DOE-EM/GJTAC1655

# Moab UMTRA Project
# Revegetation and Weed Control Plan

Revision 8

February 2022

U.S. Department of Energy

Office of Environmental Management

*Prepared by the Technical Assistance Contractor under contract number DE-EM0005014*
*for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.*

# Moab UMTRA Project Revegetation and Weed Control Plan

## Revision 8

## Review and Approval

2/3/2022

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## Revision History

| Revision | Date | Reason for Revision |
|---|---|---|
| 0 | April 2009 | Initial issue. |
| 1 | September 2010 | Update includes 2010 areas and future planning. |
| 2 | July 2014 | Update includes 2014 areas and activities. |
| 3 | June 2017 | Revision includes update to performance monitoring and activities and incorporation of the Weed Control Plan (formerly DOE-EM/GJTAC1406). |
| 4 | July 2018 | Updated to include watering schedule and various new methodologies. |
| 5 | August 2019 | Periodic update to reflect SME recommendations and associated procedures. |
| 6 | July 2020 | Periodic update to establish revegetation zones and zone numbers. |
| 7 | February 2021 | Revisions to include updated goals, priorities, 1-, 3-, and 5-year plans, and noxious weed management. |
| 8 | February 2022 | Revision includes updates to 1-, 3-, and 5-year plans and tracking tools; addition of comparison tracking tool figures. |

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# Acronyms and Abbreviations

| | |
|---|---|
| BLM | Bureau of Land Management |
| BMP | best management practices |
| CA | Contamination Area |
| CAA | Clean Air Act |
| CFR | Code of Federal Regulations |
| CJ | Crescent Junction |
| CO | Colorado |
| CWA | Clean Water Act |
| DOE | U.S. Department of Energy |
| DOT | U.S. Department of Transportation |
| DNR | Division of Natural Resources |
| dS/m | deciSiemens per metre |
| EMS | Environmental Management Standard |
| EO | Executive Order |
| ESA | Endangered Species Act |
| FEIS | Final Environmental Impact Statement |
| FIFRA | Federal Insecticide, Fungicide, & Rodenticide Act |
| FFSL | Forestry, Fire, and State Lands |
| H&S | Health and Safety |
| LM | Legacy Management |
| MBTA | Migratory Bird Treaty Act |
| MOA | memorandum of agreement |
| MOU | memorandum of understanding |
| MSO | methylated seed oil |
| NEPA | National Environmental Policy Act |
| NHPA | National Historic Preservation Act |
| NPS | U.S. National Park Service |
| RRR | Rim to Rim Restoration |
| SDS | safety data sheets |
| SME | subject matter expert |
| SOP | standard operating procedure |
| SURP | Southeast Utah Riparian Partnership |
| TAC | Technical Assistance Contractor |
| UPDES | Utah Pollutant Discharge Elimination System |
| UMTRA | Uranium Mill Tailings Remedial Action |
| USACOE | U.S. Army Corps of Engineers |
| USGS | U.S. Geological Survey |
| USU | Utah State University |
| UTV | utility terrain vehicle |
| WRI | Watershed Restoration Initiative |

## 1.0 Introduction

The Moab Uranium Mill Tailings Remedial Action (UMTRA) Project Revegetation and Weed Control Plan outlines the vision, goals, priorities and planning, implementation, monitoring and evaluation on the project site for the next 5 years (2022-2026). The revegetation workflow is illustrated below (Figure 1).

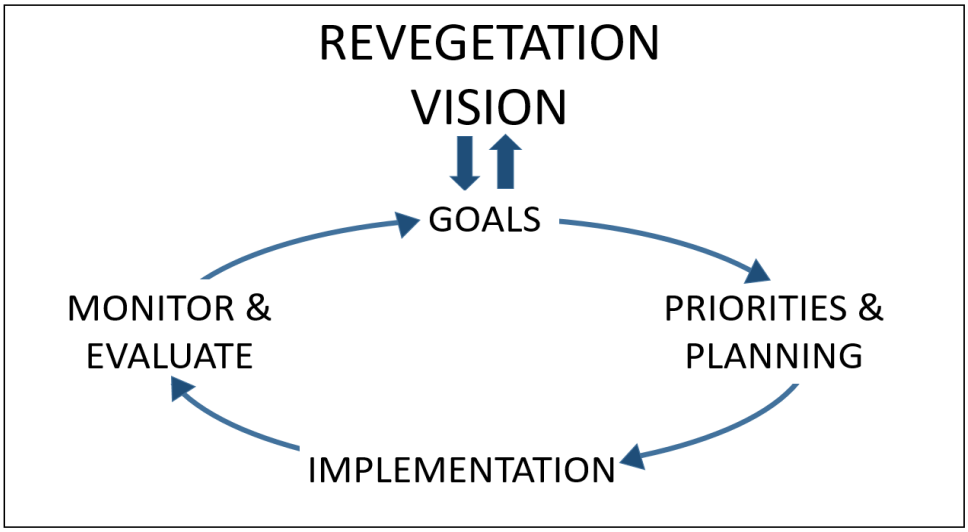


*Figure 1. Workflow of Overall Revegetation and Weed Control Program*

Both revegetation and weed control are critical in restoring the Project's remediated areas to a sustainable, resilient, native ecosystem. Revegetating with desirable, native plant species stabilizes soil, decreases competition of weed species, minimizes fugitive dust production, reduces water-use, and controls erosion and off-site transport of sediment. Native revegetation also promotes biodiversity, improves wildlife habitat and aesthetics, and encourages potential recreational opportunities.

Non-native weed species can be invasive and aggressive with the potential to cause significant damage to native ecosystems and/or cause economic losses. Invasive plants are a concern because of their potential to reduce native plant diversity, increase soil erosion, degrade wildlife habitat, damage watersheds, and adversely impact the general ecological health of native ecosystems (Idaho Power 2020). Ecological damage from uncontrolled weed infestations can be permanent, rendering lands unable to return naturally to their pre-invasion condition (Lowry et al. 2017).

Careful, species-specific planning and long-term efforts are necessary to achieve desired results, especially in disturbed, arid ecosystems. The purpose of this document is to outline a plan that will promote good stewardship, conservation of natural resources, and improve resilient native ecosystems while complying with applicable federal, state, and local regulations.

### 1.1 Background

The Moab UMTRA Project site is a former uranium ore-processing facility located about 4 miles northwest of the city of Moab in Grand County, Utah. The site is owned by the Department of Energy (DOE) and encompasses 480 acres, of which approximately 130 acres are covered by a

uranium mill tailings pile. The Moab Project mission is to safely remediate contaminated ground water and relocate residual radioactive material from the Moab site to a DOE-constructed disposal facility near Crescent Junction, approximately 30 miles north. Remediated areas are being revegetated for a self-sustaining native plant community and managed for noxious and invasive weeds.

## 1.2 Site Description

The Moab UMTRA project site includes the Contaminated Area (CA) and the Revegetation Area (Figure 2). The CA is the location of the tailings pile and active remediation efforts. The Revegetation Area consists of approximately 185 acres (formerly 135 acres) that have been remediated. It surrounds the CA to the north, northeast, east, and southeast.

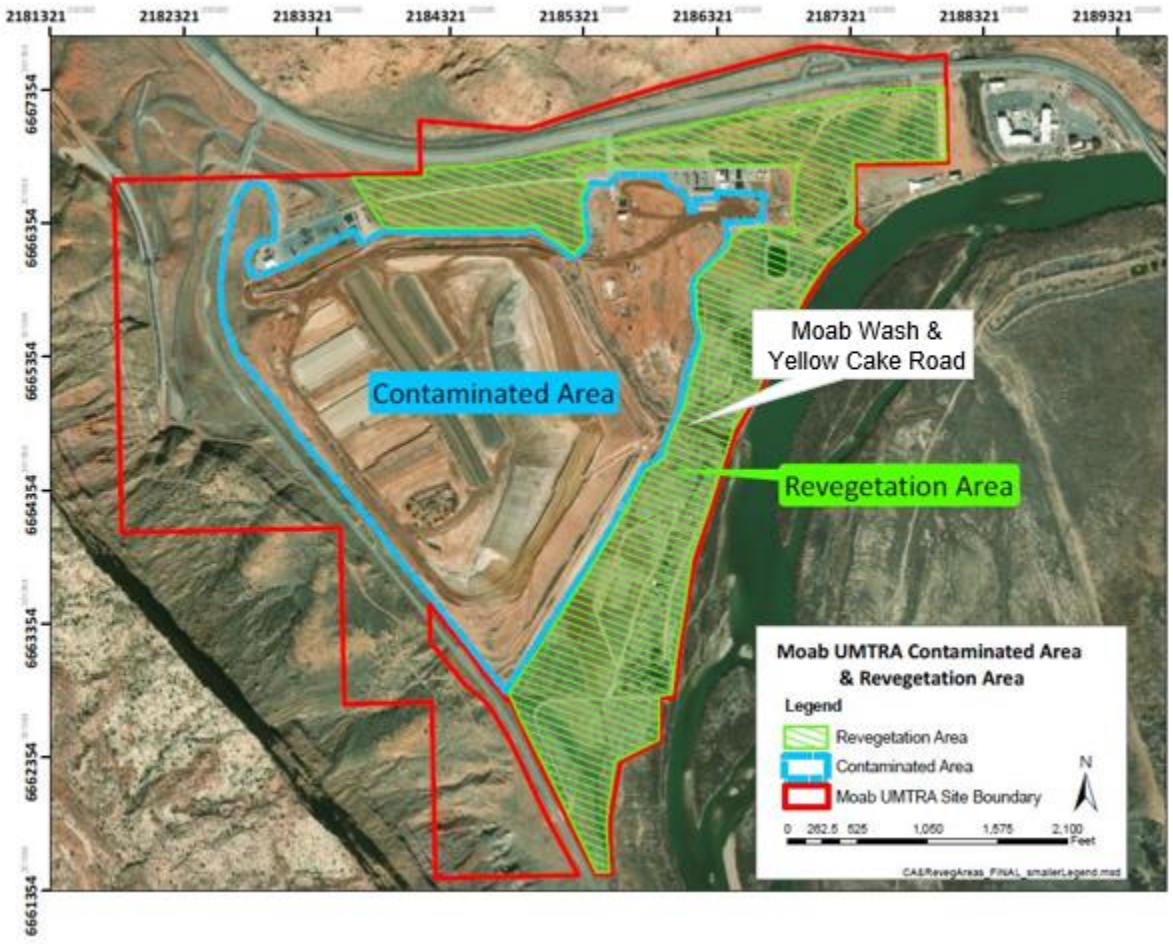


*Figure 2. Contaminated Area and Revegetation Area of Moab UMTRA Project Site*

The Colorado River forms the eastern boundary of the Moab Project site. The site is transected by the Moab Wash, an ephemeral stream which flows during significant storm events. Approximately one-third of the site lies within the 100-year floodplain of either the Colorado River or Moab Wash. The Moab site is susceptible to flooding from the Colorado River and/or Moab Wash during runoff of spring snowmelt in the Rocky Mountains, generally reaching a maximum flow between late May and early June. Thunderstorms in the drainage basin of the Moab Wash can also have an impact on the floodplain at the Moab site. Groundwater underlying the site moves from northwest to the southeast, discharging to the Colorado River.

The climate of the Moab site is semi-arid. The 2018 average annual temperature was approximately 58°F. January is the coldest month, with low temperatures averaging 20°F, and July is the warmest month, with high temperatures averaging 101ºF. The total rainfall is approximately 9 inches with half of the precipitation falling from July through September. Most of the rainfall occurs as high-intensity, convective thunderstorms in late summer. Light snow falls in winter, but usually does not remain on the ground very long.

The primary hydrogeologic unit at the Moab site consists of unconsolidated alluvium on the valley floor flanked by consolidated sandstones and shale on the canyon walls beyond the site boundary. Soil at the site is highly disturbed due to the removal of 36-72 inches of topsoil during previous remediation efforts. Soils at the site are variable, but generally are alkaline, salty, and fine grained, which further complicates vegetation establishment.

Flooding can impact portions of the Revegetation Area. A berm located along the Colorado River north of the Moab Wash and several off-pile areas of the site were remediated in the winter of 2010/2011. As part of this remediation, the berm previously installed along the riverbank north of Moab Wash and more than 158,000 cubic yards of contaminated soil were removed, creating areas of lower elevation. As a result of the soil remediation activities, this eastern off-pile area has been more susceptible to flooding at lower river stages.

Where the Yellow Cake onsite road crosses Moab Wash (Figure 2), the southern side of the crossing has historically been an entry point for higher flood waters to enter the southern end of the site (i.e., the well field). In spring 2021, a berm was constructed at this location. It has successfully demonstrated preventing storm water from late summer monsoons from entering the well field and shows promising results for keeping higher flood waters out.

At higher river stages, the natural downward slope in topography along the site also allows flood waters to enter from the southern end, inundating the general southern part of the site (i.e., the well field). Due to the bottomland morphology of much of the well field, high-water floods can result in standing water several feet deep. Poor drainage is an issue, leading to high salt concentrations and poor soil quality in this area (Parent 2010). Refer to *Moab UMTRA Flood and Drought Mitigation Plan* (DOE-EM-GJ1640) and *Moab UMTRA 2019 Flood Response Summary* (DOE–EM/GJTAC3035) for more details on flooding.

The Moab site consists of upland and riparian vegetation characteristic of the Colorado Plateau. Plant communities are comprised of a mixture of salt desert shrub, mixed desert shrub, and lowland riparian. Predominant native vegetation includes cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*), Gooding's willow (*Salix goodingii*), rabbit brush (*Ericameria nauseosa*), four-wing salt bush (*Atriplex canescens*), sand sagebrush (*Artemisia filifolia*); native grasses such as alkali sacaton (*Sporobolus airoides*), inland salt grass *(Distichlis spicata*), and native forbs including scarlet globemallow (*Sphaeralcea coccinea*), Rocky Mountain bee plant (*Cleome serrulata*), firecracker penstemon (*Penstemon eatonii*), and annual sunflowers (*Helianthus annuus*).

