North Tongass Integrated Weed Management Project

Non-native Plants Resource Report

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Introduction

This report summarizes the non-native plant data available for the North Tongass Integrated Pest Management Project and analyzes the effects of the proposed activities on non-native plants. Non-native plant species fall into several categories having particular definitions which are linked to laws, executive orders and Forest Service policy (FSM 2900). In this document non-native plants of management concern are referred to as 'invasive plants' or 'weeds'.

Issues identified for this project are linked to the effects of herbicides and other weed treatment methods on natural resources, such as fish, water, wildlife, wilderness character and non-target plant species. Unlike these resources, non-native plants are the impetus behind the proposed action. As such, non-native plants, or weeds as an issue, were not specifically identified either from internal or external comments during the scoping period. The issue of weeds is predominantly an internal issue directly linked to the Tongass National Forest Land and Resource Management Plan desired condition for biodiversity (USFS 2016). This project is designed to help move the Tongass National Forest toward the desired condition with regard to invasive species.

Proposed Action and Alternatives

Alternative 1 (No Action)

Under the No Action Alternative, the activities proposed in the action alternatives would not be implemented. The No Action Alternative, however, would not preclude future weed management in the project area. This alternative represents the existing condition and the anticipated future conditions (which will include some, but not all treatment methods proposed in this project) and serves as a baseline to compare the effects between alternatives. This alternative assumes 13 acres of treatment annually based on the average number of acres treated during the past 5 years (Krosse 2017b).

If an action alternative is not selected, the continued use of district-level categorical exclusions (CEs) is anticipated to continue to allow limited treatment of invasive plants using manual, mechanical, and chemical methods at designated Forest Service administrative and recreation sites. These two categories applicable for this project are listed in 36 CFR 220.6(d):

- Repair and maintenance of administrative sites, including applying registered pesticides for rodent or vegetation control.
- Repair and maintenance of recreation sites and facilities, including applying registered pesticides for rodent or vegetation control.

For this project, designated administrative sites and recreation sites and facilities include the following locations: Forest Service offices, visitor centers, employee housing, warehouse compounds, developed campgrounds, day use areas, parking areas, boat launches, recreation cabins, and remote airstrips associated with recreation cabins. Infestations located outside these areas would not be treated with herbicides.

Alternative 2 (Proposed Action) – Integrated Pest Management, Including Herbicides

This alternative proposes an integrated pest management approach on National Forest Systems lands (including Wilderness), as well as non-federal lands (private, city, state, or other) in order to allow for a comprehensive approach to weed management, and enable future partnerships with other landowners using federal funding as it becomes available to local communities through grants or other initiatives.

Treatment types analyzed in this alternative include manual (e.g. hand pulling, digging, clipping), mechanical (e.g., mowing), and chemical (herbicides) to eradicate, control, or contain populations of weeds. We will use these methods of treatment at known infestation sites as well as currently undocumented infestation sites. Total weed treatment within the project area is not expected to exceed 88 acres in any year for Alternative 2 (Krosse 2017b).

This alternative was designed to provide a decision-making framework for treatment strategies for existing and new infestations. From this framework, site-specific treatment prescriptions are proposed for priority infestations on an annual basis. Site-specific prescriptions include the eradication, control or containment of existing and new infestations of invasive plant species. The number of entries into the same infestation area would vary by species and method of treatment selected. Some species such as Japanese knotweed and reed canarygrass may need multiple treatments in one growing season.

The number of acres proposed for treatment within the project area is based on the current inventory of invasive plants on all five Ranger Districts, the National Monument and all non-federal lands within this project area; a total of about 1,412 acres of known infestations. Though many of these populations are important to treat, the sheer number and distribution of sites coupled with yearly funding fluctuations make priority-setting difficult. For this reason, specific infestations selected for treatment will be analyzed yearly through an implementation planning process. An annual treatment plan will be required to determine the program of work each year.

Prioritization of treatment is proposed to occur annually using a decision framework that provides a consistent process to determine priorities for treatment of target weeds and the selection of treatment methods, including the use of Early Detection and Rapid Response (EDRR). For example, some weeds are not considered highly invasive and may be treated wherever control of an infestation is feasible. Alternatively, other widespread aggressive weed species (e.g., reed canarygrass or orange hawkweed) may be a priority for treatment in certain areas such as a riparian area while an infestation is small and manageable, but large infestations along a roadside may be tolerated and not treated at all. This flexibility is needed to effectively manage the priorities for infestation treatments with available resources and personnel.

Glyphosate, aminopyralid, imazapyr and metasulfuron methyl were selected as the suite of chemical control methods to be analyzed for this project. Herbicide use is proposed using ground-based methods, such as spot spraying and selective hand application (wicking/wiping and stem injection) that targets individuals and groups of plants, and non-aerial broadcast spray. These treatment methods and the ultimate selection of them at a particular sites will be based on management objective, accessibility, topography, the infesting species, and size of the infestation. To reduce potential spray drift or run-off, herbicides will not be applied when average wind speeds exceed 10 mph or immediately prior to, during, or immediately after a rain event at the treatment site.

Mulching, seeding and planting of desirable vegetation may occur to restore treated sites and help prevent re-infestation. In addition, preventative measures detailed in the Tongass National Forest Guidance for Invasive Plant Management (Krosse 2017) would be ongoing and a part of the weed management strategy. Annual monitoring of selected treatment areas would evaluate the effectiveness of the treatment method and possibly modify the management strategy, including the method and type of continued or follow-up treatments needed.

Project Design Features – Herbicide Application

The following project design features (PDFs) are incorporated into Alternative 2 to increase the efficiency and effectiveness of infestation treatments and to reduce potential adverse impacts of to non-target resources.

1. A treatment plan will be developed for all infestations to be treated each year. This plan will be reviewed by the appropriate district specialists for potential resource concerns.
2. All treatments will comply with State of Alaska laws and regulations pertaining to application of pesticides, including certification requirements for pesticide applicators, and permitting and reporting requirements for application of pesticides to water or discharge of pesticides into water.
3. Aquatic formulations of the proposed herbicides will be used on wet sites (see PDFs for soils and aquatic resources. Only aquatic formulations of glyphosate will be used.
4. To reduce potential spray drift or run-off, herbicides will not be applied when average wind speeds exceed the maximum wind speed stated in the product labeling, or seven miles per hour if no maximum wind speed is stated in the labeling.
5. Imazapyr will be applied by hand application (wicking/wiping or stem injection) or spot spray only. Broadcast spray application of imazapyr is prohibited.
6. All chemical treatments within designated wilderness areas must be approved by the Regional Forester. Approval for chemical treatments in non-wilderness areas may be delegated by the Regional Forester to another responsible official.
7. Notification signage will be placed in developed recreation sites, and in other areas of concentrated public use such as trailheads and picnic areas located on a road system, immediately before applying herbicides at those sites, and the signage will remain in place for at least 24 hours after application, or the time period required for safe entry as specified on the product label, whichever is greater.

