community

Riparian Scrub-Shrub Wetlands

The scrub-shrub wetland communities are found in areas along the irrigation ditches that run through the trail corridor right-of-way along Catherine store road. The dominant vegetation species within this community are willow spp. with *Salix exigua* (coyote willow) being the dominant species observed. The understory and graminoid vegetation are dominated by *Phalaris arundinacea* (reed canary grass). Other species found include *Heracleum maximum* (cow parsnip), *Pascopyrum smithii* (western wheatgrass), *Maiathemum stellatum* (false Solomonseal) and *Solidago canadensis* (Canada goldenrod).



Figure 8 - View looking at representative scrub-shrub wetland community

B. Soils

Throughout the trail corridor, remnant gravel/cobble base material from the old railroad is present, detracting from the overall conditions of the topsoil found in many areas. An NRCS Soils Survey Report was generated for the corridor and is included in Appendix 5. A total of seventeen (17) soil types were identified within the corridor, the dominant soil types include:

- 1.) Antencio-Azeltine complex, 3 to 6 percent slopes (38.3%)
- 2.) Southace cobbly sandy loam, 12 to 25 percent slopes (12.6 %)
- 3.) Southace cobbly sandy loam, 6 to 12 percent slopes (10.1%)

Soil sample test analysis results for locations throughout the Rio Grande Trail corridor provided by RFTA staff, and additional soil tests conducted by Triton Environmental staff on a consultant field site visit indicate that the sub soils are relatively healthy with no major nutrient or organic matter deficiencies. RFTA soil test results are included in *Appendix 6 – RFTA Haney Soil Test Data*. Continued soil monitoring is recommended every 3 years. In areas of high traffic soil compaction is evident where social footpaths have been established this is especially noticeable in the section that runs through the town of Carbondale railroad milepost #372 -373.

C. Impairment Ratings

To help identify areas for recommended seeding efforts, impairment ratings were established to assess the varying conditions throughout the corridor. Areas considered as being moderately impaired were the dominant condition, consisting of approximately half the current conditions found in this section of the trail corridor. Low and significantly disturbed areas comprise the other half of current conditions found, with areas of significant impairment being the more prevalent of the two. A breakdown of the impairment conditions can be found in Table 2 below, and for the distribution of the impairment conditions of the trail corridor refer to *Appendix 3, Corridor Panel Maps and Site Photos*.

Table 2. Rio Grande Trail Corridor Impairment Ratings

Impairment Rating	Total Acres	Total Linear Miles #	Total Number of Areas Identified
Low	22 acres	1.67 miles	6
Moderate	53 acres	4.5 miles	15
Significant	32 acres	2.83 miles	10

Areas indicated as having significant impairments are designated as top priorities for restoration seeding efforts moving forward and have been identified for the areas of recommended restoration seeding efforts. Areas indicated as having moderate impairments are designated as low priority for restoration efforts, with the possibility for future seeding efforts, which would largely consist of inter-seeding native mixes to improve species diversity and improve noxious vegetation conditions. Areas indicated as low impairment ratings have no need for restoration seeding activities under current conditions, but may need to be addressed in the future if the areas are disturbed.

4. Recommendations

The following recommendations were developed based off the findings in the existing conditions analysis and they include:

- Restoration seeding
- Soil management
- Erosion control
- Monitoring and Maintenance

Each of these are reviewed in sections 5 a-c below and detailed specifications are included in *Appendix 4, Seeding, Soil Preparation and Erosion Control Specifications*. A total of ten (10) recommended restoration seeding sites were identified and consist of all areas identified as significantly impaired (Table 3), below.

Table 3. Rio Grande Trail Corridor Recommended Restoration Areas

RECOMMENDED RESTORATION AREA	MILEPOST #	AREA (ACRES)	LINEAR LENGTH (MILES)	RECOMMENDED SEED MIX (#)
1	367-368	16.1	1.1	2
2	368	1.2	0.1	2 and 5
3	371	0.6	0.07	5
4	372	1.9	0.2	2
5	372.5	4.1	0.4	1
6	373	0.6	0.1	1
7	373	0.6	0.2	1
8	374	1.5	0.13	4
9	374.5	5.1	0.5	2
10	375	0.1	0.03	5
TOTAL		31.9	2.83	2

A. Recommended Seed Mixes

Existing vegetation types within the project corridor were analyzed to identify species specific seed mixes that will maximize restoration success. The following seed mixes were developed specifically for restoration efforts of the various vegetation communities throughout this segment of the Rio Grande Trail corridor. These seed mixes have been developed based upon observed *native* plant species currently found growing within the trail corridor. The established native seed mixes are designed to increase the diversity, distribution, and composition of native plant species in accordance with the vegetation community the seed mix is associated with. A deliberate attempt has been made to include a large number of different grasses and forbs, as establishing a diverse distribution of species will have a tendency to be more resistant to drought, floods, and pathogens that monotypic or low diversity plantings. The inclusion of a diverse seed mix is also greatly beneficial to wildlife, increasing ecological and intrinsically value to a restoration area and will allow for different micro niches to be established by associated plants. A total of four (4) types of restoration areas were identified, mapped and reviewed with RFTA staff. The following seed mixes were developed to address each type:

1. Native grass and forb
2. Sagebrush shrubland
3. Mixed shrubland ***No restoration areas identified for this phase/section of trail*
4. Erosion Control
5. Riparian/scrub-shrub wetland

Native Grass and Forb

Three (3) areas (Table 4) totaling 5.3 acres were identified as locations for native grass and forb restoration seeding. These areas are located in the trail corridor section that runs through the town of Carbondale, from railroad milepost 372.3 to 373.2. The establishment of this mix will provide both aesthetic and ecological benefits, increasing the diversity of grasses and showy forbs that will add color and texture to the landscape while providing valuable pollinator habitat.

Table 4. Native Grass and Forb Restoration Seeding Areas

Native Grass and Forb Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (miles)	Seed Mix (#)	Recommended Seeding Method
5	372.5	4.1	0.4	1 (79.95 lbs)	Broadcast
6	373	0.6	0.1	1 (11.7 lbs)	Broadcast
7	373	0.6	0.2	1 (11.7 lbs)	Broadcast
Total		5.3	0.7	103.35 lbs.	

Table 5. Native Grass and Forbs Seed Mix

Seed Mix #1. Native Grass and Forbs Mix (19.5 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	12%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	14%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Bouteloua gracilis</i>	Blue grama	10%
<i>Koeleria macrantha</i>	Prairie junegrass	8%
<i>Elymus trachycaulus</i>	Slender wheatgrass	12%
<i>Stipa comata</i>	Needle and thread	12%
Forbs		
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot	2%
<i>Chrysopsis villosa</i>	Hairy golden aster	1%
<i>Delphinium nuttallianum</i>	Nuttall's larkspur	1%
<i>Gaillardia aristata</i>	Blanket flower	1%
<i>Ipomopsis aggregata</i>	Skyrocket gilia	2%
<i>Penstemon strictus</i>	Rocky Mountain penstemon	8%
<i>Phlox hoodii</i>	Spiny phlox	4%
<i>Ratibida columnifera</i>	Prairie coneflower	2%
<i>Sphaeralcea coccinea</i>	Scarlet globemallow	1%

Sagebrush Shrubland

Four (4) areas (Table 6) totaling 24.3 acres were identified as locations for sagebrush shrubland restoration seeding. These areas are spread throughout the trail corridor make up the largest areas for recommended restoration seeding efforts. The sage brush communities identified for restoration efforts are currently dominated by annual mustards, kochia, smooth brome and cheatgrass and have nominal to no shrub establishment. The sagebrush shrubland mix was created to re-establish degraded sagebrush shrubland communities and create a more diverse and healthier understory, while connecting these degraded areas to other well-established sagebrush communities throughout the corridor.

Table 6. Sagebrush Shrubland Restoration Seeding Areas

Sagebrush Shrubland Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (miles)	Seed Mix (#)	Recommended Seeding Method
1	367-368	16.1	1.1	2 (289.8 lbs)	Broadcast/Drill
2	368	1.2	0.1	2 (21.6 lbs), 3*	Broadcast
4	372	1.9	0.2	2 (34.2 lbs)	Broadcast
9	374.5	5.1	0.5	2 (91.8 lbs)	Broadcast
Total		24.3	1.9	437.4 lbs.	

*Substitute Seed Mix #3 Riparian Scrub-Shrub Mix in riparian areas along the banks of Cattle Creek as needed

Table 7. Sagebrush Shrubland Seed Mix

Seed Mix #2. Sagebrush Shrubland Mix (18 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	14%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	12%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Elymus trachycaulus</i>	Slender wheatgrass	10%
<i>Festuca saximontana</i>	Rocky Mountain fescue	10%
<i>Pascopyrum smithii</i>	Western wheatgrass	10%
<i>Stipa lettermanii</i>	Lettermans needlegrass	10%
Forbs		
<i>Arenaria hookeri</i>	Hookers sandwort	2%
<i>Balsamorhiza sagittata</i>	arrowleaf balsamroot	2%
<i>Chysopsis villosa</i>	Hairy golden aster	2%
<i>Dlephinium nuttallianum</i>	Nuttals larkspur	4%
<i>Phlox hoodii</i>	spiny phlox	4%
Shrubs		
<i>Artemisia tridentat spp. Vaseyana</i>	mountain sagebrush	2%
<i>Artemisia figida</i>	fringed sage	2%
<i>Artemisia nova</i>	black sagebrush	1%
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	5%

Erosion Control

One (1) area (Table 10), totaling 1.5 acres has been identified for erosion prevention restoration seeding. This area is located at railroad milepost #374, and is identified by the steep, eroding hillside with bare soils and minimal vegetation cover. This seed mix was created as an aggressive, native grass mixture developed for quick establishment on highly disturbed sites, and areas where erosion and weed control is a priority. Regreen, a hybrid sterile cover crop is included in the mix to provide quick cover as a nursery crop; providing initial cover to reduce weed establishment while allowing native species to establish. The intent of this mix is to re-vegetate areas of man-made or natural disturbances resulting in complete loss of vegetation where erosion and noxious vegetation is a concern.

Table 8. Erosion Control Restoration Seeding Areas

Erosion Control Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (miles)	Seed Mix (#)	Recommended Seeding Method
8	374	1.5	0.13	4 (49.5 lbs)	Hydroseeding
Total		1.5	0.1	49.5 lbs.	

Table 9. Erosion Control Seed Mix

Seed Mix #4. Erosion Control Mix (33 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	25%
<i>Bromus marginatus</i>	Mountain brome	30%
<i>Pascopyrum smithii</i>	Western wheatgrass	20%
<i>Elymus glaucus</i>	Blue wildrye	25%
<i>Triticum aestivum x Elytrigia Elongata</i>	Regreen (sterile cover crop)	16 lbs/ac

Riparian/Scrub-Shrub

Two (2) areas (Table 8) totaling .7 acres were identified as locations for riparian/scrub-shrub restoration seeding. These areas are located along the irrigation ditches that occupy the trail corridor right-of-way. In addition to the two areas identified along the irrigation ditches, a small portion of restoration area 2, along Cattle Creek should be seeded using the riparian/scrub-shrub mix. This seed mix was developed with the intention to stabilize eroding banks along irrigation while increasing diversity within the riparian/scrub-shrub areas.

Table 10. Riparian/Scrub-Shrub Restoration Seeding Areas

Riparian Scrub-Shrub Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (miles)	Seed Mix (#)	Recommended Seeding Method
3	371	0.6	0.07	3 (9.9 lbs)	Broadcast
10	375	0.1	0.03	3 (1.65 lbs)	Broadcast
Total		0.7	0.1	11.55 lbs	

Table 11. Riparian/Scrub-Shrub Seed Mix

Seed Mix #5. Riparian Scrub-Shrub Mix (16.5 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Calamagrostis canadensis</i>	Bluejoint reedgrass	10%
<i>Elymus trachycalus</i>	Slender wheatgrass	15%
<i>Juncus arcticus</i>	arctic rush	8%
<i>Poa palustris</i>	fowl bluegrass	10%
<i>Pascopyrum smithii</i>	western wheatgrass	15%
<i>Stipa viridula</i>	green needlegrass	10%
Forbs		
<i>Erigeron speciosus</i>	Aspen daisy	5%
<i>Heracleum maximum</i>	cow parsnip	3%
<i>Maiathemum stellatum</i>	false Solomonseal	3%
<i>Mentha arvensis</i>	wild mint	2%
<i>Monarda fistulosa</i>	wildbergamot beebalm	2%
<i>Solidago canadensis</i>	Canada goldenrod	2%
<i>Thalictrum fendleri</i>	meadowrue	2%
<i>Vicia americana</i>	American vetch	3%
Shrubs		
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	3%
<i>Rhus trilobata</i>	skunkbush sumac	3%
<i>Ribes cereum</i>	wax current	2%
<i>Rosa woodsii</i>	Woods rose	2%

B. 2020 Restoration Priority Areas

Four (4) areas were identified for priority restoration activities for the year 2020. Areas Identified are included in Table 12. Below, and detailed locations of these areas are provided in *Appendix 2 – 2020 Restoration Priority Areas*.

Table 12. 2020 Restoration Priority Areas

Restoration Priority Areas							
Priority Restoration Area	Impairment Area (#)	Area (acres)	Linear Length (miles)	Seed Mix (#)	Seeding Rate (lbs/acre)	Recommended Seeding Method	Total lbs of Mix Needed
1	8	1.5	0.13	4	33	Hydroseeding	49.5
2	2	1.2	0.1	3	16.5	Broadcast	19.8
3	7	0.55	0.1	1	19.5	Broadcast	10.725
4	4	1.95	0.18	2	18	Broadcast	35.1
Total		5.2	0.51				115.125

C. Seeding Methods, Soil Preparation and Erosion Control

Seeding Methods

Once the appropriate seed mix is selected for the area to be restored, the method of applying the seed will need to be determined. Determining the method of application will be dependent on the existing site conditions. Some of the factors influencing method selection are; site access, the size and slope of the area to be seeded, and existing vegetative and substrate conditions. The method used for seeding will determine the seeding application rate and necessary preparation of the seedbed.

Broadcast seeding is performed either with mechanical “cyclone” seeders, by hand seeding, or by other methods that scatters seed over the bare soil surface. When broadcast seeding, it is essential that steps be taken to ensure good seed to soil contact. It is recommended that seeding is completed with two separate applications crossing the area at right angles to one another to guarantee even coverage. Broadcast seeding methods are recommended for all restoration seeding areas not specified for erosion control restoration seeding activities.

Drill seeding and the use of a no till drill is recommended for large, continuous sites with rolling to flat topography. It is also a useful method for inter-seeding native pastures and restoration areas where an increased diversity of vegetation is desired. Drill-seeding allows for the establishment of native stands of vegetation with minimal impacts and disturbances to the soil. Drill seeding is most appropriate for level ground. Do not attempt to drill seed slopes greater than 3:1. Drill seeding application is limited by the ability to safely use equipment on steep slopes. The majority of the suggested seeding areas throughout the corridor are not suitable for drill seeding efforts, however, recommended seeding area number one is a large enough area with flat topography that lends itself well to drill seeding efforts.

Hydroseeding is recommended for areas with steep slopes and where access by foot and other equipment is limited and broadcast seeding is not achievable. Seed should be applied evenly across the entire sight at the suggested seeding rate, using a fan-type nozzle and approximately 500 gallons of water per acre for the slurry mixture. It is a great option for erosion control seeding efforts and it is recommended that restoration area 8 be seeded using this process.

Do not seed during high winds or when the ground is frozen or otherwise unable to be worked. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage. If possible, deliver seed to site location in the original unopened containers and keep all certified labels for proper record keeping.

Soil Preparation

Prior to seeding, all remnant gravel/cobble material should be removed from the site and the soils should be completely free of weeds and other competing vegetation. If a layer of thatch (dead vegetation) covers most of the soil, burn or mow and rake the area so your seed will come in contact with the soil when you put it down. Soil preparation includes scarification or tilling as necessary, areas with highly compacted soils may need to be ripped or disked and areas where light soil compaction exists hand tilling and raking may suffice. Loosen subgrade to a minimum depth of 2 inches and maximum depth of 6 inches. A fertilizer that provides key nutrients to the plants in early growth stages and acts as quick acting

germination seeding supplement should be utilized to promote better establishment of newly seeded vegetation.

If topsoil is necessary, do not spread if planting soil or subgrade is frozen, muddy, or excessively wet. Spread approximately ½ the thickness of planting soil over loosened subgrade. Mix thoroughly into top 6" of subgrade. Spread remainder of planting soil and loosen the surface of areas to be seeded with hand rakes before applying seed. Limited disturbance of previously established seeded areas may leave the existing root mass and structure in place as evidenced by regeneration of the existing grasses. Observe level of disturbance and compaction of the soil; removal of detritus, light scarifying (harrow) and topdressing, followed by over seeding may be suitable in these areas.

Erosion Control and Protection of Seeded areas

It is important to protect seeded areas against erosion by uniformly spreading straw mulch after completion of seeding operations. Spread the straw mulch uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1-1/2-inches (38-mm) loose depth over seeded areas. Spread by hand, blower, or other suitable equipment. Alternatively, Hydrostraw (800) 545-1755 may be applied at a rate of 2,500 lbs./acre. Once spread, anchor the straw mulch by crimping into topsoil by suitable mechanical Equipment, followed by application of tackifier via hydroseeder. Anchoring is not necessary if using tackified Hydrostraw. Protect seeded slopes exceeding 3:1 against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.

It will also be essential to protect the seeded areas from pedestrian foot traffic, following the completion of seeding and erosion control efforts, barriers should be placed around the seeded area to sufficiently keep pedestrians from accessing the area until establishment of desired vegetation.

Monitoring and Maintenance

The purpose of post-restoration monitoring is to evaluate the long-term vegetative cover and density, habitat quality and noxious and invasive weed densities, as well as assessing the stability of soils in areas where erosion has been an issue. Monitoring of restoration areas should include both qualitative and quantitative analysis. Monitoring should occur for a minimum of three years following restoration seeding activities.

Through quantitative analysis, the success of the reseeding activities should be monitored and assessed on a yearly basis for at least 3 years. Vegetation sampling plots will be used to measure plant density, cover, and bare ground. Additionally, it is important to monitor the establishment of weed species in accordance with the Roaring Fork Transportation Authority Integrated Weed Management Policy and Plan. Newly established weed infestations need to be identified and treated regularly to help insure the establishment of desired vegetation. Following the restoration seeding efforts, other disturbances that may hinder restoration of the newly seeded areas need to be monitored and assessed. Identification of any disturbances such as animal grazing and disturbances or unauthorized pedestrian traffic will need to be addressed immediately and closely monitored.

Restoration seeding efforts will generally be considered successful when vegetation within the restored areas supports non-noxious plants that are similar in forb, graminoid, and woody plant density and cover to those growing similar, undisturbed vegetation communities. Where initial restoration and plant establishment efforts fail to make progress towards meeting plant establishment standards after 3 years, reseeding may be necessary on portions of the Rio Grande Trail Right-of-Way.

Roaring Fork Transportation Authority

Rio Grande Trail Restoration Seeding Plan

Mile Post 360-367

Glenwood Springs to Cattle Creek Road

GARFIELD COUNTY, COLORADO

Prepared By : DHM DESIGN



October 2020

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Appendices

Appendix 1 – Existing Corridor Conditions Map

Appendix 2 – 2021 Restoration Priority Areas

Appendix 3 – Corridor Panel Maps and Site Photos

Appendix 4 – Seeding, Soil Preparation, and Erosion Control Specifications

Appendix 5 – NRCS Soil Report

Appendix 6 – RFTA Haney Soil Test Data

1. Executive Summary

This comprehensive restoration-seeding plan was developed for the Roaring Fork Transportation Authority (RFTA) by DHM Design Ecological Services for the Glenwood Springs to Cattle Creek Road (historic railroad mm posts 360 to 367) section of the Rio Grande Trail Corridor. The purpose of this plan is to provide the following:

- A detailed analysis of current existing conditions
- Restoration recommendations for short-term and long-term management and budgeting.
- Project specific specifications and methods for seeding, soils management, and erosion control best management practices
- Restoration requirements and monitoring protocol for contractors and RFTA employees

Restoration of vegetative plant communities throughout an extensive, linear right-of-way corridor that bisects numerous land use types and ecological communities poses many unique challenges. It also provides valuable opportunities to connect and restore fragmented habitats through establishment of native vegetation communities, reduce noxious vegetation, improve soil health, reduce the potential for erosion, and improve overall aesthetic quality. This plan recognizes the importance of healthy plant communities as an essential foundation for ecosystem integrity, aesthetic value, functional management and diversity. Healthy plant communities create habitat for animals, provide ecosystem benefits that sustain people, their communities, and have intrinsic and irreplaceable biotic value. This report is intended to be utilized as a planning tool for RFTA staff to budget, initiate, and track the success of restoration seeding efforts throughout this section of the Rio Grande Trail corridor.

2. Introduction

The Rio Grande Trail Corridor was built on the historic foundation of the old Denver and Rio Grande Western Railroad corridor that ran from Glenwood Springs to Aspen, Colorado and is approximately 42 miles in length, with RFTA owning the 33 mile stretch from Glenwood Springs to Woody Creek. The trail corridor passes through three counties, including Garfield, Eagle, and Pitkin County. Over the extent of the trail, it gains 1,800 ft of elevation from Glenwood Springs to Aspen and dissects the Roaring Fork Valley, occupying the biologically diverse habitats associated with the Roaring Fork River and vegetation communities found throughout the valley. The section of trail analyzed for this plan extends from railroad milepost # 360 - 367, and is referred to as the Glenwood Springs to Cattle Creek Road Section, (see Figure 1 on the following page and *Appendix 1 – Restoration Seeding Plan Graphic*).

This restoration seeding plan is intended to be utilized in conjunction with the current weed management plan and activities to provide the basis for establishing self-sustaining plant communities and to restore degraded areas that are susceptible to erosional activity and continued invasion by noxious vegetation. This plan also provides a uniform framework for future restoration needs following future man-made or natural disturbances occurring throughout the corridor and provides detailed restoration guidelines for contractors and RFTA employees working within the Rio Grande Corridor.



Figure 1- Project Extent

3. Methods

A. Desktop Analysis

To initiate the plan development, DHM conducted a comprehensive and thorough desktop analysis of existing natural resource management data and reports provided by RFTA including:

- Roaring Fork Transportation Authority Integrated Weed Management Policy and Plan (2003)
- Soil test analysis (5 sample sites provided within Survey extent)
- RFTA Railroad Right-of-Way Ownership Atlas

In addition to the documents provided by RFTA, the following documents were identified and reviewed for the report:

- NRCS Soil Report
- Google Earth and ESRI Aerial Imagery
- CNHP Ecological Systems Definitions

B. Field Survey Methods

DHM Design conducted field surveys on April 22, 2020 and May 25, 2020 to evaluate the planning area which includes a 7-mile section of the corridor extending from the Colorado River in Glenwood Springs to County Road 154. The purpose of the survey was to evaluate the existing conditions, identify dominant vegetation types, and locate and prioritize individual restoration zones. Impairment ratings were established and used to evaluate the corridor conditions and prioritize restoration zones. For the purpose of this plan, the entire corridor was assigned an impairment rating of:

- **Significant** – Highly disturbed areas affected by surrounding land use generally lacking vegetation, or areas with lacking healthy native vegetation structure, or areas influenced by erosional issues.
- **Moderate** – evidence of disturbance, but functioning vegetation communities exist with lack of species diversity or presence of non-native or nuisance vegetation. Potential for erosion.
- **Minimal** - Well established ground cover and species diversity consistent with areas vegetation community. Stable soils with no presence of erosion.

Impairment ratings were determined by analysis of the following metrics observed in the field: vegetation conditions, soil conditions and slope, aesthetics, and surrounding land use. Existing conditions metrics are included in Table 1 on Page 4 of this plan. These four (4) evaluation metrics are critical for understanding the restoration need, type of restoration required, implementation strategies and recommended monitoring throughout the corridor. Each metric should be considered and reviewed to assess and prioritize projects into the future. Detailed definitions of metrics used can be found in table 1 on the next page.



Figure 2 - Significant impairment conditions (MM 365.75)



Figure 3 - Moderate impairment conditions (MM 366.5)

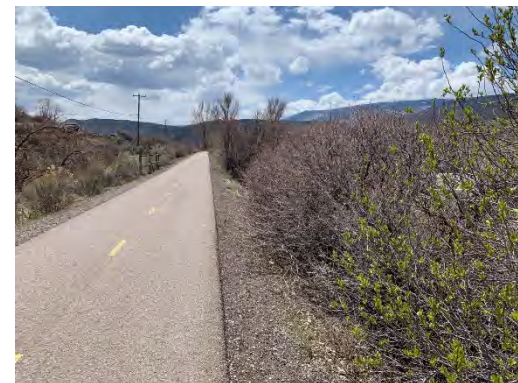


Figure 4 - Low impairment conditions (MM 363.5)

Table 1. Existing Conditions Metrics, Impairment Levels and Evaluation Criteria

<i>Existing Condition Metric</i>	<i>Impairment Level/Evaluation Criteria</i>
<i>Vegetation Conditions</i>	<ul style="list-style-type: none"> • Significant: dominated by non-native or nuisance vegetation, minimal existing ground cover • Moderate: Moderate ground cover/non-native vegetation • Low: Well established ground cover and species diversity consistent with areas vegetation community
<i>Soil Conditions and Erosion</i>	<ul style="list-style-type: none"> • Significant: Gravel/coble covering topsoil or soil compaction present. Steep slopes, 3-1 with bare soils • Moderate: Moderately compacted soils with sparse gravel/cobble cover • Low: No compaction or erosion evident, no gravel/cobble
<i>Surrounding Land</i>	<ul style="list-style-type: none"> • Significant: High level of disturbance cause by surrounding land use • Moderate: Moderate level of disturbance caused by surrounding land use • Low: Low level of disturbance caused by surrounding land use
<i>Aesthetics/Visual Impact</i>	<ul style="list-style-type: none"> • Significant: Highly visible areas in proximity to high traffic areas • Moderate: Moderately visible areas in proximity to moderate traffic areas • Low: Low visibility areas in proximity to low-moderate traffic areas

In addition to the impairment conditions, dominant vegetation types were observed and recorded and broad vegetation communities were identified. Representative photos of each impairment area were taken and are provided in *Appendix 3, Corridor Panel Maps and Site Photos*. A Trimble handheld GPS device was used to map the existing conditions of the trail corridor and impairment rating conditions were digitized using ArcMap to display and provide area calculations. Establishment of 2020/2021 restoration priority areas were identified based upon observed conditions and input from RFTA staff.

4.Existing Conditions Analysis

A matrix of well-established vegetation communities and stressed native plant communities exist throughout the Rio Grande Trail Corridor. Many areas have been severely degraded and consist of primarily non-native annual grasses and forbs and state-listed noxious vegetation. These degraded conditions persist primarily from two causes; 1.) The corridor exists on and within the historic railroad corridor; and 2.) There is a significant mix of land use types that occur today that fragment habitat. The transition of the old railroad corridor to a multi-use trail corridor with a commitment to preserving, maintaining and enhancing the corridor to provide natural and scenic open space areas offers the

ability to restore these struggling plant communities and create well established native plant communities.

A. Vegetation Communities

To understand the existing conditions, vegetation communities were evaluated in the field. A total of Four (4) dominant vegetation communities were identified and they include:

1. Sagebrush shrublands
2. Mixed mountain shrublands
3. Lower-Montane Riparian forest
4. Scrub-shrub Wetlands

A large portion of these communities are in ruderal conditions, with anthropogenic disturbances being present throughout, but the natural state of these communities will be used as reference to restoration and native seed mixes.



Figure 5 - View looking at well-established sagebrush shrubland community

Sagebrush shrublands

This vegetation community occupies the majority of the upland areas of the Rio Grande Trail corridor, generally occupying more gentle to moderate slopes. These shrublands are dominated by *Artemisia tridentata* (mountain big sagebrush), with areas of co-dominance to dominance by *Chrysothamnus nauseosus* (rubber rabbitbrush). The dominance of *C. nauseosus* is indicative of the historical and current disturbances throughout the corridor, as *C. nauseosus* is a pioneer species with the ability to establish following disturbances. The shrub overstory is typically the dominant layer, with an absence of tree species and sparse understory vegetation of forbs and graminoids. The composition of the understory vegetation for sagebrush communities varies throughout the corridor, but generally the healthier, more intact communities are dominated by graminoids: *Elymus trachycaulus* (slender wheatgrass), *Pascopyrum smithii* (western wheatgrass) *Festuca idahoensis* (Idaho fescue) with sparse forbs *Artemisia ludoviciana* (white sage), *Heterotheca villosa* (hairy goldenaster), *Salidago altissima* (goldenrod), *Phlox hoodii* (spiny phlox) and *Ritibida columnifera* (prairie coneflower).

Lower Montane Mixed Shrublands

The lower montane mixed shrubland community is distinguished by the presence of a dominant shrub layer consisting of *Amelanchier alnifolia* (Serviceberry), *Quercus gambelii* (Gamble oak), snowberry (*Symphoricarpos occidentalis*) *Prunus virginiana* (chokecherry) and *Rhus trilobata* (skunkbush shumac). The presence of a dense canopy cover from the shrub matrix restricts the understory to sparse populations of shade tolerant graminoids and forbs. The mixed mountain shrub



Figure 6 - View looking at well-established mixed mountain shrubland community

land communities have relatively intact native vegetation establishment with the presence of noxious vegetation scattered throughout. *Clematis ligusticifolia* (Western white clematis) is well established throughout the lower-to mid-shrub species canopy. The mixed mountain shrublands are found in a matrix throughout the upland area with sagebrush vegetation communities, generally occupying more mesic and steeper areas.

