North Zone Weed Environmental Analysis

Karst Resources Report

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for:
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Contents

Current Invasive Plant Infestations on Karst Terrains

Approximately 28.2 acres of invasive weed populations exist on known karst lands. Most of infestations occur on the Hoonah Ranger District but are found on all districts except for Yakutat Ranger District. The majority of these infestations occur along the road corridor or in young-growth stands; very few infestations are in undisturbed areas. Some of the infestations may occur on high vulnerability karst. These areas have high density of karst features and are conduits to a subsurface hydrologic system. Table 1 shows acres of weed infestations by karst vulnerability class. Appendix A shows the species found on all karst lands and a full list of known infestation by location is in Appendix B of this report.

There are currently no inventoried invasive weed populations on documented high-vulnerability karst lands because these lands have not been assessed for vulnerability. Therefore, it is possible that some of these infestations are on high vulnerability karst lands. Most karst lands adjacent to invasive weed populations are likely low to moderate vulnerability karst, however there is potential for high vulnerability karst at higher elevations.

Table 1. Infestations in karst by vulnerability.

Karst vulnerability	Acres infestation	Total infestation %	Karst vulnerability
High	0.00	0	High
Medium	0.00	0	Medium
Low	0.00	0	Low
Carbonate geology, but vulnerability not assessed	66.17	4.69	Carbonate geology, but vulnerability not assessed
Noncarbonated geology	1,346.03	95.31	Noncarbonated geology
Grand Total	1,412.20		

Appendix H of the 2016 Forest Plan Amendment provides direction for conducting karst vulnerability assessments prior to any surface management practice. The karst vulnerability assessment process is designed to identify those karst features (e.g. the subsurface drainage network) that are most vulnerable to the impacts of sediments or other debris that may enter karst features as a consequence of surface activities (USDA 2016, page H-6). Manual and mechanical weed treatment methods have the highest potential to add sediment or other debris to the karst systems. Depending on the outcome of a karst vulnerability assessment, some management practices are avoided in high vulnerability karst, such as timber management and related activities, some recreational development, road construction and quarry development.

The Forest Plan's karst vulnerability assessments did not discuss the input of pesticides into the waters of the karst system (surface or subsurface). Therefore, the vulnerability assessment process, as currently described in Appendix H of the Forest Plan (2016), does not specifically address effects from herbicides to water quality and impacts to aquatic organisms.

Effects of Weed Treatments on Karst Features

The potential effects of weed treatments in karst lands are two-fold: the first is the potential for sediments to enter open karst features and subsurface drainage networks as a result of manual or mechanical treatment methods. The second is the impacts of the herbicides on water when or if it enters the karst system.

Some manual and mechanical treatment methods have the potential to disturb surface soils by digging, hoeing, raking and/or scraping. Soils become displaced and subject to erosion by wind or rain. If the disturbance is near a water body (stream, pond or lake), sediment has the potential to enter the water system. Manual and mechanical treatments could lead to localized sedimentation and turbidity to water and fish habitat because of trampling and soil sloughing due to stepping on banks and removal of weed roots. The amount of localized sediments and turbidity would be negligible because weed populations along streams within the project area are not extensive enough to result in significant sedimentation and turbidity.

Using herbicides decreases the potential for surficial erosion because the plant root mass is left undisturbed. However, herbicide treatments along streams and roadside ditches in karst lands may result in herbicide reaching water bodies through drift, runoff, and/or leaching. If the herbicides does reach the water, karst topography typically allows for rapid recharge of flow through fractures in rock and through subsurface conduits, providing little opportunity for natural filtering to occur (Prussian and Baichtal, 2007). In addition, the coarse-textured soils formed from the weathering of calcareous rock and the abundant rainfall mean that any herbicide entering a karst system will be rapidly percolated through the soil and transported off site.

Whether herbicides enter the subsurface waters of karst features or not, the body of literature suggests that at the planned rate of application combined with spot spray or broadcast treatment methods, the likelihood for adverse risk to water quality or aquatic organisms is minor. Detailed summaries of the effects to water quality (sediment, turbidity and temperature), watersheds, riparian condition, roads and municipal watershed and domestic water supplies are provided in the Hydrology Resource Report for the North Zone Weed EA (Whitacre 2018). See the Aquatic Organisms Resource Report for this project (Schneider 2018) for a full description of effects to indigenous fish species, amphibians, threatened, endangered and sensitive aquatic species and aquatic habitat.

Persistence of the two chemicals (aquatic formulations of imazapyr and glyphosate) proposed for weed treatments near aquatic systems have minor effects to water quality and aquatic organisms. The movement, persistence, and fate of an herbicide in the environment determine the likelihood and nature of exposure fish and other aquatic organisms may receive. The primary determinants of exposure of herbicide to water quality and aquatic organisms are herbicide properties, application rate, extent of application, application timing, precipitation amount and timing, and proximity to habitat (NMFS 2007).

Herbicides have been shown to affect aquatic ecosystem components; however, concentrations of herbicides coming in contact with water following treatments are unlikely to be great enough to cause such changes (SERA 2011a and 2011b). While the herbicides considered for use in this project kill aquatic plants, other aquatic habitat features and the food chain would not be adversely impacted because:

• The amount of herbicide that could be delivered is relatively low in comparison with levels of concern.
• The duration to which any non-target organism (including aquatic plants) would be exposed is very short-lived and impacts to aquatic organisms would be localized.