Alternative 3 – Integrated Pest Management without Herbicides

Alternative 3 is the same as Alternative 2, the Proposed Action, other than it removes herbicides as an option for treatment. This alternative was developed in response to comments received during scoping. Members of the public were concerned that herbicides could have an adverse effect on humans, and on plants used for subsistence use, such as berries located near or within invasive plant treatments areas.

This alternative may fulfill the purpose and need but would be dependent on staffing and funding. This alternative addresses public perception related to the issues of herbicide toxicity, effects to non-target plants, wildlife, and soils by eliminating herbicides as a treatment method from consideration.

Without herbicide as a treatment option, more emphasis would be placed on using hand pulling and mechanical treatments. Infestations of some weed species (e.g. Japanese knotweed, reed canarygrass, and orange hawkweed) would be more difficult to control or eradicate without the use of herbicides. This alternative assumes an average of 25 acres of weed treatment annually (Krosse 2017b).

Affected Environment

Current Inventory of Non-native Plants

The main sources of invasive plant data in the project area are the US Forest Service Natural Resource Information System (NRIS) and the Alaska Exotic Plants Information Clearinghouse (AKEPIC). Because data-sharing occurs between these two data systems, there is considerable overlap. Non-native plant surveys throughout the project area have mainly occurred in concert with other program activities, namely wilderness monitoring, recreation facilities inspections, timber sale projects and other special use permit applications. Field inventories have identified approximately 1,412 acres of infestations consisting of 131 different weed species within the boundaries of the project area (Appendix A). Most infestations are predominantly located in disturbed areas: along road systems and within rock pits, at administrative sites, and in areas utilized for recreation such as campgrounds, dispersed recreation sites, cabins, and trails. Most infestations also occur in disturbed areas, because many weeds do not grow well under the shade of natural vegetation, and some species such as garlic mustard and bishop's goutweed can persist and even thrive in forested settings. An additional 41 non-native plant species that currently are not known to occur but could potentially be introduced and spread in the project area are included in a watch list (Appendix B).

Invasive Plant Transportation Vectors

Roads are conduits for the spread of weeds, facilitating their rapid transport and dispersal (e.g., by seeds and vegetative reproductive parts attached to vehicles) and providing disturbed ground and altered habitat for easy colonization and establishment of invasive plants. Roads and trails may also serve to introduce weeds onto areas with intact native plant communities and where ecological integrity are highly valued. For example, the only known infestation of bishop's goutweed occurs in relatively intact forest in the Lena Beach Recreation Area, which is located on the city of Juneau road system. The road system across the project area is concentrated around communities and in areas in which extensive timber harvest has previously occurred.

Timber harvest, road building, and other ground-disturbing activities contribute to the spread of weeds, as the habitat conditions that facilitate colonization are created, such as changes in sunlight from forested conditions to open sun and/or soil disturbance that result from these activities. Recreation activities (e.g. hiking, camping) can spread weeds along trail systems and at both remote and developed recreation sites. In addition, weeds are spread through the movement of water in creeks and across wetlands. Floods move weed seeds and materials into adjacent riparian areas. Wind and sea wave action may also move lightweight and/or buoyant seeds long distances to infest new areas.

Intentional and accidental introductions have primarily occurred over the past century, but major introductions have occurred most rapidly over the past 50 or 60 years. Intentional introductions of weeds for erosion control have contributed to a number of infestations that are now targets for to control. Commercial landscape nurseries or other vendors (such as grocery stores in local communities) sell, or once sold, exotic species for domestic landscaping that have later been found to be invasive. While most ornamental plants have not yet spread to federal lands, the potential for them to do so exists.

Without treatment, weeds may spread to new areas and displace native vegetation. In the Pacific Northwest, the average rate of spread is about 8-12 percent per year (USFS 2008). In southeast Alaska, rate of spread may be lower due to factors such as length of the growing season, remoteness of the area, and lack of extensive road systems, coupled with the relatively intact ecosystems with very little intensive site disturbance in the majority of the project area.

Invasive Plant Management Activities

Invasive plant infestations have been treated via manual methods (hand pulling, digging) or mechanical methods (mowing, tarping) in previous years, with a very minor amount of herbicide treatment at selected administrative and recreation sites. The total acreage of treatments accomplished in the project area since 2006 is 87.7 acres, with an average treatment area of 0.6 acres. The average annual infestation acreage treated across the project area over last five years (2012-2016) is 14.7 acres. Most treated infestations have been small and isolated, and most have been less than 0.1 acre in area.

Between 2013 and 2015, the herbicide glyphosate was spot applied by hand sprayer and backpack sprayer on 7 acres at 3 sites in the project area, including two Forest Service administrative offices and one Forest Service recreation area. These treatments occurred under a Categorical Exclusion (CE) for these sites.

Environmental Consequences

Methodology

The effects of project alternatives on invasive plants were analyzed by qualitatively evaluating, based on relevant literature, the effectiveness of three categories of invasive plant treatments (manual, mechanical, and chemical) in controlling or eradicating infestations, as well as possible indirect effects to risk of invasive plant spread due to impacts on non-target vegetation.

Forest Service herbicide risk assessments were used to evaluate the effects of broadcast spray applications of the proposed herbicides on off-site terrestrial vegetation, which could affect the risk of invasive plant infestation at those sites. These risk assessments incorporate the GLEAMS root zone model to examine the movement of chemicals to water bodies in various types of soils under different meteorological and hydrogeological conditions (SERA 2010). Further information on GLEAMS is provided in the project record. The typical application rate in pounds acid equivalent per acre (lbs a.e./acre) for each proposed herbicide was compared with the No Observable Effects Concentrations (NOECs) for the more sensitive and more tolerant terrestrial plants evaluated in the referenced risk assessments.

Cumulative effects to invasive plants are caused by the addition of the effects from this proposed action to all the other effects resulting from actions that have taken place in the past, present and reasonably foreseeable future in the project area, including management actions such as cabin and trail maintenance, timber harvest and road building. For this project, reasonably foreseeable actions are those that are expected to occur within the next five years. A Catalog of Events that lists all activities considered for cumulative effects is included in the project record. Based on available documentation regarding the projects, these activities were categorized for their effects on invasive plant risk, and the effects of this project, when combined with the effects these activities, on overall invasive plant infestation risk in the project area was evaluated.

