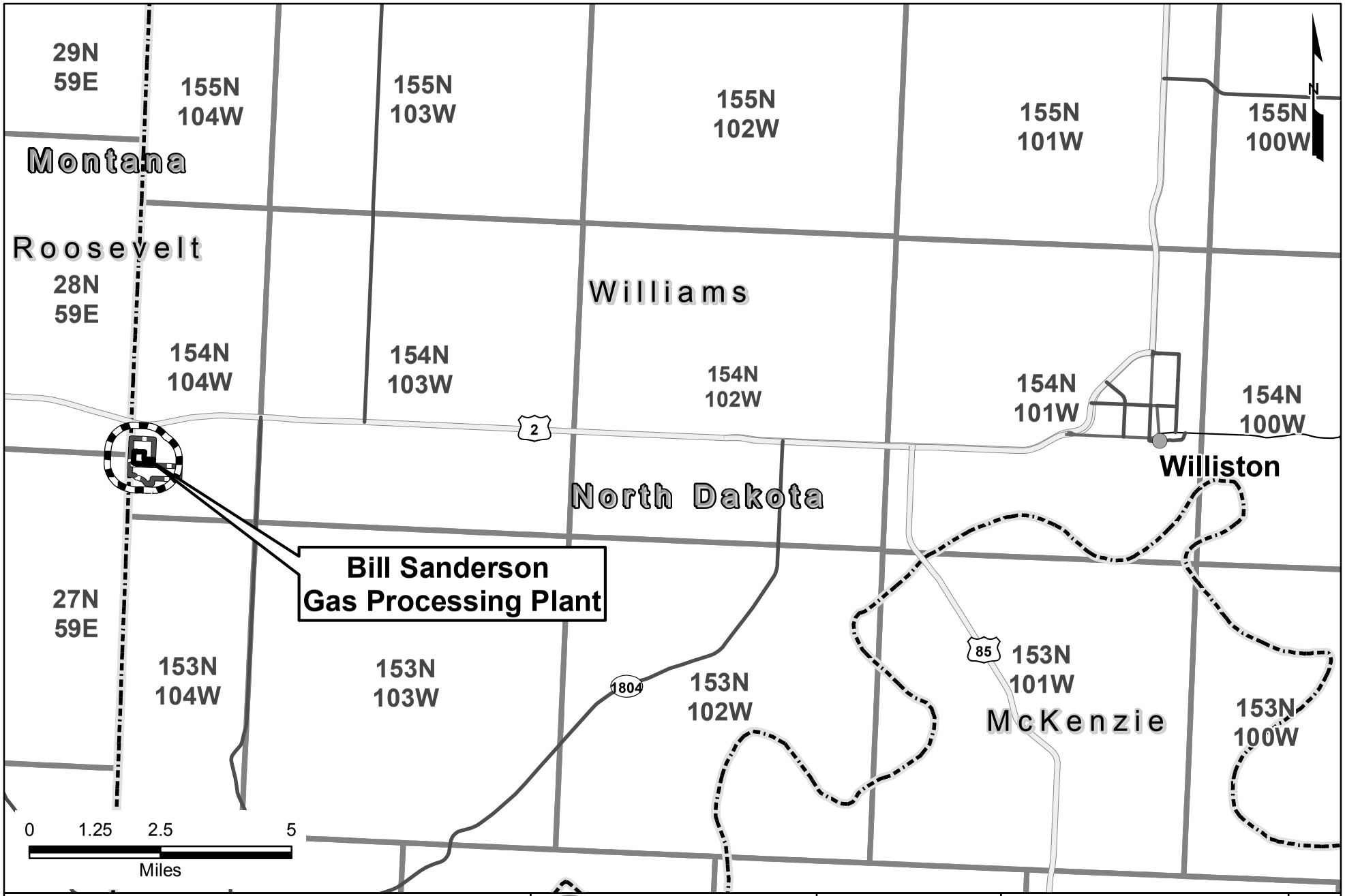
OE2 North LLC
Bill Sanderson Gas Plant PU-20-82
Response to ND PSC Staff's February 21, 2020 Information Request

Item	*Request for Information*	*Response*	*Attachment*
1	Revise Map for newspaper publication– zoom out and show the nearest town and roads	Revised the map included as an attachment to this response.	Yes
2	**The following Project control documents, and for those not complete, provide the status and completion date(s):**		
2a	Construction and Environmental Program Plan	Construction and environmental controls are included in the Project SWPPP and Spill Contingency Plan included as an attachment to this response. The SWPPP will be submitted by February 28, 2020.	Yes
2b	Erosion Control Plan	Erosion control details are included in the Project SWPPP. The SWPPP will be submitted by February 28, 2020.	No
2c	Revegetation Plan	Revegetation details are included in the Project SWPPP. The SWPPP will be submitted by February 28, 2020.	No
2d	Weed Management Plan	Weed Management Plan included as an attachment to this response.	Yes
2e	Dust Control Plan	Dust Control Plan included as an attachment to this response.	Yes
2f	Environmental Training Plan	Prior to commencing construction of the Project, OE2 North will conduct a comprehensive environmental training for all Project personnel and contractors who will be working in the field. OE2 North will conduct a Project-specific training presentation for Project personnel that covers all aspects of environmental expectations, regulations, and OE2 North policy. Topics covered will include General Guidelines & Contractor Expectations, Project Staff, Project Permits and Plans, Compliance and Mitigation Measures, Migratory Bird Treaty Act, Cultural Resources and Unanticipated Discoveries, Environmentally Sensitive Areas, and Public Relations. An open question and answer session will be provided to ensure contractors and all Project personnel have an understanding of Project-related environmental requirements and processes.	No
3	Additional information regarding the plant expansion. Reference to the press release for the project that talks about future expansion.	Outrigger has no definitive plans at this time to expand the Plant beyond what is included in the application.	No



LEGEND

- Study Area
- Facility Boundary
- Field Survey Boundary
- County Boundary
- Township/Range
- City/Town

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Bright People. Right Solutions.

OUTRIGGER ENERGY

PROJECT NO.	20203533
DRAWN:	02/27/2020
DRAWN BY:	A.Leonard
CHECKED BY:	N. Elzinga
FILE NAME:	PSC.mxd

Project Location Map

OE2 North, LLC
Bill Sanderson Gas Processing Plant Project
Sec. 27, T154N, R104W
Williams County, North Dakota

FIGURE
1

OE2 North LLC

Spill Contingency Plan

Contents

Introduction

Purpose and Scope

OE2 North LLC ("Outrigger") has prepared this Spill Contingency Plan in accordance with 40 CFR 112.7(d) to address the possibility of discharges of oil and other hazardous substances from Outrigger construction activities in Williams County North Dakota. The purpose of the plan is to define procedures for responding to discharges that may threaten navigable waters.

The plan outlines procedures to ensure the protection of the public, employees, contractors, and other first responders in the event of a discharge. Additionally, the response procedures outlined in the plan will minimize damage to the environment, natural resources, and equipment from a discharge of hazardous substances. The plan follows the content and organization of 40 CFR part 109 and describes the distribution of responsibilities and basic procedures for responding to a discharge and performing cleanup operations.

Resources at Risk

The primary construction area is located approximately 19 miles west of Williston, North Dakota within the watershed of the Missouri River. The facility diagram included in Appendix C indicates the layout of proposed site and drainage. Ground cover during construction will consist of compacted soil, gravel, and low-lying vegetation. Drainage slopes generally northwest.

Due to the remote nature of the site risk to the public is minimal in the event of a discharge. Outrigger will coordinate with local emergency responders in the event of a discharge that could affect public health and safety.

Risk Assessment

Operations at the site will involve the use of portable fueling equipment and the presence of various quantities of hydrocarbon fuels and oils, generally approximately 500 gallons per container. Additionally, various other chemicals will be stored on-site including coolants, lubricants, and other hazardous liquids. The discharge of these substances could reach local waterways that feed into the Missouri River.

Response Strategy

Outrigger personnel and contractors are equipped and trained to respond to minor discharges from activities at the site. Minor discharges can generally be described as those where the quantity of product discharged is small, the discharged material can be easily stopped and controlled, the discharge is localized, and the product is not likely to seep into groundwater or reach surface water. Response to minor discharges as well as larger spills may necessitate the assistance of outside contractors or other responders.

Spill Discovery and Response

Distribution of Responsibilities

Outrigger has the primary responsibility for providing the initial response to discharge incidents originating from its construction activities. To accomplish this, Outrigger has designated the construction manager, Mel Palmer, as the response coordinator (RC) in the event of a spill or discharge. The RC will coordinate spill response in the event of a discharge and has the authority to commit the necessary services and equipment to respond to a discharge (including local first responders, contractors, or others, as appropriate).

The RC will also direct initial notifications and initial response actions in accordance with training and capabilities. In the event of a fire or emergency that threatens the health and safety of those present at the site, the RC will direct evacuations and contact local first responders.

In the event of an emergency involving outside response agencies, the RC's primary responsibility is to provide information regarding the characteristics of the materials and equipment involved and to provide access to Outrigger resources as requested. The RC shall also take necessary measures to control the flow of people, emergency equipment, and supplies and obtain the support of local law enforcement as needed to maintain control of the site. These controls may be necessary to minimize injuries and confusion.

Finally, the RC serves as the coordinator for communications by acquiring all essential information and ensuring clear communication of information to emergency response personnel. The RC has access to reference material at the field office either as printed material or on computer files that can further assist the response activities.

Whenever circumstances permit, the RC will transmit assessments and recommendations to Outrigger management for direction. Management is contacted in the following order: (1) Director of Engineering; (2) EHS Manager.

In the event that the construction manager is not available, the responsibility and authority for initiating a response to a discharge rests with the most senior Outrigger employee on site at the time the discharge is discovered or with the contractor Field Supervisor (or next person in command) if contractor personnel are the only personnel on site.

Response Activities

In the event of a discharge, the priority is to stop the product flow and to shut off all ignition sources, followed by the containment, control, and mitigation of the discharge. This plan outlines actions to be performed to respond to a spill.

The construction area will be manned daily and the maximum amount of time until a major or minor discharge would be discovered can be up to 8 hours. Appropriate notifications will occur immediately upon discovery of reportable discharges.

Upon discovery of a discharge, if safe to do so, personnel will remove ignition sources, work to isolate or stop the leak, and notify the RC. Initial notification to the RC should include the exact location of the discharge, material involved, estimate of the quantity, environmental conditions, circumstances that may

hinder response, and any injuries. The RC will then assess the situation to determinate whether the discharge threatens site personnel, the public, waterways, or equipment. After assessment the RC will request outside assistance from local emergency responders and/or contractors as needed, evaluate the need to evacuate employees, notify local fire and/or police departments if appropriate, communicate with neighboring property owners should their property be threatened, and finally inform Outrigger management of the situation.

The RC will direct the initial control of a discharge by Outrigger or it's contractors. After ensuring the safety of the public and employees all effort will be made to prevent hazardous materials from reaching water. Actions taken to control a discharge may include, but are not limited to, use of sorbent materials, use of trenches or berms to direct flow, digging of temporary containment pits, or use of a cleanup contractor. Once cleanup is complete all contaminated materials will be disposed of in accordance with state and federal regulations. Following cleanup, Outrigger will document the cause, response to and, and cleanup efforts and provide closure to any agencies requiring notice.

Discharge Notification

Instructions and phone numbers for reporting a discharge to the National Response Center and other federal, state, and local authorities are provided in Appendix B to this Plan. Any discharge to water must be reported immediately to the National Response Center. The Response Coordinator must ensure that details of the discharge are recorded on Outrigger's discharge notification form.

If the discharge qualifies under 40 CFR 112 (see Appendix B for conditions), the EHS Manager is responsible for ensuring that all pertinent information is provided to the EPA Regional Administrator.

Response Resources and Preparedness Activities

Equipment, Supplies, Services, and Manpower

Spill response equipment will be available onsite include sorbent materials, "Oil-dry" loose sorbent material, absorbent pads, personal protective equipment, brooms, and combustible gas meters. This material is sufficient to respond to most minor discharge occurring at the facility and to initially contain a major discharge while waiting for additional material or support from outside contractors.

