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Brynildson Water Treatment Facility
Integrated Vegetation and Noxious Weed Management Plan

Antero Resources Piceance Corporation

Photo 1. Location of proposed Brynildson Water Treatment Facility, viewing from the southwest

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Commercial Applicator Recommendations

A certified commercial applicator is a good choice for initial control efforts. An applicator has the full range of knowledge, skills, equipment, and experience desired when dealing with Canada thistle and other difficult vegetation.

A reputable local company, Julius Ag, Andy Julius, Certified Applicator's License No. 11210, Julius Ag, 2169 I-70 West Frontage Road, Debeque, CO 81630, (970) 379-6917, has the experience and knowledge necessary for success. Reclamation farming with multiple seed bin range drills and related equipment is also available through Julius Ag.

An alternative applicator using V/AMF and other natural products locally is: Alpha Natural, Inc., 1808 Road 245, New Castle, CO 81647, (970) 984-2467.

> Common chemical and trade names may be used in this report. The use of trade names is for clarity by the reader. Inclusion of a trade name does not imply endorsement of that particular brand of herbicide and exclusion does not imply non-approval. Certified commercial applicators will decide which herbicide to use and at what concentration. Landowners using unrestricted products must obey all label warnings, cautions, and application concentrations. The authors of this report are not responsible for inappropriate herbicide use by readers.

LITERATURE CITED

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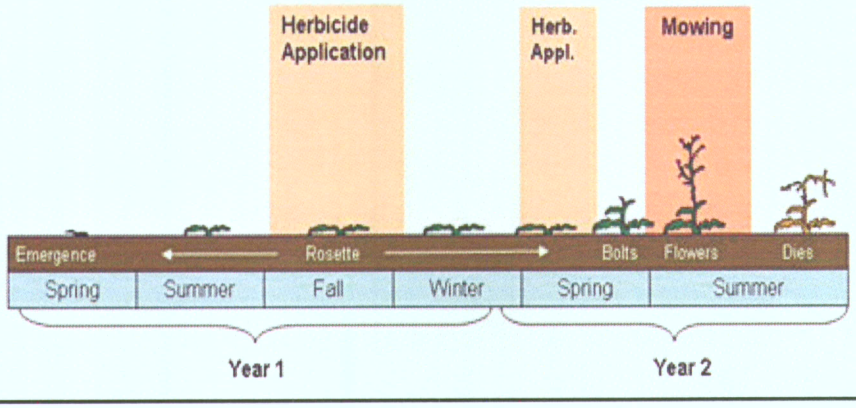
Alternative seeding methods include but are not limited to:

- harrow with just enough soil moisture to create a rough surface, broadcast seed and re-harrow, preferably at a 90 degree angle to the first harrow,
- hand raking and broadcast followed by re-raking at a 90 degree angle to the first raking.
- These are not the only means of replanting the site. However, these methods have been observed to be effective in similar landscapes.

Life Cycle and Management Calendars

Figure 1 is a 2-year calendar for control and life cycle of biennial thistles. Not included is mechanical control, which is cutting of rosettes below the soil surface and can be done any time during the rosette stage.

Figure 1. Life Cycle and Management strategies for biennial thistles.



(Hartzler, 2006)

Table 5 is for Garfield County listed noxious weed species that may be present in the vicinity.

Table 5. Noxious Weed Biology

Species	Type*	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Houndstongue	B	rosettes	-->	prebud	flowering - seed set			germination			-->	-->	-->
salt cedar*	P	semi-dormancy		-->	leaves emerge	flowering & seed set		growth	flowering & seed set		senescence & semi-dormancy		
common burdock	B			germination	rosettes	bolting	→	flowering – seed set	→	→	rosettes		
Russian knapweed	P				emerges	→	flowering		→	regrowth	→		

B = biennial; **P** = perennial

Shaded areas indicate best control timing.
*Tamarisk control can be done at any time of year, but is easier when leaves are absent and weather is cooler.

(Sirota, 2004)

Alternative Methods

An alternative method, particularly for cheatgrass infestations and poor to non-existent topsoils, is the application of vesicular-arbuscular mycorrhizal fungi (V/AMF). These fungi, mostly of the genus *Glomus,* are symbiotic with about 80% of all vegetation. In symbiosis, the fungi increase water and nutrient transfer capacity of the host root system by as much as several orders of magnitude (Barrow and McCaslin, 1995).