Based on the currently known invasive plant infestations in the project area, the current maximum acreage of treatments in the project area would be 1,412 acres. This total acreage could increase or decrease over time as new infestations are found and treated infestations are reduced in area or eradicated. In reality, the total acreage that will actually be treated is likely to be far less than the maximum, due to the fact that not all infestations in all locations are priorities for management, many infestations are in remote areas with difficult access, and the limitations of funding and personnel are likely to constrain treatment activities. The average annual infestation acreage treated across the project area over last five years (2012-2016) is 14.7 acres, or one percent of the total acreage of currently known infestations. It is expected that annual treatment acreages will remain a substantially small proportion of the total infestation acreage under all project alternatives. Annual treatment estimates used for economic analysis for this project are 13, 88, and 25 acres for Alternatives 1, 2, and 3, respectively, and each year’s treatment is expected to be 80% effective where herbicides are in the range of available methods (Alternative 2), and 25% effective if herbicide use is restricted as in Alternatives 1 and 3 (Krosse 2017b). Each year’s treatment is expected to be 80% effective where herbicides are in the range of available methods (Alternative 2), and 25% effective if herbicide use is restricted as in Alternatives 1 and 3. (Krosse 2017b).

Effects Common to All Alternatives

Manual, mechanical, and chemical treatments are likely to directly kill or severely damage the targeted invasive plants. The time for direct effects of herbicide application to become visibly apparent could be delayed, depending on the plant species being treated, the physiological pathway of the herbicide used, the application rate, and weather conditions at the time of application. The effects of these treatment methods are considered to be beneficial because the management objective of this project is to contain, control or eradicate infestations of invasive plant species.

Indirect effects from manual or mechanical methods could include disruption or erosion of soils in or adjacent to a treated infestation, which may provide favorable conditions for further spread of the infestation or the establishment of new invasive species.

Indirect effects of herbicide application include off-site movement of chemicals via spray drift, surface water runoff, or soil percolation, which could damage or kill non-target vegetation and provide favorable conditions for the spread of the infestation or establishment of new invasive species. The potential movement of spray drift would depend upon the size of the spray droplet of the mixture and weather conditions at the time of application, particularly wind speed and direction. The risk of drift with broadcast spraying under similar weather conditions is higher compare to spot application because of the larger spray volumes used with broadcast spraying and its lower accuracy of application to targeted invasive plants. The indirect effects due to soil percolation depend upon the soil type where the treatment occurs, as each soil type has different properties of absorption and molecular transfer. Most of the soils in site types that are likely to be treated contain moderately to highly permeable gravels, organic soils, or mineral soils. Impermeable clay soils are unlikely to occur in the site types that are likely to be treated; therefore, herbicides will not likely flow downslope over long distances due to surface water runoff. Herbicide percolation rates and dispersal attributes also depends upon the type of herbicide used and the weather conditions during the herbicide application.

Comparison of Alternatives

Alternative 1 (No Action)

Under the No Action alternative, invasive plant infestations would continue to be treated by manual and mechanical methods under an integrated pest management approach, as provided in the Forest Plan standards and guidelines for invasive species. Treatment of infestations by chemical methods would occur only in specific areas that qualify for treatment with herbicides under criteria for Categorical Exclusions (CEs), such as administrative sites and recreation sites.

Manual, mechanical, and chemical treatments would likely have beneficial direct effects with regard to management objectives to contain, control, or eradicate targeted invasive plant infestations. Indirect adverse impacts due to on-site ground disturbance or off-site spray drift, surface runoff, or soil percolation of herbicides on natural vegetation and subsequent spread of invasive plants into these area is possible, but the likelihood is low because invasive plant management best practices that are designed to prevent the spread of invasive plants would be implemented (Krosse 2017),as well as implementation of soil and water BMPs (designed to prevent adverse disturbance levels) and project design feature (PDFs) outlined in this EA.

Herbicides would not be used to treat infestations outside areas that do not qualify for pesticide treatment under a CE. Some species that cannot be effectively controlled by manual or mechanical treatments could potentially spread on the landscape or establish new infestations in these areas. The rate of spread and establishment is uncertain and would likely vary according to species, site conditions, and presence of transportation vectors. These infestations could compete with the natural vegetation for resources and make them more vulnerable to loss. However, invasive plants generally spread only in habitats that have been substantially disturbed, although a few species such as garlic mustard, orange hawkweed and bishop’s goutweed are able to persist under the shade of natural vegetation. Therefore, the consequence of impacts is expected to be low. Because of these factors, the overall effect of this alternative on invasive plant risk is expected to be beneficial to minor.

Alternative 2 (Proposed Action)

Under this alternative, invasive plant infestations throughout the project area would be treated according an integrated pest management approach as provided in the Forest Plan standards and guidelines for invasive species (USDA 2016) and Forest Service policy (FSM 2900), using manual, mechanical, and chemical methods. The inclusion of herbicides as a treatment option for all sites could increase the effectiveness of control of large infestations, especially those of species such as Japanese knotweed that generally cannot be controlled by manual or mechanical treatments. Even with herbicides included as an option in the management program, some infestations could continue to spread, either due to lack of effectiveness of an herbicide application or the inability to treat all spreading infestations with available resources. Some spreading infestations could potentially encroach on natural vegetation. However, invasive plants generally are most competitive in habitats that have been substantially disturbed rather than intact natural vegetation.

Herbicides are designed to be toxic to vegetation, so they are likely to kill or damage targeted invasive plants, which would be considered a beneficial effect from a management perspective of achieving the desired condition. In some situations, herbicide application may be the only practical management alternative for control or eradication of an invasive plant infestation.

Hand application (wicking/wiping or stem injection) of herbicides is unlikely to result in movement of herbicides beyond the individual plants being treated, due to the precise application methods and small amounts of herbicides used. Risks to non-target vegetation are possible from herbicide spray application. These are identified in Forest Service risk assessments, which evaluate the effects of these chemicals on more sensitive and more tolerant terrestrial plants. Five exposure scenarios were considered: direct spray, spray drift, runoff, wind erosion, and the percolation of contaminated water through soil. All of these exposure scenarios are situationally variable because the levels of exposure are highly dependent on site-specific conditions. Thus, this information is intended to represent plausible conditions that could occur, but it may over- or under-estimate actual exposures in actual field conditions.

The four herbicides proposed for use in the project (Aminopyralid, Glyphosate, Imazapyr and Metasulfuron Methyl) have varying effects on terrestrial plants. The proposed herbicides were evaluated based on their toxicity and risk of both direct (direct herbicide exposure) and indirect effects (spray drift, surface run off, wind erosion, and soil percolation) to terrestrial plants, including non-target sensitive and rare plants. Data are available for deriving toxicity values for most sensitive and most tolerant species for foliar exposures in their respective Forest Service risk assessments referenced below. All of these exposure scenarios are dominated by situational variability because the levels of exposure are highly dependent on site-specific conditions. Thus, this information is intended to represent conservative but plausible conditions that could occur but may be over- or under-estimating actual exposures in some cases.