Due, in large part, to the removal of top soil during previous remediation efforts, much of the off-pile area at the site has been populated with non-desirable weeds. Many undesirable flora species have spread and most of these species thrive in soils that are alkaline, highly saline, and lacking in organic material. Prominent non-native species include tamarisk *(Tamarix ramosissima)*, kochia (*Bassia scoparia*), Russian knapweed (*Acroptilon repens*), Russian olive

(*Elaeagnus angustifolia*), cheatgrass *(Bromus tectorum*), tumbleweed (*Salsola tragus*), perennial pepperweed *(Lepidium latifolium*), and halogeton (*Halogeton glomeratus*).

Side channels of the Colorado River run adjacent to the site and may provide critical habitat for larval and young-of-year federally protected native fish species. The site is home to resident wildlife including mule deer, coyote, rabbits, ravens, raptors, and bluebirds. Situated along the Colorado River corridor, many other wildlife pass through the site including beavers, otters, turkeys, eagles, pheasants, Great blue heron, sand hill crane, Canadian geese, and the occasional mountain lion, black bear, and big horn sheep.

### 1.3 Purpose and Scope

DOE's vision of the Moab UMTRA Project site is a self-sustaining native landscape that will require little to no maintenance in 5 years (2022-2026). The scope of this document focuses on revegetation and weed control within the Revegetation Area of the Moab UMTRA Project site. This document will focus on revegetation objectives, address weed control and propose treatments for noxious and non-noxious weed species.

The following goals are provided for revegetation efforts and weed control at the site (note that "current" refers to the time of writing of this document, February 2022, and "recent" refers to within the recent timeline, approximately 1-2 years):

> Goal 1. In areas of recent human-caused disturbance, establish a vegetative cover to stabilize the soil, provide dust control, minimize erosion and off-site transport of sediment, and prevent noxious weeds from establishing in these areas.
>
> Goal 2. Control weeds (both noxious and non-noxious) throughout site using an integrated weed management approach from the *Utah Strategic Plan for Managing Noxious Weeds* (Whitesides 2004).
>
> Goal 3. In underperforming areas of bare soil due to high salinity and/or poor soil quality, either establish vegetative ground cover or determine that vegetative cover is not possible due to poor conditions. In the latter, manage for protecting physical soil crust to prevent on-site fugitive dust emissions.
>
> Goal 4. In areas with dominant non-native, non-noxious vegetation cover (e.g., kochia), establish a native vegetation community to ultimately outcompete undesirable vegetation and become self-sustaining.
>
> Goal 5. Maintain areas of self-sustaining, low maintenance native plant communities. Wherever possible, avoid or minimize disturbance and loss of native plant communities, and conserve biocrust where it is present.

## 2.0 Revegetation Priorities and Planning

The second step in the workflow is determining the priorities and planning for revegetation projects.

## 2.1 Revegetation Management Zones

For management purposes, revegetation zones in the Revegetation Area are categorized by similar current vegetative composition and cover, and/or ecological potential. Most are delineated by road boundaries or washes, but a few are demarcated by discernable differences in vegetation and/or soil (Figure 3).

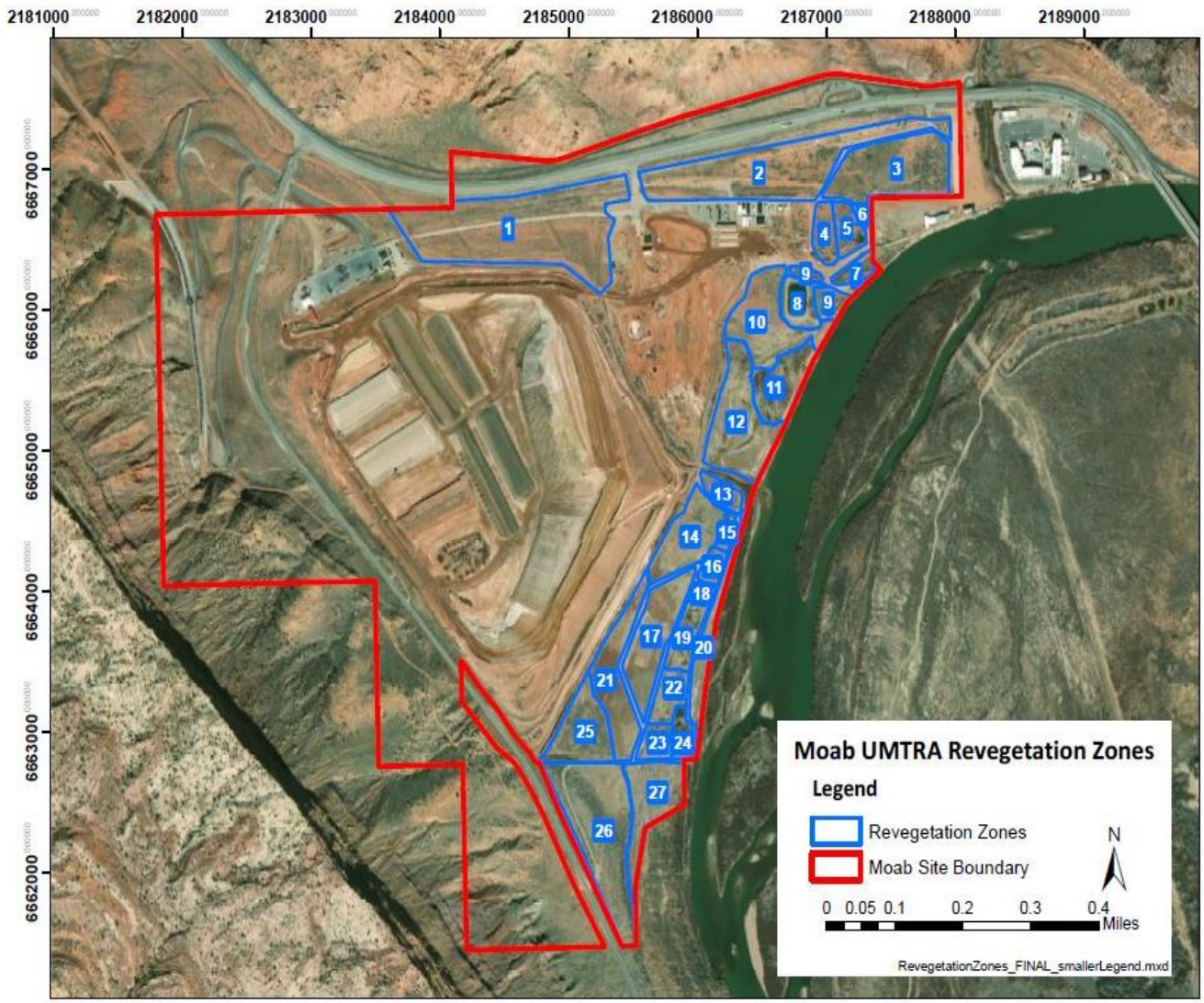


*Figure 3. Revegetation Management Zones*

In previous years, the Revegetation Area was delineated by irrigation zones. These are no longer used or are being phased out. A map of these historic irrigation zones has been included for reference purposes (Figure 4).


*Figure 4. Moab Site – Historic Irrigation Zones*

## 2.2 Revegetation Management Priorities and One-, Three-, and Five-Year Plans

Revegetation priorities are based on short- and long-term goals outlined to achieve the vision of a self-sustaining native plant landscape. To assist in determining management priorities and planning, the revegetation management zones were combined based on the five goals listed above, reflecting current conditions of soil and/or vegetation and/or level of effort needed (Table 1).

Five current condition categories were created and revegetation zones were designated into one or more categories. Priorities ranging from Highest to Lowest were assigned to each current condition based on ecological need and/or level of effort required. One-, three- and five-year plans are provided for each current condition, outlining success criteria.

It is noted that a few zones could be categorized in different conditions (e.g., Zone 3 is mostly self-sustaining native plant population, but also has Russian knapweed, a noxious weed species). In these cases, zones were designated by the condition that is a higher priority (e.g., Zone 3 is in the Noxious Weeds condition).

To aid in monitoring progress, color codes are assigned to the five priorities (highest = red, higher = orange, medium = yellow, lower = yellow-green, lowest = green). This tool can be used to track progress and monitor success criteria based on the one-, three-, and five-year goals (Table 1; Figure 5). Colors are based on the order of the priorities, which are founded on the outlined goals. These will be evaluated on an annual basis along with the one-, three-, and five-year benchmarks. As goals and/or priorities change order (e.g., accomplishments, current conditions improvement, vegetation establishment, etc.), colors on the tracking tool will reflect this progress.

See Figure 5 for the current revegetation and weed control priorities and Figure 6 for a comparison of the previous and current priorities. For 2022, the noxious weed category was further subdivided into two categories to differentiate between the number of species left untreated (orange = 2+ untreated noxious weed species, tan = 1 untreated noxious weed species).

## 2.3 Revegetation Planning Assumptions

This revegetation plan is intended as guidance for the Moab UMTRA Project site. It may be modified, altered, or departed from as specific locations warrant, as needs arise, and/or as priorities change.

## 2.4 Jurisdiction and Regulatory Compliance in Revegetation Areas

Revegetation areas may be subject to jurisdiction and regulations of another entity, which may impact revegetation activities (Table 2). Approximately 4.7 acres located along the Colorado River near the Moab Wash were identified in the *Moab UMTRA Project Floodplain and Wetlands Assessment for Additional Interim Actions at the Moab Project Site* (DOE-EM/GJ805-2005) as Jurisdictional Wetlands. Disturbance of jurisdictional wetland areas would require a 404 permit that may have additional requirements for reconstruction or mitigation.

Revegetation staff will ensure that compliance with rules and regulations are being met for revegetation activities. If there is any uncertainty regarding regulations associated with revegetation work, staff should bring these concerns to the attention of the Field Manager.

In regards to weed control, two more items are part of the regulatory framework:

1. Executive Order
   Executive Order 13751, *Safeguarding the Nation from the Impacts of Invasive Species* (December 5, 2016), calls on federal agencies to prevent the introduction, establishment, and spread of invasive species and to eradicate and control populations of invasive species that are established.

2. State of Utah
   Utah noxious weed law is administered by the Utah Department of Agriculture and Food. Pursuant to Utah Noxious Weed Act (Utah Code 4-17-101 et seq.) and Utah Administrative Code R-68, it is the duty of every property owner to control and prevent spread of noxious weeds within their possession or control. As per authority vested in the Commissioner of Agriculture and Food under Section 4-17-3, a state noxious weed list has been designated and published (Appendix A).

*Table 1. Revegetation Current Conditions, Priorities, and One, Three, and Five-Year Plans*

| ***Priorities & Color Code*** | **Highest (Red)** | **Higher & High (Orange & Tan)** | **Medium (Yellow)** | **Lower (Yellow-green)** | **Lowest (Green)** |
|---|---|---|---|---|---|
| ***Zones*** | 16, 18, 19, 22, 23 | Higher priority (2+ untreated species; orange): 11, 13, 14, 15, 20, 24<br>High priority (1 untreated species; tan): 3, 4, 5, 7, 8, 9, 10, 15 | 12, 17, 21 | 6, 27 | 1, 2, 25, 26 |
| ***Current Condition (based on outlined goals)*** | Bare soil due to disturbance | Noxious weeds | Bare soil due to high salinity and poor soil quality | Non-native vegetative ground cover | Mostly self-sustaining native plant population |
| ***Description of Current Condition*** | - Human-caused disturbance, ~13 acres<br>- Historically flood-irrigated plots with previous cottonwood stands in wellfield<br>- Dead and dying cottonwood trees were removed & processed<br>- Vegetative debris was collected & removed<br>- Old flood berms were removed and area graded and contoured<br>- Zone 15 was a one-acre test plot and lessons learned will be applied to rest of 12-acre area<br>- Repeat photo monitoring project established for Zone 15<br>- Currently soil is prepared for seeding | - 8 species of noxious weeds onsite<br>- 9 different weed species of management concern<br>- Throughout site<br>- Early detection-rapid response important<br>- See Tables 4, 5, & 6 for summaries and progress of weed control activities | - Underperforming “trouble” areas where nothing, or very little, is growing<br>- Prone to flooding<br>- Bottomland morphology with poor drainage<br>- Very high soil salinity, alkalinity, and poor soil quality<br>- Physical crust in some areas<br>- Fill dirt (e.g., old flood berms, dredged pond sediment, Arches material, etc.) was transported to this area and 1-few inches was placed on top of underperforming soils<br>- Currently burn box area | - Areas with ground cover predominantly non-native (technically not noxious) vegetation (e.g., kochia, Russian thistle) | - Currently little maintenance needed<br>- Few weeds<br>- Healthy biocrust present in certain areas |

*Table 1. Revegetation Current Conditions, Priorities, and One, Three, and Five-Year Plans (continued)*

| | | | | | |
|---|---|---|---|---|---|
| ***Reasons For Priorities*** | - Need for soil stability through revegetation<br>- Weeds easily get established in places of disturbance<br>- Could easily become infested with noxious weeds and create a much bigger problem | - Compliance with Executive Order 13751, *Safeguarding the Nation from the Impacts of Invasive Species* and State of Utah noxious weed law<br>- It will take years of diligent effort to control current noxious weed populations<br>- Emergent noxious weeds need to be controlled before becoming a significant infestation | - Soil stability (either through vegetation or soil crust)<br>- Reducing bare soil, if possible<br>- Improving soil quality and conditions to possibly support vegetation | - Non-native, non-noxious ground cover is better than bare ground<br>- Need to establish native vegetation that can outcompete non-native vegetation | These areas can generally be defined as successfully revegetated |
| ***1-Year Plan*** | - Design and build irrigation system<br>- Native vegetation seeding and planting<br>- Watering regime to promote establishment of native vegetation<br>- Prevent noxious weeds from getting established<br>- Manage non-native species (e.g., mowing kochia)<br>- Establish repeat photo monitoring project of area | - Continue with noxious weed program (outlined later in document)<br>- Early detection - rapid response to emerging weed population<br>- Focus on orange zones in weed tracking tool (Fig. 7)<br>- Develop weed mapping program<br>- New revegetation personnel to acquire pesticide applicator license certification<br>- Monitor previously treated areas | - Continue with USGS experimental plots: monitor and apply prescribed treatments, as necessary<br>- Test small area of transported fill material with native seed to see if vegetation can establish<br>- Manage non-native species (e.g., mowing kochia) that do grow there | Maintain (mow and weed kochia, Russian thistle etc.) | - Soil sampling (for comparative analysis)<br>- Maintain<br>- Protect areas from being disturbed |