Contractors and employees on-site during construction will be familiar with response procedures for a discharge. Employees and contractors will be familiar with the facility layout, location of spill response equipment, ad response strategies. To respond to large discharges and ensure the removal and disposal of cleanup debris, Outrigger is establishing agreements with local specialized cleanup contractors. These contractors will have immediate access to an assortment of equipment and materials, including mechanical recovery equipment for use on water and on land. Outrigger will ensure contractors are able to respond to a spill in a timely manner.

Access to Receiving Waterbody

The nearest waterways are intermittent tributaries of the Little Muddy Creek and would be the first affected by a spill. The site will be graded so to direct flows into a retention pond that would mitigate access to these waters.

Communications and Control

The RC is responsible for communicating the status of the response operations and for sharing relevant information with involved parties, including local, state, and federal authorities. Primary communication will be via cell phone; however, radios and other means of communication may be used as well.

Training Exercises and Updating Procedures

Outrigger will provide necessary on-the-job training to ensure proper response to a spill can be achieved. Training may include briefings on the location and use of spill response materials, review of contractor training and policies, and training for Outrigger personnel on this plan.

Following a response to a discharge, the RC will evaluate the actions taken and identify procedural areas where improvements are needed. The RC will conduct a briefing with field personnel, contractors, and local emergency responders as appropriate to share lessons learned.

Appendix A – Emergency Contacts

Facility Operations

Name	Title	Telephone
Mel Palmer	Construction Manager	307-371-2303
Andrew Perdue	Engineering Director	720-361-2580
Wade Janecek	EHS Manager	720-361-2549

Local Emergency Responders

Name	Telephone	Address
Fire/Police Departments	911 (701) 572-2196 (fire)	317 11th St. W, Williston ND (fire)
CHI St. Alexius Health Williston	(701) 774-7400	1301 15th Ave West, Williston ND

Appendix B – Discharge Notification Procedures

Circumstances, instructions, and phone numbers for reporting a discharge to the National Response Center and other federal, state, and local agencies, and to other affected parties, are provided below. Note that any discharge to water must be reported immediately to the National Response Center.

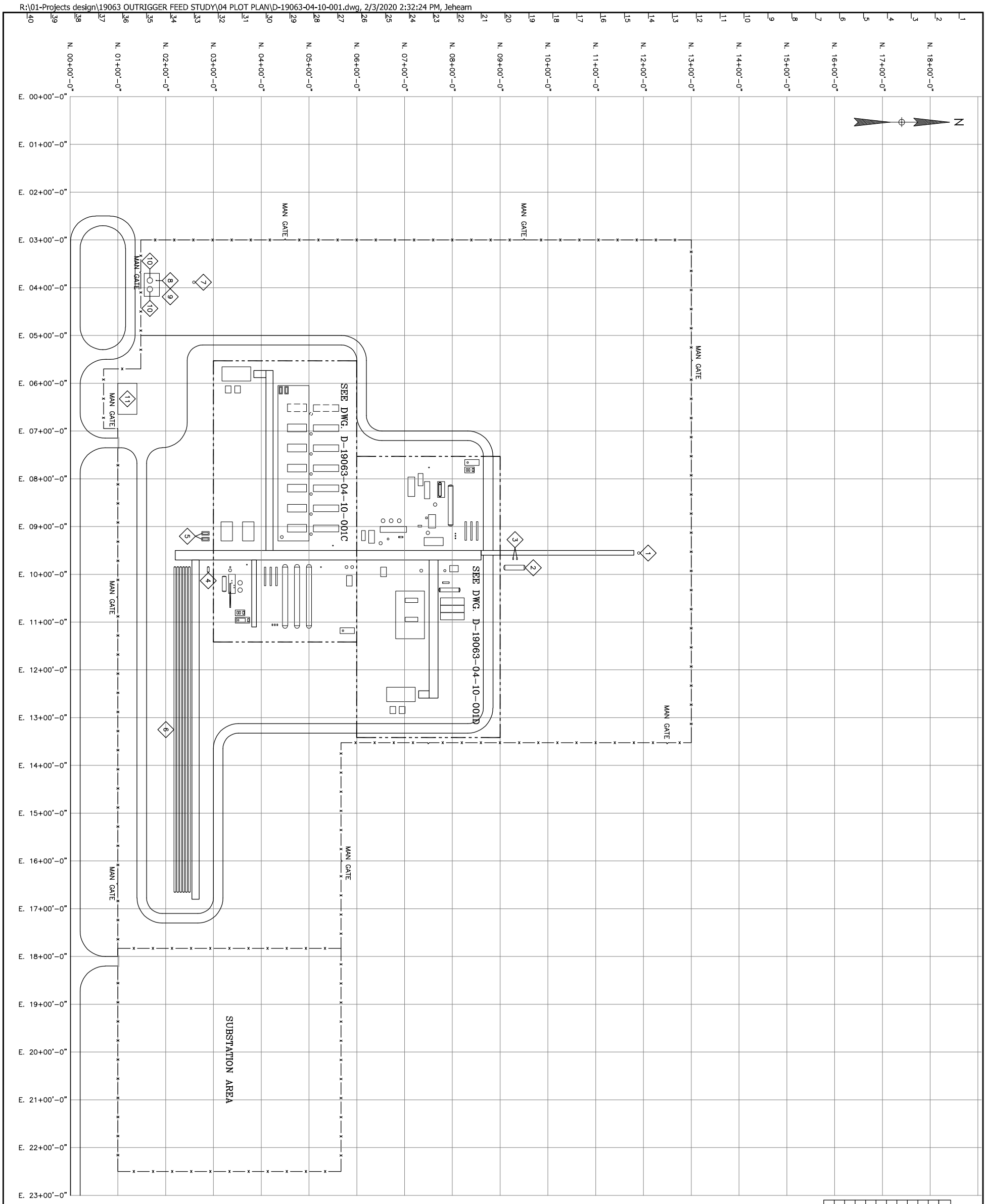
Construction Manager, Mel Palmer (24 hours) (307) 371-2303

Local Emergency (fire, explosion, or other hazards) 911

Agency/Organization	Agency Contact	Circumstances	When to Notify
Federal Agencies			
National Response Center	1-800-424-8802	Discharge reaching navigable waters	Immediately (verbal)
EPA Region VIII (Hotline)	(303) 312-6312	Discharge reaching navigable waters; or, discharge of 1,000 gallons or more; or, second discharge of 42 gallons or more over a 12-month period.	Immediately (verbal)
State Agencies			
North Dakota Department of Environmental Quality	1-701-328-5210	Spills that threaten the waters of the state.	Immediately (verbal)
North Dakota Oil and Gas Division	1-701-328-8020		
North Dakota Department of Emergency Services	1-701-328-8100 or 1-800-472-2121		

Appendix C – Facility Diagram

R:\01-Projects design\19063 OUTRIGGER FEED STUDY\04 PLOT PLAN\D-19063-04-10-001.dwg, 2/3/2020 2:32:24 PM, Jehearn



MARK	DESCRIPTION
1	FLARE STACK
2	FLARE K.O. DRUM
3	FLARE K.O. DRUM PUMP
4	CLOSED DRAIN FLASH TANK
5	STABILIZER COMPRESSOR L.O. TANKS
6	HARP SLUG CATCHER
7	TANK FARM FLARE
8	TANK FARM FLARE K.O.
9	TANK FARM FLARE K.O. PUMP
10	SLOP TANK
11	CCR/WAREHOUSE

BCCK CONFIDENTIAL INFORMATION

OUTRIGGER ENERGY II, LLC.
SANDERSON PLANT
WILLIAMS COUNTY, NORTH DAKOTA

OVERALL PLOT PLAN

REV.	DWG. No.
B	D-19063-04-10-001B

BCCK ENGINEERING, INC.
BUSINESS CONFIDENTIAL
2500 N. Big Spring
Midland, Texas 79705
(432) 685-6095

	NAME	DATE
DESIGN	JEH	12/19
DRAWN	JEH	1/20
CHK.		
Q. A.		
CAD FILE	D-19063-04-10-001	
PLOT DATE		
SCALE	1"=100'-0"	

	NAME	DATE	REF. DWG. NUMBER	REFERENCE DWG TITLE
C/S				
ELECT.				
INSTR.				
PROC.				
MECH.				
PIPING				
PROJ. MGR.				

NO	DATE	REVISIONS	D/C	APP.
B	2/3/20	REVISED PER CLIENT COMMENTS	JEH RWD	JEH
A	1/24/20	ISSUED FOR BID	JEH RWD	JEH

Bill Sanderson Gas Processing Plant Project

Weed Management Plan

February 2020

TABLE OF CONTENTS

ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

EI	Environmental Inspectors
OE2	OE2 North LLC
Plan	Weed Management Plan
Project	Bill Sanderson Gas Processing Plant Project
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

Noxious weed control practices for the OE2 North LLC (OE2) Bill Sanderson Gas Processing Plant Project (Project or Plant) described in this *Weed Management Plan (Plan)* are being developed in compliance with the Williams Weed District and the 2020 North Dakota Weed Control Guide.

2.0 GOALS AND OBJECTIVES

This Plan prescribes methods to prevent and control the spread of noxious weeds during and following construction of the Project. OE2 and its contractors will be responsible for implementing the methods described in this Plan.

This Plan is applicable to the construction and operation of the proposed 39-acre Plant Site that is disturbed during the construction and operation of the proposed facilities.

3.0 NOXIOUS WEED SPECIES LISTS

A weed is commonly defined as a plant that grows out of place. A noxious weed is any plant officially designated by a federal, state, or county government as injurious to public health, agriculture, recreation, wildlife, or property (Sheley, Petroff, and Borman, 1999). Noxious weeds are opportunistic plant species that readily flourish in disturbed areas, thereby preventing native plant species from establishing successive communities.

Invasive species in North Dakota are controlled and regulated under North Dakota Law (NDCC § 4.1-47-02). Counties and cities have the option to add additional weeds for enforcement only in their jurisdiction.

The State of North Dakota has 13 state-listed noxious weeds:

- Absinth Wormwood (*Artemisia absinthium L.)*
- Canada Thistle (*Cirsium arvense (L.) Scop.*)
- Dalmatian Toadflax (*Linaria genistifolia spp. dalmatica*)
- Diffuse Knapweed (*Centaurea diffusa Lam.*)
- Houndstongue (*Cynoglossum officinale L.*)
- Leafy Spurge (*Euphorbia esula L.*)
- Musk Thistle (*Carduus nutans L.*)
- Palmer amaranth (*Amaranthus palmeri*)
- Purple Loosestrife (*Lythrum salicaria L., Lythrum virgatum L.,* and all cultivars)
- Russian Knapweed (*Centaurea repens L.*)
- Saltcedar (*Tamarisk spp.*)
- Spotted Knapweed (*Centaurea maculosa Lam.*)
- Yellow Toadflax (*Linaria vulgaris*)

Williams County, North Dakota recognizes the following additional plant as an invasive weed:

- Narrowleaf Hawksbeard (*Crepis tectorum*)

To comply with North Dakota Law (NDCC § 4.1-47-02), OE2 has prepared this Plan specifying the weed management procedures to be implemented. **Attachment 1** to this Weed Management Plan includes the fact sheets for the *Identification and Control of Invasive and Troublesome Weeds in North Dakota* developed by the North Dakota State University (NDSU) for each of the species listed above. Regulations also require that OE2 reseed, plant, or otherwise manage the area to establish a beneficial plant cover. To this end, OE2 has included the methods to be used to accomplish

revegetation, the time and method of seeding, fertilization practices, and recommended plant species for the Project in the Project SWPPP document.

4.0 NOXIOUS WEED SPECIES MANAGEMENT

This Plan is designed to:

- Treat specific infestation areas as recommended by weed districts prior to construction, pending seasonal limitations;
- Prevent the introduction and spread of weeds via construction equipment during construction;
- Contain weed seeds and propagules by preventing segregated topsoil from being spread to adjacent areas; and
- Treat infestations that may develop during operations.