Lower Montane Forested Riparian

The forested riparian communities are found at the northern end (MM 361 – 360.5) of the corridor where the trail parallels the Roaring Fork River, in close proximity to the confluence with the Colorado River. This vegetative community is located in the high traffic area of Glenwood Springs, and has been altered by human influences. Distinguishing vegetation includes mature canopy trees dominated by narrowleaf cottonwood (*Populus angustifolia*), box elder (*Acer negundo*), and Siberian elm (*Ulmus pumila*).



Figure 7 - View looking at representative forested riparian community

Scrub-Shrub Wetlands

The scrub-shrub wetland communities are found in areas along the irrigation ditches that run through the trail corridor right-of-way. The dominant vegetation species within this community are willow spp. with *Salix exigua* (coyote willow) being the dominant species observed. The understory and graminoid vegetation are dominated by *Phalaris arundinacea* (reed canary grass). Other species found include *Heracleum maximum* (cow parsnip), *Bromus inermis* (Smooth brome), *Pascopyrum smithii* (western wheatgrass), *Maiathemum stellatum* (false Solomonseal) and *Solidago canadensis* (Canada goldenrod)

B. Soils

Throughout the trail corridor, remnant gravel/cobble base material from the old railroad is present, detracting from the overall conditions of the topsoil found in many areas. An NRCS Soils Survey Report was generated for the corridor and is included in Appendix 5. A total of eight (8) soil types were identified within the corridor; the dominant soil types include:

- 1.) Antencio-Azeltine complex, 1 to 3 percent slopes (62%)
- 2.) Begay sandy loam, 6 to 12 percent slopes (12.5 %)
- 3.) Torriothents–Rock outcrop complex, Steep (8.2%)
- 4.) Southace cobbly sandy loam, 12 to 25 percent slopes (7.6%)

Soil sample test analysis results for locations throughout the Rio Grande Trail corridor provided by RFTA staff indicate that the sub soils are relatively healthy with no major nutrient or organic matter deficiencies. RFTA soil test results are included in *Appendix 6 – RFTA Haney Soil Test Data*. Continued soil monitoring is recommended every 3 years. In areas of high traffic soil compaction is evident where

social footpaths have been established this is especially noticeable in the section that runs through the town of Glenwood Springs, in close proximity to the school and River (railroad milepost #361.5 -360.5).

C. Impairment Ratings

To help identify areas for recommended seeding efforts, impairment ratings were established to assess the varying conditions throughout the corridor. Areas considered as having low impairment were the dominant condition, consisting of approximately two thirds of the current conditions found in this section of the trail corridor. Moderately and significantly disturbed areas comprise the other third of current conditions found, with areas of moderate impairment being the more prevalent of the two. Significantly impaired areas comprise a considerably small area of the corridor, making up a total of 7.025 acres of the 80.4 acres Identified. A breakdown of the impairment conditions can be found in Table 2 below, and for the distribution of the impairment conditions of the trail corridor refer to *Appendix 3, Corridor Panel Maps and Site Photos*.

Table 2. Rio Grande Trail Corridor Impairment Ratings

Impairment Rating	Total Acres	Total Linear Miles #	Total Number of Areas Identified
Low	47.02 acres	4.5 miles	8
Moderate	25.03 acres	3.2 miles	10
Significant	7.025 acres	1.1 miles	25

Areas indicated as having significant impairments are designated as top priorities for restoration seeding efforts moving forward and have been identified for the areas of recommended restoration seeding efforts. Areas indicated as having moderate impairments are designated as low priority for restoration efforts, with the possibility for future seeding efforts, which would largely consist of inter-seeding native mixes to improve species diversity and improve noxious vegetation conditions. Areas indicated as low impairment ratings have no need for restoration seeding activities under current conditions, but may need to be addressed in the future if the areas are disturbed.

4. Recommendations

The following recommendations were developed based off the findings in the existing conditions analysis and they include:

- Restoration seeding
- Soil management
- Erosion control
- Monitoring and Maintenance

Each of these are reviewed in sections 5 a-c below and detailed specifications are included in *Appendix 4, Seeding, Soil Preparation and Erosion Control Specifications*. A total of twenty-five (25) recommended restoration seeding sites were identified and consist of all areas identified as significantly impaired (Table 3), below.

Table 3. Rio Grande Trail Corridor Recommended Restoration Areas

RECOMMENDED RESTORATION AREA	MILEPOST #	AREA (ACRES)	LINEAR LENGTH (FEET)	RECOMMENDED SEED MIX (#)
1	360.5	0.07	170	1
2	360.5	0.02	33	1
3	360.6	1.00	790	3
4	360.75	0.05	203	1
5	360.8	0.07	65	3
6	361.2	0.24	285	2
7	362	0.15	200	4
8	362.6	0.34	315	4
9	363	0.63	640	2
10	363.25	0.04	75	3
11	363.6	0.02	50	3
12	363.75	0.17	205	4
13	363.9	0.03	50	4
14	364.2	0.01	30	3
15	364.5	0.27	225	2
16	365	1.96	770	2
17	365.25	0.43	450	2
18	365.5	0.19	176	5
19	365.5	0.31	285	3
20	365.6	0.04	100	5
21	365.75	1.7	1,170	4
22	365.8	0.05	60	4
23	365.9	0.03	60	3
24	366	0.275	490	4
25	366.1	0.06	45	4
	TOTAL	7.025	5801	

A. Recommended Seed Mixes

Existing vegetation types within the project corridor were analyzed to identify species specific seed mixes that will maximize restoration success. The following seed mixes were developed specifically for restoration efforts of the various vegetation communities throughout this segment of the Rio Grande Trail corridor. These seed mixes have been developed based upon observed *native* plant species currently found growing within the trail corridor. The established native seed mixes are designed to increase the diversity, distribution, and composition of native plant species in accordance with the vegetation community the seed mix is associated with. A deliberate attempt has been made to include a large number of different grasses and forbs, as establishing a diverse distribution of species will have a tendency to be more resistant to drought, floods, and pathogens than monotypic or low diversity plantings. The inclusion of a diverse seed mix is also greatly beneficial to wildlife, increasing ecological and intrinsically value to a restoration area and will allow for different micro niches to be established by associated plants. A total of five (5) types of restoration areas were identified, mapped and reviewed with RFTA staff. The following seed mixes were developed to address each type:

1. Native grass and forb
2. Sagebrush shrubland
3. Mixed shrubland
4. Erosion Control
5. Riparian/Scrub-shrub

Native Grass and Forb

Three (3) areas (Table 4) totaling 5.3 acres were identified as locations for native grass and forb restoration seeding. These areas are located in the trail corridor section that runs through the town of Glenwood Springs, from railroad milepost 360 to 361. The establishment of this mix will provide both aesthetical and ecological benefits, increasing the diversity of grasses and showy forbs that will add color and texture to the landscape while providing valuable pollinator habitat.

Table 4. Native Grass and Forb Restoration Seeding Areas

Native Grass and Forb Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix (#)	Recommended Seeding Method
1	360.5	0.07	170	1 (1.365 lbs)	Broadcast
2	360.5	0.02	33	1 (0.4 lbs)	Broadcast
4	360.75	0.05	203	1 (0.975 lbs)	Broadcast
Total		0.14	0.7	2.75 lbs.	

Table 5. Native Grass and Forbs Seed Mix

Seed Mix #1. Native Grass and Forbs Mix (19.5 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	12%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	14%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Bouteloua gracilis</i>	Blue grama	10%
<i>Koeleria macrantha</i>	Prairie junegrass	8%
<i>Elymus trachycaulus</i>	Slender wheatgrass	12%
<i>Stipa comata</i>	Needle and thread	12%
Forbs		
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot	2%
<i>Chrysopsis villosa</i>	Hairy golden aster	1%
<i>Delphinium nuttallianum</i>	Nuttall's larkspur	1%
<i>Gaillardia aristata</i>	Blanket flower	1%
<i>Ipomopsis aggregata</i>	Skyrocket gilia	2%
<i>Penstemon strictus</i>	Rocky Mountain penstemon	8%
<i>Phlox hoodii</i>	Spiny phlox	4%
<i>Ratibida columnifera</i>	Prairie coneflower	2%
<i>Sphaeralcea coccinea</i>	Scarlet globemallow	1%

Sagebrush Shrubland

Five (5) areas (Table 6) totaling 3.54 acres were identified as locations for sagebrush shrubland restoration seeding. These areas are spread throughout the trail corridor make up the largest areas for recommended restoration seeding efforts. The sage brush communities identified for restoration efforts are currently dominated by annual mustards, kochia, smooth brome and cheatgrass and have nominal to no shrub establishment. The sagebrush shrubland mix was created to re-establish degraded sagebrush shrubland communities and create a more diverse and healthier understory, while connecting these degraded areas to other well-established sagebrush communities throughout the corridor.

Table 6. Sagebrush Shrubland Restoration Seeding Areas

Sagebrush Shrubland Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix	Seeding Method
6	361.2	0.24	285	#2 (4.32 lbs)	Broadcast
9	363	0.63	640	#2 (11.34 lbs)	Broadcast
15	364.5	0.27	225	#2 (4.86 lbs)	Broadcast
16	365	1.96	770	#2 (35.28)	Broadcast
17	365.25	0.43	450	#2 (7.74)	Broadcast
Total		3.53	2370	63.54 lbs	

Table 7. Sagebrush Shrubland Seed Mix

Seed Mix #2. Sagebrush Shrubland Mix (18 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	14%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	12%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Elymus trachycaulus</i>	Slender wheatgrass	10%
<i>Festuca saximontana</i>	Rocky Mountain fescue	10%
<i>Pascopyrum smithii</i>	Western wheatgrass	10%
<i>Stipa lettermanii</i>	Lettermans needlegrass	10%
Forbs		
<i>Arenaria hookeri</i>	Hookers sandwort	2%
<i>Balsamorhiza sagittata</i>	arrowleaf balsamroot	2%
<i>Chrysopsis villosa</i>	Hairy golden aster	2%
<i>Dlephinium nuttallianum</i>	Nuttals larkspur	4%
<i>Phlox hoodii</i>	spiny phlox	4%
Shrubs		
<i>Artemisia tridentat spp. Vaseyana</i>	mountain sagebrush	2%
<i>Artemisia figida</i>	fringed sage	2%
<i>Artemisia nova</i>	black sagebrush	1%
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	5%

Lower Montane Mixed Shrubland

Seven (7) areas (Table 8) totaling 1.54 acres were identified as locations for montane mixed shrubland restoration seeding. These areas occur throughout the corridor in a matrix with the sagebrush shrubland communities. The mixed shrublands tend to occupy the steeper, rocky slopes of the trail corridor and may contain larger trees and shrubs in more mesic locations closer in proximity to the Roaring Fork River. The Montane Mixed shrubland mix was developed to establish a diverse understory forb and graminoid layer with more shade tolerant species while including key shrub species to increase the canopy cover in degraded areas.

Table 8. Lower Montane Mixed Shrubland Restoration Seeding Areas

Montane Mixed Shrubland Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix	Seeding Method
3	360.6	1.00	790	#3 (18 lbs)	Broadcast
5	360.8	0.07	65	#3 (1.26 lbs)	Broadcast
10	363.25	0.04	75	#3 (0.72 lbs)	Broadcast
11	363.6	0.02	50	#3 (0.36 lbs)	Broadcast
14	364.2	0.01	30	#3 (0.18 lbs)	Broadcast
19	365.5	0.31	285	#3 (5.58 lbs)	Broadcast
23	365.9	0.03	60	#3 (0.54 lbs)	Broadcast
Total		1.54	1115	27.72 lbs	

Table 9. Lower Montane Mixed Shrubland Seed Mix

Seed Mix #3 Montane Shrubland Mix (18 lbs/acre)		
Scientific name	Common name	Mix%
Graminoids		
<i>Bouteloua cutipendula</i>	Sideoats gramma	12%
<i>Carex inops</i>	Sun sedge	10%
<i>Festuca arizonica</i>	Arizone fescue	16%
<i>Koelerian macrantha</i>	Prairie junegrass	12%
<i>Muhlenbergia montana</i>	Mountain Muhly	12%
Forbs		
<i>Achillea millefolium</i>	Western yarrow	2%
<i>Geranium viscosissimum</i>	Sticky geranium	5%
<i>Maianthemum stellatum</i>	False Solomon seal	3%
<i>Phlox hoodii</i>	Spiny phlox	3%
<i>Thalictrum fendleri</i>	Fendler's meadow-rue	2%
<i>Vicia americana</i>	American vetch	3%
Shrubs		
<i>Amelanchier utahensis</i>	Utah serviceberry	6%
<i>Artemisia tridentata spp. Vaseyana</i>	Mountain sagebrush	4%
<i>Cercocarpus montanus</i>	Mountain mahogany	5%
<i>Symphoricarpos oreophilus</i>	Mountain snowberry	5%

Erosion Control

Eight (8) areas (Table 10), totaling 2.38 acres has been identified for erosion prevention restoration seeding. These areas are identified by steep, eroding hillside with bare soils and minimal vegetation cover. This seed mix was created as an aggressive, native grass mixture developed for quick establishment on highly disturbed sites, and areas where erosion and weed control is a priority. Regreen, a hybrid sterile cover crop is included in the mix to provide quick cover as a nursery crop; providing initial cover to reduce weed establishment while allowing native species to establish. The intent of this mix is to re-vegetate areas of man-made or natural disturbances resulting in complete loss of vegetation where erosion and noxious vegetation is a concern.

Table 10. Erosion Control Restoration Seeding Areas

Erosion Control Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix	Seeding Method
7	362	0.15	200	#4 (4.95 lbs)	Hydroseeding
8	362.6	0.34	315	#4 (11.22 lbs)	Hydroseeding
12	363.75	0.17	205	#4 (5.61 lbs)	Hydroseeding
13	363.9	0.03	50	#4 (0.99 lbs)	Hydroseeding
21	365.75	1.7	1,170	#4 (56.1) lbs)	Hydroseeding
22	365.8	0.05	60	#4 (1.65 lbs)	Hydroseeding
24	366	0.275	490	#4 (9.075 lbs)	Hydroseeding
25	366.1	0.06	45	#4 (1.98 lbs)	
Total		3.05	2,535	100.65 lbs	

Table 11. Erosion Control Seed Mix

Seed Mix #4. Erosion Control Mix (33 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	25%
<i>Bromus marginatus</i>	Mountain brome	30%
<i>Pascopyrum smithii</i>	Western wheatgrass	20%
<i>Elymus glaucus</i>	Blue wildrye	25%
<i>Triticum aestivum x Elytrigia Elongata</i>	Regreen (sterile cover crop)	16 lbs/ac

Riparian/Scrub -shrub

Two (2) areas (Table 12) totaling 0.23 acres were identified as locations for riparian/scrub-shrub restoration seeding. These areas are located along the Glenwood ditch, where the hydrology of the ditch will support a diversity of shrubs and herbaceous species that grow well in more mesic to wet conditions. These areas have been identified as disturbances or poor vegetation quality along the ditch that are not regularly impacted or used as access areas for the ditch.

Table 12. Riparian/Scrub-shrub Restoration Seeding Areas

Native Grass and Forb Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix (#)	Recommended Seeding Method
18	365.5	0.19	176	1 (1.365 lbs)	Broadcast
20	365.6	0.04	100	1 (0.4 lbs)	Broadcast
Total		0.23	276	2.75 lbs.	

Table 13. Riparian Scrub-shrub Seed Mix

Seed Mix #5. Riparian/Scrub-shrub Mix (16.5 lbs/acre)		
Scientific name	Common name	Mix%
Graminoids		
<i>Calamagrostis canadensis</i>	Bluejoint reedgrass	10%
<i>Elymus trachycalus</i>	Slender wheatgrass	15%
<i>Juncus arcticus</i>	arctic rush	8%
<i>Poa palustris</i>	fowl bluegrass	10%
<i>Pascopyrum smithii</i>	western wheatgrass	15%
<i>Stipa viridula</i>	green needlegrass	10%
Forbs		
<i>Erigeron speciosus</i>	Aspen daisy	5%
<i>Heracleum maximum</i>	cow parsnip	3%
<i>Maiathemum stellatum</i>	false Solomonseal	3%
<i>Mentha arvensis</i>	wild mint	2%
<i>Monarda fistulosa</i>	wildbergamot beebalm	2%
<i>Solidago canadensis</i>	Canada goldenrod	2%
<i>Thalictrum fendleri</i>	meadowrue	2%
<i>Vicia american</i>	American vetch	3%
Shrubs		
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	3%
<i>Rhus trilobata</i>	skunkbush sumac	3%
<i>Ribes cereum</i>	wax current	2%
<i>Rosa woodsii</i>	Woods rose	2%

B. 2020 Restoration Priority Areas

Six (6) areas were identified for priority restoration activities for the year 2021. Areas Identified are included in Table 12. Below, and detailed locations of these areas are provided in *Appendix 2 – 2021 Restoration Priority Areas*. Specific approaches for each restoration priority area have been identified and outlined in detail in the sections below, describing site specific methods and management for each.

Table 12. 2021 Restoration Priority Areas

2021 Restoration Priority areas							
Restoration Priority	Impairment area #	Length (Feet)	Area (acres)	Seed Mix	Seeding Rate	Seeding Method	Total lbs of Mix Needed
1	21	1,170	1.7	4	33 lbs/acre	Hydroseeding	56.1
2	24	490	0.275	4	33 lbs/acre	Hydroseeding	9.075
3	17	450	0.43	2	18 lbs/acre	Broadcast	7.74
4	9	640	0.63	2	18 lbs/acre	Broadcast	11.34
5	15	225	0.27	2	18 lbs/acre	Broadcast	4.86
6	25	45	0.06	4	33 lbs/acre	Broadcast	1.98

Restoration Priority 1

This 1.7-acre area is located at mile-marker 365.75 and has been identified as a top priority due its steep slope with high erosional potential and recent disturbances from construction of a new path, leading to large areas of bare soil. With the addition of the new bike path to access the Riverview School, it will be important to establish vegetation on the slope between the upper Rio Grande Trail and the lower trail to prevent erosion and provide a more desirable aesthetic. Seed mix #4 should be used throughout, as erosion control and rapid establishment of vegetation are the top priorities for this area. The following means/methods are recommended specific to this site:

1. Manage vegetation, creating a weed free planting surface.
2. Preserve well established rabbit brush and sage brush in scattered densities throughout the slope and seeding area.
3. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
4. Blow compost or topsoil with soil amendments added onto gravelly slope to a depth of 4-6 inches. Vegetation establishment is poor in coarse, gravelly to rocky soils, applying compost or topsoil will provide a medium for seeding establishment.
5. Universally apply seed via hydroseeding method using provided seed mix # 4 at a rate of 33 lbs./acre.
6. Stabilize seeded slope using either erosion control blanket or Hydraulic mulch and tackifier.
7. Protect seeded areas from foot traffic and wildlife, installing temporary fencing until vegetation is well established
8. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 9 View looking NW at Priority 1. Bare soils from construction disturbances



Figure 10. View looking East at Priority 1.



Figure 11. View looking NW at steep slope between trails.

Restoration Priority 2

This 0.55-acre area is located at mile-marker 366 along the steep slope between the Glenwood Ditch and Rio Grande Trail. This area has been identified as a priority because the high potential of erosion associated with the areas of poor vegetation cover and bare soils on areas with steep slopes from the Glenwood ditch to the trail. Seed mix #4 should be used throughout, as erosion control and rapid establishment of vegetation are the top priorities for this area. The following means/methods are recommended specific to this site:

1. Manage vegetation, creating a weed free planting surface.
2. Preserve well established sage brush and other shrub species in scattered densities throughout the slope and seeding area.
3. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
4. Blow compost or topsoil with soil amendments added onto gravelly slope to a depth of 4-6 inches. Vegetation establishment is poor in coarse, gravelly to rocky soils, applying compost or topsoil will provide a medium for seeding establishment.
5. Universally apply seed via hydroseeding method using provided seed mix # 4 at a rate of 33 lbs./acre.
6. Stabilize seeded slope using either erosion control blanket or Hydraulic mulch and tackifier.
7. Protect seeded areas from foot traffic and wildlife, installing temporary fencing until vegetation is well established
8. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 12. View looking N at bare soil on steep slope



Figure 13. View looking NW at area of poor vegetation on steep slope



Figure 14. View Looking N at area of bare soil on steep slope

Restoration Priority 3

This 0.43-acre area is located on the north side of the trail at mile-marker 365.25 within the sagebrush shrubland community. It is distinguished by two highly disturbed areas, creating isolated patches of high-density noxious vegetation and non-native weedy species within the sagebrush stands. This area has been identified as a priority due to the potential to re-establish native vegetation and enhance the surrounding sagebrush community surrounding it. The following means/methods are recommended specific to this site:

1. Manage vegetation, creating a weed free planting surface and removing competing vegetation.
2. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
3. Loosen and scarify soil to a minimum depth of 2 inches, using a combination of hand tools or lightly tilling using an ATV with a tiller or drag chain harrow connection.
4. Apply soil amendments, recommended fertilizer for all seeding activities is ***Biosol Forte 7-2-1*** applied at rate of 50-60 lbs./acre. Substitutions may be made based upon differing needs from site specific soil test results.
5. Universally spread seed using broadcast seeding methods and seed mix #2 at a rate of 18 lbs./acre.
6. Immediately following seeding and fertilization, disperse certified weed free straw, uniformly covering the area without any major gaps.
7. Apply organic tackifier at rate of 150 lbs./acre to completely cover weed free straw mulch immediately following installation of mulch.
8. Protect seeded areas from foot traffic and wildlife, installing temporary fencing until vegetation is well established
9. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 15. View Looking NW at area of high density weedy vegetation. Figure 16. View looking SE at high density weedy vegetation

Restoration Priority 4

This 0.63-acre area is located at mile-marker 363 covering a 640-foot stretch between highway 82 and the Rio Grande Trail. This area has moderately steep slopes with high density of noxious and no-native weedy vegetation. This area has been identified as a priority to help enhance and connect the surrounding sagebrush communities, providing a greater aesthetic and ecological benefit. The following means/methods are recommended specific to this site:

1. Manage vegetation, creating a weed free planting surface and removing competing vegetation.
2. Remove Siberian elm found throughout through cut-stump treatment methods.
3. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
4. Preserve well established scattered sage brush and rabbit brush in the area.
5. Loosen and scarify soil to a minimum depth of 2 inches, given the moderate slope of the area, it is suggested this be done with rakes and various hand tools, avoiding the use of motorized equipment.
6. Apply soil amendments, recommended fertilizer for all seeding activities is ***Biosol Forte 7-2-1*** applied at rate of 50-60 lbs./acre. Substitutions may be made based upon differing needs from site specific soil test results.
7. Universally spread seed using hand broadcast seeding methods and seed mix #2 at a rate of 18 lbs./acre.
8. Immediately following seeding and fertilization, disperse certified weed free straw, uniformly covering the area without any major gaps.
9. Apply organic tackifier at rate of 150 lbs./acre to completely cover weed free straw mulch immediately following installation of mulch.
10. Install straw wattles perpendicular to the slope.
11. Protect seeded areas from foot traffic and wildlife, installing temporary fencing until vegetation is well established
12. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 17. View looking N at area of high density Field Bindweed.



Figure 18. View looking NW at restoration Priority 4.

Restoration Priority 5

This 0.27-acre area is located at mile-marker 364.5 within the sagebrush shrub land community. The area has been impacted by significant die-back of the sagebrush and contains high densities of non-native weedy grasses and herbaceous forbs. This area has been identified as a priority to remove the dead sagebrush and weedy vegetation and restore the area to support a healthy sagebrush community. The following means/methods are recommended specific to this site:

1. Collect soil samples from the site and submit for testing to help determine if there are underlying soil conditions that are causing significant die-back of vegetation in the area.
2. Remove dead sagebrush vegetation from the area, fully removing all above ground vegetation and stumps.
3. Manage vegetation, creating a weed free planting surface and removing competing vegetation.
4. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
5. Loosen and scarify soil to a minimum depth of 2 inches, using a combination of hand tools or lightly tilling using an ATV with a tiller or drag chain harrow connection.
6. Apply soil amendments, recommended fertilizer for all seeding activities is ***Biosol Forte 7-2-1*** applied at rate of 50-60 lbs./acre. Substitutions may be made based upon differing needs from site specific soil test results.
7. Universally spread seed using broadcast seeding methods and seed mix #2 at a rate of 18 lbs./acre.
8. Immediately following seeding and fertilization, disperse certified weed free straw, uniformly covering the area without any major gaps.
9. Apply organic tackifier at rate of 150 lbs./acre to completely cover weed free straw mulch immediately following installation of mulch.
10. Protect seeded areas from foot traffic and wildlife, installing temporary fencing until vegetation is well established
11. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 19. View looking N at area of dead sagebrush vegetation.

Restoration Priority 6

This 0.06-acre area is located at mile-marker 366.1 north of the Rio Grande Trail. The area is used as access to the Glenwood Ditch and consists of compacted soils with sparse vegetation cover and high densities of noxious vegetation. The priority for restoration in this area is to establish and maintain a healthy and resilient ground cover to withstand the impacts of accessing the ditch and reduce establishment of noxious vegetation. The following means/methods are recommended specific to this site:

1. Coordinate with Glenwood Ditch operators on restoration timing. Once restoration seeding activities have started, access should be avoided until establishment of grass (at least 1 full growing season).
2. Manage vegetation, creating a weed free planting surface and removing competing vegetation.
3. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
4. Loosen compacted soil by lightly discing or tilling the soil to a minimum depth of two inches.
5. Apply soil amendments, recommended fertilizer for all seeding activities is **Biosol Forte 7-2-1** applied at rate of 50-60 lbs./acre. Substitutions may be made based upon differing needs from site specific soil test results.
6. Universally spread seed using broadcast seeding methods and seed mix #4 at a rate of 33 lbs./acre.
7. Immediately following seeding and fertilization, disperse certified weed free straw, uniformly covering the area without any major gaps.
8. Apply organic tackifier at rate of 150 lbs./acre to completely cover weed free straw mulch immediately following installation of mulch.
9. Protect seeded areas from foot traffic and wildlife, installing temporary fencing until vegetation is well established
10. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 20. View looking N at compacted soils and high density scotch thistle.

C. Seeding Methods, Soil Preparation and Erosion Control

Seeding Methods

Once the appropriate seed mix is selected for the area to be restored, the method of applying the seed will need to be determined. Determining the method of application will be dependent on the existing site conditions. Some of the factors influencing method selection are; site access, the size and slope of the area to be seeded, and existing vegetative and substrate conditions. The method used for seeding will determine the seeding application rate and necessary preparation of the seedbed.

The timing for seeding activities is essential to the overall success, as water is a critical element needed for establishment. Without access to consistent irrigation, it is important to time seeding efforts when water is most naturally abundant to the germinating seedlings. In the arid climate of the west, there are three (3) time periods to be considered to optimize available moisture. These include:

1. Fall dormant seeding (mid-October to early November)
2. Early spring, following melting of snow on site (mid-April to May)
3. Summer monsoon months (mid-July to early August)

Given varying climatic conditions from year-to-year, there is no guarantee that any of these given times will provide the adequate moisture needed, and special attention should be given to climatic conditions and trends when choosing the proper time to seed.

Broadcast seeding is performed either with mechanical “cyclone” seeders, by hand seeding, or by other methods that scatters seed over the bare soil surface. When broadcast seeding, it is essential that steps be taken to ensure good seed to soil contact. It is recommended that seeding is completed with two separate applications crossing the area at right angles to one another to guarantee even coverage. Broadcast seeding methods are recommended for all restoration seeding areas not specified for erosion control restoration seeding activities.

Drill seeding and the use of a no till drill is recommended for large, continuous sites with rolling to flat topography. It is also a useful method for inter-seeding native pastures and restoration areas where an increased diversity of vegetation is desired. Drill-seeding allows for the establishment of native stands of vegetation with minimal impacts and disturbances to the soil. Drill seeding is most appropriate for level ground. Do not attempt to drill seed slopes greater than 3:1. Drill seeding application is limited by the ability to safely use equipment on steep slopes. The majority of the suggested seeding areas throughout the corridor are not suitable for drill seeding efforts, however, recommended seeding area number one is a large enough area with flat topography that lends itself well to drill seeding efforts.

Hydroseeding is recommended for areas with steep slopes and where access by foot and other equipment is limited and broadcast seeding is not achievable. Seed should be applied evenly across the entire sight at the suggested seeding rate, using a fan-type nozzle and approximately 500 gallons of water per acre for the slurry mixture. It is a great option for erosion control seeding efforts and it is recommended that restoration area 8 be seeded using this process.

Do not seed during high winds or when the ground is frozen or otherwise unable to be worked. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage. If possible, deliver seed to site location in the original unopened containers and keep all certified labels for proper record keeping.

Soil Preparation

Prior to seeding, all remnant gravel/cobble material should be removed from the site and the soils should be completely free of weeds and other competing vegetation. If a layer of thatch (dead vegetation) covers most of the soil, burn or mow and rake the area so your seed will come in contact with the soil when you put it down. Soil preparation includes scarification or tilling as necessary, areas with highly compacted soils may need to be ripped or disked and areas where light soil compaction exists hand tilling and raking may suffice. Loosen subgrade to a minimum depth of 2 inches and maximum depth of 6 inches. A fertilizer that provides key nutrients to the plants in early growth stages and acts as quick acting germination seeding supplement should be utilized to promote better establishment of newly seeded vegetation.