*Table 1. Revegetation Current Conditions, Priorities, and One, Three, and Five-Year Plans (continued)*

| | | | | | |
|---|---|---|---|---|---|
| ***3-Year Plan*** | - Native vegetation established<br>- Monitor and prevent noxious weeds from becoming established<br>- Manage non-native vegetation (e.g., mowing kochia)<br>- Decreasing irrigation<br>- Consider planting forbs, shrubs, and trees<br>- Improve wildlife habitat | - Continue with weed program<br>- Downgrade all zones in weed tracking tool (Fig. 7) to 1 noxious weed species or less<br>- If noxious weeds are at manageable level, begin treating weed species of concern<br>- Establish native vegetation to outcompete weed species<br>-Monitor progress | - USGS experimental plot results expected in fall 2022<br>- Evaluate and implement research results as appropriate<br>- If 1-Year seed tests were successful, continue with native seeding in larger areas<br>- Monitor and evaluate | - These areas will take higher precedence<br>- Outcompete non-native vegetation while establishing a native plant community | - Maintain and monitor<br>- Protect areas from being disturbed |
| ***5-Year Plan*** | - Self-sustaining native plant community<br>- Part of wildlife corridor<br>- Monitor and maintain | - Low maintenance level<br>- No orange or red zones in weed tracking tool (Fig. 7)<br>- All green or yellow-green zones throughout site (Fig. 7)<br>- Monitor known “hot spots”<br>- Continue treating weed species of concern<br>- Continue to establish native vegetation to outcompete weed species<br>- Monitor and maintain | - Continue implementing research results<br>- Monitor and maintain | - Self-sustaining native plant community<br>- Monitor and maintain | - Self-sustaining native plant community<br>- Monitor and maintain areas of biodiversity and healthy biocrust |

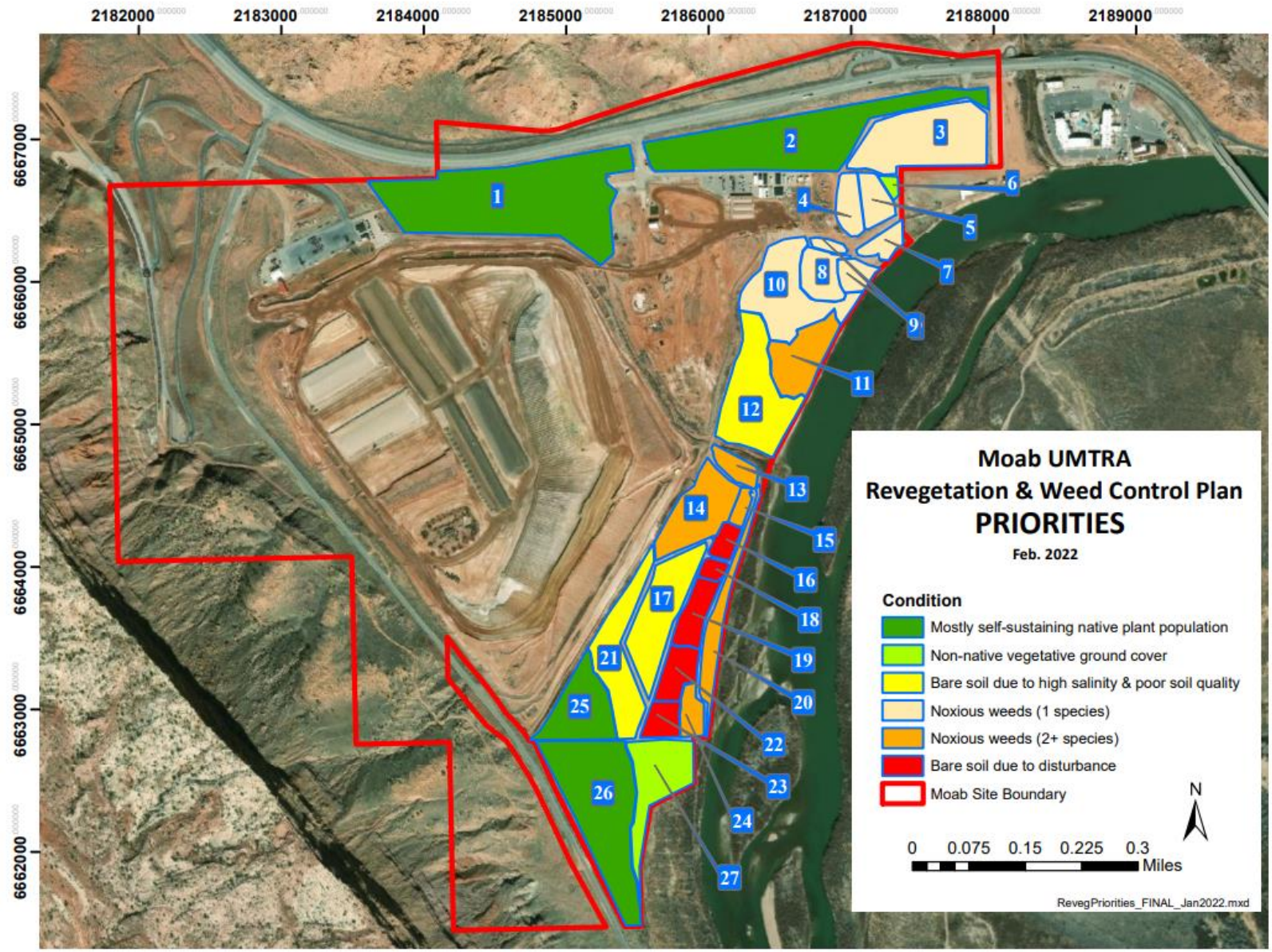


*Figure 5. Tracking Tool for Revegetation and Weed Control Priorities. Priorities and color codes as follows: Highest = red, higher = orange, high = tan, medium = yellow, lower = yellow-green, and low = green*

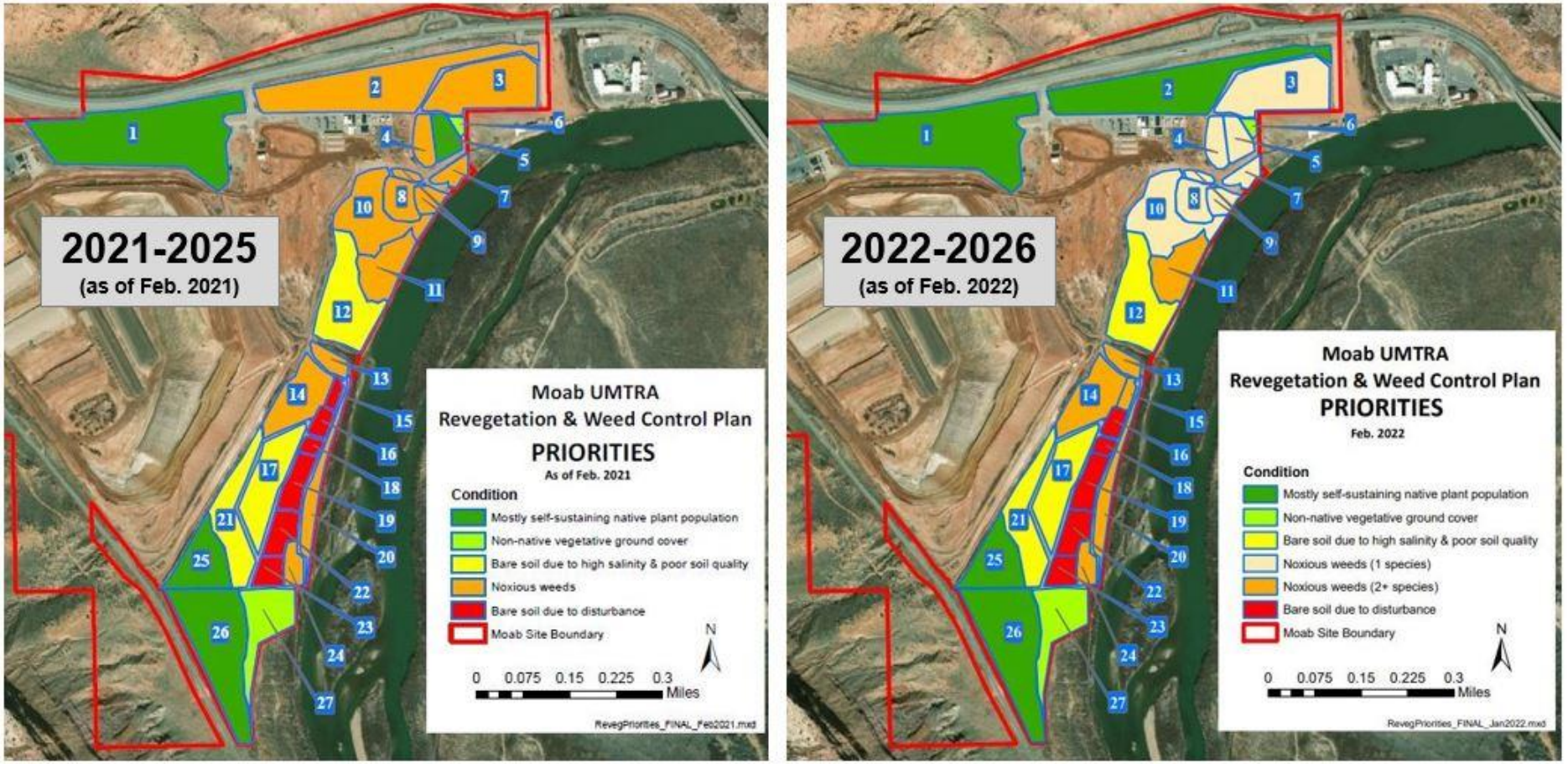


*Figure 6. Comparison of Previous and Current Revegetation and Weed Control Priorities. Priorities and color codes as follows: Highest = red, higher = orange, high = tan, medium = yellow, lower = yellow-green, and low = green*

*Table 2. Environmental Compliance and Impacts on Revegetation Activities*

| **Compliance Obligation (Issue Agency/Regulator)** | **Summary** | **Permit, Agreement, or Action** | **Impact(s) on Revegetation Activities** |
|---|---|---|---|
| Section 7 of the Endangered Species Act of 1973 (ESA) as amended (16 U.S.C. 1532 et seq.) and the Interagency Cooperation Regulations (50 CFR 402) | The ESA prohibits activities that would jeopardize the continued existence of an endangered or threatened species or cause adverse modification to a critical habitat. | The Project reviewed work activities for potential impacts on threatened or endangered species. Critical fish habitat is protected by interception of contaminated groundwater and injection of fresh water in wells near the Colorado River.<br><br>Biological Opinion and Incidental Take Statements for Moab and Green River. | Revegetation work completed near the Colorado River side channel habitats must be in compliance with the Biological Opinion of the Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah, Final Environmental Impact Statement (FEIS). |
| National Environmental Policy Act (NEPA) | NEPA requires federal agencies to follow a prescribed process to anticipate impacts on the environment of proposed major federal actions and alternatives. DOE codified its implementation of NEPA in 10 CFR 1021, "National Environmental Policy Act Implementing Procedures." | NEPA reviews are required periodically to ensure proposed Project activities are within the original bounds of the Final Environmental Impact Statement (FEIS). | An Environmental Aspects Checklist (Form 3000 on SharePoint) must be completed for any new non-routine activity to determine if a NEPA review is required. |
| Federal Insecticide, Fungicide, & Rodenticide Act (FIFRA) | FIFRA governs the distribution, sale, and use of pesticides. This Act categorizes pesticides as either restricted or general use. | General use pesticides applied at the Moab and Crescent Junction (CJ) sites. | Any revegetation activity which includes pesticides (which includes herbicides) must comply with FIFRA. |
| Clean Air Act (CAA) | CAA establishes the requirements for facility air quality and air emissions. | The CAA is enforced at the state level through fugitive dust control plans prepared for the Moab and CJ sites. | Implementing control measures while doing revegetation activities that can produce dust or affect air quality (e.g., mowing, seeding, etc.). |
| Utah Administrative Code (UAC) R307-205-8,"Emission Standards; Fugitive Emissions and Fugitive Dust; Tailings Piles and Ponds" | This state administrative code establishes minimum work practices and emission standards for sources of fugitive emissions and fugitive dust. | Monitor fugitive dust emissions by individuals certified to EPA Method 9 and implement the controls outlined in the site fugitive dust control plans to the greatest extent practicable. | Implementing control measures while doing revegetation activities that can produce dust (e.g., mowing, seeding, etc.). Opacity will comply with program requirements. |

*Table 2. Environmental Compliance and Impacts on Revegetation Activities (continued)*

| **Compliance Obligation (Issue Agency/Regulator)** | **Summary** | **Permit, Agreement, or Action** | **Impact(s) on Revegetation Activities** |
|---|---|---|---|
| 33 USC 1251, Clean Water Act (CWA) / National Pollutant Discharge Elimination System (NPDES)<br><br>Utah Administrative Code (UAC) Rule 317-8-3.9, "Storm Water Discharges" | Under the CWA, the NPDES was designed to regulate and control pollutants from industrial wastewater and storm water discharges, both of which can have negative impacts on the quality of U.S. surface waters. The federal discharge requirements are implemented by the Utah Pollutant Discharge Elimination System (UPDES), an equivalent state system. | Utah Pollutant Discharge Elimination System (UPDES) Storm Water General Permits, Moab and CJ<br><br>Annual Notice of Intent (NOIs)<br><br>Implement site Storm Water Pollution Prevention Plans | Revegetation activities that disturb the land surface must be in compliance with the *Moab UMTRA Project Moab Site Storm Water Pollution Prevention Plan* (DOE-EM/GJRAC1475) |
| Clean Water Act (CWA) Section 404 | Restore and maintain the chemical, physical, and biological integrity of the Nation's waters. Prohibit the discharge of any pollutant into a navigable water, including wetlands, unless otherwise authorized by a permit. | Joint 404/Stream Channel Alteration Permit for Off-Pile Remediation; U.S. Army Corps of Engineers (USACOE), Utah Division of Water Rights | Notify the TAC Environmental Manager when planning work within 30 ft of the Colorado River or Moab Wash. A 404 permit may be necessary. |
| National Historic Preservation Act (NHPA) | Memorandum of agreement (MOA) are in place among DOE, the Utah State Historic Preservation Office, the Utah Department of Transportation (DOT), and the Bureau of Land Management (BLM) for protection of cultural and historic resources at the Project sites. | Annual cultural resource inventory performed at the Crescent Junction site for Native American art sites, and an annual report prepared and submitted in accordance with the applicable MOA. The conditions of the Moab site MOA have been previously met. | Any discovery of cultural resources must be reported to the TAC Environmental Manager and no further surface-disturbing activity will take place unit DOE makes a decision concerning the disposition of the items. |
| Migratory Bird Treaty Act (MBTA) | The MBTA implements various treaties and conventions among the U.S. and several other countries for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds, their body parts, nests, or eggs is unlawful. | Identify and/ or monitor endangered, threatened, or candidate species at Project sites. Evaluate Project activities that could impact endangered, threatened, or candidate species. | Walk down areas prior to mowing looking for ground nests and inspecting trees that are to be removed for active nests. If such nests are found, suspend activity until birds have migrated. |