Glyphosate

Glyphosate would be used to manage weed species, such as reed canarygrass, at sites occurring within or adjacent to surface water. Potential for water contamination would be low due to herbicide properties and application location, type, and method (spot spray and broadcast treatments). This herbicide was designed to be applied to emergent weeds in all bodies of fresh and brackish water which may be flowing, non-flowing, or transient (Monsanto 2005). Glyphosate adsorbs strongly to soil particles once it enters the water, and this strong adsorption prevents excessive movement in the environment (Schuette 1998). Glyphosate is highly water soluble, with a half-life[1] in water ranging from 35-63 days, and degradation in water is generally slow, since fewer microorganisms occur than in soil (ibid). Directed foliar backpack sprayer, cut-stem, or injection methods of application would be used as appropriate. Aquatic formulations of glyphosate could be applied to emergent vegetation directly over water. Mobility and transport of residual glyphosate would be limited because most would bind with organic matter and sediment in soils and water. Residual herbicide would be mostly dissipated and biodegraded within two months in upland soils and within two weeks in water (SERA 2011a).

However, herbicides that photodegrade in surface waters will degrade at a slower rate in underground systems due to lack of sunlight and fewer microbes in underground waters (Aley 2005). Given the relatively fast and free-flowing condition of subsurface waters, as supported by several dye trace tests (Baichtal 2006), karst subsurface waters are likely highly oxygenated. Dye trace tests conducted on Northern Prince of Wales Island suggest subsurface flows are high, with an estimated mean velocity of between 114 and 8,225 feet per day (Baichtal 2006). At one location on Twin Mountain, subsurface waters traveled a distance of 4,150 feet and had measure minimum velocity of 4,284 feet per day (Baichtal 2006). As such, the half-life of pesticides may be lower than described above for slow moving or stagnant waters. This factor should be considered in combination with the lack of photolysis occurring within the subsurface waters.

Imazapyr

Imazapyr is a non-selective herbicide used for control of grasses, broadleaf weeds, vines, brush species, and riparian and emergent aquatic species (SERA 2011b). It is very highly water soluble, has moderate mobility in soils and toxicity of aquatic-based versions to fish and aquatic species is low, although the available acute and chronic toxicity data suggest that trout are more sensitive than other species (ibid). Degradation of this herbicide is influenced by many factors, but typically increases with increased temperatures, increased soil moisture, and decreased clay and organic matter content, factors that are consistent with soils of southeast Alaska (with the exception of warm temperatures). The primary form of degradation in water is photodegradation, with a half-life of approximately 2 days. This generally results in lower concern for water contamination due to its rapid photodegradation by sunlight. Given the subsurface drainages in karst features, photodegradation by sunlight could be diminished. However,

[1] Half-life refers to the time required for half the amount of a substance (such as a drug, radioactive tracer, or pesticide) in or introduced into a living system or ecosystem to be eliminated or disintegrated by natural processes.

this lack of photodegradion would be ameliorated considering the rapid movement of subsurface waters through the karst ecosystem. An equally important factor involves dilution and water turnover rates. If applied to a shaded and relatively stagnant body of water in which natural dilution would be minimal, imazapyr might persist near the treatment site for a prolonged period. If applied to rapidly flowing stream, imazapyr would not occur at high concentrations at the treated site, and the concentration of imazapyr in the stream water would be diluted as the compound is transported downstream. These factors are difficult to consider with any precision (SERA 2011a).

Imazapyr has been used to control emergent plants like reed canarygrass, which would be one likely target plant in this project. Bioaccumulation of imazapyr in aquatic organisms is low; therefore the potential of exposure through ingestion of exposed aquatic invertebrates or other food sources to fish is reduced. Toxicity to fish is considered practically non-toxic (insignificant) based on tests conducted using standardized EPA protocols (ibid).

Rare Cave Obligate Amphipod Species

It is unknown to what extent the rare cave obligate amphipod species is present in karst systems within the project area. The primary information used to evaluate the effects of herbicides on aquatic organisms for this analysis (Schneider 2018) is based on laboratory and field studies of herbicide toxicity, exposure, and environmental fate to estimate the risk of adverse effects to aquatic organisms. The analysis does not consider the effects of herbicides by species; instead, the most sensitive effect from the most sensitive species tested under worse case scenarios was used to determine the toxicity indices for each herbicide from SERA risk assessments (SERA 2011a, 2011b). Quantitative estimates of dose from each exposure scenario were compared to the corresponding toxicity index to determine the potential for adverse effect. Doses below the toxicity indices resulted in negligible effects.

Acute exposure to an herbicide is generally associated with an accidental spill or application rate beyond label recommendations. Risks to aquatic organisms such as fish, amphibians, invertebrates, algae, or aquatic macrophytes can vary depending on the magnitude (dose and duration) of the exposure. Acute exposures are generally 24 hours for fish (SERA 2011b). Through the use of licensed applicators and Project Design Features, acute exposures resulting in Level of Concern (LOC) for aquatic organisms are not expected.