If topsoil is necessary, do not spread if planting soil or subgrade is frozen, muddy, or excessively wet. Spread approximately ½ the thickness of planting soil over loosened subgrade. Mix thoroughly into top 6" of subgrade. Spread remainder of planting soil and loosen the surface of areas to be seeded with hand rakes before applying seed. Limited disturbance of previously established seeded areas may leave the existing root mass and structure in place as evidenced by regeneration of the existing grasses. Observe level of disturbance and compaction of the soil; removal of detritus, light scarifying (harrow) and topdressing, followed by over seeding may be suitable in these areas.

Erosion Control and Protection of Seeded areas

It is important to protect seeded areas against erosion by uniformly spreading straw mulch after completion of seeding operations. Spread the straw mulch uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1-1/2-inches (38-mm) loose depth over seeded areas. Spread by hand, blower, or other suitable equipment. Alternatively, Hydrostraw (800) 545-1755 may be applied at a rate of 2,500 lbs./acre. Once spread, anchor the straw mulch by crimping into topsoil by suitable mechanical Equipment, followed by application of tackifier via hydroseeder. Anchoring is not necessary if using tackified Hydrostraw. Protect seeded slopes exceeding 3:1 against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.

It will also be essential to protect the seeded areas from pedestrian foot traffic, following the completion of seeding and erosion control efforts, barriers should be placed around the seeded area to sufficiently keep pedestrians from accessing the area until establishment of desired vegetation.

Monitoring and Maintenance

The purpose of post-restoration monitoring is to evaluate the long-term vegetative cover and density, habitat quality and noxious and invasive weed densities, as well as assessing the stability of soils in areas where erosion has been an issue. Monitoring of restoration areas should include both qualitative and quantitative analysis. Monitoring should occur for a minimum of three years following restoration seeding activities.

Through quantitative analysis, the success of the reseeding activities should be monitored and assessed on a yearly basis for at least 3 years. Vegetation sampling plots will be used to measure plant density, cover, and bare ground. Additionally, it is important to monitor the establishment of weed species in accordance with the

Roaring Fork Transportation Authority Integrated Weed Management Policy and Plan. Newly established weed infestations need to be identified and treated regularly to help insure the establishment of desired vegetation. Following the restoration seeding efforts, other disturbances that may hinder restoration of the newly seeded areas need to be monitored and assessed. Identification of any disturbances such as animal grazing and disturbances or unauthorized pedestrian traffic will need to be addressed immediately and closely monitored.

Restoration seeding efforts will generally be considered successful when vegetation within the restored areas supports non-noxious plants that are similar in forb, graminoid, and woody plant density and cover to those growing similar, undisturbed vegetation communities. Where initial restoration and plant establishment efforts fail to make progress towards meeting plant establishment standards after 3 years, reseeding may be necessary on portions of the of the Rio Grande Trail Right-of-Way.



Roaring Fork Transportation Authority
Rio Grande Trail Restoration Seeding Plan

Mile Post 376-382

Catherine Store Bridge to Emma Road

GARFIELD COUNTY, COLORADO

DECEMBER
2021

DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING



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Appendices

Appendix 1 – Existing Corridor Conditions Map

Appendix 2 – 2021 Restoration Priority Areas

Appendix 3 – Corridor Panel Maps and Site Photos

Appendix 4 – Seeding, Soil Preparation, and Erosion Control Specifications

Appendix 5 – NRCS Soil Report

Appendix 6 – RFTA Haney Soil Test Data

1. Executive Summary

This comprehensive Restoration Seeding Plan was developed for the Roaring Fork Transportation Authority (RFTA) by DHM Design Ecological Services (DHM) for the Catherine Store Rd. Bridge (CR 100) to Emma Road (historic railroad mm posts 376 to 382) section of the Rio Grande Trail Corridor. The purpose of this plan is to provide the following:

- A detailed analysis of current existing conditions
- Restoration recommendations for short-term and long-term management and budgeting
- Project specific specifications and methods for seeding, soils management, and erosion control best management practices
- Restoration requirements and monitoring protocol for contractors and RFTA employees

Restoration of vegetative plant communities throughout an extensive, linear right-of-way corridor that bisects numerous land use types and ecological communities poses many unique challenges. It also provides valuable opportunities to connect and restore fragmented habitats through establishment of native vegetation communities, reduce noxious vegetation, improve soil health, reduce the potential for erosion, and improve overall aesthetic quality. This plan recognizes the importance of healthy plant communities as an essential foundation for ecosystem integrity, aesthetic value, functional management and diversity. Healthy plant communities create habitat for animals, provide ecosystem benefits that sustain people, their communities, and have intrinsic and irreplaceable biotic value. This report is intended to be utilized as a planning tool for RFTA staff to budget, initiate, and track the success of restoration seeding efforts throughout this section of the Rio Grande Trail corridor.

2. Introduction

The Rio Grande Trail Corridor was built on the historic foundation of the old Denver and Rio Grande Western Railroad corridor that ran from Glenwood Springs to Aspen, Colorado and is approximately 42 miles in length, with RFTA owning the 33 mile stretch from Glenwood Springs to Woody Creek. The trail corridor passes through three (3) counties, including Garfield, Eagle, and Pitkin County. Over the extent of the trail, it gains 1,800 ft of elevation from Glenwood Springs to Aspen and dissects the Roaring Fork Valley, occupying the biologically diverse habitats associated with the Roaring Fork River and vegetation communities found throughout the valley. The section of trail analyzed for this Plan extends from railroad milepost # 376 - 382, and is referred to as the Catherine Store Rd. Bridge to Emma Road Section, (See *Figure 1 – Project Extent* on the following page and *Appendix 1 – Restoration Seeding Plan Graphic*).

This restoration seeding plan is intended to be utilized in conjunction with the current RFTA Weed Management Plan (2003) and activities to provide the basis for establishing self-sustaining plant communities and to restore degraded areas that are susceptible to erosion and continued infestation of noxious vegetation. This Plan also provides a uniform framework for future restoration needs following future man-made or natural disturbances occurring throughout the corridor and provides detailed restoration guidelines for contractors and RFTA employees working within the Rio Grande Corridor.

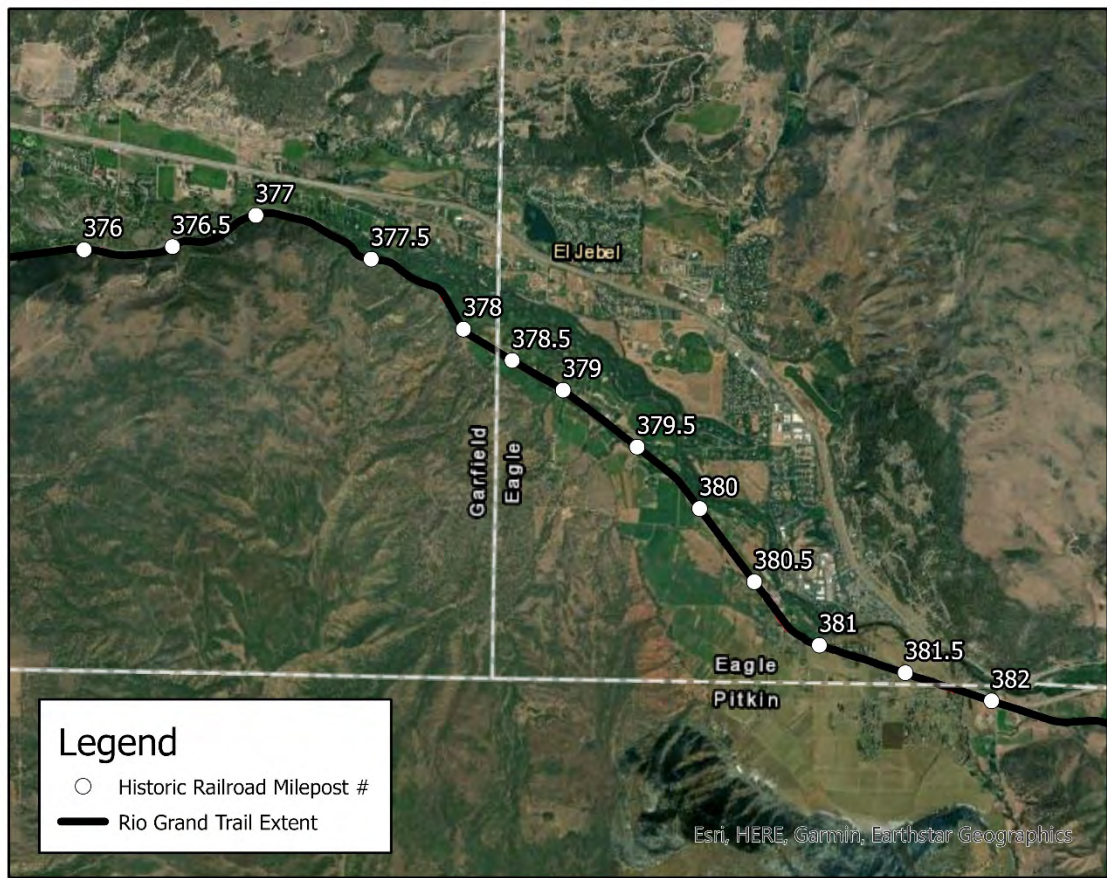


Figure 1- Project Extent

3. Methods

A. Desktop Analysis

To initiate the plan development, DHM conducted a comprehensive and thorough desktop analysis of existing natural resource management data and reports provided by RFTA including:

- Roaring Fork Transportation Authority Integrated Weed Management Policy and Plan (2003)
- Soil test analysis (3 sample sites provided within Survey extent)
- RFTA Railroad Right-of-Way Ownership Atlas

In addition to the documents provided by RFTA, the following documents were identified and reviewed for the report:

- NRCS Soil Report
- Google Earth and ESRI Aerial Imagery
- CNHP Ecological Systems Definitions

B. Field Survey Methods

DHM Design conducted field surveys on August 11th – 16th, 2021 to evaluate the planning area which includes a 5-mile section of the corridor extending from the Catherine Store Rd. bridge to Emma Road. The purpose of the survey was to evaluate the existing conditions, identify dominant vegetation types, and locate and prioritize individual restoration zones. Impairment ratings were established and used to evaluate the corridor conditions and prioritize restoration zones. For the purpose of this plan, the entire corridor was assigned an impairment rating of:

- **Significant** – Highly disturbed areas affected by surrounding land use generally lacking vegetation, or areas with lacking healthy native vegetation structure, or areas influenced by erosional issues.
- **Moderate** – evidence of disturbance, but functioning vegetation communities exist with lack of species diversity or presence of non-native or nuisance vegetation. Potential for erosion.
- **Minimal** - Well established ground cover and species diversity consistent with areas vegetation community. Stable soils with no presence of erosion.

Impairment ratings were determined by analysis of the following categories observed in the field: Vegetation conditions, soil conditions and slope, aesthetics, and surrounding land use. Existing conditions categories are included in Table 1 on Page 4 of this plan. These four (4) evaluation categories are critical for understanding the restoration need, type of restoration required, implementation strategies and recommended monitoring throughout the corridor. Each category should be considered and reviewed to assess and prioritize projects into the future. Detailed definitions of categories used can be found in table 1 on the next page.



Figure 2 - Significant impairment conditions (MM 381.5)



Figure 3 - Moderate impairment conditions (MM 381.1)



Figure 4 - Low impairment conditions (MM 377.1)

Table 1. Existing Conditions Categories, Impairment Levels and Evaluation Criteria

<i>Existing Condition Metric</i>	<i>Impairment Level/Evaluation Criteria</i>
<i>Vegetation Conditions</i>	<ul style="list-style-type: none"> • Significant: Dominated by non-native or nuisance vegetation, minimal existing ground cover • Moderate: Moderate ground cover/non-native vegetation • Low: Well established ground cover and species diversity consistent with areas vegetation community
<i>Soil Conditions and Erosion</i>	<ul style="list-style-type: none"> • Significant: Gravel/coble covering topsoil or soil compaction present. Steep slopes, 3-1 with bare soils • Moderate: Moderately compacted soils with sparse gravel/cobble cover • Low: No compaction or erosion evident, no gravel/cobble
<i>Surrounding Land</i>	<ul style="list-style-type: none"> • Significant: High level of disturbance cause by surrounding land use • Moderate: Moderate level of disturbance caused by surrounding land use • Low: Low level of disturbance caused by surrounding land use
<i>Aesthetics/Visual Impact</i>	<ul style="list-style-type: none"> • Significant: Highly visible areas in proximity to high traffic areas • Moderate: Moderately visible areas in proximity to moderate traffic areas • Low: Low visibility areas in proximity to low-moderate traffic areas

In addition to the impairment conditions, dominant vegetation types were observed and recorded and broad vegetation communities were identified. Representative photos of each impairment area were taken and are provided in *Appendix 3, Corridor Panel Maps and Site Photos*. ArcGIS Collector applications for hand held units, utilizing a GNSS receiver for accuracy, were utilized to map the existing conditions of the trail corridor and impairment rating conditions were digitized using ArcMap to display and provide area calculations. Establishment of 2021/2022 restoration priority areas were identified based upon observed conditions and input from RFTA staff.

4.Existing Conditions Analysis

A matrix of well-established vegetation communities and stressed native plant communities exist throughout the Rio Grande Trail Corridor. Many areas have been severely degraded and consist of primarily non-native annual grasses and forbs and state-listed noxious vegetation. These degraded conditions persist primarily from two causes; 1.) The corridor exists on and within the historic railroad corridor; and 2.) There is a significant mix of land use types that occur today that fragment habitat. The transition of the old railroad corridor to a multi-use trail corridor with a commitment to preserving,

maintaining and enhancing the corridor to provide natural and scenic open space areas offers the ability to restore these struggling plant communities and create well established native plant communities.

Conditionally, a large portion of this trail segment is found to be in good condition with low impairment, consisting of large swaths of relatively intact native vegetation and low impairment ratings observed. There is a distinguishable distribution of these higher quality areas, with the lower portion (mm 376 - 378.5) being comprised largely of the wilderness area with minimal development. The upper portion, particularly from mm 380 to 382 is found in an area of high development and disturbances, containing the highest density of significantly impacted areas.

A. Vegetation Communities

To understand the existing conditions, vegetation communities were evaluated in the field. A total of Four (4) dominant vegetation communities were identified and they include:

1. Sagebrush shrublands
2. Mixed mountain shrublands
3. Lower-Montane Riparian forest
4. Scrub-shrub Wetlands

Given the proximity of the trail to the Roaring Fork River and the aspect and topology of this section, the vegetative communities consist primarily of riparian associated ecosystems and mesic conditions with more scattered sagebrush communities in the less frequent xeric zones. The descriptions of these communities are based upon the higher quality settings, describing the typical native vegetation observed and providing a basis for reference communities and developing seed mixes.

Non-native and noxious vegetation is a significant component of the vegetative composition throughout the trail corridor, most noticeably within the higher disturbance areas, but influencing the higher quality communities as well. In general, these species are found throughout the corridor and are not largely confined by vegetative communities. Characteristic non-native vegetation includes: smooth brome, Siberian elm, crested wheatgrass, reed canary grass, kochia, chicory, western salsify various annual mustards. Characteristic noxious vegetation includes: field bindweed, Canada thistle, plumeless thistle, Scotch thistle, houndstongue, cheatgrass, common tansy, common mullein, and common burdock.

Sagebrush Shrublands

The sagebrush shrubland communities are more minor characteristic through this portion of the Rio Grande Trail, with scattered occurrences found throughout in the more xeric upland areas and flatter section of the trail. These shrublands, and areas that would have historically been sagebrush dominant become more frequent in the upper portions of the trail, as trail moves away from the Roaring Fork River and out of the steep, narrow valleys – opening up into a broader valley shelf. These shrublands are dominated by *Artemisia tridentata* (mountain big sagebrush), with areas of co-dominance to dominance by *Chrysothamnus nauseosus* (rubber rabbitbrush). The dominance of *C. nauseosus* is indicative of the historical and current disturbances throughout the corridor, as *C. nauseosus* is a

pioneer species with the ability to establish following disturbances. The shrub overstory is typically the dominant layer, with an absence of tree species and sparse understory vegetation of forbs and graminoids. The composition of the understory vegetation for sagebrush communities varies throughout the corridor, but generally the healthier, more intact communities are dominated by graminoids: *Elymus trachycaulus* (slender wheatgrass), *Pascopyrum smithii* (western wheatgrass) *Festuca idahoensis* (Idaho fescue) with sparse forbs *Artemisia ludoviciana* (white sage), *Heterotheca villosa* (hairy goldenaster), *Salidago altissima* (goldenrod), *Phlox hoodii* (spiny phlox) and *Ritibida columnifera* (prairie coneflower).

Lower Montane Mixed Shrublands

The lower montane mixed shrubland community is distinguished by the presence of a dominant shrub layer consisting of *Amelanchier alnifolia* (Serviceberry), *Quercus gambelii* (Gamble oak), snowberry (*Symphoricarpos occidentalis*) *Prunus virginiana* (chokecherry) and *Rhus trilobata* (skunkbush sumac), and transitioning *Pinus edulis* (pinyon pine) and *Juniperus monosperma* (one-seeded juniper) – with the pinyon juniper communities being more dominant in the higher elevations above the trail corridor. The presence of a dense canopy cover from the shrub matrix restricts the understory to sparse populations of shade tolerant graminoids and forbs. The mixed mountain shrub land communities have relatively intact native vegetation establishment with the presence of noxious vegetation scattered throughout. *Clematis ligusticifolia* (Western white clematis) is well established throughout the lower-to mid-shrub species canopy. The mixed mountain shrublands are found in a matrix throughout the upland areas with sagebrush vegetation communities, generally occupying more mesic and steeper areas.



Figure 5 - Mixed shrubland community, with a well-established and healthy shrub community comprised of a diversity of native species.

Lower Montane Forested Riparian

The forested riparian communities of the Rio Grande River are the dominant community found through this section of the corridor, with the trail paralleling the Roaring Fork River for much of its extent. Distinguishing vegetation includes mature canopy trees dominated by narrowleaf cottonwood (*Populus angustifolia*) and scattered Colorado blue spruce (*Picea pungens*). Box elder (*Acer negundo*), and Siberian elm (*Ulmus pumila*), often indicators of disturbed settings, are found in isolated areas and are minor components of the canopy and overall structure of the overstory.



Figure 6 - forested riparian community along the Roaring Fork River, evident by overstory cottonwood trees and willow dominant shrub layer.

Scrub-Shrub Wetlands

The scrub-shrub wetland communities are found in areas along the irrigation ditches that run through the trail corridor right-of-way. The dominant vegetation species within this community are willow spp. with *Salix exigua* (coyote willow) being the dominant species observed. The understory and graminoid vegetation are dominated by *Phalaris arundinacea* (reed canary grass). Other species found include *Heracleum maximum* (cow parsnip), *Pascopyrum smithii* (western wheatgrass), *Maiathemum stellatum* (false Solomonseal) and *Solidago canadensis* (Canada goldenrod).



Figure 7 - scrub shrub and emergent wetland complex found in larger Riparian extent at mm 378.7.

B. Soils

Throughout the trail corridor, remnant gravel/coble base material from the old railroad is present, detracting from the overall conditions of the topsoil found in many areas. An NRCS Soils Survey Report was generated for the corridor and is included in Appendix 5. A total of nine (9) soil types were identified within the corridor; the dominant soil types include:

- 1.) Grotte gravelly loam complex, 25 to 65 percent slopes (40.6%)
- 2.) Atencio-Azeltine complex, 3 to 6 percent slopes (29 %)
- 3.) Torriothents–Camborthids - rock outcrop complex, 6-65percent (13.9%)
- 4.) Redrob loam, 1 to 6 percent slopes (6.8%)

Soil sample test analysis results for locations throughout the Rio Grande Trail corridor provided by RFTA staff indicate that the sub soils are relatively healthy with no major nutrient or organic matter deficiencies and increasing soil health over the timeframe of sampling in this section of trail. RFTA soil test results are included in *Appendix 6 – RFTA Haney Soil Test Data*. Continued soil monitoring is recommended every 3 years. In areas of high traffic, soil compaction is evident where social footpaths have been established. This is especially noticeable in areas where access to the Roaring Fork River has been established.

C. Impairment Ratings

To help identify areas for recommended seeding efforts, impairment ratings were established to assess the varying conditions throughout the corridor. Areas considered as having low impairment were the dominant condition, consisting of over 70% of the current conditions found in this section of the trail corridor. Moderately and significantly disturbed areas comprise the other approximate third of current conditions found, with areas of moderate impairment being the more prevalent of the two. Significantly impaired areas comprise a considerably small area of the corridor, making up a total of 3 acres of the 73.42 acres Identified. A breakdown of the impairment conditions can be found in Table 2 below, and for the distribution of the impairment conditions of the trail corridor refer to *Appendix 3, Corridor Panel Maps and Site Photos*.

Table 2. Rio Grande Trail Corridor Impairment Ratings

Impairment Rating	Total Acres	Total Linear Miles #	Total Number of Areas Identified
Low	52.25 acres	3.5 miles	3
Moderate	18.17 acres	1.54 miles	13
Significant	3 acres	.96 miles	11

Areas indicated as having significant impairments are designated as top priorities for restoration seeding efforts, with all areas of significant impairment recommended for restoration seeding efforts. Additional moderately impaired areas (6 total) have been recommended for seeding efforts, and consist of isolated areas identified as moderately impaired within surrounding high-quality areas. More expansive areas of moderate impairments are designated as low priority for restoration efforts, with the possibility for future seeding efforts, which would largely consist of inter-seeding native mixes to improve species diversity and improve noxious vegetation conditions. Areas indicated as low impairment ratings have no need for restoration seeding activities under current conditions, but may need to be addressed in the future if the areas are disturbed.

4. Recommendations

The following recommendations were developed based off the findings in the existing conditions analysis and they include:

- Restoration seeding
- Soil management
- Erosion control
- Monitoring and Maintenance

Each of these are reviewed in *Section C* of the recommendations and detailed specifications are included in *Appendix 4, Seeding, Soil Preparation and Erosion Control Specifications*. A total of seventeen (17) recommended restoration seeding sites were identified and consist of all areas identified as significantly impaired with six (6) additional moderately impaired areas (Table 3), on the following page.

Table 3. Rio Grande Trail Corridor Recommended Restoration Areas

RECOMMENDED RESTORATION AREA	MILEPOST #	IMPAIRMENT RATING	AREA (ACRES)	LINEAR LENGTH (FEET)	RECOMMENDED SEED MIX (#)
1	376.1	Significant	0.17	193	2
2	376.2	Significant	0.03	95	3
3	376.5	Moderate	0.13	205	3
4	376.6	Moderate	0.43	110	3
5	376.8	Significant	0.03	85	4
6	376.9	Significant	0.07	136	4
7	377.5	Moderate	0.07	170	1
8	377.8	Significant	0.16	135	4
9	377.9	Moderate	0.34	308	1
10	378.2	Significant	0.08	205	1
11	378.3	Moderate	0.42	365	1
12	379	Moderate	0.23	245	1
13	380	Significant	0.11	280	5
14	380.7	Significant	0.68	630	3
15	381.5	Significant	1.43	1030	2
16	381.5	Significant	0.53	410	2
17	381.7	Significant	0.39	475	3
TOTAL			5.32	5077	

A. Recommended Seed Mixes

Existing vegetation types within the project corridor were analyzed to identify species specific seed mixes that will maximize restoration success. The following seed mixes were developed specifically for restoration efforts of the various vegetation communities throughout this segment of the Rio Grande Trail corridor. These seed mixes have been developed based upon observed *native* plant species currently found growing within the trail corridor. The established native seed mixes are designed to increase the diversity, distribution, and composition of native plant species in accordance with the vegetation community the seed mix is associated with. A deliberate attempt has been made to include a large number of different grasses and forbs, as establishing a diverse distribution of species will tend to be more resistant to drought, floods, and pathogens than monotypic or low diversity plantings. The inclusion of a diverse seed mix is also greatly beneficial to wildlife, increasing ecological and intrinsically value to a restoration area and will allow for different micro niches to be established by associated plants. A total of five (5) types of restoration areas were identified, mapped and reviewed with RFTA staff. The following seed mixes were developed to address each type:

1. Native grass and forb
2. Sagebrush shrubland
3. Mixed shrubland
4. Erosion Control
5. Riparian/Scrub-shrub

Native Grass and Forb – Mix #1

Five (5) areas (Table 4) totaling 1.15 acres were identified as locations for native grass and forb restoration seeding. These areas are generally located in the upper wilderness section of the trail corridor, from railroad milepost 377.5 to 379. The establishment of this mix will provide both aesthetic and ecological benefits, increasing the diversity of grasses and showy forbs that will add color and texture to the landscape while providing valuable pollinator habitat.

Table 4. Native Grass and Forb Restoration Seeding Areas

Native Grass and Forb Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix (#)	Recommended Seeding Method
7	377.5	0.07	170	1 (1.365 lbs)	Broadcast
9	377.9	0.34	308	1 (6.63 lbs)	Broadcast
10	378.2	0.08	205	1 (1.56 lbs)	Broadcast
11	378.3	0.42	365	1 (8.19 lbs)	Broadcast
12	379	0.23	245	1 (4.485 lbs)	Broadcast
Total		1.15	1293	22.23 lbs.	

Table 5. Native Grass and Forbs Seed Mix

Seed Mix #1. Native Grass and Forbs Mix (19.5 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	12%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	14%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Bouteloua gracilis</i>	Blue grama	10%
<i>Koeleria macrantha</i>	Prairie junegrass	8%
<i>Elymus trachycaulus</i>	Slender wheatgrass	12%
<i>Stipa comata</i>	Needle and thread	12%
Forbs		
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot	2%
<i>Chrysopsis villosa</i>	Hairy golden aster	1%
<i>Delphinium nuttallianum</i>	Nuttall's larkspur	1%
<i>Gaillardia aristata</i>	Blanket flower	1%
<i>Ipomopsis aggregata</i>	Skyrocket gilia	2%
<i>Penstemon strictus</i>	Rocky Mountain penstemon	8%
<i>Phlox hoodii</i>	Spiny phlox	4%
<i>Ratibida columnifera</i>	Prairie coneflower	2%
<i>Sphaeralcea coccinea</i>	Scarlet globemallow	1%

Sagebrush Shrubland - Mix #2

Three (3) areas (Table 6) totaling 2.13 acres were identified as locations for sagebrush shrubland restoration seeding. These areas are located at the upper and lower sections of the trail segment, and generally focus on larger areas to re-establish sagebrush communities. The sage brush communities identified for restoration efforts are currently dominated by annual mustards, kochia, smooth brome and cheatgrass and have nominal to no shrub establishment. The sagebrush shrubland mix was created to re-establish degraded sagebrush shrubland communities and create a more diverse and healthier understory.

Table 6. Sagebrush Shrubland Restoration Seeding Areas

Sagebrush Shrubland Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix	Seeding Method
1	377.5	0.17	193	#2 (3.06 lbs)	Broadcast
15	381.5	1.43	1030	#2 (25.74 lbs)	Broadcast
16	381.5	0.53	410	#2 (9.54 lbs)	Broadcast
Total		2.13	1633	38.34 lbs	

Table 7. Sagebrush Shrubland Seed Mix

Seed Mix #2. Sagebrush Shrubland Mix (18 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	14%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	12%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Elymus trachycaulus</i>	Slender wheatgrass	10%
<i>Festuca saximontana</i>	Rocky Mountain fescue	10%
<i>Pascopyrum smithii</i>	Western wheatgrass	10%
<i>Stipa lettermanii</i>	Lettermans needlegrass	10%
Forbs		
<i>Arenaria hookeri</i>	Hookers sandwort	2%
<i>Balsamorhiza sagittata</i>	arrowleaf balsamroot	2%
<i>Chrysopsis villosa</i>	Hairy golden aster	2%
<i>Dlephinium nuttallianum</i>	Nuttals larkspur	4%
<i>Phlox hoodii</i>	spiny phlox	4%
Shrubs		
<i>Artemisia tridentat spp. Vaseyana</i>	mountain sagebrush	2%
<i>Artemisia frigida</i>	fringed sage	2%
<i>Artemisia nova</i>	black sagebrush	1%
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	5%

Lower Montane Mixed Shrubland – Mix #3

Four (4) areas (Table 8) totaling 1.63 acres were identified as locations for montane mixed shrubland restoration seeding, and occur throughout the extent of the trail corridor. Mixed shrublands tend to occupy the steeper, rocky slopes of the trail corridor extend into the flat areas with more mesic locations closer in proximity to the Roaring Fork River, forming a matrix with the forested riparian communities. The Montane Mixed shrubland mix was developed to establish a diverse understory forb and graminoid layer with more shade tolerant species while including key shrub species to increase the canopy cover in degraded areas.