*Table 2. Environmental Compliance and Impacts on Revegetation Activities (continued)*

| **Compliance Obligation (Issue Agency/Regulator)** | **Summary** | **Permit, Agreement, or Action** | **Impact(s) on Revegetation Activities** |
|---|---|---|---|
| DOE O 436.1, "Departmental Sustainability"<br><br>Executive Order (EO) 13834 on Efficient Federal Operations | DOE O 436.1 requires all DOE sites to implement sound stewardship practices protective of the air, water, land, and other natural resources impacted by DOE operations. It also requires DOE sites to cost effectively meet or exceed compliance requirement for applicable environmental, public health, and resource protection laws, regulations, and DOE requirements. | Develop annual Site Sustainability Plan and implement an Environmental Management Standard (EMS). | Purchase items from the Bio-based list when feasible (www.biopreferred.gov) and report purchases to the TAC Environmental Manager. Recycle or upcycle revegetation equipment, materials and supplies when possible.<br><br>Revegetate with Utah native "Water Wise" plants and/or pollinators to the extent practical. |
| EO 11988, "Floodplain Management" | DOE's implementation of regulations in 10 CFR 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements," identify the requirements of EO 11988 for actions that may affect floodplains. Portions of the Moab site fall within the 100-year floodplain of the Colorado River. | Activities conducted in the floodplain require evaluation. | Prior to implementation, discuss all floodplain revegetation activities with TAC Environmental Manager to ensure compliance. |
| EO 11990, "Protection of Wetlands" | 10 CFR 1022 implements the requirements of EO 11990 for actions that may affect wetlands. | Evaluate Project activities that could impact jurisdictional wetlands. | It was noted in the *Moab-Flood Plain and Wetlands Assessment for Additional Interim Actions* (2005) that 4.7 acres of wetlands exist on-site along the Colorado River. If any work is planned beyond the berm of the Colorado River, contact the TAC Environmental Manager. |

# 3.0 Revegetation Implementation

Sustainable revegetation needs to be accomplished within the confines of the existing ecosystem of the area (Anderson 2002). Advice from local Subject Matter Experts (SME) and collaborative research from strategic partnerships (e.g., U.S. Geological Survey, Rim to Rim Restoration) will help guide the decision-making process for best management practices, depending on the project. This will be important given some of the challenging conditions onsite.

A site assessment of the biological resources required for revegetation is a good practice. It may include a characterization of the vegetation, evaluation of the soils, history of disturbance, climatic data, or identification of possible "troubled areas" (Anderson 2002). Time is a critical factor for establishing a native revegetation planting, and it may take several years, or even decades, for the revegetation areas to begin to resemble native plant communities found on the undisturbed portions of the site. Other environmental conditions, such as drought or extreme heat, may factor into the establishment of vegetation.

Where feasible, begin with a small scale pilot project before implementing a plan for an entire area. This helps in determining effectiveness of a particular approach, which can conserve funds and avoid wasted time (Sher 2010). To initiate this concept, a 2-year collaborative research project with the U.S. Geological Survey (USGS) began in fall 2020 investigating revegetation variables (e.g., soil amendments, seed mixes, fertilizers, etc.) in the wellfield (Zone 17). Experimental plots (336 total) were installed and baseline data was collected in summer 2021. Research performed on site by USGS and UMTRA staff can be used as a tool for successful revegetation of the site.

## 3.1 Soil Characterization

Knowing your soil type is vital to revegetation (K. Dohrenwend, personal communication, Jan. 20, 2021). Soil sample data will support decisions regarding plant species and other necessary additional steps needed to affect successful revegetation (Sher 2010). Some soil conditions may require the use of amendments which can be time consuming and expensive.

However, many native species do not need soil amendments and adverse conditions can be addressed through the selection of appropriate plants, such as salt tolerant species (Dohrenwend 2013). Land managers in upper Colorado River basin have found that selection and use of halophytic (i.e., salt loving) species is the best management response to restoration situations exhibiting elevated soil salinity (Sher 2010).

In active flood areas, it is also important to note that soil conditions may be significantly altered during a flood. These dynamics may be a factor in the revegetation process and are considered in site management planning.

## 3.2 Seedbed Preparation

Proper seedbed preparation is essential for establishment of vegetation. Depending on soil type and conditions, certain areas may require various soil amendments and/or treatments before seeding. Addition of compost or mycorrhizal inoculants may help. The soil bed may receive further preparations such as disking or tilling to promote proper conditions for seedbeds. Soil compaction may also need to be addressed.

Addressing soil issues can greatly enhance establishment of species. However, it should be acknowledged that addressing some of these problems may be logistically or fiscally infeasible in some zones, and thus may be the reason to deprioritize them for revegetation (e.g., very little will establish in soil salinity levels over 15 dS/cm). The addition of clean fill dirt, when available, may aid in the establishment of these areas.

Compost is being created onsite and revegetation staff continue to explore best management practices. Composted materials and wood chips may be used to create a soil amendment for underperforming areas to improve soil chemistry and fertility.

## 3.3 Seeding, Seed Mixes & Planting

One of the most important aspects of the revegetation effort is species selection. Native species are often required because they are either adapted to the conditions that will exist at the site after revegetation, or they are disturbance-adapted and perform well during the first few years (Anderson 2002). Past performance of particular plant species in similar conditions and availability of seed or plant material should be considered in the species selection process. The source of the seed or plant materials should be as close as possible, geographically, to the area being revegetated (Anderson 2002), including collecting seeds from onsite plants when feasible. UMTRA staff collaborated with National Park Service biologists to learn techniques for collecting and processing seed and plan on using this knowledge in the future.

Seed mixes need to be carefully selected and targeted towards current soil conditions (i.e., salt-tolerant species). When seeding, mixes of native species (grasses, forbs, and shrubs) are used to encourage overall successful vegetation establishment. Because of the challenging conditions onsite, the final vegetation cover may not be biodiverse. It is noted that the revegetation subject matter expert (SME) has stated for certain areas onsite (i.e., bare ground due to poor soil conditions), it may take several years to establish native vegetation, if at all (K. Dohrenwend, personal communication, Jan. 20, 2021). This is not a result of lack of effort, but rather due to the ecological and environmental limitations.

Although, initially, the common native plant species that are being seeded have been carefully selected for the limiting conditions in some areas onsite, other native grasses, forbs, shrubs, or trees could be seeded and planted at a future time, if desired, to provide greater diversity to the revegetation locations. Succession is also a natural process, with some species performing better initially and being replaced by other species over time. This should be anticipated and planned for (Sher 2010). Another consideration is planting initial vegetation (e.g., grasses) that will still allow the use of an herbicide (e.g., broadleaf herbicide) without harming that species (Sher 2010).

Time is a critical factor for establishing a native revegetation planting. It may take several years, or even decades, for the revegetation areas to begin to resemble native plant communities found on the undisturbed portions of the site. Native plants often take longer to germinate and establish than non-native species. For the first year or two, many native species spend most of their energy developing a substantial root system before sending up much aboveground growth. It is also normal for revegetation efforts and plant succession to go through an initial stage of annual weeds followed by the establishment and dominance of the desired perennial species.

There are many aspects to seeding success, some of which we have no control (Mealor). Seeding may be done by broadcasting, drill seeding, or hand seeding. Depending on the location and purpose, planting may consist of seeding or planting poles or cuttings and, in some cases, may involve using containerized stock. Considerations, such as application rate, timing, warm vs cool season seeds, wind, and herbivory, will be evaluated at the time of planting (K. Dohrenwend, personal communication, Jan. 20, 2021).

Noxious weed species are prohibited species (Table 3) and use of non-native plants is to be avoided to the extent practical. Selected seed mixes shall be verified weed-free prior to purchasing.

Documentation of seeding and planting activities will be essential in the monitoring and evaluation process, especially since many seeds will not germinate for years after planting and some only after other species have established (Sher 2010).

## 3.4 Watering

Irrigation may be used to help establish vegetation growth in newly planted areas and to facilitate additional growth in areas that have been revegetated. A variety of irrigation methods are available including sprinklers, hose reels, drip systems, and flooding. The watering schedule will be designed to encourage permanent establishment of plants. After the first few years, the amount of irrigation water applied is reduced to encourage plant adaptation to the local water table/precipitation. The goal is to establish resilient native vegetation that does not require supplemental watering.

Past lessons learned show that improper watering has led to a host of problems. This includes a previous stand of planted cottonwoods in the wellfield that were constantly flood irrigated and when the watering regime changed (to encourage the roots to go deeper), trees experienced mortality, fell over, and created safety hazards. SMEs and irrigation resources will be consulted to ensure proper water methods and timing. Irrigation type, design, and scheduling will be targeted for each zone. This is an on-going project which requires substantial maintenance and effort. Much of the historical irrigation layout is no longer relevant, and a large portion of the above ground system has been damaged beyond use by years of exposure in the desert environment.

Water application is recorded via irrigation log and will be updated to accurately track water use. A focus on reducing water use, as possible, throughout the life of the Project, is also important given the current and forecasted state of drought in this area.

## 3.5 Revegetation Activities & Vegetative Debris

Revegetation activities are important to the maintenance of the Revegetation Area along with specific project objectives. These activities include mowing, pruning, thinning, chipping/shredding, and mulching. Periodic thinning of mature cottonwood and willow trees is performed to improve overall growth and avoid creating a safety hazard. Tree trimmings from pruning/thinning may be shredded in a chipper and spread or composted. These activities may create large quantities of vegetative debris, in particular woody debris.

Vegetative debris will be evaluated on a case-by-case basis and may be dealt with in a variety of ways: chipping, mulching, composting, burning (i.e., in the burn box), or taken to landfill.

This document will not go onto details about how to perform each these revegetation activities; more information is available in the *Moab UMTRA Project Revegetation Operations and Maintenance Manual* (DOE–EM/GJTAC2262).

## 4.0 Weed Control

Managing noxious and invasive weeds is a critical component to achieve DOE's vision for a self-sustaining native plant landscape (Mattson et al. 2020). This Weed Control Plan uses an integrated framework of techniques to control present and prevent future infestations of noxious weeds, enhance the native plant communities, reduce wildfire hazards, and improve wildlife habitat.

This section of the document addresses *Goal #2: Control weeds (both noxious and non-noxious) throughout site using an integrated weed management approach from the Utah Strategic Plan for Managing Noxious Weeds* (Whitesides 2004) listed above. Refer to Table 1 for one-, three-, and five-year success criteria for the weed plan.

### 4.1 Weed Control Objectives

As appealing as it is to have a goal of being noxious-weed free onsite, the reality is that the Moab UMTRA Project site is located along the Colorado River, which is a major corridor for spreading invasive weed species. Without great expense, it is difficult, if not impossible in the long term, to maintain a weed-free island surrounded by weed-covered lands. This is a regional problem and one that other organizations are also tackling.

Collaborations and strategic partnerships with other land agencies are important to address shared weed problems. The Moab UMTRA site boundary is considered the berms closest to the river, thus the extent of onsite management. Any vegetation towards the river from the berms will be managed by Utah Division of Natural Resources. Collaboration will allow beneficial management for both agencies. Currently, revegetation staff are collaborating with Utah Department of Natural Resources to address encroaching noxious weeds along the shared eastern site boundary.

Given the location of the project site, weed control will most likely always be a management concern. However, it may be feasible to keep weed populations to a low maintenance level by following the *Utah Strategic Plan for Managing Noxious Weeds* (Whitesides 2004) as a guideline. Objectives of the Moab UMTRA weed control plan, specifically for noxious weeds:

1. Prevention
    a. Education and Personnel Training
2. Early Detection and Rapid Response
3. Management of Established Populations
    a. Identify the perimeter
    b. Eradicate satellite populations
    c. Contain and suppress main population

d. Treatment methods
e. One, three, and five-year management plans

4. Revegetation or Restoration
5. Monitoring and Reporting

## 4.2 Weed Classifications and Weed Lists

Invasive plant species are non-native, aggressive plants with the potential to cause significant damage to native ecosystems and/or cause significant economic losses. Invasive plants are opportunistic plant species that readily flourish in disturbed areas, are difficult to control, and thereby, can compete with and/or prevent native plant species from re-establishing (Idaho Power 2020).

Invasive noxious weeds have been described as a raging biological wildfire—out of control, spreading rapidly, and causing enormous economic losses (Lowry et al. 2017). Noxious weeds are capable of spreading at rates of up to 60% annually (Smith et al. 1999). Devastation caused by noxious weeds is enormous. Economic losses from weeds exceed $30 billion annually in the U.S. and the cost continues to grow (Pimentel et al. 2005).

Noxious weeds are a subset of invasive plants that are officially designated by a federal, state, or local agency as injurious to public health, agriculture, recreation, wildlife, or property (Sheley and Petroff 1999).