Chronic exposure to an herbicide is generally associated with repeated treatments over time. Risks to aquatic organisms such as fish, amphibians, invertebrates, algae, or aquatic macrophytes can vary depending on the magnitude (dose and duration) of the exposure. Chronic exposures are generated by continuous exposure for 96-hours up to and including complete lifecycle studies, depending on chemicals (SERA 2011b). Chronic exposure to fish is not expected to occur with this project because herbicides will typically be applied once a year on average. Also, herbicides proposed for use are metabolized and excreted faster than they can accumulate in the bodies of aquatic animals, or are used at such low application rates and in a selective manner, that overexposure is unlikely.

For imazapyr, exposure to fish, aquatic plants, and algae are below levels of concern. There is a potential risk to aquatic macrophytes and zooplankton at all application rates. Aquatic phase amphibians are assumed to be as sensitive as fish.

For glyphosate, the aquatic formulation could exceed level of concern for fish at typical and highest application rate. However, exposures are below level of concern for aquatic invertebrates, amphibians, macrophytes, algae, and plants.

Project Design Features for Karst Ecosystems

In addition to following all label instructions for herbicide applications, the following design criteria are provided for additional levels of protection to karst ecosystems.

- The District/SO Geologist or Karst Specialist will review treatment plans. A karst vulnerability assessment will be completed prior to any surface management practice, including the consideration of applying herbicide in karst terrain.
- All hydrology and fisheries project design features will be applied to all karst lands proximal to any losing stream, or within any catchment basin for a karst groundwater systems.
- All soil project design features will be applied to karst lands to avoid soil disturbance.

Effects by Alternative

Alternative 1

Alternative 1 emphasizes manual and mechanical treatments with a minor amount of chemical treatments at administration and recreation sites. This alternative has the highest potential to add sediment into karst ecosystems due to the soil disturbance that is an outcome of digging, hoeing, and scraping the soil surface. Effects are minor because the limited acres of invasive plants within karst ecosystems is small and by adhering to soil quality standards and the project design criteria for soils, the input of sediments and overall soil disturbance levels is anticipated to be very low.

Alternatives 2 and 3

Both Alternatives 2 and 3 propose herbicide application (such as broadcast spraying, spot spraying, and hand/selective treatment) on invasive plant populations throughout the project area, as well as manual and mechanical treatment (hand pulling and tarping) particularly in areas with site-specific conditions or public concerns.

The potential effects of invasive plant treatments in karst lands are two-fold: the first is the potential for sediments to enter open karst features and subsurface drainage networks as a result of manual or mechanical treatment methods. The second are the impacts of the herbicides on water quality when or if it enters the karst system.

The preferred method of invasive plant treatment for the North Zone Weed Project is herbicide application, through foliar spot treatment, stem injection, brushing, broadcast spraying or other targeted spraying. Using herbicides rather than manual or mechanical methods decreases the potential for surficial erosion because the plant root mass is left undisturbed. However, herbicide treatments along streams and roadside ditches in karst lands may result in herbicide reaching water bodies through runoff and/or leaching. Whether herbicides enter the subsurface waters of karst features or not, literature suggests at the planned rate of application combined with treatment methods, the likelihood for adverse risk to water quality or aquatic organisms is minor (Whitacre 2019; Schneider and Castro 2019).

Four herbicides considered for use include glyphosate and imazapyr (aquatic-approved formulations) and aminopyralid (a selective herbicide used to target aster, legume and nightshade family plants among others) and methsulfuron methyl. The aquatic formulations of imazapyr and glyphosate proposed for invasive plant treatments near aquatic systems would be expected to have only minor effects to water

quality and aquatic organisms. Alternative 2 proposes lower application rates than Alternative 3. Nonetheless, while the herbicides considered for use in this project kill aquatic plants, aquatic habitats and the food chain would not be adversely impacted because:

- The amount of herbicide that could be delivered is relatively low in comparison with levels of concern.
- The duration to which any non-target organism (including aquatic plants) would be exposed is very short-lived and impacts to aquatic organisms would be localized.

Alternative 2 has no broadcast spraying in or near streams or karst features. Nonetheless, the types of chemical application methods proposed in Alternative 3 (including spot spraying, wicking, injection and broadcast) have negligible potential to harm beneficial uses of surface water and the function of aquatic organism when project design features are applied.

The use of herbicides adjacent and within water bodies will be allowed using only aquatic formulations of glyphosate and imazapyr. All label instructions for herbicide applications will be followed. In addition to label instructions for each herbicide, PDFs for karst requires a District/SO Geologist or Karst Specialist to review the treatment plans. A karst vulnerability assessment will be completed prior to any surface management practice, including the consideration of applying herbicide in karst terrain.

These and other design features as described in the Implementation Plan, Appendix A, are expected to minimize impacts to karst lands in the project area. Appendix A contains more-detailed information and guidance on the proposed use of herbicides, limitations, and required design features to reduce risk and potential effects to karst systems, as well as other project area resources.

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Appendix A. Invasive species found on karst lands within the project area.