Table 8. Lower Montane Mixed Shrubland Restoration Seeding Areas

Montane Mixed Shrubland Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix	Seeding Method
3	376.5	0.13	205	#3 (2.34 lbs)	Broadcast
4	376.6	0.43	110	#3 (7.74 lbs)	Broadcast
14	380.7	0.68	630	#3 (12.24 lbs)	Broadcast
17	381.7	0.39	475	#3 (7.02 lbs)	Broadcast
Total		1.63	1420	29.34 lbs	

Table 9. Lower Montane Mixed Shrubland Seed Mix

Seed Mix #3 Montane Shrubland Mix (18 lbs/acre)		
Scientific name	Common name	Mix%
Graminoids		
<i>Bouteloua cutipendula</i>	Sideoats gramma	12%
<i>Carex inops</i>	Sun sedge	10%
<i>Festuca arizonica</i>	Arizone fescue	16%
<i>Koelerian macrantha</i>	Prairie junegrass	12%
<i>Muhlenbergia montana</i>	Mountain Muhly	12%
Forbs		
<i>Achillea millefolium</i>	Western yarrow	2%
<i>Geranium viscosissimum</i>	Sticky geranium	5%
<i>Maianthemum stellatum</i>	False Solomon seal	3%
<i>Phlox hoodii</i>	Spiny phlox	3%
<i>Thalictrum fendleri</i>	Fendler's meadow-rue	2%
<i>Vicia americana</i>	American vetch	3%
Shrubs		
<i>Amelanchier utahensis</i>	Utah serviceberry	6%
<i>Artemisia tridentata</i> spp. <i>Vaseyana</i>	Mountain sagebrush	4%
<i>Cercocarpus montanus</i>	Mountain mahogany	5%
<i>Symphoricarpos oreophilus</i>	Mountain snowberry	5%

Erosion Control – Mix #4

Four (4) areas (Table 10), totaling 0.29 acres have been identified for erosion prevention restoration seeding. These areas are identified by steep, eroding hillside with bare soils and minimal vegetation cover. This seed mix was created as an aggressive, native grass mixture developed for quick establishment on highly disturbed sites, and areas where erosion and weed control is a priority. Regreen, a hybrid sterile cover crop is included in the mix to provide quick cover as a nursery crop; providing initial cover to reduce weed establishment while allowing native species to establish. The intent of this mix is to re-vegetate areas of man-made or natural disturbances resulting in complete loss of vegetation where erosion and noxious vegetation is a concern.

Table 10. Erosion Control Restoration Seeding Areas

Erosion Control Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix	Seeding Method
2	376.2	0.03	95	#4 (1 lbs)	Hydroseeding
5	376.8	0.03	85	#4 (1 lbs)	Hydroseeding
6	376.9	0.07	136	#4 (2.31 lbs)	Hydroseeding
8	377.8	0.16	135	#4 (5.28 lbs)	Hydroseeding
Total		0.29	451	9.59 lbs	

Table 11. Erosion Control Seed Mix

376.2		
Scientific name	Common Name	Mix %
Graminoids		
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	25%
<i>Bromus marginatus</i>	Mountain brome	30%
<i>Pascopyrum smithii</i>	Western wheatgrass	20%
<i>Elymus glaucus</i>	Blue wildrye	25%
<i>Triticum aestivum x Elytrigia Elongata</i>	Regreen (sterile cover crop)	16 lbs/ac

Riparian/Scrub-shrub – Mix #5

One (1) area (Table 12) totaling 0.11 acres was identified for riparian/scrub-shrub restoration seeding. This area is located along a ditch lateral in a swale that parallels the trail, where the hydrology of the ditch will support a diversity of shrubs and herbaceous species that grow well in more mesic to wet conditions. This area has been identified as having high disturbances or poor vegetation quality along the ditch that are not regularly impacted or used as access areas for the ditch.

Table 12. Riparian/Scrub-shrub Restoration Seeding Areas

Native Grass and Forb Restoration Seeding Areas					
Recommended Restoration Area	Milepost #	Area (acres)	Linear Length (Feet)	Seed Mix (#)	Recommended Seeding Method
19	380	0.11	280	5 (1.83 lbs)	Broadcast
Total		0.21	280	1.83 lbs.	

Table 13. Riparian Scrub-shrub Seed Mix

Seed Mix #5. Riparian/Scrub-shrub Mix (16.5 lbs/acre)		
Scientific name	Common name	Mix%
Graminoids		
<i>Calamagrostis canadensis</i>	Bluejoint reedgrass	10%
<i>Elymus trachycalus</i>	Slender wheatgrass	15%
<i>Juncus arcticus</i>	arctic rush	8%
<i>Poa palustris</i>	fowl bluegrass	10%
<i>Pascopyrum smithii</i>	western wheatgrass	15%
<i>Stipa viridula</i>	green needlegrass	10%
Forbs		
<i>Erigeron speciosus</i>	Aspen daisy	5%
<i>Heracleum maximum</i>	cow parsnip	3%
<i>Maiathemum stellatum</i>	false Solomonseal	3%
<i>Mentha arvensis</i>	wild mint	2%
<i>Monarda fistulosa</i>	wildbergamot beebalm	2%
<i>Solidago canadensis</i>	Canada goldenrod	2%
<i>Thalictrum fendleri</i>	meadowrue	2%
<i>Vicia american</i>	American vetch	3%
Shrubs		
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	3%
<i>Rhus trilobata</i>	skunkbush sumac	3%
<i>Ribes cereum</i>	wax current	2%
<i>Rosa woodsii</i>	Woods rose	2%

B. 2021 Restoration Priority Areas

Five (5) areas were identified for priority restoration activities for the year 2021. Areas Identified are included in Table 12. Below, and detailed locations of these areas are provided in *Appendix 2 – 2021 Restoration Priority Areas*. Specific approaches for each restoration priority area have been identified and outlined in detail in the sections below, describing site specific methods and management for each.

Table 12. 2021 Restoration Priority Areas

2021 Restoration Priority areas							
Restoration Priority	Impairment area #	Length (Feet)	Area (acres)	Seed Mix	Seeding Rate	Seeding Method	Total lbs of Mix Needed
1	2	95	.03	4	33 lbs/acre	Hydroseeding	1
2	6	136	0.07	4	33 lbs/acre	Hydroseeding	2.31
3	15	1030	1.43	2	18 lbs/acre	Broadcast	25.74
4	16	410	0.53	2	18 lbs/acre	Broadcast	9.54
5	17	475	0.39	3	18 lbs/acre	Broadcast	7.02

Restoration Priority 1

This 0.03-acre area is located at mile-marker 376.2 and has been identified as a top priority due its steep slope with high erosion potential associated with the areas of poor vegetation cover and bare soils on areas directly up slope of the trail. It is located within the steep, sloping portion of the trail at the lower entry to the wilderness section, with steep north facing slopes along the southern bank of the Roaring Fork River. Seed mix #4 should be used throughout, as erosion control and rapid establishment of vegetation are the top priorities for this area. The following means/methods are recommended specific to this site:

1. Manage vegetation, creating a weed free planting surface.
2. Preserve well established and establishing chokecherry in scattered densities throughout the slope and seeding area.
3. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
4. Blow compost or topsoil with soil amendments added onto gravelly slope to a depth of 4-6 inches. Vegetation establishment is poor in coarse, gravelly to rocky soils, applying compost or topsoil will provide a medium for seeding establishment.
5. Universally apply seed via hydroseeding method using provided seed mix # 4 at a rate of 33 lbs./acre.
6. Stabilize seeded slope using Hydraulic mulch and tackifier.
7. Protect seeded areas from foot traffic and wildlife, installing temporary fencing at the foot of the slope until vegetation is well established.
8. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 8 – View looking east (up valley) at priority area 1.



Figure 9 - View looking west (down valley) at priority area 1.

Restoration Priority 2

This 0.07-acre area is located at mile-marker 376.9 and has been identified as a top priority due to its steep slope with high erosional potential associated with the areas of poor vegetation cover and bare soils on areas directly up slope of the trail. It is located within the steep canyon area at the lower entry to the wilderness section, with steep north facing slopes along the southern bank of the Roaring Fork River. Seed mix #4 should be utilized throughout, as erosion control and rapid establishment of vegetation are the top priorities for this area. The following means/methods are recommended specific to this site:

1. Manage vegetation, creating a weed free planting surface.
2. Preserve well established sage brush and chokecherry in scattered densities throughout the slope and seeding area.
3. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
4. Blow compost or topsoil with soil amendments added onto gravelly slope to a depth of 4-6 inches. Vegetation establishment is poor in coarse, gravelly to rocky soils, applying compost or topsoil will provide a medium for seeding establishment.
5. Universally apply seed via hydroseeding method using provided seed mix # 4 at a rate of 33 lbs./acre.
6. Stabilize seeded slope using Hydraulic mulch and tackifier.
7. Protect seeded areas from foot traffic and wildlife, installing temporary fencing at the foot of the slope until vegetation is well established
8. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 10 - View looking east (up valley) at priority area 2.



Figure 11 – View looking west (up valley) at priority area 2.

Restoration Priority 3

This 1.43-acre area is the largest recommended restoration area and is located on both sides of the trail at the upper end of the trail segment at mile-marker 381.5. It is surrounded by low density rural and agricultural development, resulting in large expanses of ruderal conditions throughout this portion of the trail corridor. This location provides great opportunity to develop functioning sagebrush shrublands within the trail corridor. The following means/methods are recommended specific to this site:

1. Manage vegetation, creating a weed free planting surface and removing competing vegetation.
2. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
3. Clear dead willow patch.
4. Loosen and scarify soil to a minimum depth of 2 inches, using a combination of hand tools or lightly tilling using an ATV with a tiller or drag chain harrow connection.
5. Apply soil amendments, recommended fertilizer for all seeding activities is **Biosol Forte 7-2-1** applied at rate of 50-60 lbs./acre. Substitutions may be made based upon differing needs from site specific soil test results.
6. Universally spread seed using broadcast seeding methods and seed mix #2 at a rate of 18 lbs./acre.
7. Immediately following seeding and fertilization, disperse certified weed free straw, uniformly covering the area without any major gaps.
8. Apply organic tackifier at rate of 150 lbs./acre to completely cover weed free straw mulch immediately following installation of mulch.
9. Protect seeded areas from foot traffic and wildlife, installing temporary fencing until vegetation is well established.
10. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 12 - dead willow stand to removed (south side of trail).



Figure 13 & 14 - View Looking SE at high density smooth brome with native rabbit brush pockets along the trail edge.

Restoration Priority 4

This 0.53-acre area is located at mile-marker 381.5, and with its close proximity to priority #3, will restore an expansive sagebrush shrubland through this section of trail. This area has moderately steep slopes with high density of noxious and non-native weedy vegetation on the southern side of the trail, with more flat topography along the northern side. This area has been identified as a priority to help enhance and connect the surrounding sagebrush communities. providing a greater aesthetic and ecological benefit. The following means/methods are recommended specific to this site:

1. Manage vegetation, creating a weed free planting surface and removing competing vegetation.
2. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
3. Loosen and scarify soil to a minimum depth of 2 inches, using a combination of hand tools or lightly tilling using an ATV with a tiller or drag chain harrow connection.
4. Apply soil amendments, recommended fertilizer for all seeding activities is **Biosol Forte 7-2-1** applied at rate of 50-60 lbs./acre.



Figure 15 - view southside of trail, with moderate slope and noxious and weedy vegetation.

- Substitutions may be made based upon differing needs from site specific soil test results.
5. Universally spread seed using hand broadcast seeding methods and seed mix #2 at a rate of 18 lbs./acre.
 6. Immediately following seeding and fertilization, disperse certified weed free straw, uniformly covering the area without any major gaps.
 7. Apply organic tackifier at rate of 150 lbs./acre to completely cover weed free straw mulch immediately following installation of mulch.

9. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 16 - View looking west (down valley) and north side of trail.



Figure 17 - View of southern slope and surrounding of priority 4.

Restoration Priority 5

This 0.39-acre area is located at mile-marker 381.7, on either side of the bridge spanning Sopris Creek. The areas immediately adjacent to and above the creek are in a ruderal condition with poor vegetation establishment. Yellow sweet clover is the dominant vegetation and shrub establishment is nonexistent. Establishing native vegetation, including shrub species, will help stabilize the banks to the creek and reduce runoff in the area. Additionally, the native vegetation will provide many aesthetical and ecological benefits. The following means/methods are recommended specific to this site:

1. Manage vegetation, creating a weed free planting surface and removing competing vegetation.
2. Remove any dead vegetation (thatch) and woody debris from the seeding area prior to seeding. Removal of thatch will help ensure maximum soil contact with the seed.
3. Remove large rocks to greatest extent possible.
4. Loosen and scarify soil to a minimum depth of 2 inches, using a combination of hand tools or lightly tilling using an ATV with a tiller or drag chain harrow connection on the flat section above the creek and utilizing hand tools on the slopes and areas adjacent to the creek.
5. Apply soil amendments, recommended fertilizer for all seeding activities is ***Biosol Forte 7-2-1*** applied at rate of 50-60 lbs./acre. Substitutions may be made based upon differing needs from site specific soil test results.
6. Universally spread seed using broadcast seeding methods and seed mix #3 at a rate of 18 lbs./acre.
7. Immediately following seeding and fertilization, disperse certified weed free straw, uniformly covering the area without any major gaps.
8. Install straw waddles along the moderate banks to the creek to control runoff and water velocity during rain events.
9. Apply organic tackifier at rate of 150 lbs./acre to completely cover weed free straw mulch immediately following installation of mulch.
10. Protect seeded areas from foot traffic and wildlife, installing temporary fencing until vegetation is well established
11. Continue to monitor site and maintain free of competing weedy vegetation.



Figure 18 - flat, upland expanse above Sopris Creek (view to the E.



Figure 19 –View of slope to western bank of Sopris Creek.

C. Seeding Methods, Soil Preparation and Erosion Control

Seeding Methods

Once the appropriate seed mix is selected for the area to be restored, the method of applying the seed will need to be determined. Determining the method of application will be dependent on the existing site conditions. Some of the factors influencing method selection are; site access, the size and slope of the area to be seeded, and existing vegetative and substrate conditions. The method used for seeding will determine the seeding application rate and necessary preparation of the seedbed.

The timing for seeding activities is essential to the overall success, as water is a critical element needed for establishment. Without access to consistent irrigation, it is important to time seeding efforts when water is most naturally abundant to the germinating seedlings. In the arid climate of the west, there are three (3) time periods to be considered to optimize available moisture. These include:

1. Fall dormant seeding (mid-October to early November)
2. Early spring, following melting of snow on site (mid-April to May)
3. Summer monsoon months (mid-July to early August)

Given varying climatic conditions from year-to-year, there is no guarantee that any of these given times will provide the adequate moisture needed, and special attention should be given to climatic conditions and trends when choosing the proper time to seed.

Broadcast seeding is performed either with mechanical “cyclone” seeders, by hand seeding, or by other methods that scatters seed over the bare soil surface. When broadcast seeding, it is essential that steps be taken to ensure good seed to soil contact. It is recommended that seeding is completed with two separate applications crossing the area at right angles to one another to guarantee even coverage. Broadcast seeding methods are recommended for all restoration seeding areas not specified for erosion control restoration seeding activities.

Drill seeding and the use of a no-till-drill is recommended for large, continuous sites with rolling to flat topography. It is also a useful method for inter-seeding native pastures and restoration areas where an increased diversity of vegetation is desired. Drill-seeding allows for the establishment of native stands of vegetation with minimal impacts and disturbances to the soil. Drill seeding is most appropriate for level ground. Do not attempt to drill seed slopes greater than 3:1. Drill seeding application is limited by the ability to safely use equipment on steep slopes. The majority of the suggested seeding areas throughout the corridor are not suitable for drill seeding efforts, however, recommended seeding area’s 15 and 16 may be large enough area’s with flat topography to lend themselves well to drill seeding efforts.

Hydroseeding is recommended for areas with steep slopes and where access by foot and other equipment is limited and broadcast seeding is not achievable. Seed should be applied evenly across the entire sight at the suggested seeding rate, using a fan-type nozzle and approximately 500 gallons of water per acre for the slurry mixture. It is a great option for erosion control seeding efforts and it is recommended that restoration areas located along the steep north facing canyon wall at the lower end of the project extent.

Do not seed during high winds or when the ground is frozen or otherwise unable to be worked. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage. If possible, deliver seed to site location in the original unopened containers and keep all certified labels for proper record keeping.

Soil Preparation

Prior to seeding, all remnant gravel/cobble material should be removed from the site and the soils should be completely free of weeds and other competing vegetation. If a layer of thatch (dead vegetation) covers most of the soil, burn or mow and rake the area so your seed will come in contact with the soil when you put it down. Soil preparation includes scarification or tilling as necessary, areas with highly compacted soils may need to be ripped or disked and areas where light soil compaction exists hand tilling and raking may suffice. Loosen subgrade to a minimum depth of 2 inches and maximum depth of 6 inches. A fertilizer that provides key nutrients to the plants in early growth stages and acts as quick acting germination seeding supplement should be utilized to promote better establishment of newly seeded vegetation.

If topsoil is necessary, do not spread if planting soil or subgrade is frozen, muddy, or excessively wet. Spread approximately ½ the thickness of planting soil over loosened subgrade. Mix thoroughly into top 6" of subgrade. Spread remainder of planting soil and loosen the surface of areas to be seeded with hand rakes before applying seed. Limited disturbance of previously established seeded areas may leave the existing root mass and structure in place as evidenced by regeneration of the existing grasses. Observe level of disturbance and compaction of the soil; removal of detritus, light scarifying (harrow) and topdressing, followed by over seeding may be suitable in these areas.

Erosion Control and Protection of Seeded areas

It is important to protect seeded areas against erosion by uniformly spreading straw mulch after completion of seeding operations. Spread the straw mulch uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1-1/2-inches (38-mm) loose depth over seeded areas. Spread by hand, blower, or other suitable equipment. Alternatively, Hydrostraw (800) 545-1755 may be applied at a rate of 2,500 lbs./acre. Once spread, anchor the straw mulch by crimping into topsoil by suitable mechanical Equipment, followed by application of tackifier via hydroseeder. Anchoring is not necessary if using tackified Hydrostraw. Protect seeded slopes exceeding 3:1 against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.

It will also be essential to protect the seeded areas from pedestrian foot traffic, following the completion of seeding and erosion control efforts, barriers should be placed around the seeded area to sufficiently keep pedestrians from accessing the area until establishment of desired vegetation.

Monitoring and Maintenance

The purpose of post-restoration monitoring is to evaluate the long-term vegetative cover and density, habitat quality and noxious and invasive weed densities, as well as assessing the stability of soils in areas where erosion has been an issue. Monitoring of restoration areas should include both qualitative and quantitative analysis. Monitoring should occur for a minimum of three years following restoration seeding activities.

Through quantitative analysis, the success of the reseeding activities should be monitored and assessed on a yearly basis for at least 3 years. Vegetation sampling plots will be used to measure plant density, cover, and bare ground. Additionally, it is important to monitor the establishment of weed species in accordance with the Roaring Fork Transportation Authority Integrated Weed Management Policy and Plan. Newly established weed infestations need to be identified and treated regularly to help insure the establishment of desired vegetation. Following the restoration seeding efforts, other disturbances that may hinder restoration of the newly seeded areas need to be monitored and assessed. Identification of any disturbances such as animal grazing and disturbances or unauthorized pedestrian traffic will need to be addressed immediately and closely monitored.

Restoration seeding efforts will generally be considered successful when vegetation within the restored areas supports non-noxious plants that are similar in forb, graminoid, and woody plant density and cover to those growing similar, undisturbed vegetation communities. Where initial restoration and plant establishment efforts fail to make progress towards meeting plant establishment standards after 3 years, reseeding may be necessary on portions of the of the Rio Grande Trail Right-of-Way.

Contractor List

Triton Environmental

Laura Finch: Phone: 720-557-5842

<http://tritonenviro.com/>

Hydrostraw Distributor - Rivendell Sod

<http://rivendelldistribution.com/>

Phone: 970-945-2568

Flexterra

<http://www.profilevs.com/products/hydraulic-erosion-control/flexible-growth-medium-fgm>

Native Seed Distributers:

Pawnee Buttes Seed Inc.

<http://www.pawneebutteseed.com>

Phone: 800-782-5947

Arkansas Valley Seed.

<http://www.avseeds.com>

Phone: 303-320-7500

Granite Seed and Erosion Control

<https://graniteseed.com/>

Phone: 720-496-0600

Rivendell Sod Farm

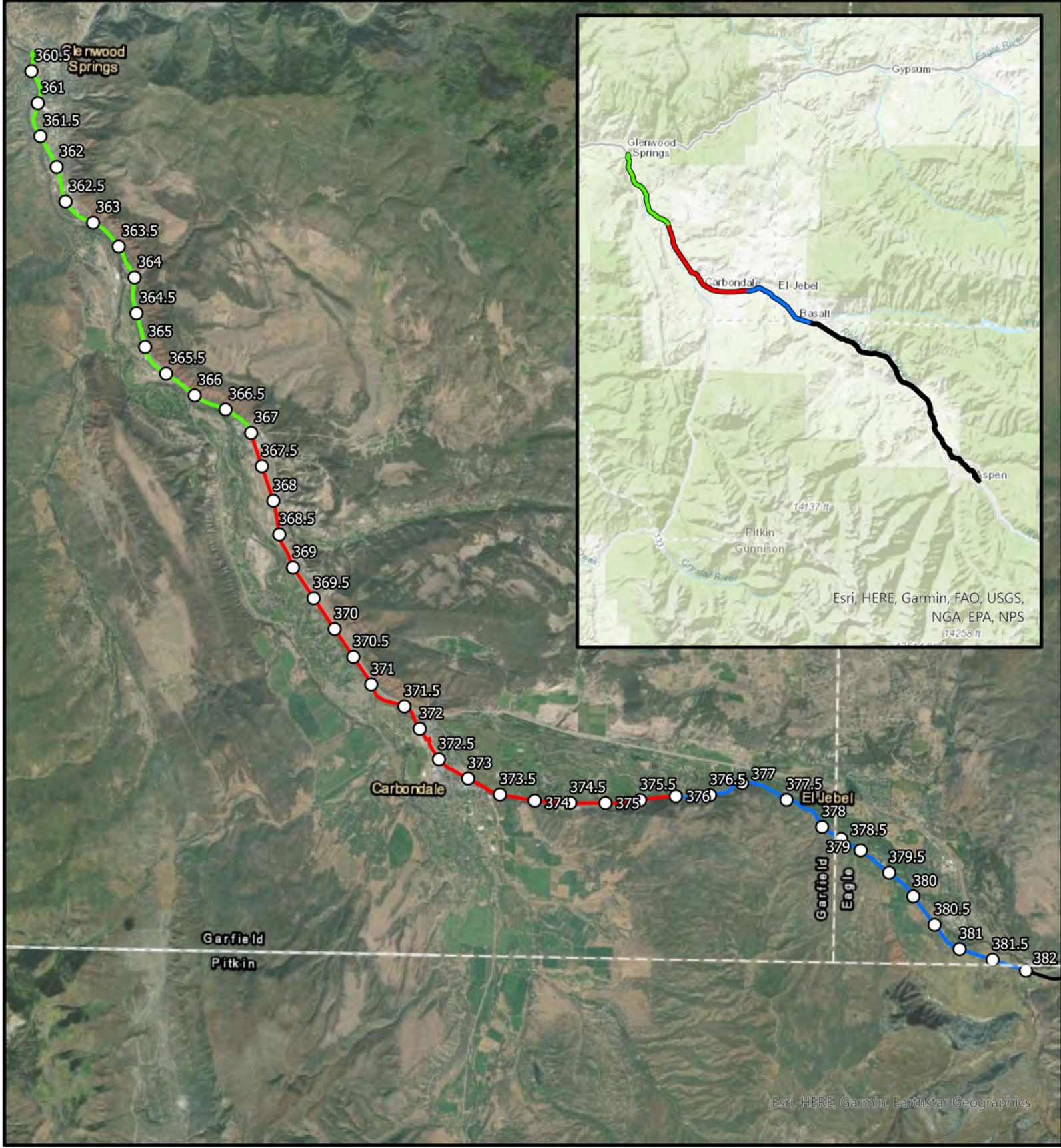
<https://rivendellsodfarm.com/>

Phone: 970-945-2468

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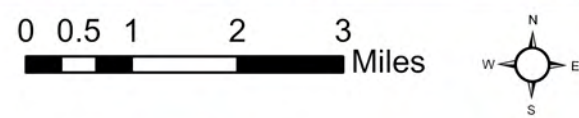
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Accessed November, 2019.

APPENDIX 1 – RIO GRANDE TRAIL RESTORATION
SEEDING PLAN PROJECT OVERVIEW MAP

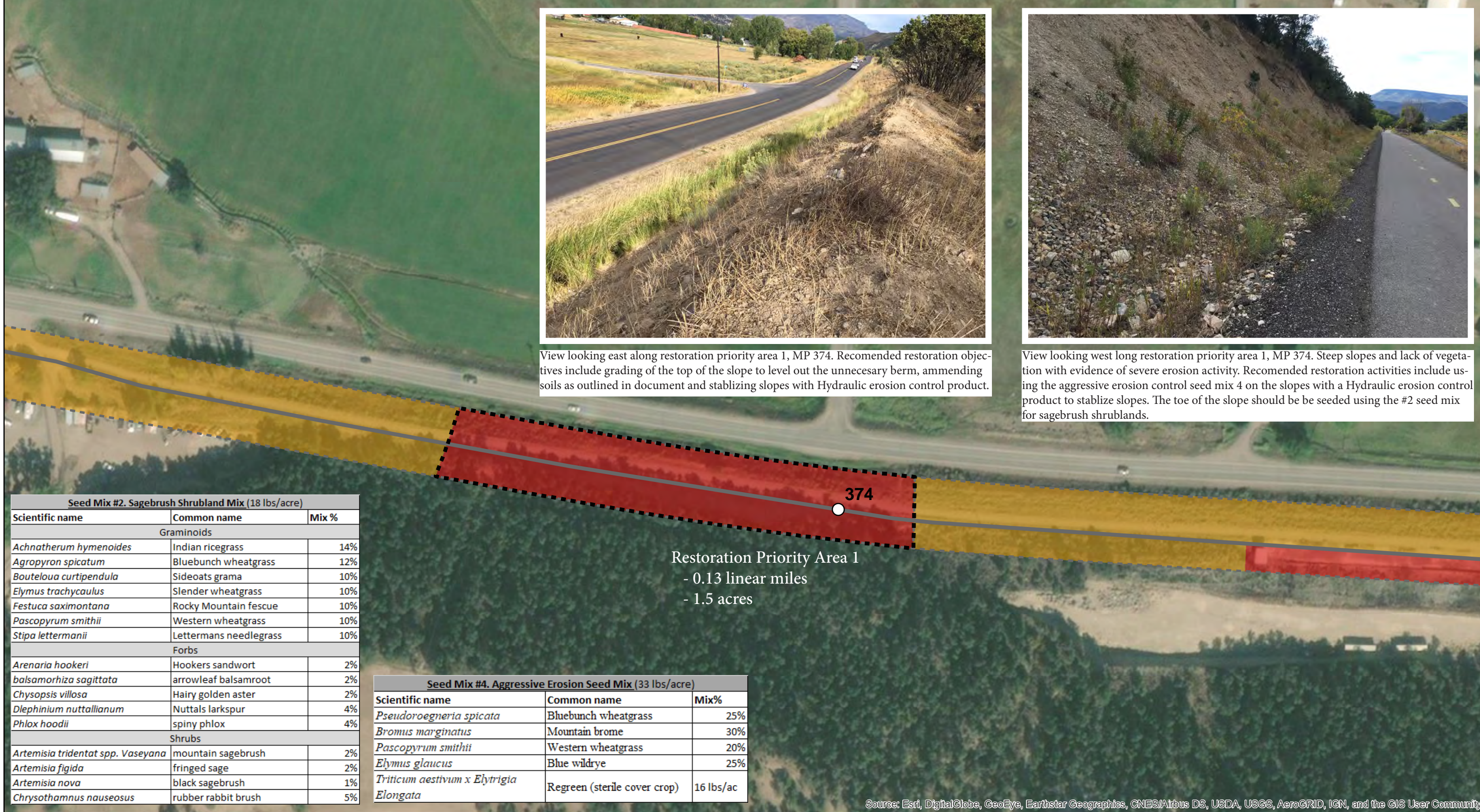


Rio Grande Trail Restoration Seeding Project Extent Overview Map

- Trail Segment
- Phase 1 (mm 367-376)
 - Phase 2 (mm 360-367)
 - Phase 3 (mm 376-382)
- Historic Railroad Milepost #
- Rio Grande Trail Extent



APPENDIX 2 – 2021 RESTORATION PRIORITY AREAS



View looking east along restoration priority area 1, MP 374. Recommended restoration objectives include grading of the top of the slope to level out the unnecessary berm, amending soils as outlined in document and stabilizing slopes with Hydraulic erosion control product.



View looking west along restoration priority area 1, MP 374. Steep slopes and lack of vegetation with evidence of severe erosion activity. Recommended restoration activities include using the aggressive erosion control seed mix 4 on the slopes with a Hydraulic erosion control product to stabilize slopes. The toe of the slope should be seeded using the #2 seed mix for sagebrush shrublands.