### 4.2.1 State Of Utah

Under the Utah Noxious Weed Act, five classes of noxious weeds have been designated for the state of Utah based on preventive or management measures:

> Class 1A. Early Detection Rapid Response / Watch List: Declared noxious and invasive weeds not native to the state of Utah and not known to exist in the State that pose a serious threat to the state and should be considered as a **very high priority**.
> Class 1B. Early Detection Rapid Response: Declared noxious and invasive weeds not native to the State of Utah that are known to exist in the state in very limited populations and pose a serious threat to the state and should be considered as a **very high priority**.
> Class 2. Control: Declared noxious and invasive weeds not native to the state of Utah, that pose a threat to the state and should be considered a **high priority** for control. Weeds listed in the control list are known to exist in varying populations throughout the state. The concentration of these weeds is at a level where control or eradication may be possible.
> Class 3. Contain: Declared noxious and invasive weeds not native to the State of Utah that are widely spread. Weeds listed in the containment noxious weeds list are known to exist in various populations throughout the state. Weed control efforts may be directed at **reducing or eliminating new or expanding weed populations**. Known and established weed populations, as determined by the weed control authority, may be managed by any approved weed control methodology, as determined by the weed control authority. These weeds pose a threat to the agricultural industry and agricultural products and should not enter commercial channels.
> Class 4. Prohibited for sale or propagation: Declared noxious and invasive weeds, not native to the state of Utah, that pose a threat to the state through the retail sale or propagation in the nursery and greenhouse industry. Prohibited noxious weeds are

> annual, biennial, or perennial plants that the commissioner designates as having the potential or are known to be **detrimental to human or animal health, the environment, public roads, crops, or other property**.

See Appendix A for the State of Utah noxious weed list, which has been updated since the previous revision of this document.

### 4.2.2 Grand County

The Utah Noxious Weed Act states that "*Each county in Utah may have different priorities regarding specific State designated Noxious Weeds and is therefore able to reprioritize these weeds for their own needs*."

See Appendix B for the 2022 Grand County noxious weed list, which has been updated since the previous revision of this document.

### 4.2.3 Moab UMTRA Project Site

A Moab UMTRA site-specific target weed list was created in 2020, which compiled noxious weeds lists from Grand County and State of Utah. Invasive (but technically not noxious) weed species of ecological impact and of management concern (e.g., kochia) were determined by revegetation personnel and also included on the Moab UMTRA site-specific target list. Because noxious weed lists are continually updated by the state and county to reflect new invasive species, the site-specific Moab UMTRA target list was updated in 2022 (Table 3).

A total of 65 (previously 60) weed species are on the Moab UMTRA target list: 56 noxious weed species (previously 51) and 9 invasive weed species of concern (Table3). Noxious weeds will be of highest priority.

It is noted that Phragmites *(Phragmites australis* subsp. *americanus)* is present on site in two small patches (<200 sq ft), but is the native subspecies, not the noxious introduced variety *(Phragmites australis*). Project staff will continue to monitor for presence of any non-native Phragmites.

Cheatgrass (*Bromus tectorum*) was intentionally not included on the target weed list or in the previous weed mapping. It is pervasive and considered beyond management control throughout much of the West. However, new treatment strategies are promising. Future plans may consider these new options.

## 4.3 Current Noxious Weed Inventories, Surveys, and Results

A weed inventory and mapping were conducted by revegetation personnel in summer 2020 based on the site-specific target weed list. This established the baseline data for the weed control program. See *Moab UMTRA Project Revegetation and Weed Control Plan Revision 7* (DOE–EM/GJTAC1655) for details and methodologies.

*Table 3. Updated Moab UMTRA Site-specific Target Weed List 2022*

| GRAND & STATE NOXIOUS (Class 2-4) | |
|---|---|
| Bermudagrass | *Cynodon dactylon* |
| Black Henbane | *Hyoscyamus niger* |
| Canada thistle | *Cirsium arvense* |
| Cogongrass | *Imperata cylindrical* |
| Dalmatian toadflax | *Linaria dalmatica* |
| Dame's Rocket | *Hesperis matronalis* |
| Diffuse knapweed | *Centaurea diffusa* |
| Dyers woad | *Isatis tinctoria* |
| Field bindweed | *Convolvulus arvensis* |
| Hoary cress | *Cardaria spp.* |
| Houndstongue | *Cynoglossum officinale* |
| Jointed Goatgrass | *Aegilops cylindrical* |
| Leafy spurge | *Euphorbia esula* |
| Medusahead | *Taeniatherum caput-medusae* |
| Musk thistle | *Carduus nutans* |
| Myrtle spurge | *Euphorbia myrsinites* |
| Perennial pepperweed | *Lepidium latifolium* |
| Perennial Sorghum spp. (Incl. but not limited to Johnson grass and Sorghum almum) | *Sorghum halepense* & *Sorghum almum* etc. |
| Phragmites (Common reed, non-native variety) | *Phragmites australis* |
| Poison hemlock | *Conium maculatum* |
| Puncturevine (goathead) | *Tribulus terrestris* |
| Purple loosestrife | *Lythrum salicaria* |
| Quackgrass | *Agropyron repens* |
| Ravenna grass | *Tripidum ravennae* |
| Rush skeletonweed | *Chondrilla juncea* |
| Russian knapweed | *Centaurea repens* |
| Russian olive | *Elaeagnus angustifolia* |
| Scotch broom | *Cytisus scoparius* |
| Scotch thistle | *Onopordum acanthium* |
| Spotted knapweed | *Centaurea maculosa* |
| Squarrose knapweed | *Centaurea squarrosa* |
| Tamarisk/Salt cedar | *Tamarix ramosissima* |
| Yellow Starthistle | *Centaurea solstitialis* |
| Scotch broom | *Cytisus scoparius* |
| Yellow toadflax | *Linaria vulgaris* |

| UMTRA-SPECIFIC WEEDS OF CONCERN | |
|---|---|
| Bull thistle | *Cirsium vulgare* |
| Crested wheatgrass | *Agropyron cristatum* |
| Halogeton | *Halogeton glomeratus* |
| Kochia | *Kochia scoparia* |
| Tumbleweed | *Salsola tragus* |
| Tumbling mustard | *Sisymbrium altissimum* |
| Wooly mullein | *Verbascum thapsus* |
| Yellow salsify | *Tragopogon dubius* |
| Yellow sweet clover | *Melilotus officinalis* |

| GRAND & STATE NOXIOUS (Class 1B & 1A) | |
|---|---|
| Class 1B: Early Detection Rapid Response (EDRR) | |
| African mustard | *Brassica tournefortii* |
| Blueweed (Vipers bugloss) | *Echium vulgare* |
| Camelthorn | *Alhagi maurorum* |
| Common St. Johnswort | *Hypericum perforatum* |
| Cutleaf vipergrass | *Scorzonera laciniata* |
| Elongated mustard | *Brassica elongata* |
| Garlic mustard | *Alliaria petiolata* |
| Giant reed | *Arundo donax* |
| Goatsrue | *Galega officinalis* |
| Japanese knotweed | *Polygon cuspidatum* |
| Oxeye daisy | *Chrysanthemum leucanthemum* |
| Purple starthistle | *Centaurea calcitrapa* |
| Class 1A: EDRR / Watch List | |
| African rue | *Peganum harmala* |
| Common crupina | *Crupina vulgaris* |
| Malta starthistle | *Centaurea melitensis* |
| Mediterranean sage | *Salvia aethiopis* |
| North African grass | *Ventenata dubia* |
| Plumeless thistle | *Carduus acanthoides* |
| Small bugloss | *Anchusa arvensis* |
| Spring millet | *Milium vernale* |
| Syrian beancaper | *Zygophyllum fabago* |

Results from the 2020 Moab UMTRA project site weed mapping showed 16 different weed species based on the target weed list, specifically 7 different noxious weed species (6 of which are Class 3 and 1 species is Class 4) and 9 different invasive weed species of concern.

In 2021, no official inventory or mapping was conducted, however, revegetation personnel visually monitored for weeds throughout the site while doing other revegetation activities. One additional noxious weed species, goathead (also known as puncture vine, *Tribulus terristris*), was detected onsite in 2021 which had not been present in 2020, increasing the total number of noxious weed species to 8. This species was not present onsite until late summer monsoon precipitation occurred, creating ideal conditions for this weed.

Goat heads appeared to be encroaching into site along the eastern and southern boundaries (Zones 2, 3, and 26), mostly as seeds were washed into the site from nearby roads (e.g., Hwy

279, Hwy 191). Revegetation crews conducted "early detection – rapid response", hand-pulling all known infestations.

Summary of 2021 target species from weed list (Table 4) based on observational data:
- 8 different noxious weed species (7 of which are Class 3 and 1 species is Class 4).
- 9 different invasive weed species of concern.

See Tables 4 and 5 for current status of noxious weed species onsite and summary of weed control activities conducted in 2021. Revegetation crews treated many of the noxious weed species, starting with the smaller infestations first.

*Table 4. Current Status of Noxious Weed Species Onsite and Summary of Weed Control Activities from 2021*

| | NOXIOUS WEED SPECIES ONSITE | CURRENT STATUS | NUMBER OF ZONES MAPPED IN 2020 (of 27 zones total) | NUMBER OF ZONES TREATED IN 2021 | NOTES |
|---|---|---|---|---|---|
| 1 | Tamarisk | Most wide-spread and extensive noxious weed onsite; all growth stages present | 24 | 3: complete<br>2: partial | This will be the most challenging noxious weed to treat. |
| 2 | Russian knapweed | Mostly large, sparsely covered patches throughout site | 16 | 12 | Treatments from fall 2020 showing significant success. |
| 3 | Russian olive | A few seedlings scattered throughout site | 15 | 13 | In 2021, over 95% of all Russian olive onsite were treated. With approval from the state, Russian olives along shared boundary (on river berm) were also treated. |
| 4 | Perennial pepperweed | Small infestations with moderate cover are interspersed throughout the site | 7 | 9 | This species, detected in 2020, invaded more zones in 2021. Revegetation crews conducted early detection - rapid response. |
| 5 | Goathead (puncturevine) | Encroaching from seeds washing in along boundaries | 0 | 3 | New species detected onsite in 2021. Revegetation crews conducted early detection - rapid response. |
| 6 | Bermuda grass | Small (<200 sq ft), contained patches | 1 | 1 | Treated; monitoring area. |
| 7 | Canada thistle | Small (<200 sq ft), contained patches | 1 | 1 | Treated; monitoring area. |
| 8 | Field bindweed | Small (<200 sq ft), contained patches | 1 | 1 | Treated; monitoring area. |

For management priorities, color-coded designations were assigned to each zone. Colors were assigned for the number of different noxious weed species present and untreated in individual

zones: green represents zero noxious weed species present; yellow-green is 1 noxious weed species, yellow is 2 different noxious weed species, orange is 3 different noxious weed species, and red is 4+ different species of noxious weeds present in that zone.

Results for all 27 zones can be seen in Table 5 and Figure 7. Similar to the tracking tool for the overall revegetation and weed control priorities (Figure 5), the purpose of this tool is to track progress and monitor success criteria for the noxious weed program. See Figure 8 for comparison of previous and current tracking tools of priorities for noxious weeds only.

Table 6 provides a summary and comparison of previous and current number of noxious weed species untreated. Overall, weed control efforts are reducing the number of different noxious weed species in treated zones. All red zones (4+ different noxious weed species) were eliminated and most of orange and yellow zones (3 and 2 different noxious weed species, respectively) decreased to fewer number of noxious weed species.

It is important to note that weed control is a dynamic situation. Due to adaptations and abilities of noxious weed species to rapidly invade and outcompete native vegetation, managing noxious weeds takes diligent effort over time and continual monitoring. Rarely does one treatment completely eliminate the species. Changes in environmental conditions (e.g., drought) can alter surroundings for favorable situations for certain noxious weed species. Eliminating seed banks in the soil may take a tremendously long time, depending on species and environmental factors. Revegetation personnel are prepared for this and continue to monitor the site, especially treated areas.

Currently, invasive weed species (non-noxious) of concern were not treated this year. Future plans may include this.

*Table 5. Current Moab UMTRA Noxious Weed Presence, Treatment, and Priority Color-Coding Designations.*

| ZONE | Bermuda grass | Canada thistle | Field bindweed | Goathead | Perennial pepper-weed | Russian knapweed | Russian olive | Tamarisk | # of Diff. Noxious Weed Species | Priority Color Code |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | 0 | Green |
| 2 | | | Treated | Treated | | Treated | Treated | Treated | 0 | Green |
| 3 | | | | Treated | | X | Treated | Treated | 1 | Yellow-green |
| 4 | | | | | | Treated | Treated | X | 1 | Yellow-green |
| 5 | | | | | | Treated | Treated | X | 1 | Yellow-green |
| 6 | | | | | | | | | 0 | Green |
| 7 | | | | | Treated | Treated | | X | 1 | Yellow-green |
| 8 | | | | | | | X | Treated | 1 | Yellow-green |
| 9 | | | | | Treated | Treated | Treated | X | 1 | Yellow-green |
| 10 | | | | | Treated | Treated | Treated | X | 1 | Yellow-green |
| 11 | | | | | Treated | X | Treated | X | 2 | Yellow |
| 12 | | | | | Treated | Treated | Treated | Partially treated | 1 | Yellow-green |
| 13 | | | | | | X | | X | 2 | Yellow |
| 14 | | | | | Treated | X | | X | 2 | Yellow |
| 15 | | | | | | X | X | X | 3 | Orange |
| 16 | | | | | Treated | | Treated | X | 1 | Yellow-green |
| 17 | Treated | | | | Treated | Treated | | X | 1 | Yellow-green |
| 18 | | | | | | Treated | | | 0 | Green |
| 19 | | | | | | | | X | 1 | Yellow-green |
| 20 | | Treated | | | | X | Treated | X | 2 | Yellow |
| 21 | | | | | Treated | | | X | 1 | Yellow-green |
| 22 | | | | | | Treated | Treated | X | 1 | Yellow-green |
| 23 | | | | | | Treated | Treated | X | 1 | Yellow-green |
| 24 | | | | | X | X | Treated | X | 3 | Orange |
| 25 | | | | | | | | X | 1 | Yellow-green |
| 26 | | | | Treated | | | | Partially treated | 1 | Yellow-green |
| 27 | | | | | | Treated | | X | 1 | Yellow-green |
| **Total Zones Treated** | **1** | **1** | **1** | **3** | **9** | **12** | **13** | **5** | **---** | **---** |
| **Total Zones Un-treated** | **0** | **0** | **0** | **0** | **1** | **7** | **2** | **19** | **---** | **---** |