Scientific name	Common name
Achillea ptarmica	sneezeweed
Arrhenatherum elatius	tall oatgrass
Capsella bursa-pastoris	shepherd's purse

Carnegiea gigantea	saguaro
Cerastium fontanum	common mouse-ear chickweed
Cerastium fontanum ssp. vulgare	big chickweed
Cirsium arvense	Canada thistle
Dactylis glomerata	orchardgrass
Deschampsia elongata	slender hairgrass
Elymus repens	quackgrass
Galeopsis bifida	splitlip hempnettle
Galeopsis tetrahit	brittlestem hempnettle
Leucanthemum vulgare	oxeye daisy
Linaria vulgaris	butter and eggs
Matricaria discoidea	disc mayweed
Phalaris arundinacea	reed canarygrass
Phleum pratense	timothy
Plantago major	common plantain
Poa annua	annual bluegrass
Poa palustris	fowl bluegrass
Poa pratensis	Kentucky bluegrass
Polygonum aviculare	prostrate knotweed
Ranunculus acris	tall buttercup
Ranunculus repens	creeping buttercup
Rumex acetosella	common sheep sorrel
Sagina procumbens	birdeye pearlwort
Schedonorus phoenix	tall fescue
Schedonorus pratensis	meadow fescue
Stellaria media	common chickweed
Tanacetum vulgare	common tansy
Taraxacum officinale	common dandelion
Trifolium dubium	suckling clover
Trifolium hybridum	alsike clover
Trifolium pratense	red clover
Trifolium repens	white clover

Appendix B. Site IDs provide locations of weed infestations on karst lands.

SITE_ID_FS	Plant code	Scientific name	Common name
100531P002549	TAVU	**Tanacetum vulgare**	common tansy
100531P002563	CABU2	**Capsella bursa-pastoris**	shepherd's purse
100531P002586	ACPT	**Achillea ptarmica**	sneezeweed
100531P002600	TRDU2	**Trifolium dubium**	suckling clover
100531P101159	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P101160	SCPH	**Schedonorus phoenix**	tall fescue
100531P101161	TRRE3	**Trifolium repens**	white clover
100531P101162	PLMA2	**Plantago major**	common plantain
100531P101163	TAOF	**Taraxacum officinale**	common dandelion
100531P101178	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P101179	SCPH	**Schedonorus phoenix**	tall fescue
100531P101180	TRRE3	**Trifolium repens**	white clover
100531P101181	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P101182	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P101183	TRRE3	**Trifolium repens**	white clover
100531P101184	SCPH	**Schedonorus phoenix**	tall fescue
100531P101185	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P101193	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P101194	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P101195	PLMA2	**Plantago major**	common plantain
100531P101196	TAOF	**Taraxacum officinale**	common dandelion
100531P101197	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P101198	TRRE3	**Trifolium repens**	white clover
100531P101199	SCPH	**Schedonorus phoenix**	tall fescue
100531P94661	SCPH	**Schedonorus phoenix**	tall fescue
100531P94783	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P95268	TRRE3	**Trifolium repens**	white clover
100531P97316	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P97317	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97318	PLMA2	**Plantago major**	common plantain
100531P97319	POAN	**Poa annua**	annual bluegrass
100531P97320	POPA2	**Poa palustris**	fowl bluegrass
100531P97321	TRRE3	**Trifolium repens**	white clover

100531P97322	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P97323	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97324	PLMA2	**Plantago major**	common plantain
100531P97325	POAN	**Poa annua**	annual bluegrass
100531P97326	POPA2	**Poa palustris**	fowl bluegrass
100531P97327	SCPH	**Schedonorus phoenix**	tall fescue
100531P97328	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97329	POAN	**Poa annua**	annual bluegrass
100531P97330	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97331	PLMA2	**Plantago major**	common plantain
100531P97332	POAN	**Poa annua**	annual bluegrass
100531P97333	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P97334	SCPH	**Schedonorus phoenix**	tall fescue
100531P97335	PLMA2	**Plantago major**	common plantain
100531P97336	POAN	**Poa annua**	annual bluegrass
100531P97337	TRRE3	**Trifolium repens**	white clover
100531P97338	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97339	POAN	**Poa annua**	annual bluegrass
100531P97340	POPA2	**Poa palustris**	fowl bluegrass
100531P97341	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P97342	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97343	POAN	**Poa annua**	annual bluegrass
100531P97344	POPA2	**Poa palustris**	fowl bluegrass
100531P97345	STME2	**Stellaria media**	common chickweed
100531P97409	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97411	POAN	**Poa annua**	annual bluegrass
100531P97414	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97415	PHPR3	**Phleum pratense**	timothy
100531P97416	PLMA2	**Plantago major**	common plantain
100531P97417	POAN	**Poa annua**	annual bluegrass
100531P97418	POPA2	**Poa palustris**	fowl bluegrass
100531P97419	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P97420	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97421	PLMA2	**Plantago major**	common plantain
100531P97422	POAN	**Poa annua**	annual bluegrass
100531P97423	TRRE3	**Trifolium repens**	white clover
100531P97424	PHAR3	**Phalaris arundinacea**	reed canarygrass