Seed Mix #2. Sagebrush Shrubland Mix (18 lbs/acre)		
Scientific name	Common name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	14%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	12%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Elymus trachycaulus</i>	Slender wheatgrass	10%
<i>Festuca saximontana</i>	Rocky Mountain fescue	10%
<i>Pascopyrum smithii</i>	Western wheatgrass	10%
<i>Stipa lettermanii</i>	Lettermans needlegrass	10%
Forbs		
<i>Arenaria hookeri</i>	Hookers sandwort	2%
<i>balsamorhiza sagittata</i>	arrowleaf balsamroot	2%
<i>Chrysopsis villosa</i>	Hairy golden aster	2%
<i>Dlephinium nuttallianum</i>	Nuttals larkspur	4%
<i>Phlox hoodii</i>	spiny phlox	4%
Shrubs		
<i>Artemisia tridentat spp. Vaseyana</i>	mountain sagebrush	2%
<i>Artemisia figida</i>	fringed sage	2%
<i>Artemisia nova</i>	black sagebrush	1%
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	5%

Seed Mix #4. Aggressive Erosion Seed Mix (33 lbs/acre)		
Scientific name	Common name	Mix%
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	25%
<i>Bromus marginatus</i>	Mountain brome	30%
<i>Pascopyrum smithii</i>	Western wheatgrass	20%
<i>Elymus glaucus</i>	Blue wildrye	25%
<i>Triticum aestivum x Elytrigia Elongata</i>	Regreen (sterile cover crop)	16 lbs/ac

Restoration Priority Area 1
 - 0.13 linear miles
 - 1.5 acres

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Grande Trail Restoration Seeding Report

Reccomended Restoration Zone 1



Legend

- Mileposts #
- ⬜ Restoration Priority Area
- Rio Grande Trail
- Low
- Moderate
- Significant

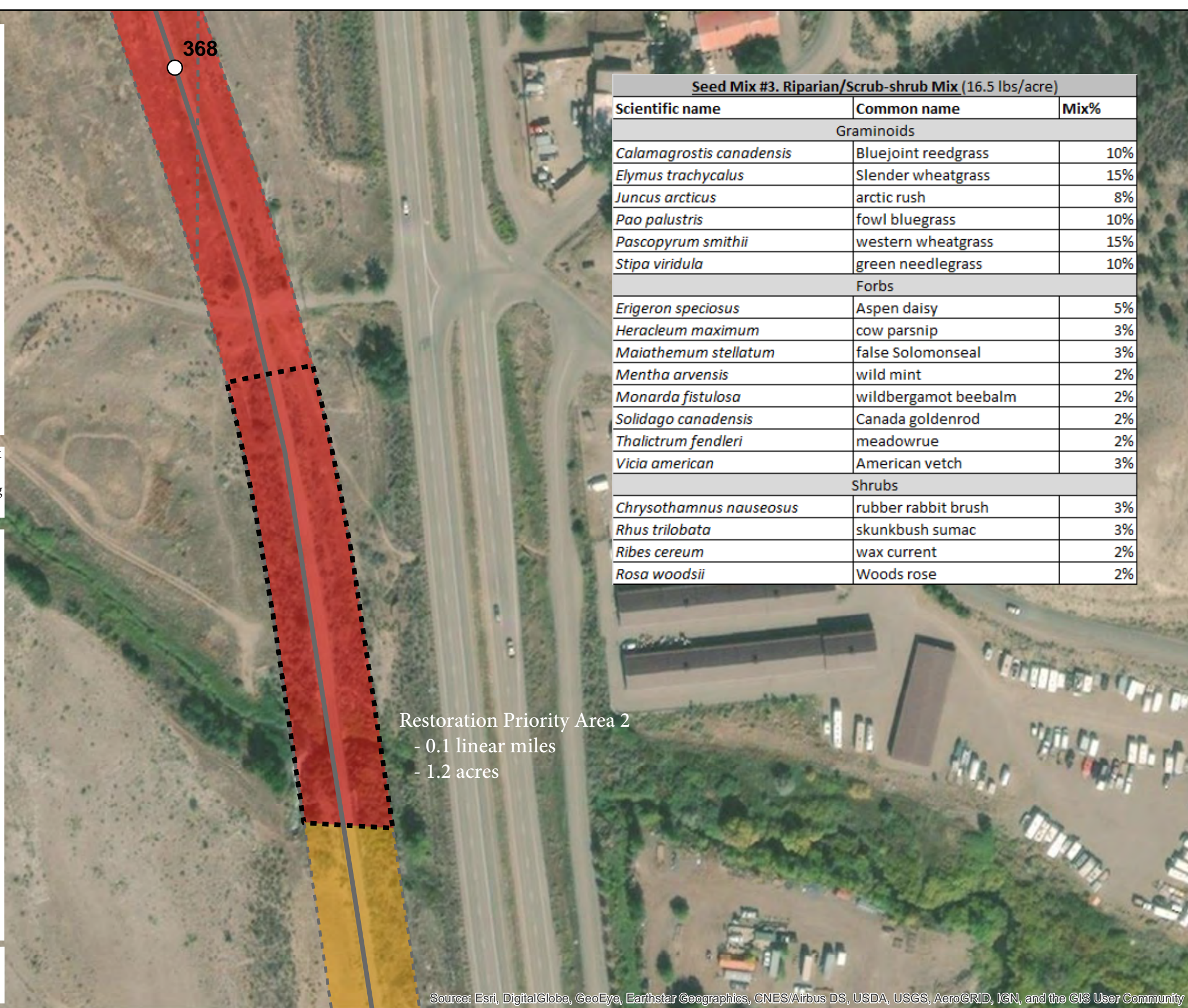




Photo 1. View looking west long restoration priority area 2, MP 368.1. Steep slope and lack of under-story vegetation with high potential for erosion. Recommended restoration activities include control of clematis, removal of gravel and preparation of topsoil, broadcast seeding effort and erosion control measures.



Photo 2. View looking south along restoration priority area 2, MP 368.1. Recommended restoration objectives include retention of shrub layer and control of cheatgrass in addition to previously stated restoration activities.



Rio Grande Trail Restoration Seeding Report

Recommended Restoration Zone 2



Legend

- Mileposts #
- ⬜ Restoration Priority Area
- Rio Grande Trail
- Low
- Moderate
- Significant





Photo 1. View looking N along 2020 restoration priority area 3, MP 373. Recommended restoration objectives include control of annual weedy vegetation, removal of gravel/cobble for soil preparation and to improve soil contact with seed, seed area with *Seed Mix 1. Grass and Forb Mix*.



Photo 2. View looking NW along 2020 restoration priority area 3, MP 373. Recommended restoration objectives include control of annual weedy vegetation, removal of gravel/cobble for soil preparation and to improve soil contact with seed, seed area with *Seed Mix 1. Grass and Forb Mix*.

Seed Mix #1. Native Grass and Forbs Mix (19.5 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	12%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	14%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Bouteloua gracilis</i>	Blue grama	10%
<i>Koeleria macrantha</i>	Prairie junegrass	8%
<i>Elymus trachycaulus</i>	Slender wheatgrass	12%
<i>Stipa comata</i>	Needle and thread	12%
Forbs		
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot	2%
<i>Chrysopsis villosa</i>	Hairy golden aster	1%
<i>Delphinium nuttallianum</i>	Nuttall's larkspur	1%
<i>Gaillardia aristata</i>	Blanket flower	1%
<i>Ipomopsis aggregata</i>	Skyrocket gilia	2%
<i>Penstemon strictus</i>	Rocky Mountain penstemon	8%
<i>Phlox hoodii</i>	Spiny phlox	4%
<i>Ratibida columnifera</i>	Prairie coneflower	2%
<i>Sphaeralcea coccinea</i>	Scarlet globemallow	1%

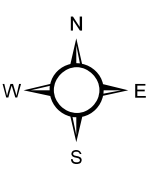
373

Restoration Priority Area 3
 - 0.1 linear miles
 - 0.55 acres

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Grande Trail Restoration Seeding Reccomended Restoration Area 3

Date: December 2019
 Author: DHM Design



Legend

- Milepost # Restoration
- ⋯ Priority Area
- Rio Grande Trail

Impairment

- Low
- Moderate
- Significant

Projected Coordinate System:
 NAD_1983_StatePlane_Colorado_Central_



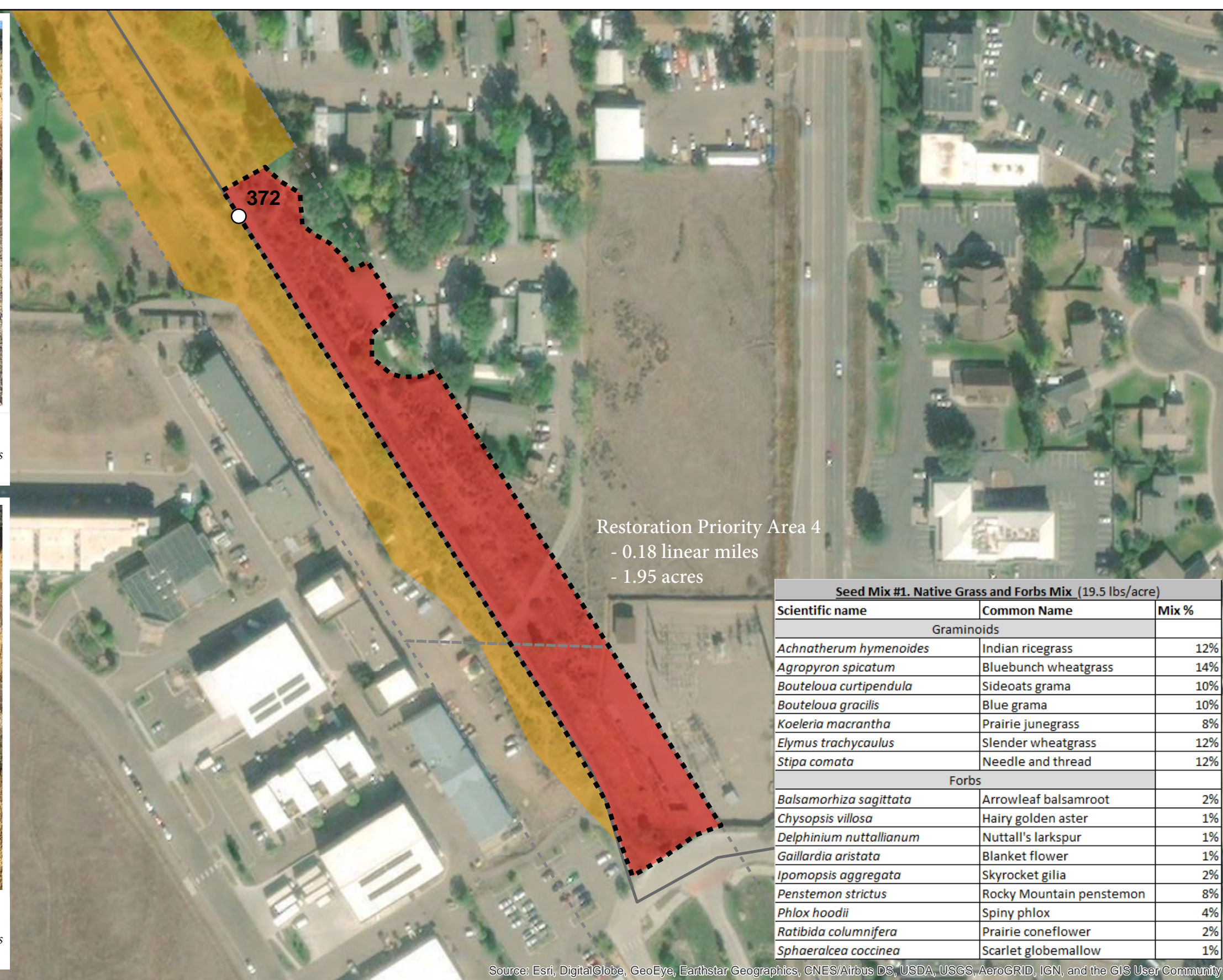
DHM DESIGN



Photo 1. View looking N along 2020 restoration priority area 3, MP 373. Recommended restoration objectives include control of annual weedy vegetation, removal of gravel/cobble for soil preparation and to improve soil contact with seed, seed area with *Seed Mix 1. Grass and Forb Mix*.



Photo 2. View looking NW along 2020 restoration priority area 3, MP 373. Recommended restoration objectives include control of annual weedy vegetation, removal of gravel/cobble for soil preparation and to improve soil contact with seed, seed area with *Seed Mix 1. Grass and Forb Mix*.

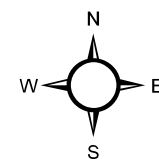


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Grande Trail Restoration Seeding Recommended Restoration Area 4

Legend

- Milepost #
- ⬜ Restoration Priority Area
- Rio Grande Trail
- Low
- Moderate
- Significant



1:1,500



DHM DESIGN

0 150 300 600 Feet



View looking NW at Restoration Priority Area 1 from Rio Grande trail. Establishing native grasses along the poorly vegetated bank using seed mix #4 will help prevent erosion and provide aesthetical and ecological benefits.



View Looking NW at Restoration Priority Area 1 for newly constructed trail. Bare soil areas should be seeded with seed mix #4 to provide quick establishment of native grasses to compete with noxious vegetation and to stabilize the soil.

Seed Mix #4. Aggressive Erosion Seed Mix (33 lbs/acre)		
Scientific name	Common name	Mix%
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	25%
<i>Bromus marginatus</i>	Mountain brome	30%
<i>Pascopyrum smithii</i>	Western wheatgrass	20%
<i>Elymus glaucus</i>	Blue wildrye	25%
<i>Triticum aestivum x Elytrigia Elongata</i>	Regreen (sterile cover crop)	16 lbs/ac



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Restoration Seeding Priority 1

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- Restoration Priority Area
- Agricultural
- Low
- Moderate
- Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



DHM DESIGN

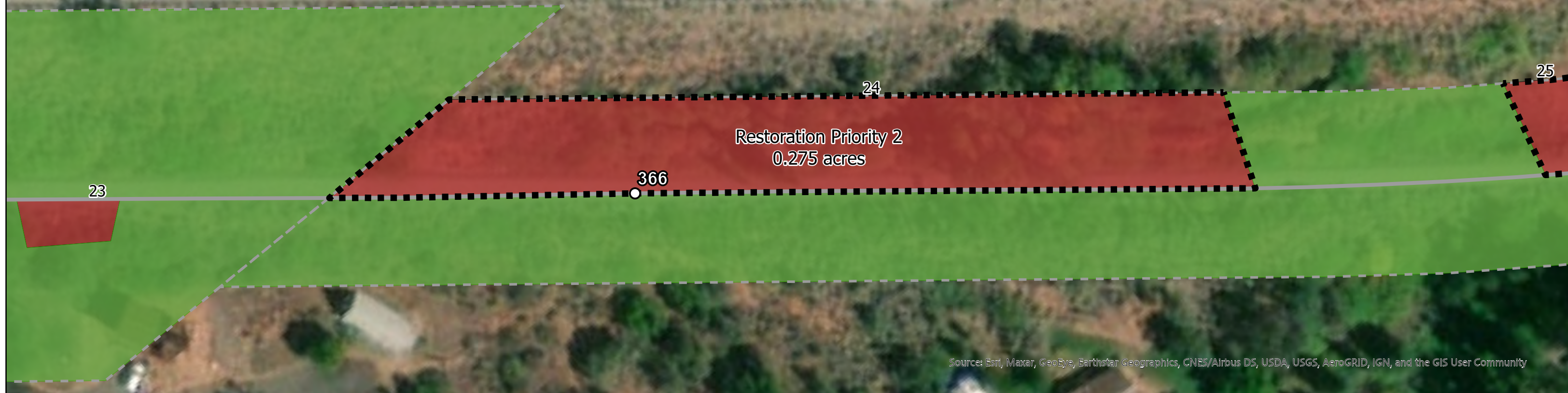


View looking NW at Restoration Priority Area 2 from Rio Grande trail. Managing cheatgrass and establishing native grasses along the poorly vegetated bank using seed mix #4 will help prevent erosion along the steep bank between the Glenwood Ditch and Rio Grande Trail.



View looking N at Restoration Priority Area 2 from Rio Grande trail. Establishing native grasses along large, bare areas on steep slopes using seed mix #4 will help prevent erosion along the steep bank between the Glenwood Ditch and Rio Grande Trail.

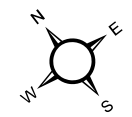
Seed Mix #4. Aggressive Erosion Seed Mix (33 lbs/acre)		
Scientific name	Common name	Mix%
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	25%
<i>Bromus marginatus</i>	Mountain brome	30%
<i>Pascopyrum smithii</i>	Western wheatgrass	20%
<i>Elymus glaucus</i>	Blue wildrye	25%
<i>Triticum aestivum x Elytrigia Elongata</i>	Regreen (sterile cover crop)	16 lbs/ac



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Restoration Seeding Priority 2

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- Restoration Priority Area
- Agricultural
- Low
- Moderate
- Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



DHM DESIGN



View looking NW at Restoration Priority Area 3 from Rio Grande trail. Highly disturbed area with high densities of non-native vegetation amongst sagebrush community. Manage non-native vegetation and seed area using seed mix #2 to improve vegetative conditions.



View looking E at Restoration Priority Area 3 from Rio Grande trail. Highly disturbed area with high densities of non-native vegetation, managing the non-native vegetation and seeding area with seed mix #2 will improve vegetative conditions.

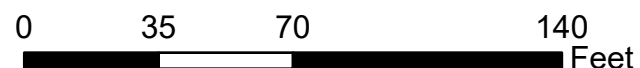
Seed Mix #2. Sagebrush Shrubland Mix(18 lbs/acre)		
Scientific name	Common name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	14%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	12%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Elymus trachycaulus</i>	Slender wheatgrass	10%
<i>Festuca saximontana</i>	Rocky Mountain fescue	10%
<i>Pascopyrum smithii</i>	Western wheatgrass	10%
<i>Stipa lettermanii</i>	Lettermans needlegrass	10%
Forbs		
<i>Arenaria hookeri</i>	Hookers sandwort	2%
<i>balsamorhiza sagittata</i>	arrowleaf balsamroot	2%
<i>Chysopsis villosa</i>	Hairy golden aster	2%
<i>Dlephinium nuttallianum</i>	Nuttals larkspur	4%
<i>Phlox hoodii</i>	spiny phlox	4%
Shrubs		
<i>Artemisia tridentata spp. Vaseyana</i>	mountain sagebrush	2%
<i>Artemisia figida</i>	fringed sage	2%
<i>Artemisia nova</i>	black sagebrush	1%
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	5%



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Restoration Seeding Priority 3

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- Restoration Priority Area
- Agricultural
- Low
- Moderate
- Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



DHM DESIGN

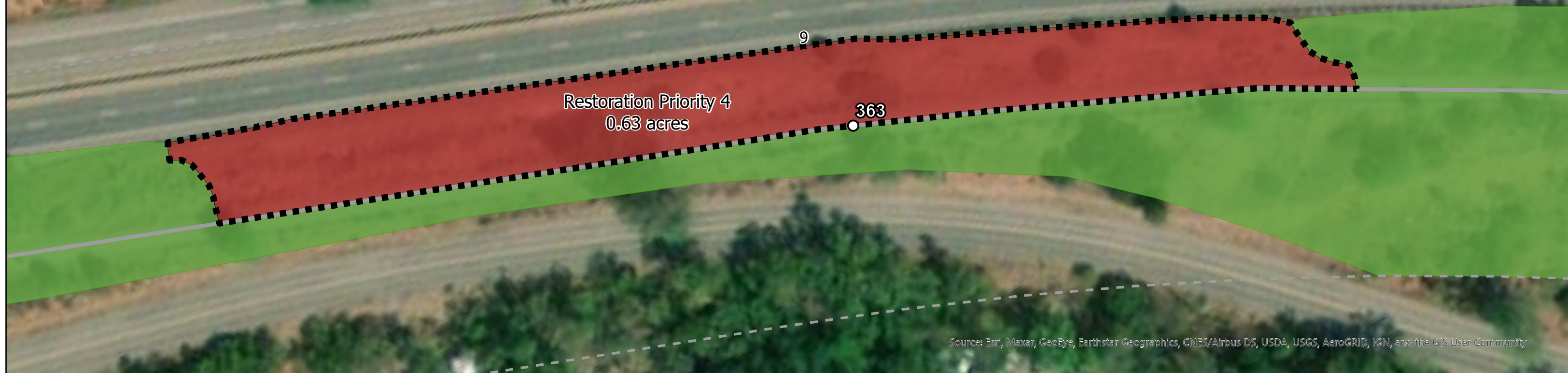


View looking N at Restoration Priority Area 4 from Rio Grande trail. Highly disturbed area with high densities of non-native vegetation amongst sagebrush community on moderate slope between HWY 82 and trail. Manage non-native vegetation and seed area using seed mix #2 to improve vegetative conditions.



View looking NW at Restoration Priority Area 4 from Rio Grande trail. Highly disturbed area with high densities of non-native vegetation amongst sagebrush community on moderate slope between HWY 82 and trail. Manage non-native vegetation and seed area using seed mix #2 to improve vegetative conditions.

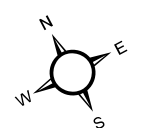
Seed Mix #2. Sagebrush Shrubland Mix(18 lbs/acre)		
Scientific name	Common name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	14%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	12%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Elymus trachycaulus</i>	Slender wheatgrass	10%
<i>Festuca saximontana</i>	Rocky Mountain fescue	10%
<i>Pascopyrum smithii</i>	Western wheatgrass	10%
<i>Stipa lettermanii</i>	Lettermans needlegrass	10%
Forbs		
<i>Arenaria hookeri</i>	Hookers sandwort	2%
<i>balsamorhiza sagittata</i>	arrowleaf balsamroot	2%
<i>Chysopsis villosa</i>	Hairy golden aster	2%
<i>Dlephinium nuttallianum</i>	Nuttals larkspur	4%
<i>Phlox hoodii</i>	spiny phlox	4%
Shrubs		
<i>Artemisia tridentata</i> spp. <i>Vaseyana</i>	mountain sagebrush	2%
<i>Artemisia frigida</i>	fringed sage	2%
<i>Artemisia nova</i>	black sagebrush	1%
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	5%



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Restoration Seeding Priority 4

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- ▣ Restoration Priority Area
- ▣ Agricultural
- ▣ Low
- ▣ Moderate
- ▣ Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet

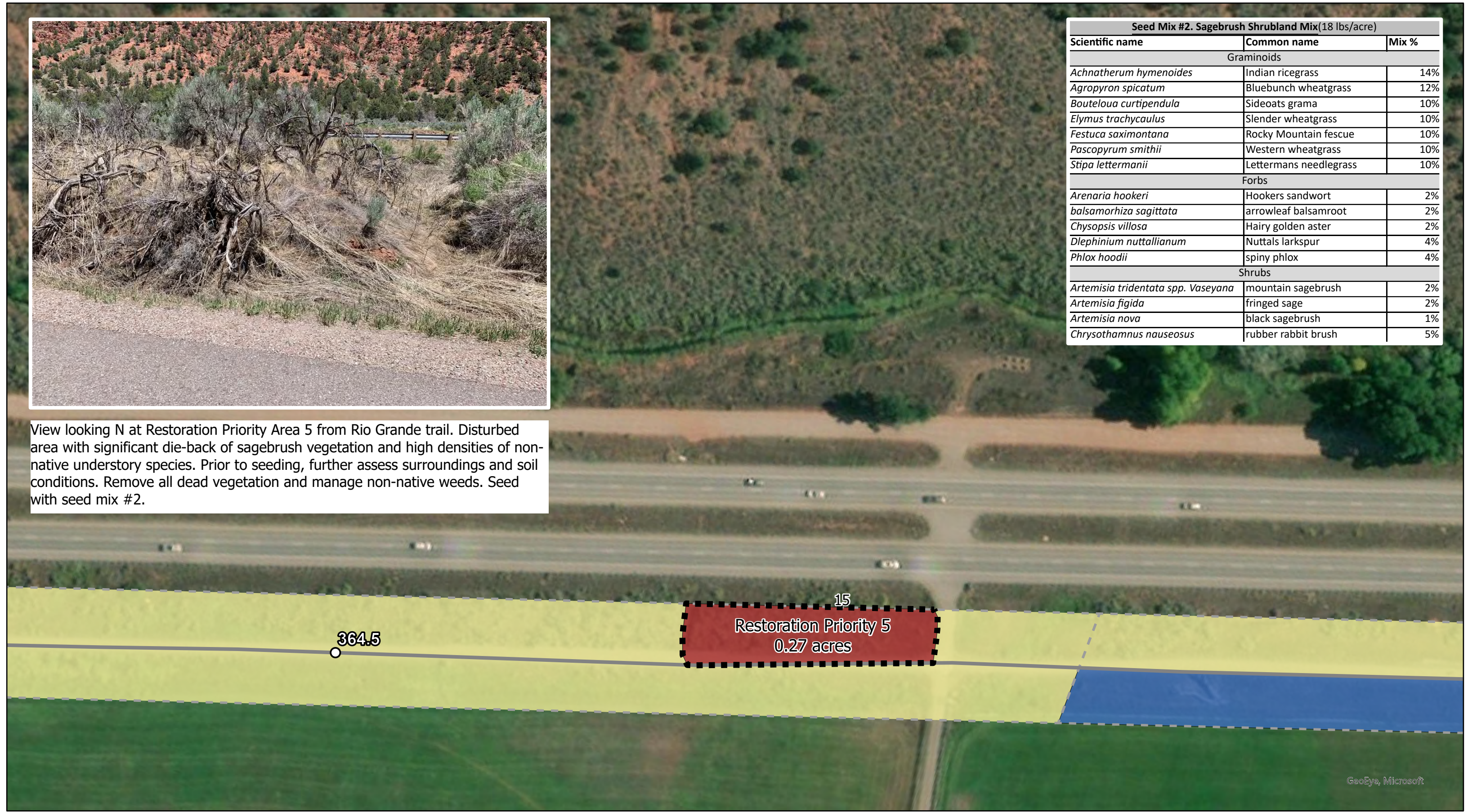


DHM DESIGN



View looking N at Restoration Priority Area 5 from Rio Grande trail. Disturbed area with significant die-back of sagebrush vegetation and high densities of non-native understory species. Prior to seeding, further assess surroundings and soil conditions. Remove all dead vegetation and manage non-native weeds. Seed with seed mix #2.

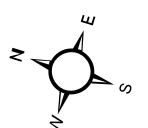
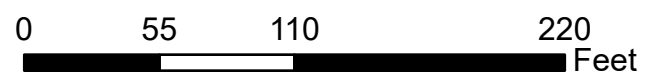
Seed Mix #2. Sagebrush Shrubland Mix (18 lbs/acre)		
Scientific name	Common name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	14%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	12%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Elymus trachycaulus</i>	Slender wheatgrass	10%
<i>Festuca saximontana</i>	Rocky Mountain fescue	10%
<i>Pascopyrum smithii</i>	Western wheatgrass	10%
<i>Stipa lettermanii</i>	Lettermans needlegrass	10%
Forbs		
<i>Arenaria hookeri</i>	Hookers sandwort	2%
<i>balsamorhiza sagittata</i>	arrowleaf balsamroot	2%
<i>Chysopsis villosa</i>	Hairy golden aster	2%
<i>Dlephinium nuttallianum</i>	Nuttals larkspur	4%
<i>Phlox hoodii</i>	spiny phlox	4%
Shrubs		
<i>Artemisia tridentata</i> spp. <i>Vaseyana</i>	mountain sagebrush	2%
<i>Artemisia figida</i>	fringed sage	2%
<i>Artemisia nova</i>	black sagebrush	1%
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	5%



GeoEye, Microsoft

Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Restoration Seeding Priority 5

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- Restoration Priority Area
- Agricultural
- Low
- Moderate
- Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



DHM DESIGN



View looking N at Restoration Priority Area 6 from Rio Grande trail. Disturbed area with compacted soils and high densities of noxious vegetation from access to the Glenwood Ditch. Coordinate efforts with ditch owners. Manage noxious vegetation and lightly till compacted soil prior to seeding area with seed mix #4.