4.1 Identification of Problem Areas

OE2 will work with the County Weed Control Board to identify known locations of weed infestations in the Project area. In addition to infestation areas identified by the weed districts and landowners, additional areas containing noxious species may be identified prior to construction by the Environmental Inspectors (EI), which will be demarcated using color-coded flagging or signage within the Plant Site. Identification of existing noxious weed locations will alert environmental inspection and construction personnel to implement weed control measures during construction.

4.2 Treatment Measures

OE2 will implement weed control at identified infestation areas based on County weed agency input or by the EIs. Weed control measures may include the application of herbicide or mechanical, and/or alternative methods. The weed control measure chosen will be the best method available for the time, place, and species of weed as identified through consultation with the appropriate regulatory agencies. OE2 will follow the treatment measures listed on the Fact Sheets for each of the species of concern included in **Attachment 1**.

Herbicide application is an effective means of reducing the size of weed populations. Herbicide treatment methods will be based on species-specific and area-specific conditions (e.g., proximity to wetlands, open water, riparian areas or agricultural areas, and time of year) and will be applied in accordance to the 2020 North Dakota Weed Control Guide (available online). Spot herbicide applications will be the preferred option. In areas of dense infestation, a broader application may be used. Pending the seasonal start of construction, preconstruction treatment of infestation areas may be conducted and will be controlled as described in section 7.1, to minimize the impacts on the surrounding vegetation. Preconstruction applications will be completed in accordance with applicable chemical contact times (as specified by the manufacturer) in advance of clearing and grading within the construction right-of-way. Treatment may be restricted in areas that are not readily accessible (e.g., difficult topography, saturated/inundated soils, etc.).

Mechanical control (e.g., mowing) can also be an effective control measure specifically for annual species (i.e., not for perennial rhizomatous species). The efficacy of mechanical control measures is dependent upon proper timing to cut the vegetation prior to the maturation of seed and may require multiple treatments during the growing season.

4.3 Preventative Measures

The following measures will be implemented to prevent the spread of noxious weeds.

- Prior to the beginning of construction of the project, all contractor vehicles and equipment (including timber mats) will be cleaned of soil and debris capable of transporting weed propagules. The contractor will maintain logs documenting the cleaning history of each piece of equipment and will make logs available to OE2, upon request. Contractor vehicles and equipment will be inspected and may require additional cleaning, if necessary, prior to mobilization to the Site. Cleaning will be conducted using high pressure washing equipment or compressed air, and/or manually remove excess soil from the tracks, tires, and blades of equipment.
- Areas of the Plant Site where weed infestations are identified will be clearly marked prior to construction. In these areas, the contractor may elect to conduct full topsoil stripping and will stockpile cleared vegetation and segregated topsoil within the Site. The stockpiles will be identified as noxious weed stockpiles with signs and be maintained adjacent to the areas from which they were obtained to eliminate the transport of soil-borne noxious weed propagules to other areas within the Site. During reclamation, the contractor will return topsoil and vegetative material to the areas from which they were obtained. Alternately, for annual weed species the contractor may elect to mow the infested area before the species begins seeding, thus eliminating the threat of spreading seeds during topsoiling and construction.
- In areas where full topsoil stripping is implemented, equipment required for initial vegetation clearing and topsoil segregation will be cleaned using one of the methods described above prior to leaving the area. Once the topsoil has been segregated, subsequent equipment will not require cleaning, as it will not come into contact with noxious weeds or the topsoil containing weed seeds and propagules.
- The contractor will ensure straw bales used to construct sediment control devices or used as mulch applications are certified weed free and obtained from approved certified sources as recommended by the County weed agency.
- The contractor will ensure seed mixes and mulching materials used for revegetation are certified weed free and obtained from approved certified sources as recommended by County weed agencies.

4.4 Post-Construction Treatment Methods

OE2's objective is to comply with the requirements to prevent the spread of noxious weeds and treat areas of the Plant Site where weed species form a significant portion of the vegetation community in comparison to adjacent undisturbed areas.

In the event noxious weed species become established in the Plant Site, OE2 will make good faith efforts to control weeds within the Site and to work with adjacent landowners to prevent the spread of the species to adjacent lands. Post-construction weed control measures may include the application of herbicide or mechanical methods. OE2 will control noxious weed species at OE2-managed aboveground facility sites to prevent the spread onto adjacent properties.

Post-construction herbicide applications will be conducted prior to seed maturation where possible.

Applications will be controlled, as described in Section 7, to minimize the impacts on the surrounding vegetation. As discussed in Section 5.2, herbicide treatment methods will be based on species-specific and area-specific conditions (e.g., proximity to water, riparian areas or agricultural areas, and time of year) and will be coordinated with the local county and regulatory agencies. Spot herbicide applications will be the preferred option. In areas of dense infestation, a broader application will be used and a follow-up seeding program implemented according to revegetation measures discussed in the Project SWPPP. The timing of subsequent revegetation efforts will be based on the persistence of the selected herbicide. OE2 will communicate with a designated representative of each county to inform them of the location and type of treatment administered by OE2 or its contractor.

Mechanical methods entail the use of equipment to mow weed populations for annual species (i.e., not for perennial rhizomatous species). Mechanical treatments will be conducted prior to seed maturation where required. If such a method is used, subsequent seeding will be conducted if necessary to re-establish a desirable vegetative cover that will stabilize the soils and slow the potential re-invasion of weeds.

During routine operations activities, if noxious weed species are identified that are not listed on the county or state weed lists, OE2 will treat the affected area as quickly as possible by means of chemical, cultural, or biological control measures.

5.0 MONITORING

EIs will periodically monitor the Plant Site to capture revegetation growth. Should the EIs identify noxious weed populations in the Plant Site, they will report their findings to the OE2 operations and maintenance division to determine the appropriate action to control the spread of the weeds. Noxious weed management will be conducted in accordance with state and county regulations.

6.0 HERBICIDE USE

6.1 Herbicide Application and Handling

Herbicide application will be based on information gathered from consultations with local weed districts and state agencies. Before application, OE2 or its contractor will obtain required permits from the local weed district or the state agency. Herbicide application will be conducted in accordance with applicable laws and regulations by a state-licensed contractor

All herbicide applications will follow United States Environmental Protection Agency (USEPA) label instructions. Application of herbicides will be suspended when any of the following conditions exists:

- Wind velocity exceeds 6 miles per hour during application of liquid or granular herbicides;
- Snow or ice covers the foliage of noxious weeds; or
- Precipitation is occurring or is imminent.

Vehicle-mounted sprayers (e.g., handgun, boom, and injector) may be used mainly in open areas that are readily accessible by vehicle. Hand application methods (e.g., backpack spraying) that target individual plants may be used to treat small or scattered weed populations or in rough terrain. Calibration checks of equipment will be conducted at the beginning of spraying and periodically to ensure that proper application rates are achieved.

Herbicides will be transported to the Project Site daily with the following provisions:

- On-site herbicide quantities will be limited where practical;
- Concentrate will be transported in approved containers only, in a manner that will prevent tipping or spilling, and in a compartment that is isolated from food, clothing, and safety equipment;
- Mixing will be conducted in an upland area at a distance greater than 100 feet from open or flowing water and wetlands, greater than 200 feet from private wells, and greater than 400 feet from public wells. The property owner would be consulted about the presence and location of wells prior to herbicide application; and
- All herbicide equipment and containers will be maintained as needed and inspected for leaks daily.

6.2 Herbicide Spills and Cleanup

OE2 has developed a Spill Contingency Plan for the Project that incorporates all reasonable precautions to be taken to avoid spills of all potentially hazardous materials. In the event of a spill, cleanup will be immediate and will be conducted in accordance with the Spill Contingency Plan.

Herbicide contractors are responsible to keep spill kits in their vehicles and in herbicide storage areas to allow for quick and effective response to spills. Items to be included in the spill kit are:

- Protective clothing and gloves;
- A minimum of 20 pounds of suitable commercial adsorbent and barrier materials;
- Plastic bags and bucket;
- Shovel;
- Fiber brush and screw-in handle;
- Dust pan;
- Caution tape; and
- Detergent.

Response to an herbicide spill will vary depending on the material spilled and the size and location of the spill. The order of priorities after discovering a spill are to protect the safety of personnel and the public, minimize damage to the environment, and conduct cleanup and remediation activities.

6.3 Worker Safety and Spill Reporting

All herbicide contractors will obtain and have readily available copies of the appropriate safety data sheets and the herbicide labels for the herbicides used. All herbicide spills will be reported in accordance with applicable laws and requirements. Further information regarding spill response and reporting is detailed in the Spill Contingency Plan.

ABSINTH WORMWOOD

(*Artemisia absinthium* L.)

ABSINTH WORMWOOD

State Listed Noxious Weed

Absinth wormwood is a member of the sagebrush family, which is easily recognized by the strong sage odor. The plant also is known as American or common wormwood, mugwort or madderwort, and wormwood sage. Unlike other plants in the sagebrush family, absinth wormwood dies back to the root crown each winter, with new shoots emerging each spring. Absinth wormwood is grown in herb gardens for the sage flavor of the leaves. The young flower heads are the source of aromatic oil used to prepare vermouth and absinth. The oil of absinth wormwood is also an active ingredient in antiseptic liniments.

Identification and growth form:

Absinth wormwood is a perennial fragrant forb or herb. The plant commonly grows 3 to 5 feet tall at maturity. Absinth wormwood is woody at the base and regrows from the soil level each spring from a large taproot. Leaves are light to olive green, 2 to 5 inches long and divided two or three times into deeply lobed leaflets. Leaves and stems are covered with fine, silky hairs that give the plant a grayish appearance. Flower stalks appear at each upper leaf node and produce numerous yellow flower heads 1/8 inch in diameter, which appear from late July through mid-August in North Dakota. Each fruit contains one seed, which is less than 1/16 inch long, smooth, flattened and light gray-brown. These small seeds are scattered easily by wind, water and animals, and in hay. Absinth wormwood is a prolific seed producer but also can spread by short roots. The plant is most often found on dry soils, in overgrazed pasture and rangeland, wastelands and roadsides.

Why is this plant a concern?

Absinth wormwood causes economic losses by reducing available forage, tainting the milk of cattle that graze it, and medically as a pollen source for allergies and asthma. Absinth wormwood can reduce forage production severely in pasture and rangeland and is especially troublesome when land is overgrazed. Allergy sufferers should avoid walking through absinth wormwood infestations when the plant is flowering in late July and August.

How do I control this plant?

Chemical. A variety of auxin-type herbicides, including products that contain clopyralid (Stinger, Transline or Curtail), dicamba (various), Milestone (aminopyralid), 2,4-D, Tordon (picloram) and glyphosate (various), will control absinth wormwood. These herbicides should be applied when the plant is at least 12 inches tall and actively growing. Herbicides applied too early in the growing season generally result in poor control. If a fall treatment is desired, the plants should be mowed in early to midsummer to promote active regrowth and to improve herbicide coverage.

Cultural. Livestock generally will not graze absinth wormwood except in early spring. Mowing and cultivation do not control this weed.

Biological. No biological control agents or pathogens are available for this weed.

CANADA THISTLE

[*Cirsium arvense* (L.) Scop.]

Female flower

Male flower

CANADA THISTLE

State Listed Noxious Weed

Canada thistle was introduced in North America as a seed contaminant in both French and British colonies. The first legislation to control the weed was passed by Vermont in 1795. Canada thistle has the dubious distinction of being one of three weeds listed in 1885 by Dakota Territory as required of "every person" to be destroyed. The native distribution of Canada thistle includes Europe, North Africa and central Asia. It also is found in China and Japan and has spread so extensively that it is difficult to distinguish the plant's original native range. Canada thistle is considered to be naturalized in the northern Great Plains

Identification and growth form:

Canada thistle is a long-lived perennial that usually grows 2 to 3 feet tall and bears alternate, dark green leaves that vary in size. The leaves are oblong, usually deeply cut, and have spiny, toothed edges. Canada thistle has small (3/4 inch diameter), compact flower heads that appear on the upper stems.