Aminopyralid: This herbicide is designed to control broadleaved plants and annual grasses. Perennial grasses are more tolerant to its effects. Consequently aminopyralid applications would mainly target broadleaved invasive plants. The chemicals in this herbicide mimic growth hormones and cause uncontrolled growth in plants. At sufficiently high levels of exposure, the abnormal growth is so severe that vital functions cannot be maintained and the plant dies.

Potential sources of effects to non-target terrestrial plants from application are summarized below. These risks are discussed in more detail in the referenced Risk Assessment for this chemical (Durkin 2007).

1. Direct Spray: Unintended direct spray will result in an exposure level equivalent to the application rate. For many types of herbicide applications, it is plausible that some non-target rare plants immediately adjacent to the application site could be sprayed directly. The direct spray of non-target rare plants is less likely in spot spraying applications using a backpack sprayer than in broadcast spray application methods. For spot spray applications, this scenario should be regarded as an extreme/accidental form of exposure that is not likely to occur in most applications.

2. Herbicide drift: Drift appears to present the highest potential risk to non-target rare plants. For ground based applications at the typical application rate, the hazard for drift generally does not exceed the NOEC at distances beyond 25 feet from the application site for sensitive species, and zero feet for tolerant species (Tables 1 and 2). Spot treatments using a backpack sprayer would likely cause little if any damage due to drift, especially if applied on calm days.

3. Runoff: Adverse effects on sensitive non-target rare plant species associated with runoff appear to be a concern only in areas with high runoff potential, such as clayey soils. Because soils in the project area are predominantly organic, loamy and sandy, the runoff potential is low. Modeling of the hazard level does not exceed the NOEC for both sensitive and tolerant species under annual rainfall amounts up to 250 inches (Tables 1 and 2).

4. Wind Erosion: The hazard associated with erosion of contaminated soil by wind is substantially below the level of concern for both sensitive and tolerant species (Tables 1 and 2). Wind erosion only occurs when bare mineral soils are exposed during high velocity wind events. Since most soils in the project area are overlain by thick organic surface layers, wind erosion potential is extremely low.

5. Percolation: Studies show that aminopyralid can percolate to greater than 60 inches below the surface. This is well below the root zone for all non-target rare plants as well as most other plants in the project area (Durkin 2007). Percolation depth also depends upon the soils present and precipitation during application.

Glyphosate: A broad-spectrum, non-selective, post-emergence systemic herbicide that is effective on both broadleaf plants and grasses by inhibiting or causing cessation of growth, cellular disruption, and, at sufficiently high levels of exposure, plant death. The time required for these effects to become evident can vary, depending on the plant species, growth rate, climate, and application rate. Glyphosate is generally more effective when directly applied to the foliage of growing plants.

Potential sources of effects to non-target terrestrial plants from application are summarized below. These risks are discussed in more detail in the referenced Risk Assessment for this chemical (Durkin 2011).

1. Direct Spray: Glyphosate appears to be more toxic to vegetative vigor given direct application to the foliage of growing plants. Visual injury occurs in plants at an application rate of about 0.03 lb a.e./acre. Exposures substantially above 0.7 lbs/acre may have long term impacts on bryophyte and lichen communities. Unintended direct spray should be regarded as an extreme/accidental form of exposure that is not likely to occur in most Forest Service applications.

2. Herbicide drift: For relatively tolerant plant species, there is no indication that glyphosate is likely to result in damage at distances as close as 25 feet from the application site. For sensitive species at the upper range of application rates, there is a risk of damage to offsite vegetation at distances of up to 100 feet for sensitive species and 25 feet for tolerant species (Tables 1 and 2). Many applications of glyphosate are conducted by spot spray applications using backpacks. In such cases, little if any damage due to drift would be anticipated.

3. Runoff: Non-target terrestrial plants are not likely to be affected by runoff of glyphosate under most conditions. (Newmaster et al. 1999). Because glyphosate is strongly

adsorbed into soil, relatively little if any absorption occurs through the roots. Additionally, microbial degradation in soils occurs very quickly with this herbicide.

4. Wind Erosion: The off-site hazard associated with wind erosion of glyphosate-contaminated soil is substantially below the level of concern for both sensitive and tolerant species (Tables 1 and 2).

5. Percolation: Percolation represents the amount of the herbicide that is transported below the root zone and should not affect off-site vegetation. Based on GLEAMS modeling, the maximum penetration of glyphosate into clay or loam soils is estimated to be 4 to 12 inches, with the depth of penetration increasing as rainfall rates increase. In predominantly sand soils, glyphosate may penetrate to a depth of about 8-18 inches, depending on rainfall rates.

Imazapyr: An effective herbicide that controls a variety of grasses, broadleaf weeds, vines, and brush species. Post-emergence application is more effective than pre-emergence application and time to completely kill may require several weeks (Peoples 1984). After foliar application, imazapyr is transported via the phloem and thus is able to control deeply rooted weeds. Under some conditions, terrestrial applications of imazapyr could damage non-target terrestrial or aquatic vegetation. Imazapyr may also be used to control aquatic macrophytes. Effective aquatic applications of imazapyr is likely to damage non-target aquatic macrophytes and may damage some species of algae.

Potential sources of effects to non-target terrestrial plants from application are summarized below. These risks are discussed in more detail in the referenced Risk Assessment for this chemical (Durkin 2004).

1. Direct Spray: Imazapyr is an effective herbicide and even plants that may be tolerant that are directly sprayed with imazapyr at normal application rates are likely to be damaged.

2. Off-Site Drift: Off-site drift of imazapyr may cause damage to more sensitive plant species at distances of up to about 900 feet from broadcast application sites (Table 1). However, the design feature that prohibits broadcast spray application of Imazapyr will reduce or eliminate the risk of non-target plant damage due to off-site drift. Spot applications by backpack sprayer are likely to have substantially lower hazard levels due to the targeted application to individual plants and lower spray volumes.

3. Runoff: Some herbicides may be absorbed by plant foliage, translocated to the roots of plants, and subsequently exuded from the roots to the surrounding soil, posing a risk to neighboring plants. This process, referred to as allelopathy has been demonstrated in some herbicides. Studies suggest that imazapyr has the potential to induce allelopathic effects. Nonetheless, given the relatively rapid movement of imazapyr in soil, the potential for allelopathic effects may not have a practical or substantial impact on potential risk to non-target rare plants. Off-site runoff exposure is more plausible if there is substantial rainfall immediately after a treatment and the soil type is a

dominated by clay, where run off would be more rapid. However, clay soils are rarely found in the project area.