100531P97656	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P97657	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97658	PLMA2	**Plantago major**	common plantain
100531P97659	POAN	**Poa annua**	annual bluegrass
100531P97660	TRRE3	**Trifolium repens**	white clover
100531P97781	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P97782	DAGL	**Dactylis glomerata**	orchardgrass
100531P97783	SCPH	**Schedonorus phoenix**	tall fescue
100531P97784	MADI6	**Matricaria discoidea**	disc mayweed
100531P97785	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P97786	PLMA2	**Plantago major**	common plantain
100531P97787	POAN	**Poa annua**	annual bluegrass
100531P97788	POPA2	**Poa palustris**	fowl bluegrass
100531P97789	POPR	**Poa pratensis**	Kentucky bluegrass
100531P97790	RUAC3	**Rumex acetosella**	common sheep sorrel
100531P97791	SAPR	**Sagina procumbens**	birdeye pearlwort
100531P97792	TAOF	**Taraxacum officinale**	common dandelion
100531P97793	TRHY	**Trifolium hybridum**	alsike clover
100531P97794	TRRE3	**Trifolium repens**	white clover
100531P98173	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P98174	DAGL	**Dactylis glomerata**	orchardgrass
100531P98175	LEVU	**Leucanthemum vulgare**	oxeye daisy
100531P98176	PHPR3	**Phleum pratense**	timothy
100531P98177	PLMA2	**Plantago major**	common plantain
100531P98178	POAN	**Poa annua**	annual bluegrass
100531P98179	POPR	**Poa pratensis**	Kentucky bluegrass
100531P98180	RUAC3	**Rumex acetosella**	common sheep sorrel
100531P98181	SAPR	**Sagina procumbens**	birdeye pearlwort
100531P98182	TAOF	**Taraxacum officinale**	common dandelion
100531P98183	TRRE3	**Trifolium repens**	white clover
100531P98184	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P98185	DAGL	**Dactylis glomerata**	orchardgrass
100531P98186	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P98187	PHPR3	**Phleum pratense**	timothy
100531P98188	PLMA2	**Plantago major**	common plantain
100531P98189	POAN	**Poa annua**	annual bluegrass
100531P98190	POPA2	**Poa palustris**	fowl bluegrass
100531P98191	POPR	**Poa pratensis**	Kentucky bluegrass

100531P98192	RARE3	**Ranunculus repens**	creeping buttercup
100531P98193	TAOF	**Taraxacum officinale**	common dandelion
100531P98194	TRPR2	**Trifolium pratense**	red clover
100531P98195	TRRE3	**Trifolium repens**	white clover
100531P98196	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P98197	DAGL	**Dactylis glomerata**	orchardgrass
100531P98198	SCPH	**Schedonorus phoenix**	tall fescue
100531P98199	MADI6	**Matricaria discoidea**	disc mayweed
100531P98200	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P98201	PLMA2	**Plantago major**	common plantain
100531P98202	POAN	**Poa annua**	annual bluegrass
100531P98203	POPA2	**Poa palustris**	fowl bluegrass
100531P98204	POPR	**Poa pratensis**	Kentucky bluegrass
100531P98205	RUAC3	**Rumex acetosella**	common sheep sorrel
100531P98206	TRHY	**Trifolium hybridum**	alsike clover
100531P98207	TRRE3	**Trifolium repens**	white clover
100531P98232	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100531P98233	PHAR3	**Phalaris arundinacea**	reed canarygrass
100531P98234	PLMA2	**Plantago major**	common plantain
100531P98235	POAN	**Poa annua**	annual bluegrass
100531P98236	RARE3	**Ranunculus repens**	creeping buttercup
100531P98237	TAOF	**Taraxacum officinale**	common dandelion
100531P98238	TRRE3	**Trifolium repens**	white clover
100532IP000001	CIAR4	**Cirsium arvense**	Canada thistle
100532IP000013	TAOF	**Taraxacum officinale**	common dandelion
100532IP000014	TRRE3	**Trifolium repens**	white clover
100532IP000015	RARE3	**Ranunculus repens**	creeping buttercup
100532P000002	LEVU	**Leucanthemum vulgare**	oxeye daisy
100532P000032	TAOF	**Taraxacum officinale**	common dandelion
100532P000039	POPR	**Poa pratensis**	Kentucky bluegrass
100532P100001Y13	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P100846	DAGL	**Dactylis glomerata**	orchardgrass
100532P100847	TRRE3	**Trifolium repens**	white clover
100532P100848	PLMA2	**Plantago major**	common plantain
100532P100849	LEVU	**Leucanthemum vulgare**	oxeye daisy
100532P100850	POPA2	**Poa palustris**	fowl bluegrass
100532P100851	POPR	**Poa pratensis**	Kentucky bluegrass
100532P100852	POAN	**Poa annua**	annual bluegrass
100532P100853	TRPR2	**Trifolium pratense**	red clover
100532P100854	TAVU	**Tanacetum vulgare**	common tansy