Canada thistle has been classified into several varieties. Within these varieties are many ecotypes, which differ in growth characteristics, response to day length, and susceptibility to herbicides and cultivation. For example, leaf shape, head structure, and the number and size of spines can differ with ecotypes. Canada thistle requires a 14- to 16-hour photoperiod to bolt and flower (April 19 to Aug. 22 in North Dakota). Flower color can range from purple to light lavender or even white. Stem color also can differ from green to lavender.

Flowering occurs from June to September. Male and female flowers are produced on different plants, so cross-pollination is necessary for seed production. Flowers produce from 40 to 80 seeds per head, which can move long distances, although most seed remain in the head until winter and eventually germinate nearby.

The smooth, light brown seeds (achenes) have a conical point and are loosely attached to a tannish pappus at the tip, which aids in seed dispersal by wind. Seeds mature rapidly and are able to germinate within eight to 10 days after pollination. Canada thistle overwinters in the rosette growth stage.

Canada thistle has an extensive underground root system that may penetrate the soil to a depth of 10 feet or more and grow laterally 12 to 15 feet per year. Root buds occur randomly along the roots and initiate new shoots whenever environmental conditions are favorable. Root segments as small as 0.6 inch can initiate shoot growth and become established. Canada thistle is adapted to a wide range of soils, but it produces deeper roots in clay or muck soils than in sand, gravel or limestone soils.

Root bud development can occur nearly anytime during the growing season, but is greatest when soil temperatures are warm, air temperatures are cool and the photoperiod shortens to 13 hours. These conditions generally are found during the fall growing season. Therefore, more Canada thistle root-bud development occurs in the fall than any other time of the year. Canada thistle grows best in the northern regions of North America where temperature and rainfall are moderate. Growth ceases when temperatures exceed 85 degrees for extended periods.

Why is this plant a concern?

Canada thistle has the potential to form dense infestations rapidly through vegetative reproduction, and the spread of these clones may continue indefinitely, crowding out and displacing native grasses and forbs through shading, competition and possibly allelopathy. Canada thistle spread can change structure and species composition of natural areas and reduce plant and animal diversity. Infestations of Canada thistle may contribute to the elimination of endangered and/or endemic plant species. In wildlands, Canada thistle has the potential to increase fire frequency and perhaps severity as a result of its abundant and readily ignited litter and flammable above-ground biomass.

Canada thistle can reduce yield of many crops severely. Yield losses are directly proportional to the density and patchiness of the infestation, with more than $40 million annually lost in production in North Dakota alone. Wheat is a poor competitor and Canada thistle infestations often increase in a continuous-wheat farming program. Canada thistle also can be a severe problem in corn and soybean grown in rotation, with greater losses in soybean than corn.

CANADA THISTLE

How do I control this plant?

Canada thistle is the only thistle in North Dakota that has become a cropland pest. Control strategies differ for Canada thistle in cropland compared with pasture, range and wildland.

Chemical. *Cropland.* The best approach to Canada thistle control in cropland should include an in-crop herbicide treatment to suppress Canada thistle growth, minimize crop yield losses and prepare the thistle for a fall postharvest treatment. Preharvest and fall-applied treatments provide the most effective long-term control. The best herbicide to use will vary depending on crop rotation. However, the control program must be uninterrupted for two to three years if the infestation is to be reduced.

Glyphosate (various trade names) can be used to control Canada thistle in glyphosate-resistant crops. In-crop applications will not kill established thistle stands. However, when used as part of an overall management program, glyphosate can reduce infestations.

Pasture, range and wildlands. Herbicides that control Canada thistle in noncropland include products that contain clopyralid (various), Tordon (picloram), dicamba (various) dicamba plus diflufenzopyr (Overdrive), Method (aminocyclopyrachlor) and Milestone (aminopyralid). Control is greatest when applied to Canada thistle at the early bud growth stage (early summer) or in the fall to plants in the rosette form. These herbicides applied at low rates may be the most cost-effective method for controlling dense infestations that require broadcast application. Re-treatment will be necessary for several years to obtain long-term control.

Cultural. *Cropland.* Canada thistle roots are much less winter hardy then many other perennial weeds and timely cultivation actually can increase winter kill. Soil temperatures of 20 degrees or colder can reduce Canada thistle regrowth from roots by more than 50 percent. Following crop harvest, cultivate fields before the Canada thistle is 3 inches tall and repeat before regrowth reaches 3 inches tall until freeze-up. This method has the combined advantage of decreasing carbohydrate root reserves and the bare ground from the tillage will lead to colder soil temperatures, which increases winter-kill.

An option for Canada thistle in row crops and fallow that includes both tillage and herbicides is known as the rosette technique. The objective is to prevent the plants from bolting by using tillage and/or herbicide treatments until the day length is less than 15 hours, the photoperiod required for most Canada thistle plants to bolt. The thistles then will regrow as rosettes only. Research at North Dakota State University has found herbicide absorption and translocation to the roots of Canada thistle is greater when applied to the rosette growth stage than when applied to bolted plants, making fall treatment of rosettes the most cost-effective method for long-term Canada thistle control.

The rosette technique for Canada thistle control in fallow includes the use of tillage and fall-applied herbicides, while control in row crops includes in-crop herbicide treatments, tillage and fall-applied herbicides. Periodic tillage in fallow is used to control Canada thistle shoots and other weeds until late July, when the day length is less than 15 hours. Herbicides used for Canada thistle control, such as glyphosate or clopyralid, then are applied to rosettes in late September or early October. Research at NDSU has found that cultivation until late June prevented more than 90 percent of Canada thistle from bolting in corn and soybean.

CANADA THISTLE

Pasture, range, and wildlands. Repeated mowing will reduce Canada thistle infestations. Mow whenever the plants are in the early bud growth stage to prevent seed-set. Several mowings a year are needed because plant populations vary in maturity. Mow as close to the surface as possible. If plants are cut above the terminal bud before the stems elongate, they likely will regrow. Mowing before the flowers start showing color is important because plants mowed after that likely will produce some viable seed. Mowing for several years will reduce the root vitality of Canada thistle and will prevent seed production, reducing the seed reserve. Mowing should be combined with a chemical control program for best results.

Controlled burns often are used to help restore wildlands to a more natural plant community. Contrary to popular thought, research at North Dakota State University found that fall prescribed burns did not cause a long-term increase in Canada thistle density; rather, Canada thistle emerged earlier in the burned compared with the nonburned areas. The effect was short-lived and Canada thistle densities were similar regardless of burn treatment the second growing season after the burn. Also, no differences in Canada thistle control occurred when herbicides were used alone or combined with a prescribed burn.

Biological. Two biological control agents have been introduced for Canada thistle control, and a third was introduced accidentally. To date, none have been effective at reducing the weed on a large scale. The most widespread insect is *Hadroplontus litura* (formerly *Ceutorhynchus litura*) weevil, which first was released in North Dakota in the 1970s. The larvae feed on the underground parts of Canada thistle for a short time but infestations generally are not reduced. One may take advantage of the early season stress on Canada thistle from *H. litura* feeding by using additional control methods such as mowing or applying herbicides. In addition, natural soil pathogens may become more destructive due to multiple entry sites established by the insect. However, do not expect these insects alone to reduce a Canada thistle infestation.

A gall-producing fly, *Urophora cardui*, causes meristematic galls but does little long-term damage to the perennial thistle. The Canada thistle bud weevil *Larinus planus* was an accidental introduction into North America and is not permitted for distribution. The insect feeds on developing flowers to prevent seed production. Although *L. planus* can survive under a wide range of climates, it has not reduced established Canada thistle stands.

The painted lady butterfly *(Vanessa cardui)* can be a very effective biological control agent but only on an intermittent basis. Larvae of the butterfly feed on Canada thistle plants and can eliminate an infestation. However, the insect generally is found only in southern states such as Arizona and New Mexico and will build up populations large enough to migrate north only once every eight to 11 years. The insect will migrate north as far as Canada and those fortunate enough to reside within the migratory pathway will see a dramatic decrease in the Canada thistle population. Unfortunately, the insect feeds on many plants, including crops such as soybean and sunflower, and is not a candidate for long-term biological control of Canada thistle.

A native pathogen, *Pseudomonas syringae* pv. *tagetis* (Pst), causes the top of Canada thistle plants to turn yellow to white. This pathogen may release a toxin into the phloem of Canada thistle and kill the plant. The pathogen is most widespread during wet periods. Attempts to produce this pathogen as a commercial biocide have not been successful. A native rust (*Puccinia punctiformis*) has reduced Canada thistle in the wild but has not been introduced successfully as an effective biological control agent.

DALMATIAN TOADFLAX and YELLOW TOADFLAX

[*Linaria dalmatica* (L.) Mill.] and (*Linaria vulgaris* Mill.)

Dalmatian toadflax

Dalmatian toadflax has broad heart-shaped leaves

DALMATIAN TOADFLAX and YELLOW TOADFLAX

Yellow toadflax

Yellow toadflax has narrow linnear leaves

Yellow toadflax flowers have orange throats

DALMATIAN TOADFLAX and YELLOW TOADFLAX

State Listed Noxious Weed – both species

Both Dalmatian and yellow toadflax are escaped perennial ornamental plants that were introduced in the mid-1800s. Dalmatian toadflax is native to the Mediterranean region, specifically the Dalmatian Coast of Croatia, while yellow toadflax is from Eurasia. Yellow toadflax first was recorded in North Dakota by H.L. Bolley from a collection made in Fargo and described as "most abundant in Barnes County" in the 1940s by O.A. Stevens. The first record of Dalmatian toadflax is from Walhalla in Pembina County in 1937 by Stevens.

The toadflaxes are most likely to be found along highways, railroad tracks and other transportation or communication lines, or anywhere livestock is brought into the state. Often the origins of an infested area can be traced back to an escape from an ornamental planting. Dalmatian toadflax has been reported only as small patches in a few counties, generally in the western part of North Dakota. However, yellow toadflax has been found in many counties across the state and is on the verge of becoming a major problem for land managers in North Dakota.

Identification and growth form:

Dalmatian and yellow toadflax are members of the snapdragon family and thus easily recognizable by the bright yellow flowers, which have swollen corolla tubes that flare into two "lips" with an orange throat (yellow toadflax) and long spur. The flowers are 1 to 1.5 inches long with many flowers on a raceme. Both species have an extensive creeping rhizomatous root system that spreads like leafy spurge. The most distinctive difference between the species is that Dalmatian toadflax has broad, heart-shaped leaves that clasp a woody stem, whereas yellow toadflax has narrow, linear leaves with a narrow stem.

The plants begin regrowth from the roots as soon as the soil warms in early spring. Toadflax flowers from late June through August in North Dakota and single plants may produce more than 500,000 seeds that are dispersed by wind, rain, wildlife, and movement of forage and livestock. The seed is disk-shaped, 0.08 inch in diameter and dark brown to black, and often have irregular papery wings. Seed dispersal begins a few weeks after flowering and continues into winter. The roots of a single plant can extend 10 feet and give rise to daughter plants every few inches.

Why are these plants a concern?

The toadflax species are aggressive and will displace forage in pastureland and native species in wildland. Yellow toadflax can be mildly poisonous to livestock that graze it. Although the toadflaxes may be slow to establish, once plants take root, control is very difficult since most herbicides are ineffective.

Dalmatian toadflax seedlings are relatively poor competitors with grass species, but once established, the weed can become extremely invasive, especially on dryland sites, disturbed areas and roadsides. Yellow toadflax is adapted to more moist sites than Dalmatian toadflax and often is found in pasture, meadows and ditches.

DALMATIAN TOADFLAX and YELLOW TOADFLAX

How do I control these plants?

Prevention is the best method to keep Dalmatian and yellow toadflax from invading North Dakota pasture, rangeland and wildlands. Herbicides can be effective but require repeated treatments at high rates.