4. Wind erosion: Off-site movement of Imazapyr due to wind erosion is likely to be highly site-specific. The amount of imazapyr that might be transported by wind erosion depends on several factors, including application rate, depth of incorporation into the soil, persistence in the soil, wind speed, and topographical and surface conditions of the soil. The upper limit of modeled wind erosion concentrations do not exceed the NOEC concentration for sensitive or tolerant species (Tables 1 and 2). Under desirable conditions—e.g., relatively deep (10 cm) soil incorporation, low wind speed, and surface conditions which inhibit wind erosion—it is unlikely that a substantial amount of imazapyr would be transported by wind.

5. Soil Percolation: The soils within the site types where weed treatments would occur contain low levels of clay and are typically loamy, sandy and/or gravelly. Many sites contain primarily organic soils. Soil percolation is dependent on soil texture (coarser textures percolate more quickly) and subsurface restrictive layers, such as bedrock or glacial till. In most cases, the root zone of herbaceous plants is shallower than the restrictive layers. Depending on the application rate of the herbicide, any percolated herbicide penetrates to well below the root zone and no indirect effects should occur on sensitive or rare plant species.

Metasulfuron Methyl: A selective pre-emergence and post-emergence sulfonyl urea herbicide used primarily to control many annual and perennial weeds and woody plants. This herbicide is effective on broadleaf weeds and some annual grasses. It is a systemic compound that inhibits cell division in the shoots and roots of the plant, and it is biologically active at low use rates.

Potential sources of effects to non-target terrestrial plants from application are summarized below. These risks are discussed in more detail in the referenced Risk Assessment for this chemical (Klotzbach and Durkin 2004).

6. Direct Spray: Unintended direct spray will result in an exposure level equivalent to the application rate. For many types of herbicide applications – e.g., rights-of-way management – it is plausible that some non-target plants immediately adjacent to the application site could be sprayed directly.
7. Off-Site Drift: In ground broadcast applications, metasulfuron methyl is typically applied by low boom spray and thus these estimates are used in the formal risk assessment. Drift associated with spot spray applications by backpack are likely to be much less, although studies quantitatively assessing drift after backpack applications have not been encountered. In typical backpack sprays, the distance from the spray nozzle to the ground is 3 feet or less, and droplets could drift as far as 23 feet with a windspeed of 5 miles/hour, and as far as 68 feet at 15 miles/hour. Smaller droplets will drift further, and the proportion of these particles in the spray as well as the wind speed and turbulence will affect the proportion of the applied herbicide that drifts off-site. Modeling results in the formal risk assessment indicate the maximum drift distance in which effects on offsite terrestrial vegetation are observable is 100 feet for sensitive species and 25 feet for tolerant species (Tables 1 and 2).

8. Runoff: Metasulfuron methyl or any other herbicide may be transported to off-site soil by runoff. Modeling results in the formal risk assessment for this chemical indicate that the proportion of the applied metasulfuron methyl lost by runoff indicate that runoff will be negligible in relatively wet environments on sandy or loam soils (Tables 1 and 2). In clay soils, which have the highest runoff potential, off-site concentrations in high rainfall environments may be above the NOEC for both sensitive and tolerant species. However the vast majority of soils in the project area are either loam, sand, or organic dominated.
9. Wind Erosion: Soil may be eroded or blown offsite by wind. Although no specific incidents of non-target plant damage from wind erosion have been encountered in the literature for metasulfuron methyl, this mechanism has been associated with the environmental transport of other herbicides, although the quantitative aspects of soil erosion by wind are extremely complex and site specific. Field studies conducted on agricultural sites found that wind erosion may account for annual soil losses ranging from 2 to 6.5 metric tons/ha (Allen and Fryrear 1977). The amount of metasulfuron methyl that might be transported by wind erosion depends on several factors, including the application, the depth of incorporation into the soil, the persistence in the soil, the wind speed, and the topographical and surface conditions of the soil. Under desirable conditions, like relatively deep (10 cm) soil incorporation, low wind speed, and surface conditions that inhibit wind erosion, it is likely that wind transport of metasulfuron methyl would not cause observable effects on off-site plants (Tables 1 and 2).
10. Soil Percolation: Concentrations of metasulfuron methyl vary across clay, loam, and sandy soils, and over a wide range of rainfall rates. Peak soil concentrations in the range of about 6 ppm are likely in relatively arid soils at an application rate of 1 lb a.e./acre. As rainfall rate increases, maximum soil concentrations are substantially reduced in sand and, to a lesser extent, in loam because of losses from soil through percolation.

Table 1. Risk assessment summary based on predicted off-site hazard quotients[1] of directed foliar (broadcast-spray) application of herbicides on sensitive terrestrial plant species after ground-based broadcast application.

Herbicide	Application rate, lb/acre	Maximum drift distance (ft) with hazard quotient > 1	Maximum annual rainfall (in) on loam soils with runoff hazard quotient ≤ 1	Wind erosion upper hazard quotient
Aminopyralid	0.078	50	250	5E-02
Glyphosate	2.0	500	N/A[2]	0.2
Imazapyr	0.45	> 900	N/A[2]	1.0
Metasulfuron methyl	0.03	300	250	0.1

[1] Hazard quotients are measures of toxicity derived from the functional off-site application rate divided by the NOEC for plant species. Hazard quotients greater than 1 indicate an observable toxic effect is possible.

[2] Risk assessment worksheets for these herbicides provide a single hazard quotient for runoff instead of by soil type and annual rainfall.

Table 2. Risk assessment summary based on predicted off-site hazard quotients[1] of directed foliar (broadcast-spray) application of herbicides on tolerant terrestrial plant species after ground-based broadcast application.

Herbicide	Application rate, lb/acre	Maximum drift distance (ft) with hazard quotient > 1	Maximum annual rainfall (in) on loam soils with runoff hazard quotient ≤ 1	Wind erosion upper hazard quotient
Aminopyralid	0.078	0	250	1E-04
Glyphosate	2.0	25	N/A[2]	6E-04
Imazapyr	0.45	25	N/A[2]	2E-04
Metasulfuron methyl	0.03	25	250	1E-03

[1] Hazard quotients are measures of toxicity derived from the functional off-site application rate divided by the NOEC for plant species. Hazard quotients greater than 1 indicate an observable toxic effect is possible.

[2] Risk assessment worksheets for these herbicides provide a single hazard quotient for runoff instead of by soil type and annual rainfall.