100532P100855	SCPH	**Schedonorus phoenix**	tall fescue
100532P100856	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100532P100857	PHPR3	**Phleum pratense**	timothy
100532P100858	RARE3	**Ranunculus repens**	creeping buttercup
100532P100859	MADI6	**Matricaria discoidea**	disc mayweed
100532P100860	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P100861	POAV	**Polygonum aviculare**	prostrate knotweed
100532P101080	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P101081	LEVU	**Leucanthemum vulgare**	oxeye daisy
100532P101082	TRRE3	**Trifolium repens**	white clover
100532P101083	RARE3	**Ranunculus repens**	creeping buttercup
100532P101084	PLMA2	**Plantago major**	common plantain
100532P101085	TAOF	**Taraxacum officinale**	common dandelion
100532P101086	POPA2	**Poa palustris**	fowl bluegrass
100532P101087	DEEL	**Deschampsia elongata**	slender hairgrass
100532P101088	POAN	**Poa annua**	annual bluegrass
100532P101089	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100532P101090	PHPR3	**Phleum pratense**	timothy
100532P101091	DAGL	**Dactylis glomerata**	orchardgrass
100532P101092	SCPH	**Schedonorus phoenix**	tall fescue
100532P101093	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P101094	SCPH	**Schedonorus phoenix**	tall fescue
100532P101095	POPA2	**Poa palustris**	fowl bluegrass
100532P101096	POAN	**Poa annua**	annual bluegrass
100532P101097	DAGL	**Dactylis glomerata**	orchardgrass
100532P101098	TRPR2	**Trifolium pratense**	red clover
100532P101099	PLMA2	**Plantago major**	common plantain
100532P101100	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100532P101101	LEVU	**Leucanthemum vulgare**	oxeye daisy
100532P101102	TRRE3	**Trifolium repens**	white clover
100532P101103	TAOF	**Taraxacum officinale**	common dandelion
100532P101104	SAPR	**Sagina procumbens**	birdeye pearlwort
100532P101105	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P101106	POPA2	**Poa palustris**	fowl bluegrass
100532P101107	POPR	**Poa pratensis**	Kentucky bluegrass
100532P101108	POAN	**Poa annua**	annual bluegrass
100532P101109	LEVU	**Leucanthemum vulgare**	oxeye daisy
100532P101110	TRPR2	**Trifolium pratense**	red clover
100532P101111	TRRE3	**Trifolium repens**	white clover

100532P101112	PLMA2	**Plantago major**	common plantain
100532P101113	TAOF	**Taraxacum officinale**	common dandelion
100532P101114	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100532P101115	SCPH	**Schedonorus phoenix**	tall fescue
100532P101116	DAGL	**Dactylis glomerata**	orchardgrass
100532P101186	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P101187	SCPH	**Schedonorus phoenix**	tall fescue
100532P101188	TRRE3	**Trifolium repens**	white clover
100532P101189	DAGL	**Dactylis glomerata**	orchardgrass
100532P101190	PHPR3	**Phleum pratense**	timothy
100532P101191	PLMA2	**Plantago major**	common plantain
100532P101192	TAOF	**Taraxacum officinale**	common dandelion
100532P94422	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100532P94431	DAGL	**Dactylis glomerata**	orchardgrass
100532P94660	SCPH	**Schedonorus phoenix**	tall fescue
100532P94782	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P94908	PLMA2	**Plantago major**	common plantain
100532P94967	POAN	**Poa annua**	annual bluegrass
100532P95180	TAOF	**Taraxacum officinale**	common dandelion
100532P95267	TRRE3	**Trifolium repens**	white clover
100532P99859	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99860	SCPH	**Schedonorus phoenix**	tall fescue
100532P99861	PHPR3	**Phleum pratense**	timothy
100532P99862	DAGL	**Dactylis glomerata**	orchardgrass
100532P99863	PLMA2	**Plantago major**	common plantain
100532P99864	TAOF	**Taraxacum officinale**	common dandelion
100532P99865	TRHY	**Trifolium hybridum**	alsike clover
100532P99866	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99867	SCPH	**Schedonorus phoenix**	tall fescue
100532P99868	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99869	SCPH	**Schedonorus phoenix**	tall fescue
100532P99870	DAGL	**Dactylis glomerata**	orchardgrass
100532P99871	POPR	**Poa pratensis**	Kentucky bluegrass
100532P99872	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99873	SCPH	**Schedonorus phoenix**	tall fescue
100532P99881	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99882	POAN	**Poa annua**	annual bluegrass
100532P99883	SCPH	**Schedonorus phoenix**	tall fescue
100532P99884	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed

100532P99885	PLMA2	**Plantago major**	common plantain
100532P99886	TAOF	**Taraxacum officinale**	common dandelion
100532P99887	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99888	SCPH	**Schedonorus phoenix**	tall fescue
100532P99889	TAOF	**Taraxacum officinale**	common dandelion
100532P99890	PLMA2	**Plantago major**	common plantain
100532P99891	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99892	SCPH	**Schedonorus phoenix**	tall fescue
100532P99893	POPR	**Poa pratensis**	Kentucky bluegrass
100532P99894	POAN	**Poa annua**	annual bluegrass
100532P99895	POPA2	**Poa palustris**	fowl bluegrass
100532P99896	DAGL	**Dactylis glomerata**	orchardgrass
100532P99897	PHPR3	**Phleum pratense**	timothy
100532P99898	SAPR	**Sagina procumbens**	birdeye pearlwort
100532P99899	RARE3	**Ranunculus repens**	creeping buttercup
100532P99900	RAAC3	**Ranunculus acris**	tall buttercup
100532P99901	PLMA2	**Plantago major**	common plantain
100532P99902	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100532P99903	TAOF	**Taraxacum officinale**	common dandelion
100532P99904	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99905	SCPH	**Schedonorus phoenix**	tall fescue
100532P99906	PLMA2	**Plantago major**	common plantain
100532P99907	PHPR3	**Phleum pratense**	timothy
100532P99908	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100532P99909	TAOF	**Taraxacum officinale**	common dandelion
100532P99910	DAGL	**Dactylis glomerata**	orchardgrass
100532P99911	TRRE3	**Trifolium repens**	white clover
100532P99912	POPR	**Poa pratensis**	Kentucky bluegrass
100532P99913	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99914	SCPH	**Schedonorus phoenix**	tall fescue
100532P99915	POPA2	**Poa palustris**	fowl bluegrass
100532P99916	PHPR3	**Phleum pratense**	timothy
100532P99917	DAGL	**Dactylis glomerata**	orchardgrass
100532P99918	PLMA2	**Plantago major**	common plantain
100532P99919	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed
100532P99920	TAOF	**Taraxacum officinale**	common dandelion
100532P99921	TRRE3	**Trifolium repens**	white clover
100532P99922	SCPH	**Schedonorus phoenix**	tall fescue
100532P99923	PHAR3	**Phalaris arundinacea**	reed canarygrass