Chemical. Tordon (picloram), Plateau (imazapic) and Telar (chlorsulfuron) will control Dalmatian toadflax when applied at maximum use rates during flowering or late fall. No herbicide is labeled for yellow toadflax control, but research has found that a combination treatment of Tordon plus Overdrive (dicamba plus diflufenzopyr) applied from mid-June through mid-September will reduce yellow toadflax infestations for a least two years. See the latest edition of the "North Dakota Weed Control Guide" for application rate and timing recommendations.

Cultural. The long-term use of proper stocking rates to maintain competitive forage species has helped reduce the spread of toadflax into grazing lands. Burning is not effective because soil temperatures do not get high enough to kill the roots. Burning even may have a detrimental effect and cause an increase in the number of stems due to reduced cover.

Biological. Several insects have been introduced for toadflax control. The stem-boring weevil *Mecinus janthiniformis* has been the most successful and can reduce Dalmatian toadflax stands relatively quickly. *M. janthiniformis* larvae mine in Dalmatian toadflax stems, which slowly causes the plants to wilt and die. Repeated attempts to establish *M. janthiniformis* on yellow toadflax in North Dakota have failed, likely because the larvae cannot survive in the much narrower diameter stem of yellow compared with Dalmatian toadflax. *Mecinus janthinus* is currently being evaluated for yellow toadflax control.

A foliage feeding moth, *Calophasie lunula*, was introduced in the U.S. in 1968 but has had little effect on controlling yellow toadflax. Several other insects have been introduced for biological control of both toadflax species but have not established or have not controlled the weeds

SPOTTED and DIFFUSE KNAPWEED

[*Centaurea stoebe* spp. *micranthos* (Gugler) Hyek] and (*C. diffusa* Lam.)

Diffuse knapweed flower with spiny bracts

Spotted and diffuse knapweed

Spotted knapweed flower with black bracts

SPOTTED and DIFFUSE KNAPWEED

State Listed Noxious Weed (both species)

The knapweeds are one of the most rapidly spreading invasive species in the western U.S. Knapweeds already infest more acreage than leafy spurge in Montana and Minnesota, and have been found in more than 25 counties in North Dakota. Knapweeds are related to thistles and can spread even faster. For instance, spotted knapweed infested approximately 25 acres in eight North Dakota counties in 1984 and had spread to more than 1,000 acres in 14 counties by 1997. Diffuse knapweed can spread as quickly as spotted knapweed but has been kept in check in North Dakota and infests less than 650 acres. Spotted knapweed had infested more than 30,000 acres by 2017.

Identification and growth form:

Both are short-lived perennials or sometimes biennial plants reproducing solely by seed. Seed remains viable in the soil five years or more, so infestations may occur a number of years after vegetative plants have been eliminated. The seeds can germinate from spring through early fall. Seedlings emerging in the fall often overwinter as a rosette of leaves, resuming growth again in the spring. The plants grow 2 to 4 feet tall with one or more stems. The leaves are pale green and 3 to 4 inches long. Rosette leaves are deeply lobed. The physical appearance of these two knapweed species is similar, except diffuse knapweed is generally shorter and more highly branched. Plants flower from early July through August and produce 1,000 or more seeds per plant.

These species are distinguished by the bracts below the flower. Spotted knapweed has stiff, black-tipped bracts while diffuse knapweed has a rigid terminal spine about one-third of an inch long with four to five pairs of shorter, lateral spines (crablike). If the plant is not flowering, search for last season's flower stalk and identify the plant based on the flower bracts. Both species have pink to light purple and occasionally white flowers.

Why is this plant a concern?

Spotted and diffuse knapweed are aggressive, introduced weed species that rapidly invade pasture, rangeland and fallow land and cause a serious decline in forage and crop production. Spotted knapweed has few natural enemies and is not preferred by livestock as forage. Knapweed infestations in North Dakota largely can be traced to seed or hay brought in from neighboring states. Researchers in Montana have observed that spotted knapweed may remain in a confined location for several years and then spread rapidly to adjacent areas. Controlling spotted and diffuse knapweed plants when they are first observed and monitoring the site for several years to prevent reinfestation from seed are important

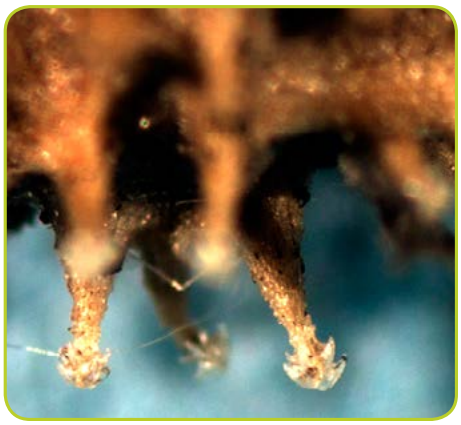
How do I control these plants?

Chemical and Cultural. Spotted and diffuse knapweed confined to small, well-defined areas should be pulled by hand or treated with a herbicide as soon as detected to avoid spread of the weed. First, all visible knapweed plants should be removed and destroyed by burning or mulching. Then the areas should be treated with a herbicide to prevent reinfestation from seedlings. The most effective herbicides for spotted and diffuse knapweed control include Milestone (aminopyralid), Tordon (picloram) and dicamba (various). Treat an extra 10 to 15 feet around the knapweed patches to control seedlings. A careful follow-up program is necessary to control missed plants and seedlings. Many attempts to control knapweed have failed because follow-up treatments were not applied.

Biological. In general, the knapweed infestations are small enough that herbicide and hand removal are the best and most cost-effective treatments in North Dakota. Biological control agents have been introduced in neighboring states to control spotted knapweed. There are 13 biological control agents currently permitted for use against knapweed species. Consult the N.D. Dept. of Agriculture or NDSU weed specialists for the latest information on which agents may be successful in the state.

HOUNDSTONGUE

(*Cynoglossum officinale* L.)



HOUNDSTONGUE

State Listed Noxious Weed

Houndstongue is a biennial poisonous herb that is native to Eurasia. The plant is a member of the Borage family, which includes more commonly known plants such as Virginia Bluebells, Forget-Me-Nots and the fiddlenecks. Houndstongue commonly is found in disturbed areas, including roadsides, trails, and in pasture and woodlands following soil disturbance or overgrazing.

Identification and growth form:

Houndstongue is a biennial that forms a rosette the first year of growth and bolts and flowers the second season. The plant only reproduces from seed, but can spread great distances because the barbs on the nutlets cling to clothing, machinery and animals. The leaves are oblong, very pubescent and rough, which resembles a hound's tongue. Plants bolt during early summer, the second year of growth, to a height of 1 to 4 feet and flower in mid-June. The flowers are small, arranged in clusters and not showy. Flower color ranges from red to burgundy. Each flower produces three to four nutlets, which are flat and tear-drop shaped with a very hard seed coat and numerous barbs. Plants generally are found along trails and roadsides, on the edge of wooded areas and in disturbed habitats. Infestations often establish near areas where cattle and other livestock rub against something such as fence posts and trees or shrubs.

Why is this plant a concern?

Houndstongue tends to be a nuisance weed rather than a noxious plant unless infestations grow to become large patches. The nutlets often become imbedded in the wool or hair of livestock, which can cause a loss of value of the wool and/or increase costs to remove the burs. Eye damage can occur if burs become embedded in the eye or eyelids. The burs can be problematic for hikers, hunters and fishermen and also to their pets.

Houndstongue contains alkaloids that are especially toxic to cattle and horses. The plant is rarely eaten in the green state; however, animals will eat the dried plant in hay. Sheep are more resistant to the pyrrolizidine alkaloids than other livestock, while horses, especially when confined to small areas infested with houndstongue, are more likely to ingest toxic levels. Fatal liver disease in horses occurred following two weeks of feeding hay with as little as 6 percent houndstongue.

How do I control this plant?

Prevention is the best method to keep houndstongue from invading North Dakota. Use only certified weed seed-free hay and eradicate new infestations before the plant can spread.

Chemical. Escort (metsulfuron) is very effective for controlling houndstongue and can be applied throughout the growing season. First-year houndstongue rosettes are easily controlled with 2,4-D applied from late May to mid-June. Second-year plants are much less susceptible to 2,4-D. Plateau (imazapic) at high rates will control houndstongue both pre- and post-emergence, but grass injury, especially to the cool season species is likely when Plateau is applied at the maximum rate.

Biological. A root weevil, *Mogulones crucifer,* has been released for control of houndstongue in Canada. The insect has become well-established in Alberta and has greatly reduced the houndstongue infestation in that province. The insect has spread naturally and become established in Washington state. However, this biological control agent has not been approved for release in the U.S. and interstate movement is not allowed. Several other insects have been evaluated for biological control of houndstongue; however, initial results were not nearly as promising as those of the root weevil.

LEAFY SPURGE

(*Euphorbia esula* L.)

State Listed Noxious Weed

Leafy spurge was once the most difficult noxious weed to control in North Dakota and infests all 53 counties. Scientists at the North Dakota Agricultural College (NDAC) recognized leafy spurge could be a problem soon after it was first identified in the state, growing along a Fargo street in 1909. However, the plant was not added to the state noxious weed list until 1935, when leafy spurge was found growing in all but 10 counties. The largest single infestation at that time was estimated to be 193 acres in Foster County.

Latex is found in all plant parts

True flower

Leafy spurge gall

Aphthona lacertosa

Aphthona nigriscutis

LEAFY SPURGE

Despite several control programs led by the State Agriculture Department and NDSU Extension, leafy spurge doubled in acreage every 10 years, reaching nearly 1.8 million acres in the 1980s. A coordinated integrated program of biological, chemical and cultural methods directly led to the first-ever reports of a decline in leafy spurge infestation in the state in the 1990s.

Identification and growth form:

Leafy spurge is a long-lived perennial that normally grows 2 to 3 feet tall from a woody crown from below the soil surface. Each crown area produces several upright stems, giving the plant a clumplike appearance. The plant bears numerous linear-shaped leaves with smooth margins. The leaves have a characteristic bluish-green color but turn yellow or reddish orange in the fall. Stems originating from crown buds and roots begin growth in late April, making leafy spurge one of the first plants to emerge in the spring. The early and rapid growth gives leafy spurge a competitive advantage over crop and pasture plants. All parts of the plant contain a milky juice called latex, which is a useful identifying characteristic.

Leafy spurge produces a flat-topped cluster of yellowish-green petal-like structures called bracts, which surround the true flowers. The showy, yellow bracts appear in late May and early June, giving the plant the appearance of "blooming." However, the true flowers, which are small and green, do not develop until mid-June. Spring-applied herbicides are more effective on plants with developing true flower parts than on plants with developed bracts but undeveloped flowers.

Seeds are borne in pods, which contain three gray-brown, oblong, smooth seeds. After the seed has matured, the seed pods burst explosively and throw seeds up to 15 feet from the parent plant. An average of 140 seeds is produced per stem, and seeds may remain viable in the soil at least eight years.

Leafy spurge seeds may germinate to re-establish infestations where total control of leafy spurge tops and roots has been achieved. The peak period of germination is late May and early June, but seeds can germinate and seedlings become established throughout the growing season. Leafy spurge seedlings have a remarkable capacity for vegetative reproduction and can reproduce vegetatively within seven to 10 days after emergence. Seedlings typically do not flower during the first year.

The root system of leafy spurge is extensive and consists of numerous coarse and fine roots that occupy a large volume of soil. Roots are most abundant in the upper foot of soil, but some roots can extend to a depth of 15 feet or more. The roots are woody and durable in structure, with numerous buds capable of producing new shoots. The root system contains a large nutrient reserve capable of sustaining the plant for years.

Why is this plant a concern?

Leafy spurge infestations may have more than 200 stems per square yard in sandy soil and even higher densities in heavy clay soil. Patches of leafy spurge usually spread vegetatively from 1 to 3 feet per year and form dense stands that crowd out other plants by shading and competing for moisture and nutrients. Forage production may be reduced to 20 percent or less and most native plants are eliminated because they cannot out-compete this weed.