Over-the-counter V/AMF or AMF commercial products, which are better adapted to coating seeds when reseeding and treating roots of live seedling trees and shrubs at time of planting, come in powder form and are available from many different sources. Some applicators, including a New Castle company (Alpha Natural, Inc), collect and grow local accessions of V/AMF. The latter are applied to weed patches and are reputed to greatly increase competition of native plants, with Canada thistle in particular, thereby providing a non-chemical control of some noxious weeds.

Re-vegetation

Soil types in the area generally support many of the same species of native vegetation. The following seed mix is from the reclamation plan developed for the Antero Lundgren pit by WWE. The mix includes four species of aggressive native grasses to discourage invasion by nearby weeds. In areas that may be subject to treatment using selective herbicides, WWE recommends omitting the two forbs and seeding only grasses (Table 4):

Table 4. Brynildson Water Treatment Facility recommended seed mix and rate for drill or hydro-seed application.

Scientific Name/Seeds per Pound	Common Name/Preferred Cultivar	No. PLS/Ft^2	% of Mix by PLS Wt.	Application Rate Lbs PLS/acre
Linum perenne, 293,000	blue flax	4	5	0.6
Elymus lanceolatus psammophilus 156,000	streambank wheatgrass	10	21	2.8
Pascopyrum smithii, 140,000	western wheatgrass/ Arriba	10	23	3.1
Sitanion hystrix, 192,000	bottlebrush squirreltail	4	7	0.9
Pseudoroegneria spicata spicata 140,000	bluebunch wheatgrass/ P7	4	9	1.25
Sanguisorba minor, 55,000	small burnet	6	35	4.8
Total		**38 PLS/FT^2**	**100**	**13.45 lbs PLS/AC**
NRCS, 2006, CNHP, 1998, NRCS, 2002.				

Seeding rate should be doubled for broadcast application. Preferred seeding method is hydro seeding or multiple seed bin rangeland drill with no soil preparation other than simple grading to slope and waterbars. Seed should be bagged separately so each size group of seed can be metered at the appropriate rate.

Most herbicide applications should use a surfactant as directed on the herbicide label or other adjuvants as called for on the herbicide label.

Grazing:

To encourage reestablishment of desirable vegetation, removal or significant reduction of domestic livestock grazing is recommended for areas surrounding the facility site. Intense grazing by wintering mule deer and elk may negatively affect reclamation.

Mechanical:

It is recommended senescent, seed-bearing, listed weeds be cut, bagged and disposed of in a licensed landfill (Photos 4 and 5). Rosettes can be cut with a shovel below the surface of the soil on plants which are not yet dormant (Photos 6 and 7). Even with some seed drop, cutting and bagging will greatly reduce seed release. Future need to do mechanical or other control methods should be reduced after only two seasons of cutting and bagging.

Photo 4. Seed bearing burdock.

Photo 5. Seed bearing musk thistle.

Photo 6. Houndstongue rosette.

Photo 7. Musk thistle rosette.

Table 3. Treatment Strategies for Perennials
Target: Deplete nutrient reserves in root system, prevent seed production

3. Mowing usually is not recommended because the plants will flower anyway. Seed production should be reduced. Many studies have shown that mowing perennials and spraying the re-growth is not as effective as spraying without mowing. Effect of mowing is species dependent; therefore, it is imperative to know the species and its basic biology. Timing of application must be done when biologically appropriate, which is not necessarily convenient.
4. Tillage may or may not be effective. Most perennial roots can sprout from pieces only 1/2" - 1" long. Clean machinery thoroughly before leaving the weed patch.
5. Hand pulling is generally not recommended for perennial species unless it is known the plants are seedlings and not established plants. Hand pulling can be effective on small patches but is very labor intensive because it must be done repeatedly.

Best Management Practices

The following practices should be adopted for any construction project to reduce the costs of noxious weed control. The practices include:

- top soil, where present, should be segregated from deeper soils and replaced as top soil on the final grade
- in all cases, temporary disturbance should be kept to an absolute minimum
- equipment and materials handling should be done on established sites
- disturbances should be immediately replanted with the recommended mix in the re-vegetation section

In areas with slope greater than 3%, imprinting of the seed bed is recommended. Imprinting can be in the form of dozer tracks or furrows perpendicular to the direction of slope. When hydro-seeding or mulching, imprinting should be done prior to seeding unless the mulch is to be crimped into the soil surface. If broadcast seeding and harrowing, imprinting should be done as part of the harrowing. Furrowing can be done by several methods, the most simple of which is to drill seed perpendicular to the direction of slope in a prepared bed. Other simple imprinting methods include deep hand raking and harrowing, always perpendicular to the direction of slope.