Summary of Effects

Manual, mechanical, and chemical treatments would likely have beneficial direct effects with regard to management objectives to contain, control, or eradicate targeted invasive plant infestations. Indirect adverse impacts due on-site ground disturbance to spray drift, surface runoff, or soil percolation of herbicides on off-site vegetation and subsequent spread of invasive plants into these area are possible, but the likelihood is low because of the project features that are designed to minimize ground disturbance during manual or mechanical treatments and off-site movement of herbicides during chemical treatments, and because invasive plant management best practices that are designed to prevent the spread of invasive plants would be implemented (Krosse 2017a). Because of these factors, the overall effect of this alternative on invasive plant risk is expected to be negligible to beneficial.

Alternative 3

Under this alternative, invasive plant infestations would continue to be treated by manual and mechanical methods under an integrated pest management approach, as provided in the Forest Plan standards and guidelines for invasive species. No infestations in any location would be treated with herbicides.

Manual and mechanical treatments would likely have beneficial effects with regard to management objectives to contain, control, or eradicate targeted invasive plant infestations. Indirect adverse impacts due to on-site ground disturbance and subsequent spread of invasive plants into disturbed areas are possible, but the likelihood is low because of project features that are designed to minimize ground disturbance, and invasive plant management best practices that are designed to prevent the spread of invasive plants would be implemented (Krosse 2017a).

Some species that cannot be effectively controlled by manual or mechanical treatments could potentially spread on the landscape or establish new infestations. The rate of spread and establishment is uncertain and would likely vary according to species, site conditions, and presence of transportation vectors. These infestations could compete with natural vegetation for resources. However, invasive plants generally spread only in habitats that have been substantially disturbed, although a few species such as garlic mustard, orange hawkweed and bishop's goutweed are able to persist under the shade of natural vegetation. Therefore, the consequence of adverse impacts is expected to be low. Because of these factors, the overall effect of this alternative on invasive plant risk is expected to be negligible to beneficial.

Cumulative Effects

Past, present, or reasonably foreseeable future activities are documented in the project Catalog of Events, which is included in the project record. Most of these activities are expected to have negligible to minor effects on invasive plant risk in the project area (Table 3). For example, activities such as transportation improvements or hydropower projects may create ground disturbance and modify natural vegetation, but they are not expected to substantially affect the overall infestation risk in the project area. Timber sales may also have minor effects because of the risk of invasive plant introductions to disturbed areas through contaminated logging operations (e.g. equipment). Because almost all of these past, present, or reasonably foreseeable activities are expected to have negligible to minor effects on soils and natural vegetation in the project area, and because of the potential beneficial effects of this project on the control or eradication of infestations, the overall effects of this project under all alternatives, when combined with cumulative effects of these activities, is expected to be negligible.

Table 5. Summary of expected effects of past, present, and reasonably foreseeable future actions on invasive plant infestation risk in the project area, based on the project Catalog of Events.

Project type	Number of actions	Number of actions by level of effect[1]			
		Negligible	Minor	Moderate	Major
Hydropower	8	2	6	0	0

Land Exchange	2	5	0	0	0
Minerals	35	0	35	0	0
Recreation	23	7	14	2	0
Special Uses	40	34	6	0	0
Timber	23	0	23	0	0
Transportation	15	1	14	0	0
Wildlife/Fisheries	17	10	7	0	0
Total	166	59	105	2	0

[1] **Negligible** effects may or may not cause observable changes to natural conditions; regardless, they do not reduce the integrity of a resource.

Minor effects cause observable and short-term changes to natural conditions, but they do not reduce the integrity of a resource.

Moderate effects cause observable and short-term changes to natural conditions, and/or they reduce the integrity of a resource.

Major effects cause observable and long-term changes to natural conditions, and they reduce the integrity of a resource.

Summary of Effects

All alternatives for this project could have minor effects on non-target vegetation, which in some circumstances could provide opportunities for introduction and spread of invasive plants. However, project design features will greatly reduce or eliminate this risk. In addition, any effects to non-target vegetation should be offset by the beneficial effects from all project alternatives due to the control and eradication of invasive plant infestations in the project area which could pose potential threats to natural habitats. Therefore, the overall effects to invasive plant infestation risk under all project alternatives is expected to be negligible to beneficial.

Monitoring Recommendations

A critical component to effectively treating weed infestations is monitoring. There are two types of monitoring that will be addressed: 1) implementation monitoring and 2) effectiveness monitoring. The overall strategy for monitoring treatments in the project area is to implement and monitor where feasible and affordable; no action will be taken where infeasible and too expensive.

Implementation Monitoring

At a minimum, implementation of any treatment plan will include annual accomplishment reporting. Accomplishment reporting is done through the Forest Service Activity Tracking

System (FACTS). A requirement of accomplishment reporting is to delineate the infestation acres and treatment area, entering that information into the NRIS-IS database. In addition, treatment acres, treatment methods, including specific chemical brands used (for herbicide applications) are documented. Cost of treatments is also documented and will be monitored throughout this project. An efficacy rating is also entered into the database for treated infestations.

Effectiveness Monitoring

Approximately 50% of the acres treated annually will be monitored for efficacy (effectiveness of the treatment), as a requirement of Forest Service accomplishment reporting. Treated sites will be evaluated as to the relative amount of the target species killed, ranging from no effect (0% mortality) to completely effective (100% mortality).

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Appendix A – List of Known Non-Native Plants in the Project Area

Scientific Name	Common Name	Plant Code	Number of Infestations	Acres	Invasiveness Rank
Achillea millefolium var. *millefolium*	common yarrow	ACMIM2	62	0.79	NR
Achillea ptarmica	sneezeweed	ACPT	1	0.18	46
Aegopodium podagraria	bishop's goutweed	AEPO	1	0.07	57
Agrostis capillaris	colonial bentgrass	AGCA5	1	0.01	NR
Agrostis gigantea	redtop	AGGI2	1	0.01	NR
Agrostis stolonifera	creeping bentgrass	AGST2	27	1.49	NR
Alchemilla mollis	lady's-mantle	ALMO12	6	0.19	56
Alchemilla vulgaris	hairy lady's mantle	ALVU2	1	0.25	NR
Alliaria petiolata	garlic mustard	ALPE4	12	7.47	70
Alopecurus geniculatus	water foxtail	ALGE2	1	0.00	49
Alopecurus pratensis	meadow foxtail	ALPR3	20	0.18	52
Anthemis cotula	stinking chamomile	ANCO2	2	4.77	41
Anthoxanthum odoratum	sweet vernalgrass	ANOD	4	0.12	NR
Arrhenatherum elatius	tall oatgrass	AREL3	3	0.29	NR
Atriplex patula	spear saltbush	ATPA4	2	0.12	NR
Avena fatua	wild oat	AVFA	1	0.05	NR
Brassica rapa	field mustard	BRRA	84	34.92	50
Brassica rapa var. *rapa*	field mustard	BRRAR	3	4.33	50
Calystegia sepium ssp. *sepium*	hedge false bindweed	CASES	1	0.00	NR
Campanula rapunculoides	rampion bellflower	CARA	4	0.01	64
Capsella bursa-pastoris	shepherd's purse	CABU2	15	4.49	40
Centaurea montana	perennial cornflower	CEMO	5	0.45	46
Cerastium fontanum	common mouse-ear chickweed	CEFO2	45	94.37	36
Cerastium fontanum ssp. *vulgare*	big chickweed	CEFOV2	501	18.17	36
Cerastium glomeratum	sticky chickweed	CEGL2	3	0.80	36
Cerastium tomentosum	snow in summer	CETO2	3	0.11	NR
Chenopodium album	lambsquarters	CHAL7	3	1.85	37
Chenopodium album var. *album*	lambsquarters	CHALA	5	0.45	37
Cirsium acanthodontum	fewleaf thistle	CIAC	1	0.11	NR
Cirsium arvense	Canada thistle	CIAR4	10	1.18	76
Cirsium arvense var. *argenteum*	Canada thistle	CIARA3	1	0.01	76
Cirsium vulgare	bull thistle	CIVU	1	0.03	61