Leafy spurge contains a toxic substance that, when consumed by livestock, is an irritant, emetic and purgative. It causes scours and weakness in cattle and may result in death. The toxin has produced inflammation and loss of hair on the feet of horses from freshly mowed stubble during haying and has caused mortality of sheep that grazed leafy spurge exclusively. However, sheep and goats will graze leafy spurge as a portion of their diet and can be used as a form of cultural control. Animals will eat dried plants in hay, but many livestock, particularly cattle, avoid eating live plants

LEAFY SPURGE

How do I control this plant?

Leafy spurge control must be considered a long-term management program. Generally, less than 6 inches of the root system is destroyed regardless if the control method is biological, chemical or cultural. Research at North Dakota State University has shown that more of the root system is killed when a combination of control methods are used, compared with any method used alone.

Chemical. Proper timing of herbicide applications is essential for good leafy spurge control. Leafy spurge is most susceptible to dicamba (Banvel and other trade names), Facet L (quinclorac), Method (aminocyclopyrachlor), and Tordon (picloram). Plateau (imazapic), fall-applied, provides better long-term control and less grass injury than spring or summer treatments. Combinations of Tordon plus Plateau or Tordon plus Plateau plus 2,4-D applied in June provide improved leafy spurge control compared with Tordon plus 2,4-D or Plateau applied alone in June. The Tordon plus Plateau combination is not recommended for use in the fall.

The combination of Tordon plus Overdrive also will improve leafy spurge control compared with Tordon used alone. Overdrive contains dicamba plus difluenzopyr, which is an anti-auxin compound that often improves broadleaf weed control when applied with auxin-like herbicides such as Tordon, dicamba and 2,4-D.

Glyphosate (various) applied for leafy spurge control has a different optimum application timing than the auxin herbicides (2,4-D, dicamba, picloram and quinclorac) or Plateau. Glyphosate is most effective for leafy spurge control when applied either after seed filling in midsummer or after fall regrowth has begun but before a killing frost. Glyphosate alone applied during spring growth stages generally provides poor long-term control.

Grazing. Sheep and goats provide an alternative for controlling leafy spurge top growth in pasture and rangeland. Grazing alone will not eradicate leafy spurge but will reduce the infestation, slow the spread of the weed and allow grasses to be grazed by cattle and horses.

Aphthona larvae

Longhorned beetle larvae

Leafy spurge hawkmoth

Grazing should be started early in the spring when the plant first emerges. On large infestations, pastures should be divided so animals can be rotated regularly and the entire infestation grazed in a timely manner.

Sheep and goats are best suited to control leafy spurge on large infestations or along waterways and tree areas where chemical control is restricted or cost is prohibitive and/or where success with biological control agents has been minimal.

Leafy spurge provides good forage value and compares favorably with widely used regional forages such as alfalfa (*Medicago sativa* L.), smooth brome (*Bromus inermis* Leyss.) and crested wheatgrass (*Agropyron desertorum* Fischer ex Link). Before moving animals to a leafy spurge-free area, they should be contained for three to five days so viable seed can pass through the digestive system.

Biological. Biological control of leafy spurge was initiated in the mid-1980s. To date, 10 species of insects have been released in North Dakota for control of leafy spurge, and six have become established. Four of the six established insects are flea beetles (*Aphthona* spp.), which have reduced the leafy spurge density more than any other agent.

LEAFY SPURGE

The first flea beetle released in North Dakota was *Aphthona flava* Guill in 1986. This flea beetle has established at only a few sites in the state and occurs at densities too low to be effective. In 1988, a mixed population of *Aphthona czwalinae* Weise and *Aphthona lacertosa* Rosenhauer were released near Valley City, N.D. By 1995, the majority (greater than 90 percent) of this mixed population was *A. lacertosa*. Two additional flea beetles, *Aphthona cyparissiae* Koch and *Aphthona nigriscutis* Foudras, were released the following year. *A. lacertosa* and *A. nigriscutis* were established in almost every county in North Dakota by 1996 and have become the major biocontrol agents used for leafy spurge control.

Although *Aphthona* spp. adults feed on leafy spurge foliage, the major damage to the plant occurs when the larvae feed on the roots. Larvae feed on both the fine feeder roots used by the plant to absorb water and nutrients and the storage tissue of the root crown. This feeding both destroys root tissue directly and causes the plant to be more susceptible to other methods of control, such as herbicides and infection from soil borne pathogens.

Research at North Dakota State University found flea beetle establishment was best on silt loam, silt clay loam, clay loam and clay soils with an organic matter content of 6 percent to 9.5 percent. Flea beetles were least productive in fine sand to loamy fine sand soils with an organic matter content of 1 percent to 3 percent. In addition, the release area needs to be well-drained and not subject to frequent prolonged flooding or standing water, which will kill the larvae. Generally, flea beetles have not been very successful in controlling leafy spurge growing along waterways, in shaded areas or in very sandy soil.

The *Spurgia esulae* gall midge causes stem tip galls on leafy spurge, thereby decreasing seed production. It has been most successful near wooded areas. However, a second control method was needed to reduce the original leafy spurge infestation and to prevent spread from roots. A stem-boring beetle, *Oberea erythrocephala* Shrank, has been released and established in North Dakota in the 1980s, but to date, the population never has increased to sufficient numbers to decrease leafy spurge. The spurge hawkmoth (*Hyles euphorbiae* L.), a foliar feeder, was introduced in the 1970s but generally has not survived and when it did survive, control was too late in the growing season to be very useful.

Limitations to biological control. Although flea beetles have become established throughout North Dakota, they have not been successful in all environments. To date, approximately 30 percent of the releases have established and the leafy spurge stem density has been reduced. In another 30 percent of the releases, the insects have become established but the population density is too low to be effective. In the remaining releases, flea beetles have not established.

Cultural. Cultural control of leafy spurge includes properly timed cultivation and/or planting of competitive grass species. Cultural methods that only control leafy spurge top growth include mowing and fire. All cultural control methods are more successful when combined with herbicide treatments than when used alone.

Leafy spurge infestations must be controlled with herbicides such as glyphosate prior to seeding grass species. Some perennial grass species that have competed effectively to provide leafy spurge control include: Bozoisky Russian wildrye [*Psathyrostachys juncea* (Fisch.) Nevski] and Luna pubescent wheatgrass [*Agropyron trichophorum* (Link) Richter], Rebound smooth brome (*Bromus inermis* Leyss.) and Rodan western wheatgrass [*Pascopyrum smithi* (Rydb.) A. Löve]. They are examples of grass species that can compete relatively well with leafy spurge. Not only were the grasses very competitive with leafy spurge, but they also provided high yields and good nutritive value for grazing. Grazing following grass establishment should be limited and conducted at the proper growth stage of the grasses or leafy spurge will re-infest the seeded area rapidly.

Mowing and burning have been ineffective for reducing leafy spurge infestations, but may result in uniform regrowth that allows a more timely herbicide treatment. Also, mowing will reduce seed production if repeated every two to four weeks during the growing season.

MUSK THISTLE

(*Carduus nutans* L.)

State Listed Noxious Weed

Musk thistle is the most common biennial invasive thistle in North Dakota. Musk thistle is native in southern Europe and western Asia and was introduced into North America in the early 1900s. Two subspecies that differ in flower size and pubescence occur in North Dakota.

Identification and growth form:

Musk thistle likely is the most easily identified invasive thistle in North Dakota, yet many people confuse this plant with either bull thistle or plumeless thistle. Musk thistle often grows in excess of 6 feet tall, has very large flowers that tend to droop, and the flower has very characteristic brown bracts that resemble a pine cone. The flowers usually are deep rose, solitary and very large, ranging from 1.5 to 3 inches in diameter. Rosettes are dark green with a light green midrib, usually smooth and lacking pubescence and often grow 2 feet or more in diameter.

Musk thistle stems are usually very branched with spiny wings; however, the wings are interrupted and not complete along the stem as with bull or plumeless thistle. The leaves are oblong to lanceolate and lobed with slender spines along the margin. They generally have little pubescence underneath, which helps distinguish musk thistle from plumeless thistle. However, the subspecies *C. nutans macrocephalus* (Desf.) has very pubescent leaves.

Musk thistle flowers from July to late September. The average musk thistle plant produces in excess of 10,000 seeds per plant and, under favorable conditions, may produce 120,000 seeds per plant. Seed germination averages 30 percent. The seed generally germinates in the summer and fall, and the plant overwinters as a rosette. The following spring, the plant resumes vegetative growth, bolts and flowers. After setting seed, the plant

MUSK THISTLE

dies, thereby completing the life cycle. Occasionally biennial thistles have winter annual, annual or short-lived perennial characteristics.

Why is this plant a concern?

Musk thistle tends to invade overgrazed or otherwise disturbed pastures, rangeland, roadsides and waste areas. Movement into cropland is generally from nearby noncropland or roadsides. Musk thistle spreads rapidly and can form very dense stands that crowd out desirable forages and native species.

How do I control this plant?

Since biennial plants such as musk thistle reproduce only from seed, the key to a successful management program is to control the plants before flowering.

Chemical. Fall is the preferred time for applying herbicides for biennial thistle control. Fall treatment allows more time for herbicide application than in the spring and thistle control is generally best with fall treatments. Seedlings that emerge in summer after tillage or previous herbicide applications will not bolt but remain in the rosette stage. Biennial thistles are most susceptible to herbicides in the rosette form.

Biennial thistles can be controlled effectively with Milestone (aminopyralid), Stinger, Transline or Curtail (clopyralid), Tordon (picloram), Method (aminocyclopyrachlor), or dicamba (various) or dicamba plus diflufenzopyr (Overdrive). Products that contain metsulfuron (Escort, Cimarron Max, others) will control biennial thistles in the spring and will eliminate seed production when applied in the bolting to bud growth stages.

Cultural. Repeated mowing will reduce musk thistle infestations. Mow whenever the plants are in the early bud growth stage to prevent seed-set. Several mowings a year are needed because plant populations vary in maturity. Mow as close to the surface as possible. Plants should be cut below the terminal bud before the stem elongates or the weed will regrow. Mowing before the flowers start showing color is important because plants mowed after that likely will produce some viable seed. Mowing should be combined with a chemical control program for best results.

Biological. The seed weevil *Rhinocyllus conicus* was introduced from Eurasia to control musk thistle by reducing seed production. Larvae develop in the flower head and consume the seed as it develops. The weevils can reduce seed production by nearly 80 percent, but they are attracted more to earlier blooming rather than to later blooming flowers. The late-season flowers produce seeds with little damage from the weevil, which sustains the musk thistle population. Building a high enough population of insects to greatly reduce seed production takes five to 10 years. These insects first were introduced into North Dakota in the early 1970s. *R. conicus* is not specific to musk thistle and has been found feeding on other invasive thistles, such as Canada thistle. However, this insect also feeds on native thistles, including several that are on the protected or endangered species list and interstate transport is not permitted.

The thistle crown weevil *(Trichosirocalus horridus)* was introduced into North America from Europe in the mid-1970s. Larvae of this insect feed on the growing tip as the musk thistle rosette bolts. While seldom effective by itself, it does help control musk thistle when combined with *Rhinocyllus conicus.* Feeding by *T. horridus* larvae on musk thistle growing tips causes the plant to produce multiple shoots. The resulting flower heads are reduced in size and produce fewer seeds, and the increased number of flower heads results in an increased population of *R. conicus*. Interstate transport of *T. horridus* is no longer permitted.

The rust fungus *Puccinia carduorum* was released in the eastern U.S. in 1987 for Canada thistle control. The rust has moved westward by natural unaided spread and can reduce musk thistle, especially when in combination with the previously mentioned insects.