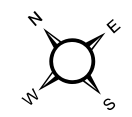
Seed Mix #4. Aggressive Erosion Seed Mix (33 lbs/acre)		
Scientific name	Common name	Mix%
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	25%
<i>Bromus marginatus</i>	Mountain brome	30%
<i>Pascopyrum smithii</i>	Western wheatgrass	20%
<i>Elymus glaucus</i>	Blue wildrye	25%
<i>Triticum aestivum x Elytrigia Elongata</i>	Regreen (sterile cover crop)	16 lbs/ac



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Restoration Seeding Priority 6

Author: DHM Design
Date: October 2020



Legend

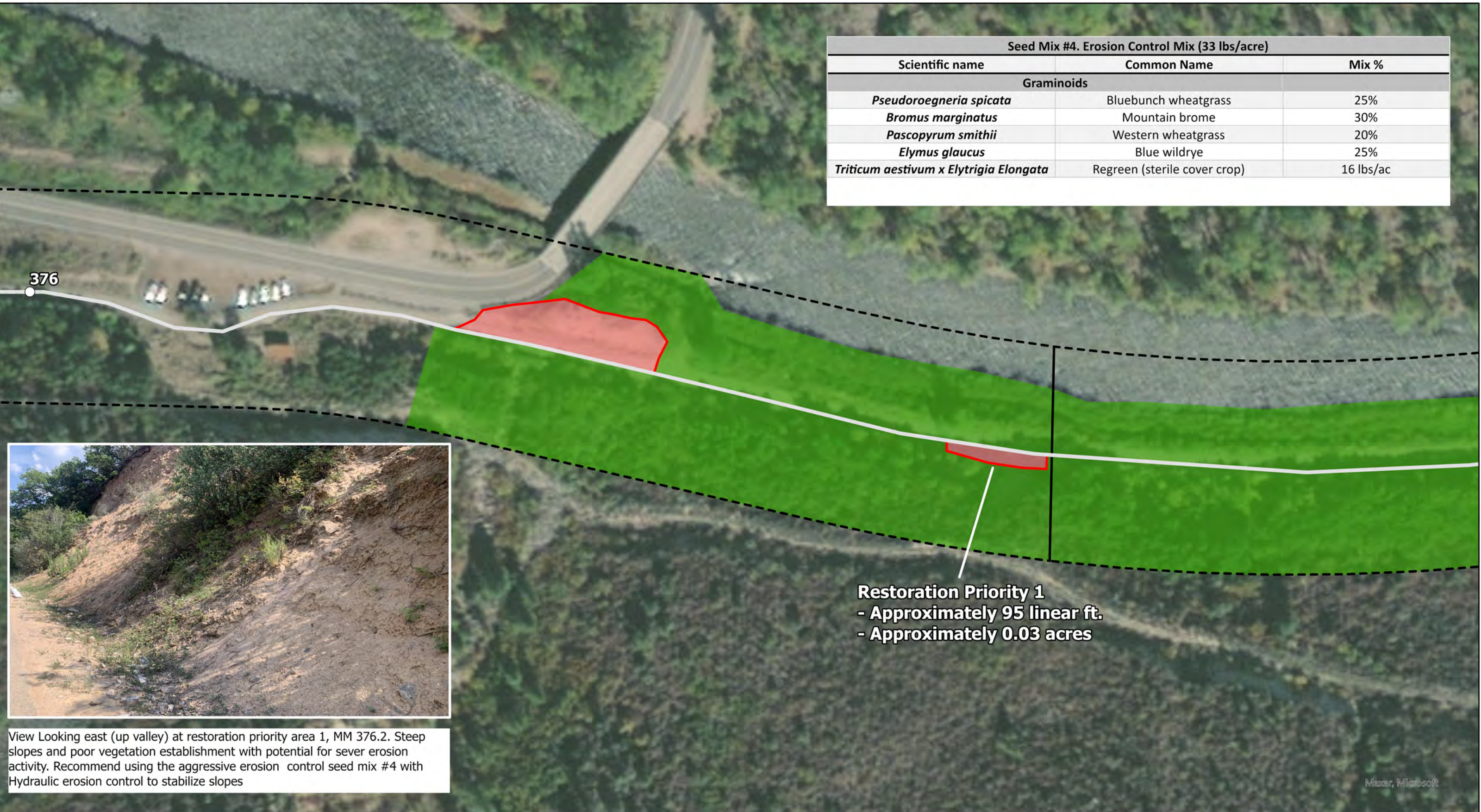
- Historic Railroad Mileposts #
- Rio Grande Trail
- ⋯ Restoration Priority Area
- Agricultural
- Low
- Moderate
- Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



DHM DESIGN

Seed Mix #4. Erosion Control Mix (33 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	25%
<i>Bromus marginatus</i>	Mountain brome	30%
<i>Pascopyrum smithii</i>	Western wheatgrass	20%
<i>Elymus glaucus</i>	Blue wildrye	25%
<i>Triticum aestivum x Elytrigia Elongata</i>	Regreen (sterile cover crop)	16 lbs/ac



Restoration Priority 1
 - Approximately 95 linear ft.
 - Approximately 0.03 acres



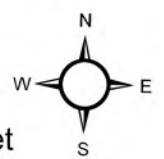
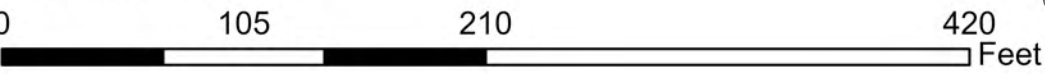
View Looking east (up valley) at restoration priority area 1, MM 376.2. Steep slopes and poor vegetation establishment with potential for sever erosion activity. Recommend using the aggressive erosion control seed mix #4 with Hydraulic erosion control to stabilize slopes

Maxar, Microsoft

Rio Grande Trail Restoration Seeding Recommended Priority Area 1

Author: DHM Design

Date: December 2021



- Historic Railroad Milepost #
- Rio Grand Trail Extent
- - - Rio Grande Trail ROW
- Impairment Rating
- ▨ Dirt road/shoulder
- Low
- Moderate
- Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
 URBAN DESIGN + LAND PLANNING
 ECOLOGICAL PLANNING



View Looking west (down valley) at restoration priority area 2, MM 376.9. Steep slopes and poor vegetation establishment with potential for severe erosion activity. Recommend using the aggressive erosion control seed mix #4 with Hydraulic erosion control to stabilize slopes

Restoration Priority 2
 - Approximately 136 linear ft.
 - Approximately 0.07 acres

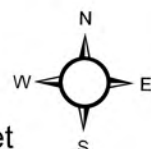
Seed Mix #4. Erosion Control Mix (33 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	25%
<i>Bromus marginatus</i>	Mountain brome	30%
<i>Pascopyrum smithii</i>	Western wheatgrass	20%
<i>Elymus glaucus</i>	Blue wildrye	25%
<i>Triticum aestivum x Elytrigia Elongata</i>	Regreen (sterile cover crop)	16 lbs/ac

Maxar, Microsoft

Rio Grande Trail Restoration Seeding Recommended Priority Area 2

Author: DHM Design

Date: December 2021

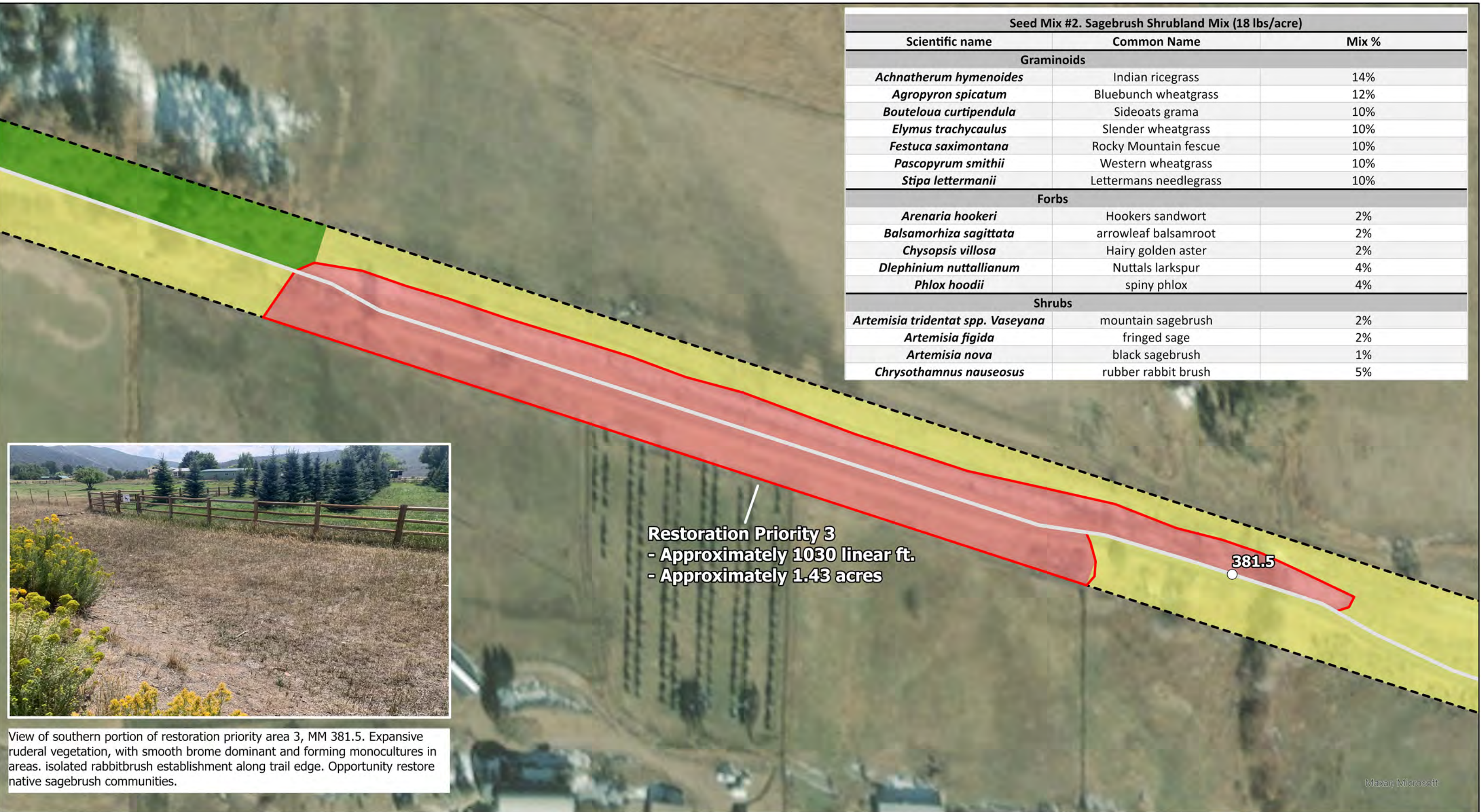


- Historic Railroad Milepost #
- Rio Grand Trail Extent
- - - Rio Grande Trail ROW
- Impairment Rating
- Dirt road/shoulder
- Low
- Moderate
- Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
 URBAN DESIGN + LAND PLANNING
 ECOLOGICAL PLANNING

Seed Mix #2. Sagebrush Shrubland Mix (18 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	14%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	12%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Elymus trachycaulus</i>	Slender wheatgrass	10%
<i>Festuca saximontana</i>	Rocky Mountain fescue	10%
<i>Pascopyrum smithii</i>	Western wheatgrass	10%
<i>Stipa lettermanii</i>	Lettermans needlegrass	10%
Forbs		
<i>Arenaria hookeri</i>	Hookers sandwort	2%
<i>Balsamorhiza sagittata</i>	arrowleaf balsamroot	2%
<i>Chysopsis villosa</i>	Hairy golden aster	2%
<i>Dlephinium nuttallianum</i>	Nuttals larkspur	4%
<i>Phlox hoodii</i>	spiny phlox	4%
Shrubs		
<i>Artemisia tridentat spp. Vaseyana</i>	mountain sagebrush	2%
<i>Artemisia figida</i>	fringed sage	2%
<i>Artemisia nova</i>	black sagebrush	1%
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	5%



View of southern portion of restoration priority area 3, MM 381.5. Expansive ruderal vegetation, with smooth brome dominant and forming monocultures in areas. Isolated rabbitbrush establishment along trail edge. Opportunity restore native sagebrush communities.

Restoration Priority 3
 - Approximately 1030 linear ft.
 - Approximately 1.43 acres

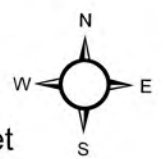
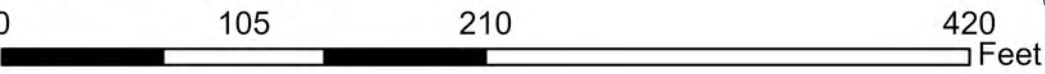
381.5

Maxar, Microsoft

Rio Grande Trail Restoration Seeding Recommended Priority Area 3

Author: DHM Design

Date: December 2021



○ Historic Railroad Milepost #

— Rio Grand Trail Extent

--- Rio Grande Trail ROW

Impairment Rating

▨ Dirt road/shoulder

■ Low

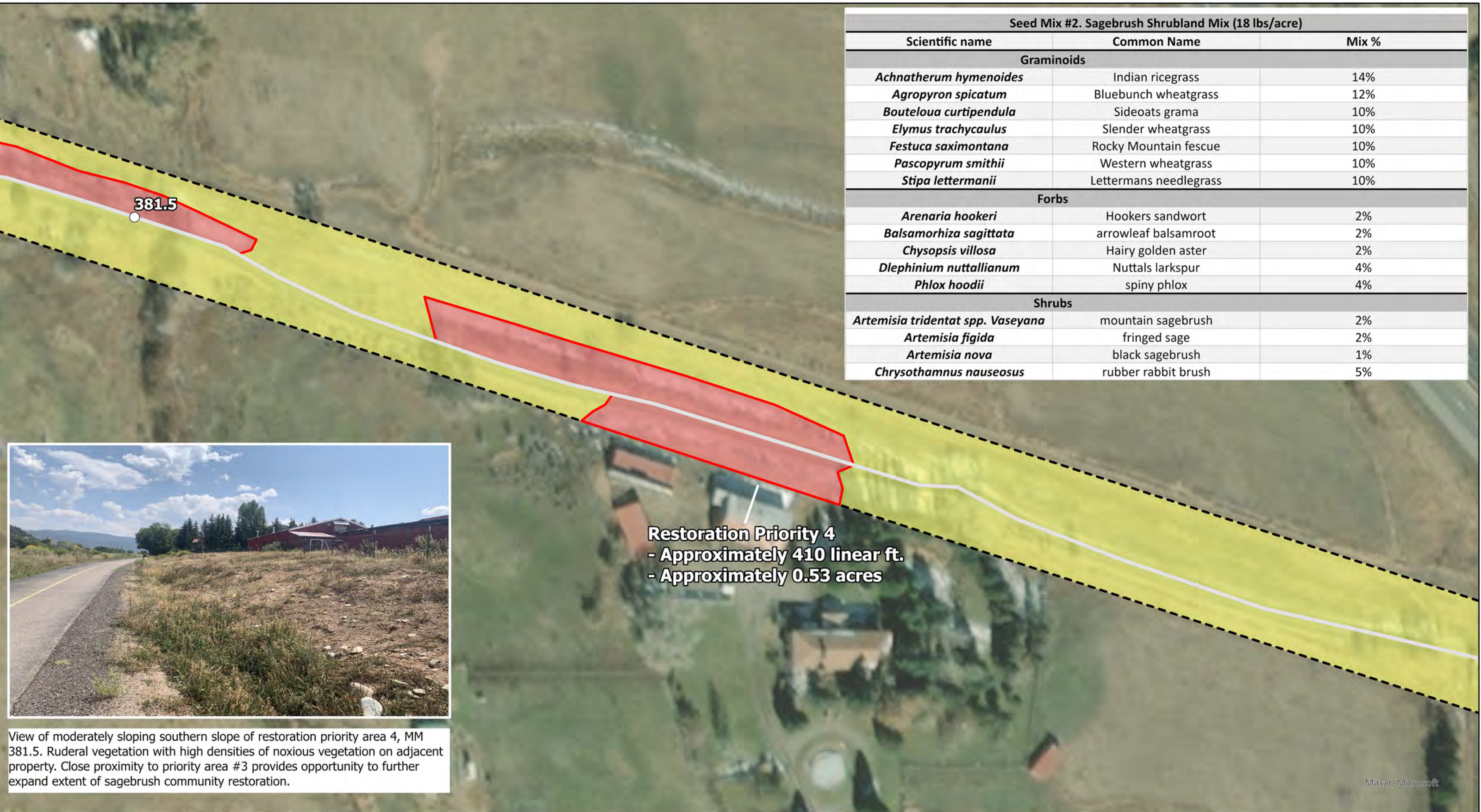
■ Moderate

■ Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
 URBAN DESIGN + LAND PLANNING
 ECOLOGICAL PLANNING

Seed Mix #2. Sagebrush Shrubland Mix (18 lbs/acre)		
Scientific name	Common Name	Mix %
Graminoids		
<i>Achnatherum hymenoides</i>	Indian ricegrass	14%
<i>Agropyron spicatum</i>	Bluebunch wheatgrass	12%
<i>Bouteloua curtipendula</i>	Sideoats grama	10%
<i>Elymus trachycaulus</i>	Slender wheatgrass	10%
<i>Festuca saximontana</i>	Rocky Mountain fescue	10%
<i>Pascopyrum smithii</i>	Western wheatgrass	10%
<i>Stipa lettermanii</i>	Lettermans needlegrass	10%
Forbs		
<i>Arenaria hookeri</i>	Hookers sandwort	2%
<i>Balsamorhiza sagittata</i>	arrowleaf balsamroot	2%
<i>Chysopsis villosa</i>	Hairy golden aster	2%
<i>Dlephinium nuttallianum</i>	Nuttals larkspur	4%
<i>Phlox hoodii</i>	spiny phlox	4%
Shrubs		
<i>Artemisia tridentat spp. Vaseyana</i>	mountain sagebrush	2%
<i>Artemisia figida</i>	fringed sage	2%
<i>Artemisia nova</i>	black sagebrush	1%
<i>Chrysothamnus nauseosus</i>	rubber rabbit brush	5%



Restoration Priority 4
 - Approximately 410 linear ft.
 - Approximately 0.53 acres



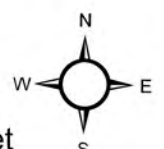
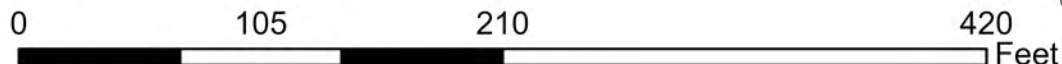
View of moderately sloping southern slope of restoration priority area 4, MM 381.5. Ruderal vegetation with high densities of noxious vegetation on adjacent property. Close proximity to priority area #3 provides opportunity to further expand extent of sagebrush community restoration.

Maxar, Microsoft

Rio Grande Trail Restoration Seeding Recommended Priority Area 4

Author: DHM Design

Date: December 2021



○ Historic Railroad Milepost #

— Rio Grand Trail Extent

- - - Rio Grande Trail ROW

Impairment Rating

▨ Dirt road/shoulder

■ Low

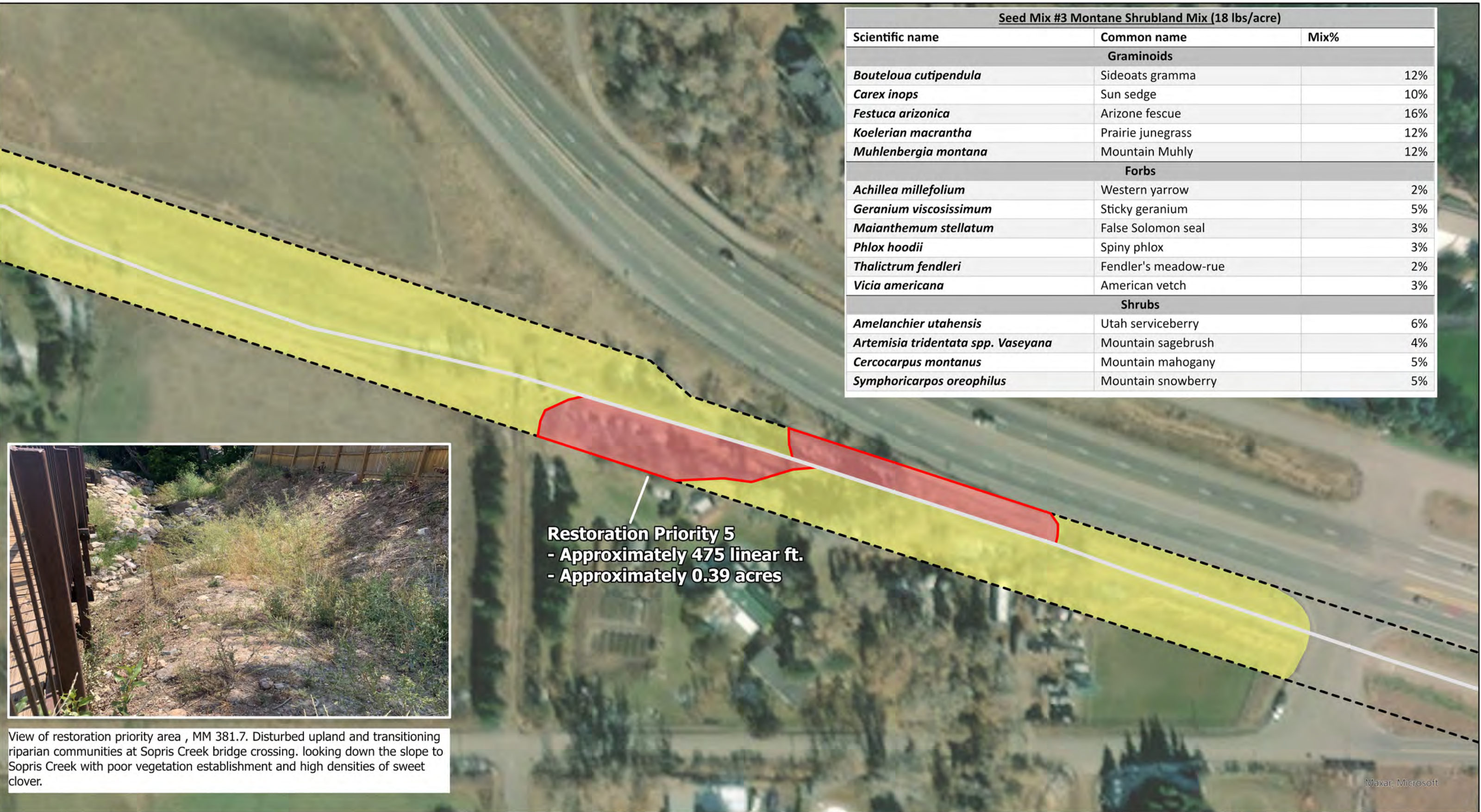
■ Moderate

■ Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
 URBAN DESIGN + LAND PLANNING
 ECOLOGICAL PLANNING

Seed Mix #3 Montane Shrubland Mix (18 lbs/acre)		
Scientific name	Common name	Mix%
Graminoids		
<i>Bouteloua cutipendula</i>	Sideoats gramma	12%
<i>Carex inops</i>	Sun sedge	10%
<i>Festuca arizonica</i>	Arizona fescue	16%
<i>Koeleria macrantha</i>	Prairie junegrass	12%
<i>Muhlenbergia montana</i>	Mountain Muhly	12%
Forbs		
<i>Achillea millefolium</i>	Western yarrow	2%
<i>Geranium viscosissimum</i>	Sticky geranium	5%
<i>Maianthemum stellatum</i>	False Solomon seal	3%
<i>Phlox hoodii</i>	Spiny phlox	3%
<i>Thalictrum fendleri</i>	Fendler's meadow-rue	2%
<i>Vicia americana</i>	American vetch	3%
Shrubs		
<i>Amelanchier utahensis</i>	Utah serviceberry	6%
<i>Artemisia tridentata</i> spp. <i>Vaseyana</i>	Mountain sagebrush	4%
<i>Cercocarpus montanus</i>	Mountain mahogany	5%
<i>Symphoricarpos oreophilus</i>	Mountain snowberry	5%



Restoration Priority 5
 - Approximately 475 linear ft.
 - Approximately 0.39 acres

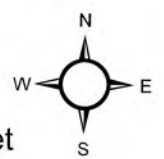
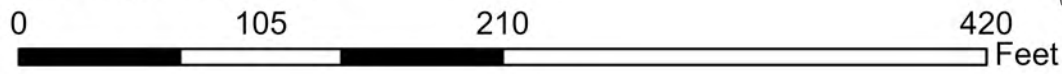
View of restoration priority area , MM 381.7. Disturbed upland and transitioning riparian communities at Sopris Creek bridge crossing. looking down the slope to Sopris Creek with poor vegetation establishment and high densities of sweet clover.

Maxar, Microsoft

Rio Grande Trail Restoration Seeding Recommended Priority Area 5

Author: DHM Design

Date: December 2021



○ Historic Railroad Milepost #

— Rio Grand Trail Extent

- - - Rio Grande Trail ROW

Impairment Rating

▨ Dirt road/shoulder

■ Low

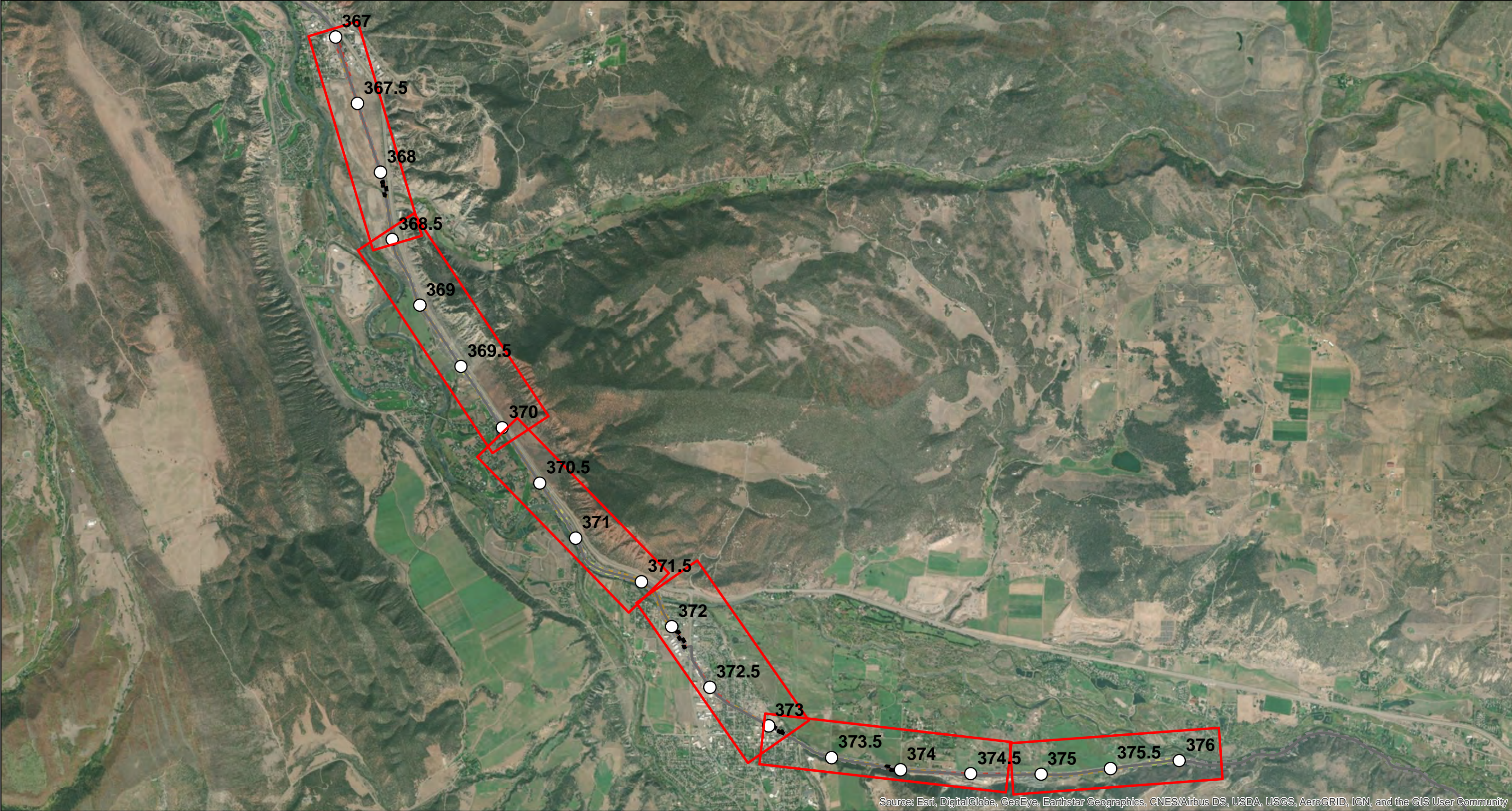
■ Moderate

■ Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
 URBAN DESIGN + LAND PLANNING
 ECOLOGICAL PLANNING

APPENDIX 3 – CORRIDOR PANEL MAPS AND SITE PHOTOS



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

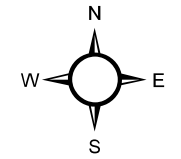
Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview

Author: DHM Design
Date: December 2019

Projected Coordinate System:
NAD_1983_StatePlane_Colorado_Central_FIPS_0502_Feet



1:41,089.33



Legend

- Milepost #
- ⋯ Restoration Priority Area
- Rio Grande Trail

Impairment

- Low
- Moderate
- Significant



DHM DESIGN

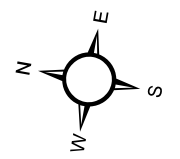


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, U

Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview - 1

Author: DHM Design
Date: December 2019

Projected Coordinate System:
NAD_1983_StatePlane_Colorado_Central_FIPS_0502_Feet



Legend

- Milepost #
- ▭ Restoration Priority Area
- Rio Grande Trail
- Low
- Moderate
- Significant



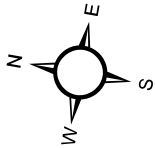
DHM DESIGN



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, U

Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview - 2

Author: DHM Design
Date: December 2019



Projected Coordinate System:
NAD_1983_StatePlane_Colorado_Central_FIPS_0502_Feet

Legend

- Milepost #
- ▭ Restoration Priority Area
- Rio Grande Trail
- Low
- Moderate
- Significant



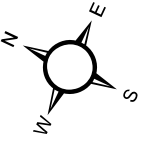
DHM DESIGN



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and

**Rio Grande Trail Restoration Seeding
Trail Corridor Impairment Ratings and Overview - 3**

Author: DHM Design
Date: December 2019



Legend

- Milepost #
- ⋯ Restoration Priority Area
- Rio Grande Trail
- Low
- Moderate
- Significant

Projected Coordinate System:
NAD_1983_StatePlane_Colorado_Central_FIPS_0502_Feet



DHM DESIGN



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User C

Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview - 4

Author: DHM Design
Date: December 2019

Projected Coordinate System:
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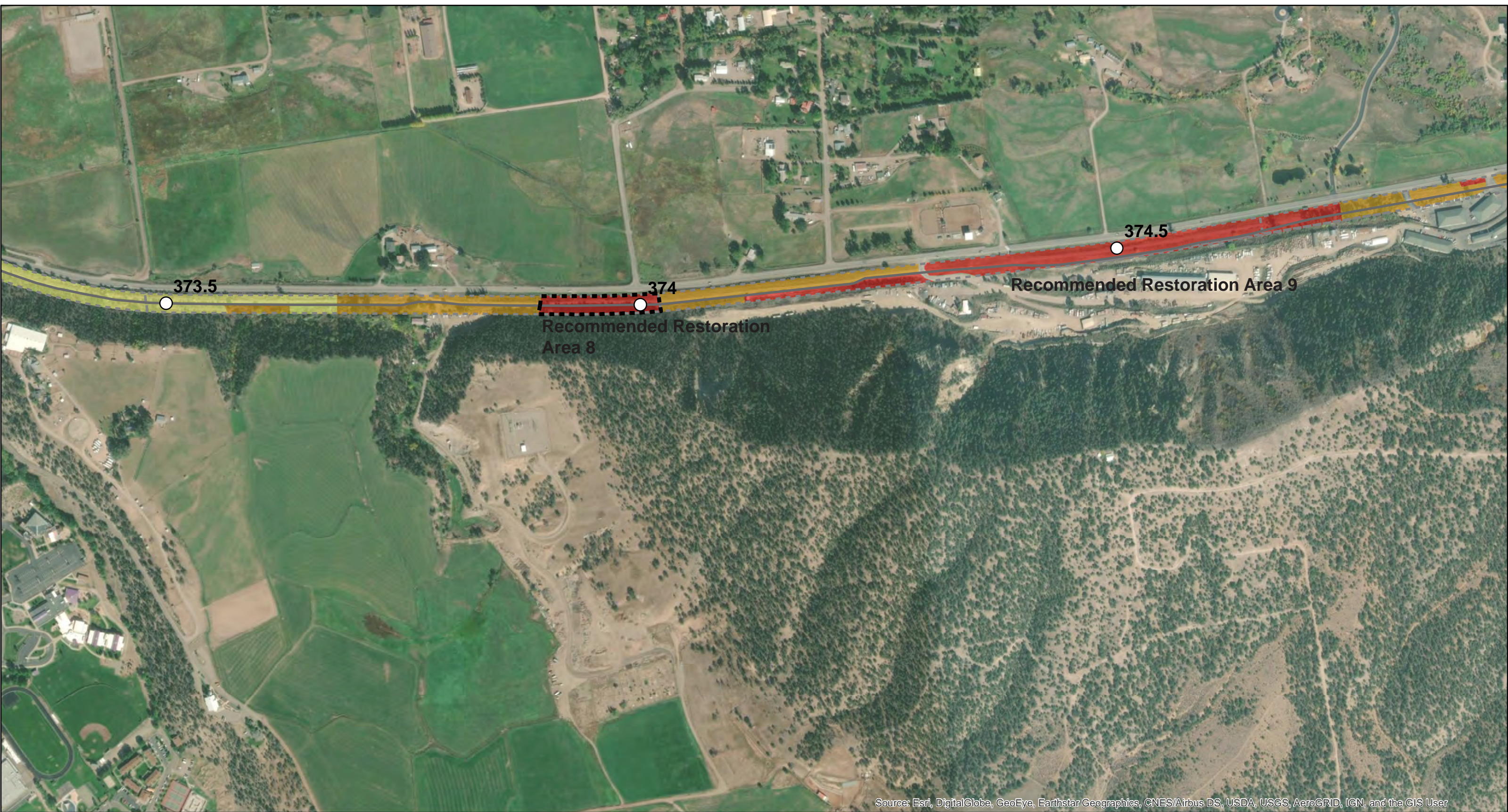


Legend

- Milepost #
- ⋯ Restoration Priority Area
- Rio Grande Trail
- Low
- Moderate
- Significant



DHM DESIGN

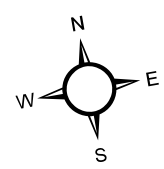


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview - 5

Author: DHM Design
Date: December 2019

Projected Coordinate System:
NAD_1983_StatePlane_Colorado_Central_FIPS_0502_Feet



Legend

- Milepost #
- ▭ Restoration Priority Area
- Rio Grande Trail
- Low
- Moderate
- Significant



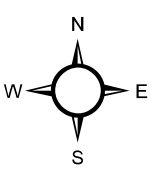
DHM DESIGN



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview - 6

Author: DHM Design
Date: December 2019



Legend

- Milepost #
- ⋯ Restoration Priority Area
- Rio Grande Trail
- Low
- Moderate
- Significant

Projected Coordinate System:
NAD_1983_StatePlane_Colorado_Central_FIPS_0502_Feet





1. View looking SE at significant impairment area. Scattered sagebrush and rabbit brush with cheatgrass and annual mustards dominating the understory. Bare soils present.