*"X" = weed species present and untreated, "Treated" = zone was treated in 2020 and/or 2021 and is currently being monitored.*
*Color codes are based on number of different noxious weed species present and untreated: green = 0, yellow-green = 1, yellow = 2, orange = 3, red = 4+*

*Table 6. Comparison of Previous and Current Number of Noxious Weed Species Present and Untreated*

| | | Number of Zones | |
|---|---|---|---|
| **Number of Noxious Weed Species Present & Untreated** | **Corresponding Color Code** | **As of Feb. 2021** | **As of Feb. 2022** |
| 0 | Green | 3 | 4 |
| 1 | Yellow-green | 4 | 17 |
| 2 | Yellow | 6 | 4 |
| 3 | Orange | 7 | 2 |
| 4+ | Red | 7 | 0 |

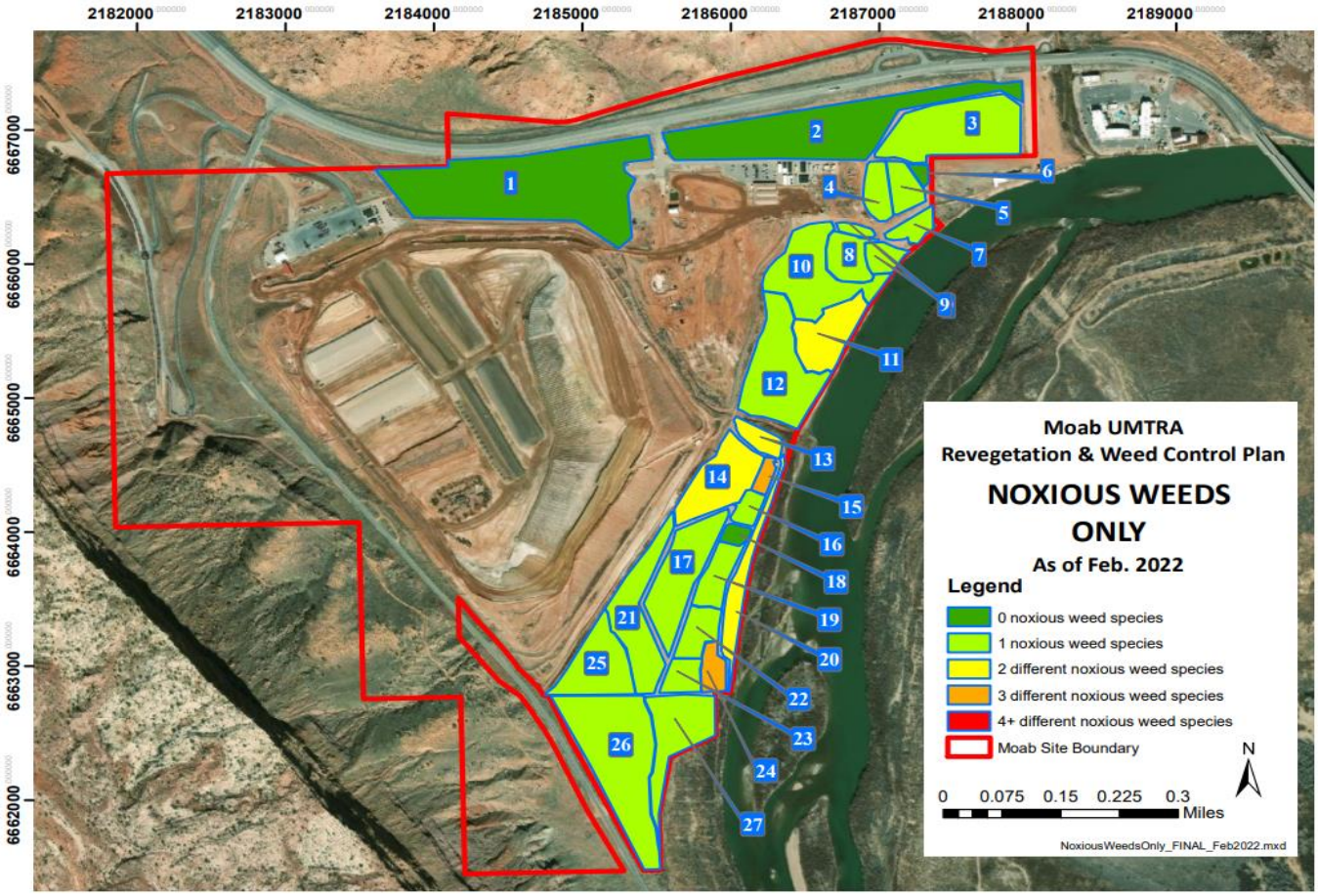


*Figure 7. Tracking Tool for Priorities for Noxious Weeds Only,*
*Color codes are based on number of different noxious weed species present and untreated:*
*green = 0, yellow-green = 1, yellow = 2, orange = 3, red = 4+*

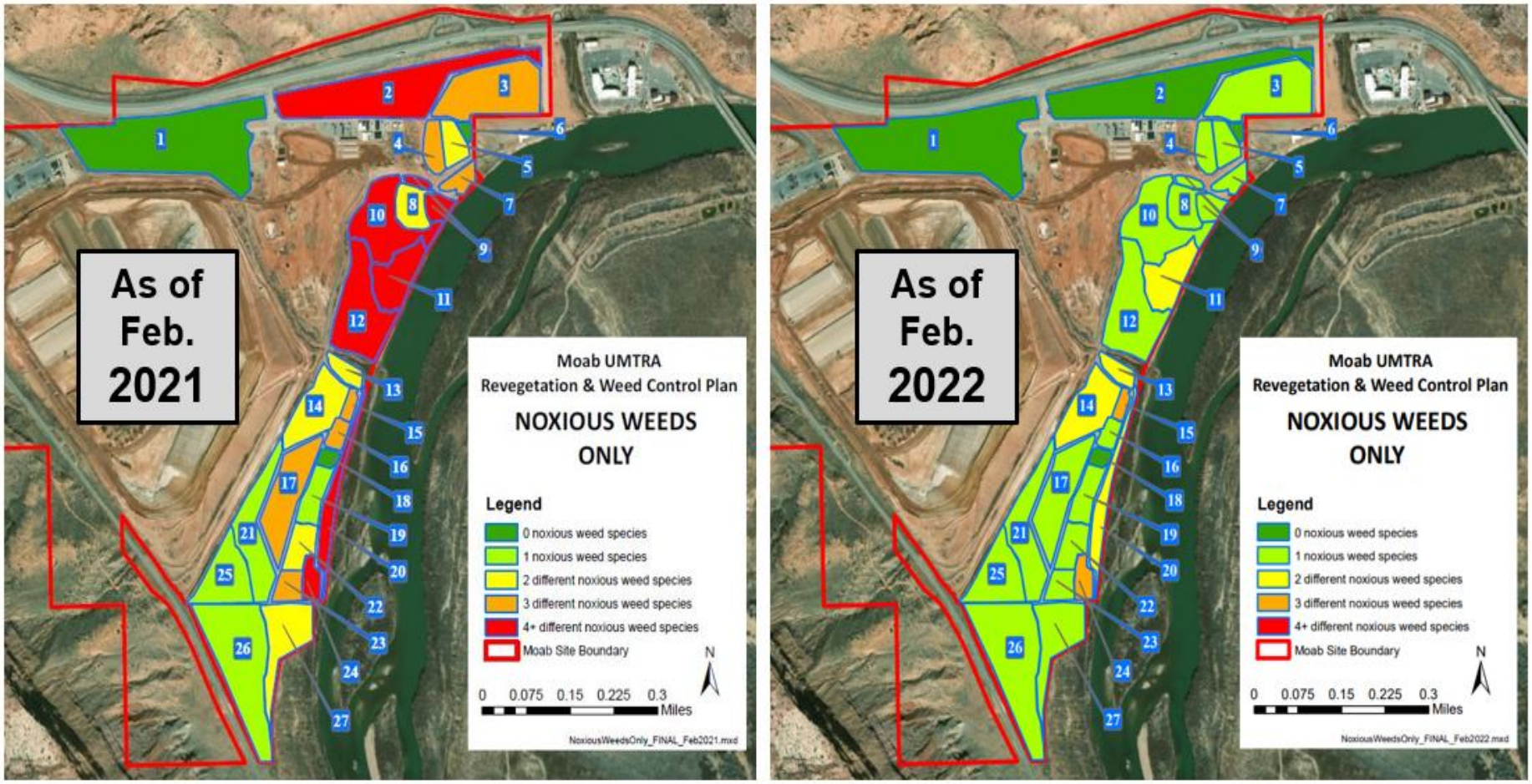


*Figure 8. Comparison of Previous and Current Tracking Tool of Priorities for Noxious Weeds Only*
*Color codes are based on number of different noxious weed species present and untreated:*
*green = 0, yellow-green = 1, yellow = 2, orange = 3, red = 4+*

## 4.4 Management of Noxious Weeds & Weeds Species of Concern

This section of the Plan describes the steps Moab UMTRA will take to prevent and control the establishment and spread of noxious weed species using the *Utah Strategic Plan for Managing Noxious Weeds* (Whitesides 2004) key elements.

### 4.4.1 Prevention

Prevention is the best method of weed management (Dewey 1995). The most efficient and cost-effective way of dealing with noxious weeds is to prevent them in the first place.

### 4.4.2 Education and Personnel Training

All revegetation and other on-the-ground personnel (i.e., Technical Assistance Contractors (TAC) employees, groundwater, air monitoring, etc.) will be instructed on the importance of controlling noxious weeds and trained in weed identification. Moab UMTRA personnel detecting emerging noxious weed infestations will be key to prevention.

Revegetation personnel will be trained in weed mapping and inventory methods and be familiar with established populations of noxious weeds. Knowledge of weed ecology, reproduction, and known pathways for invasive species will help identify the most susceptible areas. Personnel will be trained in treatment strategies, equipment, and best management practices (BMPs). Those using herbicides are highly encouraged to acquire their herbicide/pesticide applicators license certification through the State of Utah.

Other preventative actions may include:

- Reseeding significantly disturbed areas with a native seed mix to help outcompete non-native species
- Avoiding disturbance of soil in stable areas or places not actively being managed
- Ensuring any imported materials (e.g., straw, hay, mulch, gravel, seed, compost, etc.) are weed-free
- Using wattles in places where roads are draining into surrounding areas and weed species are spreading
- Developing designated vehicle turn-out and/or turn-around spots along roads in Revegetation Area to reduce disturbing soil
- Avoiding use of noxious weed species in the compost
- Considering impact of noxious weeds when moving soil from one area to another
- Choosing areas free of noxious weeds as the origin location to reduce seed dispersal on site
- Cleaning of equipment, boots, undercarriages, and tires to avoid seed dispersal
- Personnel will inspect, remove, and appropriately dispose of weed seed and plant parts found on their clothing and equipment
- Evaluating engineering controls to determine volume and occurrence of flood events in revegetation areas.

### 4.4.3 Early Detection and Rapid Response

Detecting new invaders early and taking urgent action before they become significant, ecosystem-altering or economically devastating issues is first line of defense (Whitesides 2004). The goal is to keep newly detected weed species from becoming established.

Early detection actions include:

- Revegetation and other TAC personnel to be aware of potential invaders "watch list". Train personnel in plant identifications and what to look out for
- Develop routine and systematic surveys as part of weed management program
- Know high risk areas and monitor frequently
- Report new invasions to revegetation and/or weed management lead
- Keep abreast of emerging county and state noxious weed species (e.g., African Rue recently discovered in Grand County)
- Share pertinent findings with Grand County Weed District and other surrounding land owners (e.g., Bureau of Land Management, private property) to educate others and promote partnerships

Rapid response actions include:

- Act as soon as possible
- Follow the species-specific treatment (see Table 7), which outlines best management practices. Knowing proper treatment strategies is important before taking action. Some actions can produce negative results (i.e., tilling promoting root reproduction, etc.)
- Research treatment strategies, if uncertain
- Utilize resources, such as Utah State University (USU) Extension, Grand County Weed District or Rivers Edge West, for treatment methods and information.

### 4.4.4. Management of Established Populations

For established populations of noxious weeds, the goal is to identify the size of the infestation and work from the edges towards the central area of infestation. Weed mapping and inventories will be an important tool to identify established populations and track progress of treatment strategies.

The main objectives of controlling established weed populations are as follows:

Identify the perimeter: during weed mapping, finding the outer perimeter of the infestation is important to know the size of the infestation.

Eradicate satellite populations: eliminate smaller populations until one main infestation is left to control and manage, using species-specific treatment strategies and BMPs.

Contain and suppress main population: once satellite populations have been controlled, direct all efforts on the main area of infestation to control and ultimately, eliminate.

### 4.4.5 Treatments

Control of noxious weeds will be implemented through mechanical, biological, and chemical control measures:

Mechanical: removal of aboveground plants and/or roots with hand tools or heavy machinery (e.g., tractor with mowing attachment). Mechanical methods can be useful for smaller, isolated populations of noxious weeds in areas of sensitive habitats. Some rhizomatous plants can spread through mechanical means, therefore, implementation of this method will be species specific. Mechanical treatments that disturb the soil surface within native habitats will be avoided in favor of herbicide application. This will help prevent soil disturbance and establishment of new colonies of weeds.

Biological: use of living organisms (insects, diseases, and livestock) to control noxious weeds (i.e., biocontrol). Many noxious weed species are from other continents (usually Eurasia) and recently introduced into North America. They have few natural enemies to control their population here. The biological control agent is typically adapted to a specific species and selected for their ability to attack critical areas of the plant that

contribute to its persistence. Some biocontrol (e.g., gall wasps for Russian knapweeds) must be purchased in other states and a permit is required to cross state lines.

Chemical: use of selective herbicides, specific to weed species. Herbicide treatment can be effective for large populations of noxious weeds where other means of control may not be feasible. Vehicle-mounted sprayers (i.e., Utility Terrain Vehicle - UTV) may be used in open areas readily accessible by vehicles. Hand sprayers and backpack sprayers will be used in small areas or areas hard to access by UTV. Impacts to non-target plant species and other environmental concerns will be addressed before applying herbicide. The DOE prefers that all herbicides used on-site are 2, 4-D-free and/or bio based.