Herbicides:

Herbicide treatment in fall (after approximately August 15 when natural precipitation is present) is the best method to control difficult perennials such as Russian knapweed. Difficult species respond better to application of a combination of two or more chemical modes of action (biological reason for plant death) rather than one. It has also been found that use of two different groups of chemicals in the same mode of action can increase effectiveness on difficult species, such as phenoxys and benzoic acids or carboxylic acids and benzoic acids in a mix. Some are available commercially pre-mixed, e.g. Crossbow® and Super Weed-be-Gone Max®, which are available over the counter. Many of the most effective herbicides are restricted use and available only for licensed applicators.

Professionals or landowners using herbicides must use the concentration specified on the label for the target species. Herbicides generally do not work better at higher concentrations. Label restrictions and formulations must be adhered to for compliance with regulations.

Table 1. Brynildson Water Treatment Facility list of possible noxious weeds.

Common Name*/ USDA Symbol	*Scientific Name*	Type**	Control Methods
common burdock ARMI2	***Arctium minus***	B	Cut and dig rosettes and bolting plants, re-seed with aggressive grasses. Herbicides probably necessary due to widespread infestation and large number of seed-bearing mature plants.
common mullein[C] VETH	*Verbascum thapsis*	B	same as common burdock
houndstongue CYOF	***Cynoglossum officinale***	B	Re-seed with aggressive grasses, remove at flowering or early seed, dig or grub at pre-bud or rosette stage or apply herbicides.
Russian knapweed	***Acroptilon repens***	P	Re-seed disturbed sites with fast growing grasses, herbicide in fall (Curtail recommended), allelopathic – tillage may be necessary
Musk thistle	***Carduus nutans***	B	Tillage or hand grubbing in the rosette stage, mowing at bolting or early flowering, seed head & rosette weevils, leaf feeding beetles, herbicides in rosette stage.

* 8 CCR 1203-19, Colorado Department of Agriculture, **Bold type on Garfield County list,** [B]State of Colorado "B" list, [C]State of Colorado "C" list. (State of Colorado, 2005) **A=annual, B=biennial, and P=perennial.

The strategies summarized in Table 2 for annuals and biennials and in Table 3 for perennials are those found to be most effective depending on the growth habits of each species, i.e., annual, biennial, or perennial. This information is contained herein to emphasize the importance of knowing for certain the species of weeds present.

Table 2. Treatment Strategies for Annual and Biennial Noxious Weeds
Target: Prevent Seed Production

1. Hand grub (pull), hoe, till, cultivate in rosette stage and before flowering or seed maturity. If seeds develop, cut and bag seed heads.
2. Chop roots with a spade below soil level.
3. Treat with herbicide in rosette or bolting stage, before flowering.
4. Mow biennials after bolting stage, before seed set. Mowing annuals will not prevent flowering but can reduce total seed production.

Table 3. Treatment Strategies for Perennials
Target: Deplete nutrient reserves in root system, prevent seed production

1. Allow plants to expend as much energy from root system as possible. Do not treat when first emerging in spring but allow growth to bud/bloom stage. If seeds develop, cut and bag if possible.
2. Herbicide treatment at bud to bloom stage or in the fall (recommended after August 15 when natural precipitation is present). In the fall plants draw nutrients into the roots for winter storage. Herbicides will be drawn down to the roots more efficiently at this time due to translocation of nutrients to roots rather than leaves. If the weed patch has been present for a long period of time, another season of seed production is not as important as getting the herbicide into the root system. Spraying in fall (after middle August) will kill the following year's shoots, which are being formed on the roots at this time.

Land to be managed

Recommendations made in this report apply to the Brynildson Water Treatment Facility site, but take into consideration observations made in the surrounding area.

The proposed facility location is bordered on three sides by two pipeline rights-of-way and an active well location. To effectively manage noxious weeds and other vegetation on the Brynildson Water Treatment Facility site, adjacent disturbed areas must be considered in the management plan. Disturbed areas immediately adjacent (within 10 meters) to the proposed location had no observable infestation of Garfield County regulated noxious weeds on the date of inspection. However, the presence of several weedy species in surrounding disturbed areas indicates high levels of susceptibility to infestation. In addition, several individuals of one Garfield County listed weed, *Tamarix ramosissima*, were observed approximately 200 yds north of the site, along the road that runs below the rim of the mesa. The abundance of weeds near the proposed location may be detrimental to the success of any weed or vegetation management efforts on the water treatment site.