PALMER AMARANTH

(*Amaranthus palmeri* S. Watson)

County Listed Noxious Weed

Palmer amaranth is a member of the pigweed family and is native to the southwestern and southcentral U.S. as far south as northwestern Mexico and as far north as southern Nebraska. The plant is one of the more aggressive pigweed species and often hybridizes with other pigweeds, including redroot pigweed (*A. retroflexus* L.) and waterhemp [*A. rudis tuberculatus* (Moq.) Sauer]. Palmer amaranth has developed resistance to multiple classes of herbicides and become one of the most difficult to control weeds in croplands of the Midwest and northern Great Plains.

Identification and growth form:

Palmer amaranth is a summer annual that emerges from seed throughout the growing season. The plant commonly grows 6 to 8 feet tall and can reach more than 10 feet in height. The plant has one very thick central stem, often more than 5 inches in diameter, which supports many lateral

PALMER AMARANTH

branches. Under optimum conditions, the plant can grow 2 to 3 inches per day. Palmer amaranth leaves are smooth, 2 to 8 inches long, arranged in an alternate pattern and lance or egg-shaped. The leaves have a small, sharp spine on the leaf tip. A whitish V-shaped or thumbprint mark is found on leaves of some but not all plants. Palmer amaranth is dioecious, with male and female flowers appearing on long leafless branching spikes at the top of the plant. The flowers are green, not showy, and end in three spiny bracts. The seed head spikes can be up to 3 feet long, and the female flowers are very prickly.

Palmer amaranth reproduces only by seed. Seed viability is more than 90 percent the first year after flowering and declines slowly through time, with some seed remaining viable for three to five years. Each plant can produce from 100,000 to more than 500,000 seeds, which are small (1 to 1.3 millimeters) and dark reddish brown. Palmer amaranth spreads from region to region as a contaminant in seed, livestock feed and hay. Once established in an area, the plant can be spread on farm equipment, in manure and by wildlife that feed on the seed.

Why is this plant a concern?

Palmer amaranth has reduced yield up to 91 percent in corn and 79 percent in soybean. The weed has a wide genetic diversity, which allows the plant to adapt to new environments and has enabled the weed to develop resistance to many herbicides used to control pigweed species. Palmer amaranth has developed resistance to ALS, HPPD and PPO inhibitors, dinitroanilines triazines and glyphosate, leaving few options for control in cropland. Once introduced, Palmer amaranth can spread quickly. For instance, it infested four southern Iowa counties in 2016 but was found statewide in more than a third of the counties one year later.

How do I control this plant?

Chemical. Palmer amaranth is difficult to control because it can be resistant to multiple classes of herbicides and their different modes of action. Foliar-applied herbicides must be applied before Palmer amaranth plants are taller than 4 inches. Herbicides that control or suppress susceptible Palmer amaranth include auxins such as dicamba, chloroacetamide, diphenylethers, glufosinate, glyphosate and HPPD inhibitors. Consult the latest edition of the "North Dakota Weed Control Guide" (W253) and the NDSU Palmer amaranth website (www.ag.ndsu.edu/palmeramaranth) for updates on controlling Palmer amaranth infestations.

Cultural. Early identification and eradication are the best method to prevent Palmer amaranth from becoming established in North Dakota. Use seed from reliable sources that are certified weed-free. Much of the spread of Palmer amaranth in neighboring states was due to planting infested seed. If plants are found, they should be removed by hand and destroyed. Place plants into large plastic garbage bags when removing them from fields to prevent seed spread, then burn or compost the plant material. Mowing is not an effective control method because plants will regrow from cut stalks and set-seed, often out of sight below the crop canopy.

Crop rotation is important to prevent Palmer amaranth from becoming established in North Dakota. Rotate soybean with grass crops such as wheat or corn or a perennial forage to help prevent the weed from spreading. Rotating crops allows the use of herbicides from various chemical families that are more effective on Palmer amaranth and other pigweed species than soybean herbicides and will reduce the buildup of herbicide-resistant populations.

Palmer amaranth sometimes is called carelessweed. Carelessness in allowing just a few plants to become established can result in large crop losses in only a few years. Be vigilant in scouting and removing even a single Palmer amaranth plant.

Biological. No biological control agents or pathogens are available for this weed.

PURPLE LOOSESTRIFE

(*Lythrum salicaria* L.)

State Listed Noxious Weed

Purple loosestrife, a beautiful garden plant with an aggressive nature, first was introduced into North America in the early 1800s. The plant was sold in North Dakota by its genus name, *Lythrum,* for at least 50 years. Lythrum plants were brought to North Dakota for flower gardens because of their striking color, ease of growth, winter hardiness and lack of insect or disease problems. The garden varieties of purple loosestrife were sold by many cultivar names, including Morden Pink, Dropmore Purple and Morden Gleam. These garden cultivars were thought to be sterile but now have been shown to cross-pollinate with the wild *Lythrum* type and sometimes with other *Lythrum* cultivars.

Identification and growth form:

Purple loosestrife is a rhizomatous perennial forb. Wild infestations are associated with moist or marshy sites. The stems are erect (1.5 to 8 or more feet tall) and four to six angled, and can be smooth or pubescent with few branches. Leaves are simple (0.75 to 4 inches long, 0.2 to 0.5 inch wide), entire, and can be opposite or whorled.

The most identifiable characteristic of purple loosestrife is the striking rose to purple flowers. The flowers are

Galerucella spp. feeding on leaves

PURPLE LOOSESTRIFE

arranged on a spike, which can be a few inches to 3 feet long. Each flower has five to seven petals arising from a cylindrical green tube. The plant usually flowers from early July to mid-September in North Dakota. The seed capsule is two-celled and contains many very small seeds (1 millimeter long or less). The roots become thick and woody in mature plants. The aerial shoots die in the fall and new shoots arise the following spring from buds at the top of the root crown. Although the root crown expands and produces more shoots each year, the maximum growth of the root crown diameter is limited to about 20 inches.

Spread of purple loosestrife is primarily by seed, but the plant also can spread vegetatively from stem cuttings. Research at NDSU has shown that seed viability of purple loosestrife growing in North Dakota wetlands ranged from 50 percent to 100 percent. With approximately 2.7 million seeds produced per plant, purple loosestrife has the potential to spread rapidly once established in an area.

Why is this plant a concern?

The most destructive impact of purple loosestrife invasions is on the ecology of aquatic sites. Purple loosestrife forms dense monotypic stands as it displaces native wetland plants. Under optimum conditions, a small, isolated group of purple loosestrife plants can spread to cover aquatic sites in just one growing season. When purple loosestrife replaces native vegetation, it also can displace wildlife. Waterfowl, especially ducks, avoid wetlands that have become dominated with purple loosestrife. In addition, overall waterfowl production decreases as suitable nesting habitat is eliminated. The plant's growth is generally too compact to offer cover, and cover may be as crucial to wildlife as food.

How do I control this plant?

Several methods are available for purple loosestrife control, including mechanical, biological and chemical. The size and location of a specific infestation will determine the best control methods. In general, small infestations of a few plants can be controlled by digging, especially when plants are only a few years old. Larger infestations require treatment with herbicides and/or biological control agents.

Chemical. Herbicides can be used to control purple loosestrife in areas too large to be controlled by digging. Also, herbicides can be applied to individual plants selectively in landscape situations to prevent killing desirable plants. Infestations growing along streams or in marshy areas may require specialized equipment and application by trained professionals.

Glyphosate (various trade names) will provide good control of purple loosestrife when applied from July to early September. Many formulations of glyphosate are sold but only those labeled for aquatic use can be applied in or near water. Garlon (triclopyr) is a selective broadleaf herbicide that will not kill cattail or other desirable monocot species. Garlon will provide good to excellent purple loosestrife control when applied in the pre- to early flower or late-flower growth stages but should not be used in landscapes or flower beds because soil residual of the herbicide may prevent establishment of other horticultural plants. Milestone (aminopyralid) and Capstone (aminopyralid plus triclopyer) can be used in seasonally dry wetlands.

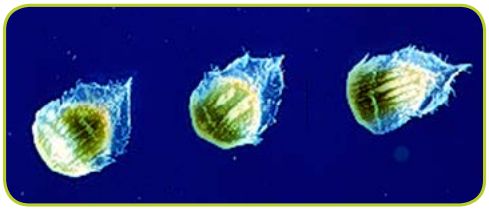
Biological. Three biocontrol insect species were introduced in North Dakota in 1997. They were:

Galerucella pusilla — a leaf-feeding beetle
Galerucella calmariensis — a leaf-feeding beetle
Hylobius transversovittatus — a root-mining weevil

Of these insects, the two *Galerucella* spp. leaf-feeding beetles have been most successful. These insects overwinter as adults and lay eggs in early June in North Dakota. The adults and especially the larvae feed on the leaves and flowers of purple loosestrife. Following several summers of heavy feeding, purple loosestrife infestations have been reduced greatly. However, since the largest infestations in North Dakota are in urban areas, mosquito control programs have kept these insects from becoming well established.

RUSSIAN KNAPWEED

[*Acroptilon repens* (L.) DC.] syn. (*Centaurea repens* L.)



RUSSIAN KNAPWEED

State Listed Noxious Weed

Russian knapweed is the most widespread of the knapweeds in North Dakota. It also is the only perennial of the noxious knapweeds and is the most difficult to control. Russian knapweed often is found in poorly drained and saline/alkaline soils with supplemental water sources such as rivers and streams. This persistent weed often is found in southwestern North Dakota, but increasingly infestations have been found statewide. Russian knapweed grows especially well in areas with supplemental water sources such as the Little Missouri and Heart rivers in North Dakota.

Identification and growth form:

Russian knapweed is a long-lived, deep-rooted perennial with growth characteristics similar to Canada thistle. The weed emerges in the spring from roots and grows to 2 to 3 feet tall and is shrublike with spreading branches. Once established, Russian knapweed spreads mainly by underground root stocks as seed production is limited compared with other knapweed species. The leaves are alternate and lobed lower on the plant while upper leaves are entire. Flowering occurs from June to September and flowers vary from light pink to lavender. The stems die back to the soil surface each year.

Two key characteristics distinguish Russian knapweed from spotted and diffuse knapweed. First, the flowers have rounded bracts with transparent tips that are quite different in appearance than the dark bracts of spotted and diffuse knapweed. Second, the root of this perennial is dark brown to black, scaly as if the plant had been burned, and can grow to depths of greater than 20 feet. The flowers of Russian knapweed vary from light pink to lavender.

Why is this plant a concern?

Russian knapweed can spread rapidly and is very competitive with native species. Russian knapweed will reduce forage production to near zero as the site often becomes a monoculture. Russian knapweed also will infest roadsides, pasture and rangeland and is the only knapweed in the state that causes significant losses in cropland.

How do I control this plant?

Russian knapweed is one of the most difficult perennial weeds to control. If the plant is found in cropland, then a combination of cultivation and herbicide treatments will suppress the plant. However, herbicides at labeled rates for cropland use will not control Russian knapweed.

Chemical. Tordon (picloram) is one of the most effective herbicides used for Russian knapweed control. The best control is obtained when picloram is applied following several hard frosts (mid-October). Russian knapweed plants may be dormant with gray stems and no leaves, but control the following spring is nearly 100 percent. Application in mid-September or during flowering in midsummer provides shorter-term control than late applications. Other herbicides used for Russian knapweed control include Escort (metsulfuron) and Milestone (aminopyralid).

Cultural. Livestock generally will not graze Russian knapweed. Mowing and cultivation do not control this weed.

Biological. Exploration and evaluation of biocontrol agents for Russian knapweed are in progress. The gall fly *Jaapiella ivannikovi* was released in 2009, has established and will be available for wider distribution. A gall wasp, *Aulacidea acroptilonica*, also was released but has had minimal impact.

SALTCEDAR

(*Tamarix* spp.)

SALTCEDAR

State Listed Noxious Weed

Saltcedar is the common name for several introduced species of shrubs or small trees, including *Tamarix chinensis, T. parviflora* and *T. ramosissima.* Saltcedar is native to Eurasia and first was introduced into the U.S. to reclaim eroded areas and prevent further loss of stream banks, primarily in the southwest. Saltcedar has been sold in the horticultural industry, primarily for its wide adaptability and pink flowers. Saltcedar became established in North Dakota as escapes from ornamental plantings or from seed floating along rivers.