Scientific Name	Common Name	Plant Code	Number of Infestations	Acres	Invasiveness Rank
Conyza canadensis	Canadian horseweed	COCA5	1	0.53	NR
Crepis capillaris	smooth hawksbeard	CRCA3	1	4.76	NR
Crepis tectorum	narrowleaf hawksbeard	CRTE3	7	7.95	56
Cytisus scoparius	Scotch broom	CYSC4	3	0.20	69
Dactylis glomerata	orchardgrass	DAGL	116	6.28	53
Daphne mezereum	paradise plant	DAME3	1	0.07	NR
Daucus carota	Queen Anne's lace	DACA6	1	0.02	NR
Deschampsia elongata	slender hairgrass	DEEL	36	0.44	35
Digitalis purpurea	purple foxglove	DIPU	65	2.93	51
Elymus repens	quackgrass	ELRE4	13	0.07	59
Elymus sibiricus	Siberian wildrye	ELSI	5	0.03	53
Erysimum cheiranthoides	wormseed wallflower	ERCH9	2	0.82	NR
Euphorbia esula	leafy spurge	EUES	1	0.01	84
Fallopia convolvulus	black bindweed	FACO	4	0.16	50
Fallopia japonica	Japanese knotweed	FAJA2	2	2.35	87
Fragaria ananassa	garden strawberry	FRAN	13	0.29	NR
Galeopsis bifida	splitlip hempnettle	GABI3	4	1.41	50
Galeopsis tetrahit	brittlestem hempnettle	GATE2	72	15.14	50
Geranium robertianum	Robert geranium	GERO	8	0.26	67
Gnaphalium palustre	western marsh cudweed	GNPA	4	0.01	NR
Hesperis matronalis	dames rocket	HEMA3	6	0.02	41
Hieracium aurantiacum	orange hawkweed	HIAU	29	0.95	79
Hieracium caespitosum	meadow hawkweed	HICA10	7	7.00	79
Hieracium umbellatum	narrowleaf hawkweed	HIUM	11	0.42	51
Holcus lanatus	common velvetgrass	HOLA	6	0.54	56
Holcus mollis	creeping velvetgrass	HOMO	1	0.00	NR
Hordeum jubatum	foxtail barley	HOJU	13	2.31	63
Hordeum jubatum ssp. *jubatum*	foxtail barley	HOJUJ	4	1.45	63
Hypericum perforatum	common St. Johnswort	HYPE	8	0.31	52
Hypochaeris radicata	hairy cat's ear	HYRA3	10	0.82	44
Impatiens glandulifera	ornamental jewelweed	IMGL	2	0.01	82
Iris pseudacorus	paleyellow iris	IRPS	1	0.00	66
Lapsana communis	common nipplewort	LACO3	14	0.12	33
Leontodon autumnalis	fall dandelion	LEAU2	5	0.98	51
Leucanthemum maximum	max chrysanthemum	LEMA8	1	0.00	NR

Scientific Name	Common Name	Plant Code	Number of Infestations	Acres	Invasiveness Rank
Leucanthemum vulgare	oxeye daisy	LEVU	166	27.21	61
Linaria vulgaris	butter and eggs	LIVU2	11	2.88	69
Lolium arundinaceum	tall fescue	LOAR10	337	13.30	63
Lolium perenne	perennial ryegrass	LOPE	2	0.45	52
Lolium perenne ssp. *multiflorum*	Italian ryegrass	LOPEM2	46	1.35	52
Lolium perenne ssp. *perenne*	perennial ryegrass	LOPEP	7	0.08	52
Lolium pratense	meadow fescue	LOPR7	9	3.73	NR
Lupinus polyphyllus	bigleaf lupine	LUPO2	9	4.71	71
Lupinus polyphyllus ssp. *polyphyllus* var. *polyphyllus*	bigleaf lupine	LUPOP4	111	165.35	71
Lysimachia nummularia	creeping jenny	LYNU	1	0.00	NR
Matricaria discoidea	disc mayweed	MADI6	145	8.38	32
Matricaria recutita	German chamomile	MARE6	1	0.00	NR
Medicago lupulina	black medick	MELU	6	0.40	48
Melilotus alba	sweetclover	MEAL12	6	0.35	69
Melilotus officinalis	sweetclover	MEOF	2	0.18	69
Mentha spicata	spearmint	MESP3	1	0.06	43
Myosotis scorpioides	true forget-me-not	MYSC	71	1.71	54
Myosotis sylvatica	woodland forget-me-not	MYSY	3	0.01	NR
Myrrhis odorata	anise	MYOD	2	0.02	NR
Phalaris arundinacea	reed canarygrass	PHAR3	936	104.81	83
Phleum pratense	timothy	PHPR3	270	14.91	54
Plantago lanceolata	narrowleaf plantain	PLLA	1	0.01	NR
Plantago major	common plantain	PLMA2	751	84.69	44
Poa annua	annual bluegrass	POAN	593	33.20	46
Poa compressa	Canada bluegrass	POCO	10	0.64	39
Poa pratensis	Kentucky bluegrass	POPR	227	11.28	52
Poa pratensis ssp. *pratensis*	Kentucky bluegrass	POPRP2	1	1.30	52
Poa trivialis	rough bluegrass	POTR2	2	1.40	52
Polygonum aviculare	prostrate knotweed	POAV	6	0.73	45
Polygonum bohemicum	Bohemian knotweed	POBO10	15	0.23	87
Polygonum convolvulus	black bindweed	POCO10	6	8.16	50
Polygonum cuspidatum	Japanese knotweed	POCU6	182	27.13	87
Prunus avium	sweet cherry	PRAV	2	0.27	NR
Ranunculus acris	tall buttercup	RAAC3	81	1.87	54
Ranunculus repens	creeping buttercup	RARE3	473	41.54	54
Rheum rhabarbarum	garden rhubarb	RHRH2	3	0.53	NR