2. View looking W at area of significant impairment, high densities of noxious vegetation, including Canada thistle and common tansy along steep slope to irrigation ditch.



3. View looking W at area of significant impact. Steep slope to Cattle Creek, with moderate shrub cover but limited graminoid and forb cover with poor top soil conditions.



4. View looking N at area of significant impairment. Evidence of erosion and poor vegetation establishment along steep bank of irrigation ditch.



5. View looking NE at area of significant impairment. Area of high disturbance and non-native forbs and graminoids not consistent with native vegetation communities



6. View looking W at area of significant impairment. Sagebrush shrubland community with large areas of bare soil with minimal vegetation establishment.



1. View looking W at area of moderate impairment. Good sage cover with high densities of annual weedy species, including cheatgrass.



2. View looking S at moderate impairment area, increase plant diversity and shrub cover through seeding effort.



3. View looking E at area of moderate impairment. Well established sagebrush cover with poor understory vegetation consisting of annual weeds.



4. View looking N at area of moderate impairment. Good vegetation cover, but poor vegetation composition and diversity with high densities of reed canary grass along irrigation ditch.



5. View looking S at area of moderate impairment. Well established tree, shrub and graminoid forb layer with high densities of noxious vegetation (common tansy).



6. View looking W at area of moderate impairment. Well established sagebrush cover with poor understory vegetation consisting of annual weeds.



1. View looking E at area of low impairment. Minimal disturbances to natural vegetation consistent with a mixed mountain shrubland. Good vegetation cover and composition.



2. View looking NE at area of low impairment. Good native vegetation establishment consistent with a mixed shrubland community.



3. View looking NE at area of low impairment. Good native vegetation establishment consistent with a mixed shrubland community.



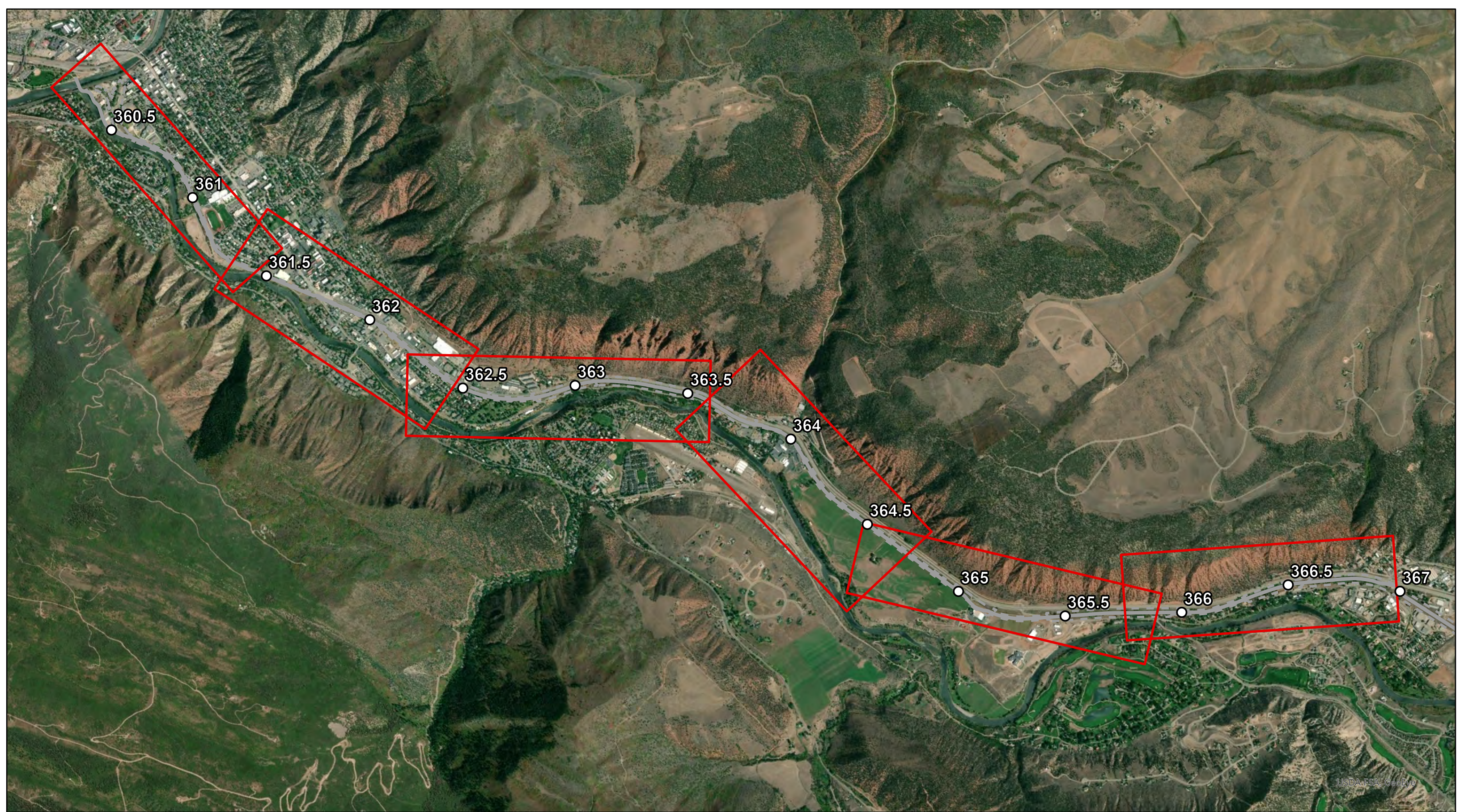
4. View looking north west at area of low impairment. Good sagebrush establishment and vegetation structure consistent with sagebrush shrubland communities.



5. View looking NW at area of low impairment. Good establishment of native vegetation consistent with a sagebrush shrubland community.

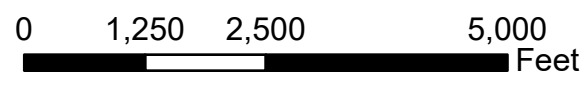


6. View looking SE at area of low impairment. Good vegetation establishment consistent with a mixed shrubland community.



Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Trail Corridor Overview Panels

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- Restoration Priority Area
- Agricultural
- Low
- Moderate
- Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



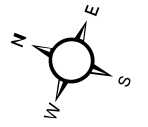
DHM DESIGN

USDA FSA, GeoEye



Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Trail Corridor Impairment Overview - 1

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- ▣ Restoration Priority Area
- ▣ Agricultural
- ▣ Low
- ▣ Moderate
- ▣ Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



DHM DESIGN



GeoEye, Microsoft

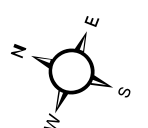
Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Trail Corridor Impairment Overview - 2

Author: DHM Design
Date: October 2020

Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- Restoration Priority Area
- Agricultural
- Low
- Moderate
- Significant (Recommended Restoration)

Projected Coordinate System:
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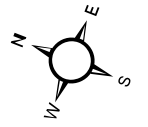


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Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Trail Corridor Impairment Overview - 3

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- ■ ■ Restoration Priority Area
- Agricultural
- Low
- Moderate
- Significant (Recommended Restoration)

Projected Coordinate System:
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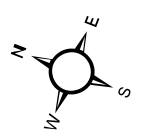


DHM DESIGN



Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Trail Corridor Impairment Overview - 4

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- ▤▤▤ Restoration Priority Area
- Agricultural
- Low
- Moderate
- Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



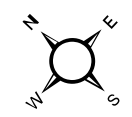
DHM DESIGN



GeoEye, Microsoft

Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Trail Corridor Impairment Overview - 5

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- ▣ Restoration Priority Area
- ▣ Agricultural
- ▣ Low
- ▣ Moderate
- ▣ Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



DHM DESIGN



USDA FSA, GeoEye

Rio Grande Trail Restoration Seeding: Cattle Creek Road (CR 154) to Glenwood Springs. Trail Corridor Impairment Overview - 6

Author: DHM Design
Date: October 2020



Legend

- Historic Railroad Mileposts #
- Rio Grande Trail
- ▣ Restoration Priority Area
- ▣ Agricultural
- ▣ Low
- ▣ Moderate
- ▣ Significant (Recommended Restoration)

Projected Coordinate System:
NAD_1982_StatePlane_Colorado_Central_FIPS_0502_Feet



DHM DESIGN



PHOTO 1: View looking N at area of significant impairment (MM 366.1). Highly disturbed area associated with access for ditch maintenance. bare, compacted ground with high densities of noxious vegetation.



PHOTO 2: View looking NE at area of significant impairment (MM 360.6). Area of high disturbance and noxious vegetation, including yellow toadflax, thistles, cheatgrass and weedy annual mustard species.



PHOTO 3: View looking E at area of significant impairment (MM361.25). Area of high disturbance between trail and school field. Contains non-native forbs and graminoids not consistent with native vegetation communities.



PHOTO 4: View looking N at area of significant impairment (MM 366). Steep slope with bare ground present - high potential for erosion. Impairment associated with irrigation that parallels the trail in this section.



PHOTO 5: View looking NE a area of significant impairment (MM 363.75). Moderate slope with high densities of bindweed and cheatgrass and patches of bare ground with potential for erosion.



PHOTO 6: View looking N at area of significant impairment (MM 365.25). Large, disturbed opening in sagebrush community consisting of high density annual mustards, common tansy, cheatgrass, and bindweed.



PHOTO 1: View looking NW at area of moderate impairment (MM 366.75). Established Sagebrush vegetative community with cheatgrass and annual mustards dominating understory



PHOTO 2: View looking N at area of moderate impairment (MM 366.5). Established Sagebrush vegetative community with cheatgrass and annual mustards dominating understory



PHOTO 3: View looking SE at area of moderate impairment (MM 365).



PHOTO 4: View looking NW at area of moderate impairment (MM 362.75). Sagebrush community dominated by smooth brome. Adequate vegetation cover, beneficial to reduce smooth brome populations and increase diversity.



PHOTO 5: View looking SE at area of moderate impairment (MM 364.5). Vegetation on right strongly influenced by agricultural use. Established sagebrush with annual weeds present on the left.



PHOTO 6: View looking N at area of moderate impairment (MM 361). Area lacking shrub cover consistent with sagebrush communities, but understory vegetation in adequate condition.



PHOTO 1: View looking N at area of low impairment a (MM 363.5). Minimal disturbance to natural vegetation consistent with lower montane shrublands. Good vegetation cover and diversity.



PHOTO 2: View looking S at area of low impairment (MM 361.5). Good native vegetation establishment and diversity consistent with mixed montane shrubland.



PHOTO 3: View looking S at area of low impairment (MM 363). Good native vegetation establishment and diversity consistent with mixed montane shrubland.



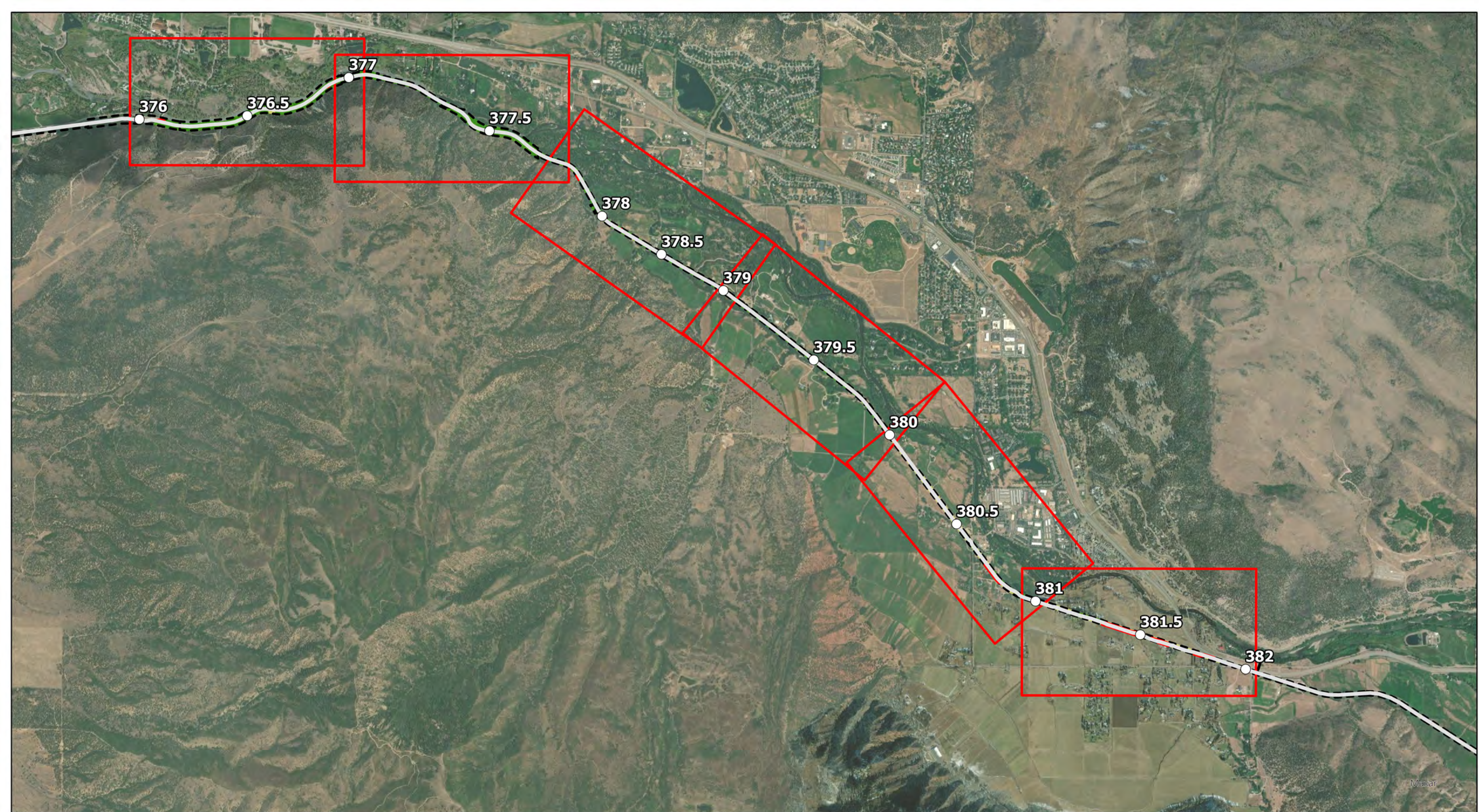
PHOTO 4: View looking S at area low impairment (MM362.75). Good native vegetation establishment and diversity consistent with sagebrush shrublands.



PHOTO5: View looking S at area of low impairment (MM 361.25). Good native vegetation establishment and diversity consistent with mixed montane shrubland.



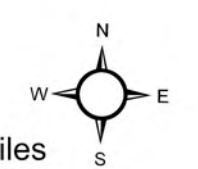
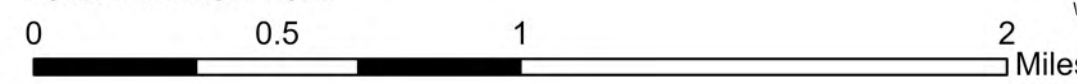
PHOTO 6: View looking S at area of low impairment (MM 361.25). Good native vegetation establishment and diversity consistent with mixed montane shrubland. Trees and large shrubs present suggesting mesic conditions.



Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview

Author: DHM Design

Date: December 2021



- Historic Railroad Milepost #
- Rio Grand Trail Extent
- - - Rio Grande Trail ROW
- ▨ Dirt road/shoulder
- Low
- Moderate
- Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING

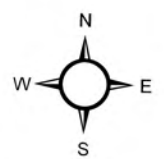
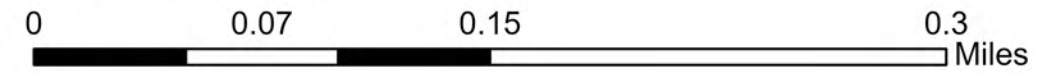


Maxar, Microsoft

Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview - 1

Author: DHM Design

Date: December 2021



- Historic Railroad Milepost #
- Rio Grand Trail Extent
- - - Rio Grande Trail ROW
- Impairment Rating
- Dirt road/shoulder
- Low
- Moderate
- Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING

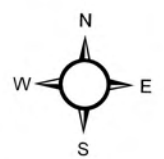
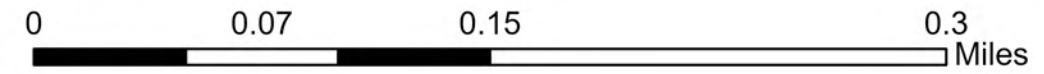


Maxar, Microsoft

Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview - 2

Author: DHM Design

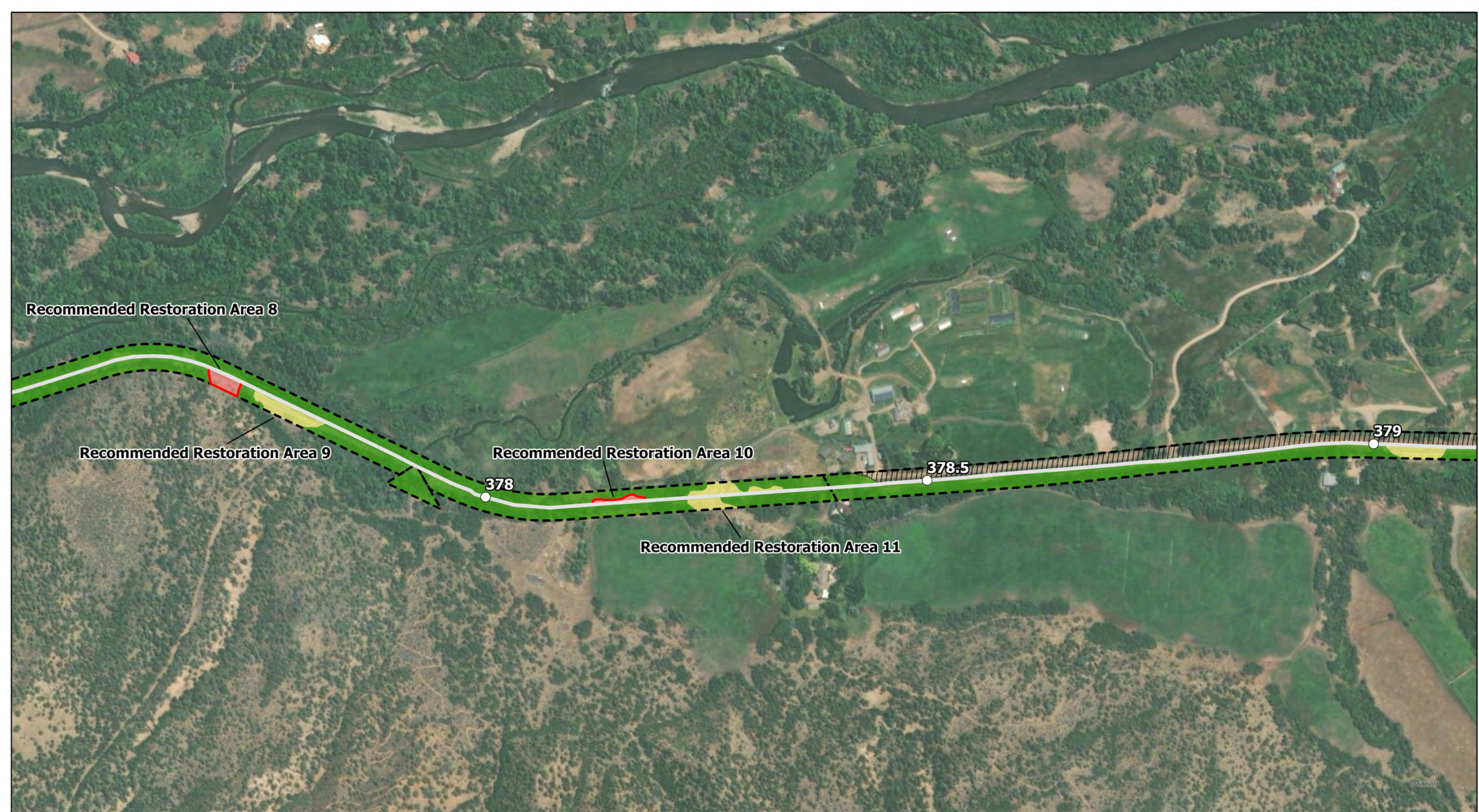
Date: December 2021



- | | | |
|-------|------------------------------|--------------------------|
| ○ | Historic Railroad Milepost # | Impairment Rating |
| — | Rio Grand Trail Extent | Dirt road/shoulder |
| - - - | Rio Grande Trail ROW | Low |
| | | Moderate |
| | | Significant |



DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING



Recommended Restoration Area 8

Recommended Restoration Area 9

Recommended Restoration Area 10

Recommended Restoration Area 11

378

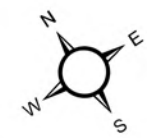
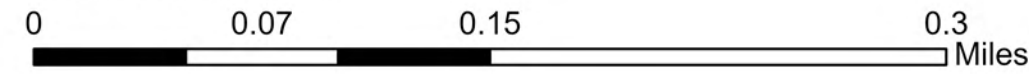
378.5

379

**Rio Grande Trail Restoration Seeding
Trail Corridor Impairment Ratings and Overview - 3**

Author: DHM Design

Date: December 2021



- Historic Railroad Milepost #
- Rio Grand Trail Extent
- - - Rio Grande Trail ROW
- Impairment Rating
- ▨ Dirt road/shoulder
- Low
- Moderate
- Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING



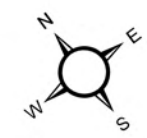
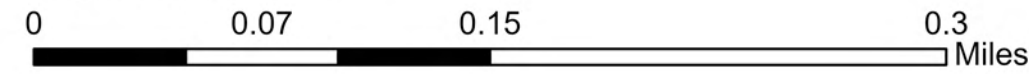
Recommended Restoration Area 12

Maxar

Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview - 4

Author: DHM Design

Date: December 2021



- Historic Railroad Milepost #
- Rio Grand Trail Extent
- - - Rio Grande Trail ROW
- ▨ Dirt road/shoulder
- Low
- Moderate
- Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING

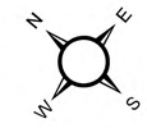
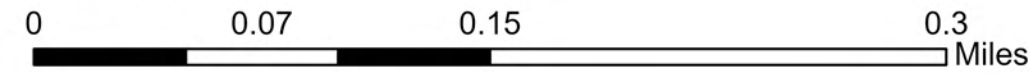


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Rio Grande Trail Restoration Seeding Trail Corridor Impairment Ratings and Overview - 5

Author: DHM Design

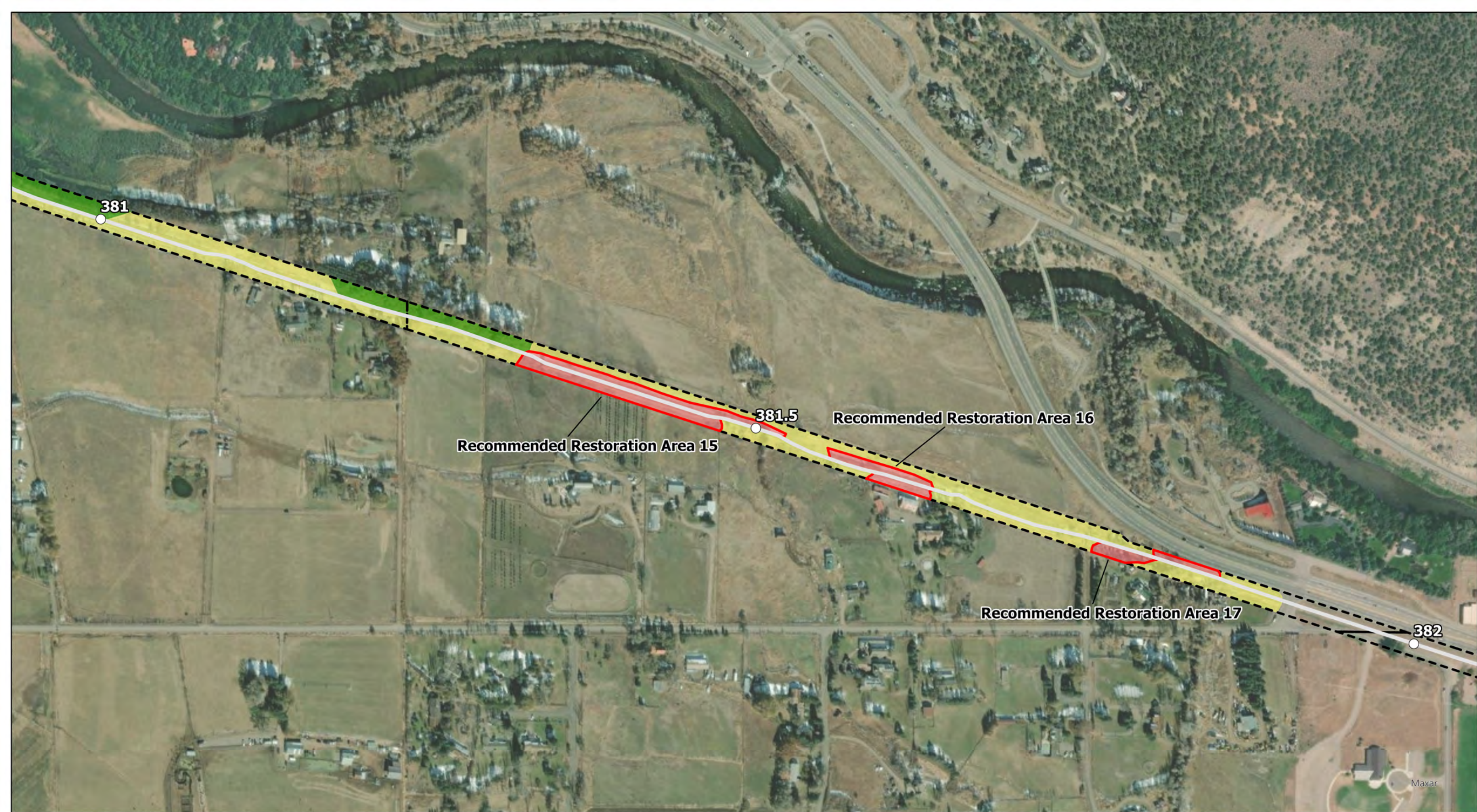
Date: December 2021



- | | | |
|-------|------------------------------|--------------------------|
| ○ | Historic Railroad Milepost # | Impairment Rating |
| — | Rio Grand Trail Extent | Dirt road/shoulder |
| - - - | Rio Grande Trail ROW | Low |
| | | Moderate |
| | | Significant |



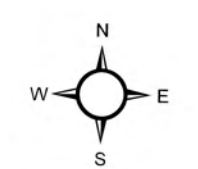
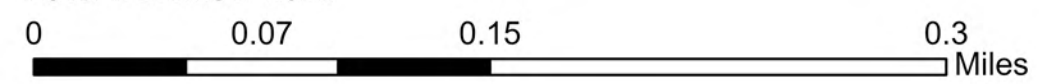
DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING



**Rio Grande Trail Restoration Seeding
Trail Corridor Impairment Ratings and Overview - 6**

Author: DHM Design

Date: December 2021



- Historic Railroad Milepost #
- Rio Grand Trail Extent
- - - Rio Grande Trail ROW
- ▨ Dirt road/shoulder
- Low
- Moderate
- Significant



DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING



1. View looking west at significant impairment area. Steep bank with poor vegetation establishment with high erosion potential and issues.