Treatments will be carefully researched for best management practices— a wrong treatment for a species may exacerbate the infestation. Control measures will be based on species-specific and site-specific conditions (e.g., proximity to water or riparian areas, season of application, occurrence of special status plant species, etc.). Noxious weed control measures will be implemented in accordance with existing state and county regulations. Care must be exercised during treatment of weeds to prevent seed spread and dispersal.

Moab UMTRA species-specific control methodologies are documented in Table 7. This compilation was created based on recommendations from SMEs such as Navarro (previous DOE-Legacy Management contractor), Grand County weed department, Dinosaur National Monument, and other local weed managers. As of this writing, research into certain treatments for specific species is still being conducted.

*Table 7. Species-specific Weed Treatment Strategies for Moab UMTRA*

| WEED SPECIES | STRATEGY | NOTES |
|---|---|---|
| **NOXIOUS WEED SPECIES ONSITE** | | |
| **Bermuda grass** *(Cynodon dactalon)* | 2-4-D herbicide | Round Up® was recommended by SME. Try 2-4-D substitution since Round Up® is not currently approved by Technical Assistance Contractor (TAC) Health & Safety (H&S) and is not recommended for use by DOE Department of Sustainability. |
| **Canada thistle** *(Cirsium arvense)* | Milestone® herbicide. Fall is the best time. | |
| **Field bindweed** *(Convolvulus arvensis)* | Recommended herbicides are 2,4-D, dicamba, picloram, and glyphosate. It will take multiple treatments and frequent pulling of new sprouts to completely eradicate. | Small patch near guard shack. SME has information on biocontrol (mites, need permit to bring over from Colorado - CO). |
| **Perennial pepperweed** (*Lepidium latifolium*) | Spray right before or right as its flowering<br>• Use Telar® herbicide (granular, mix with water)<br>• Spray on ground surrounding pepperweed. | Timing of applying herbicide is very important. Beware of surrounding trees, can be very impactful. |

*Table 7. Species-specific Weed Treatment Strategies for Moab UMTRA (continued)*

| | | |
|---|---|---|
| **Russian olive** (*Elaeagnus angustifolia*) | • Cut close to ground<br>• Treat stem<br>• Brush dust away from stump and apply Triclopyr/Garlon® 3A thoroughly around root collar.<br>• Can be applied as long as the ground is not frozen, but best in late summer or early fall, before leaf drop. | Application by brush rather than spray can be an effective method, protecting nearby species.<br>SME also recommended Round Up® as a potential treatment too, although it has shown mixed results. Try 2-4-D substitution since Round Up® is not currently approved by Health & Safety (H&S). |
| **Russian knapweed** (*Acroptilon repens*) | Use Milestone® herbicide. Spray during bud phase before it flowers or late Sept-Nov when it's fully dead/brown at end of season. | • Timing of applying herbicide is very important.<br>• SME has information on biocontrol (gall wasps, need permit to bring over from CO). |
| **Tamarisk** (*Tamarix ramosissima*) | Spring or fall is ideal time for treatment and not when plant is water stressed.<br>Seedlings and saplings ≤2" diameter:<br>• Leave standing & apply foliar application, treating the main stem<br>• Use herbicide Garlon® 3A (active ingredient Triclopyr) at 13 oz:1 gal water with methylated seed oil (MSO) at recommended rates)<br>Saplings and trees ≥ 2" diameter:<br>• Cut close to ground<br>• Treat stem<br>Brush dust away from stump and apply Triclopyr (Garlon® 3A) around root collar thoroughly. It is important to apply within 5 minutes of cutting stem. If thin bark, applicator can cover the entire stump with herbicide. | • SME advised Garlon® 4 is more effective than Garlon® 3A but is temperature-restricted and harder to use because of that (Garlon® 4 volatizes above 86°F)<br>• Bio-control (Tamarisk beetle, *Diorhabda elongata*) seems to be doing a good job reducing tamarisk foliage in 2020 |
| **INTRODUCED SPECIES OF CONCERN, UMTRA SPECIFIC LIST** | | |
| Crested wheatgrass (*Agropyron cristatum*) | Mow before it flowers | |
| Halogeton (*Halogeton glomeratus*) | Eradicate before it goes to seed in July & August.<br>Use Telar® herbicide combined with Plateau® herbicide. Treat a minimum of a 3 ft radius on the ground surrounding Halogeton | |
| Kochia *(Bassia scoparia)* | Mow. Herbicide resistant | SME recommend seed removal. Because kochia is an annual, this can be done through repetitive mowing every year before it goes to seed |
| Tumbleweed *(Salsola tragus)* | Mow. Reseed other desirable plants to outcompete | |
| Tumbling mustard *(Sisymbrium altissimum)* | Mowing, digging or hand pulling in early spring works well (before it goes to seed) | |

*Table 7. Species-specific Weed Treatment Strategies for Moab UMTRA (continued)*

| | | |
|---|---|---|
| Wooly mullein *(Verbascum thapsus)* | Hand pulling before seed set works well. Treat with glyphosate (e.g., Roundup®) or Triclopyr (Garlon®) if infestation is large. | Minimize soil disturbance since loose soil will facilitate mullein seed germination. Two biocontrol available: 1) European curculionid weevil (*Gymnaetron tetrum*), 2) mullein moth (*Cucullia verbasci*) |
| Yellow salsify *(Tragopogon dubius)* | Hand pull | |
| Yellow sweet clover *(Melilotus officinalis)* | Milestone® herbicide applied in spring or early summer | |

Current treatment examples at Moab UMTRA project site include mechanical means (i.e., mowing) for kochia and tamarisk, herbicide application on Russian knapweed, and the tamarisk leaf beetle (*Diorhabda elongata*) which defoliates tamarisk. The tamarisk beetle is currently present onsite, having been released by Grand County in 2001.

Treatment results will be assessed and methods re-evaluated, if necessary. Discussions with DOE Legacy Management (LM) or other local SMEs are also advisable.

### 4.4.6 Herbicide Application, Handling, Storage, Spills and Cleanup

Safety procedures for using chemical methods can be found in IWP/JSA Number: *TAC IWP/JSA-013, Vegetative Debris Management.*

The current list of Moab UMTRA approved herbicides is provided in Appendix C. All manufacturer safety data sheets (SDS) for these herbicides can be located on the DOE SharePoint webpage and next to the herbicide storage cabinet. Any new herbicide must be approved by Health & Safety before purchasing and application.

Herbicide application, handling, and storage actions include:

- Revegetation personnel using herbicide are strongly encouraged to acquire a Utah herbicide/pesticide applicator license certification
- Following all FIFRA regulations (Table 2)
- The herbicide applicator will have readily available copies of the appropriate SDSs for the herbicides used
- Herbicide applications will follow, by law, all label guidelines, as well as any federal, state, and/or county regulation. Application rates will be based on product label instructions
- Herbicide handling will include all personal protective equipment (PPE) stated on the label for mixing and applying, and also approved by Health & Safety
- All herbicide equipment and containers will have secondary containers and also be inspected for leaks. All herbicide equipment will be maintained and cleaned
- Calibration checks of equipment will be conducted prior to, and periodically during application to ensure proper rates are achieved

- Mixing will be done over a drip-catching device in an area devoid of sensitive vegetation and in an area that will limit human and wildlife exposure
- Disposal of spent containers will be in accordance with the herbicide label or local authorities
- Herbicides will be stored in a cabinet with secondary containers in the event of a leak
- Herbicides capable of freezing will be stored in a climate-controlled environment during the winter months (currently stored in a climate-controlled room in the Atlas Building year-round)

All reasonable precautions will be taken to avoid herbicide spills. According to IWP/JSA Number: *TAC-IWP/JSA-016, TAC General Site Hazards* clean-up of small chemical spills dictates following standard operating procedure (SOP) and/or SDS for accidental release measures.

### 4.4.7 Revegetation and Restoration

After invasion by an aggressive weed species and subsequent successful control/management activities, revegetation and restoration may be needed to return the site to a desirable species composition (Whitesides 2004). Refer to the *Revegetation Implementation* section for more details.

Revegetation and restoration actions related to this Noxious Weed Plan:

- Obtain knowledge of the system
- Collaborate with partners for research and experiments with restoring degraded lands (i.e., US Geological Survey, Rim to Rim Restoration)
- Take soil samples for nutrient analysis and amend, if necessary
- Develop a plan for each zone, including seeding and watering components
- Plant seeds with end result in mind
- Plant/seed native vegetation that is suitable for the local conditions
- Seed mixes will be determined by soil type and site-specific conditions
- Use of weed-free seed mixes
- If areas are expected to be disturbed due to future projects, develop a seed mixture and application plan to reduce weed establishment
- Re-evaluate annually

## 5.0 Monitoring and Evaluation

Monitoring and evaluation is the final step in the workflow of revegetation and weed control. It is a critical step in determining short- and long-term success towards achieving the vision of a self-sustaining native plant community. Restoration takes time and is an art form as much as it is a science (Sher 2010). Many factors can influence the success of revegetation. Some of these include variable climate (precipitation amounts, timing of precipitation events, temperatures), seedbed preparation, seed variability, soil fertility, undesirable species competition for resources, and herbivory.

Monitoring provides feedback on effectiveness of action steps taken and if goals, priorities, and/or implementation techniques need to be modified, altered, and/or maintained. Unknown challenges may be revealed, priorities may change, or efforts may need to be steered in a new direction as projects are implemented.

All revegetation projects should have appropriate monitoring and management to increase the probability that initial revegetation efforts will succeed. Initial success in all revegetation efforts is not a guarantee of long-term viability. Even if all these factors are favorable and conditions are conducive for revegetation success, a planting may still fail. Altering irrigation, fertilization, remedial planting, and invasive species control are examples of actions identified during monitoring as needed to improve restoration (Sher 2010).

When managing for weed control, monitoring invasive and noxious weed populations is a critical component at every stage of the weed plan. Prevention and early detection rely on monitoring to identify emerging weed species. Rapid response and treatment strategies need monitoring to assess results of actions taken. Comparing weed inventories over time is imperative to track populations over time, find any spread of new or known species, and report progress and success.

Monitoring can save significant time and money in the long term by addressing a wide range of problems before they become main factors in failure of the restoration effort. Post-planting monitoring, flexibility, and willingness to learn from mistakes are critical aspects of long term success (Sher 2010).

Success criteria is outlined in the one-, three-, and five-year plans for each goal/current condition and priorities on the Project site (Table 1). Success criteria are provided as initial guidance; however, common sense combined with scientific data must be applied to final evaluations to determine whether further management actions are required. Also, conditions at some locations may never reach specified success criteria simply because the physical, environmental, and climatic factors at a location are not conducive for substantial vegetation growth.

Monitoring can be qualitative (e.g., photo points, field notes) and/or quantitative (e.g., permanent transects, quadrats, digital mapping, data collection). Collection of baseline data is an important first step (Sher 2010). Larger projects should have more intensive monitoring programs included as part of the project plan and implementation to help inform maintenance actions and to help future project managers learn from success and failure of past projects. Specific data to be collected should be guided in part by the original restoration goal (Sher 2010). If possible, past research done onsite would be replicated.

The color-coding tracking tools (Figures 5, 7, 6 and 8) will be for useful for monitoring and reporting progress over time. The colors on the revegetation and weed control priority tracking tool (Figure 5) will be adjusted as needed as goals and priorities change. On the noxious weed tracking tool (Figure 7), colors will be updated as the number of different noxious weed species in each zone change. Comparison figures (Figures 6 and 8) also show progress and demonstrate changes over time.

For long-term maintenance, monitoring on a regular basis is essential. Evaluations will be conducted annually at revegetation locations until success criteria have been achieved or until determined to be unnecessary. After locations have met success criteria, they will be incorporated into a rotation in which they will continue to be monitored every few years. The primary purpose of the continued monitoring is to demonstrate that the success criteria continue to be met and whether additional management actions are necessary. Regulatory requirements may have their own monitoring protocols and success criteria.

Reporting and documentation of monitoring and evaluation will be important for documentation purposes and also to track progress. Informing others of successful strategies, lessons learned,

and any emerging weed species will be helpful not only to Moab UMTRA Project, but also to other local land managers, collaborators and partners.

## 6.0 Strategic Partnerships

Over the past three years revegetation staff have been working to build strategic partnerships with various public and private entities. These relationships are being established to share relevant and non-classified information between parties that will benefit the Moab UMTRA site as well as the greater community in ecological restoration efforts. These relationships were generally established through the participation of UMTRA staff in local and regional ecological working groups. As the project progresses, participation in these groups should be encouraged to continue building relationships that benefit the Project in both an objective aspect as well as good public relations.

The following is a list of entities with whom relationships have been established and a brief description of the purpose of each of them. Any formal partnerships will be detailed and recorded in an official memorandum of understanding (MOU) between all parties involved.

**U.S. Geological Survey (USGS) – Southwest Biological Science Center:**

USGS scientists with expertise in soil restoration and revegetation of highly disturbed landscapes were invited to collaborate with Moab UMTRA revegetation staff. A Memorandum of Understanding (MOU) was drafted between the two agencies extending until 2025. As mentioned previously, in fall 2020, 336 experimental plots were installed in the well field (Zone 17) with the purpose of researching revegetation variables (e.g., soil amendments, seed mixes, fertilizers, biocrust inoculations, watering regimes, etc.). Baseline data was collected in summer 2021. Research performed on site by USGS and UMTRA staff can be used as a tool for successful revegetation of the site. Research should also be used to develop scientific literature that will be beneficial to the broader community of land managers and scientists involved in ecological restoration of disturbed landscapes.

**U.S. National Park Service (NPS):**

In March 2020 Moab TAC staff traveled to Canyonlands National Park to salvage grasses from an area that is planned to be developed for employee housing. Staff received approximately 105 live plants from the park and transplanted them on site in zones 2 and 3.

In summer 2021, Moab TAC staff conducted a biocrust salvage project from a construction area inside of Arches National Park. Healthy biocrust was collected, brought onsite, and placed in various areas to test biocrust as a possible restoration technique. Fill dirt from another Arches National Park construction project was also brought onsite and placed in the wellfield.

Moving forward UMTRA staff and NPS plan to coordinate on future projects including additional plant and biocrust salvaging and acquiring excess soil from park projects to use as amendments at site revegetation areas. Crews have also collaborated on seed collection efforts.