Identification and growth form:

Saltcedar is a shrubby bush or tree that can range in size from 5 to 20 feet tall. The bark is a reddish brown, especially on younger branches. The leaves are small and flat and resemble evergreen shrubs such as arborvitae. Flowers are pink to white and five-petaled, and appear from mid to late summer. The seeds are extremely tiny and similar in size and color to pepper. Each seed has a pappus, which allows it to float long distances in water or move in the wind. Seeds are short-lived and usually germinate within a few months after dispersal.

Once saltcedar seed germinates, it can grow rapidly to a small flowering shrub in one to two years. The plant is deciduous and very hardy, and horticultural varieties are advertised to grow "in sun or shade, and in wet or dry areas" from USDA hardiness zones 2 to 7. The plant quickly establishes a long, woody taproot to support a voracious thirst for water. The root system is capable of producing many new shoots if the top growth is removed by mechanical control methods or fire.

Why is this plant a concern?

Saltcedar can become a monoculture quickly along lakes and waterways. In the early morning and evening, moisture with high salt content is exuded from the foliage, causing the soil to become saline. Saltcedar can choke waterways and even has dried up entire lakes. Native riparian species are quickly displaced by saltcedar, which in turn causes displacement of native birds and animals that generally do not feed on the leaves or eat the saltcedar seeds. Saltcedar, even in the seedling stage, will tolerate short-term flooding and can establish away from waterways when seeds are washed in during flooding. Once established, the plants can become so thick cattle will not graze the area.

How do I control this plant?

Prevention is the best method to keep saltcedar from invading North Dakota wetlands and wildlands. Scouting along waterways and removal of ornamental plantings have been effective in reducing the spread of saltcedar in North Dakota.

Chemical. Arsenal (imazapyr) is the most widely used herbicide to control saltcedar. Arsenal also can be applied with a glyphosate formulation labeled for use in water. Do not remove saltcedar top growth for three years following herbicide application or resprouting will occur. Garlon (triclopyr) has been effective when applied in the spring or late fall.

Cultural. Control methods such as burning or bulldozing have not been successful.

Biological. Several leaf beetles (*Diorhabda* spp.) have been released in North America to control saltcedar. The insects feed on leaves of saltcedar and slowly reduces plant vigor. However, the insects have not been consistently successful in reducing saltcedar infestations. Biological control of saltcedar in North Dakota is not recommended because of the small size of most plants and low infestation levels in the state.

NARROWLEAF HAWKSBEARD

(*Crepis tectorum* L.)

County Listed Noxious Weed

Narrowleaf hawksbeard is native to Siberia and much of Eurasia. The plant is a member of the sunflower family and has bright yellow flowers very similar to dandelion or sowthistle. Narrowleaf hawksbeard commonly is found in most of Canada, including the neighboring provinces of Manitoba and Saskatchewan, where it is listed as a noxious weed. Narrowleaf hawksbeard will grow in many ecological zones, ranging from forests, lakeshores and seashores to dry prairies, mountains and parklands. Although narrowleaf hawksbeard can be found as far south as New Mexico and north to Alaska, the weed is primarily problematic in the northern tier of U.S. states and Canadian Prairie Provinces. Prior to 1950, O.A. Stevens of the North Dakota Ag College reported narrowleaf hawksbeard was well-established along a road in Walhalla, N.D., and had collected samples from Bottineau and Stark counties.

NARROWLEAF HAWKSBEARD

Identification and growth form:

Narrowleaf hawksbeard is a winter or spring annual that grows 2 to 3 feet tall from a tap-rooted basal rosette. The plant has a single main stem and often branches. The leaf shape gradually changes, going from the base to the tip of the plant. Rosette leaves are up to 6 inches long, 1 inch wide and coarsely toothed with a pointed tip. Basal leaves die off as the plant matures, which can help distinguish this plant from common dandelion or annual sowthistle. Stem leaves are alternate, and go from 4 inches long to less than an inch at the tip of the plant. Leaves are wider at the tip than the stem and often have a pair of small lobes at the base and curled edges. A white milky sap is found throughout the plant.

Mature narrowleaf hawksbeard has bright yellow dandelion-like flowers, which are found from late May through September in North Dakota. The seed are dark purple to brown, ribbed and attached to a pappus that will carry them in the wind or on animals. Each plant contains 30 to 70 flowers and can produce up to 50,000 seeds. Narrowleaf hawksbeard reproduces only by seed, which has a short dormancy and can germinate shortly after dispersal. Up to 90 percent of the seedlings that emerge from August to mid-September will overwinter. Survival declines the later in the season that seeds germinate, but even those that emerge in early to mid-October can overwinter and should be controlled.

Why is this plant a concern?

Narrowleaf hawksbeard traditionally was found along roadsides and disturbed land in North Dakota but now has become especially troublesome in no-till cropland, cropland seeded with cereals, pulses or oilseed crops, hay fields, and along newly established pipelines. Narrowleaf hawksbeard develops rapidly in the spring, which gives the species a competitive advantage, especially in forage crops. The weed will outcompete annual crops for nutrients and moisture, thus reducing yield, and can displace native plants in wildlands.

How do I control this plant?

Chemical. Narrowleaf hawksbeard is best controlled in late fall or very early spring with herbicides. The plant is much more difficult to control after bolting. Glyphosate applied alone or with other herbicides such as dicamba or 2,4-D will control rosettes in the fall. High rates of 2,4-D alone will control narrowleaf hawksbeard but can damage some crops. 2,4-DB is more effective than 2,4-D for control of this weed and is useful in forage crops such as alfalfa. Low rates of 2,4-D and dicamba generally do not control narrow leaf hawksbeard in the spring; rather glyphosate at 2 quarts per acre or more is required. ALS-inhibiting herbicides such as metsulfuron or tribenuron also will control this weed and often are mixed with glyphosate. Consult the latest edition of the "North Dakota Weed Control Guide" (W253) for additional herbicides used to control narrowleaf hawksbeard.

Cultural. Because narrowleaf hawksbeard only spreads by seed, plant certified weed-free seed and clean all farm equipment before moving from an infested to a noninfested field. Cultivation in late fall or very early spring will remove this weed from cropland. Preventive management such as maintaining good crop cover, minimizing disturbance and removing infestations when they are small will help contain the spread of narrowleaf hawksbeard. Mowing of noncrop sites before seed-set will reduce the spread of this weed.

Biological. No biological control agents or pathogens are available for this weed.

Bill Sanderson Gas Processing Plant Project

Dust Control Plan

February 2020

Introduction

OE2 North LLC (OE2) proposes to construct the Bill Sanderson Gas Processing Plant Project (Project or Plant), that will consist of a gas processing plant permitted under the North Dakota Public Service Commission (PSC) Certificate of Site Compatibility. The nameplate processing capacity of the Plant will be 250 million standard cubic feet per day (MMscfd). The 39-acre Plant Site will be located approximately 15 miles west of Williston, North Dakota, in Section 27, Township 154 North, Range 104 West, Williams County, North Dakota on a parcel owned by OE2 (henceforth referred to as the Project Site).

Construction of the Project will involve land-disturbing activities, which can increase the susceptibility of soils to erosion caused by wind and water. Wind erosion can damage the productivity of the land by reducing soil moisture, altering soil structure, and carrying away soil nutrients and topsoil. A small amount of soil loss from wind erosion occurs naturally; however, human activity, such as construction of a gas processing plant, can dramatically increase soil loss due to wind erosion (fugitive dust) and potentially create conditions that could affect air quality and safety. Fugitive dust is a type of non-point source air pollution that can cause respiratory distress for construction workers, as well as for nearby residents and wildlife. Additionally, fugitive dust can create a safety hazard by obscuring visibility for equipment operators, construction personnel, and traffic on public roads near the Project.

OE2 has developed this *Dust Control Plan* as a guide for construction and field personnel on implementation of appropriate measures to minimize and control the generation of fugitive dust during construction activities associated with the Project. It will be the responsibility of the Project contractors, working with OE2's field representatives, to identify activities that are generating dust and to at all times control airborne dust levels during construction activities to acceptable levels that are in compliance with any applicable standards, including those established by the North Dakota Department of Health (NDDOH), and other regulating agencies and local ordinances.

Fugitive Dust Sources

OE2 has attempted to identify the primary potential sources of fugitive dust, which include:

- Vegetation clearing activities;
- Initial grading of topsoil and subsoil;
- Excavation and backfilling;
- Grading associated with reestablishing contours and restoring segregated topsoil;
- Vehicle traffic on unimproved public and private access roads;
- Vehicle and equipment travel within the Site;
- Open-bodied trucks hauling sand, soil, gravel, or other materials; and
- Activities at Project facilities such as material storage yards, contractor yards, parking areas, and aboveground facility locations.

OE2's Contractors and field representatives will identify activities that are generating fugitive dust, implement feasible dust abatement techniques or Best Management Practices (BMPs) to control dust, and maintain compliance with applicable fugitive dust regulations.

Fugitive Dust Control Measures

Dust suppression measures will be employed as necessary to control fugitive dust emissions during the construction of the proposed Plant where dust could compromise safety or become a public nuisance. This will also apply to access roads where dust raised by construction vehicles may irritate or inconvenience local residents as they approach the Plant Site. To minimize wind erosion and fugitive dust emissions during construction, OE2 will implement the following reasonably available control measures:

- Disturb no more earth than required for construction to occur;
- Use dust abatement techniques (i.e., applying water or approved nontoxic chemical dust suppressants) on unpaved or un-vegetated areas or other areas susceptible to wind erosion within the Plant Site footprint. (Note: utilization of chloride-containing additives is limited to roads. Application of dust suppressants will be repeated as necessary and as determined by the Environmental Inspector (EI) or OE2 representative);
- Water for dust control will be obtained from wells, municipal sources, and nearby rivers where the necessary water purchase agreements and permits required by federal, state, and local agencies for the procurement of water have been secured. No unapproved water sources will be used for Project activities, including dust control;
- Temporarily stockpiled soils (topsoil and spoil) will be sprayed with water or approved chemical dust suppressant to create a semi-hard protective layer to minimize wind erosion, if necessary, and as determined by the EI or OE2 representative. (Note: utilization of chloride-containing additives is limited to roads and is not permitted on stockpiled soils);
- Emissions from construction equipment combustion, open burning, and temporary fuel transfer systems and associated tanks will be controlled to the extent required by state and local agencies through the permitting process;
- Project-related traffic speeds will be controlled within the Project facility and the access road to the Plant Site; where construction activities approach dwellings, farm buildings, commercial areas, and other areas occupied by people; and on unpaved access roads. A speed limit of 25 mph will be followed on unimproved roads. Additional speed limit restrictions may be required by the property owner/tenant on private lands or by the county on public roads (e.g., posted speed limits);
- Speed limits will be decreased when excessive winds prevail and where sensitive areas such as public roads are adjacent to access roads or the Plant Site;
- Open-bodied trucks carrying sand, soil, gravel, or other materials will be covered where necessary to prevent such materials from being expelled;
- Construction entrance/exit access locations onto paved roads will be cleaned at a minimum of once every 48 hours, or as needed or specified by the EI if materials are observed to be accumulating on the road surface;

- When opacity along dirt roads exceeds 20 percent (objects partially obscured), construction activity will cease until dust control measures are employed; and
- Other dust control measures, such as the use of wind fences or berms, may also be implemented as needed.

The frequency of water application will largely depend on weather conditions. If seasonal or other weather conditions prevent compliance with the time frames, the contractor will stabilize the Plant Site and maintain erosion and sediment control measures until cleanup can be conducted.

Regulatory Applicability

The following agencies are responsible for air quality management in areas of Project construction activities:

- North Dakota Department of Health

This Dust Control Plan has been developed to meet the regulatory requirements of North Dakota Administrative Code Article 33-15. While the state of North Dakota has no specific regulations in relation to construction dust control, OE2 and its contractors will utilize measures outlined in this Plan to minimize dust during construction.