100532P99924	PLMA2	**Plantago major**	common plantain
100532P99925	TAOF	**Taraxacum officinale**	common dandelion
100532P99926	TRRE3	**Trifolium repens**	white clover
100532P99927	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99928	SCPH	**Schedonorus phoenix**	tall fescue
100532P99929	PHPR3	**Phleum pratense**	timothy
100532P99930	SCPH	**Schedonorus phoenix**	tall fescue
100532P99931	PHPR3	**Phleum pratense**	timothy
100532P99932	TRRE3	**Trifolium repens**	white clover
100532P99933	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99934	SCPH	**Schedonorus phoenix**	tall fescue
100532P99935	PHPR3	**Phleum pratense**	timothy
100532P99936	DAGL	**Dactylis glomerata**	orchardgrass
100532P99937	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99938	AREL3	**Arrhenatherum elatius**	tall oatgrass
100532P99939	POPA2	**Poa palustris**	fowl bluegrass
100532P99940	DAGL	**Dactylis glomerata**	orchardgrass
100532P99941	SCPH	**Schedonorus phoenix**	tall fescue
100532P99942	PHPR3	**Phleum pratense**	timothy
100532P99943	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99944	SCPH	**Schedonorus phoenix**	tall fescue
100532P99945	TRRE3	**Trifolium repens**	white clover
100532P99946	POPA2	**Poa palustris**	fowl bluegrass
100532P99947	DAGL	**Dactylis glomerata**	orchardgrass
100532P99948	AREL3	**Arrhenatherum elatius**	tall oatgrass
100532P99949	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99950	SCPH	**Schedonorus phoenix**	tall fescue
100532P99951	PHPR3	**Phleum pratense**	timothy
100532P99952	POPA2	**Poa palustris**	fowl bluegrass
100532P99953	PLMA2	**Plantago major**	common plantain
100532P99954	TAOF	**Taraxacum officinale**	common dandelion
100532P99955	TRRE3	**Trifolium repens**	white clover
100532P99956	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99957	SCPH	**Schedonorus phoenix**	tall fescue
100532P99958	PHPR3	**Phleum pratense**	timothy
100532P99959	DAGL	**Dactylis glomerata**	orchardgrass
100532P99960	PLMA2	**Plantago major**	common plantain
100532P99961	TRRE3	**Trifolium repens**	white clover
100532P99962	PHAR3	**Phalaris arundinacea**	reed canarygrass
100532P99963	PLMA2	**Plantago major**	common plantain
100532P99964	CEFOV2	**Cerastium fontanum ssp. vulgare**	big chickweed

100532P99965	TRRE3	**Trifolium repens**	white clover
100532P99966	RARE3	**Ranunculus repens**	creeping buttercup
100532P99967	CABU2	**Capsella bursa-pastoris**	shepherd's purse
100532P99968	POAN	**Poa annua**	annual bluegrass
100532P99969	TAOF	**Taraxacum officinale**	common dandelion
100532P99970	POPR	**Poa pratensis**	Kentucky bluegrass
100533IP00001	LIVU2	**Linaria vulgaris**	butter and eggs
100534P000058	ELRE4	**Elymus repens**	quackgrass
100534P000061	GATE2	**Galeopsis tetrahit**	brittlestem hempnettle
TNF-SCS02-0514_PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-SRD05-0036_PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-SRD05-0036_PLMA2	PLMA2	**Plantago major**	common plantain
TNF-SRD05-0036_POAN	POAN	**Poa annua**	annual bluegrass
TNF-SRD05-0036_TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-SRD05-0039_PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-SRD05-0039_TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-SRD05-0044_LOAR10	SCPH	**Schedonorus phoenix**	tall fescue
TNF-SRD05-0044_PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-SRD05-0044_POAN	POAN	**Poa annua**	annual bluegrass
TNF-SRD05-0048_DAGL	DAGL	**Dactylis glomerata**	orchardgrass
TNF-SRD05-0053_PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-TNFA03-003_NONE	CAGI10	**Carnegiea gigantea**	saguaro
TNF-TNFA03-004_NONE	CAGI10	**Carnegiea gigantea**	saguaro
TNF-TNFA04-017_NONE	CAGI10	**Carnegiea gigantea**	saguaro
TNF-TNFA05-066_PLMA2	PLMA2	**Plantago major**	common plantain
TNF-TNFA05-066_RARE3	RARE3	**Ranunculus repens**	creeping buttercup
TNF-TNFA05-066_TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-TNFA05-071_GABI3	GABI3	**Galeopsis bifida**	splitlip hempnettle
TNF-TONF02-0032_POPR	POPR	**Poa pratensis**	Kentucky bluegrass
TNF-USFS-1056-CEFO2	CEFO2	**Cerastium fontanum**	common mouse-ear chickweed
TNF-USFS-1056-PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-USFS-1056-PHPR3	PHPR3	**Phleum pratense**	timothy
TNF-USFS-1056-PLMA2	PLMA2	**Plantago major**	common plantain
TNF-USFS-1056-POAN	POAN	**Poa annua**	annual bluegrass
TNF-USFS-1056-TAOF	TAOF	**Taraxacum officinale**	common dandelion
TNF-USFS-1056-TRPR2	TRPR2	**Trifolium pratense**	red clover
TNF-USFS-1056-TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-USFS-1110-CEFO2	CEFO2	**Cerastium fontanum**	common mouse-ear chickweed
TNF-USFS-1110-PLMA2	PLMA2	**Plantago major**	common plantain
TNF-USFS-1110-TAOF	TAOF	**Taraxacum officinale**	common dandelion
TNF-USFS-1468-CABU2	CABU2	**Capsella bursa-pastoris**	shepherd's purse