**Rim to Rim Restoration (RRR):**

Rim to Rim Restoration is a non-profit organization in Moab, Utah dedicated to the reestablishment of native vegetation for the benefit of wildlife, recreation opportunities and to support maintaining sustainable watersheds in the Upper Colorado Plateau. RRR helps build community and facilitate regeneration of native plants through collaboration with local land managers, government agencies, non-profit organizations and community members. RRR spearheads the Utah Watershed Restoration Initiative (WRI) proposal which encourages collaborations for riparian restoration work along the Colorado River corridor. Moab UMTRA became part of the greater WRI project and was awarded native seed and herbicide in 2021. An MOU with RRR was developed in 2021.

**Utah Division of Natural Resources/ Utah Forestry, Fire, and State Lands (DNR/FFSL):**

This is an important partnership as the Moab UMTRA Project site shares boundaries with DNR/FFSL. Moab UMTRA and DNR are currently collaborating together on a WRI proposal to address encroaching noxious weeds from DNR lands onto Moab UMTRA lands along site boundaries.

Staff have also acquired native seed from DNR through a previous WRI grant for vegetative restoration along the Colorado River corridor. Seed is scheduled to be applied to the area on site referred to as "Former Policaro Property" (Zone 26 and 27, Figure 3).

**Southeast Utah Riparian Partnership (SURP):**

The Southeast Utah Riparian Partnership is a diverse public-private partnership of local, state and federal agencies; businesses; nonprofit organizations; and individuals. The group's mission is to restore, protect and maintain a healthy riparian ecosystem in Utah's Colorado River Watershed. All members of the partnership are committed to information sharing, networking, and collaborative interdisciplinary action in research, planning, monitoring and on the ground project implementation. Revegetation staff attended SURP annual meetings in 2019-2021. Many of the SURP partners are also involved in the WRI proposals and information shared with partners will also assist in specific revegetation implementation and monitoring techniques. Rim to Rim Restoration leads the SURP.

**RSI Entech, contractor for DOE Legacy Management (LM; previously Navarro):**

Moab UMTRA connected with RSI Entech, contractor for DOE LM, for guidance with weed control and overall revegetation goals. They spent time onsite in fall 2020 and again in 2021 teaching revegetation staff about weed control techniques and spraying knapweed, Russian olive, and tamarisk. This partnership will be invaluable with revegetation and weed control direction and implementation techniques.

## 7.0 Records

All documentation created as a result of compliance with this Plan is considered a Project record and will be managed in accordance with the *Moab UMTRA Project Records Management Manual* (DOE-EM/GJ1545), which follows DOE orders, policies, and regulations for retention

and maintenance of records. Documentation may include (but is not limited to):

- Inspection forms.
- Photographs.
- Corrective action logs.
- General correspondence related to storm water discharges or permitting.

Copies of inspection reports shall be retained for at least 3 years from the date of final site stabilization and termination of the UPDES Permit.

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# Appendix A:
# State of Utah Noxious Weed List 2022

## Appendix A: State of Utah Noxious Weed List 2022

**Available online at:** Utah Noxious Weed Act (R68-9):

https://ag.utah.gov/farmers/plants-industry/noxious-weed-control-resources/state-of-utah-noxious-weed-list/

The following weeds are hereby officially designated and published as noxious for the State of Utah, as per the authority vested in the Commissioner of Agriculture and Food under Section 4-17-3.
There are hereby designated five classes of noxious weeds in the state: Class 1A (EDRR Watch List), Class 1 (EDRR), Class 2 (Control), Class 3 (Containment), and Class 4 (Prohibited for sale or propagation).

**Class 1A: Early Detection Rapid Response (EDRR)** Watch List Declared noxious and invasive weeds not native to the state of Utah and not known to exist in the State that pose a serious threat to the state and should be considered as a very high priority.

Common crupina – *Crupina vulgaris*
African rue – *Peganum harmala*
Small bugloss – *Anchusa arvensis*
Mediterranean sage – *Salvia aethiopis*
Spring millet – *Milium vernale*
Syrian beancaper – *Zygophyllum fabago*
Ventenata (North Africa grass) – *Ventenata dubia*
Plumeless thistle – *Carduus acanthoides*
Malta starthistle – *Centaurea melitensis*

**Class 1B: Early Detection Rapid Response (EDRR)** Declared noxious and invasive weeds not native to the State of Utah that are known to exist in the state in very limited populations and pose a serious threat to the state and should be considered as a very high priority.

Camelthorn – *Alhagi maurorum*
Garlic mustard – *Alliaria petiolata*
Purple starthistle – *Centaurea calcitrapa*
Goatsrue – *Galega officinalis*
African mustard – *Brassica tournefortii*
Giant reed – *Arundo donax*
Japanese knotweed – *Polygonum cuspidatum*
Blueweed (Vipers bugloss) – *Echium vulgare*
Elongated mustard – *Brassica elongata*
Common St. John's Wort – *Hypericum perforatum*
Oxeye daisy – *Leucanthemum vulgare*
Cutleaf vipergrass – *Scorzonera laciniata*

## Appendix A: State of Utah Noxious Weed List 2022 *(continued)*

**Class 2: Control** Declared noxious and invasive weeds not native to the state of Utah that pose a threat to the state and should be considered a high priority for control. Weeds listed in the control list are known to exist in varying populations throughout the state. The concentration of these weeds is at a level where control or eradication may be possible.

Leafy spurge – *Euphorbia esula*
Medusahead – *Taeniatherum caput-medusae*
Rush skeletonweed – *Chondrilla juncea*
Spotted knapweed – *Centaurea stoebe*
Purple loosestrife – *Lythrum salicaria*
Squarrose knapweed – *Centaurea virgata*
Dyers woad – *Isatis tinctoria*
Yellow starthistle – *Centaurea solstitialis*
Yellow toadflax – *Linaria vulgaris*
Diffuse knapweed – *Centaurea diffusa*
Black henbane – *Hyoscyamus niger*
Dalmatian toadflax – *Linaria dalmatica*

**Class 3: Containment** Declared noxious and invasive weeds not native to the State of Utah that are widely spread. Weeds listed in the containment noxious weeds list are known to exist in various populations throughout the state. Weed control efforts may be directed at reducing or eliminating new or expanding weed populations. Known and established weed populations, as determined by the weed control authority, may be managed by any approved weed control methodology, as determined by the weed control authority. These weeds pose a threat to the agricultural industry and agricultural products.

Russian knapweed – *Acroptilon repens*
Houndstounge – *Cynoglossum officianale*
Perennial pepperweed (Tall whitetop) – *Lepidium latifolium*
Phragmites (Common reed) – *Phragmites australis* ssp.
Tamarisk (Saltcedar) – *Tamarix ramosissima*
Hoary cress – *Cardaria* spp.
Canada thistle – *Cirsium arvense*
Poison hemlock – *Conium maculatum*
Musk thistle – *Carduus nutans*
Quackgrass – *Elymus repens*
Jointed goatgrass – *Aegilops cylindrica*
Bermudagrass* – *Cynodon dactylon*
Perennial Sorghum spp.: Johnson Grass (*Sorghum halepense*) and Sorghum almum (*Sorghum almum*).

Scotch thistle (Cotton thistle) – *Onopordum acanthium*

Field bindweed (Wild Morning-glory) – *Convolvulus* spp.

Puncturevine (Goathead) – *Tribulus terrestris*

*Bermudagrass (*Cynodon dactylon*) shall not be a noxious weed in Washington County and shall not be subject to provisions of the Utah Noxious Weed Law within the boundaries of that county. It shall be a noxious weed throughout all other areas of the State of Utah and shall be subject to the laws therein.

**Class 4: Prohibited** Declared noxious and invasive weeds, not native to the state of Utah, that pose a threat to the state through the retail sale or propagation in the nursery and greenhouse industry. Prohibited noxious weeds are annual, biennial, or perennial plants that the commissioner designates as having the potential or are known to be detrimental to human or animal health, the environment, public roads, crops, or other property.

Cogongrass (Japanese blood grass) – *Imperata cylindrica*

Myrtle spurge – *Euphorbia myrsinites*

Dames Rocket – *Hesperis matronalis*

Scotch broom – *Cytisus scoparius*

Russian olive – *Elaeagnus angustifolia*

Each county in Utah may have different priorities regarding specific State designated Noxious Weeds and is therefore able to reprioritize these weeds for their own needs.

The Weed Specialist coordinates weed control activities among the county weed organizations and the agricultural field representatives. Surveys of serious weed infestations are conducted and control programs are developed through the county supervisors, county weed boards, and various landowning agencies. The weed specialist and the inspectors work continually with extension and research personnel in encouraging the use of the most effective methods to control the more serious weeds.

This entry was last updated on June 6, 2019.

# Appendix B:
# Grand County Noxious Weed List 2022

## Appendix B: Grand County Noxious Weed List 2022

Available online at: https://www.grandcountyutah.net/168/Noxious-Weeds

Notice is hereby given this 20th day of February, 2020 Pursuant to the Utah Noxious Weed Act, Section 7, to every person who owns or controls lands in Grand County, Utah, that noxious weeds standing, being, or growing on such land shall be controlled and the spread of same prevented by effective cutting, tillage, cropping, pasturing, or treating with chemicals or other methods, or combination methods, or combination thereof, approved by the County Weed Supervisor, as often as may be required to prevent the weed from blooming and maturing seeds, or spreading by root, root stalks or other means.

Upon failure to comply with this notice, the owner or persons in possession of property upon which noxious weeds are present shall be deemed negligent and enforced control measures may be imposed at the discretion of county authorities. Expenses of control measures employed by the county shall be paid directly by the owner or person in possession of the property or shall constitute a lien on the property and become collectible by taxes.

The following are declared noxious weeds for the State of Utah and the County of Grand:

**Class 1A EDRR – Early Detection Rapid Response Watch List**:

| | |
|---|---|
| Common crupina | *Crupina vulgaris* |
| African rue | *Peganum harmala* |
| Small bugloss | *Anchusa arvensis* |
| Mediterranean sage | *Salvia aethiopis* |
| Spring millet | *Milium vernale* |
| Syrian beancaper | *Zygophyllum fabago* |
| North Africa grass | *Ventenata dubia* |
| Plumeless thistle | *Carduus acanthoides* |
| Malta thistle | *Centaurea melitensis* |

**Class 1B Early Detection**:

| | |
|---|---|
| Camelthorn | *Alhagi maurorum* |
| Garlic mustard | *Alliaria petiolate* |
| Purple starthistle | *Centaurea calcitrapa* |
| Goatsrue | *Galega officinalis* |
| African mustard | *Brassica tournefortii* |
| Giant Reed | *Arundo donax* |
| Japanese Knotweed | *Polygonum cuspidatum* |
| Vipers bugloss | *Echium vulgare* |
| Elongated mustard | *Brassica elongate* |
| Common St. John's Wort | *Hypericum perforatum L.* |
| Oxeye daisy | *Leucanthemum vulgare* |
| Cutleaf vipergrass | *Scorzonera laciniata* |

## Appendix B: Grand County Noxious Weed List 2022 *(continued)*

**Class 2 Control**:

| | |
|---|---|
| Leafy spurge | *Euphorbia esula L.* |
| Medusahead | T*aeniatherum caput-medusae* |
| Rush skeletonweed | *Chondrilla juncea* |
| Spotted Knapweed | *Centaurea maculosa Lam.* |
| Purple Loosestrife | *Lythrum salicaria L* |
| Squarrose Knapweed | *Centaurea Squarrosa Gugler* |
| Dyers Woad | *Isatis tinctoria L.* |
| Yellow Starthistle | *Centaurea solstitialis L.* |
| Yellow Toadflax | *Linaria vulgaris Mill.* |
| Diffuse Knapweed | *Centaurea diffusa (Lam.)* |
| Black henbane | *Hyoscyamus niger (L.)* |
| Dalmatian Toadflax | *Linaria dalmatica (L.) Mill* |

**Class 3 Contain**:

| | |
|---|---|
| Russian Knapweed | *Centaurea repens L.* |
| Houndstounge | *Cynoglossum officianale L.* |
| Perennial Pepperweed | *Lepidium latifolium L.* |
| Phragmites | *Phragmites australis ssp* |
| Tamarisk | *Tamarix ramosissima Ledeb.* |
| Hoary cress | *Cardaria spp.* |
| Canada thistle | *Cirsium arvense (L.) Scop.* |
| Poison Hemlock | *Conium maculatum L.* |
| Musk Thistle | *Carduus nutans L.* |
| Quackgrass | *Agropyron repens (L.) Beauv.* |
| Jointed goatgrass | *Aegilops cylindrical* |
| Bermudagrass* | *Cynodon dactylon (L.) Pers* |
| Scotch Thistle | *Onopordum acanthium L.* |
| Field bindweed | *Convolvulus spp.* |
| Puncturevine (Goathead) | *Tribulus terrestris L.* |
| Perennial Sorghum spp. | (including but not limited to Johnson grass) *Sorghum halepense* (L.) Pers. and Sorghum Almum *Sorghum almum* parodi |

**Class 4 Prohibited**:

| | |
|---|---|
| Cogongrass | *Imperata cylindrical* |
| Myrtle spurge | *Euphorbia myrsinites* |
| Dame's Rocket | *Hesperis matronalis* |
| Scotch broom | *Cytisus scoparius* |
| Russian olive | *Elaeagnus angustifolia* |
| Ravenna grass** | *Tripidium ravennae*: previously *Tripidium saccharum* |

* Bermudagrass shall not be a noxious weed in Washington County and shall not be subject to provisions of the Utah Noxious Weed Act within the boundaries of the county.

** Grand County noxious weed.

# Appendix C:
# Herbicides & Accessories Approved by Moab UMTRA Project Site

# Appendix C:
# Herbicides & Accessories Approved by Moab UMTRA Project Site

Available online at: Project MSDS/SDS (TAC) - All Documents (doe.gov)

Biosafe® Weed Control
Blue Marker Dye
Clorox® bleach
Garlon® 3A
Hi-Light Blue®
LI-700® with LECI-TECH
Milestone® herbicide
Nutra-SOL® tank cleaner
Telar® herbicide
Tenkoz Amine 2-4-D herbicide
UNFOAMER®
Shake Down® unfoamer