2. View significant impairment area along the south shoulder of the trail. Accumulated and piled fill material. Remove and seed area.



3. View looking west at area of significant impairment, near upper end of wilderness area. High densities of cheatgrass and poor vegetation establishment along small berm area.



4. View looking west at area of significant impairment at upper end of trail, poor vegetation establishment and high densities of smooth brome.



5. View looking west at area of significant impairment. Highly disturbed, with high densities of woody debris dead woody vegetation.



6. View looking east at area of significant impairment. Poor vegetation establishment with bare ground and scattered weed densities.



1. View looking east at area of moderate impairment. Open area within the forested riparian community. Regenerating woody vegetation evident, but scattered densities of non-native vegetation in the herbaceous layer.



2. View looking west at area of moderate impairment. Large meadow, with varied vegetative conditions including matrix of native and non-native vegetation.



3. View looking E at area of moderate impairment. Open area within the forested riparian community. Good herbaceous establishment, but consists of high densities of smooth brome.



4. View looking at area of moderate impairment. Native bunch grass establishment with scattered densities of cheatgrass.



5. View of moderate impairment area. Established western wheatgrass and other native grasses, with intermixed annual mustards, cheatgrass and other weedy species.



6. View looking east at large expanse of moderately impaired area along Hooks Spur Rd. area of high pedestrian/recreational traffic and additional dirt trail.



1. View looking east at large expansive riparian community within the wilderness area, with low impairment through out.



2. View looking east at large expansive riparian community within the wilderness area, with low impairment through out.



3. View looking east at emergent and scrub shrub wetland community at just outside of the wilderness area at the upper end of the trail.

APPENDIX 4 – SEEDING, SOIL PREPARATION, AND EROSION CONTROL SPECIFICATIONS

Seeding Method

Once the appropriate seed mix is selected for the area to be restored, the method of applying the seed will need to be determined. Determining the method of application will be dependent on the existing site conditions. Some of the factors influencing method selection are; site access, the size and slope of the area to be seeded, and existing vegetative and substrate conditions. The method used for seeding will determine the seeding application rate (rates provided in seed mix table for drill seeding application) and necessary preparation of the seedbed.

A. Drill Seeding

Drill seeding and the use of a no till drill is recommended for large, continuous sites with rolling to flat topography. It is also a useful method for inter-seeding native pastures and restoration areas where an increased diversity of vegetation is desired. Drill-seeding allows for the establishment of native stands of vegetation with minimal impacts and disturbances to the soil.

1) Site preparation

- a) **Prepare and plan** - Limit site preparation to those areas that will be planted in the immediate future. Seed immediately after preparation of soils between the approved seeding times.
- b) **Seed during optimal germination times** - Seeding efforts should occur when soil moisture and temperature are optimum for germination:
 - i) Spring – apply seed following the spring snowmelt from late April to the beginning of May.
 - ii) Late fall – dormant seeding prior to the first perennial snow fall, from mid-October to early November.
- c) **Control weeds** - A proper seedbed should be firm and free of competing vegetation and weeds.
 - i) Control weeds prior to seeding, at the time of seeding there should be no actively growing weeds. Control methods include both chemical and mechanical treatments.
 - ii) For use with a no-till drill, seedbed should be firm, not compacted or loose.
- d) **Mow and Clear** - Mow existing vegetation prior to drilling to a height of 4-6 inches and remove large rocks or plant material.
 - i) Soil to seed contact is imperative, vegetative residue after mowing should be removed, as seeds spread on top of vegetative residue will have lower germination rates.
 - ii) Remove any large rocks, litter, twigs and branches that may disrupt the drill seeding effort.

2) Seed installation

- a) **Use seed that is in good condition** - Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage. Deliver seed to job site in the original unopened containers and submit the certified labels to the landscape architect if applicable.

- b) **Calibrate drill and load seed** – Follow manufacturer’s directions

i) Calibrate the seeder in accordance with the manufacturers manual to seed at the designated rate for seed mixes. ii) Use correct seed box on the drill in accordance with the seed sizes contained within the mix used. The drill should contain a minimum of two seed boxes: a fine seed box for smaller, native seeds and a box for larger and fluffy seeds.

c) **Drill seeds to the correct depth** - Smaller seeds shall be drilled into the soil at a depth of one-quarter inch (1/4") to one-half (1/2') inch and larger seeds up to one inch (1")

d) **Mark your progress** - In area of existing vegetation, set up physical markers to ensure overlap in path of pass.

3) Mulching

a) **Evaluate the Need for Mulch** - Mulch may not be required with installation of the native seed mixture, depending on existing site conditions. The site should be mulched to achieve 90% ground coverage (10% bare ground). If this condition already exists due to existing vegetation, mulch is not required.

b) **Only seed as much as you can mulch** – Do not seed more in one day than you can mulch in that same day. Seeded areas should not be left exposed overnight.

c) **Apply Mulch and Tackifier** - Certified weed free straw and tackifier to be applied immediately following seeding application. Alternatively, Hydrostraw (800) 545-1755 may be applied at a rate of 2,500 lbs/acre. Hydroseeding/hydrostraw may not be spread in a single application. i) Install certified weed free straw completely and thoroughly over all seeding areas immediately after seeding.

ii) Apply tackifier on top of weed free straw mulch immediately after installing certified weed free mulch. Use approved spraying machines.

iii) Use of organic tackifier: Plantago or guar base tackifier applied at (150 lb/acre). Strictly comply with equipment manufacturer's installation instructions and recommendations.

iv) Spread uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1- ½-inches loose depth over seeded areas. Spread by hand, blower or other suitable equipment.

d) **Watch out for erosion** - Protect seeded slopes exceeding 3:1 against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.

e) **Protection of seeded areas** - Provide barriers as required to prevent pedestrian traffic over newly seeded areas until completion and establishment of desired vegetation.

B. Broadcast Seeding

Broadcast seeding is performed either with mechanical "cyclone" seeders, by hand broadcasting or by any other method that scatters seed over the soil surface. It is essential that steps be taken to ensure good seed to soil contact when broadcast seeding is used. Broadcast seeding is ideal for remote sites or

areas that have limited access for tractors and other equipment needed for drill seeding methods. Other areas that are preferred for broadcast seeding include: Steep slopes, rocky ground, areas with established tree and shrub vegetation not to be disturbed and smaller, bare ground and disturbed areas that form a patchwork of areas to be seeded.

1) Site preparation a) Prepare and plan - Limit site preparation to areas which will be planted in the immediate future and seed immediately after preparation of soils between the approved seeding time period.

b) Seed during optimal germination times - Seeding efforts should occur when soil moisture and temperature are optimum for germination:

i) Spring – apply seed following the spring snow melt from late April to the beginning of May.

ii) Late fall – dormant seeding prior to the first perennial snow fall, from mid-October to early November.

c) Remove debris and vegetation - Stones larger than 1.5-inches in size, trash, debris, twigs, stems, root mat, and other matter detrimental to vegetation growth shall be removed

d) Loosen and texturize topsoil - The site should be prepared by loosening the topsoil to a minimum depth of two (2) inches and a maximum depth of six (6) inches, the soil should be texturized parallel to the contour of the planting bed to create a roughened surface. This can be accomplished by disking, chain dragging, tracked implements or use of hand rakes. For smaller, patchwork areas that are to be broadcast seeded, hand rakes are recommended. It is critical that the seedbed be loosened to a point that there are spaces for seed to filter into cracks and crevices and does not just sit on the surface of the soil.

2) Seed Installation

a) Use seed that is in good condition - Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage. Deliver seed to job site in the original unopened containers and submit the certified labels to the landscape architect.

b) Seed during optimal conditions - Seeding operations should be performed only during periods when beneficial results can be obtained. Do not seed during high winds or when the ground is frozen or otherwise unable to be worked. Avoid seeding during times of drought or excessive moisture events. Seed application should occur during the active growing season in order to achieve 4" of growth before the first killing frost.

c) Check the seeding rate - Broadcast seeding rates should be double the seeding rate for drill seeding.

d) Evenly apply seed – Sow seed in an even and measured way so that application across the site is uniform and even.

e) Rake - Broadcast seeding shall be raked into the soil to a depth of approximately one-quarter inch (1/4") to one-half inch (1/2").

f) **Apply twice** - The seeding shall be done in two (2) separate applications crossing the area at right angles to one another to guarantee even coverage.

3) Mulching

a) **Only seed as much as you can mulch** – Do not seed more in one day than you can mulch in that same day. Seeded areas should not be left exposed overnight.

b) **Apply Mulch and Tackifier** - Certified weed free straw and tackifier to be applied immediately following seeding application. Alternatively, Hydrostraw (800) 545-1755 may be applied at a rate of 2,500 lbs/acre. Hydroseeding/hydrostraw may not be spread in a single application. i) Install certified weed free straw completely and thoroughly over all seeding areas immediately after seeding.

ii) Apply tackifier on top of certified weed free straw mulch immediately after installing certified weed free mulch. Use approved spraying machines.

iii) Use of organic tackifier: Plantago or guar base tackifier applied at (150 lb/acre). Strictly comply with equipment manufacturer's installation instructions and recommendations.

iv) Spread uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1- ½-inches loose depth over seeded areas. Spread by hand, blower or other suitable equipment.

c) **Monitor for erosion** - Protect seeded slopes exceeding 3:1 against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.

d) **Protection of seeded areas** - provide barriers as required to prevent pedestrian traffic over newly seeded areas until completion and establishment of desired vegetation.

APPENDIX 5 – RFTA HANEY SOIL TEST DATA

Date Recd	2016 Sample ID	1:1 Soil pH	WDRF Buffer	1:1 Soluble Salt	Excess Lime	Organic Matter	Solvita CO2-C	H2O Total N	H2O Organic N	H2O Total Organic C
9/2/2016	MP 364.2-365	7.7	7.2	0.16	3	2.3	59.7	18.4	12.1	196
9/2/2016	MP 365-365.4	7.7	7.2	0.37	3	3.5	113	22.7	16.6	244
9/2/2016	MP 367-368	7.8	7.2	0.3	3	3.9	71.6	39.1	22.5	248
9/2/2016	MP 369.95-370.5	7.8	7.2	0.41	3	2.2	34.7	21.8	13.4	178
9/2/2016	MP 374.3-374.8	8.2	7.2	0.29	3	6.6	108	28.6	17.8	259
9/2/2016	MP 374.85-375.3	7.7	7.2	1.15	3	4	94.1	36.3	20.8	256
9/2/2016	MP 375.7-376.6	7.7	7.2	1.04	3	4.3	123	27.3	16.7	250
9/2/2016	MP 380.7-381.7	7.2	7.2	0.26	1	6.4	162	38.3	29.1	372

Date Recd	2017 Sample ID	1:1 Soil pH	WDRF Buffer	1:1 Soluble Salt	Excess Lime	Organic Matter	CO2-C	H2O Total N	H2O Organic N	H2O Total Organic C
8/25/2017	MP 364.2-365	7.9	7.2	0.24	HIGH	4.7	108	29.2	16.6	265
8/25/2017	MP 365-365.4	7.8	7.2	0.56	HIGH	4.1	38.1	30	18.5	312
8/25/2017	MP 365.4-366.9	7.9	7.2	0.31	HIGH	3.4	23	36	17.3	261
8/25/2017	MP 367-368	7.8	7.2	0.36	HIGH	4.2	22.1	44.5	17.2	253
8/25/2017	MP 369.95-370.5	7.7	7.2	1.39	HIGH	3.9	47.8	32.4	12.1	184
8/25/2017	MP 373.8-374.3	7.7	7.2	0.59	HIGH	6.2	43.5	24	16.7	285
8/25/2017	MP 374.3-375.6	7.8	7.2	0.33	HIGH	7	54.5	49	22.2	341
8/25/2017	MP 375.7-376.6	7.9	7.2	0.34	HIGH	4.7	30.3	35.3	16.1	295
8/25/2017	MP 380.7-381.7	7.6	7.2	0.27	LOW	8.3	155	38.8	18.4	306

Date Recd	2018 Sample ID	1:1 Soil pH	WDRF Buffer	1:1 Soluble Salt	Excess Lime	Organic Matter	CO2-C	H2O Total N	H2O Organic N	H2O Total Organic C
8/9/2018	MP 362.1-363.1	7.8	7.2	0.43	HIGH	5.6	68.4	26.7	19.4	281
8/9/2018	MP 364.2-365	7.8	7.2	0.26	HIGH	4.6	23.3	20.6	15.3	210

8/9/2018	MP 365-365.4	8.1	7.2	0.26	HIGH	4.8	34.7	28	21	288
8/9/2018	MP 365.4-366.9	8	7.2	0.35	HIGH	3.5	30.4	38.5	25.8	332
8/9/2018	MP 367-368	7.9	7.2	0.35	HIGH	5.3	32.9	45.4	27	296
8/9/2018	MP 369.95-370.5	7.6	7.2	1.3	HIGH	3.4	19.6	25.5	13.3	163
8/9/2018	MP 370.5-371.7	7.9	7.2	0.32	LOW	4	23.1	27.8	15.4	219
8/9/2018	MP 373.8-374.3	7.6	7.2	0.91	LOW	5.8	58.4	13.8	9.4	159
8/9/2018	MP 374.3-375.6	7.6	7.2	1.25	HIGH	6	19.3	16.6	11.2	166
8/9/2018	MP 375.7-376.6	7.9	7.2	0.48	HIGH	4.1	22.8	25	16.2	208
8/9/2018	MP 378-380.6	7.6	7.2	0.3	LOW	6.7	36.8	35.6	23.1	226
8/9/2018	MP 380.7-381.7	7.5	7.2	0.31	LOW	8.2	88.4	29.5	18.8	212

Date Recd	2019 Sample ID	1:1 Soil pH	WDRF Buffer	1:1 Soluble Salt	Excess Lime	Organic Matter	CO2-C	H2O Total N	H2O Organic N	H2O Total Organic C
9/11/2019	MP 362.1-363.1	8	7.2	0.24	HIGH	5.4	115.5	27.8	19.4	347
9/11/2019	MP 364.2-365	8.1	7.2	0.18	HIGH	4.6	37.3	17.9	12.2	262
9/11/2019	MP 365-365.4	8	7.2	0.24	HIGH	6	47.9	19.6	13.5	296
9/11/2019	MP 365.4-366.9	8.1	7.2	0.23	HIGH	4.3	33.6	27.9	19.1	361
9/11/2019	MP 367-368	8.1	7.2	0.2	HIGH	4.7	25.3	32	20.1	262
9/11/2019	MP 369.95-370.5	8.1	7.2	0.2	HIGH	4.2	22.8	23.9	16.4	265
9/11/2019	MP 370.5-371.7	7.9	7.2	0.33	HIGH	5.1	76.7	22.8	16.3	334
9/11/2019	MP 373.8-374.3	8	7.2	0.17	HIGH	9.7	107.1	15.8	10.9	287
9/11/2019	MP 374.3-375.6	7.6	7.2	1.51	HIGH	6.6	54	17	12	310
9/11/2019	MP 375.7-376.6	7.9	7.2	0.36	NONE	5.2	17.1	26.8	18.4	325
9/11/2019	MP 378-380.1	7.4	7.2	0.21	LOW	9.9	447.8	33.8	27	385
9/11/2019	MP 380.7-381.7	7.7	7.2	0.25	LOW	8.7	341.6	31.5	26.9	457

H3A Nitrate	H3A Ammonium	H3A Inorganic Nitrogen	H3A Inorganic Phosphorus	H3A Total Phosphorus	H3A Organic Phosphorus	H3A ICAP Potassium	H3A ICAP Calcium	H3A ICAP Aluminum	H3A ICAP Iron	Organic C:N
3.2	4	7.2	8.1	14	5.7	175	3555	96.54	59.7	16.1
3.5	5	8.5	8.4	15	6.5	247	3588	88.62	65.6	14.7
17.5	4	21.5	12.9	20	7.4	246	3769	114.6	56.5	11
7.2	3.7	10.9	8.9	14	5.1	153	3936	75.19	39.9	13.4
7.8	5.2	13	11.5	18	6.6	223	3667	107.5	50.6	14.5
13.3	3.9	17.2	7.6	13	5.8	338	4152	86.89	41.3	12.3
7.8	3.2	11	13.5	20	6.7	264	3868	81.12	40.3	14.9
7.9	3	10.9	34	50	15.6	294	1398	374.5	191.7	12.8

H3A Nitrate	H3A Ammonium	H3A Inorganic Nitrogen	H3A Total Phosphorus	H3A Organic Phosphorus	H3A ICAP Potassium	H3A ICAP Calcium	H3A ICAP Aluminum	H3A ICAP Iron	H3A ICAP Sulfur	H3A ICAP Zinc
9.6	1.4	11	20	5.6	199	3172	47.04	28.7	15	1.2
8.2	1.3	9.4	20	5.5	294	3236	43.12	31.3	84	0.82
15.5	0.9	16.5	18	5.1	220	3334	74.82	54.5	24	1.39
24.6	0.4	25.1	24	5	184	3140	86.46	34.5	17	0.54
15.6	1.9	17.5	14	3	221	4854	24.72	10.5	1441	0.68
4.5	1	5.5	15	4.5	219	3393	61.92	36.8	155	2.51
22.6	1.5	24.1	19	5.5	250	3379	74.89	39.8	35	5.39
15.3	1	16.4	18	5.6	225	3418	62.72	30.7	51	0.86
17.2	0.9	18.2	30	8.2	163	2126	159.7	86.2	15	14.18

H3A Nitrate	H3A Ammonium	H3A Inorganic Nitrogen	H3A Total Phosphorus	H3A Inorganic Phosphorus	H3A Organic Phosphorus	H3A ICAP Potassium	H3A ICAP Calcium	H3A ICAP Aluminum	H3A ICAP Iron	H3A ICAP Sulfur
4.8	1.9	6.7	15	10.5	4.9	216	2401	22.27	7.5	14
3.7	1.3	5	19	13.3	5.6	248	2487	22.24	8.4	40

4.5	1.8	6.3	22	16	6.1	398	2395	21.62	9.4	18
9.5	2.8	12.3	19	13.6	5.4	359	2449	20.29	7.2	39
13.9	3.6	17.5	30	21.9	8	319	2422	37.47	10.6	24
9.5	1.2	10.7	14	10.5	4	244	3765	17.16	5.9	1245
8.7	1.8	10.4	19	13.3	5.5	212	2859	22.74	10.8	44
2.9	1.1	4	13	8.6	4	186	3166	22.61	27.4	367
3.9	1.1	5	13	9.2	4.1	215	3674	20.32	8.7	721
8.2	0.8	9	14	9.5	4.3	256	2876	25.08	9	93
11.4	1.6	13	55	45.6	9.6	267	2077	52.97	23.3	17
9.7	1.6	11.3	32	24.8	6.7	168	2112	66.17	34.9	11

H3A Nitrate	H3A Ammonium	H3A Inorganic Nitrogen	H3A Total Phosphorus	H3A Inorganic Phosphorus	H3A Organic Phosphorus	H3A ICAP Potassium	H3A ICAP Calcium	H3A ICAP Aluminum	H3A ICAP Iron	H3A ICAP Sulfur
4.9	2.7	7.6	13	9.6	3.9	213	2749	23	9	9.7
2.6	2.9	5.5	14	10.9	3.4	219	2734	26	11	11.1
1.7	3.5	5.2	20	14.9	4.7	245	2725	26	12	23.3
5.6	3.6	9.1	18	13.7	4	315	2773	23	11	12
10.3	3	13.3	23	18.9	4.1	240	2708	41	12	16.6
5.8	2.8	8.6	16	12	4.4	238	2829	21	8	14.2
3.1	3.9	7	17	12.9	4.1	234	2672	30	16	46.6
1.4	5.1	6.5	7	5	2.2	113	2774	30	50	15
2.7	4.1	6.8	9	6.4	3	348	5447	15	9	2033
5.1	5	10.1	18	14	4.1	269	2800	32	13	116.5
4	5.1	9.2	50	41.5	8.1	272	1735	58	32	23.5
2.2	5.5	7.7	39	32.3	6.6	226	1689	77	42	15.2

N Min	Organic N Release	Organic N Reserve	P Min	Organic P Reserve	P Saturation Al/Fe	P Saturation Ca	Soil Health Calculation	Available N	Available P	Available K	Nutrient Value
3.6	7.5	4.6	1.6	4	8.8	0.4	6.87	29.4	22.4	209.4	132.26
9.9	16.6	0	6.3	0.2	9.7	0.4	11.78	50.2	33.8	296.6	193.64
12.1	22.5	0	7.4	< 0.1	11.8	0.5	11.24	88.2	51	294.6	223.61
4	6.6	6.7	2.9	2.2	12.2	0.4	5.72	35	27.2	183	124.5
9.8	17.8	0	6.4	0.2	11.4	0.5	11.79	61.7	41	267.8	189.38
13	20.8	0	5.8	< 0.1	10.4	0.3	12.27	76	39.8	405.1	266.71
10.2	16.7	0	6.3	0.4	16.6	0.5	12.4	55.4	45.5	316.8	211.61
20.8	29.1	0	15.3	0.2	8.7	3.5	19.32	80.1	113.4	352.8	271.9

H3A ICAP Manganese	H3A ICAP Copper	H3A ICAP Magnesium	H3A ICAP Sodium	Organic C:N	Organic N Release	Organic N Reserve	Organic P Release	Organic P Reserve	Soil Health Calculation	Available N	Available P
8.6	0.09	170	15	15.9	16.6	0	5.6	< 0.1	15.97	66.4	46.4
6.6	0.09	212	25	16.8	9	9.5	2	3.5	11.9	44.3	38.9
5.9	0.1	186	12	15.1	6.1	11.2	1.3	3.7	9.25	54.1	33.5
4.6	0.11	211	13	14.8	6	11.2	1.3	3.7	9	74.5	45.9
4	0.08	187	14	15.2	12.1	0	2.3	0.7	9.67	71.2	31.6
6.4	0.26	156	15	17.1	10.2	6.5	2.1	2.5	11.71	37.7	28.8
6.1	0.33	161	14	15.3	14.2	8	2.7	2.9	14.49	91.9	38.2
4.1	0.09	195	15	18.4	6.6	9.5	1.7	3.8	10.53	55.1	32.5
6.6	0.36	187	14	16.6	18.4	0	8.2	< 0.1	20.89	87.8	69.6

H3A ICAP Zinc	H3A ICAP Manganese	H3A ICAP Copper	H3A ICAP Magnesium	H3A ICAP Sodium	% MAC	Organic C:N	Organic N:Inorganic N	Organic N Release	Organic N Reserve	Organic P Release	Organic P Reserve
0.55	3.4	0.09	243	31	24.4	14.4	2.9	18.9	0.5	3.6	1.3
0.32	2.4	0.02	150	19	11.1	13.7	3	6.8	8.5	1.8	3.7

0.15	2.7	0.07	135	14	12.1	13.7	3.3	10.1	10.9	2.2	3.9
0.23	2.7	0.05	156	18	9.1	12.9	2.1	9.4	16.4	1.5	3.9
0.28	3	0.12	147	13	11.1	10.9	1.5	12	15	2.7	5.3
0.51	2.2	0.08	147	15	12	12.3	1.2	6.4	6.9	1.4	2.5
1.19	3.5	0.08	159	17	10.5	14.3	1.5	6.5	8.9	1.7	3.8
5.55	7.8	0.42	118	16	36.8	16.8	2.4	9.4	0	4	< 0.1
1.5	1.9	0.11	137	17	11.6	14.9	2.2	5.2	6	1.4	2.7
2.3	1.3	0.11	191	15	11	12.8	1.8	7.1	9.1	1.4	2.9
4.69	4.9	0.14	162	17	16.3	9.8	1.8	15.1	8	4.7	4.9
11.5	3.8	0.32	176	17	41.8	11.2	1.7	18.8	0	6.7	< 0.1

H3A ICAP Zinc	H3A ICAP Manganese	H3A ICAP Copper	H3A ICAP Magnesium	H3A ICAP Sodium	% MAC	Organic C:N	Organic N:Inorganic N	Organic N Release	Organic N Reserve	Organic P Release	Organic P Reserve
0.39	2.6	0.08	205	18	33.3	17.9	2.6	19.4	0	3.9	< 0.1
0.11	2.6	0.02	176	15	14.3	21.5	2.2	6.9	5.2	1.5	2
0.18	3.1	< 0.01	158	12	16.2	22	2.6	8.7	4.8	2.3	2.4
0.3	2.1	0.06	184	11	9.3	18.9	2.1	7.1	12	1.1	2.9
0.26	1.9	0.08	165	11	9.7	13.1	1.5	7.8	12.3	1.2	2.9
0.97	2.1	0.08	166	8	8.6	16.2	1.9	5.6	10.7	1.1	3.3
2.28	4.3	0.08	184	22	23	20.5	2.3	15	1.3	2.8	1.3
9.75	16.6	0.64	72	10	37.3	26.3	1.7	10.9	0	2.2	< 0.1
0.38	2.6	0.11	157	15	17.4	25.9	1.7	8.3	3.6	1.6	1.4
1.32	2.1	0.07	142	9	5.3	17.7	1.8	3.9	14.5	0.6	3.4
6.21	9	0.12	170	12	116.2	14.3	2.9	27	0	8.1	< 0.1
8.84	6.7	0.21	153	19	74.8	17	3.5	26.9	0	6.6	< 0.1

Traditional N	Haney Test N	Lbs N Difference	N savings
6.3	29.4	23.1	14.78
7	50.2	43.2	27.68
35.1	88.2	53.1	33.96
14.4	35	20.6	13.2
15.7	61.7	46	29.41
26.7	76	49.3	31.55
15.7	55.4	39.7	25.44
15.8	80.1	64.3	41.15

Available K	Nutrient Value	Traditional N	Haney Test N	Lbs N Difference	N savings
238.4	179.83	23.1	66.4	43.4	27.75
352.7	219.89	19.6	44.3	24.7	15.82
263.4	179.39	37.2	54.1	16.9	10.79
221	176.09	59.1	74.5	15.4	9.87
265.2	190.48	37.5	71.2	33.7	21.57
262.4	166.56	10.8	37.7	26.9	17.23
300.5	223.95	54.3	91.9	37.6	24.09
270	182.97	36.8	55.1	18.4	11.76
195.7	181.22	41.3	87.8	46.5	29.78

Soil Health Calculation	Available N	Available P	Available K	Nutrient Value	Traditiona I N	Haney Test N	Lbs N Difference	N savings
14.4	61.4	32.4	259.1	181.46	11.5	61.4	49.9	31.93
8.06	28.4	34.8	297.1	180.3	8.9	28.4	19.4	12.44

11.32	39.3	41.9	477.1	280.05	10.7	39.3	28.6	18.28
12.26	52.3	34.7	430.9	262.46	22.9	52.3	29.4	18.82
11.9	70.9	56.5	382.3	258.53	33.4	70.9	37.4	23.94
6.56	41.1	27.4	292.2	183.12	22.9	41.1	18.2	11.67
8.23	40.6	34.6	254.4	166.68	20.9	40.6	19.7	12.63
9.96	32.1	28.8	223.2	143.4	6.9	32.1	25.2	16.13
6.37	24.4	24.5	258.1	154.25	9.4	24.4	15	9.59
8.05	38.7	25.2	307.7	188.42	19.8	38.7	18.9	12.12
10.5	67.4	115.7	320.6	248.56	27.4	67.4	39.9	25.56
14.96	72.4	72.5	201.8	175.55	23.4	72.4	49	31.39

Soil Health Calculation	Available N	Available P	Available K	Nutrient Value	Traditiona I N	Haney Test N	Lbs N Difference	N savings
18.5	64.9	30.9	255.5	181.32	11.7	64.9	53.2	34.04
10.18	29.8	28.4	262.2	161.26	6.2	29.8	23.6	15.12
12.06	33.5	39.5	294.5	184.07	4.1	33.5	29.4	18.83
12.5	39.1	34.1	377.5	227.05	13.4	39.1	25.7	16.43
9.78	50.6	46.2	287.5	194.18	24.7	50.6	25.9	16.59
9.21	34.3	30.2	286.1	176.77	14	34.3	20.3	12.99
15.98	52.6	36.1	280.4	187.97	7.3	52.6	45.3	28.98
15.76	41.8	16.5	135	100.68	3.4	41.8	38.4	24.58
12.79	36.4	18.4	418.1	239.53	6.5	36.4	29.9	19.14
10.05	33.5	33.7	322.3	195.74	12.3	33.5	21.3	13.6
35.29	86.9	114.1	326.4	263.32	9.7	86.9	77.2	49.42
33.18	82.9	89.5	270.6	223.28	5.2	82.9	77.7	49.75