TNF-USFS-1468-CEFO2	CEFO2	**Cerastium fontanum**	common mouse-ear chickweed
TNF-USFS-1468-DAGL	DAGL	**Dactylis glomerata**	orchardgrass
TNF-USFS-1468-MADI6	MADI6	**Matricaria discoidea**	disc mayweed
TNF-USFS-1468-PHPR3	PHPR3	**Phleum pratense**	timothy
TNF-USFS-1468-PLMA2	PLMA2	**Plantago major**	common plantain
TNF-USFS-1468-POAN	POAN	**Poa annua**	annual bluegrass
TNF-USFS-1468-RUAC3	RUAC3	**Rumex acetosella**	common sheep sorrel
TNF-USFS-1468-TAOF	TAOF	**Taraxacum officinale**	common dandelion
TNF-USFS-1468-TAVU	TAVU	**Tanacetum vulgare**	common tansy
TNF-USFS-1468-TRPR2	TRPR2	**Trifolium pratense**	red clover
TNF-USFS-1468-TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-USFS-1471-CEFO2	CEFO2	**Cerastium fontanum**	common mouse-ear chickweed
TNF-USFS-1471-LOPR7	SCPR4	**Schedonorus pratensis**	meadow fescue
TNF-USFS-1471-MADI6	MADI6	**Matricaria discoidea**	disc mayweed
TNF-USFS-1471-PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-USFS-1471-PLMA2	PLMA2	**Plantago major**	common plantain
TNF-USFS-1471-POAN	POAN	**Poa annua**	annual bluegrass
TNF-USFS-1471-TAOF	TAOF	**Taraxacum officinale**	common dandelion
TNF-USFS-1471-TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-USFS-1472-LOPR7	SCPR4	**Schedonorus pratensis**	meadow fescue
TNF-USFS-1472-PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-USFS-1472-TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-USFS-1473-DAGL	DAGL	**Dactylis glomerata**	orchardgrass
TNF-USFS-1473-LOPR7	SCPR4	**Schedonorus pratensis**	meadow fescue
TNF-USFS-1473-PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-USFS-1473-PLMA2	PLMA2	**Plantago major**	common plantain
TNF-USFS-1473-TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-USFS-1474-LOPR7	SCPR4	**Schedonorus pratensis**	meadow fescue
TNF-USFS-1474-PHPR3	PHPR3	**Phleum pratense**	timothy
TNF-USFS-1474-PLMA2	PLMA2	**Plantago major**	common plantain
TNF-USFS-1474-TAOF	TAOF	**Taraxacum officinale**	common dandelion
TNF-USFS-1474-TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-USFS-1476-CEFO2	CEFO2	**Cerastium fontanum**	common mouse-ear chickweed
TNF-USFS-1476-LOPR7	SCPR4	**Schedonorus pratensis**	meadow fescue
TNF-USFS-1476-PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass
TNF-USFS-1476-PLMA2	PLMA2	**Plantago major**	common plantain
TNF-USFS-1476-POAN	POAN	**Poa annua**	annual bluegrass
TNF-USFS-1476-TAOF	TAOF	**Taraxacum officinale**	common dandelion
TNF-USFS-1476-TRRE3	TRRE3	**Trifolium repens**	white clover
TNF-USFS-1516-CEFO2	CEFO2	**Cerastium fontanum**	common mouse-ear chickweed
TNF-USFS-1516-PHAR3	PHAR3	**Phalaris arundinacea**	reed canarygrass

TNF-USFS-1516-PLMA2	PLMA2	**Plantago major**	common plantain
TNF-USFS-1516-POAN	POAN	**Poa annua**	annual bluegrass
TNF-USFS-1516-TAOF	TAOF	**Taraxacum officinale**	common dandelion
TNF-USFS-1516-TRRE3	TRRE3	**Trifolium repens**	white clover