Scientific Name	Common Name	Plant Code	Number of Infestations	Acres	Invasiveness Rank
Rosa rugosa	rugosa rose	RORU	9	0.22	72
Rubus discolor	Himalayan blackberry	RUDI2	1	0.00	77
Rumex acetosella	common sheep sorrel	RUAC3	60	17.53	51
Rumex crispus	curly dock	RUCR	33	2.09	48
Rumex longifolius	dooryard dock	RULO2	1	0.26	48
Rumex obtusifolius	bitter dock	RUOB	44	0.68	48
Sagina procumbens	birdeye pearlwort	SAPR	51	0.98	39
Schedonorus arundinaceus	tall fescue	SCAR7	4	0.69	63
Schedonorus phoenix	tall fescue	SCPH	1	0.01	NR
Senecio jacobaea	stinking willie	SEJA	4	0.64	63
Senecio viscosus	sticky ragwort	SEVI2	1	0.07	NR
Senecio vulgaris	old-man-in-the-Spring	SEVU	46	2.26	36
Silybum marianum	blessed milkthistle	SIMA3	1	0.02	NR
Sonchus arvensis	field sowthistle	SOAR2	45	15.44	73
Sonchus asper	spiny sowthistle	SOAS	1	0.02	46
Sonchus oleraceus	common sowthistle	SOOL	1	0.01	46
Sorbus aucuparia	European mountain ash	SOAU	93	6.58	59
Spergula arvensis	corn spurry	SPAR	5	0.01	32
Spergularia rubra	red sandspurry	SPRU	4	0.03	34
Stellaria media	common chickweed	STME2	84	11.89	42
Symphytum asperum	prickly comfrey	SYAS	1	0.05	NR
Symphytum officinale	common comfrey	SYOF	4	0.06	48
Tanacetum boreale	common tansy	TABO4	5	0.08	60
Tanacetum vulgare	common tansy	TAVU	32	10.12	60
Taraxacum officinale	common dandelion	TAOF	744	478.43	58
Taraxacum officinale ssp. *officinale*	common dandelion	TAOFO	64	5.62	58
Tragopogon dubius	yellow salsify	TRDU	1	0.00	50
Trifolium	clover	TRIFO	1	0.01	NR
Trifolium dubium	suckling clover	TRDU2	1	0.96	50
Trifolium hybridum	alsike clover	TRHY	145	7.23	57
Trifolium pratense	red clover	TRPR2	102	6.02	53
Trifolium repens	white clover	TRRE3	720	57.53	59
Trifolium repens var. *atropurpureum*	white clover	TRREA	2	1.13	59
Tripleurospermum perforatum	scentless false mayweed	TRPE21	1	0.00	NR
Triticum aestivum	common wheat	TRAE	1	0.05	NR
Veronica chamaedrys	germander speedwell	VECH	1	1.30	NR

Scientific Name	Common Name	Plant Code	Number of Infestations	Acres	Invasiveness Rank
Veronica officinalis	common gypsyweed	VEOF2	1	0.40	NR
Veronica serpyllifolia	thymeleaf speedwell	VESE	1	0.05	NR
Veronica serpyllifolia ssp. *serpyllifolia*	thymeleaf speedwell	VESES	18	0.04	36
Veronicastrum serpyllifolium	thymeleaf speedwell	VESE3	2	0.00	36
Vicia cracca	bird vetch	VICR	1	0.02	73

Appendix B – Watch List of Potential Non-Native Plants in the Project Area

Scientific Name	Common Name	Plant Code	Invasiveness Rank
Acroptilon repens	hardheads	ACRE3	66
Alnus glutinosa	European alder	ALGL2	61
Arabis alpina	alpine rockcress	ARAL8	NR
Brachypodium sylvaticum	slender false brome	BRSY	70
Bromus inermis	smooth brome	BRIN2	62
Bromus tectorum	cheatgrass	BRTE	78
Caragana arborescens	Siberian peashrub	CAAR18	74
Carduus acanthoides	spiny plumeless thistle	CAAC	61
Carduus nutans	nodding plumeless thistle	CANU4	61
Carduus pycnocephalus	Italian plumeless thistle	CAPY2	61
Carduus tenuiflorus	winged plumeless thistle	CATE2	61
Centaurea stoebe	spotted knapweed	CEST8	86
Convallaria majalis	European lily of the valley	COMA7	NR
Elodea canadensis	Canadian waterweed	ELODE	79
Elodea nuttallii	western waterweed	ELODE	79
Fallopia sachalinensis	giant knotweed	FASA3	87
Hedera helix	English ivy	HEHE	73
Heracleum mantegazzianum	giant hogweed	HEMA17	81
Hieracium pilosella	mouseear hawkweed	HIPI	63
Hordeum murinum ssp. *leporinum*	leporinum barley	HOMUL	60
Hydrilla verticillata	waterthyme	HYVE3	80
Ilex aquifolium	English holly	ILAQ80	67
Lepidium latifolium	broadleaved pepperweed	LELA2	71
Lonicera tatarica	Tatarian honeysuckle	LOTA	66
Lotus corniculatus	bird's-foot trefoil	LOCO6	65
Lythrum salicaria	purple loosestrife	LYSA2	84
Lythrum virgatum	European wand loosestrife	LYVI3	84

Scientific Name	Common Name	Plant Code	Invasiveness Rank
Medicago sativa ssp. *falcata*	yellow alfalfa	MESAF	64
Myriophyllum spicatum	Eurasian watermilfoil	MYSP2	90
Nymphaea odorata ssp. *odorata*	American white waterlily	NYODO	80
Persicaria wallichii	Himalayan knotweed	PEWA18	80
Phragmites australis	common reed	PHAU7	83
Prunus padus	European bird cherry	PRPA5	74
Prunus virginiana	chokecherry	PRVI	74
Securigera varia	crown vetch	SEVA4	68
Spartina alterniflora	smooth cordgrass	SPAL	86
Spartina anglica	common cordgrass	SPAN5	86
Spartina densiflora	denseflower cordgrass	SPDE2	86
Spartina patens	saltmeadow cordgrass	SPPA	86
Nanzostera japonica	dwarf eelgrass	NAJA5	53
Potentilla recta	sulphur cinquefoil	PORE5	57