Recommendations

Total, non-selective, vegetation control is recommended within the perimeter fence of the water treatment facility. Newer non-selective herbicides such as DuPont Sahara® are formulated to reduce migration and leaching into non-target areas and require very low amounts of an active ingredient, which decreases probability of bio-accumulation in non-target species.

Temporary disturbance outside the perimeter fence should be reclaimed with an appropriate seed mix and spot treated with selective herbicides or mechanical control if noxious weeds invade, all of which are described in the appropriate sections of this report.

Targeted Weeds: Although not currently found on the facility site, Table 1 lists nearby weeds and those most likely to be the subject of future control efforts within and around the site.

Table 1. Brynildson Water Treatment Facility list of possible noxious weeds.

Common Name*/ USDA Symbol	*Scientific Name*	Type**	Control Methods
cheatgrass[C] BRTE	*Bromus tectorum*	A	Plant competitive grasses, limit grazing
salt cedar	***Tamarix ramosissima***	P	Repeated or historic flooding of bottomlands to prevent seedling establishment; hand pulling seedlings; spray herbicides on basal portion of stems of young, smooth barked plants, cut larger plants and treat cut stumps within 30 minutes with herbicide plus an adjuvant (remove all stems from site after cutting - they will re-sprout if in contact with soil); shade intolerant - promote growth of native riparian species that will shade out the tamarisk.
field bindweed[C] COAR4	*Convolvulus arvensis*	P	Herbicides in fall, plant competitive grasses, introduce mites.

road running just below the rim of the mesa collects runoff water and has created conditions that allow tamarisk to thrive on the hillside above Mamm Creek along a portion of the road (Photo 4).

Photo 2. Pipeline right-of-way to the south

Photo 3. Pipeline right-of-way to the north

Photo 4. Tamarisk growing along the road to the north

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February 2007

Introduction

The plan is for the proposed Brynildson Water Treatment Facility and was prepared in compliance with Garfield County Planning and Zoning Regulation 9.07 (13), (BOCC, 2006). The treatment facility is to be constructed at the north end of Hunter Mesa overlooking Mamm Creek approximately 0.25 miles west of Garfield County Road 315 (Figure 2, attached). On February 16, 2007, a field inspection of the site was conducted by WestWater Engineering (WWE) biologists. The inspection identified appropriate topics for inclusion in an integrated vegetation and noxious weed management plan. Environmental factors considered include soil type and texture, existing land management, absence or presence of listed noxious weeds, and potential natural vegetation community.

The site of the proposed water treatment facility is adjacent to a currently active well location to the west, and between two pipeline rights-of-way to the north and south. Access to the proposed site is via the road to the existing well site.

Landscape Setting

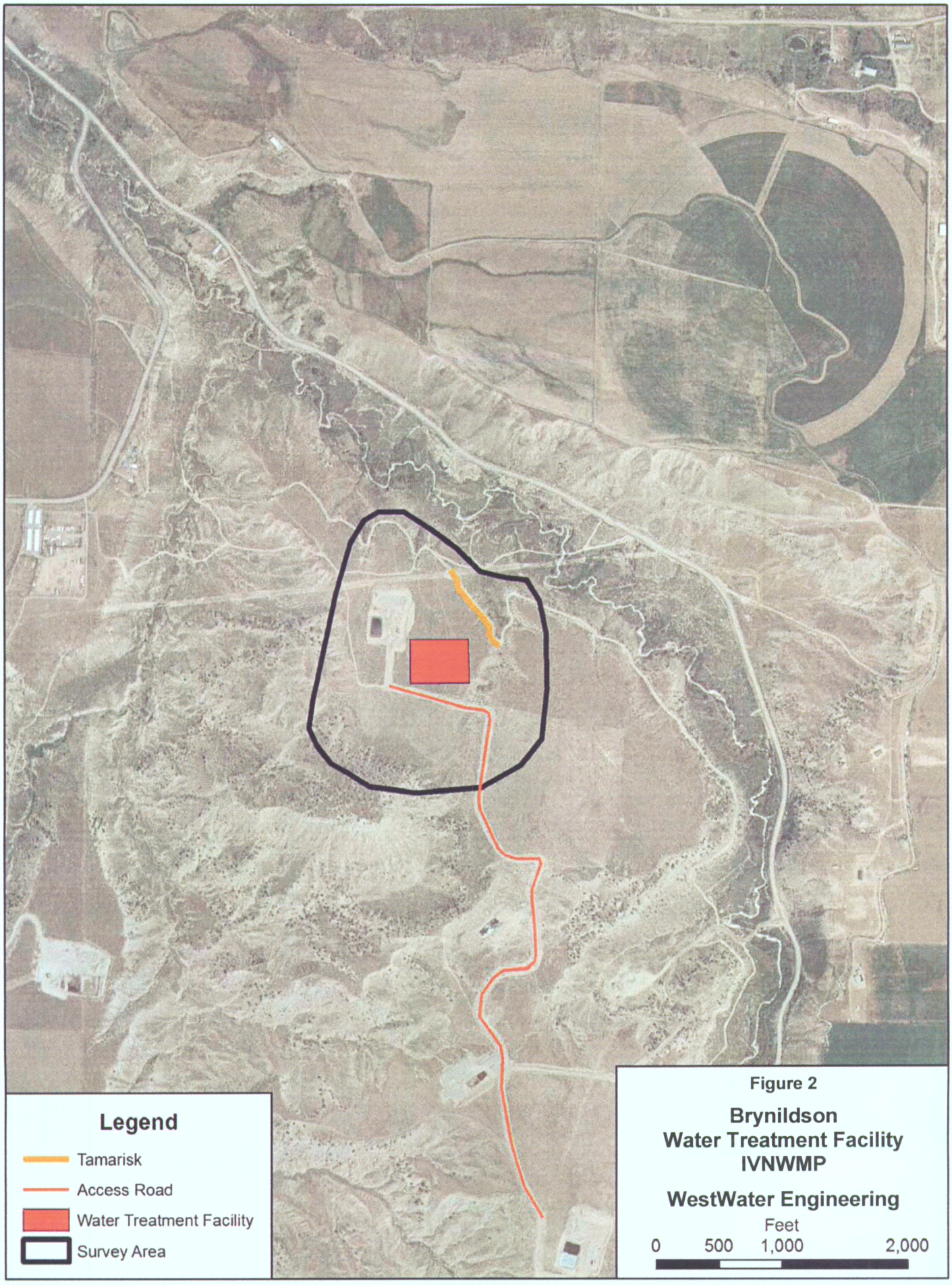
The proposed site of the Brynildson Water Treatment Facility is located on the second terrace above Mamm Creek at the north end of Hunter Mesa. The site is relatively flat but terrain drops off steeply into Mamm Creek to the northeast. To the southwest, low hills separate the project site from the rest of Hunter Mesa. Medium textured Potts loam formed in alluvium constitutes the topsoil. This series is deep, well-drained and derived from sandstone, shale or basalt. Erosion hazard is moderate (SCS, 1985).

Vegetation and Weeds

Characteristic natural vegetation at the proposed site includes wheatgrasses (*Pascopyrum* spp.), big sagebrush (*Artemesia tridentata* spp.), and needleandthread (*Hesperostipa comata*) (SCS, 1985). Currently, the site is predominantly big sagebrush (*Artemesia tridentata* spp.), snakeweed (*Gutierrezia* spp.), rabbitbrush (*Chrysothamnus* spp.), and shadscale (*Atriplex confertifolia*). The majority of the grass observed during the survey was emerging cheatgrass (*Bromus tectorum*). Slopes to the southwest are dominated by Juniper (*Juniperus* spp.) and big sagebrush, while Mamm Creek to the northeast is vegetated by typical riparian species, including willow (*Salix* spp.) and invasive Tamarisk (*Tamarix ramosissima*).

Sagebrush at the proposed location appears to have been mechanically treated and the composition of the vegetation suggests overgrazing. Recent use by horses, elk and mule deer was apparent on the day of the survey.

The proposed site is bordered on the north and south by unreclaimed or unsuccessfully reclaimed pipeline rights-of-way. The pipeline right-of-way on the southern border is predominantly bare ground and Russian thistle *(Salsola iberica)* (Photo 2). The pipeline right-of-way on the northern border is mainly cheatgrass (Photo 3). At the north edge of the proposed location, a


Legend
Tamarisk
Access Road
Water Treatment Facility
Survey Area
Figure 2
Brynildson
Water Treatment Facility
IVNWMP
WestWater Engineering
Feet
0
500
1,000
2,000